Seattle's Source Control Plan for the Lower Duwamish Waterway (2015 – 2020) May 2016 DRAFT FINAL


Before inspection


After inspection

City of Seattle

CONTENTS

FIGURES

TABLES

VOLUME 2: MAP ATLAS

VOLUME 3: APPENDICES

1. EXECUTIVE SUMMARY

1.1. BACKGROUND

Seattle Public Utilities (SPU) and other City of Seattle departments have been successfully identifying and controlling sources of contaminants to the Lower Duwamish Waterway (LDW) in coordination with the Washington State Department of Ecology (Ecology) and other agencies for over ten years through a focused, iterative source control program. The existing program and enhancements described in this Source Control Implementation plan (hereafter SCIP) are designed to meet the requirements of the 2013 National Pollutant Discharge Elimination System (NPDES) Phase I Municipal Stormwater Permit, and Model Toxics Control Act (MTCA) requirements for contamination found in the right-of-way and on City-owned properties, as well as to support Ecology's efforts to develop a source control strategy that is an integral part of the Lower Duwamish Waterway (LDW) Superfund Cleanup. The long-term goal of the City's source control program is to protect water and sediment quality in the LDW by controlling the amount of pollution discharged to and from the City-owned municipal separated stormwater system (MS4). The City's overall objective for the first five years of this long term effort is to develop tools to identify sources of pollutants to the City-owned MS4 so that local, state, and/or federal authorities can take appropriate actions to control or eliminate ongoing sources that could otherwise cause contaminants of concern in waterway sediment to reach levels that exceed the Remedial Action Levels (RALs) set by the Environmental Protection Agency (EPA). Specific objectives of this plan include:

1. Document the source control actions that the City of Seattle (City) will take over the next five years.
2. Comply with Ecology's requirement to develop an Adaptive Management Plan as required by the NPDES Phase I Permit Requirements (Ecology 2014a).
3. Manage municipal discharges to the LDW.
4. Address contamination on City-owned properties and in the ROW that may affect the LDW.
5. Support Ecology in implementing their Source Control Strategy as required by the Record of Decision (ROD) for the LDW Superfund Site (EPA 2014).

EPA and Ecology are the respective leads for cleanup of contaminated sediments and source control pollution in the LDW. In 2015, Ecology developed a protocol for determining when source control is sufficient to allow cleanup of waterway sediment to begin as defined in EPA's ROD for the LDW (EPA 2014) and plans to include the sufficiency analyses in an update of the LDW source control strategy scheduled to be published in 2016. The actions outlined by Seattle in this plan meet Ecology's goals for finding and sufficiently controlling pollutant sources before conducting active in-waterway remediation thereby minimizing the potential for sediments to exceed the remedial action levels (RALs) after cleanup. The City of Seattle is committed to working with EPA and Ecology to make the Superfund cleanup of the LDW a success.

1.1.1. THE LOWER DUWAMISH DRAINAGE SYSTEM

Approximately 20,000 acres of urban and industrial land discharge to the LDW via storm drains and CSOs. Approximately 5,500 acres are served by the City's municipal separated storm sewer system (MS4) and 416 acres are served by the City's one remaining uncontrolled combined sewer overflow (CSO) in the LDW. The City owns 18 outfalls that discharge stormwater to the LDW from drainage areas ranging in size from <1 to 2,664 acres. Three of these outfalls are owned by Seattle City Light (SCL) and serve only SCL property. The City also discharges stormwater and

sewer overflows to another 13 outfalls owned by or built by other entities[1]. Three of these connections are emergency overflows (EOF) that result in sanitary sewer overflows to the LDW only when there is a pump failure or blockage in the sanitary sewer system. The rest of these connections are stormwater discharges from the City-owned MS4.

1.1.2. EXISTING DATA ON SEATTLE DISCHARGES

SPU has analyzed over 1,100 storm drain solid samples (e.g., catch basins, inline grabs and traps) from 25 drainage systems in the LDW. There are no regulatory standards for contaminants in storm drain solids, therefore SPU uses the state Sediment Management Standards as screening levels to guide source tracing efforts. When SPU discovers contamination at concentrations above the cleanup screening levels (CSL) or the second lowest apparent effects threshold (2LAET)[2], SPU begins an iterative process of sampling surrounding facilities and inspecting businesses to identify the source. The Source Control Work Group has been using the CSL/2LAET as a screening level to locate potential sources for a number of years, because it allows the group to focus on the most serious discharges. This level has been and continues to be effective for source tracing purposes. Use of lower screening levels (e.g., SCO/LAET) would make it difficult to prioritize work for a number of chemicals, because urban storm drain solids often exceed lower screening levels even in areas with no identifiable sources. As source control efforts continue and contaminant concentrations decline, it may be possible to gradually phase in the use of lower screening levels in the future.

Three tools are used to assess potential impacts on waterway sediments from City-owned MS4 discharges:

- Source tracing data
- Comparison of near-end-of-pipe inline samples with nearby in-waterway surface sediment samples
- Sediment transport/bed composition model developed for the LDW Feasibility Study.

SPU believes that existing data indicate that stormwater discharges from the City-owned MS4 are unlikely to cause waterway sediment to exceed the RALs for most contaminants. However, certain chemicals, such as phthalates, may likely re-contaminate waterway sediments in localized areas in the immediate vicinity of large outfalls. Because phthalates are used in a wide variety of consumer products, conventional source control techniques may have some effectiveness in cases where unusually elevated levels are identified in storm drain solids; however they will be unable to fully control these chemicals. New techniques that involve regional and potentially statewide actions are needed to adequately control the discharges of phthalates to the LDW. The City will continue to work with the Ecology-led Source Control Work Group to address, to the extent possible, these types of chemicals.

1.2. SUMMARY OF 5-YEAR SOURCE CONTROL PLAN

The City of Seattle is committing to the following actions in the City-owned MS4 basins during the 5-year term of this Source Control Implementation Plan (2015-2020). Additional details on these actions are contained in Sections 4.3, 5.3, 6.3 of this plan.

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[1] Outfall ownership is not always clear. This plan identifies outfalls as either "owned by" when ownership is clear or "built by" when outfalls were constructed by others, but ownership is not clear.

[2] LAETs are the dry weight equivalent of the cleanup screening levels. The CSLs for most organic chemicals are based on total organic (TOC) normalized concentrations. However, because TOC concentrations in most storm drain solids samples are outside the acceptable range defined in the SMS, the dry weight values (LAET/2LAET) are used instead to evaluate storm drain solids data.

The City has included a schedule (Figure ES-1) that details the existing source control and municipal stormwater management activities currently being implemented in the LDW as well as programs that will be added as enhancements to the City's existing programs over the term of this plan.

In developing this plan, the City used a three-pronged approach: (1) document current source control activities in the LDW, (2) prioritize drainage basins/systems in the LDW, and (3) develop and prioritize future program enhancements. The City uses multiple lines of evidence to prioritize drainage basins/systems so that future activities can be focused on the most critical areas. Priority basins are selected as follows:

- Locations where elevated levels of contaminants were found in both offshore sediment samples collected in the vicinity of the outfall and storm drain solids samples collected from the downstream end of the drainage system (i.e., near end-of-pipe samples).
- Locations where contaminant concentrations in storm drain solids were higher than other drains in the LDW, which suggests the presence of a unique source(s) in that basin.
- Locations where offshore sediments were predicted to exceed the sediment RAL based on the sediment transport/bed composition model that was developed during the LDW Feasibility Study.

Priority basins were then ranked using the following criteria:

- Evidence of ongoing sources and pollution-generating activities in the basin based on business inspection findings.
- Drainage basin size, which provides an indication of pollutant loading potential.
- Multiple and recurring exceedances of source tracing triggers for COCs identified in waterway sediment, which indicates need for additional source tracing.
- Land use characteristics such as percentage of industrial use in the basin.

A detailed description of the data and prioritization is provided in Appendix J.

In addition to the tools above, prioritization of work includes the best professional judgment of the staff involved in the program, opportunities and emerging needs. To the extent possible, SPU will use this prioritization to help focus work by other City departments and as the SCIP program continues, we anticipate expanding the prioritization to additional programmatic activities such operation and maintenance.

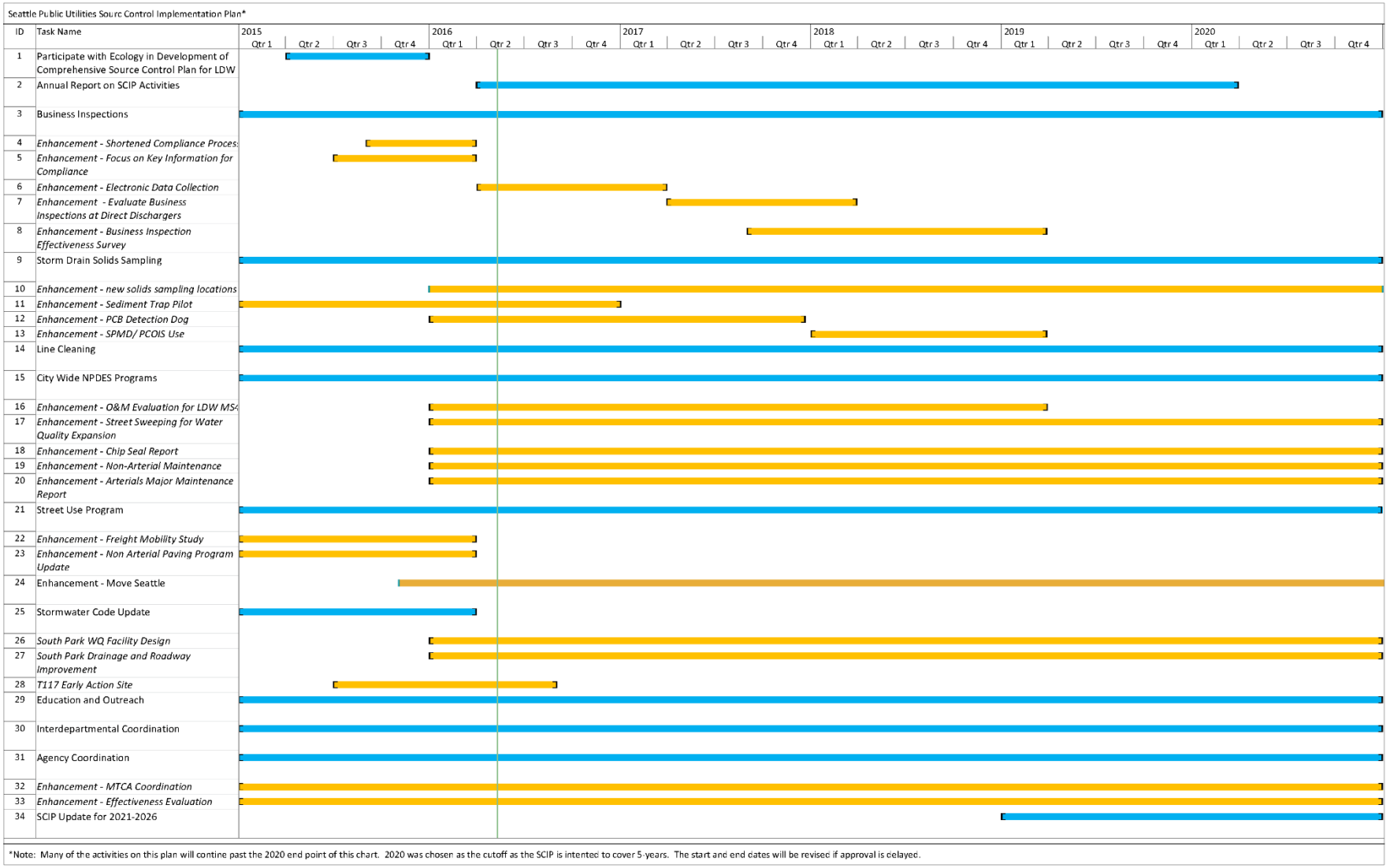

Figure ES-1: City of Seattle Source Control Implementation Plan Schedule

1.2.1. BUSINESS INSPECTION PROGRAM

SPU has conducted business inspections in support of source control efforts in the LDW since 2003. Over the past five years, SPU has conducted 200 – 350 inspections per year at 70 - 185 businesses operating in City-owned MS4 basins.[3] SPU will maintain this level of effort during this 5-year SCIP. Work will focus on the following:

- High and medium priority businesses and City-owned property in the City-owned MS4 basins discharging into the LDW as currently classified from site visits.[4]
- Supporting source tracing efforts in the City-owned MS4 basins discharging into the LDW.
- Businesses in the City-owned MS4 basins discharging into areas scheduled for active cleanup.
- New businesses that start up in the City-owned MS4 basins discharging into the LDW.
- Potential enhancements include:
  - Shortened compliance process
  - Focus on key information for compliance
  - Electronic data collection
  - Evaluate business inspections at direct dischargers
  - Business inspection effectiveness survey.

Additional information on the Business Inspection Program is located in Section 4 and in Appendix A and I of this Plan.

1.2.2. SOURCE TRACING/SAMPLING PROGRAM

With the support of an inter-agency agreement with Ecology, SPU collected about 100 - 180 source tracing samples per year between 2008 and 2013 from the City-owned MS4 system discharging into the LDW. These data, along with additional samples collected by SPU from 2013 to June 2015, have been evaluated to aid in ranking/prioritizing source tracing activities over the next five years. The evaluation involves comparing near end-of-pipe inline solids collected from the City-owned MS4 against in-waterway sediment chemistry to identify matches in chemicals that exceed certain criteria (e.g., SCO for waterway sediments and CSL/2LAET for storm drain solids). The analysis used surface sediment data from the LDW FS data base (AECOM 2012a), as well as samples collected by Ecology (SAIC 2009, 2011). In areas where early action cleanups have occurred (e.g., Diagonal/Duwamish, Norfolk, and Slip 4 early action areas), only the post-cleanup sampling results are included to better match the time period over which source samples have been collected. SPU will continue to sample the City-owned MS4 to support upcoming sediment cleanup actions. SPU has prioritized where it intends to focus its source tracing/control efforts over the next five years using existing data. Areas where additional work is needed are listed below:

- S Nevada St SD
- Diagonal Ave S CSO/SD
- 1st Ave S SD (east)
- Head of Slip 2 SD
- S River St SD
- 16th Ave S SD (east)
- Norfolk CSO/EOF/SD
- SW Dakota St SD
- SW Idaho St SD
- SW Kenny St SD/T115 CSO
- S Webster St SD
- 7th Ave S SD
- 17th Ave S SD

[3] Multiple inspections are often required to obtain compliance. Each site visit is counted as an inspection.
[4] City-owned properties are ranked and inspected using the same procedure as private businesses.

SPU has pursued and has recently obtained Ecology MTCA and Stormwater Financial Assistance Program grants to support this work through 2017. The City will continue to pursue outside funding to maintain and expand source control efforts. This sampling is expected to continue to be successful in identifying sources, which can then be controlled using existing local, state, and/or federal authorities. Source tracing activities will focus on the following activities:

- Maintaining the 22 existing sediment traps in the City-owned MS4 to aid in establishing long term trends and evaluating the effectiveness of source control actions.
- Tracing sources in problem areas/drains identified to date.
- Installing new end-of-pipe traps if ongoing pilot test identifies a suitable device for small-diameter pipes or collecting inline grabs if no suitable trap is identified
- Re-sampling in lines that have been cleaned to confirm that sources are adequately controlled.
- Following up in problem areas that may be identified as a result of sampling to be conducted during remedial design.
- Filling in gaps where additional data are needed by establishing new solids sampling locations (e.g., as yet un-sampled outfalls that are currently used by SPU).

SPU also will consider some new strategies, such as using trained detection dogs, and will continue to improve current strategies based on ten years of experience. Additional information on source tracing prioritization is contained in Section 5.3 and Appendix B, C, D and J of this plan.

1.2.3. LINE CLEANING

In 2015, SPU intends to focus on the western side of the waterway while the City's 640 S Riverside Dr. property is still vacant and can be used for solids handling. With construction of the South Park pump station planned for 2017-2018, this site will not be available during that time[5]. SPU has prioritized the following City-owned MS4 systems or sections of City-owned systems for cleaning and has secured Ecology MTCA funding through 2017 to support these efforts:

- SW Dakota St SD. All City MS4 lines
- S 96th St SD. All City MS4 lines
- Diagonal Ave S CSO/SD:
  - Ohio Ave S sub-basin
  - Diagonal Ave S SD, S Dakota St sub-basin
  - Diagonal Ave S SD, 6th Ave S/S Hinds St sub-basin
  - Diagonal Ave S SD, Bush Pl sub-basin
  - Diagonal Ave S SD, S Snoqualmie St sub-basin. This sub-basin continues to exhibit elevated levels of mercury and PCBs in inline samples collected near S Snoqualmie St and 7th Ave S. This sub-basin is an area where SPU will conduct additional source tracing. Lines will be cleaned after pollutant source(s) are found and controlled.

1.2.4. CITYWIDE SOURCE CONTROL PROGRAM

Spill Response Program

The City of Seattle will continue to operate the 24/7 spill response program to respond to spill and releases of chemicals that affect the City-owned MS4. This program includes coordination and collaboration with Ecology and King County for spill response.

[5] A portion of the property may be available for use after pump station construction is complete.

Spill Kit Incentive Program

SPU has been providing free spill kits and training on proper use of spill kits to businesses citywide since 2001. The spill kits and education are provided by the Seattle Green Business Program, a free resource conservation program offered by SPU for Seattle businesses. This program has recently been implemented by ECOSS (Environmental Coalition of South Seattle) on a regional scale as a grant-funded program due to its success in Seattle.

Municipal Operations & Maintenance

The City will continue to implement its catch basin inspection and maintenance, public stormwater facility inspection and maintenance, and private stormwater facility maintenance per the requirements of the NPDES Phase I Municipal permit in the City-owned MS4 discharging to the LDW.

In addition, SPU will be evaluating the potential to apply a Capacity, Management, Operation and Maintenance (CMOM) like program to the City-owned MS4 discharging to the LDW. SPU utilizes a CMOM program in the wastewater system and over the next five years intends to evaluate the use of CMOM principles in the storm drain system. This work will include assessing the condition of existing infrastructure, evaluating and assessing the effectiveness of existing maintenance efforts and developing revised approaches to operation and maintenance of the City-owned MS4 if warranted. Additional information on Municipal Operations and Maintenance is contained in Section 7.7 of this plan.

1.2.5. TRANSPORTATION

Over the next five years, the Seattle Department of Transportation (SDOT) will continue its efforts to maintain and improve streets in Seattle. Planned activities that may support the LDW source control program are:

- Street Sweeping
- Arterial Asphalt Concrete Program
- Chip Seal Program
- Non-Arterial Concrete and Non-Arterial Asphalt Maintenance
- Non-Arterial Paving
- Arterial Major Maintenance
- Move Seattle (levy-funded program that supports future improvements in public safety, mobility, and connectivity).

SDOT will continue to require recipients of street-use-permits to incorporate best management practices (BMPs) from the City of Seattle Stormwater Code and Directors' Rules. This process includes inspections and corrective actions if BMPs are found to be deficient. A sample permit is provided in Appendix G and more information on Transportation can be found in Section 7.8 of this plan.

S Portland St Improvements

In early 2015, SDOT and SPU completed street and drainage improvements on S Portland St between SR-99 and 8th Ave S as part of an effort to extend the West Duwamish Bike Trail from W Marginal Wy S to the existing pocket park on the Duwamish Waterway at 8th Ave S. SDOT constructed a 20-foot wide bike trail along the south side of S Portland St and regraded/paved the street to drain to a stormwater collection/conveyance system installed by SPU. Approximately two blocks of S Portland St (west of 5th Ave S and east of 7th Ave S) were previously unpaved and there was no formal drainage system in this area. A new storm drain was installed along S Portland St to collect runoff from the roadway and adjacent properties and tie into the existing

72-inch storm drain on 7th Ave S. The project constitutes part of the lower basin improvements needed to correct flooding problems in this area. See Section 7.11.27.11.3 for a description of the City's plans for improving roads and drainage in the South Park area.

1.2.6. STORMWATER MANAGEMENT/CODE

In January 2016, the City of Seattle updated and established stormwater code requirements that are equivalent to Appendix 1 of Ecology's 2013 NPDES Phase I Municipal Stormwater Permit and Stormwater Management Manual for Western Washington. These requirements guide selection of BMPs to be implemented during construction, post construction operation and maintenance, source control requirements and enforcement procedures. SPU, working with the Department of Construction and Inspection (DCI)[6] and SDOT, will continue to implement the NPDES Phase I permit requirements associated with code development and implementation during the 5-year SCIP. Additional information on the City's stormwater management/code programs can be found in Section 7.9 of this plan.

1.2.7. UTILITY MAPPING PROGRAM

Information about the City's drainage and wastewater collection/conveyance systems is maintained in an ArcGIS® platform. The GIS utility information is regularly revised to incorporate corrections identified by SPU field staff (e.g., IDDE, business inspectors, and sewer rehabilitation staff. Corrections are a top priority for the GIS program and are processed ahead of any new infrastructure data.

SPU also implemented a Surface Water Asset Management Program (SWAMP) in 2010 to field verify locations and attributes of surface drainage features throughout the City and update the GIS utility information as needed. SWAMP has completed work in most of the drainage on the west side of the LDW. Only portions of the SW Idaho St SD, Highland Park Wy SW SD, the 1st Ave S SD (west), and the SW Kenny St SD basins, and all of the SW Dakota St SD remain to be surveyed. On the east side of the LDW, portions of the S Norfolk drainage, KCIA SD #2/PS 45 EOF, I-5 SD at Slip 4 and a small part of the Diagonal Ave S CSO/SD basins have been completed. This program was funded by grants and funding for this program has ended. SPU will continue to revise GIS as new information is gained during inspections and other source control work.

1.2.8. STORMWATER IMPROVEMENT PROJECTS

SPU intends to continue planning and implementing structural stormwater controls for water quality treatment of stormwater from City-owned MS4 basins. There are currently multiple projects located in City-owned MS4 basins that will be in the planning or construction phase during this five-year SCIP period. The following three projects are large Capital Improvement Projects that are scheduled to be started during the term of this plan.

South Park Pump Station/Water Quality Facility

SPU plans to construct a pump station on the 7th Ave S drainage system to help alleviate chronic flooding problems in the lower basin. At present, this system cannot drain at high tide. The pump station will allow the main trunk line to function properly during a wide range of tidal conditions. Other local drainage improvements are needed in the lower 70-acres of the basin, but the pump station provides the first step in reducing flooding. SPU also plans to build a stormwater treatment facility to reduce pollutant loading from this 238-acre basin. SPU is currently evaluating treatment technologies and will conduct pilot testing of several technologies in 2016-2017. The water quality facility is one of the projects included in the Integrated Plan that was approved by EPA and Ecology in 2015 as part of the City's Plan to Protect Seattle's Waterways. See Section 7.11.5 for a

[6] Formerly Department of Planning and Development

discussion of the Integrated Plan. SPU intends to have the pump station constructed by 2018 and the water quality facility constructed by 2024.

South Park Drainage and Roadway Improvements

SPU and SDOT have committed $20 million over the 2015-2020 time period to improve drainage and roadways in the industrial section of the South Park neighborhood. Accelerating planned drainage and roadway improvements in the South Park neighborhood is one of the Action Plan items included in SPU's 2015-2020 Strategic Business Plan (see: http://www.seattle.gov/util/aboutus/management/director/strategicbusinessplan/). This work is needed to reduce flooding in the area. However, the proposed street improvements will also improve stormwater quality and reduce loading to the South Park Water Quality Facility described above. Funding for the improvements will be shared by SPU and SDOT. SPU is currently working with SDOT to develop partnering agreements.

T117 Early Action Site – Adjacent Streets Drainage Improvements

The streets adjacent to Terminal 117 are contaminated with PCBs from a historical asphalt manufacturing facility. SPU and Seattle City Light (SCL) are working together as part of an early action area cleanup being conducted as part of the LDW Superfund project to remove contaminated soil in the right-of-way. Cleanup, which will include removal of contaminated soil, restoration of the existing streets, and installation of a stormwater collection and treatment system began in July 2015 and is expected to be completed by July 2016. Runoff from this area previously discharged untreated to the LDW. The proposed treatment system includes a combination of bioretention cells and Filterra® tree box units with a single outfall to the waterway across the north end of Terminal 117. The treatment system has been designed in accordance with City Stormwater Code and associated stormwater manuals/Directors' Rules. Additional information about T117 is provided in Appendix D.

City Owned Property and Right-of-Way

Various City departments own approximately 2,185 acres of land in the LDW. All City departments implement pollution prevention/source control practices in accordance with the Source Control Technical Requirements Manual (City of Seattle 2016a) and are inspected using the same Business Inspection Program methods as private businesses/properties. Four properties (i.e., SPU Operations Control Center, SCL South Service Center, SDOT Sunny Jim Sign Shop, and Parks Jefferson Park Horticulture Center) trigger the NPDES MS4 permit requirements and have implemented stormwater pollution prevention plans.

Ecology's Toxics Cleanup Program has listed confirmed and suspected contaminated sites (CSCSL, Ecology 2015). Some listed sites are on City-owned properties in the LDW. As part of this plan, the City will be evaluating these sites to determine if any sites are relevant to the LDW source control program and will coordinate with staff in Ecology's Toxics Program to address the identified sites. Some of the CSCSL sites are in the public right-of-way (ROW) or on adjacent properties where contamination has extended into the ROW. In the event that city construction work in the right-of-way discovers contamination thru testing, the City or its contractor will coordinate with Ecology and follow the Model Toxics Control Act reporting requirements.

Additional information on these activities is contained in Section 7.12 of this document.

1.2.9. PUBLIC OUTREACH AND EDUCATION

During the next five years the City of Seattle will continue to implement the citywide education and outreach activities that are required by the 2013 NPDES Phase I Municipal Stormwater Permit (and the future permit when issued in 2018). These programs are:

- Auto Maintenance Program

- Natural Soil Building
- Seattle Channel
- Stakeholder Updates.

The City anticipates that as part of its LDW Source Control Program, Ecology will be developing additional education and outreach programs during the 5-year period covered by this document as the actions in the Record of Decision are implemented. The City will coordinate and adjust the education and outreach programs to support Ecology's efforts.

Additional information on these activities is contained in Section 7.13 of this document and in the City of Seattle Stormwater Management Plan.

1.2.10. INTRADEPARTMENTAL COORDINATION

During the next five years SPU will continue to lead and coordinate with other departments on the implementation of the NPDES Phase I Municipal Stormwater Permit. As part of this, SPU leads regular intradepartmental meetings to discuss permit compliance. This group is engaged to help coordinate activities by other City departments.

Other intradepartmental coordination efforts that will help implement the 5-year SCIP are the SPU Project Switchboard and City's Interdepartmental Team for Coordinated Infrastructure. These are described in more detail in Section 7.14.

1.2.11. AGENCY COORDINATION

Duwamish Inspectors Group Coordination

This group meets quarterly and consists of inspectors from the various agencies working in the LDW and was formed to help coordinate and prioritize inspections, and facilitate referrals and discussion of issues. It is anticipated that Ecology will continue to support this group as part of its LDW Source Control Program. SPU will continue to participate in this group during this 5-year SCIP.

Superfund Coordination

As EPA moves forward with implementing the selected remedy identified in the Record of Decision (EPA 2014) for the LDW Superfund Site., it is anticipated that additional coordination will be needed between the agencies and the partners involved in the cleanup. SPU will participate and coordinate with the parties involved in this effort during this 5-year SCIP to share information and ensure that City's source control efforts are synchronized with cleanup activities.

MTCA Coordination

The City is committed to working the Ecology Toxics Cleanup Program to develop an agreed process to exchange information and develop protocols for identification and collaboration around MTCA site cleanups on City-owned properties and rights-of-way affected by activities on adjacent properties that have a potential to affect water and sediment quality in the LDW.

1.2.12. EFFECTIVENESS EVALUATION

Over the next five years, the City intends to continue refining the tools that have been described and used in this plan to establish priorities for the source control activities and will coordinate with Ecology on the development of approaches that can reasonably evaluate the effectiveness of the City's source control program.

1.2.13. ANNUAL REPORTING

The City will be providing an annual report on the activities conducted in support of the SCIP each March, starting in 2017 in conjunction with the City's NPDES Phase I Municipal Stormwater Annual Report.

1.3. SUMMARY

The City is committed to continued work with the Ecology Water Quality and Toxics Cleanup programs to implement a robust source control program that complies with its NPDES Phase I MS4 permit requirements, meets the S4F adaptive management requirements and supports Ecology and EPA efforts to implement a comprehensive source control program to prevent recontamination of waterway sediments following cleanup. The experience of the past ten years shows that the City's approach to source control has been and will continue to be effective in identifying and controlling sources of pollutants associated with the City-owned MS4. However, larger regional efforts are needed to control some pollutants such as BEHP, which is frequently detected above the screening levels throughout the LDW drainage basin. Other pollutants that sometimes exceed screening levels in storm drain solids (such as zinc and PCBs) will also be challenging to fully control using standard source control tools. A strong coordinated effort will be critical to successful source control efforts in the LDW and SPU is committing to continued coordination and collaboration with Ecology and the other agencies engaged in source control in the LDW.

2. INTRODUCTION

Seattle Public Utilities (SPU) has voluntarily implemented an aggressive source control program in the LDW drainage basins since early 2003. At that time, the Lower Duwamish Waterway Group's (LDWG) municipal partners (e.g., City of Seattle, King County, and Port of Seattle), began to coordinate their efforts to identify and reduce sources of contamination to the LDW. The U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) were also beginning to develop a comprehensive strategy for controlling sources to the LDW; the final version was published by Ecology in 2004. Ecology's strategy was updated in 2012 and another update/revision is anticipated in 2016.

Since its start in 2003, Seattle's source control program has been successful in identifying and controlling sources of contaminants to the LDW. SPU's source control program includes activities specifically designed to support the cleanup of the waterway, as well as activities that are employed citywide as part of the City's stormwater management program. The LDW-specific activities extend beyond the requirements of Ecology's NPDES Phase I Municipal Stormwater Permit. The program includes more comprehensive and frequent business inspections than in other parts of the City. LDW-specific activities also include focused source sampling and targeted line-cleaning. Citywide activities that support source control efforts in the LDW include the spill response program, water quality complaint response program, illicit discharge detection and elimination program, operations and maintenance of the City-owned drainage and wastewater systems and properties, stormwater code development and implementation, drainage system retrofits and other capital improvements, public education and outreach, and interdepartmental coordination.

Remedial actions in the LDW are expected to begin in approximately five years; therefore, the top priority for this next phase of the City's long-term source control strategy is to further identify and reduce ongoing sources to the waterway of the sediment Contaminants of Concern (COCs) to allow cleanup to proceed. Due to the urban and industrial nature of the Duwamish watershed, low levels of contaminants are ubiquitous and will continue being discharged to the waterway during and after cleanup. No amount of source control efforts would eliminate these low level discharges. The City's focus over the next five years is to minimize the potential for waterway sediments to exceed the Remedial Action Levels (RALs) set by EPA.

Preventing recontamination and planning longer term objectives will require collaboration among the agencies with jurisdiction, including Ecology, EPA, and King County. The City assumes that long-term objectives will be established as part of the Ecology led Source Control Program for implementation of the Record of Decision for the LDW. The City will coordinate with Ecology and the other agencies to establish the long-term objectives and incorporate them into source control plans.

This plan describes work conducted to date to identify and control sources in the LDW and explains the City's source control program for the LDW for the next five years. It also describes what has been done and learned up to now and new strategies and improvements that will be tried and evaluated in the future. Future expansion or changes to the City source control program over the next five years will be predicated on available funding and resources, and guided by lessons learned as the program continues to mature.

Background information about the City's stormwater and wastewater infrastructure are provided in Section 3. Detailed descriptions of Seattle's LDW-specific business inspection, source tracing, and line cleaning programs, as well as activities planned over the next five years are provided in Sections 4,5, and 6, respectively. Citywide programs that support source control efforts in the LDW are described in Section 7 and Section 8 describes how the City will evaluate the effectiveness of its source control efforts. Section 9 describes mechanisms for reporting progress to Ecology.

2.1. APPROACH

In developing this plan, the City used a three-pronged approach: (1) document current source control activities in the LDW, (2) prioritize drainage basins/systems in the LDW, and (3) develop and prioritize future program enhancements. The City used multiple lines of evidence to prioritize drainage basins/systems so that future activities could be focused on the most critical areas. Priority basins are selected as follows:

- Locations where elevated levels of contaminants were found in both offshore sediment samples collected in the vicinity of the outfall and storm drain solids samples collected from the downstream end of the drainage system (i.e., near end-of-pipe samples).
- Locations where storm drain solids contaminant concentrations are significantly higher than in other drains in the LDW, which suggests the presence of a unique source(s) in that basin.
- Locations where offshore sediments were predicted to exceed the sediment RAL based on the sediment transport/bed composition model that was developed during the LDW Feasibility Study.

Priority basins were then ranked using the following criteria:

- Evidence of ongoing sources and pollution-generating activities in the basin that has based on business inspection findings.
- Drainage basin size, which provides an indication of pollutant loading potential.
- Multiple and recurring exceedances of source tracing triggers for COCs identified in waterway sediment, which indicates need for additional source tracing.
- Land use characteristics such as percentage of industrial use in the basin.

A detailed description of how basins were prioritized is provided in Appendix J.

The City also convened the SPU LDW source control team and other staff involved in citywide source control efforts to identify and prioritize potential future program improvements and/or enhancements. Each staff member submitted a list of potential improvements. Ideas for improvements generally fell within the following two categories:

- Tool to improve the effectiveness and/or efficiency of existing efforts
- New or expanded source control activity.

Future program improvements are included in this plan and are listed in each section as enhancements.

3. BACKGROUND

3.1. DRAINAGE AND WASTEWATER SYSTEMS IN THE LDW

The City owns and operates most of the municipal systems that collect stormwater and wastewater from homes and businesses throughout Seattle. King County owns the conveyance system that transports the stormwater/wastewater from the City trunk lines to the treatment plants. Both the City and County wastewater collection systems overflow to the Duwamish when there are combined sewer overflows (CSOs). When the system was originally built early in the 1900's, stormwater and wastewater were collected in the same pipes and the combined sewage was discharged to a receiving water body, including the Duwamish. Later some of the combined sewage was routed to a treatment plant, such as the one that Seattle built near Diagonal Ave S and E Marginal Wy S in 1938.

In 1961, following the formation of METRO, the City and METRO agreed that METRO would take over ownership and operation of the combined sewer trunk lines, collection pipes and associated overflow points for large (1,000 acres or more) basins.[7] The City continued operating the local drainage collection system and overflow points for smaller basins, which conveyed combined stormwater and wastewater to METRO's trunk lines. METRO agreed to "accept" the City's sewage and took responsibility for treating it.

In 1985 the Washington Legislature enacted a requirement that combined sewer overflows be reduced at the earliest possible date. The Department of Ecology directed METRO to reduce the volume of overflows from its CSOs by 75 percent by the year 2005. METRO determined that separating stormwater from sanitary sewage would be the fastest and most cost effective means to reach that goal. METRO and the City worked together to separate stormwater from wastewater in several drainage basins. The consequence of that effort was that more untreated stormwater was discharged to local water bodies. As our understanding of stormwater impacts has evolved and stormwater regulations were promulgated, CSO control projects have more recently focused on using green stormwater infrastructure to mitigate stormwater impacts to the combined sewer system.

Due to this history, the City currently is served by three kinds of drainage systems[8]:

- Separate storm sewer system where stormwater is collected in storm drains, which discharge directly to the receiving water bodies and wastewater, is collected in a sanitary sewer system which conveys flow to the King County conveyance system and treatment plants at West Point or Renton.
- Combined sewer system where stormwater and wastewater are collected in a single pipe and flow is routed to the treatment plants via the King County conveyance system. During large storm events, combined flows can exceed the capacity of the conveyance system. When this occurs, excess flows are discharged to the nearest waterway via an overflow structure to keep wastewater/stormwater from backing up into homes, businesses, and on City streets. Seattle and King County both operate combined sewer overflows (CSOs) in Seattle.
- Partially separated system where runoff from streets is generally collected in a separate storm drain system, but runoff from private properties (e.g., rooftops, yards, parking lots, and other areas) continues to discharge to the combined sewer system. These areas were once served by the combined sewer system, but the City and METRO later constructed storm drain separation projects that diverted street runoff from the combined system. Most of these separation projects were constructed in the 1960-1990s, typically to reduce the occurrences of combined sewer overflows.

A total of approximately 20,000 acres discharges to the LDW Superfund Site including approximately 8,940 acres of land in south Seattle, Georgetown, South Park, the City of Tukwila, and unincorporated King County that are served by separated storm drains (private and public) and approximately 20,000 acres that are served by combined sewers[9].

Average annual runoff is estimated at about 4,100 million gallons per year based on average rainfall conditions (1986) with an expected range of approximately 3,100 to 5,300 million gallons per year for typical dry (1993) and wet years (2002), respectively (SPU 2008)[10]. Average annual

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[7] The Metropolitan Sewerage System shall thus include' trunk or interceptor sewer facilities extending to a point within each tributary, and natural drainage area, where not more than one thousand acres remain to be served beyond the upper terminus of such trunk or interceptor sewer. Basic Agreement, p. 2.

[8] The drainage system is termed the Municipal Separate Storm Sewer System (MS4) by Ecology and EPA.

[9] Because much of the area in the LDW is partially separated, the separated storm and combined sewer basins overlap.

[10] Annual stormwater runoff was estimated from land use, soil type, slope, and rainfall using a simplified Hydrologic Simulation Program-Fortran (HSPF) model.

CSO discharges from all CSOs in the LDW, regardless of ownership, are estimated at approximately 48 million gallons per year based on 2008 to 2013 records from King County and SPU (SPU 2015 and King County 2015).

Most of the Duwamish waterfront areas discharge stormwater directly to the LDW via privately-owned storm drains or sheet flow. Upland areas are typically served by a variety of private and public (i.e., City of Seattle, Port of Seattle, City of Tukwila, King County, and Washington Department of Transportation [WSDOT]) drainage systems. Seattle owns 18 outfalls within the LDW study area. Seattle City Light (SCL) owns three of the City storm drain outfalls, which only serve property owned by SCL. Seattle also discharges stormwater to 13 other outfalls in the LDW owned by King County, WSDOT, City of Tukwila, and private entities.

In addition, Seattle operates three emergency overflows that discharge sewage to outfalls owned by King County or the City of Tukwila. Emergency overflows are located on sanitary sewer force mains to relieve backups due to pump station failure or mechanical clogging. All of the sanitary sewer pump stations in the LDW are equipped with backup generators, so these systems are not affected by power outages.

City-owned outfalls in the LDW are listed in Table 1 and shown on Map 1.

Table 1: City-owned outfalls in the LDW.

Outfall	Outfall Number[a]	Map Number.[i]	City Use	Area (acres)	Diameter (inches)
East side of waterway					
S Nevada St SD	NA	4, 29, 54	SD	23	18
Diagonal Ave S CSO/SD[c]	2155	5, 30, 55	CSO, SD	415 / 1,500[g] / 2,664	144
1st Ave S SD (east)	2503	6, 31, 56	SD	15	36
S River St SD	NA	8, 33, 57	SD	6.5	8
S Brighton St SD[b]	NA	9, 34, 58	SD	17	30
S Myrtle St SD	2026	10, 35, 59	SD	6.2	30
North Boeing Field SD	2048	None	NA	k	24
Georgetown SD	2047	12, 37, 61	SD	5.9	24
West side of waterway					
SW Dakota St SD	2253	18, 43, 67	SD	54[l]	30
SW Idaho St SD	2147	19, 44, 68	SD	423	72
SW Kenny St SD/T115 CSO[d]	2127	20, 45, 69	SD	100 / 154	48
Highland Park Wy SW SD	2125	21, 46, 70	SD	289[h]	72
S Webster St SD[e]	2113	None	SD	e	6
7th Ave S SD	2112	24, 49, 73	SD	238	72
17th Ave S SD[j]	NA	25	SD	2.9	18
Duwamish substation SD#1[f]	2099	27	SD	0.6	8
Duwamish substation SD#2[f]	2098	27	SD	1.3	8
Duwamish substation SD#3[f]	NA	27	SD	1.9	8

SD = storm drain, CSO = combined sewer overflow

Note: outfalls are listed in order from downstream end of waterway to upstream end of waterway starting with outfalls located on the east side followed by those on the west side of the waterway

624 / 5,000 / 2,613 = City CSO basin area / King County CSO basin area / separated drainage basin

a. Number from the Herrera 2004 outfall survey, used by Ecology to identify outfalls.

b. The S Brighton St outfall served as both a SD and CSO until about 2012, when the City eliminated the CSO because monitoring records showed that the combined sewer had not overflowed since 1999 when the City started monitoring CSO discharges.
c. SPU's CSO #111 and King County's Hanford #1 CSO discharge to this outfall.
d. King County's T115 CSO discharges to this outfall (100 acres)
e. A single catch basin in S Riverside Dr is connected to this outfall.
f. Owned by Seattle City Light
g. Acreage includes only areas where stormwater runoff drains to the combined sewer.
h. Does not include the approximately 7.3 acre overlap within the 1st Ave S drainage basin.
i. Refer to Map Atlas for maps. Maps are grouped by 1) drainage basin area, 2) business inspections, spills, and water quality complaints 3) samples collected in each drainage system.
j. New storm drain outfall installed in 2015 as part of the City's T-117 Adjacent Streets Cleanup project. Outfall will be put into service in 2016 when the T117 project is complete.
k. Given recent findings from video inspection, SPU will investigate whether this outfall can be taken out of service, since there no longer appear to be any active connections to this system.
l. See Section 5.3.3. 44.8 acres drains to the City-owned SW Dakota St SD system. An additional 9 acres drains to the constructed channel that discharges to the LDW downstream (i.e., east) of the City's outfall.

Outfalls owned or constructed by others in the LDW that receive stormwater and/or wastewater from City-owned systems are listed in Table 2 and shown on Map 1. The source control activities described in this plan are applicable to the portions of these systems located within the City-owned MS4.

Table 2: Other outfalls in the LDW that receive discharges from City-owned stormwater/wastewater collection systems.

Outfall Location	Outfall Number[b]	Map Number [i]	City Use	Owned or Installed by[a]	Other Use	Area (acres)[c]	Diameter (inches)
East side of waterway							
Head of Slip 2 SD	2019	7, 32	SD	Private	SD	12	24
S Garden St SD[e]	2035	11, 36, 60	SD	Private	SD	12	30
I5 SD at Slip 4	2046	13, 38, 62	SD	WSDOT	SD	150[h]	72
KCIA SD#3/PS44 EOF	2049	None	EOF	King County	SD	296	60
16th Ave S SD, east	3031 3032	14, 39, 63	SD	Tukwila	SD	12	12
KCIA SD #2/PS45 EOF	2062	None	EOF	King County	SD	233	48
KCIA SD #1	2080	15, 40, 64	SD	King County	SD	192[k]	30
S Norfolk St CSO/PS17 EOF/SD	2095	16, 41, 65	SD, EOF	Tukwila	CSO, SD	1,060[j] / 676	84
I5 SD at S Ryan St[d]	NA	17, 42, 66	SD	WSDOT	SD	529[j]	60
West side of waterway							
1st Ave S SD (west)	NA	22, 47, 71	SD	WSDOT	SD	603	Channel
2nd Ave S SD	2118	23, 48, 72	SD	Private	SD	38	24
S 96th St SD	2100	26, 50, 73	SD	Unknown	SD	1,050[g]	72
W Marginal Pl SW SD	2200	None	SD	Unknown	SD	4.6[f]	36

1,060 / 683 = CSO basin area / separated storm drain basin

Note: outfalls are listed in order from downstream end of waterway to upstream end of waterway starting with outfalls located on the east side followed by those on the west side of the waterway

EOF = emergency overflow from sewer pump station

a. Outfall constructed by or owned by others, but City-owned stormwater/wastewater systems discharge to these outfalls.
b. Number from Herrera 2004 outfall survey, used by Ecology to identify outfalls
c. Total area draining to outfall
d. Seattle installed a high flow bypass to the S Ryan St system in 1992, to divert excess flow from the S Norfolk St drainage system to prevent flooding during large storm events.
e. Outfall ownership transferred to Seattle Iron and Metals Company in 2012.
f. City-owned drainage only
g. Approximately 83 acres are served by City-owned storm drains. The remainder is in unincorporated King County.
h. Approximately 65 acres are served by City-owned storm drains. The remainder is I-5 and railroad right-of-way drainage.
i. Refer to Map Atlas for maps. Maps are grouped by 1) drainage basin area, 2) business inspections, spills, and water quality complaints and 3) samples collected in each drainage system.
j. Includes portion of S Norfolk CSO/PS 17 EOF/SD drainage basin that can discharge to the I-5 SD at S Ryan St during large storm events.
k. Approximately 86 acres are served by City-owned storm drains. The remainder is I-5 right-of-way and King County Airport property.

3.1.1. CITY STORM DRAINS

The City-owned MS4 serves an area of about 5,500[11] acres in the LDW. Stormwater runoff from the City-owned MS4 is discharged to the LDW via 31 outfalls, 18 of which are owned by the City. Maps 4-28 show the basin areas for outfalls owned by the City of Seattle and outfalls that the City uses to discharge stormwater and/or wastewater from City-owned systems.

3.1.2. COMBINED SEWER OVERFLOWS

The City and King County both operate and maintain combined sewer overflows (CSOs) in the LDW. This plan does not address actions in CSO basins as SPU and King County are currently developing and implementing Long Term Control Plans to address these discharges and associated potential sources of pollutants. The information is provided to summarize CSOs that discharge via City-owned outfalls in the LDW.

Only one City outfall in the LDW is affected by CSOs, the Diagonal Ave S CSO/SD. Both the City (CSO 111) and King County (Hanford #1) combined sewer systems overflow to the Diagonal Ave S CSO/SD outfall. CSO 111 serves an area of approximately 416 acres of mostly industrial/commercial property. The area is partially separated. CSO 111 had 8 separate overflow points in the Diagonal Ave S system (111A through 111H), but two were sealed in 2011 (111E and 111F) after records showed that these structures had not overflowed since at least 1998 and modeling indicated that these locations had a low probability of ever overflowing in the future (CH2M Hill et al. 2012). Overflow records are summarized in Table 3. In 2005, SPU modified the overflow structure on the largest overflow point (111 D) to allow more flow to enter the King County system for treatment at its West Point facility. SPU has been monitoring the system, and monitoring indicates that additional storage will be needed to adequately control the overflows from this CSO. CSO 111 is being addressed in the Long Term Control Plan (LTCP) that SPU is currently preparing to control CSOs throughout the City. The draft LTCP (CH2M Hill 2014) identified four aggregate options for controlling Seattle CSOs citywide. Three of the four options require two separate off-line storage facilities to control CSO 111, a 20,000 gallon facility for 111B and 111C and a 10,000 gallon facility for 111H.

[11] Includes portions of the I-5 corridor and railroad right-of-way that have not been separately delineated.

Table 3: CSO 111 overflow records (2007-2015).

Year	No. of Overflows	Duration (hrs)	Total Volume (gallons)	Rainfall Total (inches)
2007	11	134	22,293,000	31.8
2008	0	0	0	29.3
2009	9	7	1,483,000	37.7
2010	6	41	1,721,000	45.6
2011	2	18	1,236	35.8
2012	4	28	315,000	47.6
2013	3	4	11,507	27.9
2014	3	17	146,654	46.8

The fourth option involves a flow diversion structure to transfer flow from CSO 111 to the King County's Duwamish Pump. The preferred option will be identified in the final LTCP, which is scheduled to be completed in 2015, with controls in place by 2030. See SPU's LTCP site for more information regarding the City's CSO control plan

http://www.seattle.gov/util/EnvironmentConservation/Projects/SewageOverflowPrevention/IntegratedPlan/index.htm

The Diagonal outfall also receives overflows from King County's Hanford #1 (Hanford at Rainier) CSO. The Hanford #1 CSO serves an area of about 4,800 acres[12] of industrial and commercial land adjacent to the LDW. Overflows from this system discharge to the Diagonal Ave S CSO/SD via King County's regulator station located at 8th Ave S and S Hanford St. Annual overflows from the King County Hanford #1 CSO to the City's Diagonal Ave S CSO/SD for 2008-2013 range from a minimum of 3,354,230 gallons in 2008 to a maximum 95,194,313 gallons in 2012 and average 47,169,476 gallons per year (King County 2015a). Control of the Hanford #1 CSO is addressed in King County's CSO control plan. For further information, see King County's website at http://www.kingcounty.gov/environment/wastewater/CSO/Library/PlanUpdates.aspx.

Seattle's S Brighton CSO (116) was plugged in 2012, after monitoring determined that no overflows had occurred since 1999 when monitoring began (Figure 1 and Figure 2).

3.1.3. EMERGENCY OVERFLOWS

Seattle operates three emergency overflows on sanitary pump stations in the LDW. As explained above, EOFs are relief points on sanitary force mains to prevent sewer backups should the pump fail or a blockage occur in the line. These discharges are regulated as sanitary sewer overflows (SSO). SPU is required to submit an Environmental Incident Report Form to Ecology's Environmental Report Tracking System (ERTS) for any sanitary sewer overflow immediately after the time the City becomes aware of the discharge, has assessed the situation, taken appropriate steps to control the discharge, and submit a letter report to Ecology within five business days. The report describes 1) the reason for the discharge, 2) date and duration of the discharge, 3) estimated time the discharge is expected to continue if it has not been corrected, 4) estimated discharge volume, and 5) steps taken or planned to reduce, eliminate, or prevent future occurrences. Records from 2009-2014 indicate that EOFs occur infrequently (Table 4).

[12] Total area served by the combined sewer. Includes about 1,500 acres that drain to the combined sewer in this area (Phillips 2013).

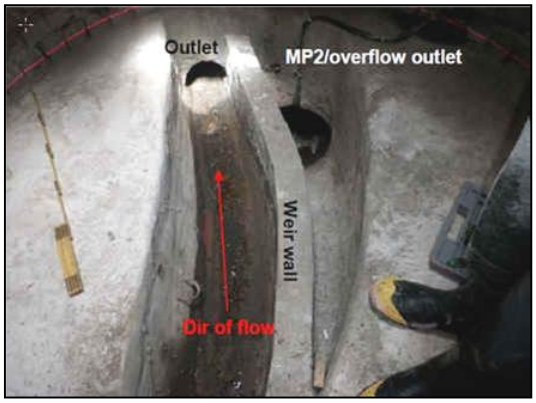


Figure 1: S Brighton CSO before sealing.

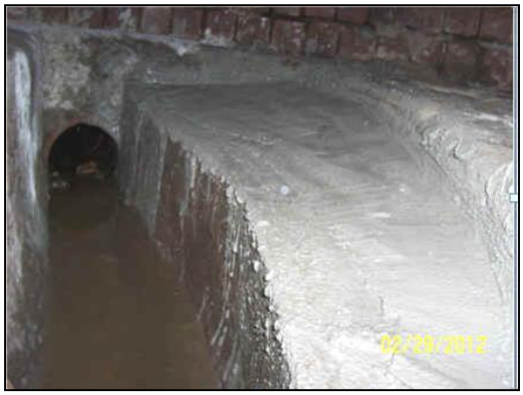


Figure 2: S Brighton CSO after sealing.

Table 4: Emergency overflow records.

Pump Station	Outfall	Reported EOFs		
		Date	Duration (hrs)	Volume (gallons)
17	Norfolk CSO/PS17 EOF/SD	12/12/10[a]	6.8	1,300,000[b]
44	KCIA SD#2/PS44 EOF	12/12/10[a]	4.4	72,000
45/78[c]	KCIA SD#2/PS45 EOF	--	--	--

a. Seattle rain gauges recorded a 50-100 year event on December 11-12, 2010. Under these conditions, inflow and infiltration can overwhelm the capacity of the sewer system, because City systems are not designed to handle this size storm event.
b. Worst case estimate. No evidence that duckbill valve opened to allow flow from the sanitary sewer to discharge to the storm drain. SPU crews did not observe any evidence of sewage in the ditch downstream of the duckbill valve (e.g., toilet paper, rags).
c. PS78 overflows to PS45.

4. BUSINESS INSPECTION PROGRAM

SPU had occasionally inspected businesses in the LDW prior to 2003[13], but 2003 marked the beginning of the City's comprehensive efforts to reduce the amount of contaminants discharged from City-owned infrastructure. Work began in the Diagonal Ave S CSO/SD system to support King County's 2004-2005 sediment cleanup at the Diagonal/Duwamish early action area and later expanded to include other early action areas identified in the LDW, as well as source control areas identified by Ecology. SPU source control efforts were prioritized to support early action area cleanups, as well as Ecology's preparation of Data Gaps and Source Control Action Reports. Since 2010, when SPU completed its first sweep of businesses in the LDW drainage basin, source control activities have been prioritized based on pollution potential and problem areas identified from ongoing source tracing activities.

[13] In the mid-1990's, SPU inspected approximately 100 businesses in the LDW under a Centennial Clean Water Fund grant from Ecology (She 1997). The study focused on outdoor activities to minimize the presence of chemicals used or generated by onsite activities that could contact stormwater runoff. In 2001, SPU inspected 200 businesses in the western portion of the Diagonal Ave S CSO/SD drainage basin. Forty percent of the businesses inspected were not in compliance with City stormwater source control requirements. In both cases, SPU inspectors worked with the business owners to improve their stormwater pollution prevention practices.

4.1. PROCESS

In 2003, business inspections started in the Diagonal Ave S CSO/SD basin to support cleanup efforts in the Diagonal/Duwamish Early Action Area. The Diagonal outfall discharges both stormwater from the City's separate stormwater system and overflows from the County and City combined sewer systems. The City and County agreed to conduct joint inspections, because the county initially had more inspectors available to conduct the work and conducting a single inspection would be less disruptive to businesses than having representatives from each program conduct individual inspections. The inspections targeted stormwater quality, industrial waste and hazardous waste management.

The King County Code regulates industrial waste and provides support to small quantity generators of hazardous waste. Seattle's Code regulates stormwater that discharges into the separated stormwater system. Code authority to regulate stormwater discharges to the combined sewer is shared by King County and Seattle. Because of overlapping and different authorities between the City and County regarding discharges to the combined system, project staff developed specific guidance for inspecting businesses in the combined areas. The goal for inspecting stormwater dischargers in combined areas is to minimize discharge of chemicals of concern to the combined sewer by preventing the accidental or deliberate discharge of concentrated products or wastes to the combined sewer.

The joint inspection program lasted for three years, at which point King County withdrew, but continued to inspect businesses that are permitted under the King County Industrial Waste program. Seattle currently carries out comprehensive inspections at businesses in the LDW to evaluate compliance with City and County regulations regarding stormwater, industrial wastewater, spill containment, and hazardous waste management practices, but refers specific industrial waste and hazardous waste issues to the appropriate King County or Ecology program for follow-up. Likewise, King County inspectors refer stormwater-related issues to SPU staff when encountered during their inspections. Section 4.2.3 contains additional information on referrals. When the inspectors find a situation that does not comply with Seattle's Code, SPU works with the business to resolve it and, when necessary, brings an enforcement action.

4.1.1. CROSS-TRAINING PROGRAM

King County and SPU organized an initial training session on January 29, 2003 to ensure that all inspectors involved in the multi-media inspections were well versed in the inspection procedures and capable of completing all aspects of an inspection (e.g., stormwater, industrial waste, and hazardous waste). The training was attended by more than 30 inspectors from King County and SPU. A training manual with accompanying reference material was provided to each inspector. In addition, a field form/checklist was developed to help ensure consistency. Each of the county programs (King County Industrial Waste, King County Local Hazardous Waste) and SPU involved in the inspection program designated a lead inspector who was responsible for coordinating the work of the other inspectors in their agency, distributing information, and meeting with the two project co-leads to discuss project procedures. During the first three years of the program, inspections were conducted in a specific geographic area and businesses were notified prior to inspections. Today, Inspectors are trained to identify potential compliance issues and those issues are referred to the agency with jurisdiction. Joint inspections are still conducted on a case by case basis.

4.1.2. INSPECTION PROCESS AND PROGRESSIVE ENFORCEMENT

SPU primarily conducts unscheduled inspections. Although this can sometimes be an inconvenience to the business owner or manager, it offers the most complete look at the business operations and their day to day housekeeping and source control practices. An inspection may need to be scheduled if the manager or site operator is not onsite or if the site is large and may take several hours to inspect.

If SPU is aware that the business has an NPDES Stormwater Permit from Ecology or an Industrial Waste permit/authorization from King County, the Inspector will call the respective agency to coordinate a joint inspection. These joint inspections are often coordinated through the Duwamish Inspectors Group, a partnership of inspectors from EPA, Ecology, King County, and Seattle that meets regularly to discuss inspection activities (see Section 7.15.1). SPU periodically updates its database with permitting information from other agencies so that Inspectors are aware when a joint inspection should be arranged.

At the initial inspection, the Inspector gathers information on stormwater source control practices, industrial waste discharges, and hazardous waste management practices. At the conclusion of the inspection, the Inspector reviews the required corrective actions and the compliance process with the owner and/or operator. In the office, the information is entered into a database and a 'Corrective Action' letter is generated, generally within two weeks. Supplemental best management practice (BMP) information is sent with the corrective action letter. The business is provided 30 days to comply with the required corrective actions. SPU uses a "progressive enforcement process" (described below) to achieve compliance. In addition, SPU has created enforcement decision-making tools (Figure 3 and Figure 4) to ensure a consistent and transparent enforcement process in the LDW and citywide.

After 30 days, the Inspector re-inspects the site to evaluate the compliance status and affirm the corrective actions have been implemented. If the business is compliant, a 'Closure' letter is sent to document the end of the inspection cycle. If the corrective actions have not been implemented, the business is issued a Notice of Violation (NOV), which includes a penalty. The penalty is based on a matrix of eight elements including:

- Public health risk
- Environmental damage or adversely affecting infrastructure
- Willful or knowing violation
- Unresponsive in correcting action
- Improper operation or maintenance
- Failure to obtain necessary permits and approval
- Economic benefit to non-compliance
- Repeat violation.

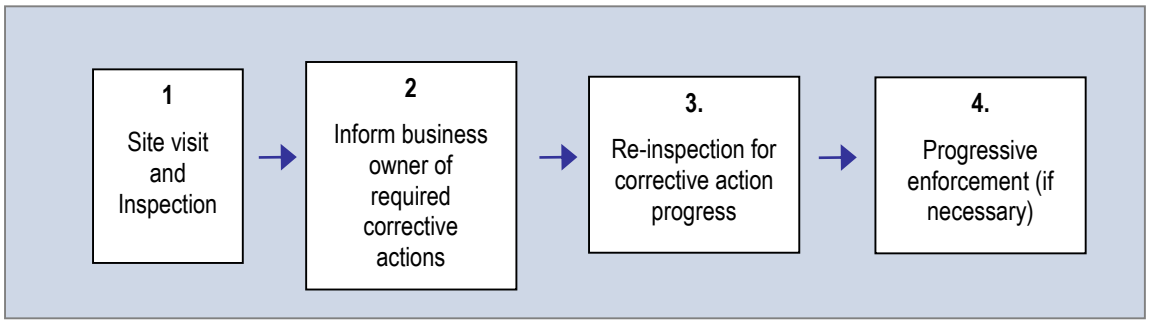


Figure 3: SPU stormwater compliance process.

For source control implementation, the penalty is generally suspended pending completion of the required corrective actions and the business is usually provided 2 weeks to comply. If the violation involves an illicit discharge or is an otherwise egregious violation, the penalty may be issued upfront and the compliance window shortened. The inspection team has flow charts detailing enforcement criteria for source control implementation and illicit discharges/connections. These flow charts ensure that there is consistency and transparency in the enforcement process. For

complex sites, such as those that may require an engineered solution to comply, the responsible party and the City may choose to enter into a Voluntary Compliance Agreement, which identifies milestones for compliance and acts as a contract between the parties. The City also has an administrative appeal process as part of its progressive enforcement process. The progressive enforcement process for inspections is outlined in Figure 4.

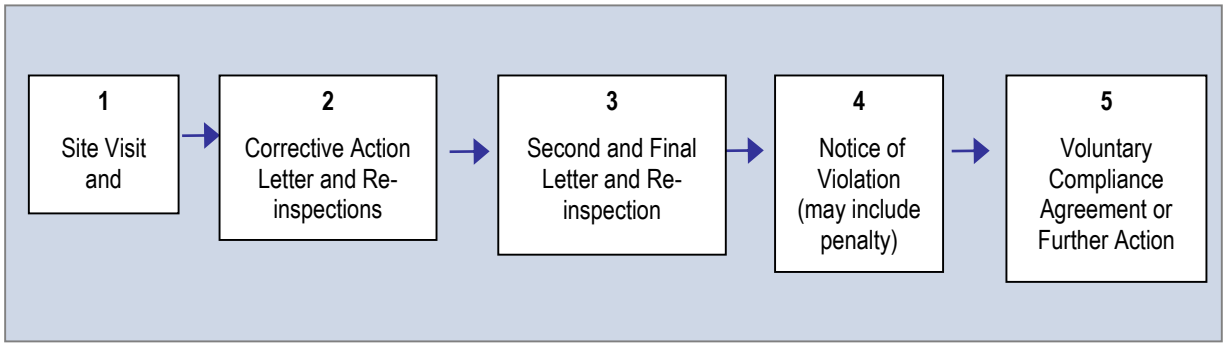


Figure 4: SPU stormwater enforcement process.

4.2. PROGRESS TO DATE

The joint SPU-King County business inspection program continued from 2003 to 2006. During that time, 1,100 inspections were completed at approximately 625 businesses, mostly in the Diagonal Ave S CSO/SD basin. In 2006, SPU took over the business inspection program while King County continued to inspect those businesses in the LDW that are permitted under its Industrial Waste Program. King County also provides technical assistance to SPU as needed on issues related to industrial waste and hazardous waste.

In 2010, the City completed the first round of inspections at the approximately 1,166 pollution-generating businesses in the Lower Duwamish drainage basin. Between 2003 and December 31, 2014, approximately 3,771 inspections (1,689 initial inspections, 1,740 follow-up inspections, and 342 screening inspections) have been completed at 1,166 businesses throughout the LDW drainage and combined sewer basins. Businesses inspected as of December 31, 2014 are shown on Maps 29-51 and are listed in Appendix A.

4.2.1. CORRECTIVE ACTIONS

When inspectors find problems, they require businesses to implement corrective actions. SPU tracks 26 different corrective actions in the Business Inspection Database. Corrective actions are grouped by regulatory program (Table 5). As of December 31, 2014, inspectors have found problems that required corrective actions at 902 of the 1,166 businesses inspected. Approximately 43 percent of the 4,524 corrective actions required between 2003 and 2014 were associated spill control and cleanup practices. Thirty-nine percent were associated with stormwater practices. The most common problems encountered during inspections are listed below (percentage of total corrective actions issued):

Lack of appropriate spill response procedures 26.3%
Onsite drainage system needs cleaning 19.7%
Lack of available spill response materials 20.9%
Employees not trained about spill procedures 20.5%
Improper housekeeping 11.2%
Improper storage of products and/or waste 9.6%

Improper waste disposal practices 8%
Improper storage of containerized materials 6.7%
Improper labeling of waste containers 6.2%
Improper washing practices 5.3%
Inadequate control and cleanup of leaks and spills 4.9%
Damaged or missing storm drain component 4.8%
Discharge of wastewater to storm drains 4.6%
Improper storage of non-containerized materials 3.8%
Requires NPDES industrial stormwater permit 3.1%

A list of all corrective actions required at each business is provided in Appendix A.

Table 5: Corrective actions tracked in Business Inspection Database.

Hazardous Waste	Spill Control	Industrial Waste
Repair or replace degraded open chemical containers	Clean and eliminate leaks and spills from storage areas	Implement pretreatment for discharge
Properly designate waste	Properly educate employees	Maintain pretreatment system
Properly dispose of waste	Improve or purchase adequate spill response materials	Obtain proper permit for facility discharge
Properly document waste disposal	Develop and implement spill response procedures	
Properly label containers		
Properly store product/waste		
Stormwater		
Don't discharge process wastewater to storm drain	Implement proper fueling operations	Obtain NPDES permit for discharge
Implement proper material transfer practices	Implement proper washing practices	Make storm drain facility parts accessible
Properly perform maintenance of vehicles and equipment	Properly store containerized materials	Storm drain facility needs to be cleaned
Implement proper housekeeping	Properly store non-containerized materials	Missing or damaged components to storm drain facility need replacement
		Correct illicit connection

4.2.2. NOTICES OF VIOLATION

From 2005 to 2014, SPU has issued 42 Notices of Violation (NOV) to businesses in the LDW (Table 6). SPU started issuing monetary penalties in 2009 when the Stormwater Code was last updated to allow penalties. Penalties are often suspended if the business corrects the problem within the specified time period.

Table 6: NOVs issued to businesses in the LDW.

NOV No.	Responsible Party	Address	Outfall	Violation	Penalty
2005-002	Ralph's Concrete	1511 Rainier Ave S	Diagonal Ave S CSO/SD	Prohibited discharge	N/A
2008-011	Zevia, LLC	14 S Idaho St	Diagonal Ave S CSO/SD	Prohibited discharge	N/A
2008-023	King Electric Manufacturing	9131 10th Ave S	S 96th St SD	Illicit connection	N/A
2009-001	North Star Casteel	3909 9th Ave S	Diagonal Ave S CSO/SD	Failure to implement source control	$500
2009-014	MacMillan Piper	655 S Edmunds St	Diagonal Ave S CSO/SD	Prohibited discharge	N/A
2009-023	Fog Tite	4819 W Marginal Way SW	SW Idaho St SD	Prohibited discharge	N/A
2009-024	Homeowner	9267 42nd Ave S	Norfolk CSO/PS17 EOF/SD	Broken side sewer	N/A
2010-005	North Star Casteel	3909 9th Ave S	Diagonal Ave S CSO/SD	Failure to implement source control	$4,000 (suspended)
2010-010	T & E International	9801 Martin Luther King Jr Way S	Norfolk CSO/PS17 EOF/SD	Illicit connection	$250
2010-013	Seattle Iron and Metal	601 S Myrtle St	S Myrtle St SD	Prohibited discharge	$500 and VCA
2010-028	Property owner	620 S Dakota St	Diagonal Ave S CSO/SD	Illicit connection	$250 (suspended)
2010-030	Nova Oil	2801 Martin Luther King Jr Way S	Diagonal Ave S CSO/SD	Illicit connection	$250 (suspended)
2010-031	Waste Management	70 S Alaska St.	Diagonal Ave S CSO/SD	Prohibited discharge	$1,000
2011-005	Property owner	1308 12th Ave S	Diagonal Ave S CSO/SD	Prohibited discharge	Withdrawn
2011-012	Steeler	10023 MLK Jr Way S	Norfolk CSO/PS17 EOF/SD	Failure to implement source control	$1500 (suspended)
2011-016	January Company	9844 40th Ave S	Norfolk CSO/PS17 EOF/SD	Illicit connection	$250
2011-027	Seattle Barrel	4716 Airport Way S	Diagonal Ave S CSO/SD	Prohibited discharge	$500
2012-002	January Company	9844 40th Ave S	Norfolk CSO/PS17 EOF/SD	Illicit connection	$16,500 (suspended)
2012-017	Western Peterbilt	3707 Airport Way S	Diagonal Ave S CSO/SD	Illicit connection	$2,000 (suspended)
VCA	Western Peterbilt - VCA	3707 Airport Way S	Diagonal Ave S CSO/SD	Illicit connection	$2,000 (suspended)
2012-019	Sequential Biodiesel	4034 W Marginal Way SW	SW Dakota St SD	Prohibited discharge	$1,000
2012-024	US Dept of Veterans Affairs	1660 S Columbian Way	Diagonal Ave S CSO/SD	Illicit connection	$250
2012-032	Rainier Commons	3100 Airport Way S	Diagonal Ave S CSO/SD	Prohibited discharge	$1,000
2012-036	Seaport Petroleum	7800 Detroit Ave S	1st Ave S SD	Failure to implement source control	$500
VCA	Seaport Petroleum	7800 Detroit Ave S	1st Ave S SD	Failure to implement source control	Issued NOV
2013-001	Independent Metals	816 S Kenyon St	Direct discharge	Prohibited discharge	$1,500
2013-021	Horizon Coach Lines	4500 W Marginal Way SW	Direct discharge	Failure to report spill	$500
2013-023	Rainier Commons	3100 Airport Way S	Diagonal Ave S	Failure to implement	$1,000

NOV No.	Responsible Party	Address	Outfall	Violation	Penalty
			CSO/SD	BMPs	
2013-028	Property owner	1510 14th Ave S	Diagonal Ave S CSO/SD	Broken side sewer	$500
2013-051	Jhovaney Pressure Washing	1st Ave S & S Denver St	Diagonal Ave S CSO/SD	Prohibited discharge	$1,500 (reduced to $500 on appeal)
2013-056	Fleetwash	7th Ave s S & S Snoqualmie	Diagonal Ave S CSO/SD	Prohibited discharge	$1,500
2014-012	Plymouth Poultry	4500 7th Ave S	Diagonal Ave S CSO/SD	Prohibited discharge	$2,000
2014-017	Uli's Sausage	601 S Nevada St	Diagonal Ave S CSO/SD	Illicit connection	$500
2014-020	Property owner	1352 MLK Jr Way S	Diagonal Ave S CSO/SD	Illicit connection	$250
2014-021	Property owner	1356 MLK Jr Way S	Diagonal Ave S CSO/SD	Illicit connection	$250
2014-022	Property owner	1362 MLK Jr Way S	Diagonal Ave S CSO/SD	Illicit connection	$250
2014-023	Property owner	2705 S Irving St	Diagonal Ave S CSO/SD	Illicit connection	$250
2014-024	Property owner	2707 S Irving St	Diagonal Ave S CSO/SD	Illicit connection	$250
2014-025	Property owner	2709 S Irving St	Diagonal Ave S CSO/SD	Illicit connection	$250
2014-026	Franz Bakery	2006 S Weller St	Diagonal Ave S CSO/SD	Illicit connection	$1,000
2014-028	Property owner	3101 25th Ave S	Diagonal Ave S CSO/SD	Broken side sewer	$500
2014-029	Property owner	3828 4th Ave S	Diagonal Ave S CSO/SD	Illicit connection	$1,500

4.2.3. REFERRALS

From 2003 to 2014, SPU has referred 249 sites to other agencies or other City Departments for follow-up. If there are hazardous waste handling, labelling, or disposal issues, the site is referred to King County Hazardous Waste program (small quantity generators) or Ecology (large quantity generators). If there are industrial waste issues (e.g., process waste being discharged to the sanitary or combined sewer), the site is referred to King County Industrial Waste program.

A list of referrals in provided in Appendix A. Referrals are summarized by agency below:

King County Hazardous Waste 31

King County Industrial Waste..... 52

Ecology Hazardous Waste Program..... 20

Ecology Water Quality Program..... 83

Other City Department/SPU Division..... 41

Other Agency..... 22

It is difficult to track status once a site has been referred to another agency. SPU typically only tracks progress of those sites referred to another City department or another division within SPU.

4.2.4. RECENT IMPROVEMENTS

Over the years, SPU has made a number of improvements and changes to the LDW Business Inspection Program to streamline enforcement, match inspection resources to sites that present the greatest risk to stormwater and sediment quality, improve data management and reporting procedures, and increase the use of analytical data for source tracing. These improvements are described in the following sections.

Priority Ranking System

The LDW Business Inspection Program has evolved to meet changing needs. The primary focus of the program from its inception to 2010 was to ensure that all businesses in the LDW Superfund site drainage basin had been assessed for their pollution-generating potential and inspected, if warranted to bring operating practices into compliance with the Stormwater Code.

Once this was accomplished, the program shifted to focus future inspections on sites posing the most risk to the LDW. This change allows SPU to direct limited resources where they could do the most good. Inspectors rank a business as low, medium, or high priority using criteria such as amount and type of outdoor activity, potential for spills, housekeeping practices, and business type. The priority level is updated each inspection cycle, meaning that over time the priority level for a business may change as conditions on the site change. As shown in Table 7, inspection frequency is then based on this priority level. SPU selected a two-year frequency rather than annual for high ranked sites to avoid having overlapping business cycles. High ranked sites are often complicated, requiring multiple follow-up inspections and sometimes fairly extensive corrective actions. Completion of the inspection cycle from initial inspection to compliance can take almost a year.

Table 7: Business inspection ranking system.

Priority Level	Inspection Frequency
High	2 years
Medium	4 years
Low	6 years

A priority level is assigned to all inspected businesses regardless of their sewer class (separated, direct discharge, etc.), although businesses that drain to the City's MS4 are inspected first to address NPDES Phase I Municipal Stormwater Permit requirements. Once the City has reached its Permit compliance target for a given year, inspections may then include businesses that do not have an Industrial Stormwater General Permit from Ecology and that discharge directly to the river. These businesses are often under-regulated because they are not inspected by Ecology and are not part of the City's MS4. Inspections at sites who have an NPDES Industrial Stormwater Permit are coordinated with Ecology. SPU also coordinates with King County Industrial Waste for sites that have a King County permit for a discharge to the sewer system and with Ecology Hazardous Waste for medium and large quantity waste generators.

Identifying New Businesses

There is fairly high turnover of business owners and operators in the LDW drainage basin. It is therefore important for the SPU inspection program to keep track of new businesses. New businesses are identified in one of two ways:

- SPU checks the Seattle business license database each year and field checks those that are likely to engage in pollution generating activities.
- Inspectors also locate new businesses while they are out in the field.

In either case, new businesses are added to the business inspection database and are then scheduled for inspection and risk ranking. The current database uses a system based on the last inspection date and priority ranking to determine which businesses need to be inspected within a given time period. Using the Business Inspection Data Base, the Program Supervisor assigns businesses to Inspectors and the Inspectors are notified of the assignments. This new system allows Inspectors to know and manage their workload for up to a year in advance.

Verifying Connections

In recent years, SPU has paid greater attention to verifying drainage connections, because inspectors have found that although a business owner or manager may think they know where their storm drains connect, their information may not be accurate. Inspectors routinely verify drainage connections through the use of dye testing, video inspection, or smoke testing. The SPU source control team also purchased a small video camera that can be inserted up to about 50 feet into pipes to check connections. When illicit connections are found, the City's progressive enforcement process is used to achieve compliance. When City mapping is found to be in error, updates are requested through the City's GIS mapping group. See Section 7.10 for an explanation of the GIS mapping program.

Assessment of Business Inspection Program Effectiveness

In 2011, SPU worked with Cascadia Consulting Group (Cascadia) to evaluate the effectiveness of its citywide stormwater pollution prevention inspections using a telephone survey (Cascadia 2012). To assess effectiveness, survey respondents were asked about a variety of the business's stormwater practices such as outdoor washing or water use, outdoor material storage, stormwater facilities, and spill response preparedness. The survey also included questions on the respondent's knowledge of Seattle's stormwater system, rating of the stormwater inspection, attitude toward stormwater pollution prevention, and demographics. A total of 171 businesses responded to the survey.

To the extent possible, the study was designed to determine whether business compliance decreased as time increased between inspections and whether there were differences in responses related to the estimated level of risk to stormwater posed by the business. The survey population was divided into four sub-populations based on a combination of permit status and the date of their most recent inspection to determine the time elapsed between the inspection and the survey:

- No permit and inspected one to two years before the survey
- No permit and inspected two to three years before the survey
- No permit and inspected three to five years before the survey
- With Ecology or King County permit and inspected one to five years before the survey.

While the majority of surveyed businesses reported following practices that prevent stormwater pollution (>80 percent), there did not appear to be any correlation between the time elapsed since the last inspection and the compliance rate. For example, businesses in the middle range (last inspected 2–3 years ago) reported the highest or lowest rates of compliance with certain pollution prevention practices. Only the awareness and frequency of onsite stormwater facility inspections appeared to decrease among respondents for whom more time had elapsed since their last inspection. Other key findings associated with non-permitted businesses inspected by SPU are summarized below:

- More than 80 percent of respondents reported compliance regarding methods used to clean outdoor areas, disposal of wash water from regular cleanup activities (such as mopping), storage of soluble materials, and spill kits and plans.
- More than 60 percent of respondents reported compliance regarding dumpster area cleanliness and disposal of water from washing large items.

- Businesses appeared to show no clear trend by risk category except regarding stormwater facility inspections and spill response preparedness. Respondents at low-risk businesses without permits appeared less likely to report inspecting facilities once a year or more and more likely to report not knowing about inspection frequency. Respondents at higher risk businesses were more likely to report having a spill kit and plan than respondents at lower risk businesses.
- The majority of all businesses reported having spill cleanup materials on hand (92 percent) and a written plan for dealing with a spill outdoors (83 percent). Among unpermitted businesses, spill response preparedness appeared to show a slight trend by risk level, with higher risk respondents being more likely to report having a spill kit and plan.
- More than half (59 percent) of all respondents recalled their business receiving an SPU stormwater inspection. Respondents who received an inspection more recently appeared more likely to recall the inspection.
- Most respondents at businesses who recalled attending the inspection agreed with a statement that the inspector helped them learn about compliance and pollution prevention, with 79 percent of them rating their agreement at least six on a seven-point scale (where seven meant strongly agree).

4.3. 5-YEAR PLAN

Over the past five years, SPU has conducted 200 – 350 inspections per year at 70 - 185 businesses operating in the Duwamish basin[14]. SPU intends to maintain this level of effort over the next five years. Work will focus on the following:

- High and medium priority businesses as currently classified from site visits
- Supporting source tracing efforts
- Areas scheduled for cleanup
- New businesses that start up in the LDW
- Joint inspections with Ecology and other agencies.

4.3.1. PROGRAM ENHANCEMENTS

SPU continually looks for ways to maximize inspection efficiency and focus resources where they will have the most benefit for pollution reduction. The prioritized ranking system and inspection scheduling system are both important steps in this effort. More enhancements are being considered for both the near and long term and will be implemented as budget and staffing resources allow.

Shortened Compliance Process

Starting in 2015, SPU will assess the usefulness of implementing shortened compliance cycles at businesses that have undergone previous inspection cycles from SPU. The intent of the business inspection program is to work with businesses to provide technical assistance and compliance assistance so that they implement and maintain source controls to prevent pollution. Businesses are expected to continue to use appropriate BMPs and comply with City source control requirements between inspection cycles. SPU anticipates that less time will be required with each subsequent inspection cycle as businesses become aware of and implement appropriate pollution prevention practices.

[14] Inspectors often conduct multiple site visits to achieve compliance. Each site visit is counted as an inspection.

Businesses that do not maintain source controls between inspection cycles may receive penalties for failure to maintain source controls. Rather than having penalties waived contingent on implementing source controls, this change may result in increased staff resources to process enforcement, but the intended result is to make businesses aware that stormwater pollution prevention is a part of doing business and is not something done to "pass inspection."

Focus on Key Information for Compliance

Starting in 2015, SPU will focus on identifying data that are most useful in achieving compliance. This will reduce the staff time onsite at the business and reduce staff time entering data, which will ultimately result in more stormwater source control inspections being performed by SPU staff. This streamlining of data collection is also the first step in moving toward an electronic field device for the inspection process. The current inspection form is eight pages long and encompasses stormwater management, industrial waste and hazardous waste management. All of the information collected is entered into a database, which is then used to generate a corrective action letter and is used to create reports and query for information. When the program was first established in 2003, various agencies requested that particular data be collected. However, over time, it has become evident that much of the data collected is not used to generate reports and that industrial waste and hazardous waste information is collected by other permitting agencies that have jurisdiction and authority over those media (e.g., King County and Ecology).

Electronic Data Collection

In 2016[15] SPU hopes to start developing field-based tools for documenting inspection results. After SPU has simplified data collection to that which is necessary for tracking and gaining stormwater compliance, SPU intends to move to electronic field devices for inspection data collection citywide. It is expected to be a significant financial expense for a field team of 10 inspectors and the success of this effort will in large part depend on funding. SPU databases (water quality investigation database and business inspection databases) would need to be upgraded to accommodate the change in technology and remote access. The addition of field devices and remote access, along with less administrative data entry, would increase efficiency.

This effort will not affect the data collection required for Ecology's Local Source Control Partnership (LSCP), which utilizes a separate inspection checklist and database. Any changes to the City's checklist will be consistent with the LSCP checklist to make sure that the appropriate information is collected. Information obtained by City inspectors under the LSCP are entered into Ecology's LSCP database and the City's business inspection database. Information obtained by City inspectors for inspections not covered under the LSCP are entered into the City's business inspection database. The City provides a monthly report to Ecology which contains a list of all businesses inspected in the LDW, the date of inspection, address and drainage basin where the business in located, business SIC code, sewer classification, and referral information. "

Direct Dischargers

To meet its Municipal Stormwater Permit compliance goals, SPU focuses its inspection resources on businesses that discharge to the LDW through the City-owned MS4. Ecology focuses its inspection resources on businesses that have as NPDES Industrial Stormwater Permit. The gap in these two efforts is the businesses located on the banks of the waterway with direct (private) discharge to the river. These businesses are often not regulated by NPDES industrial stormwater permits and since these businesses do not discharge to the City-owned MS4, inspections in these areas are not required for compliance with the Ecology's NPDES Phase I Municipal Stormwater Permit. As inspection resources allow, SPU intends to refocus efforts on these businesses and refer businesses to Ecology that should be covered by a NPDES industrial stormwater permit and King County if an

[15] This project must be approved and prioritized by the SPU Technology Board.

Industrial Waste Program Permit is required. By decreasing the amount of data collected and maximizing the efficiency of data collection and management operations, SPU hopes to increase inspection outputs. Municipal Permit compliance will always be SPU's primary priority, but once compliance is achieved within a reporting term, SPU will then look to fold direct dischargers into the inspection regime. This will include inspections on Port of Seattle property. Currently, SPU inspects only those Port facilities that drain to the City MS4.

Effectiveness Survey

As described above, SPU conducted a survey to evaluate the effectiveness of its citywide business inspection program in 2011. During the next five years, SPU will assess whether funding is available and if there is value in conducting another survey. As part of the effectiveness survey, SPU will investigate the need to refine the education and outreach that occurs during business inspections to determine if these elements should be refined to incorporate LDW source control messages developed by Ecology and EPA as part of the comprehensive source control program.

SPU will report in the 2017 annual report if an addition effectiveness assessment will be conducted. See Section 9 for description of annual reporting.

5. SOURCE TRACING/SAMPLING PROGRAM

This section describes the City's sampling efforts to identify and characterize sources of contaminants discharged to and from the City-owned drainage system. Section 5.1 describes the source tracing process and sampling methods used. Source tracing work completed to date is described in Section 5.2. Sampling activities planned for the next five years are described in Section 5.3

SPU conducts source tracing to determine the extent and location of contaminants within the drainage and wastewater systems. Sampling is designed to identify sources by sampling at key locations within these systems. Sampling generally starts at the downstream end of the system or at key junctions within the system and systematically moves upstream to identify sources. In addition, inspectors also collect samples from catch basins on private property during business inspections if problems or unusual conditions are encountered during the inspection. SPU refers to these as "private onsite catch basin" samples.

Data generated by the sampling program are used to:

- Identify sources of contaminants to the City-owned MS4
- Characterize the quality of storm drain solids discharged to the LDW for use in recontamination analyses
- Identify and prioritize City-owned MS4 sections for cleaning.

Source tracing is an iterative process and although fairly straightforward, in practice it can be difficult to locate individual sources. Tracing works best when contaminants associated with a site are significantly elevated and the site discharges into a relatively flat section of pipe where material can accumulate.

5.1. PROCESS

There are no regulatory standards for catch basin solids, inline solids, and sediment trap samples. SPU typically compares results to the state sediment management standards (SMS) and the Washington State Model Toxics Control Act (MTCA) Method A cleanup standards[16]. Although these

[16] MTCA Method A cleanup standards are used only to evaluate contaminants for which there are no sediment management standards (e.g. total petroleum hydrocarbons).

standards do not apply to storm drain solids, SPU, Ecology, and other members of the LDW Source Control Work Group commonly use the SMS as screening levels to provide a rough indication of storm drain solids quality. The SMS establish two levels:

- Sediment cleanup objective (SCO): Ecology's goal for protection of human health and the environment.
- Cleanup screening level (CSL): Maximum allowed concentration of any contaminant and level of biological effects permissible at a site or site cleanup unit after completion of a cleanup action.

Because storm drain solids samples typically contain fairly high concentrations of total organic carbon (TOC), the dry-weight equivalent SMS values (i.e., LAET and 2LAET) are used for the organic compounds where SCO/CSL values are based on TOC-normalized concentrations.[17]

SPU uses the CSL/2LAET to trigger source tracing activities. To date, SPU has focused on looking for sources of metals, PAHs, and PCBs, because they exceed the CSL/2LAET screening levels more often than other chemicals.[18] Source tracing screening levels are used to focus City activities on areas where the highest levels of contaminants are present that may be affecting the City's-owned MS4 (i.e., a "worst first" approach). To date, these levels have been effective in informing the City's actions. Screening levels may change over time to reflect overall improvements in source concentrations and/or regulatory requirements.

Comparison of storm drain sediment collected from catch basins, maintenance holes, and sediment traps to SMS criteria is considered conservative. If storm drain solids samples are below the SCO criteria, there is little chance of stormwater causing sediment offshore of the outfalls to become re-contaminated above these levels. However, a concentration above the SCO does not necessarily indicate that the sediment offshore of the outfall will exceed standards, because sediment discharged from storm drain disperses in the receiving environment and mixes with sediment from other sources before depositing.

When specific sources of contaminants are identified, SPU inspectors work with the discharger to control sources by requiring the discharger to comply with the City Stormwater Code to eliminate or modify the practice that generates the problem chemical or by moving a particular activity inside where contaminants can be effectively contained or by isolating outdoor activities to prevent contaminants from coming in contact with stormwater. In most cases, SPU has been able to effect the necessary changes using City code authority. When problems extend beyond what the City has legal authority to require, the situations are referred to partner agencies that have the appropriate authority:

- Sites with industrial waste management issues (e.g., process waste being discharged to the sanitary of combined sewer without a permit) are referred to King County Industrial Waste
- Sites with hazardous waste handling, labelling, or disposal issues are referred to King County Local Hazardous Waste Program (small quantity generators) or Ecology Hazardous Waste and Toxics Reduction (large quantity generators)
- Sites that should have an industrial stormwater general permit and do not, or sites with a permit that are not in compliance with permit requirements are referred to the Ecology Water Quality Program.
- Sites where releases of hazardous materials have occurred that require onsite cleanup are referred to EPA and/or Ecology.

[17] TOC concentrations in storm drain sediment samples ranges from 0.3 to 42 percent with average and median concentrations of 6.3 and 5.6, respectively.

[18] The one exception is BEHP, which is frequently above the 2LAET in storm drain solids samples. See Section 5.2.1 for a discussion of phthalates.

5.1.1. SAMPLING METHODS

No single sampling methodology exists to effectively trace potential sources of contaminants to LDW sediment. Therefore, a variety of sampling techniques are used. Sediment (or solids) samples, rather than whole water samples, are generally preferred because:

- Storm drain solids samples provide a more direct measure of potential contaminant contributions to waterway sediment, because many contaminants of concern are relatively insoluble and tend to attach to the particles present in stormwater/wastewater. Consequently, they are transported to the waterway primarily as particulates.
- Storm drain solids samples can be collected relatively quickly using simple tools and equipment. By comparison, stormwater sampling requires fairly expensive automatic samplers, which may require structural modifications to install, as well as considerable staff resources to operate and maintain.
- Storm drain solids that accumulate in the stormwater/wastewater systems provide a measure of pollutant contributions over a longer time period (generally what has been deposited since the system was last cleaned), whereas water samples provide only a snapshot of a single event.
- Unlike whole water samples, storm solids samples do not usually present detection limit problems for the analytical laboratory. Contaminants present in storm drain solids can usually be quantified, which makes it easier to evaluate and interpret the sample results.

Samples of solids are collected from various locations within the stormwater/wastewater collection systems. Sampling solids enables the source tracing efforts to maximize coverage of the LDW stormwater/wastewater systems and to gather information on the extent and location of contaminants within the systems. Because active City CSOs represent only 436 acres of the approximately 20,000 acres of combined sewer service area in the LDW, SPU has focused its efforts on the City-owned MS4.

Each type of sample represents a different geographic scale and a different component of the sediment in the stormwater/wastewater systems. SPU uses the following four types of samples to track and identify potential pollutant sources in the LDW:

1. Inline Sediment Traps. Sediment traps consist of a bracket mounted inside the conveyance system that contains a Teflon® bottle to passively collect suspended particulate material that passes by the sampling station (Figure 5). The Teflon® bottle is 8 inches tall. As a result, traps are only used in pipes that are 18-inches or larger in diameter[19]. Traps are generally left in place for 6 to 12 months to collect enough material for chemical analysis. Sediment traps typically represent the suspended solids that are transported in the system. Sampling stations are selected to isolate specific drainage sub-basins or capture contributions from the entire drainage basin (e.g., generally greater than 50 acres for separated storm basin). Sediment traps are typically installed to identify potential problem areas within a drainage system, and are followed up with more intensive sampling to identify potential specific contaminant sources (e.g., inline grabs and private onsite catch basin samples).
2. Inline Sediment Grab Samples. Inline sediment samples are grab samples collected from maintenance holes or other structures located on the SD line where sediment may accumulate. Like sediment traps, inline grab samples also represent contributions on a basin-wide or sub-basin scale. However, inline grabs typically represent the heavier material that accumulates and is transported in the bedload material that moves along the

[19] To obtain representative samples, the water level in the pipe needs to overtop the sample bottle during most storm events. In smaller diameter pipes, the sediment traps are only effective during larger storms.

bottom of the pipe. These samples are collected using a long-handled scoop from areas where sufficient sediment is present for chemical analysis (Figure 6). Inline sediment samples are usually collected prior to installing a sediment trap or prior to cleaning the drain to characterize the chemical quality of sediment in the SD or combined sewer system, and are useful in tracing sources in systems that are not large enough to install a sediment trap.

3. Catch Basin Solids. Catch basin samples are grab samples of solids that have accumulated in the catch basin. Catch basins are part of the stormwater collection system and collect runoff from a small catchment area (less than 0.5 acres). These structures are equipped with a small sump to capture solids and other large debris before it can enter the stormwater conveyance system (or before it can enter the combined sewer system). Because many pollutants present in urban stormwater runoff tend to adhere to solids, catch basins can also trap pollutants. The solids that accumulate in catch basins provides a measure of the quality of storm drain solids discharged from a specific location. Catch basin samples are collected either from a specific site or property (private onsite) or from the public ROW. .
4. Soil/Street Dust. Soil and street dust samples are collected to confirm offsite transport of contaminants from adjacent properties to the City right-of-way and in areas where there is no formal storm drain system to collect/convey street runoff. Like catch basin samples, soil and street dust samples represent contributions from a small local area.

Figure 5: Inline sediment trap.

Figure 6: Sediment grab

Ecology has recently funded SPU to test the new SIFT traps along with traps currently used by others (e.g., Fuller trap and Hamlin trap), as well as a new trap to be designed by SPU. The goal is to develop a device that can be easily installed and serviced in a wide range of pipe sizes. Work involves designing and testing the sediment capture ability of a new trap, and if successful, following up with by side by side testing of the new trap with others to compare both capture efficiency and chemical quality of the material sampled. In 2015, SPU tested several prototype designs in a laboratory flume to evaluate their performance. Based on the flume test results, a single design was selected for field testing. Two versions of the design were fabricated for field testing (Figure 7 and Figure 8). The new traps were installed at two test locations in early 2016.

SPU intends to continue testing the new sediment traps using Ecology stormwater financial assistance funding and should be able to report results and next steps in 2017.

Figure 7: Field prototype #1.

Figure 8: Field prototype #2.

5.1.2. SAMPLE ANALYSIS AND DATA MANAGEMENT

Source samples are routinely analyzed for the following list of parameters:

- Total solids
- Total organic carbon
- Metals (arsenic, copper, lead, mercury, and zinc)
- Total petroleum hydrocarbons, diesel and heavy oil
- PCBs by Aroclor
- Semi-volatile organic compounds
- Grain size.

Additional analyses (e.g., pH, other metals, dioxins/furans) may be performed depending on observations made during sampling, based on information obtained during the business inspection, or to support LDW sediment evaluations.

A quality assurance project plan (QAPP) was developed at the start of the sampling program (Herrera 2003) and was updated in 2009 (SPU and Pyron 2009). All samples are analyzed by Analytical Resources, Inc. (ARI) in Tukwila.

ARI sends the final laboratory analytical report and electronic data deliverable (EDD) electronically to SPU and Pyron Environmental for data validation. After validation is complete, Pyron sends the updated EDD to SPU. In 2011, with funding from Ecology, SPU purchased the EQUIS® database, a sophisticated data management software program. All historical data (i.e., 2003-2010) have been uploaded to the database and all data collected since 2011 are loaded into the database following validation. The Earthsoft EQUIS® database is a more robust system than the Excel spreadsheets that SPU previously used to manage LDW source tracing data. EQUIS® contains various modules and tools that can be used to facilitate data analyses. In particular, the mapping module allows ArcMap to directly interface with EQUIS® which allows SPU staff to rapidly plot and work with data. The streamlining of data management has improved data accessibility for analysis and reporting. Earthsoft recently developed a module to facilitate exporting data from EQUIS to Ecology's Environmental Information Management (EIM) database. All source data collected as of June 2014 have been uploaded to EIM. SPU is continuing to explore how this new system can be used to support source tracing efforts.

5.2. PROGRESS TO DATE

SPU collects about 50-175 source tracing samples per year. Sample numbers increased in 2008 when Ecology began supporting SPU source tracing efforts under an interagency agreement, which provided approximately $100,000 per year for sample collection, analysis, and data validation efforts. Since 2008, SPU has used some of its budget previously allocated for source tracing to jet and clean lines found to contain elevated levels of contaminants. Interagency agreement funding was terminated in 2014. SPU has obtained Ecology stormwater financial assistance grant program funding to cover laboratory and data validation work through June 30, 2017.

As of July 2014, SPU has collected 1,110 source tracing samples from multiple storm drains in the LDW drainage basin. Samples have been collected in 13 of the 17 city-owned outfalls and 13 of the other 15 outfalls used by the Seattle plus four other outfalls in the LDW (Table 8). Sample locations are shown on Maps 52-74. Box plots of the sample results for select chemicals are provided in Appendix B. A detailed description of the source tracing results for each major drainage basin discharging to outfalls either owned by or used to discharge stormwater and/or wastewater from City-owned systems is provided in Appendix C and a summary of the specific sources identified to date is provided in Appendix D.

Table 8: Summary of SPU source tracing samples in the LDW.

City-owned outfalls	Sample Type	Other outfalls	Sample Type
S Nevada St SD	Inline	Head of Slip 2 SD[a]	No sample[b]
Diagonal Ave S CSO/SD	Trap, CB, inline	I-5 SD at Slip 4[a]	Trap, CB, inline
1st Ave S SD, east	Inline	KC Airport SD #3/ PS44 EOF[a]	Trap, inline
S River St SD	CB, inline	KCIA SD #2/PS78 EOF[a]	Trap, inline
S Brighton SD	CB, inline	KCIA/Jorgensen SD	Trap, inline
S Myrtle St SD	CB, inline	16th Ave S SD A/B[a]	CB, inline
S Garden St SD	CB, inline	KCIA SD #1[a]	Trap, inline, CB
Georgetown flume/SD	Inline	I-5 SD at S Ryan St[a]	Inline
SW Dakota St SD	CB, inline	Norfolk CSO/ PS17 EOF/SD[a]	Trap, CB, inline
SW Idaho St SD	Trap, CB, inline	1st Ave S SD (west side)[a]	Trap, CB, inline
SW Kenny St SD/T115 CSO	Trap, CB, inline	2nd Ave S SD[a]	CB, inline
Highland Park Wy SW SD	Trap, CB, inline	16th Ave S SD (west side)[a]	CB, inline
7th Ave S SD	Trap, CB, inline	S 96th St SD[a]	Trap, inline
North Boeing Field SD	No sample[b]	Hamm Creek	Trap, inline
S Webster St SD	No sample[b]	W Marginal Pl SW SD[a]	No sample[b]
Duwamish substation SDs	No sample[bc]	17th Ave S SD	No sample[d]

Note: Outfalls are listed in order from downstream end of the waterway to upstream end of the waterway starting with outfalls located on the east side followed by those on the west side of the waterway
Trap = inline sediment trap, CB = catch basin grab sample, inline = inline grab sample

a. Receives discharges from City-owned stormwater and/or wastewater collection systems.

b. Locations where no samples are available will be targeted for sampling over the next five years. See Section 5.3 for a description of activities planned in the next five years.
c. Ecology collected water and storm drain solids samples from several locations at the Duwamish substation in December 2014. Results are not yet available for review.
d. Outfall constructed in 2015 will be put into service when City's T117 Adjacent Streets and Drainage project is completed in the third quarter of 2016.

Sample counts by sample type are summarized in Table 9.

Table 9: Source tracing sample counts by sample type.

Sample Type	Count
Sediment trap	321
Inline grab	308
Private onsite catch basin grab	198
Right-of-way catch basin grab	246
Soil/street dirt	37

A total of 43 sediment traps have been installed in 14 of the major storm drains discharging to the LDW to monitor the quality of solids discharged to the LDW and in larger basins where multiple traps are installed, to isolate contributions from major sub-basins contributing to the outfall[20]. Trap installations are summarized in Table 10 and shown on Map 75.

SPU removed the traps from the Diagonal Ave S CSO/SD system because chemical concentrations in the samples had remained fairly constant between 2003 and 2009. However, two of the traps, ST1 located near the downstream end of the drainage system (on 144-inch mainline west of E Marginal Wy S) and ST7 located on the 84-inch line at 6th Ave S and S Dakota St, were reinstalled in 2013. SPU plans to continue monitoring these sediment traps to evaluate contributions to the LDW over the long term.

[20] 39 traps remain active. SPU maintains 22 traps, King County maintains 11 traps, and Boeing maintains 6 traps.

Table 10: Sediment traps installed by SPU in the LDW.

Storm drain	No. of traps	Year Installed	Last sampled by SPU
Diagonal Ave S CSO/SD[a]	6	2003	March 2015
KCIA SD#3/PS44 EOF[b]	9	2005	May 2013
I-5 SD at Slip 4	1	2005	April 2014
KCIA SD#2/PS45 EOF	1	2008	June 2012
KCIA/Jorgensen SD[c]	2	2009	June 2012
KCIA SD#1[c]	1	2009	April 2012
Norfolk CSO/SD/PS17 EOF	5	2007	June 2014
SW Idaho St SD	3	2008	April 2013
SW Kenny St SD/T115 CSO	1	2008	April 2013
Highland Park Wy SW	2	2008	May 2014
1st Ave S SD, west side	5	2008	May 2014
7th Ave S SD	3	2008	May 2014
S 96th St SD[d]	3	2008	May 2014
Hamm Creek[d]	1	2008	May 2014
Total	43		

a. Traps removed in 2010, but two of the original five traps were reinstalled in 2013.
b. Boeing operates the seven traps on Boeing-lease property. King County started operating the two traps on King County Airport property in 2013
c. King County took over operation in 2013.
d. King County took over operation in 2016.

5.2.1. Overview by Chemicals Found in Storm Drain Solids Samples

This section summarizes results of SPU source tracing efforts in the City MS4. Data analysis focuses on results for the following chemicals of concern in waterway sediment and chemicals commonly found in storm drain solids samples collected from the City MS4 and from catch basins on private property that drain to the MS4.

- Arsenic
- Copper
- Lead
- Mercury
- Zinc
- Total petroleum hydrocarbons (TPH-oil)
- Bis(2-ethylhexyl) phthalate (BEHP)
- Butyl benzyl phthalate
- Dimethyl phthalate
- Low molecular weight polycyclic aromatic hydrocarbons (LPAH)
- High molecular weight polycyclic aromatic hydrocarbons (HPAH)
- Polychlorinated biphenyls (PCBs)
- Carcinogenic polycyclic aromatic hydrocarbons (cPAH).

LPAH = Sum of acenaphthene, acenaphthylene, anthracene, anthracene, fluorene, naphthalene, and phenanthrene.

HPAH = Sum of benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, total benzofluoranthenes, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene.

cPAH = Total toxic equivalent concentration calculated as the sum of benzo(a)pyrene, benzo(a)anthracene, total benzofluoranthenes, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene adjusted using the toxicity equivalency factors specified in WAC 173-340-900.

Overall results, which combine data for inline grabs, inline sediment traps, and grabs from private catch basins and catch basins in the right-of-way are summarized in Table 11. Chemicals of concern in the LDW sediment are frequently detected in City storm drains, but for most contaminants (i.e., arsenic, copper, lead, mercury, LPAH, HPAH, and cPAH), concentrations are relatively low with only occasional exceedances of the SMS screening levels. The major exceptions are zinc, PCBs, and bis(2-ethylhexyl)phthalate (BEHP), butyl benzyl phthalate, and dimethyl phthalate where SCO exceedances occur in 50, 41, 73, 78, and 46 percent of the samples, respectively. However, CSL/2LAET exceedances of zinc (13 percent) and PCBs (4 percent) are uncommon. Only BEHP frequently exceeds both the LAET and 2LAET screening (73 and 65 percent of the samples, respectively). Overall findings for the contaminants found in these samples are discussed in the following sections.

Table 11: Summary statistics for select contaminants in storm drain solids collected from the City MS4.

	Count	% Detect	SCO/ LAET	CSL/ 2LAET	Min	Max	Mean	Median	% of samples greater than SCO/ LAET	% of samples greater than CSL/ 2LAET
Arsenic	515	48	57	93	2.3	208	11	6.7	2	1
Copper	507	100	390	390	13	6,320	211	102	6	6
Lead	512	99.6	450	530	5	5,830	151	81	5	3
Mercury	512	68	0.41	0.59	0.01	48	0.28	0.07	6	4
Zinc	507	100	410	960	44	9,980	621	412	50	13
LPAH	500	95	5,200	5,200	10	173,200	2,066	474	6	6
HPAH	500	98	12,000	17,000	10	1,555,000	13,900	2,900	12	8
cPAH	500	100	1,000[b]	1,000[b]	9	197,900	1,851	373	20	20
PCBs	516	75	130	1,000	8	13,300	334	94	41	4
BEHP	495	99	1,300	1,900	11	200,000	10,000	4,300	73	65
BBP	495	72	63	900	10	160,000	1,930	240	78	17
DMP	496	22	71	160	9	36,000	237	65	46	24
TPH-Oil	482	99	2,000[a]	2,000[a]	32	250,000	4,430	2,000	49	49

BEHP = bis(2-ethylhexyl)phthalate BBP = butyl benzyl phthalate DMP = dimethyl phthalate
TPH-Oil = NWTPH-Dx (oil)
All units in dry weight. Metals and TPH-oil: mg/kg Organics, except cPAH: ug/kg cPAH: ug/kg TEQ

Includes all samples collected from (i.e., inline grabs inline traps, private catch basins, and catch basins in the right-of-way), except for samples collected prior to line cleaning. If lines have been cleaned, only the most recent, post-cleaning samples are included.

a. MTCA Method A soil cleanup level for industrial and unrestricted use.
b. Remedial Action Level (RAL) for the LDW.

Chemical concentrations are typically higher in samples collected from private onsite catch basins compared to right-of-way catch basins. This is expected given that onsite samples are usually collected either 1) during a business inspection when inspectors observe high-risk pollution generating activities and/or problems with the business' pollution prevention practices or 2) as the last step in source tracing to confirm that a particular site is a source of contaminants to the City storm drain system.

Arsenic

SPU does not consider arsenic a chemical of concern for municipal storm drain discharges. It has been detected in only 48 percent of the 516 samples collected and exceeds the SCO and CSL screening levels in 2 percent and 1 percent of samples collected, respectively. The highest concentration (208 mg/kg) was found in a private onsite catch basin sample (CB157F) collected in the parking lot of a metal shredding facility in the S Myrtle St SD basin. Of the three other samples that exceed the CSL screening level (93 mg/kg), one is associated with the same metal shredding facility (see discussion of Marine Lumber and Seattle Iron and Metals Company in Appendix D and two are inline grab samples collected upstream in the Diagonal Ave S CSO/SD drainage system. None of the inline samples (grabs and traps) collected near the downstream end of this system (e.g., traps and grabs) exceed the SCO screening level and arsenic does not exceed SCO in the sediment offshore of the outfall. Arsenic exceeded the SCO in less than two percent of the surface sediment samples collected from the waterway and none of these sampling locations is near an outfall that is owned by the City or that receives stormwater and/or wastewater from a City-owned system (AECOM 2012a). See Appendix J for detailed description of SMS exceedances in waterway samples collected near outfalls.

Copper

Copper was detected in all of the 507 samples collected from City storm drains, but exceeded the SCO/CSL screening level in only five percent of the samples. Twenty-three of the 31 samples that exceed the SCO/CSL are associated with specific sources that have been identified and that SPU has controlled or is working to control. Most exceedances are in private onsite catch basins at treated lumber storage (4,930 mg/kg), metal finishing (6,320 mg/kg), equipment design/testing (686 – 1,520 mg/kg), storage/warehouse for cell tower installation and repair (468 mg/kg), and recycling businesses (806 – 3,280 mg/kg). Only four of these businesses are covered by an NPDES permit (Marine Lumber, Seattle Iron and Metals Company, Recycling Depot, and MacMillan Piper). The others could likely be permitted as significant dischargers and most of these businesses have been referred to Ecology through the Environmental Reporting Tracking System (ERTS). These sites are not considered controlled and SPU continues to work with the non-permitted sites to bring them into compliance with City pollution prevention requirements. The highest concentration (6,320 mg/kg) was found in a catch basin adjacent to the dust collection system at a metal finishing facility on King County International Airport that drains to the I-5 storm drain at Slip 4 (CB45). This business has since closed and the dust collector has been removed. SPU has attempted to resample CB45 on several occasions since it was cleaned by the King County Airport, but there has not been enough sediment present to sample. Of the other 9 samples that exceeded the SCO/CSL, two were collected in 2005 from sediment traps in the Diagonal Ave S CSO/SD. Copper concentrations in subsequent samples at these locations were below the SCO/CSL screening level and copper concentrations are below the SCO in sediment samples collected offshore of the outfall. SPU will continue to check these locations, but they are considered controlled at this time. Copper exceeded the SCO in only about one percent of the surface sediment samples collected from the waterway and with the exception of one sample collected 100 feet upstream of the 2nd Ave S SD, none of these sampling locations is near an outfall that is owned by the City or that receives stormwater and/or wastewater from a City-owned

system (Windward 2010). See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

Lead was detected in all of the 513 samples collected, but exceeded the SCO and CSL screening levels in only 5 percent and 3 percent of the samples, respectively. Eleven of the 25 samples that exceed the SCO screening level are in private onsite catch basins or right-of-way catch basins that are affected by runoff from an adjacent private property. Sites containing elevated levels of lead include battery supply (805-5,830 mg/kg), recycling (724-1,540 mg/kg), auto and home supply (1,110 mg/kg), welding (473 mg/kg), and grocery outlet (476 mg/kg) businesses. Only one of the businesses (Seattle Iron and Metals Company) where lead was elevated in the private onsite drainage system is covered by an NPDES industrial permit issued by Ecology. The others could be permitted as significant dischargers. SPU will continue to inspect and work with these businesses to implement appropriate BMPs. Lead exceeded the SCO in only about two percent of the surface sediment samples collected from the waterway and none of these sampling locations is near an outfall that is owned by the City or that receives stormwater and/or wastewater from a City-owned system (AECOM 2012a). SPU will continue to work with businesses where lead has found to be a problem, but lead is not a major concern for waterway sediments. See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

Mercury

Mercury was detected in 68 percent of the 512 samples, but exceeded the SCO and CSL screening levels in only 6 and 4 percent of the samples, respectively. Elevated concentrations are generally associated with industrial activities. CB116, a private onsite catch basin at a small scrap/waste recycling facility contained the highest concentrations of mercury (10.5 – 48 mg/kg). Elevated mercury levels were also found at recycling (0.8 – 1.55 mg/kg), battery (2.05 mg/kg), and equipment design/testing (0.66 0.86 mg/kg) businesses. Only one of these businesses (Seattle Iron and Metals Company) is permitted by Ecology. The others could be permitted as significant dischargers. All four of the right-of-way catch basins where mercury concentrations were greater than the CSL (0.66-1.53 mg/kg) collect runoff from the recycling facilities (Seattle Iron and Metals Company and Recycling Depot) where onsite runoff from the private properties sheet flows to the right-of-way. These two sites are covered under NPDES industrial stormwater permits. SPU has referred Seattle Iron and Metals Company to Ecology and Ecology is working with the business owner to implement controls to reduce fugitive dust emissions to the surrounding area. SPU continues to work on track out issues from this site and has referred Recycling Depot to Ecology for action under its NPDES permit.

Mercury concentrations are also elevated (3.3-7.6 mg/kg) in inline samples collected from a small sub-basin of the Diagonal Ave CSO/SD drainage basin, located near Airport Wy S and 7th Ave S. SPU has cleaned the storm drain lines and conducted extensive source tracing efforts in this area, but has not yet identified a source. Elevated levels of mercury (2.72 and 0.55 mg/kg) were also observed in the two most recent inline grab samples collected at the ST1 sediment trap location (see Map 75). However, concentrations were lower in the corresponding trap samples (0.24 mg/kg). King County has found that mercury concentrations can be quite variable in field replicate samples, due to matrix effects. Additional sampling is needed to evaluate whether elevated mercury concentrations found at various locations in the Diagonal Ave S basin have contributed to elevated levels at this inline station located near the downstream end of the system. See Appendix C for further discussion.

A sample of material that had accumulated in front of a newly installed Filterra® stormwater treatment system on S Garden St contained 0.71 mg/kg mercury. This location receives runoff from industrial streets and properties along S Garden and 8th Ave S, and S Garden St is used by Seattle Iron and Metals to transport auto fluff from their main yard on S Myrtle St to their new facility located at 701 S Orchard St.

Only 1.8 percent of the surface sediment samples collected in the LDW were greater than the SCO and less than the CSL, while 3.1 percent of the samples were greater than the CSL (AECOM 2012a). Slip 4 and Trotsky inlet are the only sampling locations where SMS exceedances occurred near an outfall that is owned by the City or that receives stormwater and/or wastewater from a City-owned system. One sample collected 165 feet offshore of the Diagonal Ave S CSO/SD outfall exceeded the SCO for mercury, but none of the samples collected with 100 feet of the outfall exceeded the SCO. In addition, none of the samples collected since the 2004-2005 Early Action Area cleanup have exceeded the SCO for mercury. See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

Zinc

Zinc was detected in all 507 samples collected. Fifty (50) percent of the samples exceeded the SCO screening level and 13 percent exceeded the CSL screening level. Zinc is a common component of galvanized materials (e.g., fences, roofs, flashing, pipe, and heating and ventilation equipment), automobile tires, motor and hydraulic oils, and chemical treatments for moss control, so it is not unusual to find elevated levels of zinc in storm drain solids samples. However, zinc was not often found above SCO in waterway sediment. Only 3.1 percent of the surface sediment samples collected in the LDW were greater than the SCO and less than the CSL, while 1.9 percent of the samples were greater than the CSL (AECOM 2012a). One of these samples is located within 200 feet of an outfall owned by the City (Diagonal Ave S CSO/SD)[21]. Two are located near an outfall that receives stormwater and/or wastewater from a City-owned system (16th Ave S SD and 2nd Ave S SD). See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls. Because of the widespread use of zinc and the low frequency of zinc in waterway sediment, SPU has not focused source tracing efforts on zinc.

LPAH

LPAH was detected in 95 percent of the 500 samples collected, but exceeded the LAET/2LAET screening level in only 6 percent of the samples. Fifteen (15) of the 29 samples that exceed the screening levels are in private onsite catch basins. Sites containing elevated levels of LPAH include:

Parking lot at storage facility (CB221 and CB222) ..... 140,100-173,200 ug/kg dw
Fast food restaurant (CB38) .....44,860 ug/kg dw
Parking lot at a warehouse facility (CB78) .....66,230 ug/kg dw
Asphalt coating/sealant manufacturer (CB84) ..... 5,640 – 22,900 ug/kg dw
Metal finishing facility (CB45) .....21,160 ug/kg dw
Plastics manufacturer (CB1) .....17,188 ug/kg dw
Battery store (CB83) ..... 5,400 - 8,980 ug/kg dw
City maintenance yard (CB112) ..... 7,290 ug/kg dw

Only the asphalt coating/sealant manufacturer is permitted by Ecology. The highest LPAH concentrations were found in two catch basins in the parking lot at the King County Sheriff's storage facility. King County conducted follow-up sampling and determined that HPAHs were caused by old coal tar-based sealant. In 2015, King County ground off the surface of the pavement and applied a new layer of asphalt to the most of the parking area (Eckel, 2015). A small area beneath two large shipping containers that could not be reached will be coated with a paint that is designed to adhere to coal tar sealant.

[21] Sample DUD005 collected in 1994 prior to King County's 2004-2005 Duwamish/Diagonal Early Action Area cleanup. Zinc did not exceed SCO in surface sediment samples collected post-cleanup.

Other samples that exceed the LAET/2LAET screening level for LPAH include a sediment trap in the SW Idaho St storm drain (8,310 ug/kg dw), inline samples (traps and grabs) in the Diagonal Ave S CSO/SD drainage system (5,715 – 19,350 ug/kg dw), an inline grab from the Georgetown SD (5,780 ug/kg dw), and an inline grab from the S Norfolk St CSO/PS17 EOF/SD drainage system (20,650 ug/kg dw) located downstream of the asphalt coating/sealant manufacturer (MH7). The SW Idaho St storm drain system was cleaned in 2012-2013. This system was re-sampled following cleaning and the concentration of LPAH in the sediment trap sample was below the LAET/2LAET (610 ug/kg dw). See Section 6 for additional information on SPU's line cleaning program.

The two highest LPAH concentrations in the Diagonal Ave S CSO/SD drainage system (19,350 and 10,430 ug/kg dw) were found in sediment traps (ST6 and ST2, respectively) collected in 2005 and 2006. With the exception of the September 2008 sample collected at ST6 (5,560 ug/kg dw), subsequent samples collected from these traps (200-3,260 ug/kg dw) were below the LAET/2LAET screening level. ST6 is installed in the upper basin, on a 42-inch line serving a large residential sub-basin. ST2 is installed on a 72-inch storm drain that serves a residential area along S Spokane St and Beacon Ave S, as well as the I-5 interchange at S Columbia St. One right-of-way catch basin sample (ROW24) located off the driveway of a concrete pumping business that SPU has worked with for many years to implement appropriate BMPs also contained elevated levels of LPAH (9,900 ug/kg dw). This business is on SPU's list of high priority businesses and is inspected every two years.

LPAH exceeded the SCO in less than 1 percent of the surface sediment samples collected from the waterway and only one of these sampling locations is near an outfall (7th Ave S SD) that is owned by the City or that receives stormwater and/or wastewater from a City-owned system (AECOM 2012a).[22] See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

HPAH

HPAH was detected in 98 percent of the 500 samples; 12 percent and 8 percent of the samples exceeded the LAET and 2LAET screening levels, respectively. Of the 41 samples that exceeded CSL, 16 were collected from private onsite catch basins (17,340 – 1,555,000 ug/kg dw), six were collected from right-of-way catch basins (20,480 – 36,520 ug/kg dw), and 19 were collected from inline grab/trap samples (18,030 – 127,580 ug/kg dw).

The highest HPAH concentrations were found in two catch basins in the parking lot at the King County Sheriff's storage facility (1,296,000 – 1,555,000 ug/kg dw). SPU suspects that the elevated levels of HPAH may be associated with the use of coal tar-based sealant and is working with King County to implement appropriate controls. Others include:

Parking lot at a warehouse facility (CB78) ..... 191,700-585,400 ug/kg dw
Gas station (CB10) ..... 256,800 ug/kg dw
Metal finishing facility (CB45) ..... 150,600 ug/kg dw
Fast food restaurant (CB38) ..... 144,800 ug/kg dw
Asphalt coating/sealant manufacturer (CB84) ..... 17,340 - 52,200 ug/kg dw
Plastics manufacturer (CB1) ..... 51,520 ug/kg dw
City maintenance yard (CB112) ..... 31,750 ug/kg dw
Repair shop (CB2)[23] ..... 27,480 ug/kg dw
Printer (CB106) ..... 25,520 ug/kg dw

[22] LPAH exceeded the SCO offshore of the outfalls in Slip 4 prior to the 2012 cleanup, but did not exceed the SCO in the 2013 post-cleanup samples.

[23] Two previous samples collected at this site in 2003 and 2005 (6,640 – 13,900 ug/kg dw) did not exceed the 2LAET trigger.

Two of the private onsite catch basins where HPAH are elevated (17,340 – 52,200 ug/kg dw) are located at NPDES-permitted facilities (printer and asphalt coating/sealant manufacturer).

Other samples that exceed the 2LAET screening levels for HPAH include:

- Inline grabs in the SW Idaho St storm drain (88,600 – 108,800 ug/kg dw at ID-ST1), The SW Idaho St storm drain system was cleaned in 2012-2013. See Section 6 for additional information on SPU's line cleaning program.
- Inline samples (traps and grabs) in the Diagonal Ave S CSO/SD drainage system (17,550 – 127,580 ug/kg dw).
- A sediment trap, inline grab, and ROW catch basin from the S Norfolk St CSO/EOF/SD drainage system (18,030 – 57,360 ug/kg dw).
- Two ROW catch basins (RCB278 and RCB350) from the 7th Ave S SD system (23,760 – 193,000 ug/kg dw). The 7th Ave S storm drain system was cleaned in 2014. See Section 6.
- An inline grab from the Georgetown SD system (74,300 ug/kg dw).
- Right-of-way catch basin RCB60 on Diagonal Ave S west of 6th Ave S in the Diagonal Ave S CSO/SD system (32,560 ug/kg dw)
- Inline traps on the 1st Ave S SD, west drainage system (20,690 – 24,500 ug/kg dw at 1st-ST7).
- An inline grab (19,030 ug/kg dw at KN-ST1) and right-of-way catch basin (36,520 ug/kg dw at RCB53) from the SW Kenny St SD system.

These samples are discussed in more detail in Appendix C.

HPAH exceeded the SCO in 2.9 percent and the CSL in 0.48 percent of the surface sediment samples collected from the waterway (AECOM 2012a). SCO exceedances occurred in samples located within 200 feet of outfalls owned by the City or that receive stormwater and/or wastewater from a City-owned system in Slip 4 (prior to the 2012 Early Action Area cleanup) and offshore of the Diagonal Ave S CSO/SD (prior to the 2004-2005 Early Action Area cleanup), 16th Ave S SD (east), KCIA SD #2/PS78 EOF, SW Dakota St SD, 2nd Ave S SD, and 7th Ave S SD, outfalls. See Appendix J for a detailed description of SMS exceedances in waterway samples collected near outfalls.

cPAH

cPAH were detected in all of the 498 samples collected. There are no SMS for cPAH. For this analysis, the remedial action level (RAL = 1,000 mg/kg TEQ) was used to assess storm drain solids results[24]. Twenty percent of the samples exceeded the RAL. Because cPAHs are a subset of the HPAH, elevated levels of cPAH were found at the same locations as described above for HPAH.

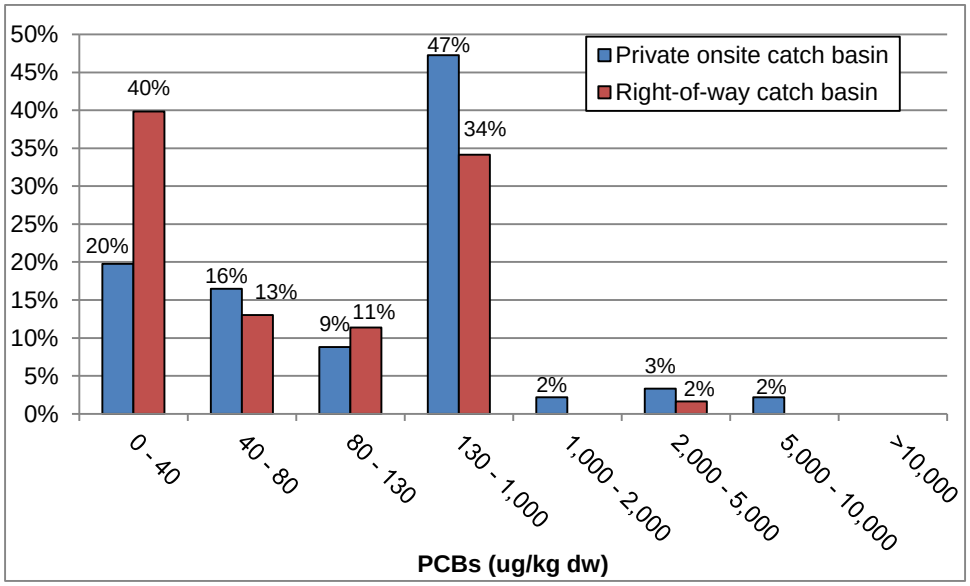
PCBs

PCBs were detected in 75 percent of the 516 samples collected. Approximately 41 percent of the samples exceeded the LAET screening level, but only 4 percent exceeded the 2LAET screening level. Relatively low levels of PCBs (100 – 300 ug/kg dw) are commonly found throughout the LDW drainage basin, but hot spots are limited to a few locations where significant sources of PCBs have been found.

As shown in Figure 9, PCB concentrations are often higher in private onsite catch basin samples than right-of-way catch basin samples. Approximately 54 percent of the private onsite catch basin samples exceed the LAET compared to only 36 percent of the right-of-way (ROW) catch basins.

[24] The RAL = MTCA Method A cleanup level for unrestricted land use for cPAHs.

Similarly, the private onsite catch basins more often exceed the 2LAET (8 percent of the samples) compared to the right-of-way catch basins (1 percent of the samples).



Note: Removed 3 right-of-way catch basins samples that are clearly affected by inputs from adjacent properties (RCB189 = 2,950 ug/kg dw, RCB225 = 8,230 ug/kg dw, and RCBSTEV4 = 12,400 ug/kg dw). See Appendix D.

Figure 9: Frequency histogram of PCBs in private onsite versus right-of-way catch basins.

To date, six significant sources of PCBs have been identified (see Appendix D for a detailed discussion of these sources):

- Terminal 117. Terminal 117 (T117) is one of seven early action sites in the LDW. Upland areas on T117, as well as adjacent streets and residential yards have been contaminated with PCBs from historic operations of a manufacturer of asphalt roofing materials. PCBs have been found in the T117 drainage system (1.2 - 16 mg/kg dw), as well as soil in the adjacent right-of-way (1.3 – 9.2 mg/kg dw) and yards (0.17 - 46 mg/kg), [Windward 2010, KCHD 2004].
- Rainier Commons property at 3100 Airport Wy S where PCB concentrations as high as 321,000 mg/kg have been found in exterior building paint (NVL 2012). The paint is in poor condition and is entering both the separated storm drain and the combined sewer systems adjacent to this property. The EPA Toxics Substances Control Act (TSCA) Program took over enforcement on this site following a 2009 inspection when up to 10,000 mg/kg PCBs was found in exterior paint samples. The first phase of the cleanup, involving paint removal from two of the 24 buildings to be cleaned, began in 2014.
- Seattle Iron and Metals Company at 601 S Myrtle St, a metal recycling facility, where PCB concentrations as high as 25 mg/kg have been detected in sediment from the onsite drainage system. Site runoff passes through an onsite treatment system before discharging to the S Garden St storm drain. Fugitive dust emissions and track out of contaminated sediment are affecting the adjacent roadways, properties, and the City storm drain systems at S Myrtle St and S Brighton St.
- Independent Metals, another metal recycling facility, where elevated levels of PCBs have been found in catch basins immediately adjacent to the metal shredding facility on 816 S Kenyon St that drains to the combined sewer system (5,300 ug/kg dw). In addition, stormwater samples collected from the storage yard discharging to the 7th Ave S SD system contained 0.03 – 1.15 ug/L PCBs.

- Western Waterproofing Company property at 4429 Airport Wy S where elevated levels of PCBs (16,100 - 145,000 ug/kg dw) have been found in an onsite catch basin, as well as surface dirt on the pavement (28,900 – 39,000 ug/kg dw).
- Sun Food Trading Company property at 4715 6th Ave S, where elevated levels of PCBs were found in paint chips collected from pavement (45,000 ug/kg) and in onsite catch basins (6,200 – 32,000 ug/kg dw).

Phthalates

Phthalates, particularly BEHP exceed the LAET/2LAET screening levels in storm drain solids collected throughout the Lower Duwamish Waterway. Overall, BEHP was detected in 99 percent of the 495 samples collected from storm drains in the LDW and exceeded the LAET/2LAET screening levels in 73 and 65 percent of the samples, respectively.

Phthalates are a class of industrial compounds commonly used as softeners in plastics, as solvents, as oil in vacuum pumps and electric capacitors and transformers, and as carriers for fragrances and pesticides. Because they are a regional concern extending beyond the Duwamish Waterway, King County and SPU joined with the City of Tacoma in 2003 to test various commonly used products and materials to help identify the source of these chemicals. The intent of that testing was to use information about the phthalate content of common consumer products in conjunction with the source tracing efforts to identify specific sources of phthalates to the storm drains and the sanitary sewer. In addition, project staff hoped to identify specific products low in phthalates that they could recommend as replacement products to businesses and residents. The testing identified phthalates (BEHP, diethylphthalate, and butyl benzyl phthalate) in a wide variety of products, including used motor oil from a commercial lube shop, used synthetic oil, various tire dressing and automotive care products, serpentine auto belts, used cigarette butts, packing peanuts, brake pads, brake pad dust, and tires (SPU and KCIW 2004, 2005).

Subsequently, the cities of Tacoma and Seattle, King County, Ecology, and EPA conducted an investigation to understand how phthalates reach Puget Sound sediments and to evaluate the relative risk of phthalates found in sediment compared to other contaminants and within the broader context of phthalate risks from all exposure pathways (Floyd|Snider 2007). The group, known as the Sediment Phthalates Work Group or SPWG, concluded that phthalates are widespread in urban and other developed areas and that they are ubiquitous in water, soil, sediment, and air. They developed the basic working model shown in Figure 10 of how phthalates may reach the LDW sediments. The basic concept is that phthalates initially enter the environment primarily through off-gassing from manufactured products. Once in the atmosphere, they attach to particulates and deposit on land and water surfaces. These particles are then transported to water bodies like the LDW through stormwater runoff (Floyd|Snider 2007).

Dioxins/Furans

SPU has analyzed dioxins/furans in 30 source samples collected from City storm drains in the LDW. Concentrations ranged from 0.51 to 143 ng/kg TEQ, with an average of 29.5 ng/kg TEQ. The highest concentration (143 ng/kg TEQ) was found in a sample of sediment that had accumulated in the temporary stormwater storage tanks at the Terminal 117 Adjacent Streets site. The tanks receive runoff from the streets adjacent to Terminal 117. The remaining samples contained less than 90 ng/kg TEQ. As shown in Figure 11, dioxin/furan concentrations in samples collected from City-owned storm drains in the LDW are generally lower than most other samples collected from storm drains in the LDW and East Waterway, but are comparable to the concentrations found in samples collected from combined sewers.

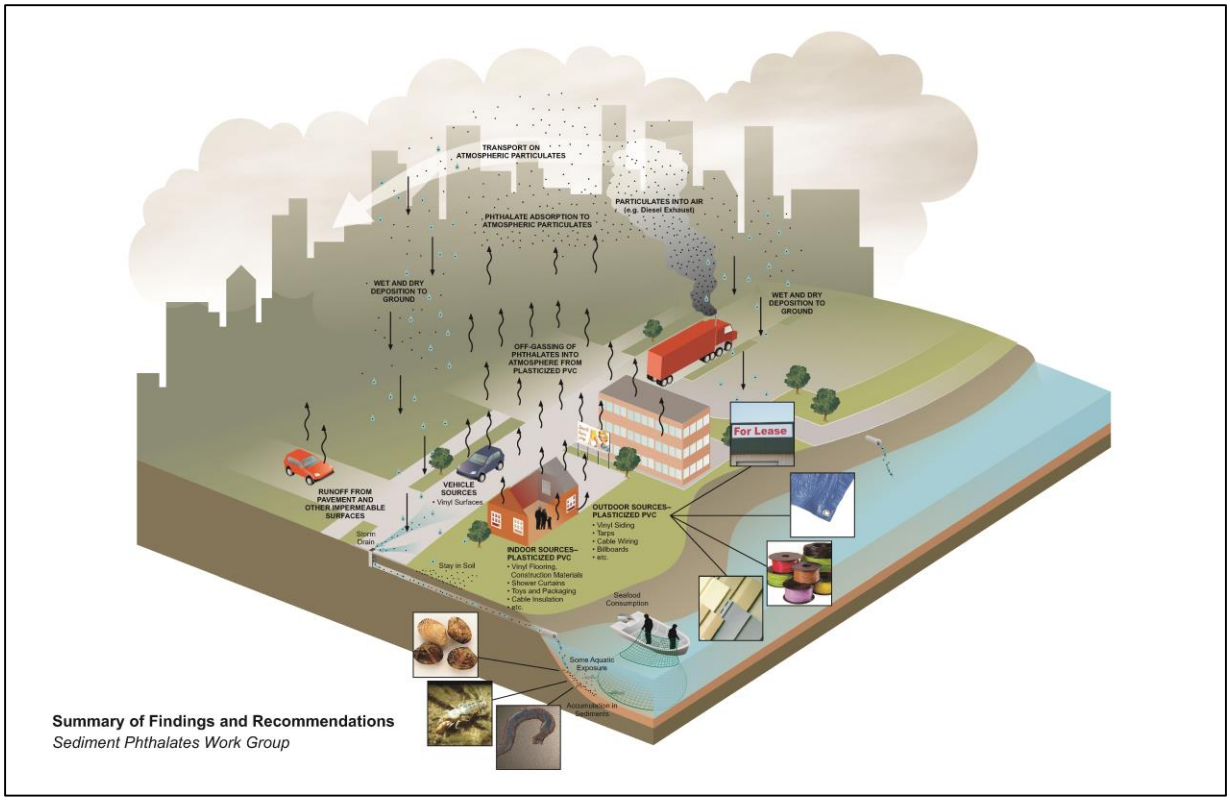


Figure 10: Conceptual site model for phthalates (Floyd|Snider 2007).

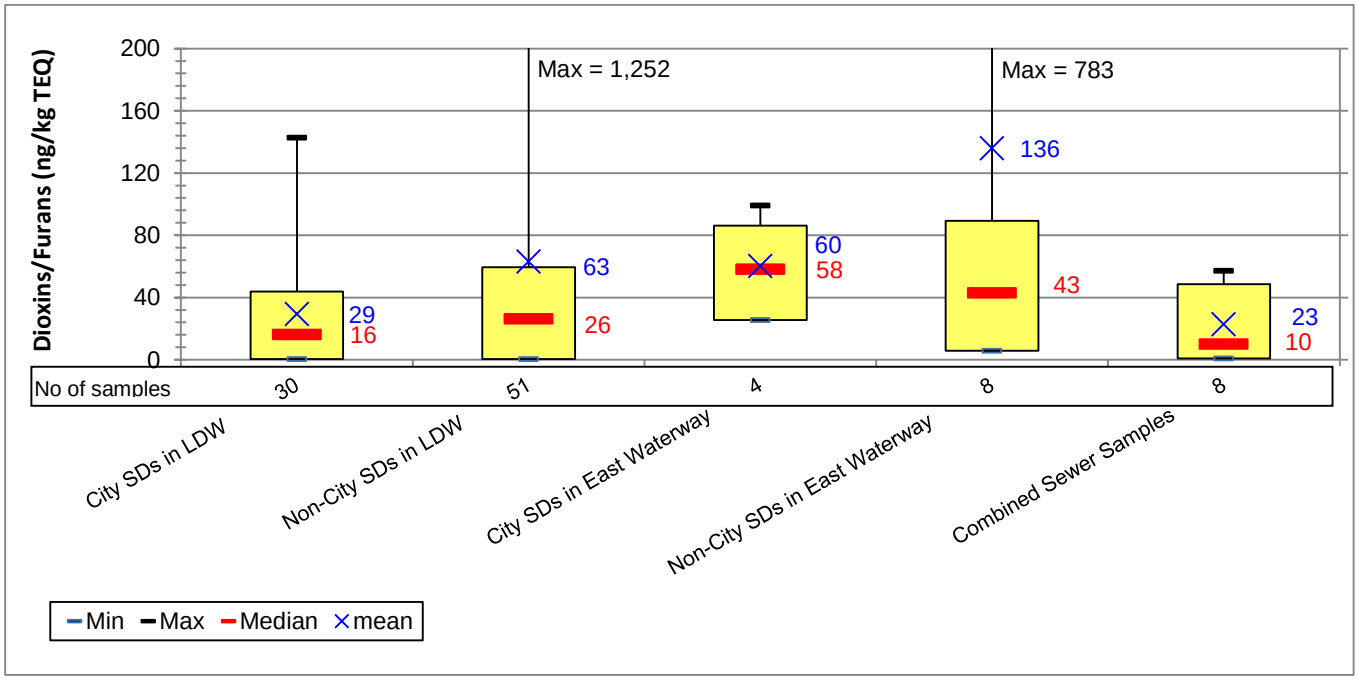


Figure 11: Comparison of dioxins/furans in City and non-City storm drains and combined sewers in the LDW and East Waterway.

5.3. 5-YEAR PLAN

Analyses of data collected over the past 10 years of source control efforts and in-water sediment investigations indicate that:

- Source tracing procedures have been and are expected to continue to be effective in identifying specific sources/hot spots that can be controlled under existing local, state, and federal regulations (see Appendix D).
- Some chemicals (e.g., zinc, phthalates, and PCBs) are found throughout the Lower Duwamish watershed and will be difficult, if not impossible to fully control using conventional source control tools.
- Certain select chemicals (e.g., phthalates) may exceed the LDW sediment RALs in small areas of the LDW, particularly offshore of large outfalls, even after all practical source controls are implemented.

Over the next five years, SPU will continue to sample the City-owned MS4 to support upcoming cleanup decisions. This sampling is expected to continue to be successful in identifying sources, which can then be controlled using existing local, state, and/or federal authorities. In the short term, monitoring will focus on source tracing using inline and grab samples of solids that accumulate in the City-owned MS4. Source tracing activities will focus on the following activities:

- Maintaining existing sediment traps to aid in establishing long term trends and evaluating the effectiveness of source control actions.
- Tracing sources in problem areas/drains identified to date.
- Re-sampling in lines that have been cleaned to confirm that sources are adequately controlled.
- Following up in problem areas that may be identified as a result of sampling to be conducted during remedial design.
- Filling in gaps where additional data are needed (e.g., as yet un-sampled outfalls that are currently used by SPU).

With the support of an Ecology grant, SPU has been collecting about 100 - 180 source tracing samples per year over the past five years. SPU was recently approved for funding under Ecology's Stormwater Financial Assistance Program to cover laboratory and data validation costs for source tracing efforts through June 30, 2017. Funding levels will be announced July 1, 2015 when the 2015-2017 State Biennial Budget is approved.

5.3.1. END-OF-PIPE CHARACTERIZATION

Sediment traps are installed in 12 of the approximately 31 outfalls that are either owned by the City or used by the City to discharge stormwater and/or wastewater to the LDW (see Map 75). Traps have been in place for six to seven years at each location. Continued monitoring, particularly at near end of pipe locations will help to assess whether source control efforts are affecting the quality of material discharged to the LDW sediments and to help identify new sources that may develop over time in the City-owned MS4. SPU will continue to retrieve and redeploy the existing traps every year. Outfalls where traps are installed and will be maintained over the next five years are listed in Table 12.

Table 12: Sediment traps that SPU will operate/maintain over next five years.

Drainage System	No. of Traps
Diagonal Ave S CSO/SD	2
I-5 SD at Slip 4	1
Norfolk CSO/SD/PS17 EOF	5
SW Idaho St SD	3
SW Kenny St SD/T115 CSO	1
Highland Park Wy SW	2
1st Ave S SD, west side	5
7th Ave S SD	3
Total	22

Over the next five years, near end-of-pipe monitoring stations will also be established in the following City-owned drainage systems:

- 1st Ave S SD (east)
- Head of Slip 2 SD
- S River St SD
- S Brighton St SD
- S Myrtle St SD
- S Garden St SD
- Georgetown SD
- SW Dakota St SD
- 17th Ave S SD

Depending on the results of the pilot test described in Section 5.1.1, the new style sediment trap may be installed in the smaller drainage systems where the trap currently used by SPU does not fit. If the pilot test is not successful in identifying a better trap design than is currently used, inline grab samples will be collected each year near the downstream ends of these smaller storm drain systems. Inline grab and inline trap sampling will occur on the same general schedule to ensure comparability. If inline grabs cannot be collected in these smaller systems due to lack of sediment accumulation, random samples will be collected from catch basins, both onsite and right-of-way, to characterize the quality of sediment discharged from these systems.

5.3.2. SOURCE TRACING PRIORITIES IN THE CITY MS4

SPU has used available storm drain solids data and recent updates to the citywide drainage basin ranking, combined with what is currently known about sources and conditions offshore of outfalls in the LDW that discharge stormwater from the City MS4 to prioritize storm drains for sampling and source investigations. Details of the prioritization process are provided in Appendix J.

The areas where SPU intends to focus its source tracing efforts over the next five years include:

- S Nevada St SD
- Diagonal Ave S CSO/SD
- 1st Ave S SD (east)
- S River St SD
- 16th Ave S SD (east)
- Norfolk CSO/EOF/SD
- SW Dakota St SD
- SW Idaho St SD
- SW Kenny St SD/T115 CSO
- 7th Ave S SD

S Nevada St SD

The 23-acre S Nevada St drainage system serves a large warehouse on the Port of Seattle's Terminal 106 property and S Nevada St (see Map 4). The west end of S Nevada St was vacated to the Port in 1970. Catch basins located on the east end of S Nevada St may collect runoff from a short section of E Marginal Wy S, but the majority of the runoff at this outfall is from roof and parking areas on adjacent Port property. Source tracing has been difficult due to the lack of accumulation of storm drain solids in this system. One inline sample has been collected near the

upper end of the system (MH206). Although concentrations were below the 2LAET/CSL screening levels, lead, mercury, and LPAH concentrations at this location were two or more times higher than the median concentrations reported at other storm drains in the LDW. SPU jetted and cleaned this system in 2015 and will resample over the next 5 years to assess whether there could be ongoing sources.

Diagonal Ave S CSO/SD

The 2,664-acre Diagonal Ave S drainage system is the largest in the City (see Maps 5a and 5b). Although concentrations of most chemicals other than phthalates have remained low in sediment offshore of the outfall since King County completed the early action cleanup in 2004, SPU has found specific problem areas within the drainage basin that warrant continued attention. Areas that warrant further investigation include (Maps 5a and 5b):

- S Snoqualmie St sub-basin where elevated levels of mercury and PCBs have been found in MH18 (see Map 80). Source tracing completed in 2014 identified several sources of PCBs, but no major source of mercury. The lines downstream of the PCB sources were cleaned in late 2014. This area will continue to be monitored to assess whether sources have been adequately controlled.
- Bush Pl sub-basin where nine (9) of the 10 inline samples collected at ST6, which is located in the 42-inch main on the east side of Rainier Ave S at Bush Pl, contain elevated levels of HPAH (16,400 – 127,580 ug/kg dw).
- Various private onsite catch basins where exceedances of SMS screening levels continue to occur.

SPU will conduct additional source tracing and inspections in these areas to determine where these chemicals are coming from and ensure that appropriate source control actions are taken.

1st Ave S SD (east)

The 1st Ave S SD (east) serves a 14.8-acre basin under the 1st Ave S Bridge (see Map 6). The drainage basin covers areas under the bridge, approaches to the bridge, and portions of E Marginal Wy S. Stormwater passes through a biofiltration swale before discharging to the waterway. Two inline grab samples have been collected from this drainage system. One sample exceeded the CSL screening level for copper and the median copper concentration was more than two times higher than the median concentrations reported at other storm drains in the LDW. SPU intends to jet and clean this system and resample, to assess whether there could be ongoing sources.

S River St SD

The S River St SD serves a 6-acre industrial area on the north side of Slip 3 (Map 8). This entire City-owned MS4 was cleaned in 2009-2010 because previous samples contained elevated levels of arsenic (12 - 110 mg/kg), copper (39 – 470 mg/kg), zinc (332 – 1,170 mg/kg), motor oil (270 – 9,300 mg/kg), and PCBs (54 – 1,490 ug/kg dw). Although HPAH did not exceed the SCO in waterway samples collected within 50 feet of the outfall, HPAH did exceed the 2LAET screening level in an inline sample collected from this system in 2012 after cleaning (26,160 ug/kg dw at MH211). Additional work is needed to identify and control the source(s) of HPAH in this system.

16th Ave S SD (east)

The 16th Ave S SD serves a 12-acre industrial basin west of E Marginal Wy S. This system collects runoff from 16th Ave S approach to the South Park Bridge (crossing into Tukwila jurisdiction), about 600 feet of E Marginal Wy S, and a portion of the Boeing property on the south side of 16th Ave S (see Map 14). SPU cleaned the City-owned portion of the 16th Ave S system in 2013 when the

South Park Bridge was under construction and there was only local traffic on 16th Ave S. The line was cleaned because of elevated levels of benzyl alcohol, benzoic acid, 2-methylphenol, and mercury. In 2014, King County installed a stormwater wet vault as part of the South Park bridge construction. The approximately 34,000 gallon wet vault treats runoff from the lower 1,000 feet of the South Park bridge approach on 16th Ave S prior to discharging to the LDW via a new 24-inch outfall. The upper 550 feet between the pedestrian tunnel and E Marginal Wy S continue to discharge untreated to the LDW via the existing outfall.

There are no businesses within City jurisdiction that SPU is able to inspect in this drainage basin. SPU will resample key maintenance holes to assess whether there are ongoing sources in the City-owned MS4.

Norfolk CSO/PS17 EOF/SD

Runoff from approximately 454 acres within the City MS4 system discharges to the Norfolk outfall[25] (see Map 16). Land use in the basin is approximately 18.5 percent residential, 3.5 percent commercial, 29.4 percent industrial, 15.9 percent open/vacant/parks, and 32.7 percent right-of-way. In 2011 SPU constructed a 5-acre foot wet pond just west of I-5 that treats runoff from the 226-acre MLK sub-basin (Map 78). Runoff from this portion of the drainage basin now passes through a 1,000 foot long heavily vegetated drainage swale, the new wet pond, and a natural wetland before discharging to the LDW.

Although only a few of the samples collected in 1999-2004 as part of the post-cleanup monitoring effort exceeded SCO concentrations offshore of the Norfolk outfall, this basin is one of the larger and more industrialized drainage basins in the LDW. PAHs are the primary chemical of concern in the Norfolk drainage basin. Chemicals that exceeded both the SCO in in-waterway sediment samples collected after the Early Action Cleanup and CSL/2LAET in inline line near-end-of-pipe samples include fluoranthene, dibenz(a,h)anthracene, and BEHP. Elevated levels of HPAH have been found in a maintenance hole on MLK Wy at S Norfolk St and in several private onsite catch basins. SPU inspectors have found and eliminated several sources and are currently working to control another source, but it is not clear that all of the major sources of PAHs in this basin have been identified. SPU will continue to focus source tracing efforts in this basin.

SW Dakota St SD

The SW Dakota St SD serves an area of about 45 acres, encompassing the commercial/industrial areas along W Marginal Wy SW, as well as developed/undeveloped residential parcels and large tracts owned by the Seattle Department of Parks and Recreation located on the hillside west of W Marginal Wy SW (Map 18). Land use in the basin is approximately 17.3 percent residential, 1.2 percent commercial, 44.7 percent industrial, 36.8 percent open/vacant/parks. The location of the SW Dakota St SD outfall was changed in 1994 when the Port constructed a wetland channel along the south side of their property at 3838 W Marginal Wy SW. The City's 30-inch diameter storm drain now discharges to the head of the channel, approximately 800 feet from the waterway. When it was constructed in 1970, the SW Dakota St SD extended east along SW Dakota St and terminated at an existing ditch located about 100 feet east of W Marginal Wy SW.

One sample has been collected within 25 feet of the City's storm drain outfall (SS2149-A). Zinc, butyl benzyl phthalate, BEHP, and PCBs exceeded the SCO, and benzyl alcohol (100 ug/kg dw) exceeded the CSL. None of the five surface sediment samples collected within 40-80 feet of the SW Dakota St channel mouth exceeded SCO levels (AECOM 2012a). However, SCO exceedances have been found in one sample (DR033) collected 150 feet offshore of the channel, but many of the chemicals exceeding SCO at this location (multiple HPAH compounds, total HPAH, PCBs) are not consistent with the chemicals exceeding screening levels in the storm drain system (zinc). SPU

[25] This includes runoff from about 2 miles of I-5. The I-5 sub-basin has not yet been delineated.

will establish an inline sampling station located near the downstream end of this system to assess PCB levels.

SW Idaho St SD

The SW Idaho St SD serves an area of about 423 acres (Map 19). The drainage basin is predominately residential (45.7 percent) with commercial/industrial areas (23.6 percent) located along W Marginal Wy SW. A significant portion of the basin is undeveloped (30.7 percent). Elevated levels of HPAH (88,600 – 108,800 ug/kg dw) were found in inline samples collected in 2009-2010 from a maintenance hole on the main trunk line above W Marginal Wy SW (ID-ST1), but after extensive source tracing and business inspections, no specific sources were identified. SPU finished cleaning all of the City-owned lines in this drainage system in 2013. SPU resampled ID-ST1 in 2014 after the line was cleaned and found lower levels of HPAH (7,430 ug/kg dw). SPU will continue to monitor the quality of solids in the City-owned MS4 after cleaning to ensure that there are no ongoing sources in this basin. Additional source tracing/source control actions will be taken as needed based on the results of future sampling.

SW Kenny St SD/T115 CSO

The SW Kenny St SD serves an area of about 154 acres, encompassing the commercial/industrial areas along W Marginal Wy SW, as well as undeveloped land located on the steep hillside west of W Marginal Wy SW (see Map 20). A significant portion of the undeveloped land (53 acres) is owned by the Seattle Department of Parks and Recreation. Land use in the basin is approximately 5.8 percent residential, 10.1 percent commercial, 28.1 percent industrial, and 56 percent open/vacant/parks.

SPU has collected 15 samples from the SW Kenny St SD. The median arsenic concentration was more than two times higher than the median concentrations reported at other storm drains in the LDW. The highest concentrations (30-70 mg/kg with an average of 48 mg/kg) were measured in the inline grab samples collected at KN-ST1 near the downstream end of the system. Two storm drain solids samples exceeded the SCO, but none exceeded the CSL screening level. Sediment trap samples collected at this location contained much lower levels of arsenic (<8-30 mg/kg) and there were no exceedances of arsenic in sediment samples collected 50-190 feet offshore of the outfall. SPU will conduct additional source tracing in this basin to look for sources of arsenic.

7th Ave S SD

The 7th Ave S SD basin is also relatively large (238 acres) and the approximately 70-acre lower basin east of SR509 is heavily industrialized (see Map 24). SPU inspectors have found a number of sources in this basin, with problem chemicals including arsenic, copper, mercury, and PCBs. However, these chemicals are not found at high concentrations in sediment samples collected offshore of this outfall, where PAHs are the only chemicals that exceed SMS. One source of PAHs (34,700 ug/kg dw LPAH and 193,000 ug/kg dw HPAH) has been identified in the drainage basin; SPU inspectors have worked with the business to cover and disconnect an exterior wire rope testing facility from the drainage system to eliminate this source.

Given the number of small businesses and variety of potential sources, SPU intends to continue working to identify and control sources in the 7th Ave S basin. Other planned activities include:

- Follow-up sampling after completion of the line cleaning in 2013 to confirm whether or not elevated levels of contaminants are continuing to enter the City MS4.
- Continued planning/investigation of a regional treatment system at the downstream end of the 7th Ave S drainage system. This project, known as the South Park Pump Station/Water Quality project is undergoing further options analysis in 2015-2016. See Section 7.11.2 for a more detailed discussion.

5.3.3. FILLING IN DATA GAPS

Over the years, SPU has continued to expand the source sample coverage by collecting both targeted and random samples in the City-owned MS4. This approach has been effective in characterizing the larger drainage systems; however, the following systems have not yet been evaluated:

- Head of Slip 2 SD. This 24-inch outfall is privately owned. It serves an approximately 12-acre basin located east of E Marginal Wy S between S Michigan St and S Fidalgo St. The basin consists almost entirely of large warehouse buildings that are occupied by a number of small businesses. With the exception of a container storage yard located at 6050 E Marginal Wy S, business activities are housed indoors. The only outdoor activities appear to be employee parking. A small portion of E Marginal Wy S and 4th Ave S also drains to this outfall.
- North Boeing Field SD. This storm drain used to serve approximately 90 acres at the north end of the King County Airport (North Boeing Field) and also served as an emergency overflow for SPU's sanitary pump station 44. However, in about 1985, the majority of the runoff and EOF were re-plumbed to the King County Airport drainage system (KCIA SD#3/PS44 EOF). Since then the North Boeing Field SD outfall has served only about 3 acres adjacent to building 7-027-1 on North Boeing Field. Boeing recently re-plumbed the remaining catch basins in this area to KCIA SD#3/PS44 EOF drainage system (Bach 2014)[26]. As a result, there no longer appears to be any runoff from North Boeing Field entering this system. SPU video-inspected this system in 2015 and confirmed that the line on North Boeing Field had been plugged. In addition, the 18-inch pipe that connects to this outfall at maintenance hole D071-052 in the middle of E Marginal Wy S appears to be filled and no longer appears to be active. SPU will investigate whether this outfall can be taken out of service.
- S Webster St SD. A single catch basin on S Riverside Dr is connected to this outfall. SPU will sample and clean this catch basin as necessary.
- 17th Ave S SD. The 17th Ave S SD was constructed by SPU in September 2015 as part of the Terminal 117 Adjacent Streets cleanup, which will remove PCB-contaminated soil present in the right-of-way adjacent to Terminal 117, construct a permanent stormwater collection/treatment system, and restore the adjacent streets (Integral, et al., 2014). The outfall will be put into service in the third quarter of 2016 when the cleanup and associated site restoration are complete. This new outfall serves an approximately 2.9-acre area that historically discharged to the waterway (see Map 25). Discharge to the waterway was interrupted in 2004 when SPU conducted an interim cleanup to contain PCBs found in the right-of-way soils until a final cleanup could be conducted in coordination with the Terminal 117 upland and sediment early action cleanup. At that time, SPU installed a temporary stormwater collection system that discharged to the combined sewer system. Since December 2004, stormwater has been collected, stored, and discharged at a controlled rate to the combined sewer system. With completion of the Adjacent Streets cleanup, stormwater will be collected and treated in a combination of bioretention cells and Filterra® tree box units. Filterra® units are being installed where infiltration is not possible due to soil characteristics or the narrow width of the right-of-way. In addition, runoff from a 0.28-acre subbasin consisting of a pedestrian pathway and adjacent landscaped areas will be collected and routed through a small shallow, vegetated depression before entering the drainage system.

[26] SPU confirmed that catch basins on North Boeing Field have been disconnected from this system during a site inspection conducted on February 18, 2015.

The stormwater treatment system is designed to treat approximately 93 percent of the total annual runoff. Bioretention cells will be infiltrating systems. Stormwater discharged from the 17th Ave S SD will consist of treated and untreated runoff from the Filterra® systems, overflows from the bioretention cells, and runoff from the 0.28-acre pedestrian pathway.

SPU intends to install a sediment trap in the last maintenance hole before the outfall to obtain storm drain solids samples and samples will also be collected from select catch basins and/or solids that accumulate in the bioretention cells to assist in source tracing, if needed.

Storm drain solids samples will be collected from these systems and, if needed, source tracing will be conducted during the next 5-year period.

5.3.4. OTHER SOURCE CONTROL PRIORITIES

SPU has identified the source of contaminants found in two other storm drains (S Myrtle St and S Garden St) and has been working with Ecology to control the offsite transport of contaminants from an NPDES-permitted facility in these basins. Additional work in these two basins is described in the following sections.

S Myrtle St SD

The S Myrtle St SD serves a 6-acre industrial basin located between Slip 3 and Slip 4 (Map 10). This entire portion of the City-owned MS4 was cleaned in 2009 – 2010 due to elevated levels of copper, lead, mercury, zinc, motor oil, and PCBs. This storm drain is heavily impacted by activities at an adjacent metal recycling facility located on the south side of S Myrtle St and its storage yard located on the north side of S Myrtle St. See discussion of Seattle Iron and Metals Company in Appendix D and Appendix C for more details.

Metals (i.e., copper, lead, mercury, and zinc) and PCBs are a continuing problem in the S Myrtle St drainage system. The source of these chemicals has been traced to Seattle Iron and Metals Company (SIMC) a large metal recycling facility. Sampling conducted to date indicates that fugitive dust emissions and track out of mud from vehicles leaving the site are affecting the adjacent roadways and properties (see discussion of Seattle Iron and Metals Company in Appendix D). Because it is an NPDES-permitted facility, SPU has referred this site to Ecology. Actions that the City will take in this area include the following:

- SPU will continue working with SIMC to ensure that they control track out issues and maintain the two Filterra® stormwater treatment units that SIMC installed adjacent to the driveway.
- SDOT will continue to sweep S Myrtle St on a weekly basis as part of the City's ongoing Street Sweeping For Water Quality Program
- The City will continue to seek funding to stabilize the unpaved shoulder that currently exists along portions of the north side of S Myrtle St.

S Garden St SD

The S Garden St SD serves a 12-acre industrial (Map 11). A metal recycling facility, Seattle Iron and Metals Company (9.6 acres) takes up the majority of the drainage basin. Runoff from approximately 0.97 acres of the S Garden St right-of-way and 0.46 acres from a rental facility on 8th Ave S, also discharge to this outfall. Runoff from yard areas at Seattle Iron and Metals is collected and treated in an onsite wastewater treatment system before discharging to the outfall. However, roof runoff from most of the buildings on the property is not treated and discharges directly to the outfall. Seattle vacated a portion of S Garden St to the metal recycling facility, Seattle Iron and Metals, Inc. (SIMC) in 1999 when they relocated to this location from their

previous location on Harbor Island and in 2012 transferred ownership of the storm drain line and outfall within the vacated section of roadway to SIMC. SIMC also agreed to install and maintain a Filterra® stormwater treatment system on S Garden St as part of a recent expansion on its 701 S Orchard St property to reduce potential impacts to this catch basin from trucks conveying auto shredding residuals along S Garden St between SIMC's metal recycling facility on 601 S Myrtle St and SIMC's new facility on S Orchard St. See Appendix C and Appendix D for further details.

The City-owned MS4 portion of this system was cleaned in 2009-2010 when other drainage systems in the area were cleaned. Only one sample had been collected from this system prior to cleaning. The sample was collected from a right-of-way catch basin (RCB146) located adjacent to the back entry way to the metal recycling facility (Map 60). Results showed elevated levels of copper (1,020 mg/kg), lead (670 mg/kg), mercury (1.08 mg/kg), and PCBs (2,560 ug/kg dw), which were comparable to the levels found in the adjacent S Myrtle St drainage system. Actions that the City will take in this area include the following:

- SPU will continue working with SIMC to control track out issues, as well as to maintain the new Filterra® stormwater treatment unit that SIMC installed on S Garden St.
- SPU will collect follow-up samples in the City-owned MS4 portion of the system to evaluate the effectiveness of source controls.
- SDOT started sweeping S Garden St in 2015 as part of the City's ongoing Street Sweeping for Water Quality Program.

5.3.5. SUMMARY OF PROPOSED SAMPLING ACTIVITIES BY OUTFALL

Table 13 summarizes SPU's planned source tracing activities in the LDW over the next five years. Planned activities include:

- Maintaining existing inline sediment traps
- Installing new end-of-pipe traps if ongoing pilot test identifies a suitable device for small-diameter pipes or collecting inline grabs if no suitable trap is identified
- Re-sampling following line cleaning to determine whether there are ongoing sources to the City-owned MS4.
- Sampling in City-owned MS4 locations that have not yet been characterized
- Continued source tracing in known problem areas
- Maintaining overflow records for City CSOs and EOFs.

Each outfall has been evaluated to determine whether it has a high potential to contribute to recontamination of waterway sediment following cleanup. Priority rankings (4th column on Table 13) are based on an analysis of stormwater solids chemistry, exceedances of source tracing screening levels in inline samples collected near the downstream end of the drainage system, and comparisons with chemistry in surface sediment samples collected within 200 feet of the outfalls. Detailed chemical by chemical analyses of priority rankings are provided in Appendix J.

Table 13: Summary of Planned Source Tracing Activities by Outfall.

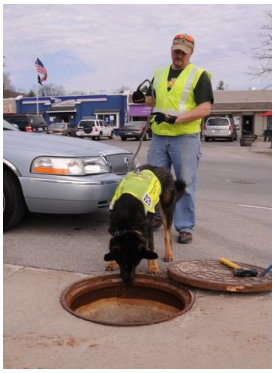
Outfall	Drainage Area (acres)	Owned by or installed by	Priority[a]	Maintain existing traps	Install trap or collect sample near end-of-pipe[b]	Resample following cleaning	Sample to fill data gap	Source tracing	Maintain overflow records[e]	Ecology coordination
S Nevada St SD	22	SPU	Y			✓				
Diagonal Ave S CSO/SD	2,664	SPU	Y	✓				✓	✓	
1st Ave S SD, east	16	SPU	Y		✓			✓		
Head of Slip 2 SD	12	Private	N		✓		✓			
S River St SD	7.6	SPU	Y		✓			✓		
S Brighton St SD	18	SPU	N		✓					
S Myrtle St SD	5.9	SPU	N		✓					f
S Garden St SD	12	Private	N		✓	✓				f
Georgetown SD	5.8	SPU	N		✓			✓		
I-5 SD at Slip 4	150	WSDOT	N	✓						
KCIA SD#3/PS 44 EOF	296	King County	N						✓	
North Boeing Field SD[c]	--	SPU	ND							
16th Ave S SD, east	11.5	Tukwila	Y			✓				
KCIA SD#2/PS78 EOF	233	King County	N						✓	
KCIA SD #1	192	King County	N		✓		✓			
Norfolk CSO/PS17 EOF/SD	769	Tukwila	Y	✓				✓	✓	
I-5 SD at S Ryan St	54.9	WSDOT	N							
SW Dakota St SD	44.8	SPU	Y		✓					
SW Idaho St SD	412	SPU	Y	✓		✓				
SW Kenny St SD/T115 CSO	155	SPU	Y	✓				✓		
Highland Park Wy SW SD	289	SPU	N	✓						
1st Ave S SD, west	603	WSDOT	N	✓						
2nd Ave S SD	38	Private	N					✓		g
S Webster St SD[d]	--	SPU	ND				✓			
7th Ave S SD	238	SPU	Y	✓		✓				h
17th Ave S SD	2.9	SPU	N		✓		✓	✓		
S 96th St SD	42	Private	N	✓						
Duwamish substation SDs	3.8	SCL	ND				✓			

a. Refer to Appendix J for analysis of priorities. ND = No data Y = Yes N = No
b. Install new trap for these small diameter outfalls or collect inline grabs near outfall
c. Given recent findings from video inspection, SPU will investigate whether this outfall can be taken out of service, since there no longer appear to be any active connections to this system.

d. Outfall serves one catch basin on S Riverside Dr.
e. Maintain CSO and SSO records to support source evaluations
f. Coordinate with Ecology on required source controls at Seattle Iron and Metal Corporation site.
g. Request Ecology to investigate drum recycling facility as potential cleanup site.
h. Request Ecology to require adjacent property owner to complete cleanup of arsenic-contaminated soil in right-of-way.
i. Sample near downstream end of City-owned system.

5.3.6. POTENTIAL ENHANCEMENTS

Detection Dog



Dogs have been used to locate a variety of chemicals (e.g., narcotics, explosives) in the field. They are also now being used to detect sewage in storm drains as part of illicit connection surveys (Environmental Canine Services 2013). The University of Washington also trains and uses dogs to locate scat from threatened and endangered species to support scientific research around the world (Conservation Canines 2013). Using trained dogs to identify PCBs in the field could be an effective way to improve source identification in the LDW. This effort would involve conducting a pilot study using trained detection dogs and handlers to evaluate whether dogs could improve source tracing activities in the LDW. SPU has obtained funding under Ecology's Stormwater Financial Assistance Program to support a pilot test. Work is scheduled to begin in 2016.

Pilot Test Passive Water Quality Samplers

The Massachusetts Institute of Technology (MIT) intends to test a polyethylene passive sampler to assess whether this type of device could be useful in assessing whether stormwater discharges are a pathway for dissolved organic compounds to enter the LDW. The polyethylene sampler is similar to other passive samplers that have been used elsewhere (Alvarez 2010). The MIT work is being conducted under a contract with the U. S. Army Corps of Engineers. Previous work involved using the polyethylene sampler to measure concentrations of PCBs in sediment pore water in the LDW (Gschwend et. al., 2013).

SPU is cooperating with MIT by installing the polyethylene samplers in two storm drains in the LDW (Diagonal Ave S CSO/SD near Airport Wy S and 7th Ave S SD near S Barton St). Work is expected to begin in May 2016. SPU will deploy the samplers during dry weather and wet weather conditions to help assess the performance of these devices in closed pipe systems. MIT will analyze samplers for the internal standards or performance reference compounds (PRCs), impregnated into the polyethylene prior to deployment to assess effectiveness.

6. LINE CLEANING PROGRAM

SPU initiated a storm drain line cleaning effort in 2008 to remove contaminated material that has accumulated in the system and prevent it from reaching the LDW. SPU allocates approximately $250,000 per year to fund both the source tracing and line cleaning programs. Funding for line cleaning has come from savings in source tracing efforts, which have largely been funded by Ecology interagency agreements between 2008 and 2013.[27] Ecology also provided $555,989 in funding in 2014 to clean the 7th Ave S SD system (approximately 11,400 feet of pipe), under an interagency agreement. In 2015, Ecology's Toxics Cleanup Remedial Action Grant (RAG) Program provided approximately $280,000 to clean the Highland Park Wy SW system (approximately 20,000 feet of pipe). The existing RAG (TCPRA-2014-SeaPUD-00025) supports line cleaning activities through June 30, 2017.

A portion of SPU's source control budget will be used over the next 5 years to continue cleaning the City-owned MS4 lines that discharge into the LDW.

[27] Ecology interagency agreements have provided approximately $100,000/year for sampling and source tracing activities.

6.1. PROCESS

Cleaning is not conducted until source tracing efforts have been exhausted in a given location or system. Depending on the situation, cleaning may be limited to a specific area where problems were identified, or the entire City-owned MS4 drainage system may be cleaned. In cases where specific sources are identified, line cleaning occurs after SPU inspectors have worked with the responsible party, verified that appropriate controls have been put in place, and the property owner has removed any contaminated sediment from the private onsite drainage system. Where no source(s) can be identified, City lines are scheduled to be cleaned after the SPU source control team has inspected all of the businesses that are considered to be potential sources and when sufficient samples have been collected upstream and downstream of a problem area to identify the pipes where sediments containing elevated levels of contaminants have accumulated. In these cases, it is assumed that there is no longer an ongoing source and cleaning is performed to remove what is considered to be legacy contaminants that may interfere with future source tracing efforts. The SPU source control team meets weekly to discuss overall progress and issues encountered by the inspectors. Information exchanged during these meetings helps to determine when source tracing has been completed. Pipe cleaning activities are prioritized based on the following criteria:

- Severity of contamination as determined by source tracing sampling (e.g., number and magnitude of exceedance of sediment management standard CSL/2LAET screening levels)
- Length of pipe affected (it is easier to schedule and implement cleaning when only a short section of line is involved)
- Depth of solids (heavy solid accumulation can reduce pipe capacity and contribute to flooding problems)
- Need for video inspection to evaluate pipe condition or support other investigations
- Availability of a suitable site to install the necessary decant/dewatering/treatment facility. Sites must have access to a sanitary sewer, access for vactor trucks and equipment, and ideally be near the area being cleaned to minimize travel time.
- Available resources. Existing budget is limited; therefore, SPU has aggressively sought outside funding to expand its line cleaning efforts.

Lines are re-sampled after sufficient material has accumulated in the system to evaluate whether sources are adequately controlled. If chemical concentrations following cleaning exceed the CSL/2LAET triggers, the source tracing/cleaning cycle begins again until confirmation samples show that concentrations remain below the CSL/2LAET.

Line cleaning work in the LDW is typically conducted by a contractor that has experience conducting similar work for the City. Line cleaning operations include installing and operating a temporary decant/treatment facility to dewater the solids removed by cleaning, jetting and cleaning lines/structures, disposing of all solids removed from the system, and video-inspecting the lines after cleaning to confirm that cleaning was successful and to assess the condition of the pipes. Sediment removed during storm drain cleaning operations typically must be dewatered prior to disposal. Excess water is removed, treated, and discharged to the local wastewater collection system under a discharge authorization with King County. Decant/treatment facilities generally include two 20,000-gallon storage tanks to remove solids by settling and a third tank to hold treated water for testing. In some cases additional filtering using bag or sand filter systems is needed to remove solids. In addition, a granular activate carbon (GAC) filter may also be required to remove PCBs and other organic chemicals that could interfere with treatment plant operations or biosolids disposal. The remaining solids are then shipped offsite for disposal, typically a Subtitle D landfill.

6.2. PROGRESS TO DATE

As of December 2015, SPU has cleaned over 77,000 feet of city-owned storm drain lines in the LDW, as well as associated catch basins, maintenance holes and other structures (e.g., vaults, gates). SPU also required adjacent property owners who had discharged contaminants to the City system to clean an additional 2,000 feet of pipe. Line cleaning activities are summarized in Table 14 and shown on Map 76.

Table 14: Summary of SPU line cleaning activities in the LDW.

Date	Outfall	Linear feet	Cost	TN removed	Description	Pollutants
2002-2003	Diagonal Ave S CSO/SD[a]	6,000	$846,000	669	Storm drain mainline and laterals (Denver Ave S, 1st Ave S, and S Dakota St) at downstream end of system	PCBs, PAH, mercury
2007-2008	Diagonal Ave S CSO/SD	NA	$30,900	960	Cleaned all CBs in ROW (approximately 3,500)	Metals and organic compounds
2008	Diagonal Ave S CSO/SD	891	$3,600	5	Airport Wy S line below Rainier Commons	Metals and organic compounds
2009-2010	S Myrtle St SD	1,500	$29,800	24	Entire city-owned MS4 system	PCBs, metals
2009-2010	Brighton Ave S CSO/SD	2,870	$56,800	47	Entire drainage system, tidally influenced	PCBs, metals
2009-2010	S Garden St SD	526	$10,400	9	Entire city-owned MS4 system	Metals
2010	T117 Adjacent Streets	1,600	$8,100	0.2	Portions of separated storm and combined sewer adjacent to T117	PCBs
2010	S River St SD	1,600	$15,700	18	Entire city-owned MS4 system	Metals
2010	2nd Ave S SD	4,400	$41,800	47	Entire piped system, but not the 2nd Ave S ditch	PCBs
2010	Diagonal Ave S CSO/SD	8,290	$79,400	89	S Snoqualmie St, 7th Ave S, 6th Ave S, S Alaska St, Airport Wy S	Mercury
2012-2013	SW Idaho St SD	13,200	$323,900	212	Entire city-owned MS4 system	HPAH and heavy sediment accumulation
2013	16th Ave S SD	1,900	b	b	Entire city-owned MS4 system	Benzyl alcohol and benzoic acid
2013	7th Ave S SD[g]	11,400	$934,000[c]	744[c]	Entire city-owned MS4 system	Metals, PCBs
2013	Diagonal Ave S CSO/SD	890	NA[e]	NA[e]	Airport Wy S line below Rainier Commons	PCBs
2014	Diagonal Ave S CSO/SD	1,140	NA[e]	NA[e]	City-owned MS4 system on 7th Ave S between S Oregon St and MH18 on S Snoqualmie St[d]	PCBs

Date	Outfall	Linear feet	Cost	TN removed	Description	Pollutants
2015	Highland Park Wy SW SD[h]	20,300	$491,100	282	All but the last 1,100 feet at the downstream end of the system	HPAH
2015	S Nevada St SD	1,120	f	f	Entire city-owned MS4 system	Lead and mercury
Totals		77,627	$2,871,500	3,106		

a. SPU source control project to support King County's Diagonal/Duwamish early action cleanup project.
b. 16th Ave S SD and SW Idaho St SD were cleaned at the same time. Costs and sediment removal quantities for 16th Ave S SD are included under the SW Idaho St SD entry.
c. Cost and sediment removed includes cleaning in the lower section of SW Idaho St SD that was conducted concurrently with the 7th Ave S SD cleaning.
d. SPU required the owner to clean the private onsite drainage system and the portion of the city-owned MS4 system that was affected by discharges from the facility.
e. Line cleaned by private property owner as directed by SPU.
f. Included with Highland Park Wy SW SD values.
g. Ecology provided $555,989 to support line cleaning
h. Ecology provided approximately $245,000 to support line cleaning.

6.3. 5-YEAR PLAN

Cleaning in many of the high priority drainage systems is complete. In 2016, SPU intends to focus on the western side of the waterway while the 640 S Riverside Dr property is still vacant and can be used for solids handling. With construction of the South Park pump station planned for 2017-2018, this site will not be available during that time. Drainage systems or sections of drainage systems that SPU intends to clean in the next five years are described below:

- SW Dakota St SD. This system serves an area of about 54 acres, encompassing the commercial/industrial properties along W Marginal Wy SW, as well as developed/undeveloped residential parcels and large tracts owned by the Seattle Department of Parks and Recreation located on the hillside west of W Marginal Wy SW (see Map 18). Zinc and phthalates were the only chemicals exceeding the CSL/2LAET screening levels; however given the relatively small size of this drainage system and its proximity to SPU's available property for solids handling, this system has been targeted for cleaning.
- S 96th St SD. The City-owned MS4 system serves about 83 acres of predominately industrial property within the S 96th St SD basin (see Map 26). Although only zinc and TPH-oil exceeded the CSL/2LAET/MTCA Method A screening levels, SPU intends to clean this line to facilitate source tracing activities
- Diagonal Ave S SD, Ohio Ave S sub-basin. Clean approximately 3,100 feet of line in an industrial sub-basin.
- Diagonal Ave S SD, S Dakota St sub-basin. Clean approximately 2,000 feet of line in an industrial sub-basin.
- Diagonal Ave S SD, 6th Ave S/S Hinds St sub-basin. Clean approximately 1,600 feet of line in an industrial sub-basin.
- Diagonal Ave S SD, Bush Pl sub-basin. Nine (9) of the 10 inline samples collected from the downstream end of this sub-basin contain elevated levels of HPAH (16,400 – 127,580 ug/kg dw). SPU will conduct additional source tracing in this area. Lines will be cleaned after pollutant source(s) are found and controlled.
- Diagonal Ave S SD, S Snoqualmie St sub-basin. This sub-basin continues to exhibit elevated levels of mercury and PCBs in inline samples collected near S Snoqualmie St

and 7th Ave S. This sub-basin is an area where SPU will conduct additional source tracing. Lines will be cleaned after pollutant source(s) are found and controlled.

Over the next 5 years, SPU will allocate approximately $100,000 per year for line cleaning activities. Given the variability in costs, it is difficult to estimate the length of line cleaning this will support. In the past 3 years, line cleaning costs have varied from $20 to over $30 per foot of pipe cleaned. Cleaning costs are affected by a number of factors, including 1) the amount of sediment that has accumulated in the system, 2) the ease of dewatering the sediment removed from the system prior to disposal (finer sediment is harder and requires more time to dewater than coarse sediment), 3) the amount of base flow in the system, which requires more extensive set to bypass base flow around the work area, 4) the degree of tidal influence from the waterway, which limits access to the pipe for cleaning, 5) the number of arterial streets involved, which increases the cost for traffic control, and 6) the level and type of contaminants presence in the storm drain solids, which necessitates additional treatment to dispose decant water to the sanitary sewer system. Without continued grant funding, SPU expects to be able to clean approximately 3,000 to 5,000 feet of pipe each year over the next 5-year period.

7. CITYWIDE SOURCE CONTROL PROGRAMS

The City of Seattle has coverage under the 2013 Phase I Municipal Stormwater Permit for stormwater discharges from the City-owned MS4. The permit requires the City to implement programmatic stormwater BMPs to reduce the discharge of pollutants to the maximum extent practicable (MEP) using all known, available and reasonable methods of prevention, control and treatment (AKART). The permit outlines programmatic elements that permittees are required to implement. The City implements these programs City wide where the City-owned MS4 is located. Below are descriptions of the City wide programs that specifically address source control and are applied in the LDW as part of Seattle's Source Control Implementation Plan.

7.1. SPILL RESPONSE PROGRAM

The City operates a 24/7 spill response program to respond to spills and discharges that are affecting City infrastructure and receiving water bodies. Calls are dispatched through the City's Operations Response Center. Once the call is received, the on call responder is paged and reports directly to the site. The role of the responder is to evaluate the scene, including all safety issues, and coordinate cleanup for the affected infrastructure and/or environment. Responders mobilize an on-call clean up contractor when necessary. SPU coordinates closely with Ecology Spill Response, Seattle Fire and Police, WSDOT and Coast Guard in protecting resources. SPU recently worked with WSDOT and Ecology to improve reporting and response on State-owned highways affecting local infrastructure and water bodies. SPU enforces in cases where it is consistent with source control procedures and regularly recovers cleanup costs when a responsible party can be identified.

Between 1999 and December 31, 2014, SPU has responded to 227 spills in the LDW (102 in the combined sewer basin and 125 in the separated storm basin). Information about spill response activities is provided in Appendix E. The most common complaint involved automobile-related fluids such as gasoline, diesel, oil, and antifreeze (54 percent). The remaining complaints involved a variety of materials including hydraulic oil, concrete/cement, paint, chemicals (e.g., solvents, acids, hazardous materials), and garbage. Spill locations occurring in the LDW are displayed on Maps 29-51 and a list of spills is provided in Appendix E.

7.2. SPILL KIT INCENTIVE PROGRAM

In 2001, SPU began its source control inspections in the Duwamish basin and it became evident that many businesses were not prepared for spills that happened on their site or that might affect drainage infrastructure. Spill prevention and cleanup preparedness were the most common

corrective actions for the businesses inspected. To address this need and incentivize source control implementation, SPU developed a Spill Kit Incentive Program (SKIP) in 2004, which is implemented through Resource Venture under contract with SPU. Businesses are provided with information about SKIP through inspections and complaint response investigations, as well as at workshops and industry events.

Businesses can sign up for the program online to receive free assistance in developing their spill plan, which is delivered, along with a laminated site map and a free spill kit. Employee training and technical assistance are typically provided when the spill kit is delivered. SPU in conjunction with Resource Venture has developed a training video on how to management spills (http://www.youtube.com/watch?v=NeH98Rx7dOE). In 2012, SPU added 'Puget Sound Starts Here' drain markers to the suite of services available during kit delivery. Evaluations of this program have shown that not only are businesses more prepared for a spill and are more apt to clean up a spill, but their participation in the program increases their awareness of how their site affects Puget Sound and stormwater issues in general. This program has been a highly successful model of private/public partnership for stormwater quality improvement and has since been adopted by many jurisdictions. As of December 31, 2014, 905 kits have been delivered to businesses in the LDW.

7.3. SEATTLE GREEN BUSINESS PROGRAM

The Seattle Green Business Program is a free resource conservation program for Seattle businesses that provides outreach and education to the business community regarding stormwater pollution prevention, as well as water conservation, waste prevention and recycling. Current efforts include the "Get on the Map" Program, which is a green business program aimed at encouraging businesses to adopt environmental actions. This program also implements the Spill Kit Incentive Program (SKIP), which provides free spill kits and assists Seattle businesses to finalize spill plans. Under this contract, the Seattle Green Business Program provides supplemental site specific technical assistance to businesses, develops targeted outreach materials in multiple languages, organizes and hosts industry-specific stormwater pollution prevention workshops.

7.4. WATER QUALITY INVESTIGATION PROGRAM

The City provides a publicly listed Water Quality Hotline and web form (http://www2.seattle.gov/util/forms/surfacewater/surfacewaterForm.asp) for the public to report potential stormwater, illicit discharge, and other water quality related problems. SPU maintains the hotline and responds to calls, which are left on a message system that sets off a messaging system to alert responders. This program also receives investigation reports directly from other City departments and agencies. If a spill is reported, the caller is directed to call the Operation Response Center (ORC) at 206-386-1800 to report the spill so that a Spill Coordinator can be dispatched immediately. SPU responds to water quality investigation calls within three business days, most often the same day. The team uses the enforcement process (see Figure 3 and Figure 4) to determine when enforcement is warranted. If a concern is reported at a business, an inspection is conducted. SPU responded to 836 water quality complaints in the LDW between 2003 and December 2014 (384 in the separated storm drain system and 452 in the combined sewer basin). Complaint locations are displayed on Maps 29-51 and a list of complaints is provided in Appendix F.

7.5. ILLICIT DISCHARGE DETECTION AND ELIMINATION

The goal of the Illicit Discharge Detection and Elimination (IDDE) Program is aimed at preventing, identifying and eliminating non stormwater discharges to the City-owned MS4. SPU uses the term IDDE to mean its Dry Weather Screening Program. The City employs a systematic approach to finding illicit discharges and illicit connections using dry weather field screening and source tracing at key locations in the City-owned MS4. Field screening is designed to identify and characterize dry-weather flows and attempt to identify pollutants which may indicate illicit discharges or connections. The dry weather field screening program uses the following process to find illicit discharges/connections:

1. Prioritizing drainage basins for field screening using existing data and basin characteristics to evaluate the potential for illicit discharges and illicit connections.
2. Identifying screening parameters to use as indicators of discharges
3. Performing field testing using the screening parameters
4. Conducting data review to compare screening results to trigger levels
5. Source tracing up the drainage where the comparison suggests that problems exist
6. Identifying and removing sources of illicit discharges and connections when found.

Drainage basins have been prioritized for field screening using existing data to weight the potential for illicit discharges and illicit connections. Factors considered during prioritization include: drainage basin size, previous data collection efforts, areas of the MS4 that discharge to 303(d) listed water bodies, areas of the MS4 that discharge in the vicinity of public water access, and areas where storm drain separation projects have occurred in the past. These screening factors are tabulated and weighted by drainage basin to generate a priority list for IDDE screening. Approximately 80 percent of the drainage system has been screened. After the primary screen of the MS4 is complete in 2015, SPU will re-evaluate screening parameters and their trigger level in anticipation of re-screening all drainage basins. This is planned because upstream illicit connections may have masked downstream ones, to identify new illicit connections, and because of the periodic and/or intermittent nature of discharges, making detection at the time of screening uncertain.

Field screening consists of visual observations, field measurements, and laboratory analysis of chemical and biological parameters to characterize flowing discharges. When flow is not present, the field screening element relies on visual observations, such as damage or staining of the MS4 infrastructure as an indication of the presence of intermittent or transitory discharges. Table 15 details the parameters typically used to identify and characterize flow types and to determine if an illicit discharge or illicit connection is suspected at each sample location. Literature has indicated that these screening parameters have been useful for identifying and characterizing residential, commercial, and industrial discharges (Brown, Caraco & Pitt, 2004).

Table 15: SPU IDDE screening parameters.

Screening Parameter	Parameter Type	Trigger Parameter
Color	Field observation	Yes
Odor	Field observation	Yes
Floatables	Field observation	Yes
Turbidity	Field observation	Yes
Conductivity	Field analysis	Yes
pH	Field analysis	Yes
Temperature	Field analysis	Yes
Estimated flow	Field analysis	No
Fluoride	Laboratory analysis – SPU Water Quality Lab	Yes

Screening Parameter	Parameter Type	Trigger Parameter
Surfactants	Field analysis	Yes
Ammonia	Field analysis	Yes
Potassium	Laboratory analysis – SPU Water Quality Lab	Yes
Fecal Coliform	Laboratory analysis - SPU Water Quality Lab	Yes

The general approach to field screening is to begin at an accessible location at or near the discharge point of a drainage basin, such as an outfall, maintenance hole, ditch, or other drainage structure. Field screening is performed at multiple key locations in most drainage basins instead of relying on one observation at the outfall. The size of the drainage basin is used to determine the number of locations screened. In large basins, key upstream maintenance holes representing major branches are screened to help detect discharges that may be diluted, and therefore, masked by blended flows at downstream locations. Source control inspection staff are responsible for field sampling and collection of samples for laboratory analyses. Sample collection consists of grab samples of flowing water. Field screening is conducted during the summer months during dry weather conditions.

For the purposes of the IDDE program, dry weather means no more than 0.04 inches of rainfall in the preceding six-hour period, with no more than 0.02 inches of rainfall in any one-hour period. Field screening samples are not collected when stormwater runoff is entering the drainage system, because stormwater will interfere with the sampling and measurement of potential illicit discharges/connections. The sampling schedule must also account for tidal intrusion in areas of the City influenced by tidal flows.

The principal components of SPU's field screening element are (Figure 12):

- Field observations of the physical and environmental conditions at each site
- Field analyses by in-situ chemical screening
- Source tracing if illicit discharges or illicit connections are suspected based on the field observations or field analyses
- Laboratory analysis of the collected samples for the remaining chemical parameters
- Additional source tracing based on laboratory analyses.

Source tracing in response to a field observation or analysis is initiated when one or more of the trigger levels for parameters listed have been reached. Many of the drainage maintenance holes in the City of Seattle have several inlets; therefore several samples may be taken at each location which can result in detection of multiple triggers. Thus, the sequence of source tracing at complex sites is prioritized based on public health and safety. For instance, flows with elevated fecal coliform values are prioritized over flows with elevated fluoride values as fecal coliform is an indicator of sewage which has the potential to be a public health risk. Additional source tracing based upon laboratory analysis of samples follows the same process as detailed in the field analysis section. Tracing will generally occur within 3 days after receiving and reviewing laboratory results. After one sub-basin is investigated, staff will return to the remaining areas that exhibited other lower priority triggers until all are investigated.

Occasionally, source tracing a specific trigger, such as conductivity, does not lead to an obvious pollution source, and SC field staff have reason to believe the trigger source is from a natural occurrence. In these instances the surrounding area will be investigated visually for any potential pollution source(s), and field and lab data will be carefully reviewed to identify the most likely cause of the trigger to be natural. In some cases there may be outstanding triggers as the IDDE dry field season ends. In these instances, field staff will review the field and laboratory data to assess each individual trigger in relation to public health and safety. Triggers suspected to be a

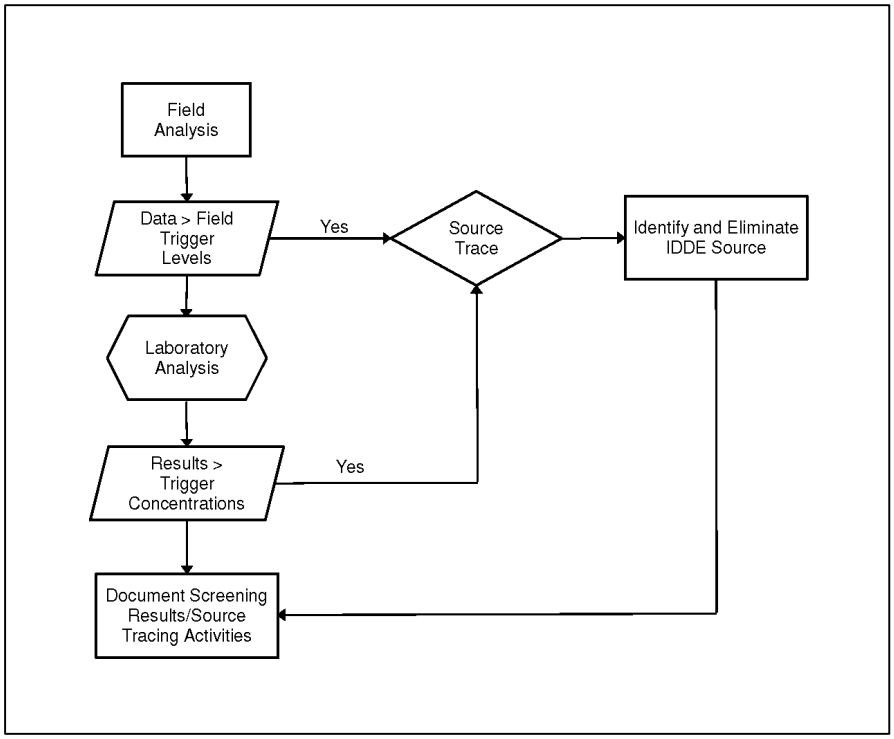


Figure 12: IDDE process.

potential severe threat to human health or the environment will be investigated further into the wet season following 'dry weather' conditions (i.e., maximum of 0.04 inches of rainfall in the preceding six hours, with no more than 0.02 inches of rainfall in any one-hour period). Techniques such as closed-circuit television (CCTV), smoke testing, and basic source tracing (i.e. visual observations, odor etc.) may be used to trace and locate sources.

SPU conducted IDDE dry weather screening in the City–owned MS4 in the LDW during the summer of 2014. These basins were not screened earlier because illicit detection screening in the LDW basins was already being accomplished through business inspections and analysis of storm drain solids. Areas investigated and sampling locations in the LDW are shown on Map 81. Appendix L provides a report on IDDE results and illicit connections discovered in the City-owned MS4 in the LDW. Findings are summarized below:

Diagonal Ave S CSO/SD. Screening triggers were exceeded at 22 locations. Of these, 18 have been resolved, including five illicit connections. Four of the illicit connections have been corrected and the fifth is undergoing additional testing (e.g., dye and/or smoke testing) to confirm whether or not interior floor drains are connected to the storm drain system. Most the other problems were associated with groundwater, tidal influence, or inflow of irrigation water from neighborhood gardens or parks. In addition, two damaged water mains were identified and repaired. SPU is continuing to investigate the remaining four locations where triggers were exceeded primarily for potassium and conductivity.

SW Kenny St SD/T115 CSO. The screening triggers for conductivity and potassium were exceeded in an area where the system is tidally influenced. Because no other triggers were exceeded, it is assumed that this is related to tidal flow.

1st Ave S SD (west). Screening triggers for fluoride, surfactant, and fecal coliform were exceeded at one location. SPU conducted extensive tracing in this area using sewage traps, optical brightener cloths and temperature sensors and has narrowed down the problem to a block of apartments. Dye testing will be conducted to identify the source(s).

Additional dry weather screening, is not planned during the 5-year term of this SCIP. SPU will continue to look for and eliminate illicit connections if they are determined through business inspections and analysis of storm drain solids during the 5-year term of this SCIP.

7.6. PRIVATE FACILITY MAINTENANCE

As required under the City's Phase I Municipal Stormwater permit, the SPU Source Control team inspects private stormwater flow control and treatment facilities throughout the City. In 2011, SPU conducted a study that justified a less frequent inspection of private stormwater facilities and informed Ecology that starting in 2012 SPU would be conducting private stormwater facility inspections for compliance with the permit on a two-year inspection cycle. SPU is currently inspecting approximately 1,500 private facilities citywide (152 within the Duwamish drainage and combined sewer basins). There are 116 flow control, 25 treatment, and 11 combined flow control/treatment facilities in the LDW. SPU facility inspectors require private facilities to be maintained in accordance with Appendix D of the City Stormwater Manual, Volume III. Private facilities in the Duwamish are typically inspected in conjunction with routine business inspections conducted as part of the LDW source control program. Facility inspections use the same enforcement procedures as the Source Control business inspection program. Private flow control and treatment facilities located in the Duwamish area are listed in Appendix K and shown on Map 83.

7.7. CITY DRAINAGE/WASTEWATER FACILITY MAINTENANCE

SPU Field Operations Division is responsible for operating and maintaining the City drainage and wastewater collection systems. SPU applies asset and risk management principles to effectively operate and maintain these systems, which allows SPU to focus on assets that have the greatest risk (i.e., likelihood and consequence) of failure and the greatest opportunity for improved system performance, rather than applying the same task frequency to every asset in the system. From a maintenance perspective, SPU does not distinguish between drainage and wastewater pipes. Pipes are simply pipes, so practices developed to address needs or problems related to one system are often applied to the other. While many off the protocols applied to these gravity systems have resulted from NPDES requirements for controlling CSOs and sanitary sewer overflows [28] (SSOs), SPU has begun to apply these same practices to its separated storm drain system. The following sections describe the existing programs and tools used to operate and maintain the drainage and wastewater systems in Seattle. Where they exist, elements specific to systems in the LDW are highlighted.

7.7.1. RISK-BASED SCHEDULING

System components with an identified maintenance need are placed on a standard preventative maintenance (PM) cycle. PM cycles can range from several years to as frequently as monthly, depending on the site. The goal of SPU's Operation and Maintenance (OM) program is to maintain capacity in the drainage and wastewater systems to minimize the risk of flooding, sewer backups, and CSOs. SPU has established 218 PMs for known problem locations in the LDW (not including routine annual catch basin and water quality structure inspections). Types of PMs in the City-owned MS4 include:

[28] SSOs are any spill, release, or diversion of municipal sewage that results in a discharge to Waters of the State (i.e., lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses. An overflow includes wastewater backup into a building (other than a backup caused solely by a blockage or other malfunction in a privately-owned sewer or building lateral) even if it does not reach Waters of the State.

- Inspect catch basin
- Video-inspect mainline
- Clean mainline
- Inspect culvert
- Clean/maintain ditch.

PM frequencies range from every 3 to 72 months, depending on the location/activity.

All maintenance activities are identified and scheduled by the SPU Planning and Scheduling Section (PASS). PASS was recently established to centralize planning and scheduling of utility maintenance tasks within a team composed of Line of Business experts to more effectively manage work orders, forecast resource needs, identify and allocate resources to maximize efficiency. Urgent or emergency work is managed at the Field Manager/Crew Chief level. Work is tracked using a computerized maintenance management system known as Maximo®. Maximo® is an enterprise asset management tool utilized by many utilities across the country to manage operation and maintenance activities.

PASS uses an internal SPU optimization program known as COTools to assess the critical nature of each system component. COTools processes information recorded from CCTV inspections (e.g., maintenance and/or structural defects) and observations from line cleaning operations (degree of root intrusion and grease/debris/sediment accumulation) through a set of algorithms to develop a recommended PM frequency, establish new PMs, and modify next cleaning date. The process is illustrated in Figure 13. COTools is currently being applied primarily to wastewater pipes, because these systems have historically been maintained more frequently and therefore the necessary information is available. However, information being generated by recent line cleaning activities in the LDW will be used in the future to establish PM cycles for key components in the drainage system.

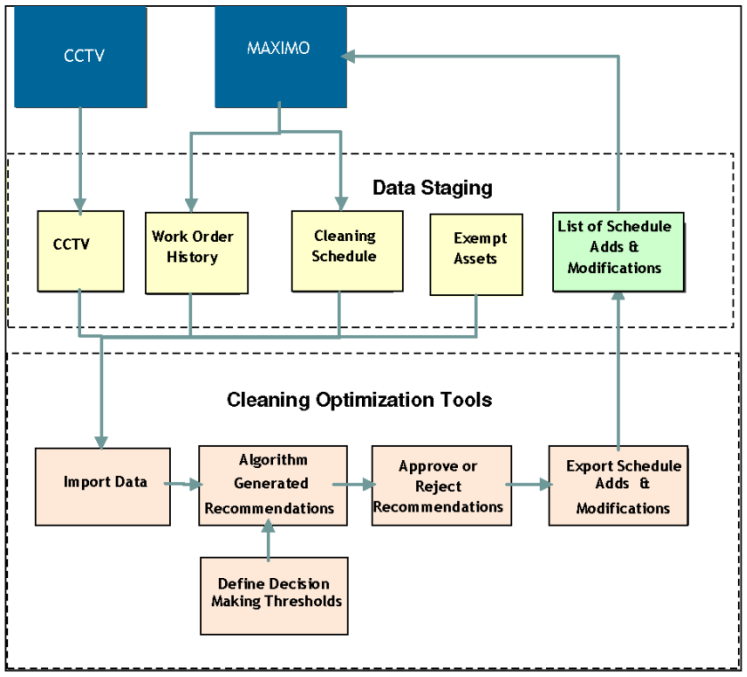


Figure 13: COTools process.

7.7.2. CATCH BASIN INSPECTION AND CLEANING

Catch basins connected to the City-owned MS4 are inspected annually, typically by a one-person Surface Water (SW) crew, although two person crews are often used on arterial streets to provide traffic control. Catch basins in the combined sewer system are inspected every other year. On average, crews can inspect about 50 catch basins per day. Inspection information is managed on an ESRI ArcMap tool that is installed on laptops assigned to each truck. The screen shows a map with colored dots, indicating which catch basins need to be inspected and those that have already been inspected. Inspectors check for presence of an outlet trap, structural defects that could disrupt service (e.g., cracks wider than ½ inch and longer than 1 foot), and measure sediment/debris depth in the sump and enter the information into the ArcMap system. If oil, paint, or unusual odors are evident, the inspector notifies the Crew Chief. Spills are reported to the SPU spill response team. Catch basins are scheduled for cleaning if solids depth exceeds 50 percent of the sump depth. Information from ArcMap is uploaded to Maximo® every night. The information is processed through internal algorithms (see description of COTools above) to assess whether or not the catch basin needs to be cleaned. The SPU System Support Group exports the list of catch basins requiring cleaning each week and prepare the Work Orders for cleaning. Different priorities are assigned to Work Orders, depending on the situation. The standard requires work to be completed within 180 days of the inspection data, although shorter time frames are assigned for higher priority/risk work. Work Order status is tracked in Maximo®. Crew chiefs receive periodic prompts from the FOM scheduling group in advance of the 180 day time limit.

Cleaning is conducted by the Underground (UG) Crew using a regular vacuum truck with a flatbed truck following for backup and safety signage (Figure 14).

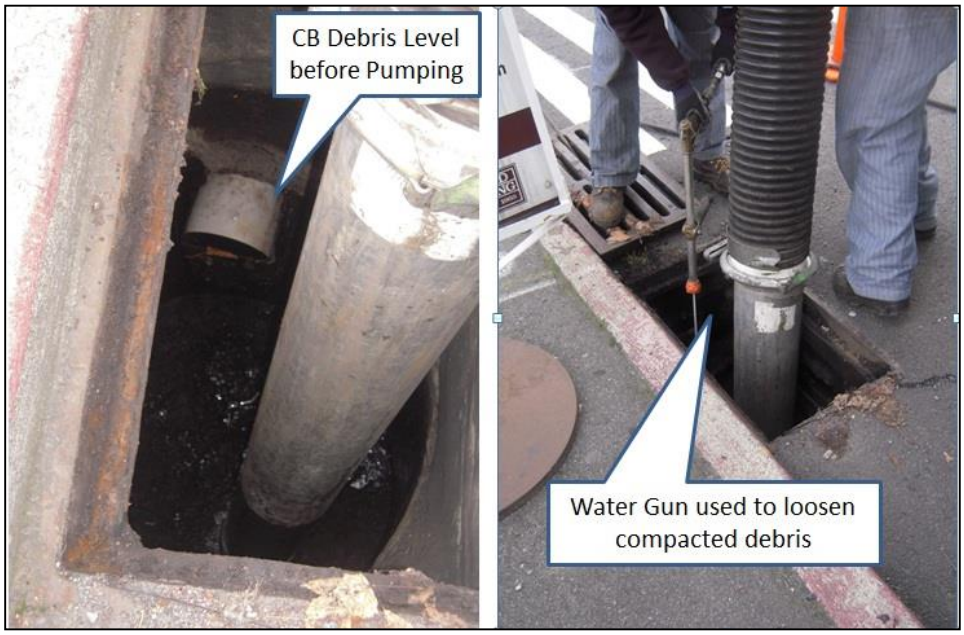


Figure 14: Catch basin cleaning

Vactor trucks return to one of two SPU vactor decant stations (one located in the Interbay area on the north end of town and one on the south end in West Seattle) where solids are dewatered prior to being transported to the Waste Management loading facility in Seattle for eventual disposal at a Subtitle D landfill. Catch basin cleaning operations in the LDW drainage/wastewater basin use the West Seattle site. Liquid is disposed in the sanitary sewer under a discharge authorization with King County.

Inlets connected to each catch basin are also inspected and cleaned if necessary. If the adjacent catch basin is scheduled for cleaning, SW inspectors scoop debris from the inlet and place it in the catch basin. If the catch basin is not scheduled to be cleaned, the material is placed in the truck and disposed at the vactor decant station at the end of the day. Water from the catch basin is then poured into the inlet to ensure that the inlet is clear. Crews can use a hand rodder to clear minor clogging in the connection from inlet to catch basin. However, severe clogging is reported to the crew chiefs who can schedule emergency cleaning.

Between 2011 and 2014, of the 2,400 – 2,700 catch basins inspected each year within the separated storm drain system in the LDW, approximately 300-600 catch basins triggered maintenance thresholds and were cleaned.

7.7.3. LINE CLEANING

SPU Line and Grade (L&G) Crews are responsible for line cleaning in most areas of the City. However, storm drains in the LDW drainage basin are cleaned by a contractor because of the contamination found in these systems. Refer to Section 6 of this document for a description of the line cleaning in the LDW.

7.7.4. TRAINING

SPU has developed Standard Operating Procedures (SOPs) for some maintenance activities and have Job Plans[29] for all maintenance activities. Operations and maintenance manuals are also routinely developed as part of the commissioning process for new capital projects (e.g., pump stations, storage systems). Crews also receive training when new projects are commissioned. Drainage and wastewater crews receive regular training to ensure that they understand and can implement the SOPs and Job Plans. In addition, as part of the City's response to the CSO Consent Decree (U.S. District Court 2013), SPU hired a national expert on utility maintenance practices in 2012 to train City crews. The contract runs through 2016. Key personnel attend two-week training sessions 2-3 times per year which focus on reviewing basic line cleaning techniques, selecting appropriate equipment/tools, equipment set up and operation, equipment maintenance and care, and causes of equipment failure. This "train the trainer" approach provides training to crew chiefs and other key personnel, who are then responsible for working with crews to implement the appropriate procedures. In 2013, training focused on techniques for cleaning large diameter pipes. The goal of these training sessions are to establish standard procedures, ensure that crews know and can demonstrate proper techniques, establish productivity goals, and to train managers to ensure that standards are maintained. In 2014, training focused on the use of new jet nozzle technology, effective capture of debris while jetting and root drag activity.

7.7.5. 5-YEAR PLAN

SPU is implementing a capacity, management, operation, and maintenance (CMOM) program as part of its efforts to reduce sanitary sewer overflows and in response to the 2013 Consent Decree with EPA and Ecology for operation and maintenance of the City's wastewater collection system. In 2012, SPU developed a CMOM performance plan, which included a roadmap describing the actions the City plans to implement over the next 6 years. Plan elements are outlined below:

- Planning and Scheduling. SPU will continue to refine planning and scheduling operations. Areas of emphasis include 1) creating and managing Work Orders to accurately reflect work so that resource needs can be identified and resources allocated, 2) analyzing data to develop appropriate preventative maintenance schedules, 3) defining the protocols for CCTV inspections in the wastewater system, and other

[29] Job plans are attached to Work Orders and describe the resources needed to perform the task (i.e., labor, equipment, and materials), identify the key steps involved, and specify what data need to be collected.

activities as needed, and 4) working with field staff, finance staff, and project managers to effectively forecast, plan, and schedule work.

- Standard Operating Procedures. SOPs are needed to establish clear roles, responsibilities, and procedures for utility maintenance staff. Development and updates of existing SOPs for routine maintenance activities will continue over the next five years.
- Crew Training. The external training sessions with the national expert on utility operation/maintenance will continue through 2016. Other activities planned over the next five years include revising the existing Training Plan to incorporate the updated maintenance protocols, developing training materials, and scheduling classroom/field training sessions.
- Quality Assurance/Quality Control. This work involves developing and implementing a QAQC program to increase efficiency. Work over the next five years will include setting performance thresholds, measuring and tracking effectiveness, and providing constructive feedback to crews to encourage improvement.

To date, the Capacity, Management, Operations and Maintenance Performance Program (CMOM) activities have focused on the City's wastewater collection system. Phase 2 of CMOM, scheduled to start in 2016, will begin to develop an approach for implementing a CMOM-like process into the stormwater collection system. Work will focus on assessing the current approach to operation and maintenance activities, condition of existing infrastructure, evaluating drainage/wastewater capacity issues and assessing the effectiveness of existing maintenance efforts and developing program requirements. The evaluation will include consideration of how best to incorporate the prioritization information from the SCIP into programmatic operation and maintenance activities conducted by SPU.

7.8. TRANSPORTATION

SDOT is responsible for maintaining streets and bridges in the City. There are approximately 724 miles of roadway in the LDW. A breakdown of roadways by basin (i.e., MS4 versus combined sewer) and ownership is provided in Table 16.

Table 16: Miles of streets in the LDW by basin and ownership.

Owner	MS4 (miles)	Combined sewer area (miles)
City	143	507
County	0	0.3
State	0.02	39.1
Private	0.36	1
Total	177	547

SDOT activities are funded from a variety of sources, including federal and state grants, gas tax revenues, local fees, and the City's General Fund. Federal and state grants must be matched with local funds. In 2006, Seattle voters passed a nine-year, $365 million levy for transportation maintenance and improvements known as Bridging the Gap (BTG) which was complimented by the commercial parking tax. BTG funds programs to address the maintenance backlog for paving; sidewalk development and repairs; bridge repair, rehabilitation and seismic upgrades; tree pruning and planting; transit enhancements; and other much needed maintenance work. Funding also supports projects that develop and implement both a Bicycle and Pedestrian Master Plan, create a Safe Routes to School Program, improve transit connections and help neighborhoods get larger

projects built through the Neighborhood Street Fund large project program. Since 2007, more than $20 million a year has been invested in street improvements along Seattle's arterial streets helping to make up for the diminishing amounts available from other sources during the economic downturn. BTG expired at the end of 2015. A new 10-year levy-funded program to support transportation improvements, knows as Move Seattle, was approved by voters in 2015. .

7.8.1. ONGOING PROGRAMS

Street Sweeping

Public rights-of-way encompass approximately 26 percent of the total land area draining to the LDW. The City has swept streets in Seattle since the turn of the century to control litter. In 2011, SPU and SDOT modified the street sweeping program to improve pollutant removal capabilities. Sweeping is conducted by SDOT staff with funding for the pollutant removal improvements provided by SPU. Modifications to the street sweeping program include using high efficiency, regenerative air sweepers in areas served by separated storm drains, and reducing sweeper speed to enhance particle pickup. In areas served by the City-owned MS4 that discharge to the LDW, approximately 6 miles of roadway are swept on a weekly basis and 31 miles are swept every other week. In areas that drain to the combined sewer, approximately 20 miles are swept every week and 93 miles are swept every other week. Active street sweeping routes in the LDW are shown on Map 77. The majority of sweeping routes in the LDW are focused on arterial streets, and in the LDW the majority of arterials discharge to the combined sewer.

Sweeping is not considered to be effective on uncurbed streets. Many industrial streets in the LDW are uncurbed. SPU and SDOT plans to add several uncurbed streets to sweeping routes in 2016 as part of the Street Sweeping Expansion proposed in the Integrated Plan and would evaluate the results to determine if additional uncurbed streets should be included in the City's street sweeping program.

Arterial Asphalt Concrete Program

SDOT's Arterial Asphalt and Concrete Program resurfaces several streets each summer with the larger goal of enhancing both mobility and safety citywide. The projects are prioritized and selected by SDOT's Pavement Engineering and Management Section based on pavement condition, volume and type of traffic, identified needs of residents and businesses, opportunities for coordination with other capital projects, and identified maintenance and liability concerns. These paving projects include enhancements such as improved curb ramps and sidewalks, providing a safer and more convenient pedestrian environment, as well as road markings and signal detectors to help bicycles and vehicles share the road more safely. Since 2008, approximately 2.8 miles of roadway in the LDW drainage basin within the City of Seattle have been paved. Paving projects that have occurred in the LDW between 2008 and 2014 are described in Appendix H and shown on Map 84.

Chip Seal Program

Chip sealing is a cost effective surface treatment used on about one quarter of Seattle's non-arterial streets. It is a preventative maintenance practice that is commonly used by many cities and counties across the country. A chip seal surface consists of an application of asphalt emulsion and a layer of "rock chips" which are about 1/4 to 3/8 of an inch wide. In the 1960's, most of these streets were dirt or gravel. The City converted them to chip seal to provide a smooth driving surface, reduce dust, eliminates pathways for pollutants to move from sub-surface to surface and improve air quality.

SDOT has divided the City into 36 grids. Each grid is placed on an approximately 10-year cycle for resealing to prevent the surface from becoming brittle and cracking, which would trigger the need for more extensive and costly repairs. Until about 2009, SDOT chip sealed approximately one grid

in the City each year. The chip sealing program was put on hold from 2009 - 2012 due to lack of funding. SDOT restarted chip sealing streets in 2013. SDOT is currently reviewing candidate areas and is developing a plan for upcoming chip sealing activities. Additional information will be provided in the annual reports. See Section 9 for a description of annual reporting for the City's source control program.

Dates when non-arterial streets in the LDW were last chip sealed are provided below:

- Between I-5 and E Marginal Wy S: 1998
- I-5 to Martin Luther King, Jr Wy S between S Spokane St and S Graham St: 2005
- I-5 to Martin Luther King, Jr Wy S between S Graham St and southern City limits: 2001
- W Marginal Wy SW to the west edge of the LDW basin from the north end to Highland Park Wy SW: 2004
- Between the waterway and SR-509 from Highland Park Wy SW to the southern City limits: 2000.

Non-Arterial Concrete and Non-Arterial Asphalt Maintenance

These two program focus on spot repairs on the City's non-arterial streets. These repairs are typically one to two block asphalt paving projects, or select panel replacements on the streets poor condition. The work is completed by City crews that are able to cost effectively complete small street rehabilitation projects. Additional information will be reported in the 2016 SCIP Annual Report.

Improvements to street conditions reduces the amount of solids generated and enhances the ability of street sweeping to remove solids and associated pollutants before they can enter the drainage system. These projects typically do not trigger stormwater code-required infrastructure upgrades. However, in some instances SPU may partner with SDOT to upgrade infrastructure. Coordination on these projects is conducted using the mechanisms described in Section 7.14 of this SCIP.

Arterial Major Maintenance

The arterial major maintenance program focuses on spot repairs on the City's arterial streets. These repairs are typically one to two block asphalt paving projects, or select panel replacements on the streets poor condition. The work is completed by City crews that are able to cost effectively complete small street rehabilitation projects. Additional information will be provided in the annual reports. See Section 9 for a description of annual reporting.

Improvements to street conditions reduces the amount of solids generated and enhances the ability of street sweeping to solids and associated pollutants before they can enter the drainage system. These project typically do not trigger stormwater code-required infrastructure upgrades. However, in some instances SPU may partner with SDOT to upgrade infrastructure. Coordination on these projects is conducted using the mechanisms described in Section 7.14 of this SCIP.

Street Use Permits

SDOT permits all activities in the public rights-of-way; permits are required for any work or occupation of the right-of-way. There are over 60 types of street use permits. SDOT has incorporated stormwater best management practices into the Street Use Permit process to control potential sources of pollutants from leaving the right-of-way and entering the City owned MS4, which helps control and regulate potential sources of pollution and provides an enforcement tool to regulate potential pollutant generating activities. The most common permits associated with source control efforts are listed below:

- Encroachments. Annual/Renewable Street Use Permits are issued for long-term use of the rights-of-way such as signs, retaining walls, structural overhangs, and sidewalk cafes. These permits require an annual fee and in some cases liability insurance or public place indemnity agreements. Although these permits are issued for uses that may seem permanent they are considered temporary in nature and can be revoked within 30 days. Many businesses in the LDW maintain Annual Street Use Permits to store equipment and other materials in the right-of-way.
- Shoring and Excavation permits are issued for excavations in or near a public right-of-way that could by the nature of the excavation affect the integrity of the right-of-way or utilities located in the right-of-way. SDOT reviews any proposed excavation that would be greater than three feet deep immediately adjacent to any given public right-of-way.
- Street Improvement Permits are required when development activities trigger requirements for street paving, curbs, or sidewalks and include construction of utilities necessary to serve the private property development. These improvements must meet SDOT design criteria.
- Utility permits are issued to private contractors and public agencies for the installation of underground and overhead utility mains and services in the public rights of way. They include power, communication, gas, steam, water, sewer, drainage, and privately owned facilities such as oil pipelines.
- Use of Street and Sidewalks for Construction and Other Purposes. Street Use permits are issued for temporary use of the rights of way during construction such as material storage, scaffolding, crane placement, or crossing curb and walk with heavy equipment. Other types include private uses of the right of way such as planting trees, block parties, and other special events, or signs. These permits are considered temporary in nature and can be revoked within 30 days.
- Gardening in Planting Strip. Street Use permits are not required for gardening activities in the planting strip. However, a permit is required when planting a tree or installing hardscape elements, like raised planting boxes or pavers, in the planting strip. These permits are free.

In 2012, SDOT revised all of the street use permits that involve storage of materials in the right-of-way to include requirements for incorporating best management practices to control stormwater. A sample permit is provided in Appendix G.

Street Use Permit Inspection and Enforcement

Following issuance of a Street Use Permit, SDOT conducts inspection and if warranted, enforcement to require permittees to comply with the stormwater best management practices required by the Street Use Permit.

During an inspection, the SDOT inspectors verify that the installation and use of the required stormwater best management practices at each site are consistent with the permit. Any deviation from compliance is addressed immediately by the SDOT inspector until compliance with the stormwater best management practices in the permit are achieved. Upon closing a Street Use Permit, the SDOT Inspector conducts a final walk-thru to verify that all required temporary stormwater best management practices have been removed, permanent stormwater best management practices (if required) are properly installed and vegetative areas are restored. In the event that there is a violation of the Street Use permit requirements, SDOT inspectors use the following progressive enforcement system to achieve compliance:

- Step 1 - Verbal Warning. The SDOT can issue the permit holder and verbal warning to correct the deficiency to achieve compliance. Verbal warnings are used when the violation or deficiency is minor and there is no impact to the City owned MS4. A follow-up inspection is conducted to determine compliance.

- Step 2 – Written Correction Notice. When an SDOT inspector determines that there are or may be impacts to the City owned MS4 a Written Correction Notice is issued to the permit holder and requires immediate corrective actions. Written Correction Notices specify that a follow-up inspection will be conducted to determine that stormwater best management practices have been implemented and the impact to the City-owned MS4 has been eliminated. If during the follow-up inspection it is determined that the permit holder has not complied, the SDOT inspector may proceed to Step 3 and issue Street Use Citation with penalty.
- Step 3 – Street Use Citation. A SDOT Inspector may issue a Street Use Citation in situations where a direct violation of stormwater best management requirements are observed or if the requirements of a Written Correction Notice are not found to be adequate during a follow up inspection. SDOT Inspectors can issue "Stop Work" orders for violations causing immediate impact to the City-owned MS4

S Portland St Improvements

In 2013-2014, SDOT and SPU worked together to design and construct street and drainage improvements on S Portland St between SR-99 and 8th Ave S as part of a project that extends the West Duwamish Bike Trail from W Marginal Wy S to the existing pocket park on the Duwamish Waterway at 8th Ave S. Project construction was completed in early 2015.

As part of the project, SDOT constructed a 20-foot wide bike trail along the south side of S Portland St and regrade/pave the street to drain to a stormwater collection/conveyance system that SPU will construct. Approximately two blocks of S Portland St (west of 5th Ave S and east of 7th Ave S) had been unpaved and there was no formal drainage system in this area (Figure 15 and Figure 16). The source control benefits of the project are that the street improvements have greatly reduced the amount of solids generated from the roadway in this area (Figure 17 and Figure 18). SPU also installed a storm drain along S Portland St to collect runoff from the roadway and adjacent properties and tie into the existing 72-inch storm drain on 7th Ave S. The project constitutes part of the lower basin improvements needed to correct flooding problems in this area (see above description of the South Park Pump Station/Water Quality project). Code compliance for this project will be implemented as part of the South Park Water Quality Project.

Figure 15: S Portland St west of 5th Ave S (looking east): before

Figure 16: S Portland St west of 5th Ave S (looking east): after

Figure 17: S Portland St east of 7th Ave S (looking east): before

Figure 18: S Portland St east of 7th Ave S (looking east): after

7.8.2. TRANSPORTATION 5-YEAR PLAN

Over the next five years, SDOT intends to continue its efforts to maintain and improve streets in Seattle. Planned activities that may support the LDW source control program are described in the following sections.

SDOT and SPU coordinate on capital projects thru the mechanisms described in Section 7.14. During future coordination, SPU will use the prioritization described in Appendix J to identify where the best opportunities to meet source control goals align with SDOT transportation goals and recommend partnering projects. This partnering may result in shared projects that result in improved roadways and retrofitting stormwater facilities.

Freight Mobility Study

SDOT embarked on two freight planning efforts in 2013-14. The first is the Industrial Areas Freight Access Project, which is being done in collaboration between the City and the Port of Seattle. The prime focus of this study is to identify improvements to freight mobility, focusing on the City's two Manufacturing and Industrial Centers (MICs): Duwamish and Ballard Interbay. The improvements identified are aimed at maintaining and improving freight access and circulation within the two MICs, including the key connections from the MICs to the regional transportation system. The result of the study will be to identify specific project recommendation to improve freight mobility in this area. The study was completed in 2015. See the following website for more information on SDOT's Freight Access Project: http://www.seattle.gov/transportation/freight_industrialareas.htm)

The second planning effort will be a full, citywide Freight Master Plan (FMP). The focus of the plan, similar to other modal master plans that SDOT has prepared over the past several years (including a Bicycle Master Plan, Pedestrian Master Plan, and Transit Master Plan), will be to identify the future citywide freight network for the city (which could likely lead to an update to the City's map of Major Truck Streets), identify project improvements for freight mobility, and identify a framework for how to prioritize improvement. The projects that are identified in the Port/SDOT Freight Access Project (noted above) will inform the projects identified in the FMP, but unlike the Freight Access Project the Freight Master Plan will be citywide in scope. The Freight Master Plan will also be ultimately reviewed and approved by City Council, similar to SDOT's other modal master plans.

Both the Freight Master Plan and the Freight Access Project are transportation planning studies which will identify and prioritize possible capital and program improvements in the Duwamish Manufacturing and Industrial Center (MIC). The Freight Access Project (FAP) has a greater focus on identifying projects in the Duwamish MIC; the Freight Master Plan is a citywide plan, and projects identified in the FAP will be incorporated into it. Both planning efforts will identify a framework for prioritizing projects, and environmental considerations will be taken into account when scoring and ranking these projects for prioritization purposes.

After the completion of the planning processes, a project enters the Capital Improvement Program (CIP). Project implementation will be dependent upon the comprehensive prioritization process that takes place when a project enters the CIP. This process includes a criterion on benefits to water quality. Projects entering actual project development and design will be scoped to reflect all applicable City code requirements for storm water management and developed in conjunction with Seattle Public Utilities.

Non-Arterial Paving Program

SDOT is currently in the planning phase of a non-arterial paving program in the industrial areas of Seattle. In the LDW, this program would be focused on improving the roadway condition of non-arterial streets in coordination with SPU and the goals of this SCIP 5-year plan. This program is has been approved by the Mayor and City Council. Next SDOT will seek voter approval of the Moving Seattle levy. Information and status of this program will be provided in future annual reports.

Move Seattle

In March of 2015, Seattle Mayor Murray launched the "Move Seattle" transportation strategy that is designed to continue maintaining and improving the transportation infrastructure of Seattle. SDOT has developed a comprehensive funding request that is expected to be presented to the public for a vote in November 2015. Contained in these plans are the expectation that SDOT and other City departments coordinate to combine projects and minimize impacts to the public and improve the environment. As part of this, SDOT and SPU are coordinating so that the information and

prioritization established by the source control activities are considered when prioritizing right-of-way projects.

7.9. STORMWATER MANAGEMENT/CODE

Stormwater management in Seattle is guided by the NPDES Phase I Municipal Stormwater Permit (MS4 permit) and the City Stormwater Code (SMC 22.800-808) and associated technical manuals, known as SPU/DPD Directors' Rules. The MS4 Permit requires that the City have an ordinance and manuals for stormwater management that are equivalent to the Ecology Stormwater Management Manual for Western Washington. To meet this requirement, the Stormwater Code and Directors' Rules were updated in 2016 and determined by Ecology to be equivalent. All Directors' Rules can be downloaded from the following City website:

http://www.seattle.gov/dpd/codesrules/codes/stormwater/default.htm.

The Stormwater Code contains regulatory requirements that provide for and promote the health, safety, and welfare of the general public and is designed to:

- Protect, to the greatest extent practicable, life, property, and the environment from loss, injury, and damage by pollution, erosion, flooding, landslides, strong ground motion, soil liquefaction, accelerated soil creep, settlement and subsidence, and other potential hazards, whether from natural causes or from human activity.
- Protect the public interest in drainage and related functions of drainage basins, watercourses, and shoreline areas.
- Protect receiving waters from pollution, mechanical damage, excessive flows and other conditions in their drainage basins that will increase the rate of down cutting, streambank erosion, and/or the degree of turbidity, siltation, and other forms of pollution, or which will reduce their flow rates or flow levels to levels which degrade the environment, reduce recharging of groundwater, or endanger aquatic and benthic life within receiving waters.
- Meet the requirements of state and federal law and the City's municipal stormwater National Pollutant Discharge Elimination System permit.
- Protect the functions and values of environmentally critical areas as required under the state's Growth Management Act and Shoreline Management Act.
- Protect the public drainage system from loss, injury, and damage by pollution, erosion, flooding, landslides, strong ground motion, soil liquefaction, accelerated soil creep, settlement and subsidence, and other potential hazards, whether from natural causes or from human activity.

To support implementation of the Stormwater Code, the Directors of SPU and SDCI have promulgated rules that provide specific technical requirements, criteria, guidelines, and additional information. In addition to the City's Stormwater Code requirements, the SDOT Right-of-Way (ROW) Improvements Manual specifies how drainage features can be incorporated into the streetscape and permitting requirements for use of the right-of-way. Specific references for locating City stormwater-related information are included below:

- Stormwater Manual Volume 1: Project Minimum Requirements describes minimum requirements for all types of land development and redevelopment and provides site assessment and planning steps, as well as drainage control review requirements (City of Seattle 2016a).
- Stormwater Manual Volume 2 Construction Stormwater Control contains temporary erosion and sediment control technical requirements which are required to prevent contaminants from leaving projects during construction. It also provides submittal

requirements for drainage control review to help ensure that stormwater controls are appropriately implement during construction (City of Seattle 2016b).

- Stormwater Manual Volume 3: Project Stormwater Control provides approved methods, requirements, criteria, details, and general guidance for analysis and design of flow control, water quality, and GSI facilities (City of Seattle 2016c).
- Stormwater Manual Volume 4: Source Control provides information to help individuals, businesses, and public agencies in Seattle implement appropriate best management practices (BMPs) for controlling pollutants at their source and preventing contamination of stormwater runoff (City of Seattle, 2016d).
- Stormwater Manual Volume 5: Enforcement provides standards, guidelines, and requirements for enforcing the Stormwater Code (City of Seattle, 2016e).
- SDOT Right-of-Way Improvements Manual, Chapter 2 defines permitting procedures for SDOT: http://www.seattle.gov/transportation/rowmanual/manual/.

7.9.1. NEW AND REDEVELOPMENT REQUIREMENTS FOR STORMWATER TREATMENT

New and redevelopment projects, including public projects, are regulated by the City of Seattle's Stormwater Code, Seattle Municipal Code 22.800(City of Seattle, 2016a) and depending on project size and location are required to comply with the on-site stormwater management, water quality, and construction site stormwater pollution prevention requirements of the code. Because the LDW is a large receiving water body, projects are not required to implement flow controls unless they discharge to the combined sewer system.

On-Site Stormwater Management - Parcel-based projects where either the total new plus replaced hard surface is 1,500 square feet or more or the land disturbing activity is 7,000 square feet or more, are required to implement On-Site Stormwater Management BMPs to reduce the runoff volume and pollutants from development using infiltration, dispersion, or retention. On-site Stormwater Management is required for roadway projects where there are 2,000 square feet or more of new plus replaced hard surfaces or 7,000 square feet or more of land disturbing activity.

The On-site Performance Standards require that the post-development stormwater discharge durations shall match the discharge durations of a pre-developed pasture condition for the range of pre-developed stormwater discharge rates between the 1 percent and 10 percent exceedance values.[30] The On-Site requirements can also be met by selecting from lists of best management practices (BMPs) that have been established for each type project (e.g., single family residential, trail and sidewalk, parcel-based, and roadway). Modelling is typically not required when using the On-Site List approach.

Water Quality Treatment Minimum Requirements Parcel based projects are required to install water quality treatment BMPs if they create greater than or equal to 1,500 square feet of new plus replaced pollution-generating impervious surface (PGIS) or greater than or equal to 7,000 square feet of land disturbing activity and, 1) the replaced hard surface is greater than or equal to 5,000 square feet or more of new plus replaced PGIS or 2) greater than or equal to ¾ acres of pollution-generation pervious surface.

Water quality treatment is required for roadway projects if, 1) the site has less than 35 percent existing hard surface coverage and the hard surface is 5,000 square feet or more, or 2) the site has greater than or equal to 35 percent existing impervious surface and the projects total new pollution-generating hard surface is 5,000 square feet or more, and the total new plus replaced pollution-generating pervious surfaces is ¾ acres or more, and the project discharges stormwater in a natural or man-made conveyance system from the project site.

[30] Percent exceedance is the percent of time, over the simulation period (i.e., 158 years), that a given flow is equaled or exceeded.

PGIS is defined as any impervious surface that is considered to be a significant source of pollutants. PGIS include those that are subject to vehicular use, industrial areas that engage in activities such as manufacturing, chemical or waste storage, or storage of leachable or erodible materials. Water quality treatment facilities such as wet/infiltration ponds, vaults, media filters, biofiltration swales/strips are required to remove 80 percent of total suspended solids from runoff. Because many of the pollutants found in urban stormwater tend to adhere to particles, these facilities are also effective in reducing the pollutant load.

7.9.2. CONTROLLING RUNOFF FROM CONSTRUCTION SITES

All projects are required to implement effective BMPs to control erosion, sediment transport, and other pollutant discharges during construction. Projects that will conduct a significant amount of excavation dewatering are also required to submit a dewatering plan for review and obtain a permit from SDCI as documented in SPU DR 02-04 (Side Sewer Permit for Temporary Dewatering). Construction dewatering involves the removal of groundwater and accumulated stormwater encountered during excavation activities. Depending on the location of the project and site conditions, stormwater and dewatering water may be treated and discharged to the storm drain system or discharged directly to the combined sewer system. It is SPU's policy to treat and discharge water from construction projects to the City drainage system or, if available, a receiving water body to avoid putting extra flow in the sanitary and combined sewer systems. Exceptions can be made for very short duration projects or if construction cannot be economically treated to permit discharge to the City drainage system.

City requirements for temporary dewatering on construction sites are described in the Groundwater/Dewatering Director's Rule SDCI 13-2010/SPU 2010/005 and the accompanying client assistance memorandum (see Appendix F). Discharges to the combined sewer must obtain a Side Sewer Permit for Temporary Dewatering from the City of Seattle and comply with King County's IWP requirements.

7.9.3. CITYWIDE SOURCE CONTROL REQUIREMENTS

The Ecology-issued NPDES Phase I Municipal Stormwater Permit requires that the City enact and enforce ordinance(s) requiring application of source control Best Management Practices (BMPs) that are functionally equivalent to the source control BMPs in Volume IV of the Stormwater Management Manual for Western Washington. The City has enacted the specific requirements for controlling sources of pollutants in urban stormwater in the Stormwater Code and the Directors' Rule Volume 1, Source Control Technical Requirements Manual (Seattle 2009a). Ecology has determined that the City's Code and Directors' Rules are functionally equivalent to the states manual. Seattle's Stormwater Code and Stormwater Manual, which establishes the pollution prevention requirements for all properties, as well as for specific business activities, forms the basis for the business inspection program and enforcement authority that SPU has implemented in the LDW. The following seven BMPs are required for all real property in Seattle:

- Eliminate illicit connections to storm drains
- Perform routine maintenance for drainage system
- Dispose of fluids and wastes properly
- Store solid wastes properly
- Prevent and clean up spills
- Provide oversight and training for staff
- Site maintenance[31].

[31] Site maintenance a new citywide BMP that is being added in Seattle's 2016 Stormwater Manual.

In addition to the seven citywide BMPs, the City's source control manual (City of Seattle 2016d) also requires certain commercial and industrial activities that drain to the MS4 to implement additional BMPs for site-specific pollution generating activities. The 38 additional site-specific BMPs are listed in Appendix I. SPU inspectors assess onsite activities to determine whether the business is in compliance with the BMPs identified in the manual. The Stormwater Code also allows for progressive enforcement to achieve compliance, including installation of structural BMPs where operational BMPs are not sufficient to control the discharge of pollutants.

7.10. UTILITY MAPPING PROGRAM

Information about the City's drainage and wastewater collection/conveyance systems is maintained in an ArcGIS® platform, which is managed by the Geographic Information System (GIS) Section of SPU's Information Technology Division. Information is regularly updated and updates are posted to the system every two weeks. Capital projects are processed through the City's engineering vault. New infrastructure are assigned equipment numbers during project design and entered into GIS as "proposed" structures when projects are advertised. Once project construction is complete and work is accepted by SPU, the new structures are entered into the permanent record. Information on private projects is obtained from SDCI on a weekly basis and posted to GIS every two weeks.

GIS utility information is also regularly revised to incorporate corrections identified by SPU field staff (e.g., IDDE, business inspectors, and sewer rehabilitation staff). Staff submit a drainage/wastewater map correction report to GIS showing the necessary corrections. Corrections are a top priority for the GIS program and are processed ahead of any new infrastructure data.

SPU also implemented a Surface Water Asset Management Program (SWAMP) in 2010 to field verify locations and attributes of surface drainage features (e.g., catch basins, inlets, maintenance holes, ditches, culverts, and biofiltration swales, bioretention cells, and weirs) throughout the City. Structures are located using survey grade geographic positioning system (GPS) equipment. The program has been systematically working through the City following 640-acre City map grids/tiles[32]. Each grid takes about 6 weeks to complete field work, data analysis/entry, and GIS updates. Most of the drainage on the west side of the LDW has been completed. Only portions of the Highland Park Wy SW SD, the 1st Ave S SD (west), and the SW Kenny St SD basins remain to be surveyed. On the east side of the LDW, portions of the S Norfolk drainage basin have been completed. The SWAMP program was grant funded and funding has ended. SPU will continue to update GIS as corrections are found during the course of source control and other work in the LDW.

7.11. STORMWATER IMPROVEMENT PROJECTS

SPU's water quality program continues to investigate opportunities to improve stormwater quality in Seattle. To date, the primary emphasis has been on leveraging water quality improvements with flood control and redevelopment projects.

7.11.1. NORFOLK WET POND/CONSTRUCTED WETLAND.

Constructed in 2011, the 5-acre-foot Norfolk wet pond/constructed wetland system, treats runoff from 226 acres of land in the Martin Luther King Jr. Way sub-basin of the Norfolk drainage basin (Figure 19 and Map 78). This facility was built as part of a drainage project that replaced a damaged section of storm drain line located between Martin Luther King, Jr Wy S and I-5. The damaged and undersized pipe was causing stormwater to back up into a sanitary sewer pump station. Repairing the line allowed runoff that had been discharging to the sanitary sewer for a

[32] For mapping purposes, the City has been divided into 640-acre grids/tiles. Each grid corresponds to a full section within a township as defined under the U.S. rectangular survey system.

number of years to reach the LDW. SPU elected to install a treatment facility to reduce pollutant loading to the waterway from this highly industrial drainage basin.

Figure 19: Norfolk/MLK wet pond.

7.11.2. South Park Pump Station/Water Quality Facility

SPU plans to construct a pump station on the 7th Ave S drainage system to alleviate chronic flooding problems in the lower basin. At present, this system cannot drain at high tide. The pump station will allow the main trunk line to function properly during a wide range of tidal conditions. Other local drainage improvements are needed in the lower 70 acres of the basin, but the pump station provides the first step in reducing flooding.

As part of pump station project, SPU is also planning to construct a stormwater treatment facility to reduce pollutant loading from the 238-acre basin. The 7th Ave S drainage basin contains the highest percentage of industrial land (34 percent) of all of the individual drainage basins that discharge to the LDW. The lower 70 acres of the basin is almost entirely industrial with numerous small and medium-sized businesses. SPU regularly inspects the businesses in this area and a number of sources have been identified and controlled (arsenic, HPAH, and PCBs). However, source controls are often difficult to sustain because of frequent changes in operations and changes in ownership. SPU is currently evaluating treatment technologies for the water quality facility. A number of options are being considered including ballasted sedimentation, chemically-enhanced sand filtration, and dissolved air floatation. The next step will be to pilot test viable treatment technologies in 2016-2017.

The water quality facility is one of the projects included in the Integrated Plan that was approved by EPA and Ecology in 2015 as part of the City's Long-Term Control Plan. See Section 7.11.5 for a discussion of the Integrated Plan. SPU intends to have the pump station constructed by 2018 and the water quality facility constructed by 2024.

7.11.3. South Park Drainage and Roadway Improvements

Accelerating planned drainage and roadway improvements in the South Park neighborhood is one of the Action Plan items included in SPU's 2015-2020 Strategic Business Plan (see: http://www.seattle.gov/util/aboutus/management/director/strategicbusinessplan/). This work is needed to reduce flooding in the area. However, the proposed street improvements will also improve stormwater quality and reduce loading to the South Park Water Quality Facility described above. SPU is currently working with SDOT to develop partnering agreements.

7.11.4. T117 Early Action Site – Adjacent Streets Drainage Improvements

The streets adjacent to Terminal 117 are contaminated with PCBs from a historical asphalt manufacturing facility. Cleanup, which includes removal of contaminated soil, restoration of the

existing streets, and installation of a stormwater collection and treatment system, began in July 2015 and is scheduled to be completed by July 2016. Work is being conducted as part of an early action area cleanup under the LDW Superfund project. Runoff from this area previously discharged untreated to the LDW. The proposed treatment system includes a combination of bioretention cells and Filterra® tree box units with a single outfall to the waterway across the north end of Terminal 117. The treatment system has been designed in accordance with City Stormwater Code and associated stormwater manuals/Directors' Rules. Additional information about T117 is provided in Appendix D.

7.11.5. INTEGRATED PLAN

In 2013, SPU negotiated a Consent Decree (CD) with EPA and Ecology for SPU's Combined Sewer Overflow Reduction Program, that allows SPU to propose an Integrated Plan for implementing stormwater control projects, integrated with CSO reduction projects as part of SPU's Long-Term Control Plan (LTCP). Stormwater water quality projects must result in significant benefits to water quality beyond those that would be achieved by the CSO projects to be deferred. Specific requirements of the Integrated Plan include:

- Stormwater water quality project(s) shall be in addition to all CSO control measures required in the LTCP. However, the schedule for completing the CSO projects that will be deferred may extend beyond the 2025 deadline.
- Must include a schedule constructing the stormwater projects and the deferred CSO control measures that will be completed after 2025.
- Must include a plan and schedule for post-construction monitoring as well as a public participation plan for developing and implementing the water quality projects/actions.

The Integrated Plan was included in SPU's Plan to Protect Seattle's Waterways Plan that was approved by EPA and Ecology in 2015. It identifies stormwater projects that will be completed by 2025, in addition to the Long Term Control Plan CSO reduction projects that will be completed by 2025 and those CSO reduction projects to be deferred until after 2025 based on the benefits of implementing the stormwater projects sooner.

The following stormwater projects located in the LDW drainage basins will be implemented as part of the Integrated Plan:

- South Park Water Quality Facility. The project is an end-of-pipe treatment system that would be sized to treat about 80 percent of the average annual runoff from the 232-acre basin to remove total suspended solids and other particulate-bound pollutants.
- Street sweeping expansion arterials. This project mainly involves increasing sweeping frequency on the arterials that are currently being swept from every two weeks to every week. In addition, a few arterials that are not currently swept would also be added. Current street sweeping routes in the LDW are shown on Map 77.

7.11.6. 5-YEAR PLAN

As part of this 5-year plan SPU is emphasizing coordination with other City departments and other agencies to identify opportunities for implementation of City-owned MS4 capital improvements in the LDW basins when other departments are conducting work. SPU will be engaging the others thru the mechanisms described in Section 7.14 of this plan to identify potential opportunities early in the process so that if feasible and funding is available, infrastructure maintenance, capital improvements or water quality improvements can be included. To the extent possible, the basin prioritization determined through the source tracing/sampling program will guide where the City will evaluate future Capital Improvements in the City-owned MS4.

7.12. CITY-OWNED PROPERTY AND RIGHT-OF-WAY

Excluding the rights-of-way (ROW), the City owns approximately 2,185 acres of land in the LDW, most of which is managed by the Department of Finance and Administrative Services (FAS), although various City Departments (e.g., Seattle Public Utilities, Seattle Department of Transportation, Seattle City Light, Seattle Fire Department, and Seattle Parks Department) utilize these properties. City-owned parcels and rights-of-way within the LDW separated storm and combined sewer overflow basins are shown on Map 79.

All City departments implement pollution prevention/source control practices in accordance with Seattle's Source Control Manual[33]. City owned properties are ranked using the same process as established for other businesses. City properties are then scheduled for a business inspection using this ranking system rotation (i.e., every 2 years for high, every 4 years for medium, and every 6 years for low) and are inspected using the same form as private businesses. An internal compliance process is available for City owned facilities with compliance issues. See Section 4.2.4 for a description of ranking and inspection processes and Section 7.9.3 for a description of citywide source control requirements. Facilities that are required to maintain a stormwater pollution prevention plan are listed in Table 17.

Table 17: City-owned facilities with SWPPPs in LDW.

Facility	Department	Address	Drainage Basin
Operation Control Center	SPU	2700 Airport Wy S	Diagonal Ave S CSO/SD drainage basin, combined sewer
South Service Center	SCL	3613 4th Ave S	Diagonal Ave S CSO/SD drainage basin, combined sewer
Sunny Jim Sign Shops	SDOT	4200 Airport Wy S	Diagonal Ave S CSO/SD drainage basin
Jefferson Park Horticulture	Parks	3801 Beacon Ave S	Diagonal Ave S CSO/SD drainage basin

7.12.1. DISCOVERING AND REPORTING CONTAMINATION

Environmental issues affecting City-owned property or the ROW are typically discovered as part of a capital project when site conditions are assessed and options for disposing excavated material are evaluated, or when contaminants are encountered unexpectedly during construction. When the City discovers contamination either on City-owned property or on projects located within the public right-of-way, Ecology is notified as required under the Model Toxics Control Act. Notifications are submitted to Ecology by the individual City department conducting the work. The City will also notify Ecology's designated source control manager (as identified by Ecology).

Map 82 shows the 153 sites in the LDW that are included on Ecology's list of confirmed and suspected contaminated sites (CSCSL, Ecology 2015). Sites are listed when available data indicate that hazardous substances are present in groundwater, surface water, soil, sediment, and/or air associated with the site. Sites are generally reported to Ecology by residents or by business owners and operators. Once listed, a site undergoes a site hazard assessment (SHA) to confirm the presence of hazardous substances and to determine the relative risk the site poses to human health and the environment. Information from the SHA is then used to develop a Washington

[33] Seattle Source Control Manual available at: http://www.seattle.gov/dpd/codesrules/codes/stormwater/default.htm

Ranking Method (WARM) score. Sites are given a score of 1 to 5 that represents the level of risk (1 being the highest).

Seventeen of the 153 listed sites are on city-owned property. Current WARM ranking and status of these sites are summarized in Table 18. Eleven of the City properties have been ranked and six received the lowest ranking (5). The South Park Landfill has a 2 ranking. Ecology is currently working to rank the CSCSL sites that are located within the LDW study area.

Table 18: City-owned properties on Ecology's confirmed and suspected site list.

Site Name	Site Address	City Department	State WARM Ranking	Status
Seattle Parks Colman School	1515 24th Ave S	Seattle Parks and Recreation	Not ranked	No action to date
Puget Park	16th Ave SW and SW Edmunds St	Seattle Parks and Recreation	4	Cleanup started
Seattle Charles St Ken Station	1030 7th Ave S	Finance and Administration	Not ranked	Cleanup started
Seattle Public Utilities Operations and Control Center	2700 Airport Wy S	Seattle Public Utilities	5	Cleanup started
Seattle Public Utilities spoils yard	5821 1st Ave S	Georgetown LLC[a]	5	Awaiting cleanup
Seattle Public Utilities SW Barton water	3816 SW Barton St	Seattle Public Utilities	Not ranked	Cleanup started
Seattle City Hillman Shops	5952 Rainier Ave S	Finance and Administration	3	Cleanup started
Seattle Fire Station #6	405 Martin Luther King Jr. Wy S	Finance and Administration	Not ranked	Cleanup started
Seattle Fire Station #14	3224 4th Ave S	Finance and Administration	5	Cleanup started
Seattle SDOT Sunny Jim site	4200 Airport Wy S	Finance and Administration	4	No action to date
640 S Riverside Drive property	640 S Riverside Dr	Seattle Public Utilities	Not ranked	Interim cleanup completed
Seattle City Light 4th Ave S site	3814 4th Ave S	Seattle City Light	5	Awaiting cleanup
Seattle City Light South Service Center	3613 4th Ave S	Seattle City Light	5	Cleanup started
Seattle City Light Georgetown Steam Plant	7370 E Marginal Wy S	Seattle City Light	5	Interim cleanup completed
South Park Landfill	8200 2nd Ave S	Seattle Public Utilities	2	Cleanup started[c]
South Seattle Transfer Station (South Park	8100 2nd Ave S	Seattle Public Utilities	Not ranked	Cleanup started[c]

Site Name	Site Address	City Department	State WARM Ranking	Status
Landfill)[b]				
Seattle West Maintenance Headquarters	9200 8th Ave SW	Finance and Administration	4	Cleanup started

a. SPU has leased this property to Georgetown LLC since 2006 for temporary storage of materials used in or excavated from SPU construction sites.
b. Transfer station is part of the South Park landfill cleanup.
c. Interim action has started on the landfill site. Remedial investigation/feasibility study is underway for the transfer station parcel.

In addition to the properties listed in Table 18, there are four listed sites where SPU sampling has confirmed that soil in the ROW has been found to contain hazardous materials (Table 19). Three of these four sites appear to be associated with activities at adjacent parcels because 1) contaminants present in the ROW are the same as the contaminants found on the adjacent property and 2) contaminant concentrations are higher on the adjacent property indicating that contamination originated on the property and not in the ROW. Source tracing data collected by SPU that documents the offsite transport of contamination from these sites has been provided to Ecology for these three properties. There may be other listed sites that have affected the adjacent ROW, but this type of information is not included in Ecology's confirmed and suspected contaminated sites list.

The fourth ROW site is located on S Portland St between 5th Ave S and 7th Ave S. This site was identified based on pre-construction sampling conducted as part of the Seattle Department of Transportation's West Duwamish Trail/S Portland St project. A source has not yet been identified for the contamination found on S Portland St.

Table 19: Public right-of-way locations on Ecology's confirmed and suspected contaminated site list as of August 2015.

Street Location	Adjacent Property	Address	State WARM Ranking
S Monroe St east of 5th Ave S	Marine Lumber	Northeast corner of 5th Ave S and S Monroe St	Not ranked
8th Ave S west of E Marginal Wy	Sternoff Metals	7201 E Marginal Wy S	5
S Myrtle St west of E Marginal Wy S	Seattle Iron and Metals, Whitehead Tyee Property, Fox Ave Building	601 S Myrtle St 730 S Myrtle St 6900 Fox Ave S	Not listed Not ranked 1
S Portland St between 5th Ave S and 7th Ave S	None identified	NA	Not ranked
Dallas Ave S, 17th Ave S, S Donovan St	Terminal 117	8700 Dallas Ave	0 (federal Superfund site)

The 23 sites described above are highlighted on Map 82. Information from the CSCSL is provided in Appendix M.

7.12.2. MANAGING CONTAMINATION ON CITY-OWNED PROPERTY

Contamination found on City-owned property often is addressed when the property is redeveloped. In some situations the City remediates its property as an independent cleanup or enters Ecology's Voluntary Cleanup Program (VCP). A few sites are addressed under MTCA orders (e.g., South Park

Landfill and the Georgetown Steam Plant). The City has compiled a great deal of information about City-owned properties in the LDW while responding to EPA's information request (under CERCLA Section 104 [e]). Ecology and the City will meet once a year, starting in 2018, to evaluate the information to identify any sites that may be relevant to LDW source control because they pose a recontamination risk. The City will then coordinate with staff in Ecology's Toxics Program to address the identified sites.

7.12.3. MANAGING CONTAMINATION IN CITY ROW

SDOT and SPU, the two City departments that frequently work in the ROW, follow a similar process for managing contaminated material in the ROW. Material that needs to be excavated for the project (e.g., for utility installation or roadway grading/construction) is tested and disposed in accordance with solid and dangerous waste regulations.

During the design and permitting of public capital projects, project staff refers to Ecology's Facility/Site Database http://www.ecy.wa.gov/fs/ to determine if there is likely contamination in the project area and assesses the risks of the project disturbing contaminated soil. The City will notify Ecology's source control manager prior to start of construction on a public project if the project will take place in an area with known contamination. Testing may occur before the project is advertised for construction if the contamination may be harmful to workers or if it would impact the project scope due to the cost of waste handling and disposal.

If suspected contaminated soils are encountered during the project's excavation work in locations that were not identified during project development, the City or its consultant profiles or designates the waste, as appropriate, then works with a licensed waste disposal facility to safely dispose of the soils and other construction debris. The City follows MTCA reporting requirements when reporting a discovery of previously unknown contamination to Ecology. When unexpected contamination is found during construction, the City will file an ERTS with Ecology and notify Ecology's designated source control manager within 3 business days of encountering suspected contamination. The results from samples collected to characterize the material for disposal will be provided to Ecology's designated source control manager when received from the analytical laboratory.

The City is working to update the Standard Specifications for Road, Bridge and Municipal Construction to require collection and analyzation analysis of contaminated soil samples from the sidewalls and bottom of the limits of excavation for reporting to Ecology in cases where previously unknown contamination that is subject to MTCA reporting requirements is discovered during excavation. The update and implementation of the new sample collection requirements will be implemented by 2018.

7.12.4. CITY PERMITTING OF CLEANUP IN THE ROW AND ECOLOGY COORDINATION

The City is committed to working with Ecology to identify coordination mechanisms to ensure contaminated soil remediation activities in the ROW are permitted and conditioned to protect the environment, the City's infrastructure, mobility, and public access during and after the cleanup. In addition, the Street Use Division of SDOT is developing a Business Procedure for permitting cleanup of contaminated soils in the ROW. This document should be finalized in 2016.

SDOT's Street Use Division issues permits for any work in the ROW, including cleanup of contaminated soils. Applicants must submit an application for a Street Use permit and place a review deposit to begin the process and cover the costs of reviewing the application and supporting materials. The application includes, but is not limited to, a site plan of the area of excavation, shoring plan, soil and groundwater testing reports, and traffic control plan. SDOT follows their existing review and conditioning process to permit the project in a manner that protects the environment, the City's infrastructure, mobility, and public access during and after the project.

For a site being addressed under an order or decree that has hazardous substance which is located in a roadway, Ecology will require the PLP to notify SDOT's Stormwater Program Manager. The potential liable party (PLP) will be required to consult with SDOT on remedial action alternatives for the roadway. As part of that consultation and during the Street Use permit review process, SDOT Street Use will consult with the SDOT Stormwater Program Manager to determine the scope of the cleanup and condition the Street Use permit to protect the City's infrastructure, mobility, and public access.

For sites where a hazardous substance is located in a roadway being addressed under Ecology's Voluntary Cleanup Program, Ecology will consult with the City to determine the most appropriate way to address the City's concerns regarding the proposed remedial action design for the ROW. If the City is concerned about a particular site in Ecology's Voluntary Cleanup Program, the City will contact Ecology's source control manager.

The City is committed to continued discussions with Ecology on notification protocol, responsibilities of PLP in the right-of-way, and processes and tracking of contamination and clean-ups in the ROW and other topics that arise during the implementation of the SCIP. The outcome of these discussions will be included in future versions of the SCIP.

7.13. PUBLIC OUTREACH AND EDUCATION

Ecology leads the overall public outreach for LDW source control strategy. The City provides education and outreach on stormwater pollution prevention citywide as part of its NPDES Phase I Municipal Permit compliance. Information on these programs can be found in the City's Stormwater Management Plan at:

http://www.seattle.gov/util/MyServices/DrainageSewer/AbouttheDrainageSewerSystem/StormwaterManagementPlan/index.htm

Specific outreach efforts led by City that are focused on the LDW are described below.

7.13.1. AUTO MAINTENANCE PROGRAM

The Automotive Maintenance program educates the general public about BMPs for pollutant source control and storage of products related to vehicle maintenance. AMP educates residents about the impacts of vehicle fluids on stormwater quality through continued training programs and a targeted media outreach campaign. Outreach activities focused on raising awareness about car maintenance BMPs through posters, brochures, and social media. Posters and brochures also were translated into Chinese, Vietnamese, Spanish, and Amharic languages and these materials were distributed to 13 Department of Neighborhoods (DON) Service Centers and Seattle Parks and Recreation Community Centers throughout the city as well as 1,500 private businesses.

In 2014, the City participated in STORM (Stormwater Outreach for Regional Municipalities), which is applying the tools SPU created in the Auto Maintenance Program Puget Sound wide in a program called the Vehicle Leaks Campaign. The program will help educate about, and repair automotive leaks that can impact stormwater discharges into the LDW.

7.13.2. NATURAL SOIL BUILDING

The Natural Soil Building Program (NSB) is supported by SPU Solid Waste and Water Supply funding as well as SPU Drainage funding and the Local Hazardous Waste Management Program in King County. The NSB Program has two components: the Master Composter Soil Builder (MCSB) volunteer training and outreach program, and the Garden Hotline (which answers phone and email requests, and also conducts classes especially for underserved and ESL audiences). The NSB program provides outreach and education on Natural Yard Care (including pesticide and fertilizer reduction) and also on RainWise techniques (LID and GSI) for the general public, residents, property owners and landscape professionals.

In 2014 the Master Composter Soil Builder program conducted two multi-day trainings for volunteers: one in the Spring for a diverse group of English-speaking MCSB volunteers, one in summer for multi-ethnic at-risk youth in collaboration with Safe Futures Youth Center in SW Seattle, and one in early fall for diverse low-income young volunteers participating in the Seattle Youth Garden Works program who will be doing outreach with future low-income participants. The newly trained volunteers joined the existing volunteer cadre in completing 959 hours of outreach and making 13,210 customer contacts on Natural Yard Care and RainWise at community events, demonstrations, and classes around Seattle. Seattle anticipates that this program will continue to educate residents in neighborhoods in and around the LDW about proper BMPs for reducing the impacts of pesticides and other contaminants associated with landscaping on stormwater.

7.13.3. 2013 SPU Website Upgrade

SPU completely re-vamped its source control website in 2013. The website now contains information about SPU's business inspection, source tracing, and line cleaning programs, as well as providing links to programs and opportunities for Seattle residents to engage in pollution reduction efforts (e.g., auto maintenance program, tips on reducing household hazardous wastes and where they can be disposed of, and provides information on how to report a water quality problem). The website also provides links to all of SPU's LDW source control progress reports. The website can be found at:

http://www.seattle.gov/util/MyServices/DrainageSewer/PollutionControl/LowerDuwamishWaterway/index.htm

7.13.4. Seattle Channel

The City of Seattle works to educate people about the City's source control program and to encourage them to take action to protect the Lower Duwamish Waterway. In 2013, SPU worked with the Seattle Channel to produce a broadcast story about the City's source control program, highlighting the importance of keeping pollution out of storm drains. This effort resulted in a short video that SPU posted on its website. SPU has also worked with a number of other local news media to highlight the City's pollution prevention efforts. The Seattle Channel aired a piece on the Duwamish for City Inside/Out, a program on the Seattle Channel that highlights interesting things about Seattle. The video covered the City's source control program in the LDW, Early Action cleanups, focusing on the Terminal 117 cleanup that is currently underway, and Bluefield Holdings' habitat restoration efforts on City properties. It can be viewed at: http://www.seattlechannel.org/videos/?videoid=x31231

Over the next five years, the City will continue to work with local news media to inform the community about the LDW cleanup and the City's ongoing efforts in the LDW and encourage residents to reduce pollution from their day-to-day activities.

7.13.5. Stakeholder Updates

Seattle regularly participates and will continue to participate in meetings to update stakeholders on source control activities. Ecology typically arranges these meetings. Meeting frequency has declined over the past few years due to Ecology resources and because stakeholder attendance had declined. Meetings are now held about once a year and the format has been changed to allow each member of the Source Control Work Group (i.e., EPA, Ecology, City of Seattle, King County, and Port of Seattle) to provide a brief status update. Stakeholders appear to like the new format, but work group members continue to outnumber the stakeholders in attendance. Perhaps this will change as cleanup approaches, but it appears that a new approach is needed to engage stakeholders and the public about source control. SPU will be working with Ecology and the other agencies involved in LDW source control efforts to identify how best to engage stakeholders about source control as it is anticipated that this will be part of Ecology's LDW Source Control Program

7.14. INTERDEPARTMENTAL COORDINATION

City departments (e.g., SPU, SCL, SDOT, SDCI) routinely coordinate on projects that affect each other's infrastructure and share in reviewing applications for private projects that involve work in the right-of-way or otherwise affect City infrastructure. The following sections describe the coordination mechanisms currently in place.

7.14.1. DRAINAGE PLAN/PERMIT REVIEW

Seattle reviews project applications, issues permits for public and private new development and redevelopment projects that involve more than 750 feet square feet of land disturbing activity, and inspects permitted projects during construction. Several City departments share responsibility for review, permitting, and inspection activities, based on the type of permit required. Responsible departments include:

- Seattle Department of Construction and Inspection (SDCI)
- Seattle Department of Transportation (SDOT)
- Seattle Public Utilities (SPU).

Table 20 summarizes the roles and responsibilities for City departments in permitting and enforcing City requirements for new development and redevelopment projects.

Table 20: City permitting responsibilities.

Permits	Responsible Department	Roles
Projects outside the public right-of way (ROW): ▪ Parcel-based projects, including private development and public projects (Parks Dept., SPU, City Light, etc.) ▪ Trail projects ▪ Single-family residential projects	SDCI	Drainage review, permit issuance, inspection
Projects in the ROW: ▪ Roadway projects ▪ Sidewalk projects ▪ ROW-use projects (e.g., material storage or tree planting)	SDOT	Permit issuance, inspection
▪ Utility projects in the ROW	SPU	Drainage review
Joint roadway and parcel-based projects	Project thresholds apply individually as noted above to each portion of the project,	

The following flow charts describe the processes within departments for project review, permit issuance, field inspection, and tracking activities (Figure 20, Figure 21, and Figure 22)

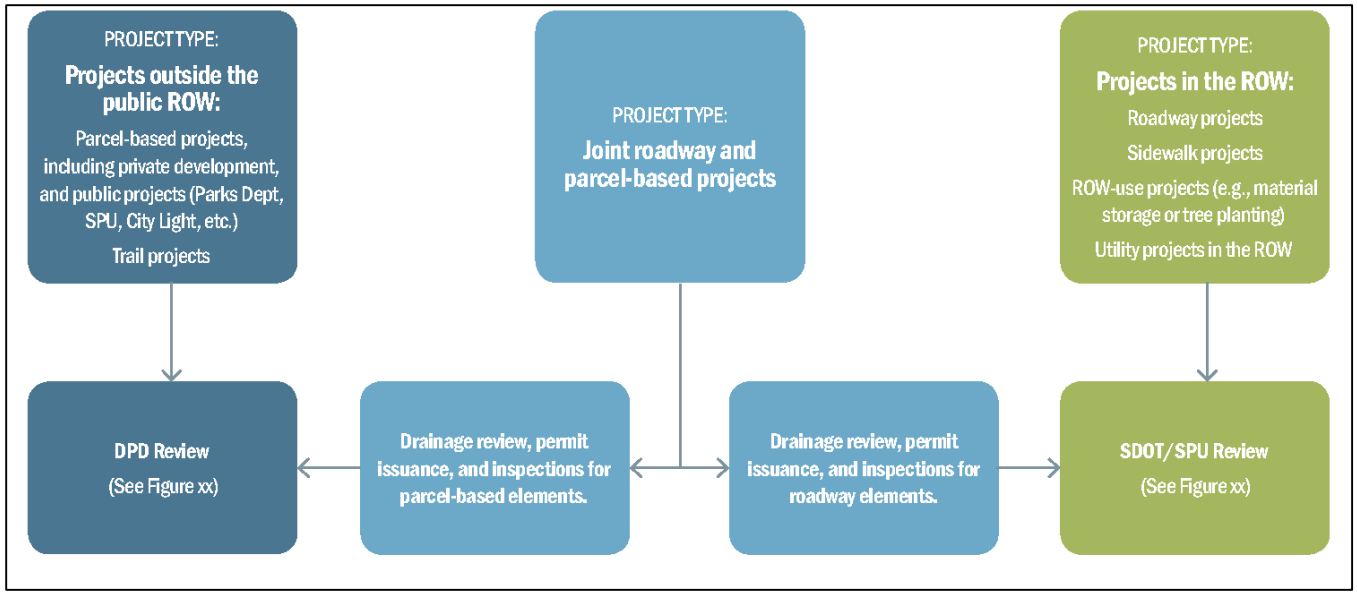


Figure 20: City departments involved in plan review.

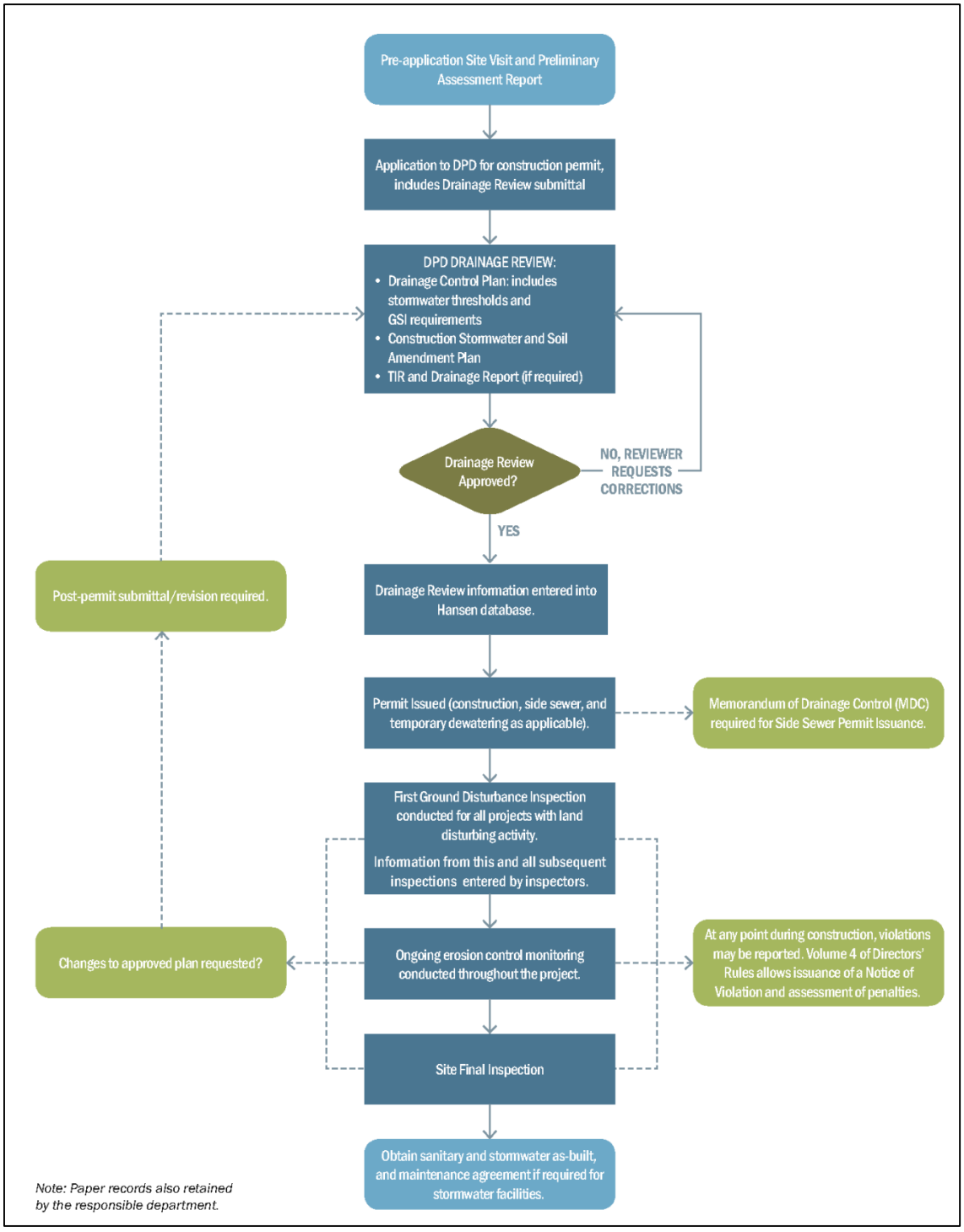


Figure 21: SDCI plan review process.

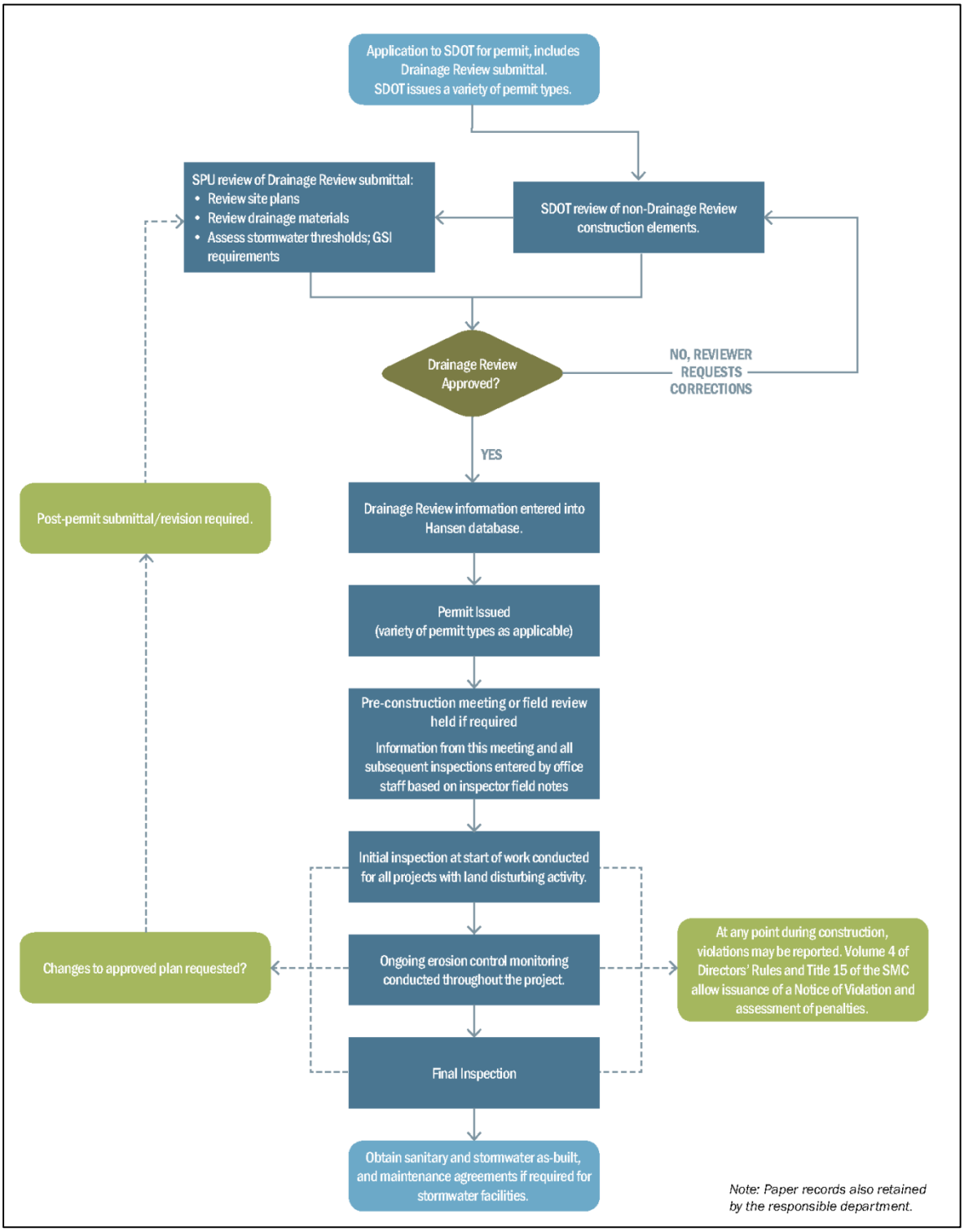


Figure 22: SDOT plan review process.

Potential Future Improvements

SPU Business Inspectors occasionally find that structural source controls (e.g., secondary containment for chemical storage tanks, roofing or other covering over outdoor activities, and

dumpsters, trash compactors, or other large waste containers located near an existing catch basin) are lacking or inadequate at businesses in the LDW. Retrofitting sites to incorporate structural controls can be expensive. To avoid costly retrofits, it is important that the need for such controls be identified when sites are redeveloped so that structural controls can be incorporated into the overall site design. While many source control problems could be avoided, they are often not discovered until after construction when the site is inspected by the Source Control Team, because the Plan Reviewer focuses on ensuring that the proposed project meets City code (e.g., building and stormwater codes) and is usually unaware of the intended site use. Modifications to the plan review process are needed to correct this problem. The Source Control Team has been and will continue to work with SDCI to incorporate changes to more effectively identify the need for structural controls early during the plan review process.

7.14.2. NPDES COORDINATION

SPU is the lead department for coordinating Permit and municipal stormwater related activities among City departments, as designated by a mayoral Executive Order dated January 29, 2008. SPU leads inter-departmental meetings to coordinate the City's stormwater management and Permit reporting efforts. These meetings are typically held quarterly, and have enabled the different departments to better coordinate stormwater-related policies, programs, and projects.

SPU represents the City at the Phase I Regional Permit Coordinators' Group, which meets to coordinate and discuss implementation of the Permit and coordination of stormwater management activities for shared waterbodies. In addition, the group discusses stormwater related issues; shares permit implementation information and identify solutions and potential future issues. SPU has established external coordination mechanisms with King County, University of Washington and Seattle Public Schools and is coordinating with other Permittees and Secondary Permittees for shared waterbodies.

7.14.3. INTERDEPARTMENTAL TEAM FOR DEVELOPMENT PROJECTS

Interdepartmental teams are typically assembled to work on large public and private capital projects (e.g., Alaskan Wy viaduct and seawall improvements, Sound Transit, University of Washington development projects) to assist developers in navigating the City permitting process, as well as to work together to ensure that all departments' needs are met. These teams meet regularly throughout the project to coordinate on design issues.

7.14.4. SPU PROJECT SWITCHBOARD

Initiated in 2010, the project switchboard enables SPU to track emerging projects led by other agencies/departments to allow SPU management to decide whether to participate on these efforts, and to position SPU to provide the lead departments with the necessary input during project design review and/or construction. SPU staff regularly communicates with other departments to determine what projects are on the horizon and at a very high level, evaluate the potential impacts and opportunities associated with each project. This information is distributed to SPU line of business directors and managers who decide how best for SPU to engage. The Switchboard operates as needed based upon input and project timelines from other agencies/departments. SPU anticipates continuing the Switchboard over the next 5-years.

7.14.5. INTERDEPARTMENTAL TEAM FOR COORDINATED INFRASTRUCTURE

Initiated two years ago, this interdepartmental team comprised of planners and project managers from SDCI, SDOT, SPU, and Seattle City Light (SCL), meets each quarter to share information about upcoming capital projects and long-term planning activities. Because each department has different funding sources and different planning horizons, the City recognized that more coordination was needed to allow departments to take advantage of opportunities afforded by work

planned by other departments and to determine how best to work together on projects that affect each other's infrastructure. For example, SDOT conducts major transportation projects through its Bridging the Gap initiative, which typically involve major construction work on arterials where other departments like SPU and SCL own and operate utilities. Sharing information during project planning, allows SPU the time needed to develop hydrologic and/or hydraulic models to evaluate drainage and wastewater needs so the necessary improvements can be designed and constructed in conjunction with planned transportation projects. Synchronizing projects and schedules between departments can result in significant cost savings. This team meets quarterly and SPU anticipates continuing to participate over the next 5-years.

7.14.6. STORMWATER CODE COORDINATION

SPU helps interpret and provide guidance to other City departments on Stormwater Code compliance issues. SPU staff provides support on new code development (e.g., upcoming revisions to the Stormwater Code) and implementation. They also supports SPU engineers and project managers to ensure that SPU capital projects comply with the code and regularly works with the SPU Source Control Team to aid in interpreting the code and working with SDCI when departmental authorities overlap on source control issues.

7.15. AGENCY COORDINATION

7.15.1. DUWAMISH INSPECTORS GROUP COORDINATION

In 2008, inspectors working in the Duwamish formed the Duwamish Inspectors Group (DIG). The DIG is made up of staff from Seattle Public Utilities Source Control, King County Industrial Waste, King County Stormwater, Ecology Water Quality, Ecology Toxics Cleanup, Ecology Hazardous Waste, and EPA. The group is a forum to coordinate inspection areas, share inspection priorities, discuss multi-media sites that may involve several agencies and share information regarding cross agency referrals of problems found during inspections. The group currently meets quarterly.

The City anticipates that DIG will continue to meet over the next five years and intends to participate in these group coordination activities.

7.15.2. LOWER DUWAMISH SOURCE CONTROL GROUP

SPU participates in monthly meetings with EPA, Ecology, King County, and the Port of Seattle to discuss issues and coordinate source control activities. The group, which is led by Ecology, has been meeting monthly since about 2004. SPU provides updates of inspection activities each month and provides an annual summary of source tracing progress.

SPU intends to continue participating on the source control group over the next five years. This group has been successful in coordinating activities, disseminating information about each other's ongoing investigations, and generally keeping LDW source control efforts on track. However, there is always room for improvement. Suggestions include:

- Engaging other resource agencies to participate in the LDW source control program. The LDW Source Control Group has tried, but often failed to gain the support of other agencies like the Puget Sound Clean Air Agency and the local Health Department. Recognizing that these agencies have limited resources and agendas, it is important that all available resources be brought to bear to ensure the long term success of LDW source control efforts.
- Tackling the larger region-wide source control issues that extend well beyond individual municipality and in some cases, even state authorities. Many of these issues (e.g., product management, air emissions from auto-shredding facilities, and mobile vehicle cleaning operations) are difficult to address using existing source control tools.

Expectations for the LDW are high and better tools are needed to realize a significant reduction in loading, particularly for those chemicals that appear to have a regional signature (e.g., PCBs, dioxins/furans, cPAH, and phthalates).

7.15.3. TACKLING REGIONAL ISSUES

One of the operating principles of Source Control is that it is more effective and less expensive to keep pollutants out of stormwater than to treat stormwater to remove pollutants once they are introduced. Moving closer to the source of pollution, it is likewise more effective to keep pollutants out of the products we use than for government to educate and require best management practices to minimize the impact of those pollutants. This last approach is often referred to as "true" source control or green product formulation.

True source control often affects products over a wide geographic region and can be most effective when addressed on a regional, state, or even national level. Although the City of Seattle represents a small geographic region, it represents a large percent of the Washington State population. As such, Seattle's representation in any regional effort can send an important message to product manufacturers about popular sentiment regarding demand for toxic-free products. Seattle is interested both in advancing regional efforts at true source control and in exploring ways to improve information about alternatives to harmful products so that consumers can make informed purchasing choices.

A diverse set of people and skills is useful in a regional coalition addressing true source control, including research, marketing, economics, industrial chemistry, and risk assessment. Likewise, a diverse set of tasks is involved with true source control. Some of those include the following:

- Determining which products would result in the most benefit as the focus of regional "greening" efforts, considering both the impact and the prevalence in use of the product – would result in creating a "dirty dozen" list
- Determining the practicality of making changes either in product formulation or in identifying substitutes for use
- Understanding the target industry and developing an approach that would yield the desired result (e.g., incentives, regulation, and taxation).
- Determining how best to reach a target consumer audience with messages about "smart, green purchasing".

As one of the steps in helping the work of true source control advance, it would be helpful to focus on a limited number of sources of the Contaminants of Concern in the LDW—a "dirty dozen". Seattle sees this effort as being best led by either Ecology or EPA, and would be willing to participate in a workgroup to accomplish this end.

Once a "dirty dozen" list of products is created, it could be helpful to conduct a survey of industries and businesses in the LDW to identify which of the "dirty dozen" products are in widest use. Should the list be formulated within the 5-year planning horizon, Seattle would be willing to begin such a survey, and would be willing to act as the project manager to see that an appropriate scope, schedule and budget are defined. The aggressiveness of the survey work would depend in part on funding resources.

Within the broader, state-wide context, the Governor has laid groundwork for true source control that targets unregulated contaminants like the Contaminant of Concern in the LDW (Office of the Governor 2014). The new approach is coupled with the planned update to Washington State's surface water quality standards for the protection of human health. House and Senate bills (SB 5406 and HB 1472) that would implement the new are part of the 2015 state legislative session, and include new state funding. The proposal involves:

- Developing a list of priority Washington chemicals that are either of high concern for children or are present in fish, wildlife, air, water, soil, or sediment
- Preparation of chemical action plans (CAPs) for the highest priority chemicals
- Implementation of an alternatives assessment to identify and compare potential chemical and non-chemical alternatives that could be used to replace the use of priority chemicals.
- Where a safer alternative exists, based on the alternatives assessment, prohibition of sale, distribution, or use of the chemical.

Seattle supports the Governor's proposal and would like to coordinate with Ecology on how our more LDW-focused ideas outlined earlier in this section might interface with this effort.

Phthalates are an example of a chemical where more innovative approaches are needed to have any success in reducing inputs to the LDW. Phthalates, particularly BEHP and butyl benzyl phthalate are commonly found at concentrations above the SMS screening levels in storm drain solids. These chemicals are present in a wide variety of consumer products and standard source control tools, which have been developed to identify specific hotspots, are ineffective when contaminants are widespread. The Sediment Phthalates Work Group, described in Section 5.2.1, developed a number of recommendations to help address phthalates. The recommendations involve the following general areas of potential action (Floyd | Snider 2007):

- Further study and research to validate the Work Group's findings regarding the problem and identify other contaminants that follow pathways similar to phthalates
- Education of appropriate agencies and the community on the Work Group's findings
- Interaction with Puget Sound Partnership and air agencies to address the air–stormwater–sediment pathway
- Evaluation and implementation (where appropriate) of stormwater source control and treatment options
- Management of phthalate recontamination at cleanup sites through site-specific operation and monitoring plans
- Consideration of a Sediment Management Standard (SMS) rule amendment to address phthalates and other pervasive pollutants
- Coordination with other phthalate risk initiatives
- Development of recommendations regarding plasticized polyvinyl chloride (PVC; (alternatives, building material standards, bans, engagement with plastics industry, incentives, etc.).

Progress has been made on some of the Sediment Phthalate Work Group recommendations. For example, the SMS were revised in 2013 and now include the new concepts of regional background and sediment cleanup units. These new concepts help the management of sediment cleanup and source control in areas where chemicals, such as phthalates, are difficult to control. Nevertheless, these new concepts do not directly address true source control.

The Governor's proposal and related legislative bills provide hope for the long-term control of sediment contaminants such as phthalates, although the process for reducing or eliminating the use of phthalates will likely take many years. In addition, because chemicals such as phthalates are so common in consumer products with long life spans, phthalates will continue to be released to the environment for years after a ban is implemented.

7.15.4. CERCLA COORDINATION

Remedial Design Sampling

Additional sediment sampling will be conducted in the waterway as part of the remedial design for the CERCLA cleanup. The City has two primary roles in this effort in relation to its ongoing source control program:

- Coordinate with the regulatory agencies and parties implementing the sediment remedy to ensure that sediment offshore of City outfalls are adequately characterized.
- Evaluate the sampling results to determine whether any additional source tracing activities are necessary.

If in-waterway surface sediment data are generated over the next five years, SPU will evaluate these data and compare them to City-owned MS4 storm drain solid data to determine whether any additional source tracing or controls are needed in the MS4.

CERCLA Cleanup Schedule and Ecology Source Control Sequencing

The schedule of upcoming CERCLA cleanups is currently unknown. Ecology is developing a sequencing strategy and timeline for source control sufficiency determinations, and Ecology is coordinating directly with EPA to inform the CERCLA schedule.

SPU has always coordinated its source tracing activities with other ongoing Superfund activities (e.g., early action cleanups and Ecology source control area investigations) and fully expects to continue this in the future. Consequently, as the CERCLA cleanup and Source Control timelines are better defined over the next five years, the priorities laid out in this plan may need to change to accommodate that planning.

7.15.5. MTCA COORDINATION IN THE ROW

As identified in Section 7.12, the City is committing to the following coordination with the Ecology Toxic Cleanup Program:

- SDOT will coordinate with Ecology so that cleanup orders issued by Ecology to private parties will include ROW cleanup when contamination in the ROW has migrated from private property or the private property is the source in some way.[34] In these instances, SDOT expects Ecology to issue orders to responsible parties and to work closely with SDOT to ensure responsible party obtains City permits to access the ROW.
- SDOT is committed to coordinating with Ecology to ensure parties doing a cleanup through the Voluntary Cleanup Program (VCP) obtain Street Use Permits as needed to clean up contamination that has extended into the ROW when such work is feasible. To facilitate this coordination, SDOT expects Ecology to notify the City of all voluntary clean-ups where contamination from private parcels may have contributed contamination to the ROW. The City also expects Ecology to require the liable party to sample at cleanup boundaries to ensure the cleanup is complete. The City will make a reasonable attempt to coordinate with private parties during their cleanup activities in the ROW. However, if the City cannot issue a Street Use Permit because it is not feasible for the private party to clean up the contamination in the ROW, the City expects Ecology will not release the liable party from liability for the contamination remaining in the ROW and will not issue an unqualified No Further Action letter for the property

[34] Usually the ROW is owned by the adjacent property owners up to the centerline. Sometimes the private property owners have used the ROW in a manner that released contamination there, such as the location for an underground storage tank that leaked.

adjacent to the ROW unless the liable party executes an agreement with SDOT acknowledging continuing liability for the ROW contamination. Situations that would make cleanup in the ROW infeasible are, for example, where the ROW is a major arterial, the cleanup would require rerouting traffic for an extended period of time, and possible detour routes are insufficient.

- The City MTCA coordination will include working with Ecology to develop a process to exchange information and develop protocols for identification and collaboration around MTCA site cleanups. Part of this process should include an Ecology deliverable to the City each year of active cleanup sites in the LDW so that SDOT can coordinate and issue permits and SDCI will be aware when conducting SEPA review and issuing permits.

8. EFFECTIVENESS EVALUATION

Over the next five years, the City intends to continue refining the tools that have been described and used in this plan to establish priorities for the source control activities and will coordinate with Ecology on the development of approaches that can reasonably evaluate the effectiveness of the City's source control program. Analyses will focus on identifying locations where discharges from City-owned outfalls could contribute to an exceedance of the LDW sediment RALs following cleanup.

As described elsewhere in this plan, the City intends to continue collecting storm drain solids samples to support its source control program and to inform future cleanup decisions. Continued sampling will be used to characterize the quality of storm drain solids discharged to the waterway, as well as to identify new sources that may occur in the future as businesses relocate, industrial and other pollution-generating activities change, and properties redevelop. City sampling efforts will include the following:

- Monitoring of existing sediment traps to characterize the quality of storm drain solids discharged to the LDW
- Establishment of near end-of-pipe sampling stations in City-owned storm drains that are not currently monitored to characterize the quality of storm drain solids discharged to the LDW (see Appendix C)
- Sampling of private onsite catch basins when businesses are inspected
- Sampling of right-of-way catch basins and inline grabs with follow up source tracing where triggers are exceeded
- Resampling storm drains following line cleaning to evaluate whether ongoing sources or new sources that may crop up in the future.

See Section 5.3 for discussion of City's sampling plans.

These data will be evaluated using box plots or other tools as they develop to assess potential changes in storm drain solids chemistry as source control progresses. While, it is anticipated that concentration levels will decline over time, the box plots will also continue to be used to support source tracing efforts by identify differences in chemical signatures between drainage systems that could indicate that these systems are being affected by specific sources.

Storm drain solids data will also be used in conjunction with upcoming waterway sediment sampling conducted as part of remedial design and ongoing cleanup activities. These data will be assessed using the tools described in Appendix J to identify possible linkages between storm drain solids and offshore sediment quality conditions.

9. REPORTING

The City will submit a report to Ecology in conjunction with the City's MS4 permit annual report by March 31 each year describing the status of source control activities. The annual report will 1) document actions taken by the City to minimize the potential for contaminant concentrations to exceed the RALs established for the LDW, 2) identify ongoing efforts and plans to integrate LDW source control priorities into ongoing citywide activities, 3) describe results of source tracing and characterization monitoring efforts in the LDW, and 4) describe the source control actions that the City will be taking during the next reporting period.

It is anticipated that the annual source control report can be tailored after the format of previous NPDES annual reports. The City will work with Ecology over the next year to develop a workable format to streamline reporting efforts so that limited staff resources can focus on implementing the source control plan. At a minimum, a series of summary charts and tables will be submitted to document City actions:

- Numbers of business inspections completed and compliance status
- Notices of Violation and Voluntary Compliance Agreements
- Sites referred to other agencies
- Numbers and locations of spills reported in the LDW drainage basin
- Numbers of source tracing samples with maps and box plots for contaminants of concern
- Comparisons of end-of-pipe source sample chemistry to results from surface sediment samples collected near the outfall.
- Feet of line cleaned and amount of sediment removed
- Miles of street swept and sweeping frequency
- Summaries of site specific investigations
- Summaries of source control effectiveness evaluations and if necessary, descriptions of any changes in priorities for City's source control program
- Status of planned capital projects (e.g., stormwater retrofits, paving and right-of-way improvement projects).

Source tracing and characterization data will also be uploaded to Ecology's EIM database by March 31 each year.

As remedial design and cleanup approaches, and cleanup schedules are developed, progress reports will focus on documenting the status of source controls in specific basins that discharge at or near proposed cleanup sites to support Ecology's sufficiency determinations.

SPU will also continue to submit summaries of inspection and source tracing efforts at the monthly Source Control Work Group meetings.

The City will use the data and information collected during the period of 2015-2019, along with the goals and objectives that Ecology will establish in the LDW Source Control Program associated with implementation of the Select Remedy for LDW, to identify and prioritize actions for the 2020-2025 SCIP. The City will provide Ecology with the next SCIP for approval in 2019 and implementation beginning in 2020.

10. RESOURCES

The City recognizes the need for additional City resources to manage and implement this plan. SPU recently assigned a senior position to work with the existing program manager and planning is underway to distribute the work load between these two staff members. In 2014, SPU also filled a permanent position to support and maintain the EQUIS database, work which was previously performed by a temporary position.

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