

City of Oregon City

625 Center Street Oregon City, OR 97045 503-657-0891

Meeting Agenda City Commission

Dan Holladay, Mayor Brian Shaw, Commission President Nancy Ide, Frank O'Donnell, Renate Mengelberg

Monday, July 17, 2017 5:30 PM Commission Chambers

Work Session - REVISED

1. Convene Work Session and Roll Call

2. Future Agenda Items

The Commission's adopted goals and available staff resources shall be considered when recommending future agenda items. The Commission may add an item to a future agenda with consensus of the Commission.

3. Discussion Items

3a. 17-405 Proposal to Proceed with Submittal of Permits and Construction of the

Annex Building at Mt. Pleasant

<u>Sponsors:</u> Community Development Director Laura Terway

<u>Attachments:</u> Staff Report

Map of Mt. Pleasant Elementary School Annex

Preliminary Plans

3b. <u>17-406</u> Clackamas Cove Water Quality and Habitat Improvement Feasibility

Study

Sponsors: Public Works Director John Lewis

Attachments: Staff Report

Draft Feasibility Study

3c. <u>17-407</u> Sewer Inflow and Infiltration Abatement Program Update

Sponsors: Public Works Director John Lewis

<u>Attachments:</u> <u>Staff Report</u>

Smoke Testing Technical Memorandum

4. City Manager's Report

5. Adjournment

Agenda Posted at City Hall, Pioneer Community Center, Library, City Web site.

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City of Oregon City

625 Center Street Oregon City, OR 97045 503-657-0891

Staff Report

File Number: 17-405

Agenda Date: 7/11/2017 Status: Agenda Ready

To: City Commission Agenda #: 3a.

From: Community Development Director Laura Terway

File Type: Report

SUBJECT:

Proposal to Proceed with Submittal of Permits and Construction of the Annex Building at Mt. Pleasant

RECOMMENDED ACTION (Motion):

Staff recommends the Commission provide approval to proceed with submittal of permits and construction of the Annex at Mt. Pleasant.

BACKGROUND:

The Community Development Department office is currently located at 221 Molalla Avenue. As the lease at this location is scheduled to expire in April of 2018, the Building and Planning Divisions received authorization from the City Commission to research the feasibility of relocating to the Annex at Mt. Pleasant. Formally utilized by the Mt. Pleasant Elementary School, the Annex building is located closest to the intersection of Linn Avenue and Warner Parrott Road.

The City purchased the property in January of 2015 and the site is currently underutilized with a Police Department gym, a single office, storage, and large unused spaces. A preliminary engineering study was presented to the City Commission in early 2017 which concluded that the bones of the structure are strong, however construction would be needed to address deferred maintenance and implement tenant improvements to convert a majority of the building to office space. A few months later, the City Commission approved a contract with ZCS Engineering, Inc. to manage the project.

City staff has been working with ZCS Engineering, Inc to develop a rough plan for the Annex at Mt. Pleasant. Enclosed are preliminary designs which would create office space for the Planning and Building Departments while retaining a large gym for the Police Department to support employees with training space and fitness equipment. The proposal will likely be slightly amended as cost estimates are refined.

If the City Commission approves with the proposed direction for the facility, a land use application is expected to be submitted in the next few weeks for a Comprehensive Plan Amendment, Zone Change, and Site Plan and Design Review. The community will have an opportunity to participate in this land use review process to determine compliance with applicable criteria in the Oregon City Municipal Code. If the applications are approved construction is expected to begin late summer/early fall and last 4-5 months.

File Number: 17-405

The project would allow the City to invest in our assets while reducing monthly operating costs for the Community Development Department. The 2017/2019 budget reflected a project cost of \$1,079,000 between the Building and Planning Divisions.

BUDGET IMPACT:

Amount: Estimated \$1,079,000 FY(s): 2015/2017 and 2017/2019

Funding Source: Departmental Budgets and General Fund

Mt. Pleasant Elementary School Annex



Legend

Taxlots

Taxlots (Outside UGB)

Unimproved ROW

Downtown Design District
City Limits

UGB

Notes

Overview Map

1: 2,400

200

400 Feet

The City of Oregon City makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, surveying or navigation purposes. Notification of any errors is appreciated.

City of Oregon City PO Box 3040 625 Center St Oregon City OR 97045 (503) 657-0891 www.orcity.org

Map created 1/31/2017



Oregon City Community Development Relocation
CONCEPT DESIGN & PROGRAMMING
JUNE 29, 2017



PROJECT SITE

Oregon City Community Development Department TI Aerial Site Plan Scale: NTS

WARNER MILNE ROAD

June 29, 2017





Oregon City Community Development Department TI Site Plan Scale: NTS

June 29, 2017















Northern Entrance



East Facade



Oregon City Community Development Department 71

Existing Exterior Conditions

June 29, 2017

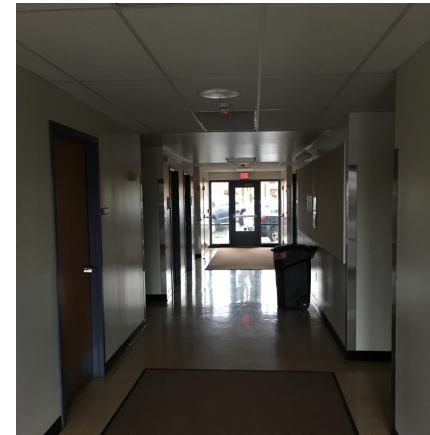




Southeastern Room





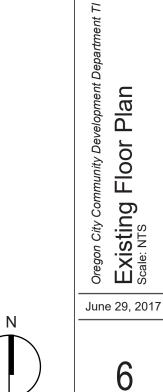


Main Corridor

Oregon City Community Development Department 71

Existing Interior Conditions

June 29, 2017











Oregon City Community Development Department TI Proposed Space Plan

June 29, 2017

Ν





June 29, 2017



Tongue and Groove 4" Wood Paneling Clear Finish



Recessed Lighting Beneath Canopy



Raised Bronze Aluminum Signage (Not Shown)



City of Oregon City

625 Center Street Oregon City, OR 97045 503-657-0891

Staff Report

File Number: 17-406

Agenda Date: 7/11/2017 Status: Agenda Ready

To: City Commission Agenda #: 3b.

From: Public Works Director John Lewis File Type: Report

SUBJECT:

Clackamas Cove Water Quality and Habitat Improvement Feasibility Study

RECOMMENDED ACTION (Motion):

This is to update the City Commission on the Clackamas Cove Water Quality and Habitat Improvement Feasibility Study prepared by Cascade Environmental Group.

BACKGROUND:

John Runyon, a watershed ecologist with Cascade Environmental Group, will be presenting a PowerPoint presentation on the Clackamette Cove Water Quality Habitat Improvement Feasibility Study (Draft). Cascade Environmental Group is under contract with the City to conduct an Environmental Feasibility Study for Clackamette Cove, and the draft report is complete and available for discussion.

The feasibility study identifies potential and feasible projects that would improve water quality and establish habitat restoration in and around Clackamette Cove.

Clackamette Cove Water Quality and Habitat Improvement Feasibility Study

REVIEW DRAFT
December 15, 2016

Prepared By:

Cascade Environmental Group, LLC. Portland, OR Contact: John Runyon



Prepared For:

City of Oregon City, Urban Renewal Commission Contact: Eric Underwood



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Acronyms and Abbreviations

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32	Best Management Practice	ВМР
33	Cascade Environmental Group	Cascade
34	City of Oregon City	City
35	Clackamette Cove	Cove
36	Clackamette Cove Feasibility Study Area	Study Area
37	Clackamas River Basin Council	CRBC
38	Clackamas River Water Providers	CRWP
39	Endangered Species Act	ESA
40	Federal Emergency Management Agency	FEMA
41	Global Positioning System	GPS
42	Greater Oregon City Watershed Council	GOCWC
43	Harmful Algal Blooms	HABs
44	Low-Impact Development	LID
45	Low-Impact Development Approach	LIDA
46	Municipal Separate Storm Sewer System	MS4
47	National Marine Fisheries Service	NMFS
48	National Pollutant Discharge Elimination System	NPDES
49	Natural Resources Damages Assessment	NRDA
50	Natural Resources Overlay District	NROD
51	National Vertical Geodetic Datum	NVGD
52	North American Vertical Datum of 1988	NAVD88
53	Ordinary High Water	OHW
54	Oregon Department of Environmental Quality	DEQ
55	Oregon Department of Fish and Wildlife	ODFW
56	Oregon Health Authority	ОНА
57	Oregon Watershed Enhancement Board	OWEB
58	Polycyclic aromatic hydrocarbons	PAHs
59	Prospective Purchaser Agreement	PPA
60	US Geological Survey	USGS
61	Water Quality and Habitat Improvement Feasibility Study	Feasibility Study

Introduction

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- The City of Oregon City (City) is designing a plan, the "Cove Development Plan", to implement a phased,
- 65 mixed-use development adjacent to Clackamette Cove (Cove), an embayment connected to the
- 66 Clackamas River. In the late summer and early fall of 2015 there was a harmful algal bloom (HAB) in the
- 67 Cove, which prompted the Oregon Health Authority (OHA) to issue a health advisory warning against
- water contact activities in the Cove because toxins produced by HABs are potentially harmful to people.
- 69 Prompted by the implementation of the Cove Development Plan, the City is evaluating the Cove's
- 70 interrelated natural resources issues with a focus on water quality, algal blooms, and fish and wildlife
- habitat. As part of this effort, the City retained Cascade Environmental Group, LLC. (Cascade) to conduct
- 72 a Water Quality and Habitat Improvement Feasibility Study (Feasibility Study). The goals of the
- 73 Feasibility Study are to: 1) to characterize the Cove's current natural and built environment in the
- 74 context of historical and current land uses and future recreational, residential, and commercial uses of
- 75 the area; and 2) identify comprehensive and integrated restoration and mitigation approaches to
- 76 prevent or mitigate future HABs, improve water quality, and enhance fish and wildlife habitat.

Clackamette Cove's Regional Setting

- 78 The Cove's expanse of open water and its immediate surrounding area were created by past gravel
- 79 mining and other industrial operations. With its location adjacent to the City's Clackamette Park and
- 80 near the confluence of the Clackamas and Willamette Rivers, the Cove provides regionally important fish
- and wildlife habitat and recreational amenities. A network of trails, parks, and natural areas connects
- 82 the Cove to the surrounding landscape and natural areas (Figure 1). A popular pedestrian/bicycle trail
- 83 generally parallels the east side of the Cove and connects Main Street to Washington Street,
- approximately one mile to the north. This trail links the City to the Clackamas River, provides a
- connection to the City of Gladstone, and provides access to a regional network of trails, parks, and
- 86 natural areas.
- 87 The Clackamas River provides important fish habitat and water resources. The river, which has some of
- 88 the healthiest native fish populations in the Willamette Basin, provides critical habitat for salmon and
- 89 steelhead, which are listed under the federal Endangered Species Act (ESA). The Willamette-Clackamas
- 90 river confluence area is recognized by the State of Oregon and federal agencies as important habitat for
- 91 salmon, steelhead, and other native fish populations, including Pacific lamprey. Maintaining water
- 92 quality in the Clackamas River is also important; the river supplies high-quality drinking water to nearly
- 93 400,000 people in the Portland Metropolitan region, including supplying drinking water to the City¹.
- 94 The Cove is located within an area encompassing lower Willamette River tributaries that collectively are
- part of a regional planning effort focused on improving water quality and native fish populations. The
- 96 Clackamas River Basin Council (CRBC) is collaborating with the Greater Oregon City Watershed Council
- 97 (GOCWC), the Oregon Watershed Enhancement Board (OWEB), the Oregon Departments of Fish and

¹ Clackamas River Water Providers (CRWP). 2016. The Clackamas River Watershed. CRWP, the City of Oregon City, OR. http://www.clackamasproviders.org/images/stories/Watershed Poster Final.pdf

98 Wildlife (ODFW) and Environmental Quality (DEQ), Clackamas County, Metro, and other partners to

99 develop a comprehensive strategy and funding framework for pursuing habitat restoration and water

100 quality improvements throughout the Clackamas River Basin and the surrounding metropolitan area.

101 Within the City, this strategic planning area encompasses the Cove, Abernethy Creek, and the

102 Willamette River from its confluence with the Clackamas River up to Willamette Falls.

The Clackamette Cove Development Plan

With their scenic location and proximity to transportation, shopping, and recreational amenities, the 104

105 undeveloped parcels adjacent to the Cove are attractive for mixed-use development. After many years

of planning, the City is partnering with a private developer to embark on a plan to design and implement

107 an ambitious multi-phased development, the Cove Development Plan, on these parcels. The purpose of 108

the Cove Development Plan is to "create an exciting new master-planned mixed-use waterfront village

that will connect developed areas with open spaces through a network of multi-modal pathways, trails,

and a waterfront esplanade"². The proposed development is located adjacent to the Cove on

111 challenging sites within the City's Urban Renewal District and will be constructed in phases over time.

112 Located next to the former Rossman Landfill and within an area of past industrial land uses, the Cove

113 Development Plan area currently is assessed at a negative value, meaning it is estimated that it would

take more money than the parcels are worth to develop them. Recognizing the "substantial cost of

115 correcting the defects in the project site and the substantial cost of building the streets, utilities, and

public amenities to create a financially viable project," the Oregon City Urban Renewal Commission has 116

agreed to reimburse the developer for a portion of the development costs after the completion of the

118 project elements.

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119 Since portions of the Cove Development Project are within the Federal Emergency Management

120 Agency's (FEMA) 100-year base flood elevation, all fill material for construction will be sourced from

121 within the 100-year floodplain. Proposed grading activities will not occur below the ordinary high water

(OHW) line of the Cove [18 feet (NAVD88)]³ and no fill will be placed within the floodway. Sourcing all fill

123 material from within the floodplain will result in balanced cut and fill within the City's Flood

124 Management Overlay District to ensure that the Cove Development Project does not reduce flood

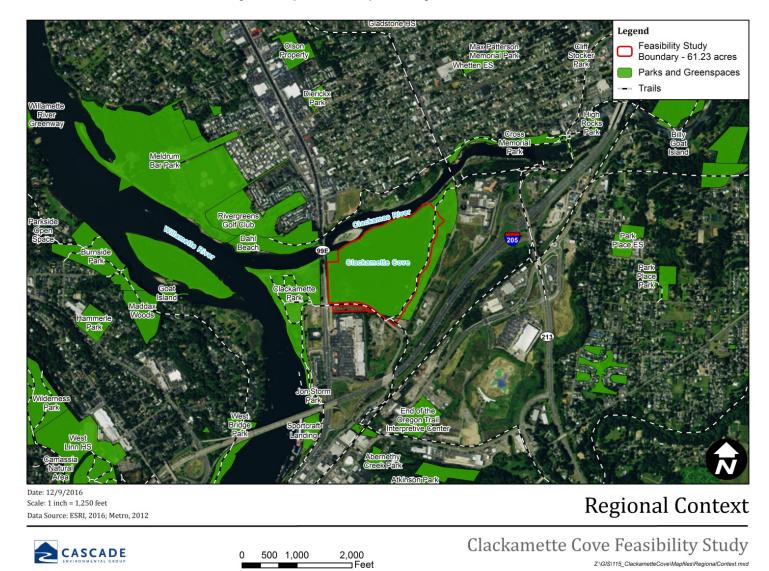
125 storage capacity.

² **Grand Cove, LLC. 2015.** The Cove, Oregon City, Oregon: An Application for Amended Concept Development Plan. Grand Cove, LLC, Denver, CO.

http://www.orcity.org/sites/default/files/fileattachments/planning/project/6059/exhibit a revised narrative 1.p

³ Pacific Habitat Services, Inc. 2015. Natural Resources Overlay District Report: Garden Apartments Project. Pacific Habitat Services, Inc. Wilsonville, OR. http://www.orcity.org/planning/project/cp-15-0001-dp-15-0001-nr-15-0005- <u>us-15-0006</u>

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- 129 The Cove Development Plan's Phase 1 development site is located along the north end of Main Street
- behind the Oregon City Shopping Center and across Main Street from the Cove (Figure 2). Construction
- of Phase 1 began in the summer of 2016 with a mass grading effort to prepare the site for development.
- 132 This work will be followed by construction of a multi-family mixed-use complex (Garden Apartments),
- stormwater treatment and conveyance facilities, and other infrastructure⁴.
- 134 Ultimate constructed grades for all buildings in the area require finished floor elevations at
- approximately 53 feet or greater in order to be above the 100-year base flood elevation. An area in the
- north-east portion of the site (the North Park site) is being excavated to provide fill and balance
- 137 floodplain storage for the Garden Apartment project and to bring portions of the North Park site to its
- final design grade for development of park areas and an amphitheater (Figure 2).
- The Phase 2 development site, which has not gained the City's final approval, will include multi-story
- residential, commercial, and restaurant spaces along the Cove's eastern edge (Figure 2) and will feature
- views of the Cove. The project will require balancing fill and floodplain storage capacity, and includes
- infrastructure improvements such as parking areas and stormwater treatment facilities. This phase will
- also provide additional public access to the Cove. Some grading will take place along the bank of the
- 144 Cove, but the exact locations and fill removal quantities have not yet been determined. The trail
- adjacent to the eastern bank of the Cove will remain.

The Feasibility Study Area

- 147 The Clackamette Cove Feasibility Study Area (Study Area) boundary encompasses 61.23 acres, including
- the open water areas, associated floodplain, and the shoreline of the adjacent Clackamas River (Figure
- 2). The entire Study Area is below FEMA's 100-year base flood elevation (approximately 48 feet
- 150 NAVD88⁵). The Cove's open water and a large portion of the banks that transition into the terraced
- 151 floodplain are below the OHW elevation. The OHW elevation is an approximate boundary between
- aguatic resources and the transition into riparian and upland areas. Areas below OHW are regulated by
- local, state, and federal agencies as aquatic and wetland resources.
- 154 The Study Area is bounded in the north by the Clackamas River and the City of Gladstone; the eastern
- 155 boundary encompasses the transition between the Cove's steep banks and the gently sloping area
- adjacent to the proposed Cove Development Plan's Phase 2 building footprint. The Tri-City Waste Water
- 157 Treatment Plant borders the northeastern portion of the Study Area; the southern border is adjacent to
- 158 Main Street and the nearby Oregon City Shopping Center is south of the area. The Study Area's western
- boundary follows McLaughlin Blvd (Highway 99E) and includes one small parcel south of Main Street,
- adjacent to the Phase 1 development site (Figure 2). A City of Gladstone parcel that includes an
- inoperative pumping station lies adjacent to the Study Area's northwest corner.

⁴ **The City of Oregon City. 2016.** Press Release: Ground Breaking Event – The Grand Cove Project. The City of Oregon City, OR. https://www.orcity.org/citycommission/ground-breaking-event-grand-cove-project

⁵ The North American Vertical Datum of 1988 (NAVD 88) is the vertical control datum of orthometric height established for vertical control surveying in the United States. Oregon City has a design flood elevation (DFE) that was set based on the 1996 flood inundation level, 50.7 feet (NAVD88).

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Date: 12/15/2016 Scale: 1 inch = 400 feet Data Source: Clackamas County, 2016; USGS, 2010

Feasibility Study Area



0 200 400 800 Feet Clackamette Cove Feasibility Study

Z\GIS\115_ClackametteCove\Mapfiles\ProjectAreas.mxd

The Feasibility Study generally focuses on characterizing and evaluating environmental features associated with open water and adjacent floodplain areas, with elevations ranging from below OHW to the 100-year base flood elevation. The Feasibility Study evaluates the current and future Cove Development Plan features that directly affect the Cove's aquatic environment, floodplain habitats, and water quality: bank grading and other activities that impact vegetation and habitats adjacent to the open water area, and stormwater conveyance into the Cove from the new development and surrounding areas. The areas within the Cove Development Plan's building footprint are not characterized in detail because the intent of this study is to evaluate the broad environmental impacts of the development and not the development's site-specific features.

The development's current and proposed site-specific features (e.g., building locations, street design details, etc.) are being evaluated by the City in reference to land use designations and appropriate municipal codes. Most of the Study Area is within the City's Natural Resource Overlay District (NROD), which is intended to protect the Clackamas River, riparian vegetation, wetlands and wildlife habitat, and their associated functions⁶. An NROD assessment that characterizes natural resource areas, wetlands, and vegetated corridor width and condition has been completed for Phase 1⁷. The assessment evaluated tree removal and other impacts within the vegetated corridor as well as the development's consistency with the NROD and assessed potential conflicts with the provisions of the Oregon City Municipal Code. The assessment found that the proposed development largely avoids adverse impacts to NROD resources through minimization and avoidance measures that include:

- Avoiding impacting wetlands or areas below OHW;
- Removing invasive, non-native plant species from the development area;
- Balancing cut and fill within the development area;
- Creating stormwater treatment and conveyance systems that will utilize pervious pavement throughout the site, bioswales within the public right-of-way, and rain gardens in the building area; and
- Leaving the majority of the site as open space or parks to assist with the protection of the aquatic and terrestrial habitat.

The NROD assessment found some unavoidable impacts (primarily tree removal) to the vegetated corridor and outlined required mitigation, which focuses on native vegetation plantings and invasive species removal at a two-to-one ratio of mitigation area to disturbance area.

The Clackamas River is evaluated relative to the Study Area in terms of its influence on the Cove (e.g., hydrology, bank erosion, and the large gravel bar at the Cove's mouth). The City's boundary is located approximately in the center of the river channel; the City does not have jurisdiction over the north bank of the Clackamas River, which is part of the City of Gladstone.

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⁶ **The City of Oregon City. 2016.** Natural Resource Overlay District. Oregon City, OR. http://www.orcity.org/planning/natural-resource-overlay-district-nrod

Pacific Habitat Services, Inc. 2015.

Clackamette Cove's Historical Development

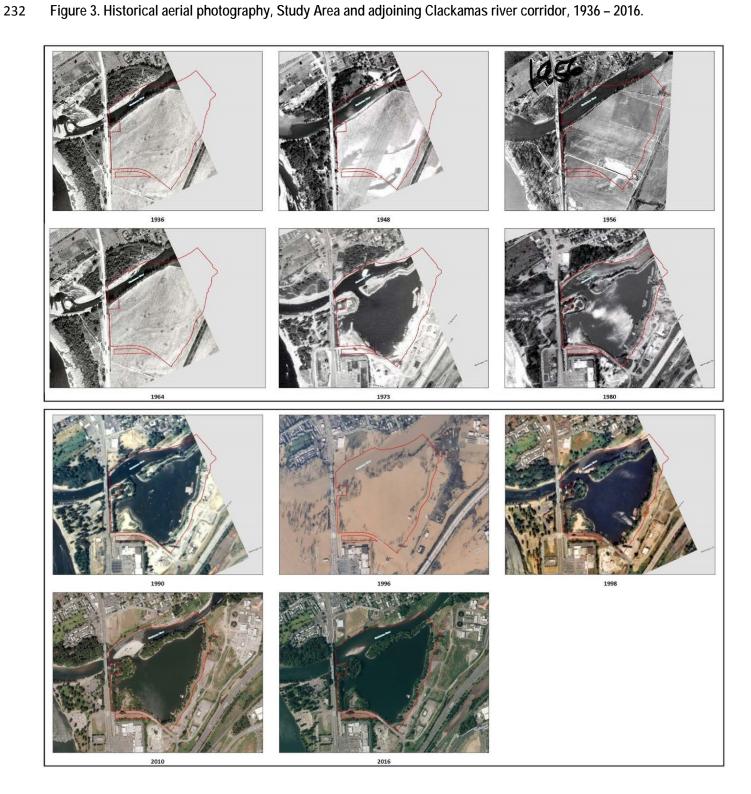
The Cove is part of a dynamic floodplain and river environment that has been modified by land uses, industrial practices, and changes in flood regimes. Historical aerial photography taken between 1936 and 2016 illustrates how the Cove and surrounding river channel and floodplain habitats have changed over time (Figure 3). Sand and gravel mining and other land uses have dramatically altered the landscape of the Willamette-Clackamas river confluence area. The period from the early 1900s through the 1960s was characterized by extensive gravel mining within the river's channels. The 1936 image shows active mining in the Clackamas and Willamette rivers below the Highway 99E Bridge.

The floodplain area that is now occupied by the Cove was used for agricultural production until the mid-1950s when Pit Rock Products began mining sand and gravel and producing concrete and asphalt⁸ at the Cove. In the 1960s a channel was dredged to create a connection between the Cove and the Clackamas River; after its creation, sand and gravel were barged to the Cove for processing and mining at the site ended. The area immediately east of the Study Area was used as a shallow, unlined landfill (Rossman Landfill) from 1960 to 1969. In 1971, the operator, Klineline Sand & Gravel, extended the sand and gravel processing operation from the Cove to this previous landfill property. The entire operation was purchased by Western Pacific Construction Materials in 1972. The property owners declared bankruptcy in late 1986, and a company called Lonestar, Inc. reportedly continued site operations in the area into the early 1990s. These operations ended in 2008 and all associated buildings were then demolished.

Frequent floods would historically inundate the floodplain surrounding the confluence of the Willamette and Clackamas Rivers, including the area now occupied by the Cove. These periodic floods would deposit sand, gravel, and cobbles (also called bedload), creating a shifting network of channels at the confluence of the two rivers. The construction of large flood control dams on upper Willamette Basin tributaries dramatically reduced flooding and decreased the amount of bedload in the system. The Cove and the surrounding floodplain, however, are still subject to flood inundation. Most large floods in the Willamette and Clackamas river basins are a result of rain-on-snow events in which warm rains rapidly melt snowpack. While the Willamette Basin dams can contain a portion of the floodwaters and reduce the magnitude and frequency of floods and associated of downstream impacts, flooding still occurs. The 1964 flood, which predated most of the Willamette Basin dams, was a large, 100-year event. The 1996 flood, the largest flood since 1964, was the result of a large rain-on-snow event in the Willamette and Clackamas river basins. The 1996 flood, which reached an elevation of 50.7 feet (NAVD88) inundated the Cove and surrounding floodplain terrace, Clackamette Park, and much of the surrounding area (Figure 3).

⁸ **Oregon Department of Environmental Quality (DEQ). 2016.** Environmental Cleanup Site Information Database Site Summary Report, Clackamette Cove. DEQ, Portland, OR. http://www.deg.state.or.us/lg/ECSI/ecsidetail.asp?segnbr=2301#siteinfo

Figure 3. Historical aerial photography, Study Area and adjoining Clackamas river corridor, 1936 – 2016.



Clackamette Cove's Natural and Built Environments

The following sections describe the Study Area's environmental setting. The focus is on summarizing the Study Area's current conditions, including topography, shoreline and bank features, Clackamas River channel dynamics, water level fluctuation, vegetation, water quality and HABs, fish and wildlife populations and habitats, and recreation and human access. In addition to summarizing current conditions, issues that should be addressed are identified for each topic. Subsequent sections of the Feasibility Study will describe strategies and approaches to comprehensively address the identified problems.

Topography, Bathymetry, and Water Level Fluctuations

Topography

The Study Area's topography has generally been disturbed by past mining and other activities. Steeply sloped banks created by mining activities separate the open water areas from the floodplain terrace areas (Figure 4). The steep banks lining the Cove transition into a floodplain terrace that is nearly level to gently sloping, with areas of minor topographic relief. Most of the Study Area has been disturbed by past mining and other industrial operations. A geotechnical survey found that much of the floodplain terrace area within Phases 1 and 2 of the Cove Development Plan has been previously filled, with the fill material generally consisting of a mix of silts, sands, gravels, boulders, and debris⁹. Large slabs of concrete and other debris were encountered on the surface and at depth throughout the Study Area.

Photo 1. Clackamette Cove's environment is characterized by steeply sloped banks composed of gravels, cobbles, boulders, and debris from past mining and other industrial land uses.



⁹ **Ash Creek Associates, Inc. 2011.** Geotechnical Assessment Clackamette Cove Development Oregon City, Oregon, Ash Creek Associates, Portland, OR.

https://www.orcity.org/sites/default/files/fileattachments/planning/project/6059/exhibit g.2 geotechnical asses sment_0.pdf

Figure 4. Clackamette Cove's topography and elevations. Note the steeply sloped banks that transition into gently sloping floodplain terrace areas.



CASCADE ENVIRONMENTAL GROUP

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0 200 400 800 Feet Clackamette Cove Feasibility Study

Bathymetric and Topographic Survey

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- A bathymetric survey of the subsurface water elevations was conducted in 2005¹⁰ (Figure 5). Cascade supplemented the previous bathymetric data with a topographic survey during the summer low-flow period (August 2016). The survey recorded precise elevations for a number of features, including shoreline water levels, points along the bank, the transition from the bank to below the water line, and the Clackamas River gravel bar near the mouth of the Cove. The waterline elevation at the time of the
- the Clackamas River gravel bar near the mouth of the Cove. The waterline elevation at the time of the survey was approximately 10 Feet (NAVD88).
- At the water's edge, the Cove's shoreline is characterized by sloped banks that drop steeply into deeper
- water areas. Elevations at the bottom surface of the Cove are variable but generally there are no
- dramatic changes in topographic relief. The lowest elevations lie within the western portion of the Cove.
- 268 Based on water depth measurements taken during the low-flow period, the water depth of the Cove
- varies in concert with the topography identified in the bathymetric survey, with most recorded depths
- 270 ranging between 6 and 12 feet; the deepest recorded depth was 18 feet (Figure 5).

Water Level Fluctuations

- Water depths, and the corresponding waterline elevations along the banks, vary throughout the year in
- response to changes in the flow of the Clackamas River. The river's higher flows in the winter and spring
- correspond to higher water elevations within the Cove. Conversely, the lowest water levels occur during
- the summer and early Fall when river flows are their lowest.
- 276 An understanding of seasonal fluctuations in water levels and how frequently different areas within the
- 277 Cove are inundated is an important element of assessing habitat potential within the Cove. Inundation
- 278 frequency is closely tied to vegetation communities and the potential for wetland habitat to occur and
- 279 persist within the Cove. Information on water level fluctuations can also guide models of habitat use and
- the prioritization of restoration actions within an environment where water levels fluctuate seasonally.
- The analysis of inundation frequencies within the Cove is based on the fact that the Cove is always
- 282 connected to the Clackamas River, even if that connection is shallow. There is a current 1-dimensional
- 283 hydraulic model that includes the Study Area, and a nearby streamflow gauge on the Clackamas River
- has a long record of mean daily discharge data 11.
- As part of this Feasibility Study, a model was created to calculate inundation frequencies for a range of
- elevations that occur within the Cove. The results of this analysis are shown in Table 1 and Figure 6¹².
- The results suggest that water surface elevations do not decline below elevation 10 feet (NAVD88) and
- that 88% of the area occupied by open water is inundated continuously.

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¹⁰ Minister-Glaeser Surveying, Inc. 2015. Minister-Glaeser Surveying, Inc, Vancouver, WA.

¹¹ **U.S. Geological Survey (USGS). 2016.** Clackamas River Near Oregon City, OR, Gauge 14211010. USGS, Washington, DC. https://waterdata.usgs.gov/usa/nwis/uv?14211010

¹² It is important to distinguish between inundation frequencies and flood probabilities. Inundation frequencies are based on data – in this case, Clackamas River discharge data from 2001-2016. Flood reoccurrence estimates, on the other hand, are the probability, expressed as a percentage, of an event of a specific magnitude occurring in any given year. For example, a 100-year flood has a one percent chance of being equaled or exceeded during any given year.

Figure 5. Clackamette Cove's subsurface water elevations. The arrow denotes the maximum depth (18 Feet) measured during low water, August, 2016.

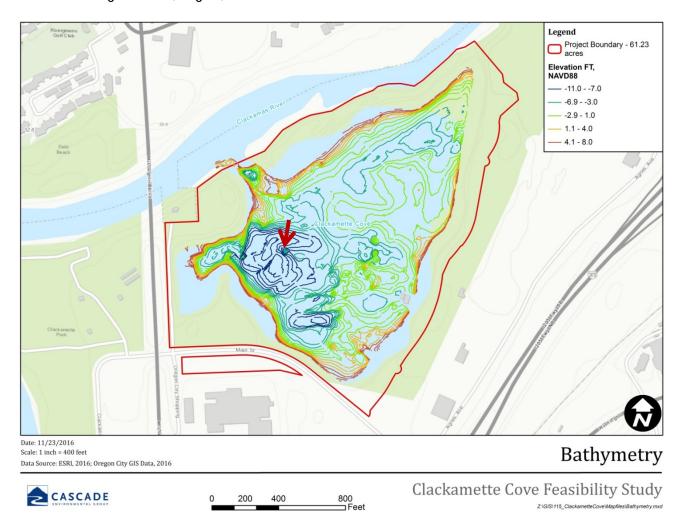


Table 1. Inundation frequencies and total acres inundated within Clackamette Cove based on Clackamas River discharge data from 2001-2016.

	Estimated Water Surface	
Time Inundated	Elev. (ft)	Area Inundated (acres)
99%	10.0	37.1
95%	10.1	37.2
90%	10.2	37.3
75%	10.4	37.4
50%	11.7	38.5
30%	12.9	39.2
10%	15.2	40.1
5%	17.1	40.7
1%	22.2	42.0

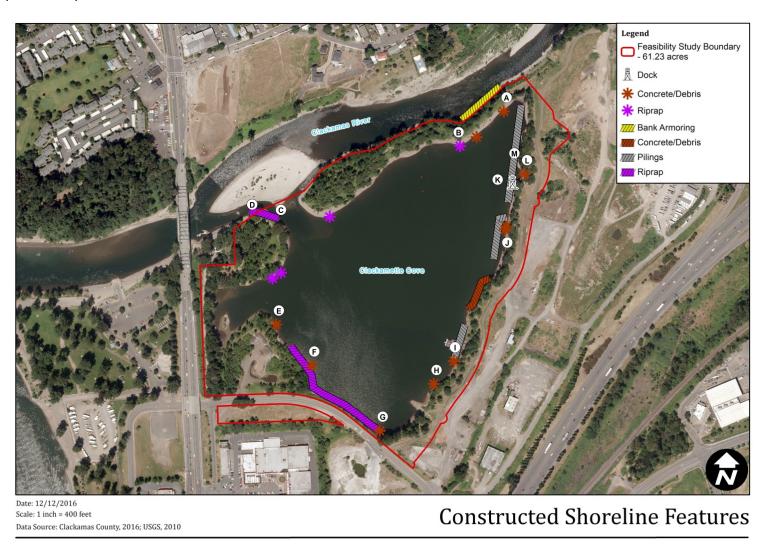
Shoreline	and	Bank	Features
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Shoreline and bank features, including industrial debris and other items, were located with a GPS¹³ and mapped as part of the topographic survey. Large areas of the shoreline and banks are covered in debris or occupied by remnant structures from past mining and other land uses (Figure 7; Photos 2a – 2m). Debris noted along the shoreline includes concrete, boulders, wire cable, and remnants of docks and other industrial structures. Several old structures, including piers and remnant docks, are located within open water areas or along the banks.

The Clackamas County sheriff's office has a boat facility along the eastern bank of the Cove. The boat facility is not actively used by the sheriff's office and other uses for the facility are being considered as part of the Cove Development Plan; additional facilities or marinas for motorized boats are not being considered as part of the plan. Any additional water access areas will be designed only for the use of non-motorized water craft.

The shoreline along the Clackamas River was not surveyed but debris was noted during field reconnaissance, including extensive areas covered in wire cable, concrete, and boulders. The City has installed vegetation and geotechnical materials along the eastern part of the Clackamas River channel bordering the Feasibility Study Area. This work is intended to armor the river bank and prevent future erosion and the possibility of the river rerouting itself through the Cove.

¹³ Global Position System (GPS)

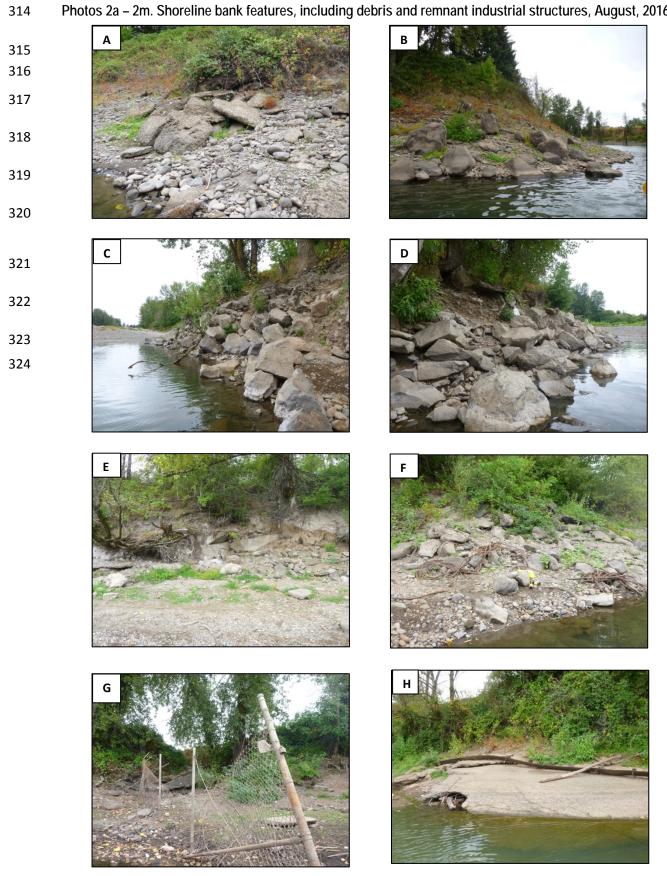


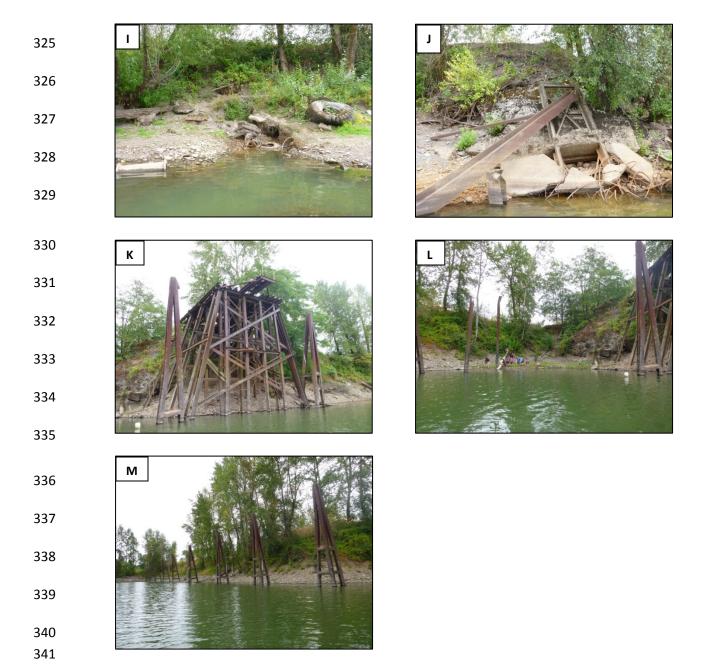
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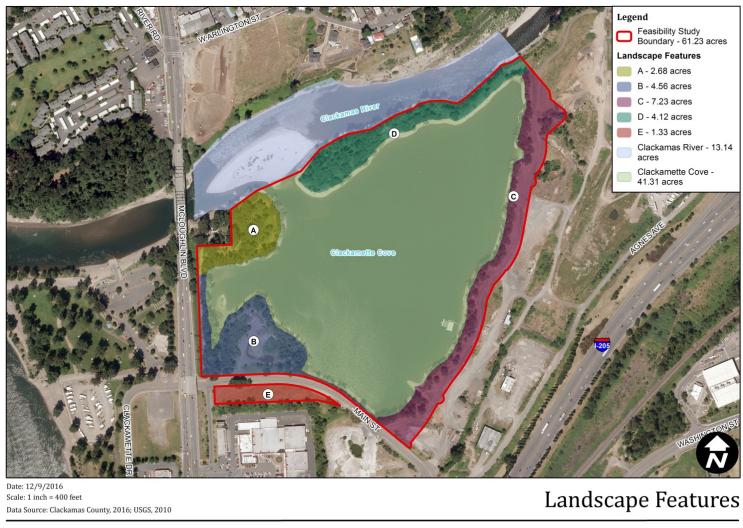
Photos 2a – 2m. Shoreline bank features, including debris and remnant industrial structures, August, 2016.





Landscape Features

Figure 7 shows the primary landscape features present in the Study Area. The landscape features were characterized based on topography, past land uses, and location relative to the current and proposed developments (Table 2). The open water area of the Cove encompasses 41.31 acres. The other landscape features consist of steeply sloped bank areas transitioning into a gently sloped floodplain terrace. The landscape features, corresponding to the designations in Figure 7, include three areas that function as peninsulas perched above the open water areas (A, North-West Peninsula; B, South-West Peninsula; D, North-East Peninsula); an expanse on the east side of the Cove adjacent to the planned Phase 2 development (C); and an isolated parcel between Main Street and the Oregon City Shopping Center (E).



Clackamette Cove Feasibility Study

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Clackamette Cove Feasibility Study

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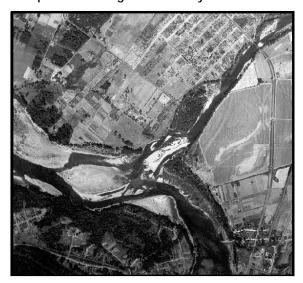
Table 2. Clackamette Cove's primary landscape features based on topographyand location relative to the current and proposed developments. Landscape feature locations are shown on Figure 7.

Landscape	Size	velopments. Landscape feature locations are	snown on igare 7.
Feature	(acres)	Description	Notes
А	2.68	The North-West Peninsula is adjacent to the mouth of the Cove. It is bordered by the Cove on the south and the Clackamas River on the north, and the City of Gladstone property and 99E to the west. The banks on both the Cove and Clackamas River sides rise steeply to the upper terrace of the peninsula where there is relatively gentle topography.	The area is bordered on the west by City of Gladstone property with an inoperative water pumping station. The City of Gladstone considers this to be surplus property and is seeking a buyer. Access to the property is by a gravel road from Main Street that parallels Highway 99E.
В	4.56	The South-West Peninsula was historically mined and then filled with a variety of materials. The peninsula is bordered on the east by Highway 99E, on the south by Main Street, and on the north by a small, shallow open-water embayment within the Cove.	Geotechnical test pits in the area found logs, boulders, cables, chain, concrete, asphalt, and random garbage in a sandy-silt matrix.
С	7.23	The eastern and southeastern portion of the Study Area, which borders the open water of the Cove to the west and Main Street to the southeast and sits adjacent to, the Phase 2 development. Steeply sloped banks transition into the relatively gentle topography of the floodplain terrace.	Geotechnical test pits in the area found variable materials: Sandy- silt topsoil, asphalt debris, dry silt, and gravel/cobbles with trace organics. This area includes a pedestrian/bicycle trail that generally parallels the east side of the Cove.
D	4.12	The North-East Peninsula is adjacent to the mouth of the Cove. The peninsula is bordered by the Cove on the south and the Clackamas River on the north, and to the northeast by the North Park site. The banks on both the Cove and Clackamas River sides rise steeply to the upper terrace of the peninsula where there is relatively gentle topography.	The City has installed vegetation, boulders, and geotechnical materials along the Clackamas River bordering the eastern portion of the peninsula to prevent further erosion.
E	1.33	An isolated parcel between Main Street to the north and the Oregon City Shopping Center to the south.	
Clackamas River	13.14	The Clackamas River corridor, bordered on the south by the mouth of the Cove and peninsulas A and D.	
Clackamette Cove	41.31	The open water area of the Cove at approximately its average annual high water level.	

Clackamas River Channel Dynamics

Historically, the channel morphology at the confluence of the Clackamas and Willamette Rivers was largely influenced by the sediment transport regime of the Clackamas River. Cobble, gravel, and sand delivery from the Clackamas River created a large depositional area and braided channel morphology where the higher-gradient Clackamas River transitioned to the lower-gradient and tidally-influenced Willamette River (Photos 3a and 3b). The disparities in the gradients of these two large river systems resulted in the formation of an alluvial fan at the mouth of the Clackamas River as coarse bed material emanating from the higher-energy Clackamas River deposited in the lower-energy confluence environment.

Photo 3a and 3b: The photo on the left shows the area surrounding the Clackamas and Willamette river confluence in the 1920's and pre-dates significant mining activity at the mouth of the Clackamas River. The photo on the right shows how mining activity in the lower Clackamas River's channel reduced bed load transport and changed channel dynamics at the confluence of the Willamette and Clackamas rivers.





Coarse bedload deposition at the mouth of the Clackamas River had a significant influence on the bed elevations and morphology of the Willamette River for thousands of feet upstream and downstream of the confluence. Goat Island is a remnant of this feature and many maps still refer to this portion of the Willamette River as the Clackamas Rapids. The bed of the Willamette River, adjacent to the Clackamas River, was 10-20 feet higher in elevation than the present day elevation. The reach at that time was most likely not influenced by tidal processes, and prior to the 1930's navigation past this portion of the Willamette River would have been difficult.

Over the past century, changes to both the Clackamas and Willamette River watersheds (i.e., dam construction, modified hydrology, levee construction, and bank revetments), along with local impacts associated with gravel mining and dredging of the Willamette to improve navigation, have resulted in major changes at the confluence. Regional-scale changes to the form and function of the Willamette and Clackamas Rivers have reduced channel complexity and narrowed and deepened the channels of these mainstem river systems, often driven by the desire to improve navigation, provide flood control, and encourage development of floodplain and terrace areas.

Dam construction in the Clackamas River basin has severely reduced the sediment supply to the lower river. Much of the remaining sediment currently delivered to the lower river is supplied from tributaries downstream of the large dams and from bank erosion along the mainstem. The reduced sediment supply has contributed to significant changes in the lower portion of the Clackamas River. The channel area from the confluence with the Willamette River to the Highway 99E Bridge functions basically as a backwater of the Willamette River during most flow conditions; during periods of high flows, the Willamette can backwater above the Highway 99E Bridge and into the Cove.

Reduced bedload in the Clackamas and Willamette rivers has contributed to channel downcutting, which has resulted in lower channel elevations than were historically present. As a result of the lower channel elevations, the Willamette and Clackamas rivers near the Cove are subject to daily changes in water surface elevations from tidal processes. During high flow periods, when the water surface elevations of the Willamette and Clackamas Rivers are higher, tidal flows can influence the Cove. During the low flow periods of the summer and early fall, a gravel bar and associated deposition at the mouth of the Cove creates a consistent 10-foot (NAVD88) water surface elevation within the Cove. Tidal flows during the low water period end approximately at the Highway 99E Bridge and do not extend into the Cove. However, observers have noted that there have been periods in the past when the Cove's summer water surface elevation was lower and tidal flows were able to access the Cove¹⁴.

Gravel Bar Creation

The Cove's opening to the Clackamas River is approximately 100 feet wide and is located several hundred feet upstream of the Highway 99E Bridge. Past mining activities have created bottom surface elevations within the Cove that are significantly lower than the channel bed elevations within the adjacent Clackamas River. Much of the coarse bedload being delivered to the lower Clackamas River is deposited upstream of the Highway 99E Bridge at the mouth of the Cove. During low-flow conditions, in the summer, the Cove is almost disconnected from the Clackamas River by the gravel bar that has formed adjacent to the Cove's mouth. This gravel bar extends several hundred feet upstream and downstream of the mouth and is currently several hundred feet across. While most of the river's flow is along its northern bank, there is evidence of some bank erosion caused by flows at the mouth of the Cove.

A number of factors appear to be contributing to a favorable depositional environment and the creation of the gravel bar at the mouth of the Cove, including: 1) The portion of the Clackamas River opposite the Cove mouth is relatively wide compared to upstream reaches and appears to be going through a depositional bar development phase similar to what previously occurred in this area historically; 2) the presence of the Cove's mouth creates favorable hydraulic conditions for deposition as flow diverges, slows down, and enters the Cove under high-flow conditions; 3) at certain times, the Willamette River backwaters into the area, creating slow flows and gravel deposition; and 4) the Highway 99E Bridge structures are too narrow to accommodate normal channel dynamics; during high water events, the bridge constricts the flow of the Clackamas River, creating a depositional environment.

¹⁴ **Jerry Herrmann. 2016.** Jerry Herrmann, Earth Crusaders-River of Life Center, Gladstone, OR. Personal Communication.

Oregon City currently has the required federal and state permits to implement a dredging plan to remove 9,000 cubic yards of cobble, gravel, and sand from the gravel bar. The stated purpose of the dredging is to provide year-round access into the Cove for watercraft for public safety. The proposed dredging plan consists of excavating a 775-foot-long by 75-foot-wide by 5-foot-deep channel from inside the north end of the Cove, out the mouth, and downstream toward the Highway 99E Bridge. The proposed excavation will cut the channel to approximately elevation zero (NVGD¹⁵) with side slopes varying between 3H:1V and 2H:1V.

Based on the geomorphic evaluation of the Clackamas River, it is not anticipated that the navigational benefits achieved by the dredging would persist for long. Keeping the navigational channel continuously open would require frequent maintenance. The configuration of the proposed channel, with up to 2H:1V side slopes and a bend at the downstream margin of the gravel bar, would likely exacerbate deposition within the newly constructed channel unless it is combined with a more aggressive periodic bar skimming (removal of the top layer of gravel in the bar). Bar skimming would provide benefits by reducing the local source of sediment that could mobilize and fill the channel, while also creating additional storage on the existing gravel bar where the depositional environment is favorable.

The conclusion that the dredged channel would not be sustainable for the long-term is based on the following observations of geomorphic conditions at the gravel bar:

- The size of the material on the bar ranges from 8" (203mm) rounded cobbles down to sand, with a D50 that was estimated to be approximately 3" (76mm). To evaluate how readily the material on the bar mobilizes, given its size, shear stress values were developed along a cross-section that cuts through the mid-point of the bar using the 2-D model developed by West Consultants for the Clackamette Park Boat Ramp. The results, shown in Table 3, suggest that much of the larger bedload delivered to the gravel bar site during high flow events will deposit there.
- Portions of the gravel bar have aggraded to the point where permanent vegetation (primarily willow) is establishing, which appears to match up with the elevation of vegetation along adjacent streambanks (Photo 4). This indicates that the height of the bar has not increased significantly for at least several years, and may not significantly increase over time.
- It appears, based on aerial photos, that the width of the bar has stayed relatively consistent since at least 2007. The height and width of the bar will likely put erosive pressure on the north bank of the Clackamas River, where the highest velocities occur. Whether the north bank erodes in response and the bar continues to widen will be a function of the resistance of the north bank materials to erosion and the bar material's resistance to mobilization. The potential for erosion on the north bank of the Clackamas River should be evaluated.

It is important to note that dredging would lower the channel connecting the mouth of the Cove to the Clackamas River. Lowering the elevation of the Cove's mouth would lower water levels in the Cove during the summer low-flow periods from its current elevation of 10 feet (NAVD88). Over time the dredged channel would fill with gravel and sediment, which would create variability in the Cove's summer water elevations until the time at which the water level equilibrates to the river channel's

¹⁵ National Vertical Geodetic Datum

depositional environment. This variability in the Cove's water surface elevations would create problematic conditions for wetland plant establishment.

Table 3. Shear stress and particle mobility conditions along a cross-section of the Clackamas River that intersects the mouth of the Cove. The results are presented from the right bank to the left bank for a range of modeling scenarios (three different combinations of Clackamas and Willamette river flood reoccurrence intervals).

	25-yr Clackamas 5-yr Willamette		25-yr Clackamas 25-yr Willamette		2-yr Clackamas 25-yr Willamette	
Bank Side	Shear Stress (lbs-sq. ft.)	Particle Mobilized (in mm))	Shear Stress (lbs-sq. ft.)	Particle Mobilized (in mm))	Shear Stress (lbs-sq. ft.)	Particle Mobilized (in mm)
Right	0.808	39.9	0.356	17.6	0.106	5.2
Bank	0.936	46.2	0.414	20.4	0.120	5.9
	1.099	54.2	0.488	24.1	0.138	6.8
	1.196	59.0	0.531	26.2	0.150	7.4
	1.295	63.9	0.577	28.5	0.164	8.1
	1.338	66.0	0.598	29.5	0.171	8.4
	1.352	66.7	0.600	29.6	0.173	8.6
	1.307	64.5	0.578	28.5	0.168	8.3
	1.217	60.1	0.531	26.2	0.157	7.7
↓	1.083	53.4	0.465	22.9	0.140	6.9
Left	0.829	40.9	0.347	17.1	0.108	5.3
Bank	0.470	23.2	0.186	9.2	0.060	3.0

Photo 4. View looking upstream from the west end of the Clackamette Cove's mouth towards the bar formation. Note the growth of vegetation at the top of the bar.



Vegetation

Cascade characterized and mapped the Study Area's vegetation communities (Figure 8). The vegetation communities are described in Table 4. Appendix A contains the photos corresponding to the Photo Points shown.

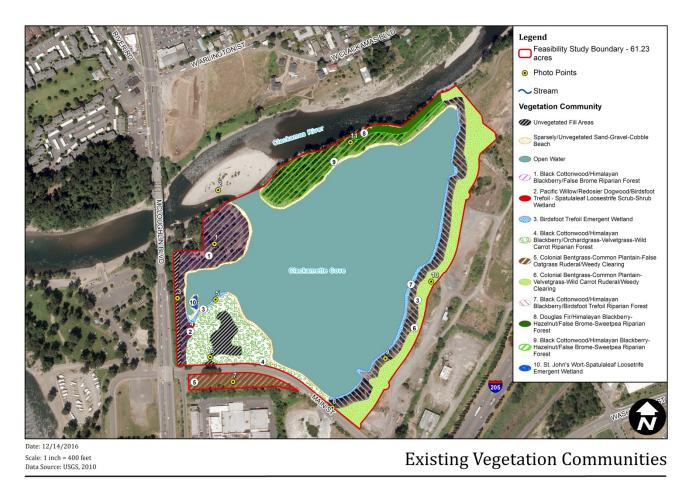
Vegetation composition and density in the Study Area varies dramatically based on elevation. Scattered plants, largely non-native weedy species, occupy the Cove's banks and shoreline. With the exception of these weedy species, the lower banks are largely unvegetated. The substrate on the banks is dominated by cobbles, gravel, and, in some places, boulders. This very coarse substrate, with little fine material or organic soil, creates very difficult conditions for plant survival. While the bank areas are periodically inundated as water levels vary throughout the course of the year, the coarse bank materials do not hold water moisture and thus provide a very harsh environment for plant establishment. In addition, the steeply sloped banks do not provide conditions that promote the establishment of wetland or other vegetation. Gentle, varied slopes (5H:1V or flatter) are necessary to allow for the establishment of wetland plant species and promote plant diversity ¹⁶.

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¹⁶ Norman, D. K., P. J. Wampler, A. H. Throop, E. F. Schnitzer, and J. M. Roloff. 1997. Best Management Practices for Reclaiming Surface Mines in Washington and Oregon. Oregon Department of Geology and Mineral Industries, Salem, OR; and Washington State Department of Natural Resources, Olympia, WA. http://file.dnr.wa.gov/publications/ger ofr96-2 best management practices.pdf

Above the OHW line, less frequent inundation and the presence of organic soils allows for the establishment of trees and other riparian vegetation on the banks and the floodplain terrace. For the most part, the riparian area is dominated by relatively large (18- to 24-inch diameter) black cottonwood (*Populus balsamifera*), Douglas-fir (*Pseudotsuga menziesii*), and other native trees, with an understory consisting largely of Himalayan blackberry (*Rubus armeniacus*), English ivy (*Hedera helix*), and other weedy species. The width of the riparian corridor along the Cove varies, from a narrow strip along the eastern side to relatively wide expanses of vegetation on the three peninsulas (Figure 8).

Figure 8. Clackamette Cove's vegetation communities. The vegetation communities are described in Table 4. Appendix A contains the photos corresponding to the photo points.



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Table 4. Description of Clackamette Cove's vegetation communities corresponding to Figure 8. Non-native vegetation/weed species are designated in bold type. Appendix A contains the photos for each vegetation community corresponding to the photo points.

	ity corresponding to the photo points.			
Figure				
#	Plant Community	Description		
1	Black Cottonwood/Himalayan Blackberry/False Brome Riparian Forest	This riparian upland forest community occupies the North-West Peninsula and the bank and terrace on the western edge of the Cove. The overstory is largely native, dominated by black cottonwood interspersed with a few Oregon ash (<i>Fraxinus latifolia</i>) and domestic cherry (<i>Prunus avium</i>) trees. A few young conifers (Douglas fir and western redcedar [<i>Thuja plicata</i>]) are emerging in the understory. The understory of this community is predominantly invasive, composed largely of dense Himalayan blackberry thickets with a scattering of other shrubs including invasive Japanese knotweed (<i>Fallopia japonica</i>) and English holly (<i>Ilex aquifolium</i>), as well as native snowberry (<i>Symphoricarpos albus</i>), hawthorn (<i>Crataegus douglasii</i>), and oceanspray (<i>Holodiscus discolor</i>). The sparse herb layer is composed of mixed grasses and weedy forb species; the invasive species false brome (<i>Brachypodium sylvaticum</i>) and field bindweed (<i>Convolvulus arvense</i>) are most prominent in the herb layer.		
2	Pacific Willow/ Redosier Dogwood/ Birdsfoot Trefoil- Spatulaleaf Loostrife Scrub-Shrub Wetland	This community occupies a small area along an intermittent stream that drains into the southwestern corner of the Cove. It is a largely native wetland community featuring an overstory of Pacific willow (Salix lasiandra) and redosier dogwood (Cornus sericea) studded with Oregon ash trees. The herbaceous layer includes weedy forb species common to shoreline areas subject to fluvial disturbance, such as birdsfoot trefoil (Lotus corniculatus) and spatulaleaf loosestrife (Lythrum portula), as well as native self-heal (Prunella vulgaris).		
3	Birdsfoot Trefoil Emergent Wetland	This herbaceous wetland community forms a narrow, linear fringe along much of the eastern shoreline of the Cove and along a segment in the southwestern portion of the area. It is dominated by birdsfoot trefoil interspersed occasionally with self-heal and other weedy forbs such as spatulaleaf loosestrife and teasel (<i>Dipsacus fullonum</i>). A few scattered redosier dogwood and Japanese knotweed shrubs are also present.		
4	Black Cottonwood/ Himalayan Blackberry/ Orchardgrass- Velvetgrass-Wild Carrot Riparian Forest	This upland forest community surrounds the concrete lot within the South-East Peninsula and forms a narrow fringe between the southern shoreline of the Cove and Main Street. The community shares similarities with Community #1, featuring an overstory dominated by native black cottonwood and an invasive understory dominated by Himalayan blackberry. However, this community includes occasional bigleaf maple (Acer macrophyllum) trees and black locust (Robinia pseudoacacia) groves within the overstory, and a more developed (though equally weedy) herbaceous layer that includes orchardgrass (Dactylis glomerata), velvetgrass (Hoclus lanatus), wild carrot (Daucus carota), tansy ragwort (Senecio jacobea), and teasel.		

Figure		
#	Plant Community	Description
5	Colonial Bentgrass- Common Plantain-False Oatgrass Ruderal/Weedy Clearing	This upland community occupies the cleared parcel along the south side of Main Street. It is composed of introduced mixed grasses such as colonial bentgrass (<i>Agrostis capillaris</i>) and false oatgrass (<i>Arrhenatherum elatius</i>) and common turf weeds such as plantain (<i>Plantago lanceolata and P. majora</i>), wild carrot , dandelion (<i>Taraxacum officinale</i>), and chicory (<i>Cichorium intybus</i>). It is regularly mown.
6	Colonial Bentgrass- Common Plantain- Velvetgrass-Wild Carrot Ruderal/ Weedy Clearing	Similar in composition to Community #5, this upland community occupies the cleared terrace along the eastern bank of the Cove. In addition to the species described above, it also features other weeds such as tansy ragwort, false brome, and hairy cat's ear (<i>Hypochaeris radicata</i>).
7	Black Cottonwood/ Himalayan Blackberry/ Birdsfoot Trefoil Riparian Forest	This community, which has a dominant black cottonwood overstory and Himalayan blackberry understory, occupies the margin of the cleared terrace and the steep eastern bank of the Cove. This riparian community also features Oregon ash and black locust groves in the overstory and Japanese knotweed and redosier dogwood in the shrub layer. The herbaceous layer features a mix of weedy forbs including birdsfoot trefoil, field bindweed, Canada thistle (Cirsium arvense), oxeye daisy (Leucanthemum vulgare), and St. John's wort (Hypericum perforatum), along with self-heal.
8	Black Cottonwood/ Himalayan Blackberry- Hazelnut/ False Brome- Sweetpea Riparian Forest	This riparian upland forest community occupies the majority of the North-East Peninsula. It is similar to Community #1 while featuring a bit more diversity in the understory. Shrub species present include hazelnut, dogwood, Scotch broom (<i>Cytisus scoparius</i>), and snowberry. The weedy herbaceous layer is co-dominated by false brome and sweet pea (<i>Lathyrus latifolius</i>) along with white sweetclover (<i>Melilotus albus</i>) and English ivy , interspersed with wild carrot , teasel , self-heal, common tansy (<i>Tanacetum vulgare</i>), culinary oregano (<i>Origanum vulgare</i>), and wild Clematis (<i>Clematis vitalba</i>).
9	Douglas Fir/ Himalayan Blackberry - Hazelnut/ False Brome-Sweetpea Riparian Forest	This community occupies the northeast side of the North-East Peninsula. It is nearly identical to Community #8 with the exception of Douglas fir as the dominant overstory species and the near absence of black cottonwood. It is unclear whether this is truly a separate community or only a minor variation. Due to the small size of the patch, the presence of the single grove of Douglas fir may be enough to outcompete other tree species and maintain the stand.
10	St. John's Wort - Spatulaleaf loosestrife Emergent Wetland	This emergent wetland community covers a small island in the western portion of the Cove. It is largely composed of herbaceous weeds: St. John's wort, spatulaleaf loosestrife, birdsfoot trefoil, and oxeye daisy, with a single redosier dogwood shrub and a single black cottonwood sapling.

Water Quality

This section describes the Cove's water quality conditions, with an emphasis on water quality factors that can affect fish populations and/or contribute to HABs: water temperatures, stormwater, and groundwater contamination.

504 Water Temperatures

Water temperatures are a critical factor in maintaining and restoring healthy fish populations. DEQ employs the 7-day moving average of maximum daily temperatures as a method to summarize and gauge the impact of water temperatures on aquatic organisms. Because maximum water temperatures are averaged over a moving seven-day window, this method of summarizing the data accounts for longer periods of high water temperatures when fish and other aquatic organisms are the most stressed by sustained high water temperatures.

DEQ has established the following water temperature standards for salmon and trout (i.e., salmonids):

- For a waterbody identified as having salmon and trout rearing, the 7-day moving average of maximum daily temperatures may not exceed 64.4 degrees Fahrenheit (18.0 degrees Celsius), and
- For a waterbody identified as a trout or salmon migration corridor, the 7-day moving average of maximum daily temperatures may not exceed 68.0 degrees Fahrenheit (20.0 degrees Celsius).

Water temperatures are influenced by solar radiation, shade, ambient air temperatures, groundwater inflows, the volume of the waterbody, and flow. Water temperatures in the Cove vary throughout the year, with the highest temperatures corresponding to the summer through early fall period when solar radiation and air temperatures are at annual highs and water flows are low.

Comprehensive water temperature data are not available for the Cove¹⁷. Water temperature data from the U.S. Geological Survey (USGS) gauge on the lower Clackamas River near the City was used to characterize the Cove's water temperature patterns. Because the Cove's temperatures and water levels are largely influenced by the Clackamas River, the nearby USGS gauge provides an approximation of the Cove's water temperature patterns. Figure 9 shows the river's 7-day moving average of maximum daily temperatures and daily mean discharge, during the years 2010 – 2016. In most years, water temperatures in the lower Clackamas River exceed DEQ's salmonid migration standard from mid-July through early September, a period that corresponds to low flows in the Clackamas River. In 2015, the state of Oregon, including the Clackamas River basin, suffered a severe drought. The dry conditions resulted in extremely low flows in the Clackamas River. By June, the river was already flowing at levels typically seen in August, with correspondingly high water temperatures.

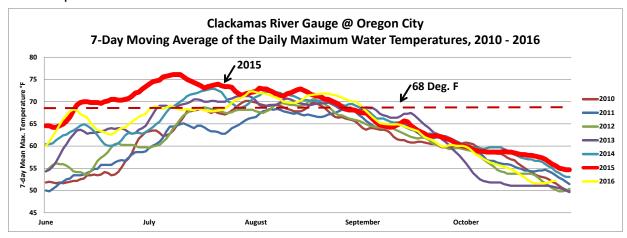
Water temperatures in the Cove are largely determined by interactions with the Clackamas River. During the summer and early fall, when water temperatures are high, there is little connection between the

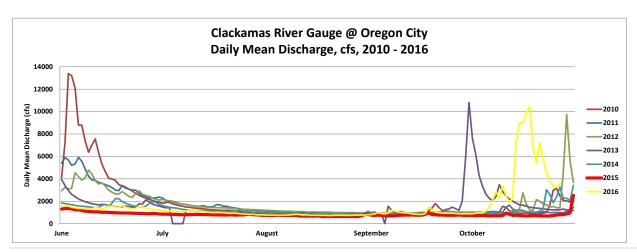
¹⁷ In August, 2016, Cascade placed water temperature/water level data loggers at three locations within the Cove. One set of data loggers was lost/stolen; the other 2 data loggers remain. The data from the loggers, however, has not been collected and analyzed because the loggers are currently under excessively deep water and will be inaccessible until water levels drop. The loggers continue to collect data and Cascade will provide the City with an analysis of the water temperatures and water levels in July, 2017.

flow of the Clackamas River and the Cove. As result, the water in the Cove is stagnant with no perceptible flow. The stagnant water condition, combined with minimal cool water inputs from the Clackamas River, creates ideal conditions for rising water temperatures. Groundwater inputs into the Cove may provide a source of cool water, but further study is necessary to characterize to what extent groundwater influences the Cove's water temperatures. Water temperature stratification can occur in lakes and other water bodies similar to the Cove, resulting in warmer water at the surface and cooler water at the bottom. Thermal stratification has been observed in the 160-foot-deep Ross Island Lagoon, another remnant gravel mine in the lower Willamette River with stagnant water conditions that is similar to the Cove. The Cove's relatively shallow depth (approximately 18 feet at the deepest location) probably minimizes any thermal stratification.

Water temperatures are the result of solar radiation inputs heating a given volume of water. As the volume of water increases, so does the amount of thermal input necessary to heat the water body. Shade from trees and other vegetation can reduce water temperatures in streams with moderate volumes of flowing water. The trees along the shore of the Cove have a negligible impact on reducing water temperatures because of the Cove's relatively large volume of deep, stagnant water.

Figure 9. 7-day moving average of the daily maximum water temperatures and daily mean discharge for the Clackamas River gauge at Oregon City, 2010 – 2016. The lowest discharge levels and corresponding highest water temperatures were recorded in 2015.





REVIEW DRAFT: Clackamette Cove Water Quality and Habitat Improvement Feasibility Study

Stormwater

Stormwater originating in the City is discharged into the Cove at two locations. Figure 10 shows the location of stormwater Outfall 1, which consists of two outlet pipes that convey stormwater from a large mixed use area to the northwest of the Cove and also from the new Phase 1 development. The conveyance pipe at stormwater Outfall 2 drains the Oregon City Shopping Center, south of the Cove (Figure 11). Combined, these two stormwater conveyance systems drain a large area of impervious surfaces (e.g., roofs, parking areas, and roads) which generates a considerable volume of stormwater runoff during periods of precipitation.

DEQ regulates stormwater runoff from the City through Municipal Separate Storm Sewer System (MS4) National Pollutant Discharge Elimination System (NPDES) Permit No. 101348. The City's MS4 NPDES permit was reissued in 2012. This permit covers all discharges of stormwater from the within the City's incorporated area, including the new Clackamette Cove Development. The permit covers 6 activities intended to improve stormwater quality over time: 1) Education, 2) outreach, 3) construction best management practices (BMPs), 4) post construction BMPs, 5) illicit discharge detection and elimination, and 6) improved municipal operations.

The City is required to submit an annual report to DEQ that summarizes accomplishments and implementation of the Stormwater Management Plan. One component of the annual reporting is a summary of stormwater quality monitoring. The water quality for the Cove's two stormwater outfalls is periodically monitored during rainfall events. Stormwater Outfall 1 is monitored at the outfall into the Cove (Figure 10). The monitoring site for stormwater Outfall 2 is near the shopping center (Figure 11).

Roadways, parking lots, and other impervious surfaces, as well as landscape surfaces, can be the source of and can accumulate a mixture of contaminants, including sediment; metals (copper, nickel, zinc, etc.); petroleum-derived compounds from oil, grease, and vehicle exhaust; and other contaminants. During rainfall events, stormwater collects these contaminants and transports them to the Cove. The City monitors stormwater that drains into the Cove's two outfalls during rain events. The monitoring samples are tested for a variety of water quality constituents, including dissolved copper, dissolved lead, dissolved zinc, E. coli bacteria, nitrate-nitrite, ortho phosphate, total dissolved and suspended solids, and other contaminants.

The City's stormwater monitoring results for the Cove's two stormwater outfalls consistently show detections of dissolved copper, zinc, and lead – all stormwater contaminates that have been linked to harmful effects on salmon and steelhead. Recent research by the National Marine Fisheries Service (NMFS) and others has shown that common stormwater contaminants can impair salmon and steelhead health in a variety of ways¹⁸. For example, petroleum-derived compounds suppress the immune system, rendering fish more vulnerable to pathogens that cause lethal diseases. Certain metals are toxic to the salmon nervous system, thereby disrupting feeding and predator avoidance. Dissolved copper is a particularly pervasive contaminant in stormwater that threatens salmon and steelhead survival. Copper in stormwater can come from a variety sources; one significant source is vehicle exhaust and brake pads. Copper, like many other metals, is toxic to the sensory systems of fish. Dissolved copper specifically

¹⁸NMFS. 2016. How Toxic Runoff Affects Pacific Salmon & Steelhead. NMFS, Pacific Northwest Region, Seattle, WA. http://www.westcoast.fisheries.noaa.gov/publications/habitat/fact_sheets/stormwater_fact_sheet_3.22.2016.pdf

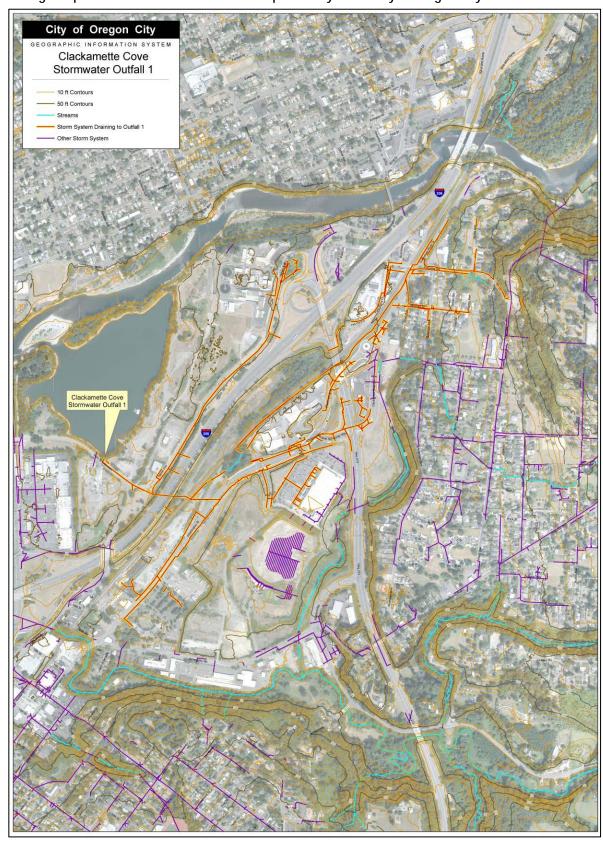
impairs salmon and steelhead's ability to detect odors. The olfactory sense guides these fishes' response to environmental cues and impairment of smell interferes with certain behaviors, including impeding predator detection and avoidance, prey detection, orientation, and homing. Disruption of these behaviors affects salmon and steelhead distribution, feeding, and reproductive success.

A fish habitat assessment evaluated the impact of Phase 1 of the Cove Development Plan, including increased stormwater discharge, on salmon and steelhead species listed as threatened or endangered under the ESA¹⁹. New stormwater facilities will treat expected pollutants (i.e. oil, polycyclic aromatic hydrocarbons [PAHs], heavy metals, nutrients, and sediments) associated with roof runoff and vehicle use. The new stormwater facilities will include a combination of Low-Impact Development Approach (LIDA) swales and storm filters designed to capture contaminates. The LIDA swales will collect and treat stormwater runoff through vegetation and soil media, while also providing flow attenuation. Portions of the existing 36-inch stormwater pipe will be upsized to a 48-inch pipe during construction of the proposed Main Street roadway improvements to provide additional stormwater capacity for future development. However, the existing outfalls into the Cove will be retained and no new outfalls are proposed.

The stormwater assessment focused on three pollutants of concern that typically occur at elevated concentrations in stormwater effluent, including dissolved copper, dissolved zinc, and PAHs (specifically fluoranthene). Based on the results of a stormwater mixing zone analysis, the assessment concluded that the effects of treated stormwater will be insignificant. This finding was based on the conclusions that 1) there is limited occurrence of ESA-listed salmonids within the Cove during the summer months when water levels and the corresponding contaminate dilution factor are at their lowest; and 2) higher concentrations of dissolved copper will immediately dilute to below water quality criteria levels upon entering the Cove.

While the findings of the assessment are valid for direct and indirect stormwater impacts on juvenile salmon and steelhead, the assessment does not evaluate stormwater impacts on aquatic habitat restoration actions. Because the stormwater discharge locations are within or near potential habitat restoration areas (e.g., created wetlands), NMFS and other agencies will seek much more rigorous stormwater quality criteria, particularly for the key contaminates of concern. Habitat restoration actions would be designed to increase the number of juvenile salmonids rearing within the Cove, and thus there would be an expectation that stormwater inputs over time would not directly or indirectly affect fish or habitat.

¹⁹ **Pacific Habitat Services, Inc. 2015.** Habitat Assessment of the Potential Effects of the Proposed Garden Apartments Project (Phase I of The Cove Development Plan) on Fish Species Listed as Threatened or Endangered under the Federal Endangered Species Act. Pacific Habitat Services, Wilsonville, OR.





Groundwater	Contamination
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- 632 Several investigations of potential groundwater contamination have been completed for areas within the Study Area²⁰. Collectively, these investigations have documented the presence of soil and 633 634 groundwater contamination that has resulted both from land uses adjacent to the Study Area and groundwater migration from off-site. Contaminants detected include moderate levels of diesel fuel and 635 636 petroleum, arsenic, and lead in soils around the former asphalt plants. Moderate levels of heavy oil-637 range petroleum were also found in some shallow sediment samples collected along the Cove's eastern 638 shoreline. Contaminants migrating in shallow groundwater from the old landfill and other areas outside 639 of the Study Area and Phase 1 and Phase 2 development footprints include chlorinated solvents, arsenic, 640 lead, and typical landfill constituents such as iron and manganese. Petroleum hydrocarbons have 641 migrated to the north end of the Study Area from a large gasoline release that occurred at an adjacent 642 property. The contaminants of concern have not been detected in water samples collected from the 643 Cove's shoreline.
- Additional detailed soil and groundwater investigations were completed before construction of the Garden Apartment complex (Phase 1 of the Cove Development Plan). Based on the available information, DEQ concluded that contaminant levels in the soils and groundwater at the Phase 1 site are currently not a threat to public health and the environment and that the site requires no further action to address contaminates²¹.
 - While it appears that groundwater contamination is not affecting the Cove's aquatic environment, additional study is necessary to ensure that there are no current or potential future direct or indirect effects on fish or aquatic habitats. Similar to the need for more evaluation of stormwater inputs, state and federal agencies will require additional evaluation of groundwater contamination before implementing habitat restoration actions. This would include evaluating potential contaminates in the Study Area, and the potential for migration of contaminates into any habitat restoration sites.

Harmful Algal Blooms

In 2015 there was an extensive algal bloom in the Cove. Based on a sample of the bloom, the OHA issued a health advisory warning against water contact activities in the Cove because toxins produced by HABs are potentially harmful to people. The health advisory, the first ever for the Cove, was in place from September 28 through November 4, 2015. A similar heath advisory was in effect in 2015 for Ross Island Lagoon.

A recent workshop with attendees from research and regulatory agencies discussed the scientific understanding of HABs, with a focus on the factors contributing to the blooms in Ross Island Lagoon and the Cove²². HABs appear to be increasing in extent and intensity in the Pacific Northwest and around the

²⁰ **Oregon Department of Environmental Quality (DEQ). 2016.** Environmental Cleanup Site Information Database Site Summary Report - Details for Site ID 2301, Clackamette Cove. DEQ, Portland, OR. http://www.deq.state.or.us/lq/ECSI/ecsidetail.asp?seqnbr=2301

²¹ **Oregon Department of Environmental Quality (DEQ). 2014.** Partial No Further Action Determination for Parker Pond Site, Oregon City. DEQ, Northwest Region, Portland, OR.

²² **Urban Green Spaces Institute, Oregon Lakes Society, and River Restoration Northwest. 2016.** Harmful Algal Bloom Workshop, July 20, 2016, Portland State University.

globe²³. In addition to the 2015 advisory, health advisories were issued for Ross Island Lagoon in 2014 and 2016 (Table 5). While a health advisory was not issued for the Cove in 2016, notices were posted warning for the public to be aware of potential HAB conditions.

Testing of HABs conducted by DEQ detected some toxins, including microcystin, which is a toxin that primarily affects the liver. People do not absorb microcystin through their skin, which reduces the risk to swimmers. However, ingesting water during swimming can be harmful. The symptoms of microcystin exposure are similar to food poisoning: vomiting, diarrhea, and occasionally fever and chills. The toxins released by the algae can also cause skin rashes. The blooms can contaminate drinking water with taste, odor, or toxic compounds. The toxins produced by HABs can also be very harmful or fatal to dogs, even at low levels.

Table 5. OHA health advisory warnings for the Cove and Ross Island Lagoon, both former gravel mines with open water areas. Information provided by the OHA.

Yea	r Location	Dominate Genus	Dates	Number of Days
201	Ross Island, lower Willamette River	Microcystis	August 19 – September 1	14
201	Ross Island, lower Willamette River	Microcystis, Dolichospermum, and Cylindrospermopsis	July 9 – October 1	84
	Clackamette Cove, lower Clackamas River	Anabaena planctonica	September 28 – November 4	37
201	Ross Island, lower Willamette River	Microcystis	September 19 – October 2	16

flow velocities²⁴. The 2015 bloom that resulted in the health advisory for the Cove corresponded to extremely low flows in the Clackamas River and correspondingly high water temperatures (Figure 9). Harmful algal species are present in the Clackamas and Willamette rivers, but usually do not create large blooms in the rivers because flowing water inhibits the growth of large colonies. Algal blooms usually occur in lakes. In the Portland metropolitan area, large algal blooms have developed in Lake Oswego and Blue Lake in Gresham. The stagnant water conditions in the Cove and Ross Island Lagoon create conditions much like a lake and provide perfect conditions for the species to multiply into large mats of green scum. The absence of a green sheen on the surface of the water doesn't necessarily mean that the

The primary catalyst for HABs in the Willamette River is warm water temperatures and minimal water

area is free from the algae because they can change their buoyancy in the water column. The colonies

tend to rise to the surface to capture sunlight for photosynthesis, and then sink down in the water

²³ While referred to as algal blooms, the organisms responsible for the blooms are photosynthetic cyanobacteria. This report uses the term harmful algal blooms (HABs) because it is the standard reference in use by the public, research institutions, and government agencies.

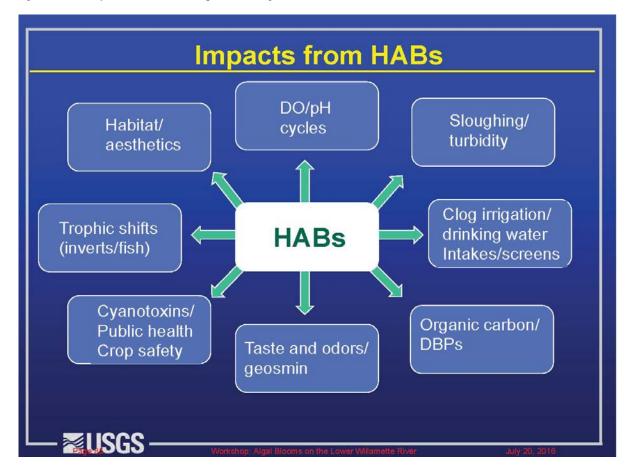
²⁴ Urban Green Spaces Institute et al., 2016.

column when they have created sufficient carbohydrates. Sometimes the bloom will be at the surface of the water, and during other times the blooms are deeper and not visible.

Nutrients entering waterways can also contribute to HABs. Phosphorus and nitrogen, which are present in many fertilizers and lawn products, can help algae grow. Phosphorous in particular can promote algal blooms. Some species of algae can metabolize atmospheric nitrogen, which means that nitrogen in the water is usually less of a factor in promoting HABs. However, while nutrients can be a factor in HABs, it appears that the primary drivers of the blooms in the Cove and Ross Island Lagoon are stagnant water followed by high water temperatures.

In addition to the threats to public health, HABs also create ecological problems and visual/aesthetic issues (Figure 12). Algal blooms can affect food web interactions by decreasing the amount of edible phytoplankton and zooplankton that fish and other primary consumers need to survive. When the cells in the bloom begin to die, dissolved oxygen levels can decrease, and pH levels can shift, which can be lethal to other aquatic organisms, including fish. Low dissolved oxygen can be made worse by overcast days and warmer temperatures.

Figure 12. Harmful algal blooms (HABs) affect human health, ecological processes, and aesthetics. (Graphic curtesy of Kurt Carpenter, U.S. Geological Survey, Portland, OR.)



The primary driver of HABs in the Cove appears to be the stagnant water conditions. Extensive algal blooms were not observed there until approximately 2013, which appeared to correspond to the extensive gravel deposition at the mouth of the Cove. It is theorized that the gravel deposition at the Cove's mouth restricted tidal flushing during the summer months and thus contributed to the algal blooms. Research has demonstrated that stagnant water contributes to the formation of extensive blooms. There is also evidence that minimal flow velocities (approximately 0.05 meters per second) are sufficient to disrupt the formation of blooms.

An analysis of Clackamas River water residence time within the Cove was conducted to better understand existing conditions within the Cove and provide a basis for recommending enhancement actions that could improve circulation and water exchange (Appendix B). Under summer low-flow conditions (642 cfs), and assuming a direct connection to Clackamas River with flows into the Cove of 7.2 cfs, the water residence time is one day – that is the entire water volume in the Cove would be replaced over a 24-hour period. While this analysis does not characterize flow velocities, it does provide strong evidence that flushing of water out of the Cove occurs on a frequent basis. The analysis assumes that water entering the Cove would be well-mixed and circulate throughout the Cove. That assumption would need to be evaluated through a more detailed hydraulic and engineering analysis. Creating appropriate flow velocities would likely require specific actions within the Cove to make full circulation a possibility. The source and location of inflow would also need to be evaluated. Preliminarily, the best approach to increasing summer inflow into the Cove from the Clackamas River would be to create a second opening (an engineered channel) to the Clackamas at a point within the North-East peninsula.

To evaluate the feasibility of this approach, a detailed engineering and hydraulic study would need to address the following topics:

- Irrespective of residence time, what are the likely circulation patterns within the Cove under a range of inflow rates? This could be addressed by running scenarios with a 2-dimensional model that has already been developed for the area. The model would need to be evaluated to determine if additional site information should be collected and if the resolution of the model is adequate to address the questions.
- If an opening is created, what would be the configuration and size to ensure the following: 1) an adequate amount of summertime flow enters the Cove; 2) that erosion of the opening does not occur during high flow conditions on the Clackamas; and 3) the opening does not accumulate sediment to the point where summertime flows no longer enter the Cove.

| Page

²⁵ **Dreher T. 2016.** River-associated cyanobacterial blooms: Why's and what's for Oregon. Presentation to the: Harmful Algal Bloom Workshop, July 20, 2016, Portland State University. Theo Dreher Professor of Microbiology, Oregon State University, Corvallis, OR.

Sediments

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- Sediment sampling and chemical analysis was completed for the Cove in 2006²⁶. The purpose was to
- assess if sediments within the Cove contain chemicals above background levels and at concentrations
- that may pose an unacceptable risk to human health or the environment.
- 757 Five surface sediment samples were collected from the Cove on April 12, 2006. The sediment samples
- 758 were analyzed for total petroleum hydrocarbons, PAHs, metals, total organic carbon, and grain size.
- 759 Chemical results from the samples, as well as 8 additional samples collected in 1998 (13 total), were
- 760 compared to conservative screening levels to assess the potential risk to human health and the
- 761 environment.
- 762 All concentrations of all tested chemicals were below screening levels for human health except arsenic
- 763 in one of the 13 samples. The concentration of arsenic in that sample was 8.6 mg/kg, only slightly above
- the background concentration of 7.9 mg/kg. For risk assessment purposes, the estimated exposure point
- concentration of arsenic in sediment (based on the data collected) is 4.2 mg/kg, below the background
- 766 concentration. Human health risks from the Cove's sediments appear to be acceptable, and recreational
- use of the Cove should not be restricted based on potential human exposure to sediments.
- 768 Concentrations of PAHs and/or metals were detected above ecological screening levels in 4 of the
- samples. Except for one sample, the detected concentrations exceeded the screening levels by less than
- 50 percent. In one sample, individual PAHs were detected at concentrations between 2 to 4 times the
- 371 screening level. The sediment ecological screening levels are generally very conservative, so these
- concentrations may not indicate unacceptable ecological risk²⁷.
- 773 Development of the Cove Development Area is subject to a Prospective Purchaser Agreement (PPA)
- between the City and DEQ. Under the restrictions of the PPA, developers of the property adjacent to the
- 775 Cove would not be required to conduct investigation or cleanup of sediments in the Cove. However, the
- 776 DEQ reserved the right to take action on sediment in the future that could include restricting access to
- 777 the sediments or water of the Cove.
- 778 According to the City's agreement with DEQ, prior to disturbing sediments or allowing use or access to
- sediments in the Cove, including for the development of restoration sites, the City is required to submit
- 780 a written report, for DEQ approval, addressing potential uses, exposure pathways, and proposed actions
- 781 to manage risks, if any²⁸.

²⁶ **Ash Creek Associates. 2006.** Sediment Sampling Report Clackamette Cove, Oregon City, Oregon. Ash Creek Associates, Portland, OR.

²⁷ Ash Creek Associates. 2006.

²⁸ Ash Creek Associates. 2006

Fish Populations and Habitat

784 Native Fish Species 785 The Cove provides aquatic habitats that are occupied by a variety of native fish species, including 786 juvenile salmon, steelhead, and Pacific lamprey. While there are no detailed observations of Juvenile 787 salmon, steelhead, and lamprey residing in the Cove, these fish are present all year in the lower 788 Willamette and Clackamas Rivers and are expected to be present in the Cove. Research has shown, for 789 example, that juvenile spring Chinook salmon occupy the lower Willamette River throughout the year, 790 with peak densities occurring in winter and spring²⁹. The research also shows that these fish are actively

growing during their residence, suggesting that feeding and rearing in these areas are important for

792 their survival.

- Salmon, steelhead, and Pacific lamprey populations are declining. The upper Willamette Basin and the lower Columbia River salmon and steelhead populations, which are at historically low numbers, are listed as threatened under the ESA. The ESA-listed fish populations include spring and fall Chinook salmon, coho salmon, and steelhead. The Willamette River Basin has the largest returns of Pacific lamprey of any of the Columbia River tributaries and also supports one of the only remaining traditional tribal harvest locations in the Columbia River Basin, at Willamette Falls. Pacific amprey populations are also declining throughout the Columbia River Basin. Pacific lamprey are listed as a sensitive species by the federal government and the State of Oregon.
- Juvenile salmon and steelhead in the Cove come from adults that spawn in the Clackamas River or tributaries in the upper Willamette Basin. During the period of high flows, the Willamette and Clackamas Rivers' flows interact, which often results in the Willamette River "backwatering" into the lower Clackamas River and the Cove. During these high-flow periods, the Cove is essentially connected to the Willamette River and is accessed by juvenile salmon and steelhead derived from both the upper Willamette Basin and Clackamas River stocks.
 - Pacific lamprey, like salmon and steelhead, are anadromous after a period growing in the ocean, adults migrate into rivers where they spawn and the juveniles, after residing for some time in fresh water, return to the ocean and thus repeat the cycle. There are no recorded observations of juvenile Pacific lamprey in the Cove; however, it is expected that they are found there since there are observations of juvenile lamprey in similar lower Willamette River habitats near the Cove open water areas with slow flows and muddy substrate.³⁰
 - Pacific lamprey adults spawn in gravel areas similar to, and often overlapping, the spawning areas preferred by salmon and steelhead. Pacific lamprey spawning has been noted in a riffle a short distance up the Clackamas River from the mouth of the Cove³¹. The presence of juvenile Pacific lamprey in

²⁹ **Friesen, T.A., J. S. Vileb, A. L. Pribylc. 2007.** Outmigration of Juvenile Chinook Salmon in the Lower Willamette River, Oregon. Northwest Science 81(3):173-190. http://www.bioone.org/doi/abs/10.3955/0029-344X-81.3.173

³⁰ Schultz, L., M. P. Mayfield, G. T. Sheoships, L. A. Wyss, B. J. Clemens, B. Chasco, and C. B. Schreck. 2014. The Distribution and Relative Abundance of Spawning and Larval Pacific Lamprey in the Willamette River Basin. Report prepared for the Columbia River Inter-Tribal Fish Commission for Project years 2011 – 2014, Portland, OR.

³¹ **Alsbury, T. 2016.** Todd Alsbury, Oregon Department of Fish and Wildlife, Clackamas, OR. Personal communication.

- Clackamette Cove probably contributes to adults spawning in the Clackamas River close to the mouth of
- the Cove. Juvenile lamprey emit bile salts that attract adults to nearby spawning areas.
- The native fish species present in the Cove varies through the course of the year. During the late fall
- through spring period when water levels are the highest and water temperatures are low, juvenile
- steelhead and salmon and adult trout are present. These fish are probably not present in the Cove
- between July and mid-October, when water temperatures are the highest. The one exception is Pacific
- lamprey juveniles, which are a native species that probably resides in the Cove all year.

Non-Native Fish Species

- Non-native warm-water fish including small- and largemouth bass, crappie, and walleye are present in
- the Cove. The Cove is a popular fishing location for these warm-water species³². Some of these non-
- native fish such as largemouth bass are predators that could consume juvenile salmon and steelhead.
- Research in the lower Willamette River has shown that densities of these predators is generally low, but
- consistently higher at sites characterized by riprap, mixed rock, and rock outcrops, similar to the Cove³³.
- This research concluded that there is very little evidence of warm-water fish predation on juvenile
- 830 salmonids. For example, by weight, the diets of largemouth bass were dominated by crayfish; while the
- diets of walleye and smallmouth bass consisted primarily of fish, the identifiable fish in their diets were
- 832 usually sculpins.

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Fish Habitat Quality

- The Cove's expanse of relatively deep water (e.g., greater than 3 feet), and simplified shoreline areas
- 835 characterized by steeply sloped banks, coarse cobbles and other materials, and minimal wetland or
- 836 other shoreline vegetation, provides very little of the habitats that juvenile salmon and steelhead need
- 837 to rear and grow during their migration to the ocean. These fish prefer to rear and feed in shallow areas
- 838 with a diversity of habitat types, including wetland vegetation and large wood. For example, juvenile
- coho salmon usually are found near shore and prefer gently sloped beach areas with sandy substrates³⁴.
- Juvenile coho avoid areas with the kinds of habitats present in the Cove: steeply sloped banks, coarse
- 841 substrates, and areas of debris.
- The limited quantities of shallow water habitat found in the Cove are also typical of current conditions in
- the lower Clackamas and Willamette rivers. Historically, the river channels in the area were lined with
- shallow water areas, extensive expanses of wetland and floodplain vegetation, and accumulations of
- large wood. Riverside development and wetland filling, gravel and wood removal, and bank hardening,
- have reduced the amount of shallow water habitats to a small fraction of the historical extent. The
- 847 Clackamas River in the vicinity of the Cove is listed as critical habitat for ESA-listed salmon and steelhead
- adult migration and juvenile rearing. As a result of these habitat alterations and the need to recover
- 849 ESA-listed salmon and steelhead, state and federal fisheries agencies have prioritized the restoration of

³⁴ Friesen et al. 2007.

³² Fishing Notes Web Site. 2016. http://www.fishingnotes.com/fishing-report/or/Clackamette-Cove

³³ Friesen et al. 2007.

shallow water habitats at the confluence of the Willamette and Clackamas rivers³⁵. Two shallow water habitat restoration projects in the vicinity of the Cove were constructed in 2016. Both of these projects are on north side of the lower Clackamas River in the City of Gladstone's Dahl Beach Park.

In contrast to salmon and steelhead, Pacific lamprey juveniles prefer deeper water habitats with abundant sediments. After hatching, Pacific lamprey spend about 4-7 years rearing in river channel sediments as filter feeding larvae (ammocoetes) prior to metamorphosing and migrating to the ocean³⁶. A sediment evaluation of the Cove found bottom materials consisted predominantly of silt with little sand or gravel content; it is likely that Pacific lamprey ammocoetes reside in the portions of the Cove where sediments and organic material has accumulated on the bottom. Because freshwater rearing

consists of a relatively high fraction of the life cycle of the Pacific lamprey, this stage is generally viewed

Wildlife Populations and Habitat

as critical for the viability of the species.

Wildlife Species

The Cove provides habitat for a variety of wildlife species. Deer, coyotes, mink, otter, and beaver have been observed there³⁷. Numerous bird species also occupy the aquatic and riparian areas, including osprey, great blue heron, and cormorants. ODFW has observed amphibian adults and egg masses, including rough-skinned newts, pacific tree frog (egg masses), and red-legged frog (egg masses)³⁸. There have been reports of native turtles in the Cove, but their presence has not been confirmed. If native turtles are not present, they could eventually move into the Cove. There is a native painted turtle population in close proximity, within the City of Gladstone's Meldrum Bar Park.

In an evaluation of habitats throughout the Study Area, ODFW noted that while some area currently provide high-quality wildlife habitat, most of the areas around the Cove do not provide good habitat because of their narrow riparian vegetation corridors and lack of diversity of habitat types, including very little wetland area³⁹.

The North-West Peninsula is the only habitat that is currently rated as 'high' quality by ODFW and it is essentially the only refuge for wildlife disturbed by human presence in the Study Area. In their evaluation, ODFW recommended that this Peninsula be set aside as wildlife habitat, with limits on human access, including decommissioning the existing trail system and providing interpretive signage describing why the refuge area was established.

³⁷ **Jerry Herrmann. 2016.** Jerry Herrmann, Earth Crusaders-River of Life Center, Gladstone, OR. Personal Communication.

³⁵ **Oregon Watershed Enhancement Board (OWEB). 2016.** Willamette River Anchor Habitat Priorities. OWEB, Salem, OR. https://www.oregon.gov/OWEB/Pages/SIPMaps.aspx

³⁶ Schultz et al. 2014

³⁸ **Oregon Department of Fish and Wildlife (ODFW). 2010.** Recommendations for Clackamette Cove Development. Memo from Elizabeth Ruther, Habitat Conservation Biologist, to Oregon City. ODFW, Clackamas, OR.

³⁹ Oregon Department of Fish and Wildlife (ODFW). 2010.

Recreation and Human Access

The Study Area is popular for boating, swimming, fishing, hiking, and bird watching. A popular pedestrian/bicycle trail generally parallels the east side of the Cove. There is an extensive network of informal trails and water access points throughout the area. Activities in the Cove include general recreation and access, as well as organized events. Triathlons – events that include running, swimming, and cycling – have been held at the Cove in the past and a triathlon event there is planned for 2017⁴⁰. In the warmer months, recurring HABs inhibit swimming and other recreational activities in the Cove.

The Study Area provides regionally important recreational resources. The trail along the east side of the area links Oregon City to the Clackamas River, provides a connection to the City of Gladstone, and provides access to a regional network of trails, parks, and natural areas. Other than this trail, human access to and use of the floodplain terrace area, banks, and water is not controlled through designated trails or formal access points. The resulting network of informal trails and water access points has led to extensive habitat impacts, including vegetation removal and trampling, erosion, and litter.

The Cove's recurring HABs result in aesthetic and visual concerns and impact recreational activities. At times the entire water surface of the Cove is covered in green mats of algae (Photo 5). The combination of the visual impact and the smell when cells begin to die creates a very unpleasant environment for recreation and other activities. Cascade staff interviewed a number of swimmers and other individuals who regularly recreate in the water at the Cove, all of whom cited the HABs as the primary issue that inhibits their enjoyment of the Cove. Most individuals said that they will not swim in the Cove after July because of health concerns.

In addition to habitat impacts from human access, the Study Area's steep topography and remnant industrial debris create an unsafe setting for recreational activities. The limited shallow areas and banks that drop steeply into deep water create a potential drowning hazard. Oregon statutes require a 3H:1V bank slope to 6 feet below the low-water mark to provide a means of escape in the event that someone were to fall in⁴¹. Piers and remnant industrial structures on the banks and in the water also create unsafe conditions.

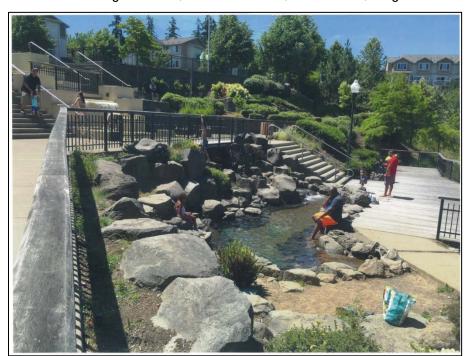
Human access should be controlled and directed in a manner that minimizes impacts to the Study Area's aquatic and riparian environments. This will entail developing and implementing a Recreation and Public Access Plan with details on formal trail locations, shoreline and water access points, and areas where human use should be discouraged to protect habitat values. Recreational facilities in the Study Area should be designed to allow for viewing of habitat areas while minimizing the impact on fish and wildlife and their habitats (Photo 6).

⁴⁰ Clackamas Cove Triathlon. 2016. http://clackamascovetriathlon.com/

⁴¹ **Norman, D. K., P. J. Wampler, A. H. Throop, E. F. Schnitzer, and J. M. Roloff. 1997.** Best Management Practices for Reclaiming Surface Mines in Washington and Oregon. Oregon Department of Geology and Mineral Industries, Salem, OR; and Washington State Department of Natural Resources, Olympia, WA. http://file.dnr.wa.gov/publications/ger of 196-2 best management practices.pdf

Photo 5. Algal bloom, Clackamette Cove, September 3, 2016.

Photo 6. An example of a recreational facility designed to direct human access away from shoreline habitat areas. This site was a former gravel mine, and is now a lake, in Beaverton, Oregon.



Integrated Approach to Improving Water Quality, Fish and Wildlife Habitat, and Human Access

 The Cove was created through gravel mining and other industrial land uses. These activities have resulted in an altered landscape that does not function as natural floodplain or river habitat. The Cove is essentially an embayment of the Clackamas River, and the connection between the Clackamas River and the Cove varies throughout the year in response to the river's flows. During periods of high flows — November through June in most years — the river and Cove are hydrologically connected. In periods of low flows in the summer and early fall, there is little direct connection between the river and the Cove. During these periods, the Cove functions more like a lake than a flowing embayment of the river, creating stagnant water conditions and high water temperatures that promote HABs.

The altered landscape left from gravel mining and other actions has also created unnatural landforms and a legacy of industrial debris and groundwater and sediment contaminates, all of which do, or have the potential to, affect habitat and fish and wildlife populations. Steep banks and minimal shallow water areas limit the establishment of riparian vegetation, wetlands, and the complex habitats preferred by fish and wildlife. The extensive industrial debris – cables, blocks of concrete and metal pieces – and remnant structures on the banks and in the open water areas further degrade habitat. Groundwater and sediment contaminates, while not currently a threat to human health and the environment, require further evaluation to ensure that they do not impact fish and wildlife restoration actions. The absence of wetland and riparian vegetation and the debris also degrade the Study Area's aesthetic and recreational qualities. Wetlands along the shoreline of the Cove, for example, would add to the area's scenic values (Photo 7).

Photo 7. An example of wetlands along the shoreline of a restored floodplain gravel mine. The formally steep banks were regraded to gentle slopes to provide a variety riparian and wetland habitats.



- While conditions in the Study Area present environmental challenges, there is also the opportunity to restore aquatic and floodplain habitats and create a valuable scenic and recreational asset. Through restoration actions, the area can provide habitats that are important to a wide array of fish and wildlife species, including ESA-listed steelhead and salmon and Pacific lamprey (a state and federal species of special concern). Addressing the HABs will address ecological concerns and improve the Study Area's recreational and aesthetic qualities.
- The key issues that must be addressed to improve the Study Area's water quality, habitat value, and recreational value are as follows:
- HABs and Connectivity to the Clackamas River
- 961 Unnatural Landforms and Debris
- Stormwater Quality and Other Potential Contaminates
- Simplified Aquatic and Wetland Habitats
- Simplified Riparian and Floodplain Habitats
- 965 Structures below the OHW line
- 966 Recreation and Human Access
- Table 6 summarizes the issues and outlines recommended approaches to address the problems.

Issue	Description	Evaluation	Recommended Approach
Harmful Algal Blooms and Connectivity to the Clackamas River	Past mining of the area has created an unnatural embayment of the Clackamas River with a narrow opening to the river. This has resulted in limited flow interaction with the river, particularly during the summer to early fall low-flow periods, which results in warm and stagnant water in the Cove. These conditions, particularly the stagnant water, create an environment that promotes HABs. The OHA closed the Cove to swimming and other water contact activities in 2015 and a general advisory was in effect in 2016. There have been similar HABs in the metropolitan area in in other legacy gravel mine sites, including Ross Island Lagoon within the Willamette River.	 Limited flow velocities within the Cove during the Clackamas River's low flow periods (July – September in most years) are the primary driver of HABs, but water temperatures also contribute to the blooms. Nutrients (primarily phosphorus) are also contributing to the blooms. The narrow mouth to the Cove limits connectivity to the river, particularly during low flow periods. The mouth is not positioned in a manner that directs flows into the Cove. A gravel bar that has developed at the mouth the Cove also contributes to restricting connectivity (and limiting boat access), but the narrow mouth and its position in the river channel is the primary factor limiting flow connectivity between the Cove and the river. Dredging the gravel bar at the mouth of the Cove would improve low water connectivity between the Clackamas River and the Cove. However, dredging would lead to lower summer water levels in the Cove. The dredged channel would, over time, fill with gravels and bedload, again limiting interaction between the river and the Cove, and gradually raising summer water elevations in response. The resulting variability in the Cove's water elevations would create poor conditions for establishing wetlands and other habitats that are dependent on water depth. Channel dredging is not sustainable over the long term. Repeated gravel bar dredging would be required to maintain the open channel at the mouth of the Cove. Permits for continued dredging would be difficult to obtain, and will become increasingly so due to concerns about ESA-listed fish. Flows with velocities as low as 0.05 meters per second can prevent HAB colonies from forming and creating extensive blooms. Creating a channel that directs flows from the Clackamas River during low flows could provide enough flow velocity during the low-flow periods to disrupt the growth of HABs. HABs disrupt aquatic recreational use of the Cove during warmer months,	 Conduct an engineering feasibility study focused on creating a stable, engineered channel throughout the North-East Peninsula that would direct flows from the river into the Cove, with an emphasis on improving connectivity. Explore a range of options, such as designing the engineered channel to provide connectivity to the river only during low-flow periods or through a range of high and low flows. Evaluate a range of hydraulic and biological conditions created by an engineered channel, through a detailed engineering study, including 2-D hydraulic modeling, to understand flow velocities that would be created within the Cove and their effect on HABs, sustainability of the engineered channel and the North-East Peninsula's banks over time, sediment deposition patterns as a result of the improved connectivity, water temperature changes, and impacts on fish and wildlife. Pursue other actions that would improve water temperatures and nutrients in the Cove over time, including creating wetland areas and enhancing floodplain vegetation.
Unnatural Landforms and Debris	Past mining and other industrial activities have created unnaturally steep banks above OHW, with coarse substrates (cobbles, boulders, etc.), and areas littered in debris. Large areas of the shoreline and banks are covered in debris or occupied by remnant structures from past mining and other land uses. Debris includes concrete, boulders, wire cable, and remnants of buildings and other industrial structures. Several old structures, including piers and docks, are located within open water areas or along the banks.	 The steep banks (nearly 1:1 slopes in many areas) rise from the bottom of the Cove to the floodplain terraces above. The uniformly steep banks limit habitat diversity and have created poor conditions for the establishment of high-quality habitat, including wetlands and riparian areas. The coarse substrate and limited fine organic matter, combined with water level fluctuations, also create poor conditions for establishing wetlands and other vegetation communities. The east side of the Cove presents the best opportunity for contouring the banks to a more natural slope. The North-West and North-East Peninsulas are narrow and subject to erosion from the Clackamas River; any bank grading in these areas would need to be done in a manner that does not create conditions that could lead to the river eroding through the peninsulas. Bank debris and remnant structures limit habitat complexity. Debris, remnant industrial structures, and steep banks create public safety hazards. The Study Area's aesthetic qualities are degraded by bank debris, remnant structures, and lack of high-quality habitat. 	 Contouring the banks to a more natural landform would improve revegetation success and provide more diverse fish and wildlife habitat. The east side of the Cove is where most of the slope grading should be focused. Bank slopes above OHW of 3H:1V or flatter should be targeted, for both optimal vegetation establishment and public safety. In some areas course substrate would need to be augmented to create soil conditions suitable for plant establishment. Debris and remnant structures should be removed as part of bank grading and habitat restoration actions.
Stormwater Quality and Other Potential Contaminates	Two primary stormwater conveyance systems that drain into the Cove. These stormwater systems drain the Oregon City Shopping Center and a large area to the south and east of the Cove. Stormwater contains copper and other constituents that can affect ESA-listed salmon and steelhead and water quality in general. Groundwater and sediment samples in the area have tested positive for some contaminates but not at levels that currently affect fish, wildlife, and human health.	 The City is applying appropriate BMPs and other actions designed to limit stormwater quantities and improve water quality. The stormwater outfalls are within areas that would be targeted for habitat restoration actions, including created wetlands and other habitats. Given the possible impact of stormwater, groundwater, and sediment contaminates on salmonid behavior and survival, NMFS, ODFW, and other state and federal agencies would expect that as the City improves habitat in the Study Area it would also pursue measures that would, over time, improve stormwater quality and ensure that groundwater and sediment contaminates would not affect habitat restoration areas and fish. Contaminants migrating in shallow groundwater from the old landfill and other areas outside of the Study Area include chlorinated solvents, arsenic, lead, and other typical landfill constituents such as iron and manganese. Concentrations of PAHs and metals were detected in some sediment samples above ecological screening levels. DEQ has evaluated the groundwater and sediment studies for the area and has found that at this time groundwater sediment contaminates do not appear to be affecting the Cove's aquatic environment or human health. 	 Implement a long-term and comprehensive approach that encompasses a variety of actions to address stormwater quality and quantity throughout each outfall's drainage area. Phase stormwater actions in over time, including "retrofitting" the existing stormwater drainage system with Low-Impact Development BMPs. Evaluate groundwater and sediment contaminates before implementing wetland and aquatic habitat restoration/mitigation actions. Assess potential direct and indirect impacts on fish and wildlife and their habitats. This would include evaluating contaminates at the restoration/mitigation site, and the potential for migration of contaminates into the restoration site.

Simplified Aquatic and Wetland Habitats	ESA-listed salmon and steelhead juveniles reside in the Cove during periods of high flow (November – June). The Cove's uniformly steep banks do not provide the kinds the complex, shallow water habitats that juvenile salmonids need to avoid predators and feed. Juvenile Pacific lamprey, a state and federal sensitive species, likely grow and feed in the Cove's sediments.	 Juvenile salmonids prefer to rear and feed in shallow areas with a diversity of habitat types, including wetland vegetation and large wood. Juvenile coho avoid areas with the kinds of habitats present in the Cove: steeply sloped banks, coarse substrates, and areas of debris. Historically, there were complex shallow water habitats throughout the lower Clackamas and Willamette Rivers. These habitats, which are essential for recovering ESA-listed salmonid populations, have been lost over time. The Willamette – Clackamas river confluence area, including the Study Area, is recognized by state and federal agencies as a high priority for habitat restoration. There are large areas of the Cove that are suitable for the creation of shallow water habitats and wetlands. Any restoration activities within the Cove should take into account the likely presence of juvenile lamprey. 	Create gentle in-water (below OHW line) slopes, 5H:1V or flatter, to allow development of wetland plant species. Create slope variations to enhance the plant diversity in created wetlands. Add large wood, including rootwads, and other structures in some areas to provide habitat complexity and cover for both fish and wildlife.
Simplified Riparian and Floodplain Habitats	For the most part, the upper banks and floodplain terraces are dominated by relatively large (18- to 24-inch diameter) black cottonwood, Douglas fir, and other native trees, with an understory consisting largely of Himalayan blackberry, English ivy, Japanese knotweed, and other weedy species. The width of the riparian corridor along the Cove varies, from a narrow strip along the eastern side to relatively wide expanses of vegetation on the three peninsulas.	 ODFW notes that while some of the Study Area currently functions as high-quality wildlife habitat, most of the area does not provide good habitat because of the narrow riparian vegetation corridors, prevalence of invasive species, and limited diversity of habitat types. The North-East Peninsula is the only habitat that is currently rated as high-quality by ODFW and it is essentially the only refuge for wildlife in the area. There are large native trees throughout the Study Area, but invasive weeds occupy understory areas, which degrades habitat quality. A variety of wildlife species have been observed in the Study Area, including amphibians: Rough-skinned newts, pacific tree frog (egg masses), and red-legged frog (egg masses). There have been reports of native turtles in the Study Area, but the observations have not been confirmed. If native turtles are not present, they could eventually move into the Study Area. There is a native painted turtle population in close proximity, within the City of Gladstone's Meldrum Bar Park. 	 Retain as many mature native trees as possible and plant native vegetation in areas that will increase the width, total area, and diversity of riparian habitat. Remove non-native plants and weeds and replant with native vegetation at appropriate elevations. Establish the North-East Peninsula as wildlife habitat, with limits on human access, including decommissioning the existing trail system. Place downed trees (mimicking natural tree fall) in the aquatic areas for aquatic-dependent species like turtles and amphibians. A variety of branch sizes allows turtles of various sizes to climb out of the water and bask and provides egg attachment sites for amphibians.
Structures below the OHW line	Currently the sheriff's boathouse is the only structure that is planned to remain in the Study Area. Existing piers and docks are slated for removal. Other existing structures, such as docks and piers, degrade the habitat and aesthetics of the Study Area	 Installation of docks or other structures below OHW would affect aquatic resources, which would require state and federal permits and would trigger mitigation to address the impacts. Docks and other structures on the surface of the water can provide hiding places for non-native fish species that prey on native fish and should be designed to minimize this function Mitigation actions to compensate for any unavoidable impacts from construction of the Cove Development Project could entail removing existing industrial structures and/or creating other habitats, including creating complex shallow water habitats. Removal of existing piers and docks would improve aquatic habitat and aesthetics. 	 Limit the number and extent of docks and other in-water structures installed in the Cove to minimize impacts on aquatic habitat. Integrate the planning for the location and types of in-water structures with planned habitat restoration areas to minimize the impact on restoration goals.
Recreation and Human Access	The Study Area is popular for boating, swimming, fishing, hiking, and bird watching. There is a well-used pedestrian/bicycle trail that generally parallels the east side of the Cove. There is an extensive network of informal trails and water access points throughout the area.	 A network of trails, parks, and natural areas connects the Study Area to the surrounding landscape and natural areas. The trail along the east side of the Cove links the City to the Clackamas River, provides a connection to the City of Gladstone, and provides access to a regional network of trails, parks, and natural areas. 	 Develop and implement a Recreation and Public Access Plan with details on formal trail locations, water access points, and areas where human use should be discouraged. Integrate the Recreation and Public Access Plan with habitat restoration plans to ensure that human impacts will not conflict with restoration goals. Establish the North-East Peninsula as wildlife habitat, with limits on human access, including decommissioning the existing trail system. Create 3H:1V slope to 6 feet below the low-water mark to provide a means of escape in the event that someone were to fall in. Remove coarse bank material and create sandy beaches for summer recreational activities as well as good winter fish rearing habitat.

Partnerships and Funding Opportunities

2 Partnerships

- 3 The CRBC is collaborating with the GOCWC, OWEB, ODFW, DEQ, Clackamas County, Metro, and other
- 4 partners to develop a comprehensive strategy and funding framework for pursuing habitat restoration
- 5 and water quality improvements throughout the Clackamas River Basin and the surrounding
- 6 metropolitan area. The CRBC's strategic planning area includes the Cove. Cascade staff are under
- 7 contract to facilitate the strategic planning effort.
- 8 At the October, 2016 CRBC meeting, Cascade staff provided an overview of the Feasibility Study and
- 9 outlined restoration opportunities in the Cove. At the meeting, Council members stated that the Cove is
- an important area for improving water quality and fish and wildlife habitat. CRBC Board Members also
- stated that they are amenable to pursuing a partnership with the City to work collaboratively on
- securing funding and implementing habitat restoration actions.
- 13 There are numerous benefits that the City could derive from a Partnership with the CRBC and
- 14 participating in the strategic planning process, including potentially securing funding for habitat
- restoration actions. CRBC's strategic planning effort is funded by OWEB and it is anticipated that OWEB
- 16 funds will assist with future restoration actions. In addition, participants in the planning process,
- including Metro and Clackamas County, will provide additional funds intended to match the OWEB
- 18 funding.
- 19 An additional benefit in participating in the strategic planning process is developing partnerships with
- 20 participating entities. Metro is a participant and is also currently facilitating and providing some funding
- 21 for the Willamette Falls Legacy project. With a location spanning both the mouth of the Clackamas River
- 22 and Willamette Falls, the City is positioned at the gateway to some of the most important salmon and
- 23 steelhead runs in the Pacific Northwest. In addition to the important fishery resources, the Cove and
- 24 Willamette Falls are also regionally important recreational and economic assets. A partnership with
- 25 Metro could assist with planning and implementing both habitat and recreational improvements at the
- 26 Cove.
- 27 There are a number of grant opportunities that could assist with funding habitat improvements at the
- 28 Cove. Grant funding entities include OWEB, the U.S. Environmental Protection Agency, Oregon State
- 29 Parks and Recreation Department, and NMFS. Collaborating with the Council, Metro, and perhaps other
- 30 entities in grant proposals will assist with securing grants.
- 31 Other Willamette River basin cities have restored former floodplain gravel mine sites from an
- 32 environmental liability to a natural resource and recreational asset. The City of Eugene's Delta Pond
- 33 project is model of a comprehensive approach to gravel mine and floodplain restoration accomplished
- through partnerships and creative funding strategies⁴². The Delta Ponds Restoration Project focused on
- 35 revitalizing the floodplain and former gravel mine sites through phased restoration of fish and wildlife

⁴² **City of Eugene. 2014.** Delta Ponds Restoration Project: From Opportunity to Completion. City of Eugene, OR. http://willametteinitiative.org/tools-resources/delta-ponds-restoration-project-opportunity-completion

- 1 habitat, water quality improvements, and better access and interpretive facilities (Photo 8). Water
- 2 quality improvements included addressing algal blooms through improved flow connectivity with the
- 3 Willamette River and other actions. The City of Eugene worked collaboratively with an extensive group
- 4 of partners including federal, state, and local organizations and community groups. Funding for the
- 5 project was through a variety of sources, including federal appropriations to the U.S. Army Corps of
- 6 Engineers and grants awards from the U.S. Bureau of Land Management, ODFW, OWEB, Oregon Parks
- 7 and Recreation Department, and NMFS.
- 8 Photo 8a 8b. Eugene's Delta Ponds are an example of floodplain gravel mines that have been restored
- 9 through phased actions. The photo on the left shows grading of fine fill material to create riparian benches
- and wetland areas. The restored area includes trail access and interpretive facilities (photo on the right).





11

12

Habitat Mitigation Banking

- 13 Environmental mitigation, or compensatory mitigation, are terms used primarily by the United States
- 14 government and the related environmental industry to describe projects or programs intended to offset
- 15 known impacts to an existing natural resource. The impacts can affect streams, wetlands, endangered
- 16 species, or other resources.
- 17 Formal environmental mitigation is part of a crediting system established by state and federal agencies
- 18 which involves allocating debits and credits. Debits occur in situations where a natural resource has
- 19 been destroyed or severely impaired and credits are given in situations where a natural resource has
- 20 been deemed to be improved or preserved.
- 21 In the lower Willamette region, including the Cove, there are three primary mitigation markets in place
- 22 or in development, including: 1) Wetlands and waters of the U.S.; 2) Natural Resources Damages
- 23 Assessment (NRDA); and 3) endangered species conservation. Each of these markets offers
- 24 opportunities to create a mitigation bank in the Cove. A mitigation bank is an area of restored habitat
- 25 from which private and government entities with environmental damages (debits) can purchase
- 26 mitigation credits that address their damages within the region ('service area') in which the damages
- 27 occur.

Wetlands and Waters of the U.S.

Of the mitigation banking options, Wetland and Waters of the U.S. mitigation banking has the longest history as a functioning mitigation market. These banks are designed to address impacts to wetland or aquatic resources authorized under the U.S. Clean Water Act. There are a number of wetland mitigation banks in the Portland metropolitan region. Wetland banks have been developed by private and public entities. The City of Eugene, for example, developed and operates a wetland mitigation bank. The City of Gresham is currently developing a mitigation bank at a former gavel mine site on Fairview Creek in partnership with the Port of Portland, which is anticipating the need for wetland credits due to anticipated infrastructure development impacts in the bank's service area (Figure 13). A private entity operates the Foster Creek Mitigation Bank, which serves development primarily in the Clackamas Basin. Credits for the Foster Creek Mitigation Bank are now being purchased for approximately \$250,000 per credit (one credit equals one acre of mitigation). The bank has a limited number of credits remaining and there are no other wetland banks that cover the same service area. The Cove is within this service area.

FAIRVIEW CREEK WETLAND MITIGATION BANK PROSPECTUS

January 27, 2014

Gresham, Oregon

Multnomah County

HUC: 1709001202

Township 1 North, Range 3 East, Section 33, Tax Lot 1302

19
20

Figure 13. The Fairview Creek Mitigation Bank Prospectus. The City of Gresham is developing a mitigation bank within former floodplain gravel mine.



Bank Sponsor:

City of Gresham Department of Environmental Services 1333 NW Eastman Parkway Gresham, OR 97030 ATTN: Kathy Majidi

Natural Resources Damages Assessment

- 2 NRDA is a framework for mitigating for past damages resulting from designated Superfund Sites. The
- 3 Lower Willamette Superfund site is located in Portland's industrial harbor. In this case, NRDA restoration
- 4 addresses past damages to fish and wildlife from ship building and other activities that damaged habitat
- 5 and released contaminates. Most of the NRDA mitigation focus is on restoring habitat for ESA-listed
- 6 salmon and steelhead, primarily restoring shallow water habitats and associated floodplain vegetation.
- 7 The parties with NRDA liabilities seeking to purchase NRDA restoration credits must obtain half the
- 8 credits from sites within the inner Portland harbor; the other half of the credits can be purchased from
- 9 an outer harbor site, located essentially above the inner harbor area up to Willamette Falls. Based on
- 10 conversations with NMFS staff, the Cove would likely be included in the outer harbor because it is
- subject to tidal flows and juvenile fish populations from both the upper Willamette River basin and the
- 12 Clackamas River occupy the area.
- 13 At this time there is one fully-approved NRDA restoration site, Alder Creek, which is operated by
- 14 Wildlands, a private entity. This site is within the inner harbor and has sold a limited number of credits
- to the City of Portland. Other restoration sites in the inner and outer harbor are now under
- 16 development. The 33-acre Rinearson Natural Area in the City of Gladstone's Meldrum Bar Park is being
- 17 developed as a NRDA restoration site through a partnership between a private entity and the City of
- 18 Gladstone. The private entity is providing most of the funding to design, permit, and restore the site,
- and the city is providing the land.
- 20 A very limited number of credits have been sold under the Portland Harbor NRDA restoration
- 21 framework. Credit costs for NRDA restoration sites are variable and will change as the market develops,
- 22 but the costs per credit are conservatively a multiple of two to three times the cost of a wetland
- 23 mitigation bank credit on a per acre basis.

24 Endangered and Sensitive Species Conservation

- 25 Conservation banks are a relatively new mitigation framework designed to address impacts to essential
- 26 habitat for special status species, including federally listed ESA species. There are no conservation banks
- 27 in Oregon, but several have recently been established in Washington. Based on conversations with
- 28 NMFS staff, there is a need for conservation banks in the Portland metropolitan area that can address
- 29 impacts ESA-listed salmon and steelhead habitat in the lower Willamette River and tributary streams.
- 30 Currently, there is not a market to base credit costs on, but it is anticipated that the credit costs would
- 31 be similar to NRDA restoration credits because both frameworks are within the same impact area
- 32 (roughly the lower Willamette River and associated floodplains) and thus competing for habitat
- 33 mitigation crediting.

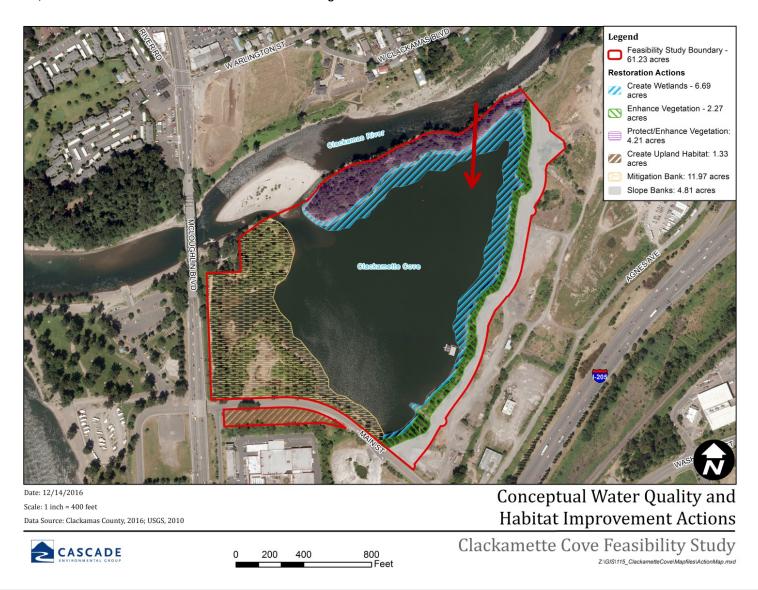
Evaluation of Mitigation Banking Opportunities for the Cove

- 2 Developing a mitigation bank in the Cove could provide the City with both restored habitat and revenue
- 3 over time. Developing a bank in the Cove would entail upfront costs to engage state and federal
- 4 agencies to design, permit, and construct the bank. The primary agencies that regulate banks are the
- 5 Oregon Division of State Lands, and the federal Corps of Engineers (wetland mitigation) or NMFS and
- 6 U.S. Fish and Wildlife (NRDA and conservation banking). Once a bank is approved, it is eligible to release
- 7 10% of its credits prior to construction. After construction, credits are released over a 5 to 10 year
- 8 period based on meeting performance criteria. Credit sales would occur over time, and depending on
- 9 the market demand, the sales could extend beyond 10 years.
- 10 The bank could be developed by the City, or through a private entity that would cover all the costs in
- return for a percentage of credit sales. It would feasible for the City to develop a mitigation bank in
- 12 partnership with a private entity for example, the City could receive credits or revenue from the entity
- in return for the use of City property. The mitigation bank could also potentially be developed and
- 14 funded by an entity that anticipates a large future mitigation need. For example, a port that is
- 15 anticipating extensive shallow water habitat impacts from expansion of its facilities could purchase the
- 16 entire bank to cover their impacts.
- 17 Based on initial conversations with state and federal agency staff, the Cove is suitable for wetland,
- 18 NRDA, and conservation credits. Because of the Cove's strategic position at the Willamette and
- 19 Clackamas river confluence, mitigation and restoration would address habitat needs for multiple ESA-
- 20 listed salmon and steelhead populations (i.e., upper Willamette and Clackamas runs) and other sensitive
- 21 species (e.g., Pacific lamprey). There are mitigation sites that cover multiple mitigation markets, and it
- 22 may be possible to create a bank that could sell credits for the three credit frameworks. It is important
- 23 to note that the state and federal agencies that were consulted about mitigation options for the Cove
- 24 were not committing to the feasibility of mitigation. The first step in exploring mitigation banking
- options would be to hold a formal "pre-prospectus" meeting with the state and federal agencies. At the
- 26 meeting, the agencies would provide their perspective on the suitability of the site, credit markets, and
- 27 outline the formal process for agency approval of the mitigation site. Based on agency feedback, a
- 28 formal Mitigation Bank Prospectus would be developed for agency review and approval. A Mitigation
- 29 Bank Prospectus is a brief document (approximately 15 pages) that outlines the entity that will develop
- 30 and run the mitigation bank (private entity, City, or a partnership), credit type(s), the potential market
- 31 for the credits and anticipated credit demand, and habitat creation / restoration area boundaries and
- 32 approach. Approval of the Mitigation Bank Prospectus sets the stage for developing the detailed
- 33 mitigation bank design and agency oversight and approval process.

1 Habitat and Water Quality Phasing and Costs

- 2 Addressing the Cove's water quality and habitat concerns will require an integrated strategy that phases
- 3 in improvements over time. An integrated strategy will entail developing an approach that
- 4 demonstrates to state and federal agencies that that HABs, stormwater quality, groundwater and
- 5 sediment contaminates, and recreational uses have been evaluated. A comprehensive and feasible plan
- 6 will need to be in place to address agency concerns before implementing habitat restoration or
- 7 mitigation banking actions.
- 8 Figure 14 shows a conceptual design for the Cove that integrates improved connectivity to the
- 9 Clackamas River with habitat improvement actions, creating more natural landforms, and developing a
- 10 mitigation bank area. All of the habitat and water quality improvements would be integrated with
- 11 carefully designed recreational access and facilities (e.g., viewing platforms), and are designed to work
- together to improve the Cove's habitat and aesthetic qualities. The areas on the map are conservative;
- the habitat improvement areas and the mitigation bank size could increase by a considerable amount.
- 14 The key variables controlling the size and relative locations of the habitat improvement areas and the
- 15 mitigation bank are 1) flow and water mixing patterns from a constructed channel to the Clackamas
- 16 River; 2) the amount of fill required to create shallow water areas and wetlands along the shoreline; and
- 17 3) the costs associated with the habitat improvements and the mitigation bank.
- 18 Table 7 outlines habitat mitigation, restoration, and water quality improvement phasing, timelines, and
- 19 concept-level costs.

Figure 14. A conceptual habitat and water quality enhancement design for Clackamette Cove that integrates improved connectivity to the Clackamas River (red arrow) with habitat restoration actions and a habitat mitigation bank.



- 1 Table 7. An outline of habitat mitigation, restoration, and water quality improvement action phasing,
- timelines, and concept-level costs. The phase timeline assume the components are completed in parallel
- during the same timeframe; the components can be completed at different timeframes, but this would extend
- 4 the phase timeline.

Phase	Phase Timeline	Action Components	Component Timeline	Conceptual Cost
Phase 1: Mitigation Bank – Agency Feedback	1 month	Mitigation bank pre-prospectus meeting with state and federal agencies	1 month	\$10,000
		Mitigation bank prospectus detailing project components for agency review and approval	6 months	\$30,000
Phase 2: Integrated Water Quality and Mitigation	6 months	Engineering feasibility study for connectivity channel to the Clackamas River	6 months	\$40,000
Approach		Partnership engagement with the Clackamas Basin Council, Metro, and other organizations and exploration of other funding options	6 months - Ongoing	N/A
		Mitigation site engineering design, permitting and agency approval	2 years	\$250,000
Phase 3: Integrated Plan	2 - 3 years	Recreation/Public access plan and trail/facility design, permitting and agency approval	12 months	\$80,000 - \$120,000
		Clackamas connectivity channel engineering design, permitting, and agency approval	12 months	\$100,000 - 200,000
		Mitigation site construction and native vegetation planting	5 months	\$400,00 - \$800,000
Phase 4: Construction	1 years	Recreation trail/facility construction	8 months	300,000 – 800,000
		Clackamas connectivity channel construction	4 months	\$300,000 - \$800,000
Phase 5: Monitoring	5-10 years	Mitigation bank performance monitoring and annual reports for agency review. Note: Credit sales are linked to successfully meeting performance objectives	5 - 10 years	\$20,000 – 40,000 (annual)
Worldoning	Ongoing	Water quality and HAB monitoring	Ongoing	\$6,000 (annual)

4 APPENDIX A

Vegetation Community Photos



Photo point 1. Photo 1. From the northwestern section of the project site looking 20° at Vegetation Community #1: Black Cottonwood/Himalayan Blackberry/False Brome Riparian Forest.



Photo point 1. Photo 2. From the northwestern section of the project site looking 110° at Vegetation Community #1.



Photo point 1. Photo 3. From the northwestern section of the project site looking 190° at Vegetation Community #1.



Photo point 1. Photo 4. From the northwestern section of the project site looking 285° at Vegetation Community #1.



Photo point 2. Photo 1. From the island at the mouth of the Cove looking 60 ° at sandbar willow, St. John's wort, and pink flower vegetation.



Photo point 3. Photo 1. From gravel access road along the western site boundary looking 0° .



Photo point 2. Photo 2. F From the island at the mouth of the Cove looking 240 ° at sandbar willow, St. John's wort, and Japanese knotweed vegetation.



Photo point 3. Photo 2. From gravel access road along the western site boundary looking 180°.



Photo point 4. Photo 1. From drainage into the Cove looking 165° upstream at vegetation community #2: Pacific Willow/Redosier Dogwood/Birdsfoot Trefoil-Spatulaleaf Loosestrife Scrub-Shrub Wetland.



Photo point 5. Photo 1. From bank at southwestern section of the site looking 220° at vegetation community #3: Birdsfoot Trefoil Emergent Wetland.



Photo point 4. Photo 2. From drainage into the Cove looking 200° downstream at vegetation community #2.



Photo point 6. Photo 1. From the southwestern section of the site looking 30° at gravel lot and vegetation community #4: Black Cottonwood/Himalayan Blackberry/Orchardgrass-Velvetgrass-Wild Carrot Riparian Forest.



Photo point 7. Photo 1. From the parcel south of the Cove looking 95° at vegetation community #5: Colonial Bentgrass-Common Plantain-False Oatgrass Weedy/Ruderal Clearing.



Photo point 8. Photo 1. From Main St. running along the southern site boundary looking 325° at vegetation community #4.



Photo point 9. Photo 1. From the southeastern bank of the cove looking 40° at vegetation community #7: Black Cottonwood/Himalayan Blackberry/Birdsfoot Trefoil Riparian Forest.



Photo point 10. Photo 1. From the Clackamas River Trail along the eastern site boundary looking 170° at vegetation Community #8: Colonial Bentgrass-Common Plantain-Velvetgrass-Wild Carrot Weedy/Ruderal Clearing.



Photo point 10. Photo 2. From the Clackamas River Trail along the eastern site boundary looking 170° at vegetation Community #8:



Photo point 11. Photo 1. From the northern section of the study area looking 65° at vegetation community #8: Douglas fir/Hazelnut-Himalayan blackberry/False Brome-Sweetpea Riparian Forest.



Photo point 11. Photo 2. From the northern section of the study area looking 245° at vegetation community #9: Black Cottonwood/Hazelnut-Himalayan blackberry/False Brome-Sweetpea Riparian Forest

APPENDIX B

Residence Times and Water Quality within Clackamette Cove

Ecological Restoration Design ~ Civil Engineering ~ Natural Resource Management

TECHNICAL LETTER

To: John Runyon, Cascade Environmental Group

From: John Dvorsky, Waterways Consulting, Inc.

Date: November 22, 2016

Re: Residence Times and Water Quality within Clackamette Cove

Waterways Consulting, Inc (Waterways) has been asked to assist Cascade Environmental Group with an overview of the residence time of water within the Cove, how additional inflow may influence residence times, and the options that may be available to improve circulation in the Cove.

One of the primary concerns amongst stakeholders of existing conditions within the Cove is poor water quality. During the summer, low flow conditions in the Clackamas River, combined with the presence of a single opening to the Cove, results in a lack of flow exchange that has led to toxic algal blooms and health alerts. The lack of flow into the Cove limits circulation and increases the residence time of water, both prerequisites for algal blooms. During the summer months the Cove is essentially a closed system.

To understand existing conditions within the Cove and provide a basis for recommending enhancement actions that could improve circulation and water exchange within the Cove we prepared an analysis of residence times for a range of conditions. The analysis included the following steps:

- 1. Using the LiDAR and bathymetric data a stage-storage curve was generated for the Cove that correlates a range of water surface elevations to the volume of water in the Cove (Figure 2).
- 2. The Stage-Storage Curve was then used to develop estimates of the residence time of water at different stages and different inflow conditions (Table 3).

The analysis assumes that water entering the Cove would be well mixed and circulate throughout the Cove. That assumption would need to be evaluated in future phases of the project and would likely require specific actions within the Cove to make full circulation a possibility. The source and location of inflow would also need to be evaluated. Preliminarily, the best approach to increasing summer inflow into the Cove from the Clackamas River would be to create a second opening to the Clackamas at the northeast end of the Cove. To evaluate the feasibility of this approach will require the following questions to be addressed:

- 1. Irrespective of residence time, what would the circulation patterns within the Cove looks like under a range of inflow rates. This could be addressed by running scenarios with a 2-dimensional model that has already been developed for the area. The model would need to be evaluated to determine if additional site information would need to be collected and if the resolution of the model is adequate to address the questions.
- 2. If an opening is created, what would be the configuration and size to ensure an adequate amount of summertime flow could enter the Cove, erosion of the opening does not occur during high flow conditions on the Clackamas, and the opening does not accumulate sediment



to the point where summertime flows no longer enter the Cove? These are all design questions that will need to be evaluated during the feasibility and design phases.

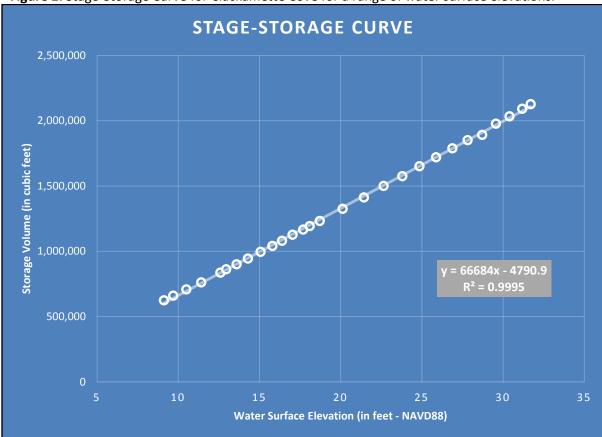




Table 3: Estimated residence time of water in Clackamette Cove under a range of water surface and inflow conditions.

Flow in Clackamas River (cfs)	Estimated WSE in Cove Using HEC-RAS (ft) ¹	Total Storage Volume in Cove (ft ³)	Flow into Cove (cfs)	Residence Time (days)
			7.2	1
626	9.1	624,003	4.8	1.5
			2.4	3
			7.6	1
970	9.7	659,380	5.1	1.5
			2.5	3
			8.2	1
1,485	10.5	707,262	5.5	1.5
			2.7	3
			8.8	1
2,000	11.4	762,244	5.9	1.5
			2.9	3
		836,982	9.7	1
3,000	12.6		6.5	1.5
			3.2	3
		900,181	10.4	1
4,000	13.6		6.9	1.5
			3.5	3
			10.9	1
5,000	14.3	944,853	7.3	1.5
			3.6	3
			11.5	1
6,000	15.1	996320.0	7.7	1.5
			3.8	3
			12.1	1
7,000	15.8	1,041,688	8.0	1.5
			4.0	3
			12.5	1
8,000	16.4	1,080,796	8.3	1.5
			4.2	3

^{1 -} Based on Mean Daily Discharge July-Oct. 2001-2016



City of Oregon City

625 Center Street Oregon City, OR 97045 503-657-0891

Staff Report

File Number: 17-407

Agenda Date: 7/11/2017 Status: Agenda Ready

To: City Commission Agenda #: 3c.

From: Public Works Director John Lewis File Type: Report

SUBJECT:

Sewer Inflow and Infiltration Abatement Program Update

RECOMMENDED ACTION (Motion):

This is to update the City Commission on the Sewer Inflow and Infiltration (I&I) Abatement Program, presented by Brown and Caldwell (B&C), who have been performing the study work for this program since Fall of 2015.

BACKGROUND:

Jon Holland, P.E., who will be leading the presentation, is a principal engineer with B&C and a recognized authority on I&I abatement throughout the Northwest. B&C is currently under contract for ongoing services related to the City's I&I abatement program. B&C completed the City's 2014 Sanitary Sewer Master Plan (SSMP), which made recommendations for further investigative work to reduce sewer I&I in Oregon City. In the past 2 years, B&C has administered additional flow monitoring and smoke testing, continuing the study work recommended in the SSMP. The draft report of the subsequent activities completed to date is available for review.

The presentation will highlight initial conclusions and explain next steps for capital improvements, policies and regulatory standards the City will need to contemplate in its efforts effectively reduce I & I.



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Technical Memorandum DRAFT

Prepared for:	City of Oregon City, Oregon
Project title:	I/I Abatement Program
Project no.:	148534
Technical Me	morandum 1
Subject:	Smoke Testing
Date:	February 10, 2017
To:	Jonathan Archibald, P.E.
From:	Ryan Retzlaff
Copy to:	Stan Kowalczyk, File
Prepared by:	Stan Kowalczyk, EIT
	Staff Nowalczyk, Eff
Reviewed by:	
neviewed by.	Ryan Retzlaff
Reviewed by:	
	Jon Holland, P.E., Oregon License 14742

Limitations:

This document was prepared solely for the City of Oregon City, OR in accordance with professional standards at the time the services were performed and in accordance with the contract between the City of Oregon City and Brown and Caldwell dated March 28, 2016. This document is governed by the specific scope of work authorized by the City of Oregon City; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the City of Oregon City and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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List of Abbreviations

BC Brown and Caldwell CCTV closed-circuit television CIP capital improvement program Oregon City City GIS geographic information system GPS **Global Positioning System** identification

ID

inflow and infiltration I/I

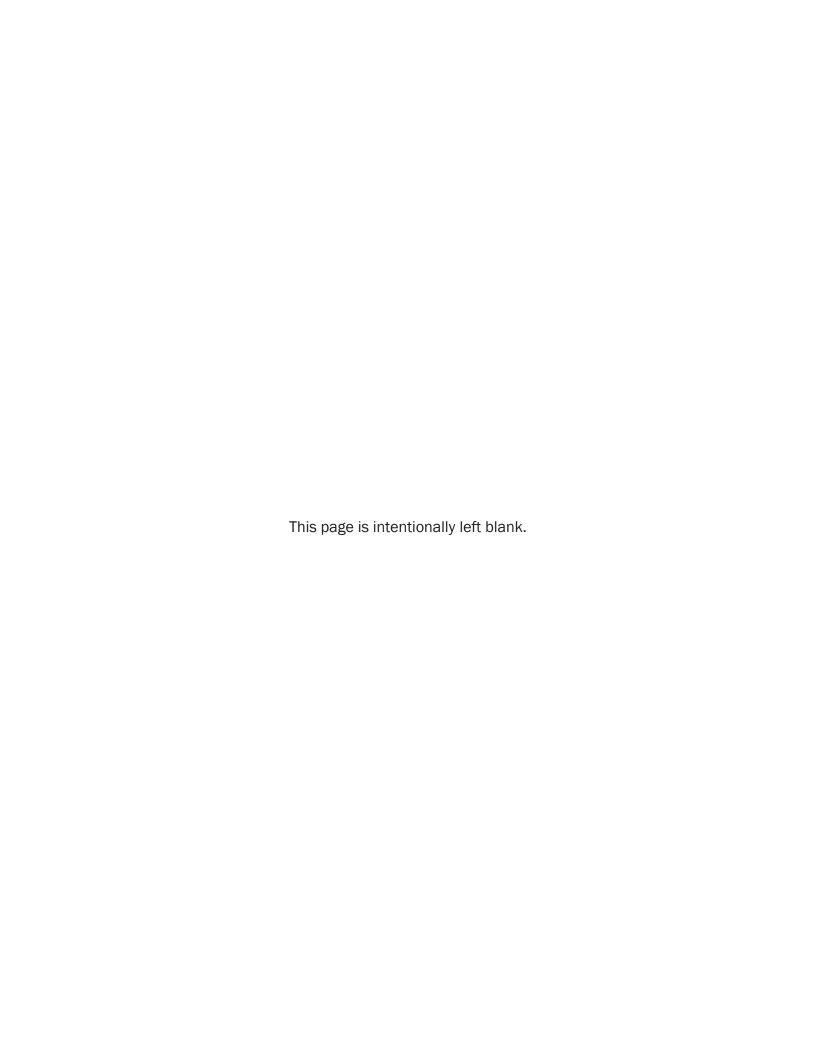
LF linear foot/feet

QA/QC quality assurance/quality control

SFE SFE Global

SSMP Sanitary Sewer Master Plan technical memorandum TM





Executive Summary

This technical memorandum (TM) describes the investigation and characterization of inflow and infiltration (I/I) sources through smoke testing of sanitary sewer pipes for the City of Oregon City. The methods and findings are described in more detail throughout this TM and include:

- Selection of basins to be smoke tested based on previously completed planning work
- Smoke testing data organization and quality assurance/quality control (QA/QC)
- Smoke testing incident characterization and mapping
- Recommendations and next steps for the I/I Abatement Program

Smoke testing was conducted in 11 sewer basins during October, November, and December of 2016. The locations selected for smoke testing are within the areas identified in the *Oregon City Sanitary Sewer Master Plan* (SSMP) as having the highest rates of I/I and were further studied with additional flow metering in 2016. The pipe and contributing areas in the 11 basins inspected are identified in Figure ES-1, below.

Table ES-1 and Figure ES-1 present the results of smoke testing by incident type and basin. Detailed basin maps can be found in Attachment A. Basins 7, 2, 8A, 8B, and 3 contained the highest concentration of incidents (80 percent). A total of 18 potential public cross-connections between the stormwater and sanitary sewer systems were identified during smoke testing. These potential cross-connections may be sources of heavy stormwater inflow directly into the sanitary sewer system. Basins 2, 7, 8A, and 4 contained the highest concentration of public cross-connections (78 percent).

Table ES-1. Summary of Smoke Testing Incidents by Type and Basin										
		Percentage of	Incident type							
Basin			Private downshouts		Private commercial connections	Ground/laterals	Miscellaneous			
1	5	4.6	1	-	-	3	1			
2	22	20.6	5	6	2	8	1			
3	12	11.2	1	2	-	5	4			
4	6	5.6	2	-	-	4	-			
5	1	0.9	-	-	-	-	1			
6	6	5.6	1	1	2	1	1			
7	23	21.5	4	8	-	11	-			
8A	16	15.0	3	7	-	6	-			
8B	13	12.1	1	5	-	6	1			
9	1	0.9	-	-	-	-	1			
10	2	1.9	-	1	-	1	-			
Total	107	100	18	30	4	45	10			



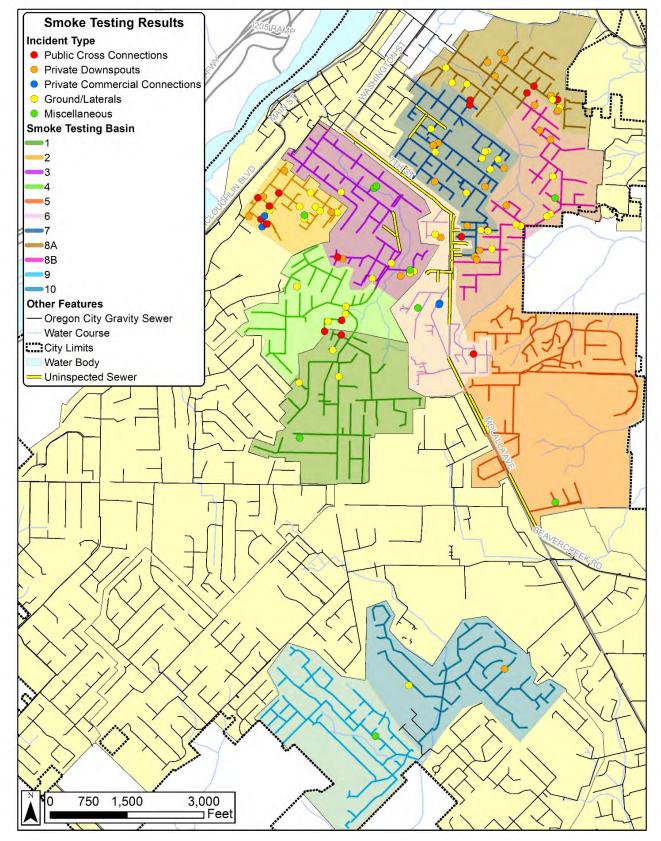


Figure ES-1. Smoke testing results



Section 1: Project Background

This section describes the goals and previously completed work of the Inflow and Infiltration (I/I) Abatement Program.

1.1 Program Goals

The goal of the I/I Abatement Program is to identify and prioritize areas in Oregon City to allow development of a prioritized plan to effectively reduce I/I into the City's sanitary sewer system. The goal of the project phase outlined by this technical memorandum (TM) is to identify potential I/I sources through smoke testing, which will be used to inform future I/I investigation and abatement efforts.

1.2 Previously Completed Work

As part of Oregon City's Sanitary Sewer Master Plan (SSMP), an analysis of a larger area was conducted to establish an initial prioritization. Figure 1 shows sewer basins that were modeled as part of the SSMP. Based on modeling results, Basins 5, 8, and 10 (identified with the rust-colored polygon in Figure 1) were identified as contributing the highest I/I rates per linear foot (LF) of sewer. Approximately 50 percent of the peak I/I flow during a 24-hour, 10-year event was attributed to these three model basins.

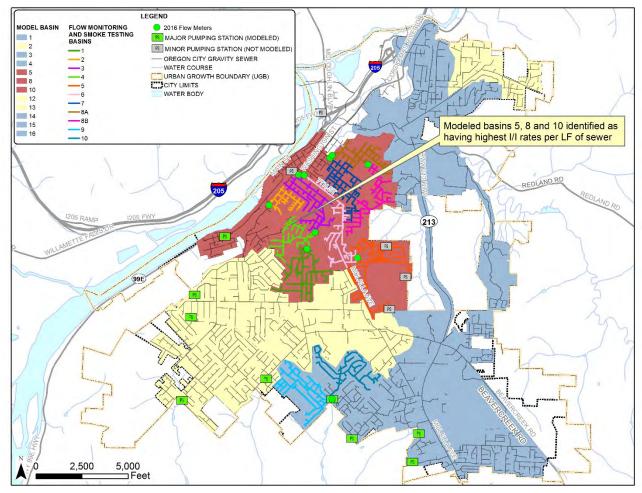


Figure 1. Previously modeled sewer basins identifying areas of initial highest priority with locations of subsequent flow monitoring and smoke testing basins



To further characterize I/I and prioritize abatement efforts, higher-resolution flow monitoring basins were selected based on the modeling results. BC selected nine flow monitoring locations within the previously modeled sewer basins identified as having the highest I/I rates. Two additional flow monitoring locations were then added near the Settler's Point Pump Station at the request of the City. Flow monitoring data were collected from the first week of January through the end of April 2016. Figure 1 shows the 11 flow monitoring basins in relation to the larger previously modeled sewer basins.

Results from analysis of the flow monitoring data indicated that the metered sewer basins with the highest rates of I/I are Basins 3, 4, and 7. These three basins make up 26 percent of the total monitored pipe length yet contribute 57 percent to 62 percent of the total I/I observed at the 11 flow monitoring locations.

Section 2: Smoke Testing

This section describes the basins that were smoke tested, the completed smoke testing work, sewers that were not smoke tested, data organization, and data quality assurance/quality control (QA/QC).

2.1 Basin Selection

Because of efficiency in locating sources of I/I, Brown and Caldwell (BC) recommended that smoke testing be conducted in all sewer basins across the city, including basins where flow monitoring data were not collected (BC 2016). After discussion with the City, it was decided that smoke testing efforts be limited to the same 11 basins where previous modeling and flow monitoring occurred.

2.2 Completed Work

BC hired SFE Global (SFE) to smoke test the sanitary sewer system in the selected 11 sewer basins and provided SFE with City maps of the sewer lines to be inspected along with manhole numbers and street names. Smoke testing entails blowing liquid smoke into an isolated pipe segment and then documenting where smoke escapes the system (other than properly vented plumbing fixtures) as potential I/I sources. Potential sources include cracks in the sewers, cross-connections between storm sewers and sanitary sewers, roof drain connections, broken/missing cleanout caps, or defective/damaged manholes.

BC worked with the City and SFE to coordinate public involvement and complete the smoke testing work to minimize impact to the public. SFE produced a smoke testing report summarizing its methods and results (Attachment B). The report provides information on each smoke testing incident or observed location of a potential I/I source. An Excel database produced by SFE provided the same information as the report, including Global Positioning System (GPS) coordinates of each smoke testing incident, in a tabular format. Further discussion regarding the data and results is included in Section 3 below.

2.3 Uninspected Sewers

A portion of the sewers in smoke testing basins 3, 5, 6, and 7 were not smoke tested. Information from SFE identifying the uninspected sewers can be found as Attachment C. All of the uninspected sewers are highlighted with a yellow line on Figures A-1 through A-12 in Attachment A.

2.4 Data Organization and QA/QC

BC reviewed the SFE report and smoke testing results and then organized a master database of all the recorded incidents, which can be found in Attachment A. SFE included a total of 108 incidents for the entire study. An identification (ID) number of 1 through 108 was attributed to each observed incident.

Based on information in the report, including photographs and documented field comments, BC modified the SFE leak source codes for 23 observed incidents that either were coded incorrectly (4 incidents) or had been



coded as "miscellaneous" (19 incidents). The majority of the 19 "miscellaneous" incidents were related to smoke coming out of the ground at a location such as a front yard, a garden, or a ditch on the side of the road. Because these incidents were all locations of smoke coming out of the ground, and their descriptions matched other incidents that were coded as "smoking ground," BC changed the leak source of these incidents from "miscellaneous" to "smoking ground."

The GPS coordinates provided by SFE for incidents 40 and 57 were incomplete. BC used the address location provided for these incidents in the SFE report and cross-referenced geographic information system (GIS) data to determine the approximate latitude and longitude coordinate for the incidents.

All data fields that were modified by BC are highlighted yellow in Table A-1 in Attachment A.

Section 3: Incident Characterization and Mapping

This section describes the characterization and mapping of smoke testing incidents.

3.1 Characterization

BC thoroughly reviewed the raw data produced by SFE to ensure QA/QC, and then further simplified the 14 documented leak source types into five incident types:

- **Public cross-connections** include stormwater catch basins (3 incidents), drains or inlets (14 incidents), and manholes (1 incident). Cross-connections have the potential to be sources of heavy inflow to the sanitary sewer system.
- **Private downspouts** drain roofs from buildings (30 incidents).
- **Private commercial connections** are various types of drains and were found to include wash pits (2 incidents), area drains (1 incident), and oil/water separators (1 incident) that is located on a private commercial property is connected to the sanitary sewer system.
- **Ground/laterals** include those cases where smoke was observed coming out of the ground through cracks in concrete pavement (10 incidents), above a suspected lateral (6 incidents), or at other ground locations (29 incidents).
- Miscellaneous are incidents that did not fall into any of the previously described categories and include smoking cleanouts (5 incidents), foundation drains (1 incident), a sanitary manhole (1 incident) indicating infiltration, or where smoke was observed inside of a house (3 incidents) due to dry traps or defective vent piping.

Table 1 provides a summary of smoke testing incidents by leak source and incident type.

Table 1. Summary of Smoke Testing Incidents by Source and Type								
Leak source Revised Percentage of quantity total incidents (%)			Incident type	Quantity	Percentage of total incidents (%)			
Catch basins	3	2.8						
Storm drains (inlets)	14	13.0	Public cross-connections	18	16.8			
Storm manholes	1	0.9						
Downspouts	30	28.0	Private downspouts	30	28.0			
Driveway drains	2	1.9	D2 - 1		0.7			
Private sump	2	1.9	Private commercial connections	4	3.7			
Service lateral	6	5.6	Ground/laterals	45	42.1			



Table 1. Summary of Smoke Testing Incidents by Source and Type							
Leak source	Revised quantity	Percentage of total incidents (%)	Incident type	Quantity	Percentage of total incidents (%)		
Cracked concrete	10	9.3					
Smoking ground	29	27.1					
Cleanout	5	4.7					
Smoke inside house	3	2.8	Martin	10			
Foundation drains	1	0.9	Miscellaneous		9.3		
Sanitary main	1	0.9					

Smoke testing incidents were also characterized according to basin location. Basins 7, 2, 8A, 8B, and 3 contained the highest concentration of total incidents (80 percent). Basins 2, 7, 8A, and 4 contained the highest concentration of public cross-connections (78 percent). Table 2 provides a summary of smoke testing incidents by incident type and basin.

	Table 2. Summary of Smoke Testing Incidents by Type and Basin								
			Incident type						
Basin	Incidents Percentage of total incidents (%)		Public cross-connections	Private downspouts	Private commercial connections	Ground/ laterals	Miscellaneous		
1	5	4.6	1	-	-	3	1		
2	22	20.6	5	6	2	8	1		
3	12	11.2	1	2	-	5	4		
4	6	5.6	2	-	-	4	-		
5	1	0.9	-	-	-	-	1		
6	6	5.6	1	1	2	1	1		
7	23	21.5	4	8	-	11	-		
8A	16	15.0	3	7	-	6	-		
8B	13	12.1	1	5	-	6	1		
9	1	0.9	-	-	-	-	1		
10	2	1.9	-	1	-	1	-		
Total	107a	100	18	30	4	45	10		

a. SFE included a total 108 incidents; however, 1 incident (ID = 83) was identified as having no observed smoke. See Table A-1 in Attachment A or SFE report in Attachment B for more information.

3.2 Mapping

The Excel database of smoke testing incidents was imported into GIS and a shapefile created to develop maps of the spatial distribution of incidents. Figure A-1 in Attachment A provides an overview map of the results of the entire smoke testing project. Figures A-2 through A-12 in Attachment A provide more detailed maps of the results of each inspected sewer basin showing the location of each incident, the type of incident, and the severity, as reported by SFE.



Section 4: Recommendations and Next Steps

This section provides recommendations and next steps for the I/I Abatement Program.

4.1 Dye Testing

Dye testing is implemented to verify a cross-connection or identify a flow path. Dye testing for cross-connection verification involves placing dye in a storm drain or catch basin and then flushing it with water. The nearby sanitary sewer is then inspected for the appearance of dyed water. If the storm system is cross-connected to the sanitary system, the dyed water will appear in the sanitary sewer.

A total of 18 likely public cross-connections were identified during smoke testing. The City should dye test each potential cross-connection to confirm the connection prior to correcting.

Table 3 provides a list of all identified public cross-connections during smoke testing.

Table 3. Public Cross-Connections							
Incident ID	Basin	Address location	Upstream manhole	Downstream manhole	Latitude	Longitude	Incident field comments
3	1	152 Harding Blvd.	13755	10864	45.34550	-122.60487	Heavy smoke from stormwater catch basin
20	2	122 S Center St.	14099	11599	45.35157	-122.61119	Storm manhole near manhole 11599 smoking
23	2	1st St. and S Center St.	12089	12091	45.35230	-122.61057	All storm drains at 1st between High and Center (4 storm drains)
24	2	1st St. and S High St.	12125	12091	45.35272	-122.61146	All storm drains at 1st between High and Center (4 storm drains)
25	2	2nd St. and S Center St.	12125	12126	45.35301	-122.60989	All storm drains at 2nd and Center (4 storm drains)
27	2	122 S Center St.	14098	11599	45.35133	-122.61075	Three catch basins in City shop parking lot
32	3	Bellevue Ave. and Brighton Ave.	11838	11554	45.34966	-122.60529	Storm drain near manhole 11554
43	4	Barclay Ave. and Har- ding Blvd.	13046	13047	45.34567	-122.60614	3 storm drains
45	4	178 Harding Blvd.	13047	13045	45.34628	-122.60486	2 storm drains near manhole 13045
50	6	515 Mt. Hood St.	10809	-	45.34466	-122.59478	Heavy smoke from storm drain; could not locate upstream manhole
53	7	13th St. and Jackson St. (South Corner)	13072	10140	45.35798	-122.59555	-
65	7	805 Taylor St.	13922	13091	45.35328	-122.59564	Catch basin and downspout cross-connected
70	7	-	13288	13109	45.35131	-122.59402	Storm drain NE of manhole 13109
73	7	418 Willamette St.	12977	12978	45.35092	-122.59595	Smoke from catch basins
84	8A	1508 Polk St.	13076	10129	45.35871	-122.59124	Smoke from catch basin
85	8A	1501 16th St. (16th and Polk)	10162	10161	45.35908	-122.59073	Storm drain at E corner of intersection
86	8A	1701 16th St. (16th and Pierce)	10066	12390	45.35839	-122.58891	Storm drain at E corner of intersection
93	8B	420 Dewey St.	13114	11505	45.35824	-122.59555	Catch basin at SE comer of Dewey and Irving Sts.



4.2 Downspout and Lateral Policy Development

A large number of smoke testing incidents were related to private downspouts or smoke coming out of the ground at a location of a suspected lateral.

The most effective I/I abatement programs include rehabilitation of service laterals. BC understands that the City is currently in the process of developing policy related to private laterals. Factors to be considered in developing new code language for service lateral rehabilitation include the following:

- Will the homeowner or the City perform the required upgrades?
- How long will the homeowner have to perform the improvements if he/she is required to perform them?
- Who will pay for the upgrades, or what will be the cost-sharing mechanism?

In addition, the City should consider developing new code that requires the disconnection of downspouts and foundation drains where alternatives to the sanitary sewer are available.

4.3 CCTV Inspection

Closed-circuit television (CCTV) inspection is a fundamental component to any sanitary sewer asset management and maintenance program. It is recommended that the City implement a citywide CCTV inspection program. In the context of the I/I Abatement Program, CCTV inspection would be analyzed to establish condition assessment of the city's sewers and to identify sources of I/I through specific sewer defects. From condition assessment, necessary programmatic solutions to reducing I/I input in the system would be developed.

BC recommends that additional CCTV inspection be coordinated with any efforts already in place so that comprehensive inspection is established across the city. Figure 2 below shows a map identifying the sewer basins by priority (Tier 1 = highest priority) for CCTV inspection based on the results of flow monitoring and smoke testing efforts. BC understands that the City has completed CCTV inspections during the past 10 years at various locations throughout the city. BC recommends that CCTV inspection be completed for pipes that have not been inspected in order of their priority identified in Figure 2.

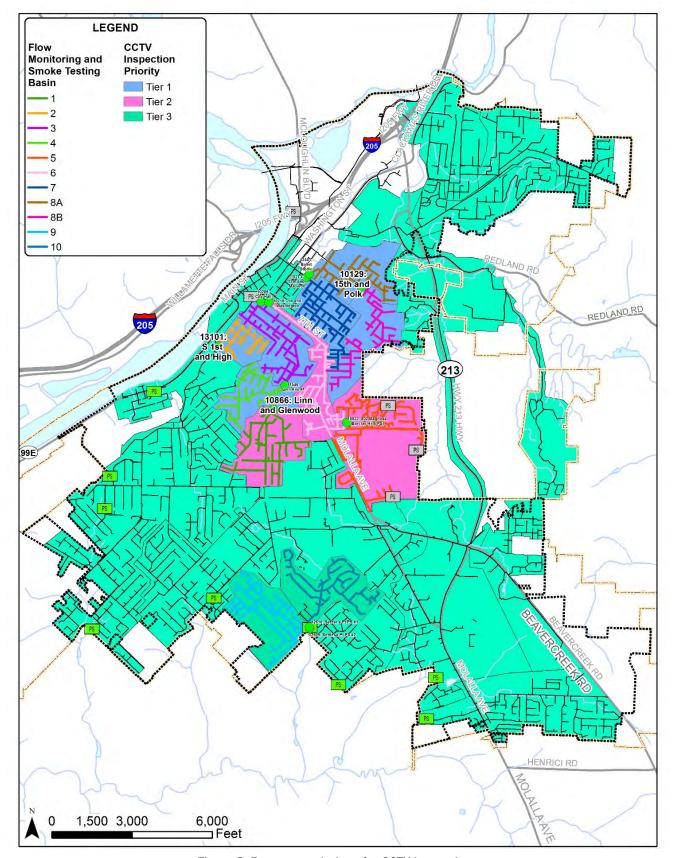


Figure 2. Recommendations for CCTV inspections



4.4 Coordination with Stormwater Master Plan

BC is currently contracted to develop a Stormwater Master Plan for the City. This work will include performing hydraulic modeling and condition assessment of stormwater assets to develop and prioritize capital improvement program (CIP) projects. I/I abatement efforts should be coordinated closely with stormwater planning efforts to inform decision making and maximize cost-effectiveness as CIP projects for the sanitary and storm systems are implemented.

References

Brown and Caldwell (BC). 2016. Flow Monitoring and I/I Characterization Memorandum, Prepared for Oregon City.

SFE Global (SFE). 2016. City of Oregon City, Oregon Sanitary Sewer Smoke Testing 2016, Prepared for Oregon City via Brown and Caldwell.



Attachment A: Smoke Testing Results

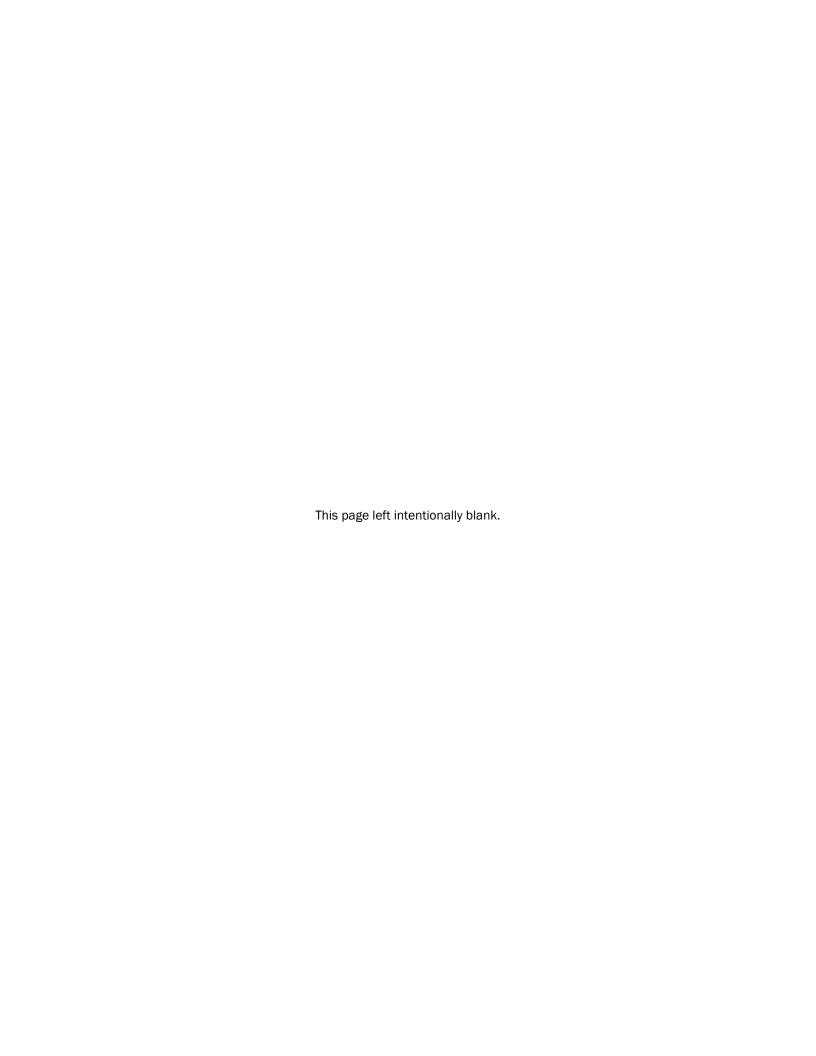


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Attachment A

Smoke Testing Results

Table A-1 provides a comprehensive list of observed smoke testing incidents. Cells that have been modified by BC from the raw data produced by SFE are highlighted yellow.

Figure A-1 provides an overview map of the results of the entire smoke testing project. Figures A-2 through A-12 provide more detailed maps of the results of each inspected sewer basin. Sewers that were not inspected during smoke testing in basins, 3, 5, 6, and 7 are identified with a yellow line.

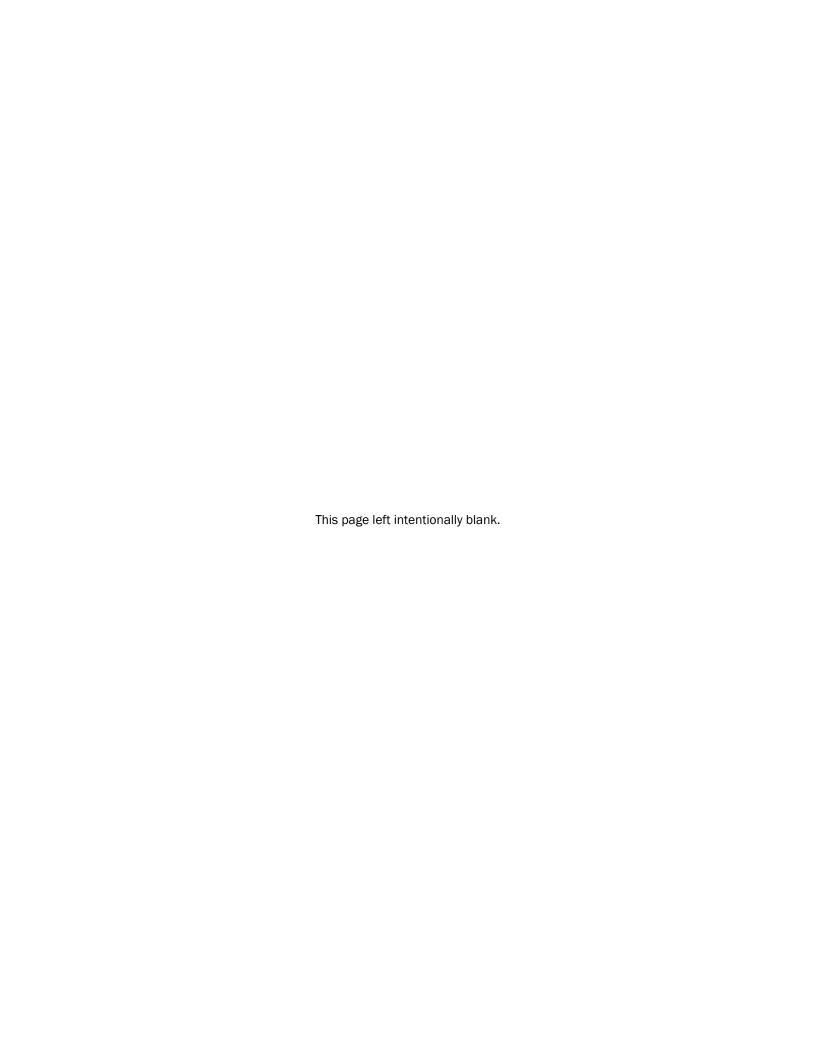


Table A-1. Smoke Testing Results												
Incident ID	Basin	Incident name	Run ID	Address location	Upstream manhole	Downstream manhole	Incident type	Leak source	Field comments	Incident severity	Latitude	Longitude
1	1	01	2	166 AV Davis Road	10893	10892	Miscellaneous	Smoke inside house	Smoke coming from crawlspace vent	Medium	45.33993	-122.60783
2	1	02	10	115 Park Drive	13756	10864	Ground/laterals	Smoking ground	Leak type is unknown, smoke coming from edge of pool, apparently connected to sanitary sewer	Medium	45.34467	-122.60548
3	1	03	10	152 Harding Boulevard	13755	10864	Public cross connections	Storm drain	Heavy smoke from stormwater catch basin	High	45.34550	-122.60487
4	1	04	14	135 Valleyview Drive	13352	10877	Ground/laterals	Smoking ground	Smoke coming from a rodent hole in the front yard	Low	45.34289	-122.60798
5	1	05	17	845 Linn Avenue	10867	11848	Ground/laterals	Smoking ground	Smoke coming from a water meter hatch	High	45.34327	-122.60497
6	2	01	1	302 Madison Street	12111	12118	Ground/laterals	Cracked concrete	Cracks in sidewalk, unknown source	Low	45.35205	-122.60540
7	2	02	1	820 3rd Street	12111	12118	Private downspouts	Downspout	Downspouts at N corner of house	High	45.35206	-122.60587
8	2	03	2	718 Spring Street	12103	12106	Ground/laterals	Cracked concrete	Leak at end of driveway/sidewalk, unknown source	Low	45.35167	-122.60790
9	2	04	2	121 Jefferson Street	13305	12107	Ground/laterals	Smoking ground	Hole in tree at E corner of property, unknown source	Low	45.35186	-122.60790
10	2	05	2	121 Jefferson Street	13306	12109	Miscellaneous	Foundation drain	Black drainage pipe along back side of property	Low	45.35186	-122.60790
11	2	06	2	213 Jefferson Street	13306	12109	Ground/laterals	Smoking ground	Leak from stone wall at SW side of property	Low	45.35232	-122.60707
12	2	07	2	210 Jefferson Street	12108	12110	Ground/laterals	Cracked concrete	Smoke from edge of sidewalk at N corner, unknown source	Low	45.35209	-122.60671
13	2	08	3	616 3rd Street	12119	12120	Ground/laterals	Smoking ground	Smoke coming from garden at N corner of property, unknown source	Low	45.35306	-122.60748
14	2	09	4	614 2nd Street	N/A	12123	Ground/laterals	Smoking ground	Smoke coming from rock wall, unknown source	Low	45.35232	-122.60828
15	2	10	5	100 S High Street	10719	12091	Private downspouts	Downspout	Leak at N comer of 100 High Street	Medium	45.35279	-122.61107
16	2	11	5	401 3rd Street	10676	10675	Private downspouts	Downspout	Downspout at S corner of property	High	45.35421	-122.60950
17	2	12	5	104 S High Street	10719	12091	Private downspouts	Downspout	Downspout at W corner of house	Medium	45.35279	-122.61107
18	2	13	6	204 S High Street	12094	13101	Private downspouts	Downspout	Downspout at W corner of house	Medium	45.35170	-122.61211
19	2	14	6	122 S Center Street	14099	11609	Private commercial connections	Driveway drain	Wash pit appears to be connected to sanitary sewer	High	45.35117	-122.61108
20	2	15	6	122 S Center Street	14099	11599	Public cross connections	Storm MH	Storm MH near MH 11599 smoking, need to verify that this is storm line/possible MH lid mislabel	Low	45.35157	-122.61119
21	2	16	7	122 S Center Street	14096	11608	Private commercial connections	Private sump	Storm drain in parking lot appears to be connected to sanitary sewer	High	45.35175	-122.61093
22	2	17	7	112 S Center Street	11608	12089	Ground/laterals	Cracked concrete	Smoke coming from edge of sidewalk, unknown source	Low	45.35206	-122.61055
23	2	18	7	1st Street and S Center Street	12089	12091	Public cross connections	Storm drain	All storm drains at 1st between High and Center have smoke coming out, 4 storm drains	High	45.35230	-122.61057
24	2	19	7	1st Street and High Street	12125	12091	Public cross connections	Storm drain	All storm drains at 1st between High and Center have smoke coming out, 4 storm drains	High	45.35272	-122.61146
25	2	20	7	2nd Street and S Center Street	12125	12126	Public cross connections	Storm drain	All storm drains at 2nd and Center have smoke coming out, 4 storm drains	High	45.35301	-122.60989
26	2	21	8	122 S Center Street	14098	11599	Private downspouts	Downspout	Leaks from gutters and downspouts at city shop	Medium	45.35133	-122.61075
27	2	22	8	122 S Center Street	14098	11599	Public cross connections	Catch basin	3 catch basins in city shop parking	High	45.35133	-122.61075
28	3	01	67	510 Monroe Street	10705	10703	Miscellaneous	Cleanout	Broken CO at corner of house	Low	45.35340	-122.60268
29	3	02	67	516 Monroe Street	10705	10703	Miscellaneous	Cleanout	Leaking cleanout	Low	45.35350	-122.60249
30	3	03	69	804 4th Street	12101	10687	Ground/laterals	Smoking ground	Leak from below sign post and curb	Medium	45.35314	-122.60516
31	3	04	76	1012 Brighton Avenue	11554	11576	Private downspouts	Downspout	Leak downspout at front corner of house	Medium	45.34958	-122.60493
32	3	05	76	Bellevue Avenue and Brighton Avenue	11838	11554	Public cross connections	Storm drain	Storm drain near MH 11554	High	45.34966	-122.60529
33	3	06	78	204 Linn Avenue	11569	11832	Ground/laterals	Smoking ground	Leak 1 was actually found during run 26, but is located within run 24; leak suspected to be from "T" in the main getting replaced	Low	45.34941	-122.60120
34	3	07	78	235 Pearl Street	11475	11476	Ground/laterals	Smoking ground	Several leaks from underneath sidewalk near MH 11476, unknown source	Low	45.34901	-122.59948
35	3	08	78	216 Pearl Street	11476	11545	Miscellaneous	Cleanout	Cleanout under front porch smoking	Low	45.34889	-122.59978
36	3	09	78	216 Pearl Street	11476	11545	Ground/laterals	Smoking ground	Smoke from hole in front yard, unknown source	Low	45.34889	-122.59977
37	3	10	78	204 Pearl Street	11476	11545	Private downspouts	Downspout	Downspouts on W side of house	High	45.34874	-122.60048
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Table A-1. Smoke Testing Results												
Incident ID	Basin	Incident name	Run ID	Address location	Upstream manhole	Downstream manhole	Incident type	Leak source	Field comments	Incident severity	Latitude	Longitude
38	3	11	78	221 Pearl Street	11476	11545	Miscellaneous	Smoke inside house	Attic vents smoking	Low	45.34907	-122.59977
39	3	12	79	157 Hazel	11566	11571	Ground/laterals	Cracked concrete	Smoke from hole in flower bed + crack in walkway, unknown source	Low	45.34856	-122.60261
40	4	01	5	639 Apperson Street	11557	11558	Ground/laterals	Smoking ground	Smoke coming from hole in yard	Low	45.34787	-122.60867
41	4	02	10	On Charman Street 250 feet W of Linn Avenue	11593	11594	Ground/laterals	Smoking ground	Medium-heavy smoke from unknown source down in ravine, no access	Medium	45.34702	-122.60457
42	4	03	11	50 feet SW of Electric Street	11583	11596	Ground/laterals	Smoking ground	In the valley of a drainage ravine that runs down to Electric Street	High	45.34663	-122.60458
43	4	04	12	Barclay Avenue and Harding Boulevard	13046	13047	Public cross connections	Storm drain	3 storm drains	High	45.34567	-122.60614
44	4	05	12	205 Harding Boulevard	13047	13045	Ground/laterals	Smoking ground	Holes in ground in front yard	Low	45.34621	-122.60590
45	4	06	12	178 Harding Boulevard	13047	13045	Public cross connections	Storm drain	2 storm drains near MH 13045	High	45.34628	-122.60486
46	5	01	2	1318 Otter Lane	12075	11294	Miscellaneous	Cleanout	11291 480 Hilltop Avenue 45.33647 122.58922, leak: unable to access leak-behind fence, no one home; possibly a cleanout	Medium	45.33684	-122.58829
47	6	01	4	420 Latourette Street	18002	18001	Miscellaneous	Cleanout	Old broken capped pipe	Low	45.34705	-122.59910
48	6	02	7	411 Pleasant Avenue	11488	11489	Private commercial connections	Private sump	Smoke from grease trap	Low	45.34733	-122.59746
49	6	03	7	411 Pleasant Avenue	11488	11489	Private commercial connections	Driveway drain	Smoke from wash drain	High	45.34726	-122.59750
50	6	04	10	515 Mt Hood Street	10809	N/A	Public cross connections	Storm drain	Heavy smoke from this storm drain, could not locate upstream MH	High	45.34466	-122.59478
51	6	06	12	326 Willamette Street	11496	N/A	Private downspouts	Downspout	Smoke from downspouts at this house	High	45.35086	-122.59750
52	6	05	12	337 Willamette Street	11496	N/A	Ground/laterals	Smoking ground	Holes in front yard, unknown source	Low	45.35102	-122.59793
53	7	01	1	13 th Street and Jackson Street (S corner)	13072	10140	Public cross connections	Storm drain		High	45.35798	-122.59555
54	7	02	9	1018 Polk Street	10110	10112	Ground/laterals	Service lateral	Hole in sidewalk, possibly a lateral	Low	45.35514	-122.59453
55	7	03	9	1112 Polk Street	10110	10112	Ground/laterals	Smoking ground	Smoke from under bush at SW corner	Low	45.35554	-122.59409
56	7	04	9		10110	10113	Ground/laterals	Service lateral	Leak from sidewalk at fencepost + driveway, possibly a lateral	Low	45.35552	-122.59431
57	7	05	10	1613 11th Street	12409	13666	Private downspouts	Downspout	Smoke from downspout and from ground near mailbox	Medium	45.35461	-122.59281
58	7	06	10	1108 Taylor Street	10116	10114	Ground/laterals	Smoking ground	Landscaping at front of house on both sides of sidewalk	Low	45.35511	-122.59330
59	7	07	10	1014 Taylor Street	13918	10116	Ground/laterals	Cracked concrete	Crack in sidewalk	Low	45.35457	-122.59388
60	7	08	12	1001 JQ Adams Street	10094	13913	Ground/laterals	Service lateral	Smoke from open pipe, unsure if it is a lateral or some sort of cleanout	Low	45.35665	-122.59846
61	7	09	15	909 Pierce Street	13635	10319	Private downspouts	Downspout	Downspout at NE corner of house	Medium	45.35363	-122.59424
62	7	10	16	914 Jackson Street	14803	13085	Private downspouts	Downspout	Downspout at SW side of house	Medium	45.35591	-122.59788
63	7	11	16	915 Jackson Street	13085	13066	Private downspouts	Downspout		Medium	45.35577	-122.59826
64	7	12	17	908 Jackson Street	13713	13085	Ground/laterals	Service lateral	Smoke from ground in line with service lateral	Low	45.35542	-122.59808
65	7	13	19	805 Taylor Street	13922	13091	Public cross connections	Catch basin	Several issues going on in this section, downspout and catch basin cross connected	Medium	45.35328	-122.59564
66	7	14	19	805 Taylor Street	13922	13091	Ground/laterals	Cracked concrete	Smoke from cracks between road and wall	Low	45.35328	-122.59564
67	7	15	19	805 Taylor Street	13922	13091	Ground/laterals	Smoking ground	Smoke from bushes and edge of wall	Low	45.35328	-122.59564
68	7	16	25	724 Van Buren Street	13096	13092	Private downspouts	Downspout	Downspouts appear to be cross connected	Medium	45.35383	-122.59808
69	7	17	27	432 Division Street	13174	13103	Private downspouts	Downspout	Downspouts appear to be cross connected	Medium	45.35151	-122.59552
70	7	18	28		13288	13109	Public cross connections	Storm drain	Storm drain NE of MH 13109	High	45.35131	-122.59402
71	7	19	28	519 Willamette Street	13288	13109	Ground/laterals	Smoking ground	Smoke from yard, unknown source	Low	45.35126	-122.59393
72	7	20	28	115 Warren Street	13104	13109	Ground/laterals	Smoking ground	Smoke from underneath new deck, possibly a covered MH	Low	45.35130	-122.59447
73	7	21	29	418 Willamette Street	12977	12978	Public cross connections	Storm drain	Smoke from catch basins, cross connection observed	High	45.35092	-122.59595
74	7	22	30	158 Warren Street	13102	13133	Private downspouts	Downspout	Smoke from drain, porch, and downspout	Medium	45.34988	-122.59489



	Table A-1. Smoke Testing Results											
Incident ID	Basin	Incident name	Run ID	Address location	Upstream manhole	Downstream manhole	Incident type	Leak source	Field comments	Incident severity	Latitude	Longitude
75	7	23	30	505 Roosevelt Street	13102	13133	Private downspouts	Downspout	Downspout at SW corner	Medium	45.34972	-122.59473
76	8A	01	2	1318 Madison Street	10158	12403	Ground/laterals	Service lateral	Multiple leaks along lateral	Low	45.35994	-122.59744
77	8A	02	4	NE side of 1005 13th Street	10148	10147	Ground/laterals	Cracked concrete	Unknown type, coming from sidewalk	Low	45.35915	-122.59695
78	8A	03	5	1510 JQ Adams Street	10794	10123	Private downspouts	Downspout	Downspout on SW side of 1511 JQ Adams	High	45.36029	-122.59431
79	8A	04	6	1320 JQ Adams Street	10139	10138	Ground/laterals	Smoking ground	Unknown type and source, smoke coming from holes in ground under bushes	Low	45.35910	-122.59582
80	8A	05	9	1205 15th Street	10125	10124	Private downspouts	Downspout	Downspout located at front of house (front door)	Medium	45.35955	-122.59370
81	8A	06	10	1616 Jackson Street	11358	11357	Private downspouts	Downspout	Smoke from downspout at NE side	Medium	45.36082	-122.59331
82	8A	07	10	1608 Jackson Street	11358	11357	Private downspouts	Downspout	Downspouts on front of house and on SW side of house both smoking	High	45.36049	-122.59300
83	8A	08	11	1616 Van Buren Street	11360	11359	None	None	No smoke from 13732–12913 possible sump pump system	None	45.36029	-122.59184
84	8A	09	14	1508 Polk Street	13076	10129	Public cross connections	Storm drain	Smoke from stormwater catch basin	High	45.35871	-122.59124
85	8A	10	18	1501 16th Street (16th and Polk)	10162	10161	Public cross connections	Storm drain	Storm drain at E corner of intersection	High	45.35908	-122.59073
86	8A	11	19	1701 16th Street (16th and Pierce)	10066	12390	Public cross connections	Storm drain	Storm drain at E corner of 16th and Pierce	High	45.35839	-122.58891
87	8A	12	19	1611 Pierce Street	12390	18024	Private downspouts	Downspout	Downspout at S corner of 1611 Pierce	Medium	45.35860	-122.58942
88	8A	13	19	1701 16th Street (16th and Pierce)	10066	12390	Ground/laterals	Cracked concrete	Sidewalk crack at E corner of 16th and Pierce, unknown source	Low	45.35839	-122.58929
89	8A	14	19	1701 16th Street (16th and Pierce)	10066	12390	Ground/laterals	Cracked concrete	Sidewalk crack at E corner of 16th and Pierce, unknown source	Low	45.35839	-122.58929
90	8A	15	19	1716 16th Street	10066	12390	Ground/laterals	Service lateral	Suspected service lateral smoking	Low	45.35795	-122.58873
91	8A	16	19	1716 16th Street	10066	12390	Private downspouts	Downspout	Smoke from downspout	High	45.35775	-122.58892
92	8A	17	19	1714 16th Street	10066	12390	Private downspouts	Downspout	Smoke from downspout	Medium	45.35781	-122.58884
93	8B	01	1	420 Dewey Street	13114	11505	Public cross connections	Catch basin	Catch basin at SE corner of Dewey Street and Irving Street	High	45.35824	-122.59555
94	8B	02	4	151 Warren Street	13599	13108	Private downspouts	Downspout	Downspout at NE corner of house	Medium	45.35022	-122.59454
95	8B	03	5	532 Willamette Street	11510	11519	Ground/laterals	Smoking ground	Hole on edge of sidewalk at NE corner of property, unknown source	Low	45.35031	-122.59360
96	8B	04	6	636 Division Street	11515	11516	Ground/laterals	Smoking ground	Smoke from ground, unknown source; likely service lateral	Low	45.35159	-122.59145
97	8B	05	6	628 Division Street	11515	11516	Ground/laterals	Smoking ground	Smoke from ground, unknown source; likely service lateral	Low	45.35165	-122.59180
98	8B	06	7	1805 9th Street	11493	11492	Private downspouts	Downspout	Downspout at E comer	High	45.35266	-122.59258
99	8B	07	8	749 Division Street	11514	11427	Ground/laterals	Smoking ground	Water meter access panel	Low	45.35226	-122.58923
100	8B	08	8	741 Division Street	11514	11427	Ground/laterals	Smoking ground	Water meter access panel	Low	45.35213	-122.58949
101	8B	09	9	1203 Division Street	10062	12908	Miscellaneous	Smoke inside house	Smoke coming from crawl space	Low	45.35312	-122.58891
102	8B	10	12	1208 Grant Street	10061	12393	Ground/laterals	Smoking ground	Smoke from ground, unknown source	Low	45.35427	-122.58912
103	8B	11	14	1901 14th Street	10057	10172	Private downspouts	Downspout	Smoke from downspouts	High	45.35624	-122.58936
104	8B	12	16	1713 14th Street	10174	10122	Private downspouts	Downspout	Smoke from downspouts	High	45.35672	-122.59021
105	8B	13	17	1601 15th Street	10179	10129	Private downspouts	Downspout	Smoke from downspouts	High	45.35806	-122.59065
106	9	01	14	19419 Provisioner Lane	10327	11742	Miscellaneous	Main sewer	MH 10325 has visible infiltration, leak source from ground water	Low	45.32408	-122.60146
107	10	01	3	19315 Whitney	11917	11921	Ground/laterals	Smoking ground	2 pipes in cement slab parking area NW of house	Low	45.32684	-122.59904
108	10	02	14	13347 Eastborne Drive	11947	11943	Private downspouts	Downspout	Old downspout connection in front yard near driveway and walkway	Medium	45.32785	-122.59181

MH = manhole.



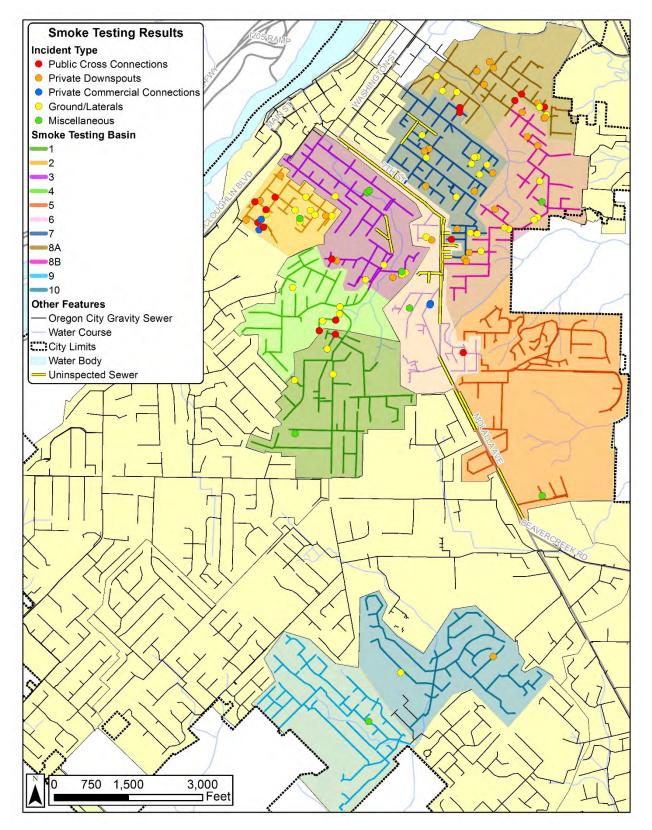


Figure A-1. Smoke testing results



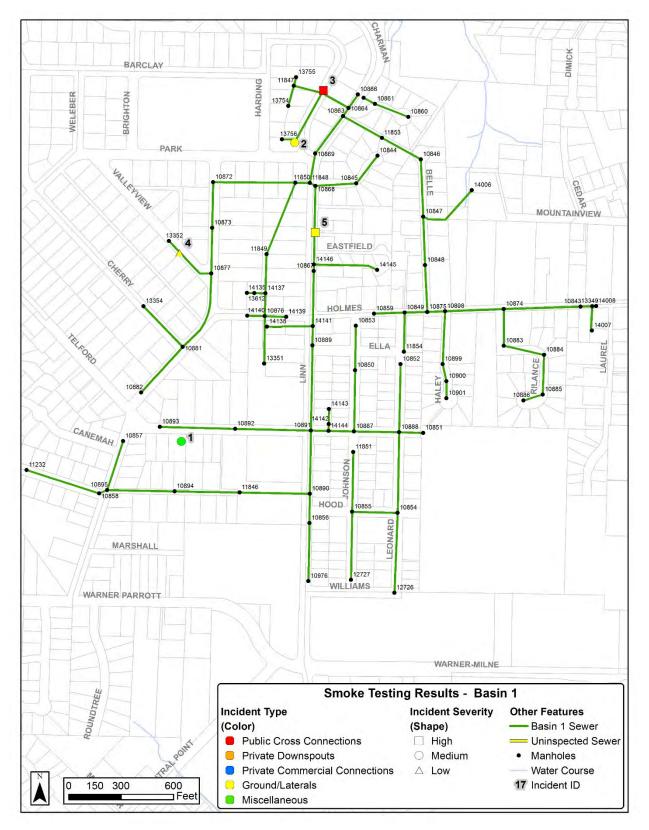


Figure A-2. Basin 1 smoke testing results



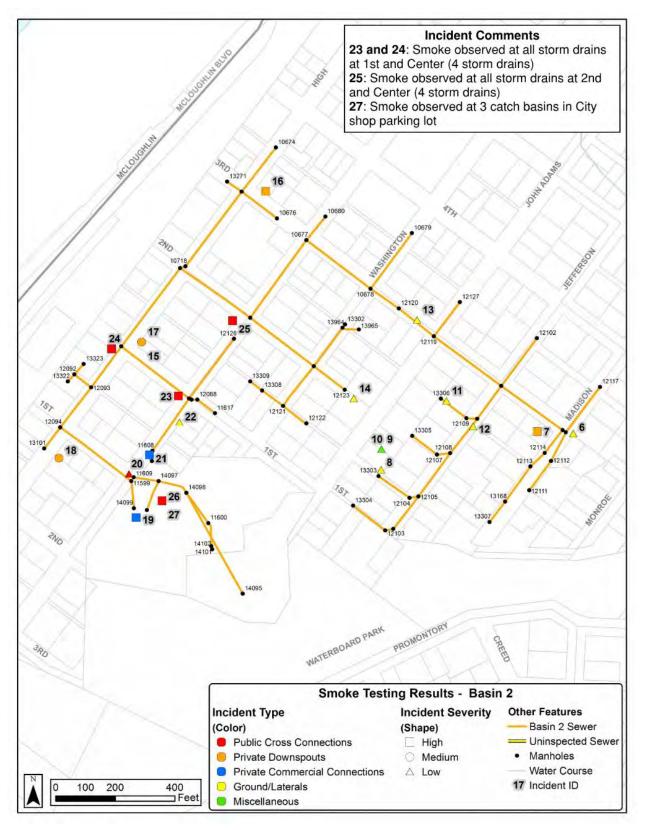


Figure A-3. Basin 2 smoke testing results



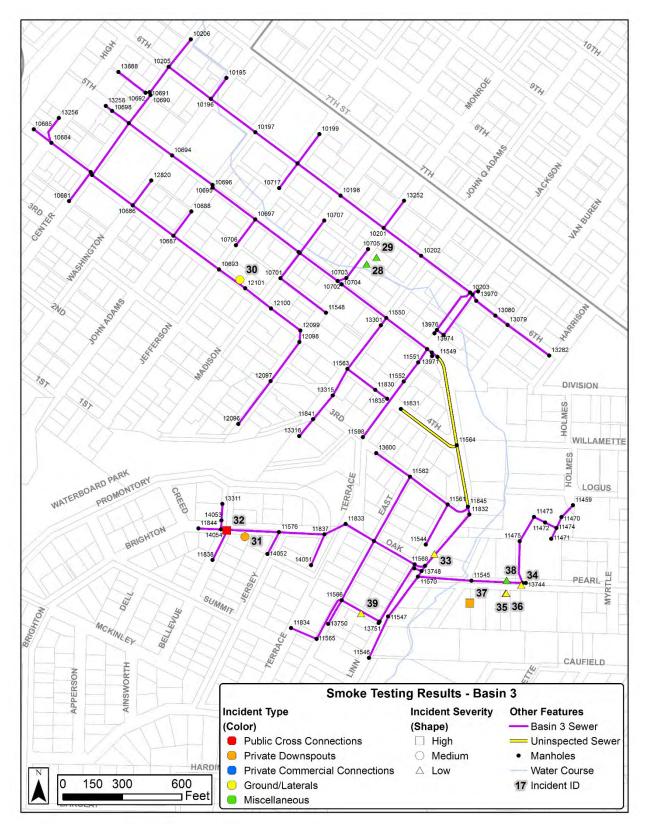


Figure A-4. Basin 3 smoke testing results



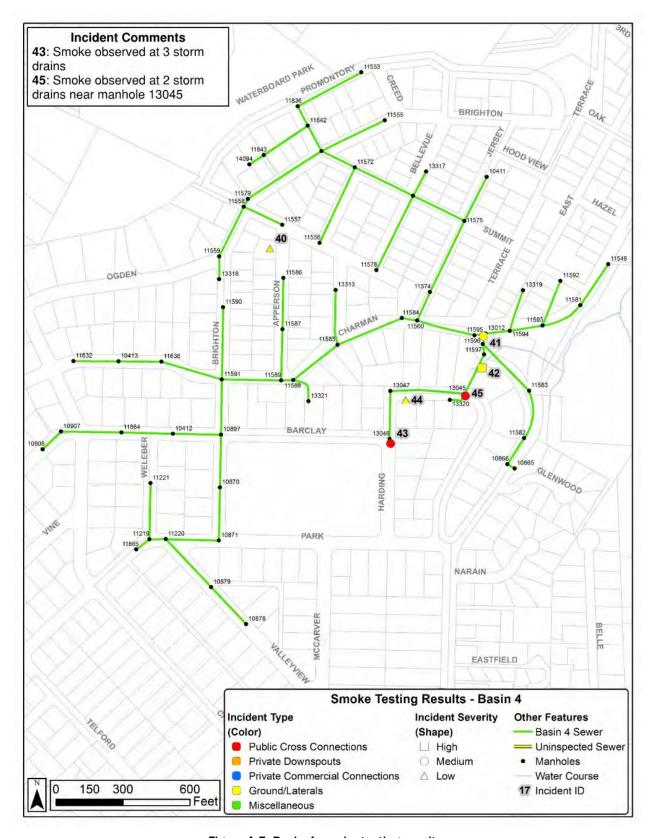
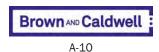


Figure A-5. Basin 4 smoke testing results



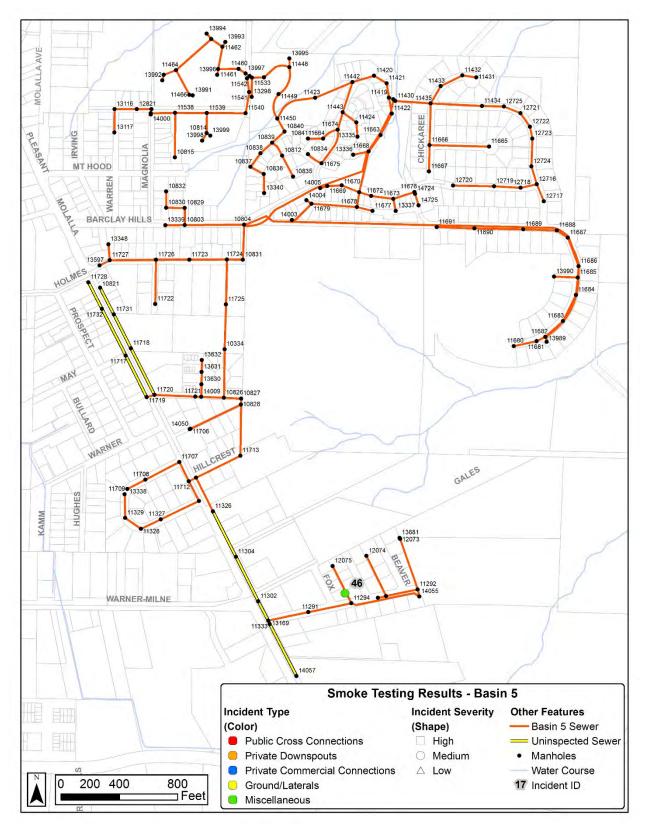
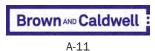


Figure A-6. Basin 5 smoke testing results



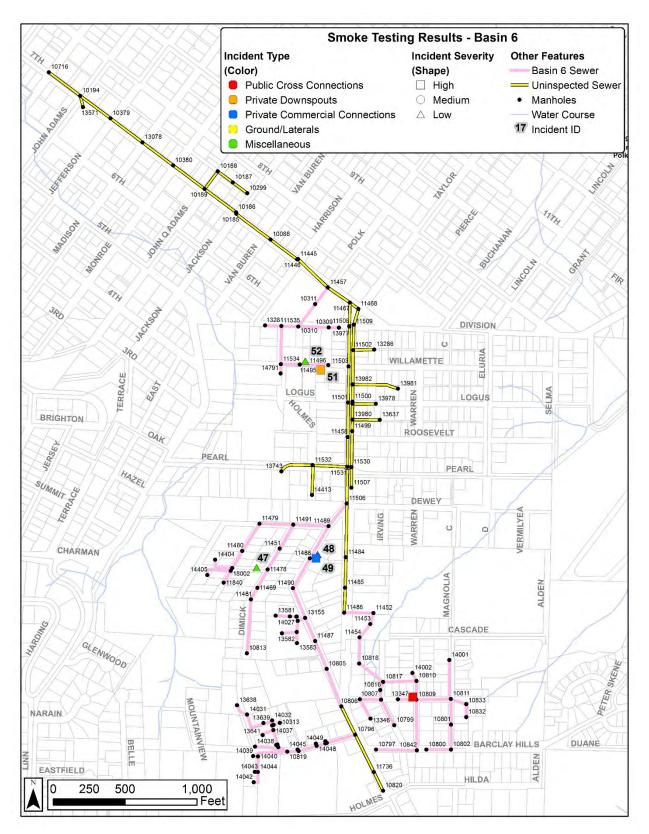
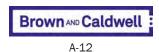


Figure A-7. Basin 6 smoke testing results



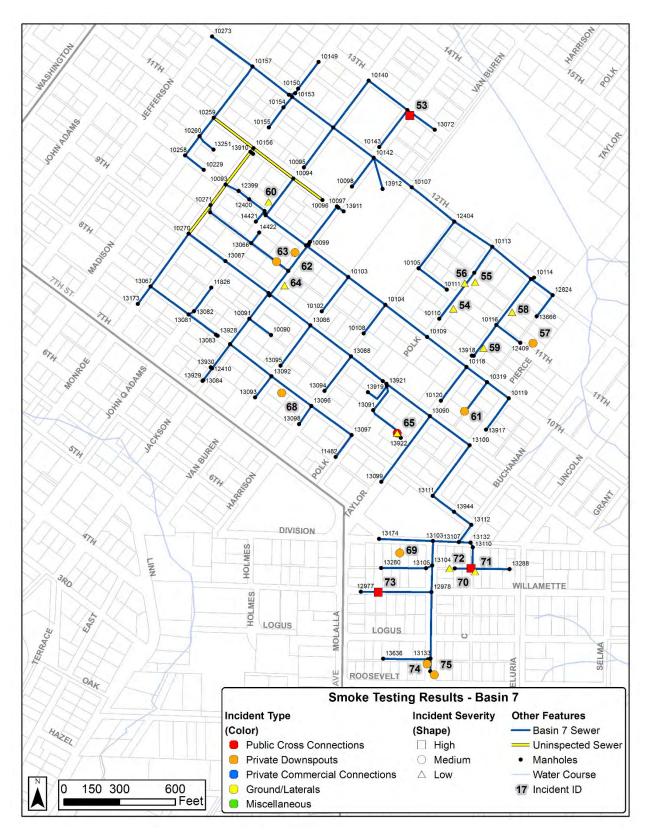


Figure A-8. Basin 7 smoke testing results



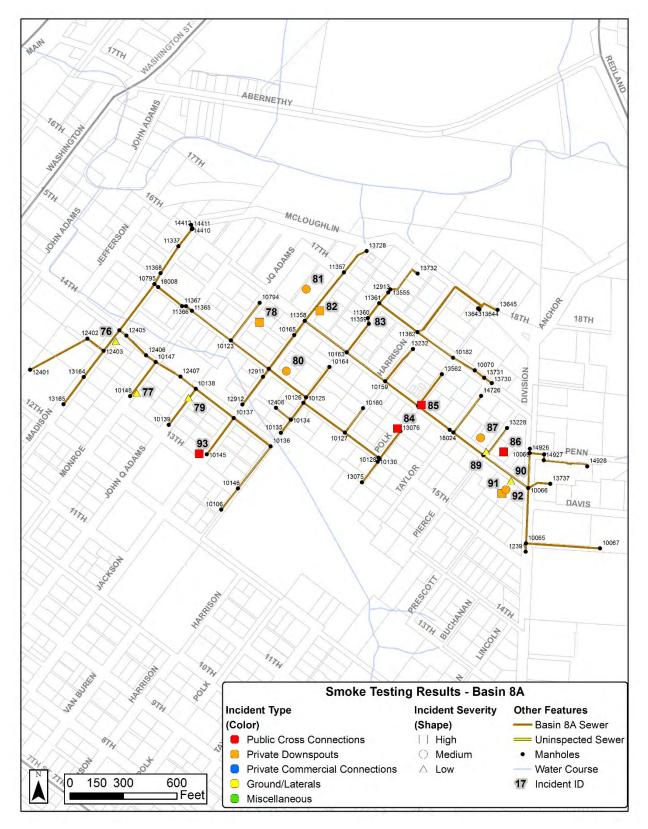


Figure A-9. Basin 8A smoke testing results



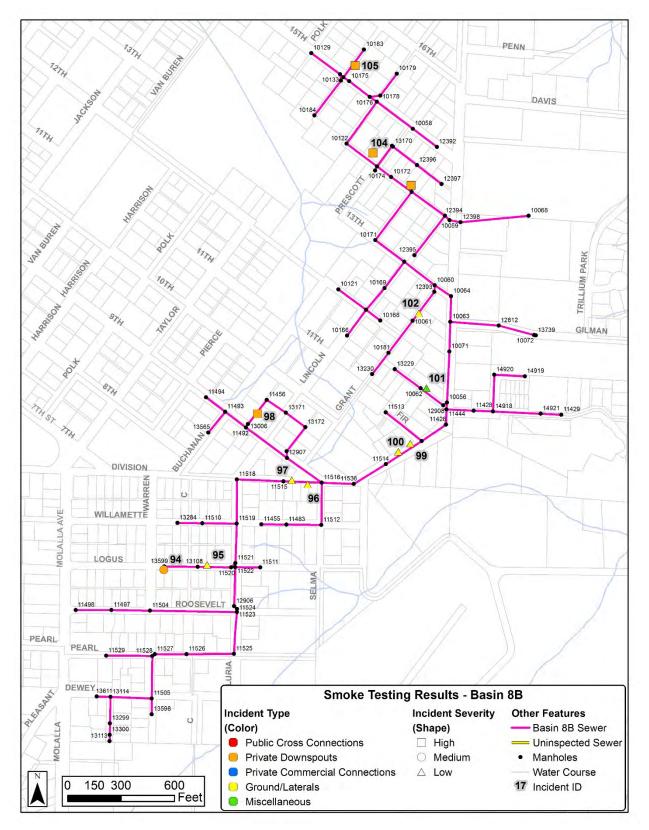


Figure A-10. Basin 8B smoke testing results



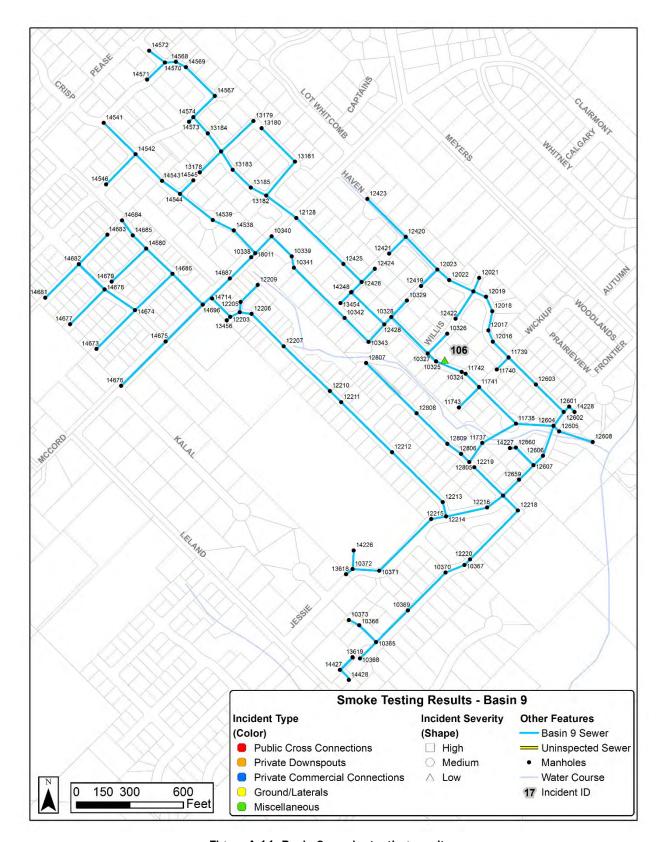
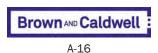


Figure A-11. Basin 9 smoke testing results



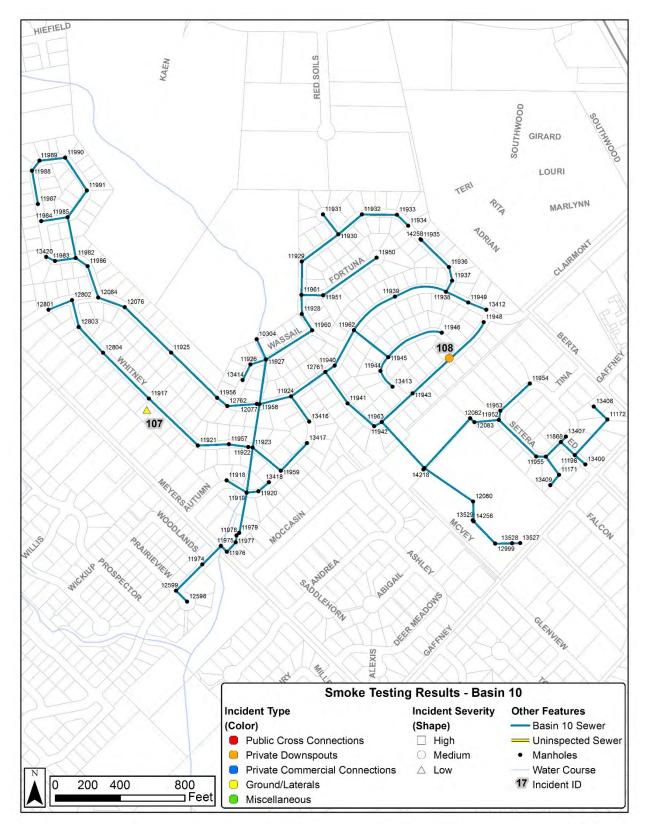
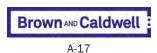


Figure A-12. Basin 10 smoke testing results



Attachment B: SFE Smoke Testing Report



Final Report for City of Oregon City, OR

Attn: Mr. Ryan Retzlaff
Brown and Caldwell

6500 SW Macadam Street

Portland, Oregon

97239

City of Oregon City, Oregon Sanitary Sewer Smoke Testing 2016



Prepared and submitted by:

SFE Global #U16-143 1313 East Maple Street Bellingham, WA 98225



December 19, 2016

Attn: Mr. Ryan Retzlaff Brown and Caldwell 6500 SW Macadam Castro Valley, CA 94546

FINAL REPORT: SFE JOB #U16-143 - OREGON CITY, OR - SANITARY SEWER SMOKE TEST

Dear Sir,

Please find enclosed SFE's Final Report for the above mentioned project. Once you have had a chance to review the report please contact me directly with any comments or questions you may have.

Although we encourage our clients not to print reports that can be utilized digitally, please feel free to let us know if you require hard copies. Thank you for having SFE conduct this work on your behalf. We appreciate the business.

Sincerely, SFE Global File #U16-143

Paul Loving

Operations Manager (604) 992-6792

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1. Introduction

SFE was retained by Brown and Caldwell, under the direction of Mr. Ryan Retzlaff, to provide consulting, technical services and equipment related to Sanitary Sewer Smoke Testing of the City of Oregon City, Oregon.

All smoke testing was conducted in October and November, 2016. This final report provides details of the tests conducted by SFE and all <u>incidents</u> whereby smoke was observed, or not observed in each area are outlined in Appendix 2. Mr. Adrian Marshall from SFE acted as Project Manager for this project.

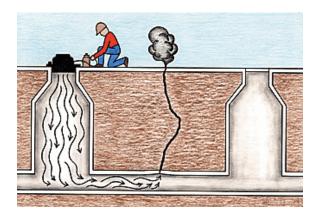
2. Smoke Testing

2.1 Smoke Testing Procedures

Smoke testing is one of the most efficient and cost effective methods of locating sources of inflow and infiltration (I&I) problems within sanitary sewers.

The non-toxic "smoke" will help find locations where storm and other sources of rain water enter the sanitary sewers. It is conducted by placing a blower over a centrally located manhole and forcing non-toxic smoke into the sanitary sewer line. As the air inside the sewer is pressurized, the smoke will fill the main line plus any and all connections. The smoke will then follow the path of any leaks to the ground's surface, quickly revealing the source of inflow and infiltration (I&I).

The smoke will be noticeable wherever there is a leak in a sanitary sewer pipe, such as a crack in a sewer pipe, a cross-connection between a storm sewer and a sanitary sewer, where a roof drain is connected to the sanitary sewer, from a broken cleanout cap, or from a defective or damaged manhole.





3. QA/QC and Safety Statement

SFE confirms that all pipeline runs were smoke tested according to industry standards and SFE's QA/QC methodology and protocol, and standard industry practice. All equipment has been removed from the site locations.

SFE has a comprehensive Company Safety Manual and can be reviewed upon request.

Where required, confined space entry procedures and general site/traffic safety was adhered to during site installation and site maintenance. SFE utilizes the "DBI SALA" rescue system, a 2800 CFM air induction device and MSA air quality monitors. All of our staff members are thoroughly trained and certified in confined space entry procedures. Certificates are available upon request.

Where required, a thorough traffic control plan was established and used by SFE Global crews. All SFE crews and vehicles are outfitted with high visibility traffic safety equipment.

A pre-job safety inspection and meeting was conducted by SFE personnel and the following potential hazards were identified:

- Need for Personal Protective Equipment
- Traffic Control Requirements
- Heavy Lifting

This project was conducted in accordance with the WCB and OSHA safety standards as documented in SFE's Safety Procedures Manual. Local emergency response procedures were reviewed. A "tail-gate" meeting was conducted by SFE to review work to be completed and the hazards present prior to this work.

Quality Assurance and Quality Control Procedures:

- All Field Crews are supplied with SFE smoke test field sheets for documentation of pertinent information.
- All Field Crews are supplied with legible City maps detailing the sewer lines, manhole numbers and street names.
- Pre-planning shall include an outline of runs laid out on the map with smoke induction and run end manholes noted.



- All incidents are detailed on the field sheets by the SFE crew foreman and shall include addresses, photos, GPS coordinates (decimal degrees), incident description, etc.
- All data entry into the SFE Smoke Testing software shall be conducted by SFE Data Processing.
- The smoke test final report shall include report body, smoke test run details, incident details and locations, maps detailing runs and if requested, raw databases for GIS.
- As a minimum 10% of the incidents shall be checked for a correlation between the incident location (i.e. address, street location) and the GPS coordinates. The SFE project manager (PM) shall ensure checks and balances are conducted for 10% of all readings. If mistakes are discovered, all incidents shall be checked by the PM.
- As a minimum, a PDF version of the final report shall be supplied to the client and printed only upon their request.

4. Conclusion

The sanitary sewer smoke test, conducted by SFE, has determined that there are several locations whereby storm and/or rain water is cross connected and entering the sanitary system. All incidents are detailed in Appendix 2 of this report.

Of particular interest are basins 2, 6 and 8A. These basins have shown several incidents of cross connections in the form of storm-water catch-basins and rainwater downspouts. There are incidents in the other basins but not to the extent showing in these three.

The following is a legend for terms utilized on the Incident Reports:

LEAK TYPE	
Codes	Definition
RWL	Rain Water Leader – Down spout
MHC	Manhole Cover
СВ	Catch Basin
SC	Service Connection
DT	Drain Tile
SPD	Swimming Pool Drain
CCD	Cleanout cap Defective



CCM	Cleanout cap Missing
CCB	Cleanout cap Broken
SI	Smoke Inside Building No Smoke from Main Vent
NS	No Smoke from Main Vent
0	Other - Specify
LEAK SURFACE COVER	
Codes	Definition
A	Asphalt Street
В	Building Movable
D	Sidewalk
E	Tress & Shrubs
G	Gravel Area
L	Asphalt Lane
N	Non Movable Structure
R	Rail Road
Т	Landscaped Area
BLVL	Landscaped Boulevard
BLVU	Unlandscaped Boulevard
LEAK SOURCE	
Codes	Definition
S	Service Connection
M	Main Sewer
ST	Storm Sewer
SD	Storm Water Ditch

Potential I&I	
Codes	Definition
0-1	Minimal
2-3	Low
4-5	Moderate
6-7	High
8-9	Very High

Should you have questions or comments please contact Paul Loving at SFE Global (604) 992-6792.

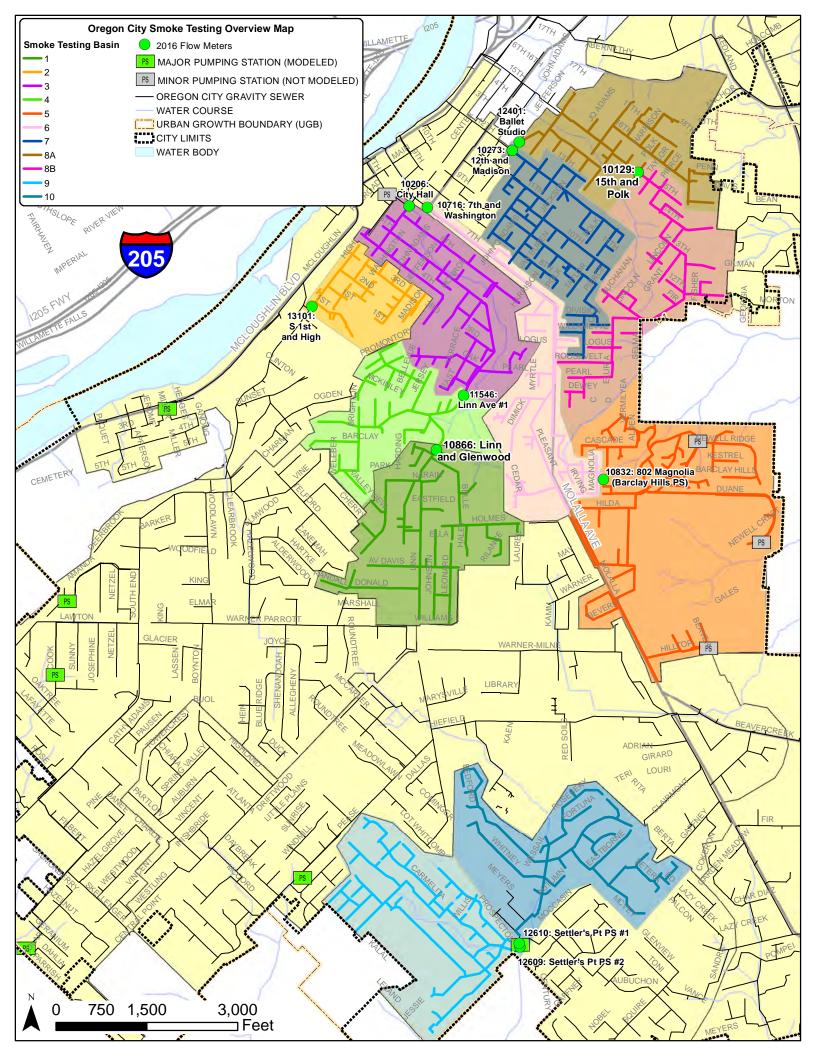
Report End December 2016

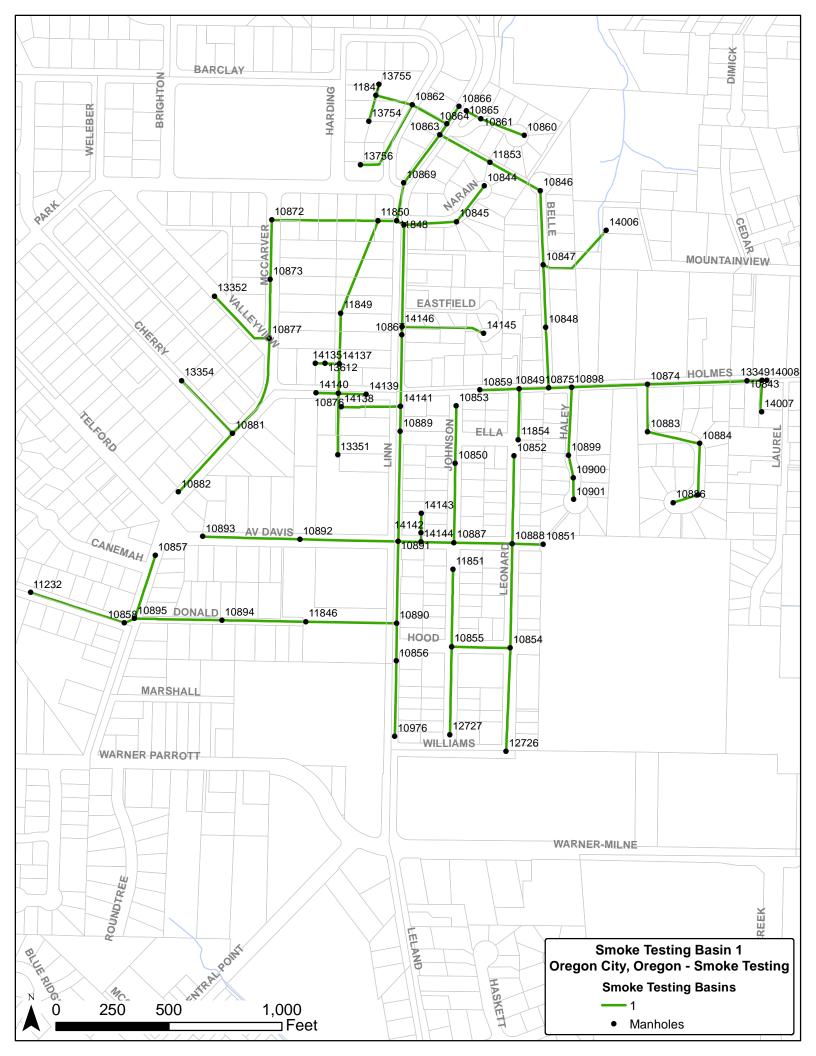
SFE Global Project U16-143



Appendix 1

Smoke Test Run Reports





Runs

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 1



Run: 01 **Date:** October 27, 2016

Run Start Manhole: 11232 Latitude 45.33943 L22.61127

Run End Manhole: 11846 45.33915 122.60645

Comments: Additional: 10857 Lat: 45.33992

Long: 122.60917

Run: 02 **Date:** October 27, 2016

Run Start Manhole: 10893 Latitude Longitude 45.34015 122.60835

Run End Manhole: 10891 45.34014 122.60493

Comments:

Run: 03 **Date:** October 27, 2016

Run Start Manhole: 11846 Latitude 45.33915 122.60645

Run End Manhole: 10891 45.34014 122.60493

Comments: Additional: 10976 Lat: 45.33780

Long: 122.60491

Runs Project:

Project: U16-143 Oregon City-Smoke Test



Basin: Basin 1

Run: 04 **Date:** October 27, 2016

Run Start Manhole: 12727 Latitude 45.33783 L22.60397

Run End Manhole: 10854 45.33889 122.60299

Comments: Additional: 11851 Lat: 45.33985

Long: 122.60401

Run: 05 **Date:** October 27, 2016

Run Start Manhole: Latitude Longitude 45.33762 122.60297

Run End Manhole: 10808 45.34016 122.60301

Comments: Additional: 10852 Lat: 45.34124

Long: 122.60302

Run: 06 **Date:** October 27, 2016

Run Start Manhole: 10853 Latitude 45.34179 Longitude 122.60404

Run End Manhole: 10887 45.34011 122.60400

Comments:

RunsProject: U16-143 Oregon City-Smoke Test

Basin: Basin 1

SFE ...

Date:

Run Start Manhole: 10888 Latitude 45.34015 122.60300

October 27, 2016

Run End Manhole: 10891 45.34014 122.60493

Comments: Additional: 14143 Lat: unable to locate Long: unable to locate

Run: 08 **Date:** October 27, 2016

Run Start Manhole: 10886 Latitude 45.34068 Longitude 122.60024

Run End Manhole: 10874 45.34211 122.60074

Comments:

Run: 07

Run: 09 **Date:** October 27, 2016

 Run Start Manhole:
 10901
 Latitude 45.34068
 Longitude 122.60195

 Run End Manhole:
 10898
 45.34207
 122.60204

Comments:

Runs Project: U16-143 Oregon City-Smoke Test

Basin: Basin 1



Run: 10	Date: October 27	, 2016	
Run Start Man	hole: 13755	Latitude	Longitude
Run End Man	hole: 10864	45.34526	122.60431
Comments: Additional	il: 13754 Lat: unable to lo Long: unable to loc		
Run: 11	Date: October 27	, 2016	
Run Start Man	hole: 10000	Latitude	Longitude
Run End Man	<u> </u>	45.34519	122.60293
	10864	45.34526	122.60431
Comments:			
Run: 12	Date: October 27	, 2016	
Run Start Man	hole: 10844	<i>Latitude</i> 45.34451	<i>Longitude</i> 122.60359
Run End Mani	hole: 11848	45.34400	122.60498
Comments:			

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 1



Run: 13 **Date:** October 28, 2016

Run Start Manhole: 10882 Latitude 45.34071 L22.60876

Run End Manhole: 10877 45.34256 122.60732

Comments: Additional: 13354 Lat: 45.34206

Long: 122.60875

Run: 14 **Date:** October 28, 2016

Run Start Manhole: 13352 Latitude Longitude 45.34311 122.60827

Run End Manhole: 10872 45.34402 122.60728

Comments:

Run: 15 **Date:** October 28, 2016

Run Start Manhole: 10872 Latitude 45.34402 Longitude 45.34402

Run End Manhole: 10864 45.34526 122.60431

Comments: Additional: 11849 Lat: unable to locate

Runs Project: U16-143 Oregon City-Smoke Test

Basin: Basin 1

Run: 16 Date: October 28, 2016

Run Start Manhole: 13351

Latitude

Longitude

Longitude

122.60497

Run End Manhole: 11849

Comments:

Additional: 14135 Lat: unable to locate

Long: unable to locate

Run: 17 Date: October 28, 2016

> Latitude Run Start Manhole: 10867 45.34265

Run End Manhole: 11848 45.34400 122.60498

Additional: 14145 Lat: unable to locate Comments:

Long: unable to locate

Run: 18 Date: October 28, 2016

> Latitude Longitude Run Start Manhole: 10891 45.34014 122.60493 Run End Manhole: 10867 45.34265 122.60497

Runs Project:

Project: U16-143 Oregon City-Smoke Test

SFE

Basin: Basin 1

Run: 19 **Date:** October 28, 2016

Run Start Manhole: 10848 Latitude 45.34277 L22.60251

Run End Manhole: 10863 45.34526 122.60431

Comments: Additional: 14006 Lat: unable to locate Long: unable to locate

Run: 20 **Date:** October 28, 2016

Run Start Manhole: Latitude Longitude 45.34201 122.60361

Run End Manhole: 10848 45.34277 122.60251

Comments: Additional: 10898 Lat: 45.34207

Long: 122.60204

Run: 21 **Date:** October 28, 2016

 Run Start Manhole:
 11854
 Latitude 45.34142
 Longitude 122.60294

 Run End Manhole:
 10849
 45.34206
 122.60293

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 1

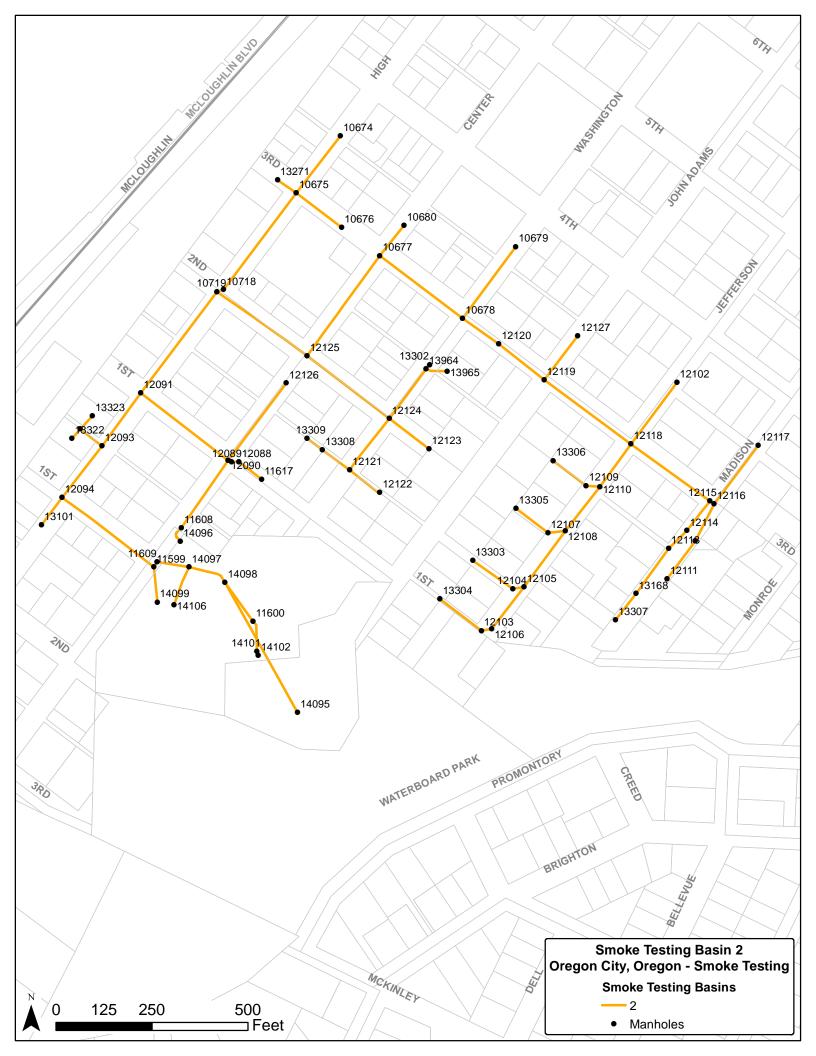


Run: 22 Date: October 28, 2016

> Latitude Longitude Run Start Manhole: 14008 45.34223 122.59879

Run End Manhole: 10898 45.34207 122.60204

Additional: 14007 Lat: unable to locate Long: unable to locate Comments:



Project: U16-143 Oregon City-Smoke Test

Basin: Basin 2



Run: 01 **Date:** November 02, 2016

Run Start Manhole: 12111 Latitude 45.35152 Longitude 45.35152 122.60601

Run End Manhole: 12118 45.35250 122.60639

Comments: Additional: 12117 Lat: 45.35250

Long:122.60508

Run: 02 **Date:** November 02, 2016

Run Start Manhole: 13304 Latitude Longitude

Run End Manhole: 12118 45.35250 122.60639

Comments: Additional: 13303 Lat: 45.35167

Long: 122.60790

Run: 03 **Date:** November 02, 2016

Run Start Manhole: 12102 Latitude 45.35292 L22.60591

Run End Manhole: 10677 45.35376 122.60892

Comments: Additional: 10679 Lat: 45.35387

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 2



Run: 04 **Date:** November 02, 2016

Run Start Manhole: 13309 Latitude Longitude 45.35245 122.60961

Run End Manhole: 10680 45.35395 122.60870

Comments: Additional: 13964 Lat: 45.35300

Long: 122.60843

Run: 05 **Date:** November 03, 2016

 Run Start Manhole:
 10674
 Latitude 45.35462
 Longitude 122.60933

Run End Manhole: 12091 45.35277 122.61137

Comments: Additional: 13271 Lat: 45.35427

Long: 122.13271

Run: 06 **Date:** November 03, 2016

Run Start Manhole: 12091 Latitude 45.35277 L22.61137

Run End Manhole: 13101 45.35165 122.61247

Comments: Additional: 14099 Lat: 45.35117

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 2



Run: 07 **Date:** November 03, 2016

Run Start Manhole: 11617 Latitude 45.35216 Longitude 122.61009

Run End Manhole: 12091 45.35277 122.61137

Comments: Additional: 12126 Lat: 45.35285

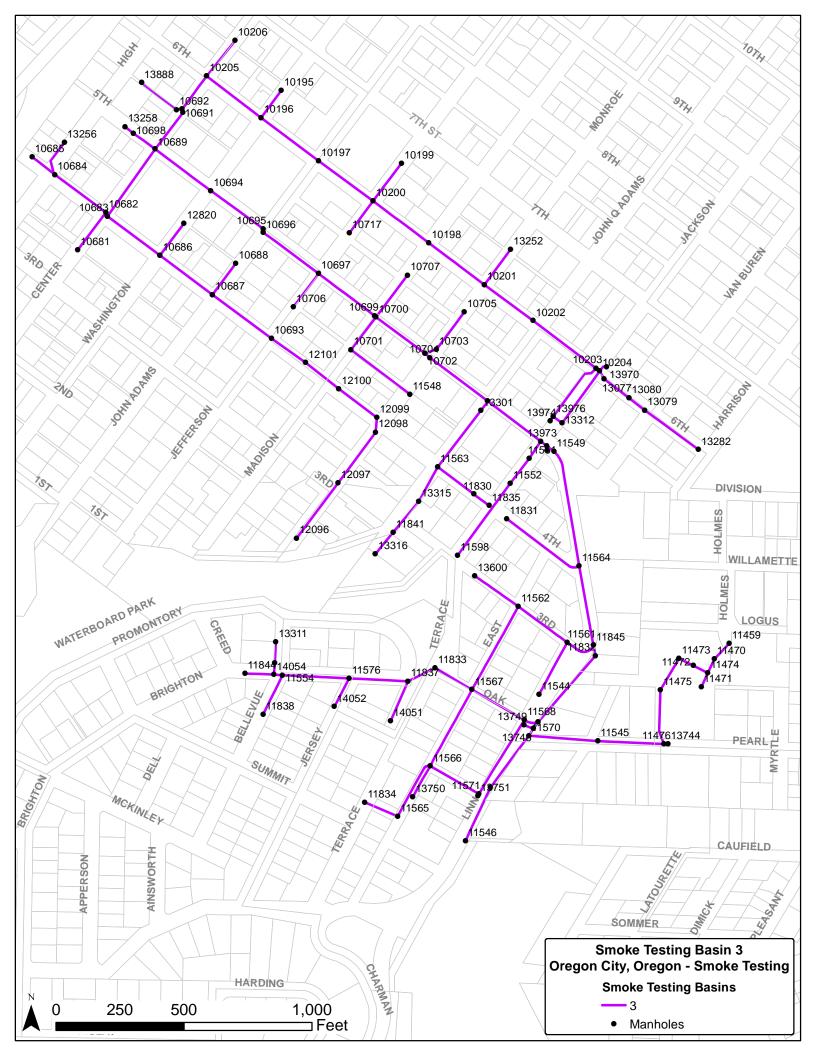
Long: 122.60989

Run: 08 **Date:** November 03, 2016

Run Start Manhole: 14095 Latitude Longitude

Run End Manhole: 11599 45.35157 122.61214

Comments: Additional: 14102 Lat: unable to locate



Project: U16-143 Oregon City-Smoke Test

Basin: Basin 3



Run: 01 **Date:** October 04, 2016

Run Start Manhole: 10685 Latitude 45.35513 L22.60932

Run End Manhole: 10683 45.35457 122.60815

Comments: Additional: 13256 Lat: 45.35517

Long: 122.60892

Run: 02 **Date:** October 04, 2016

Run Start Manhole: 13258 Latitude Longitude 45.35555 122.60793

Run End Manhole: 10681 45.35417 122.60855

Comments: Additional: 10682 Lat: 45.35456

Long: 122.60809

Run: 03 **Date:** October 04, 2016

Run Start Manhole: 10206 Latitude 45.35646 Longitude 122.60624

Run End Manhole: 10689 45.35527 122.60743

Comments: Additional: 13888 Lat: 45.35587

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 3



Run: 04 **Date:** October 04, 2016

Run Start Manhole: 10205 Latitude 45.35608 Longitude 45.35608

Run End Manhole: 10200 45.35477 122.60409

Comments: Additional: 10195 Lat: 45.35595

Long: 122.60555

Run: 05 **Date:** October 04, 2016

 Run Start Manhole:
 10199
 Latitude 45.35519
 Longitude 122.60368

Run End Manhole: 10201 45.3539 122.60239

Comments: Additional: 10198 Lat: 45.35440

Long: 122.60446

Run: 06 **Date:** October 04, 2016

Run Start Manhole: 10203 Latitude 45.35302 L22.60061

Run End Manhole: 13252 45.35429 122.60198

Comments: Additional: 10201 Lat: 45.35440

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 3



Run: 07 **Date:** October 04, 2016

Run Start Manhole: 13282 Latitude Longitude 45.35217 122.39897

Run End Manhole: 13970 45.35302 122.60051

Comments: Additional: 13079 Lat: 45.35269

Long: 122.60003

Additional: 13974 Lat: 45.35252

Run: 08 **Date:** October 04, 2016

Run Start Manhole: 13282 Latitude Longitude 45.35217 122.39897

Run End Manhole: 13970 45.35302 122.60051

Comments: Additional: 13079 Lat: 45.35269

Long: 122.60003

Additional: 13974 Lat: 45.35252

Run: 09 **Date:** October 04, 2016

Run Start Manhole: 10697 Latitude 45.35404 Longitude 122.60487

Run End Manhole: 10689 45.35527 122.60743

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 3



Run: 10 **Date:** October 04, 2016

Run Start Manhole: 10704 Latitude 45.3531 L22.6033

Run End Manhole: 10706 45.35365 122.60531

Comments:

Run: 11 **Date:** October 04, 2016

Run Start Manhole: Latitude Longitude 45.35272 122.60349

Run End Manhole: 10707 45.35398 122.60355

Comments: Additional: 10700 Lat: 45.35356

Long: 122.60403

Run: 12 **Date:** October 04, 2016

Run Start Manhole: | 13973 | Latitude | Longitude

Run End Manhole: 10703 45.35321 122.60306

Comments: Additional: 10705 Lat: 45.35357

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 3



Run: 13 **Date:** October 04, 2016

Run Start Manhole: 10687 Latitude 45.35374 Longitude 45.35374

Run End Manhole: 10682 45.35456 122.60809

Comments: Additional: 12820 Lat: 45.35452

Long: 122.60696

Run: 14 **Date:** October 04, 2016

 Run Start Manhole:
 12100
 Latitude
 Longitude

 45.35275
 122.60453

Run End Manhole: 10687 45.35374 122.60652

Comments: Additional: 10688 Lat: 45.35405

Long: 122.60616

Run: 15 **Date:** October 04, 2016

Run Start Manhole: 12096 Latitude 45.35118 L22.60516

Run End Manhole: 12100 45.35275 122.60453

Comments: Additional: 12099 Lat: 45.35249

Runs Project: U16-143 Oregon City-Smoke Test

SFE

Basin: Basin 3

Run: 16 **Date:** October 04, 2016

Run Start Manhole: 13316 Latitude Longitude

Run End Manhole: 13301 45.35262 122.6023

Comments: Additional: 11563 Lat: 45.35196

Long: 122.60300

Run: 17 **Date:** October 04, 2016

Run Start Manhole: 11598 Latitude Longitude

Run End Manhole: 11551 45.35208 122.60162

Comments: Additional: 11563 Lat: 45.35196

Long: 122.60300

Run: 19 **Date:** October 05, 2016

Run Start Manhole: 13600 Latitude Longitude

Run End Manhole: 11832 45.3501 122.60102

Comments: Additional: 11544 Lat: unable to locate Long: unable to locate

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 3



Run: 20 **Date:** October 06, 2016

Run Start Manhole: 13750 Latitude Longitude

Run End Manhole: 11562 45.35048 122.60174

Comments:

Run: 21 **Date:** October 05, 2016

 Run Start Manhole:
 11576
 Latitude
 Longitude

 45.34966
 122.60425

Run End Manhole: 11567 45.34958 122.60235

Comments: Additional: 14051 Lat: 45.34907

Long: 122.60352

Run: 22 **Date:** October 05, 2016

Run Start Manhole: 11844 Longitude 45.34968 122.60586

Run End Manhole: 11576 45.34966 122.60425

Comments: Additional: 11838 Lat: 45.34923

Runs Project: U16-143 Oregon City-Smoke Test

ty-Smoke Test

Basin: Basin 3

Run: 23 **Date:** October 05, 2016

Run Start Manhole: 11459 Latitude Longitude

Run End Manhole: 11476 45.34909 122.60049

Comments: Additional: 11471 Lat: unable to locate

Long: unable to locate

Run: 24 **Date:** October 06, 2016

Run Start Manhole: 11476 Latitude 45.34909 L22.60049

Run End Manhole: 11832 45.3501 122.60102

Comments:

Run: 25 **Date:** October 06, 2016

 Run Start Manhole:
 11834
 Latitude 45.34826
 Longitude 122.60422

 Run End Manhole:
 11571
 45.34848
 122.60227

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 3



Run: 26 Date: October 06, 2016

> Latitude Longitude Run Start Manhole: 11571 122.60227 45.34848

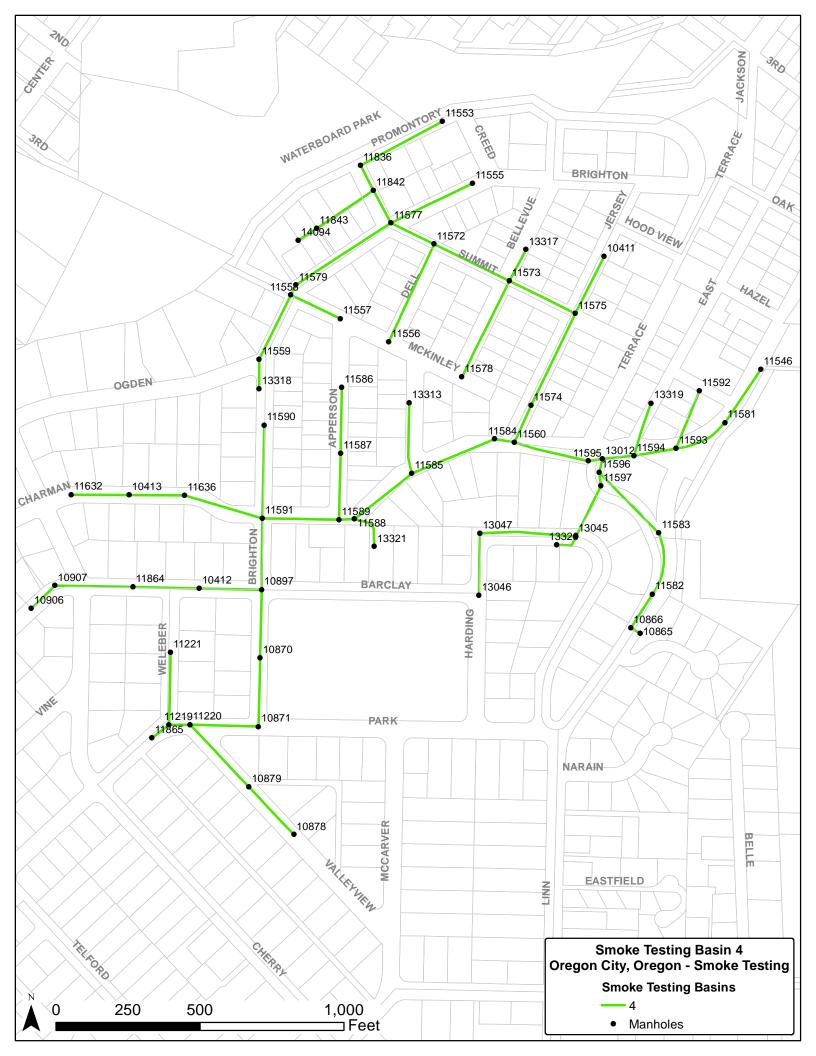
Run End Manhole: 11568 45.34929 122.6016

Additional: 11567 Lat: 45.34958 Long: 122.60235 Comments:

Run: 27 Date: October 06, 2016

> Longitude Latitude Run Start Manhole: 11546 45.34801 122.60255

> Run End Manhole: 13748 45.34908 122.60152



Project: Oregon City

Basin: Basin 4



Run: 01 **Date:** October 07, 2016

 Run Start Manhole:
 11553
 Latitude
 Longitude

 45.35015
 122.60677

Run End Manhole: 14094

Comments: Additional: 11842 Lat: 45.34963

Long: 122.60772

Run: 03 **Date:** October 07, 2016

Run Start Manhole: Latitude Longitude 45.34929 122.60749

Run End Manhole: 11573 45.34871 122.60592

Comments: Additional: 11556 Lat: 45.34815

Long: 122.60746

Run: 04 **Date:** October 07, 2016

Run Start Manhole: 11577 Latitude Longitude 45.34929 122.60749

Run End Manhole: 11573 45.34871 122.60592

Comments: Additional: 11556 Lat: 45.34815

Project: Oregon City

Basin: Basin 4



Run: 05 **Date:** October 07, 2016

 Run Start Manhole:
 11573
 Latitude 45.34871
 Longitude 122.60592

 Run End Manhole:
 11574
 45.34760
 122.60558

Comments: Additional: 10411 Lat: 45.34898

Long: 122.60468

Run: 06 **Date:** October 07, 2016

 Run Start Manhole:
 11557
 Latitude 45.34829
 Longitude 122.60819

 Pun End Manhola:
 14552
 45.34829
 122.60819

Run End Manhole: 11559 45.34791 122.60922

Comments: Additional: 13318 Lat: unable to locate

Long: unable to locate

Run: 07 **Date:** October 07, 2016

 Run Start Manhole:
 11632
 Latitude 45.34657
 Longitude 122.61172

 Run End Manhole:
 11591
 45.34641
 122.60916

Project: Oregon City

Basin: Basin 4



Run: 08 **Date:** October 07, 2016

 Run Start Manhole:
 11590
 Latitude 45.34726
 Longitude 122.60915

 Run End Manhole:
 10897
 45.34578
 122.60912

Comments:

Run: 09 **Date:** October 07, 2016

 Run Start Manhole:
 11586
 Latitude 45.34760
 Longitude 122.60812

 Run End Manhole:
 11591
 45.34641
 122.60916

Comments:

Run: 10 **Date:** October 07, 2016

Run Start Manhole: 13313 Latitude Longitude

Run End Manhole: 11589 45.34646 122.60809

Comments: Additional: 13321 Lat: unable to locate

Project: Oregon City

Basin: Basin 4



Run: 11 Date: October 07, 2016

> Latitude Longitude Run Start Manhole: 11593 45.34717 122.60420

Run End Manhole: 11560 45.34721 122.60577

Comments: Additional: 13319 Lat: 45.34758

Long: 122.60457

Run: 12 Date: October 07, 2016

> Longitude Latitude Run Start Manhole: 10865 45.34543 122.60399

Run End Manhole: 11596 122.60461 45.34692

Comments:

Run: 13 Date: October 07, 2016

> Latitude Longitude Run Start Manhole: 13046 45.34567 122.60614

Run End Manhole: 11596 45.34692 122.60461

Additional: 13320 Lat: unable to locate Comments:

Project: Oregon City

Basin: Basin 4



Run:	14	Date:	October 10, 2016

Latitude Longitude Run Start Manhole: 10906 122.61221 45.34544 Run End Manhole: 10897 45.34578 122.60912

Comments:

Run: 15 Date: October 10, 2016

> Longitude Latitude Run Start Manhole: 10871 45.34447 122.60915 Run End Manhole: 10897 45.34578 122.60912

Comments:

Run: 16 Date: October 10, 2016

> Latitude Longitude Run Start Manhole: 11221 45.34507 122.61031 Run End Manhole: 10871 45.34447 122.60915

Additional: 11865 Lat: unable to locate Comments:

Project: Oregon City

Basin: Basin 4



Run: 17 **Date:** October 10, 2016

 Run Start Manhole:
 11220
 Latitude 45.34443
 Longitude 122.61000

 Run End Manhole:
 10878
 45.34338
 122.60859

Comments:

Run: 18 **Date:** October 10, 2016

 Run Start Manhole:
 11574
 Latitude 45.34760
 Longitude 122.60558

 Run End Manhole:
 11585
 45.34691
 122.60715

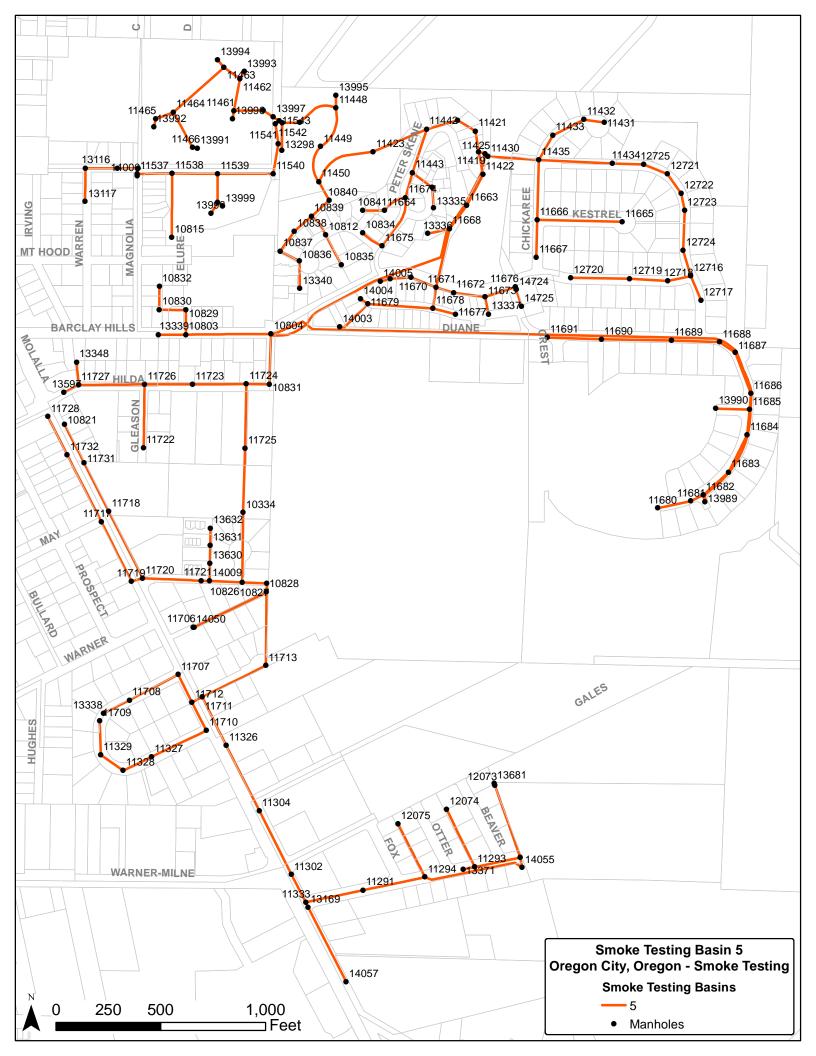
Comments: Additional: 11560 Lat: 45.34721

Long: 122.60577

Run: 02 **Date:** October 07, 2016

 Run Start Manhole:
 11555
 Latitude 45.34929
 Longitude -122.60641

 Run End Manhole:
 11558
 45.34848
 122.60880



Project: U16-143 Oregon City-Smoke Test

Basin: Basin 5



Run: 01 **Date:** November 17, 2016

Run Start Manhole: Latitude Longitude 45.33681 122.58743

Run End Manhole: 14055 45.33687 122.58646

Comments: Additional: 12074 Lat: unable to locate Long: unable to locate

Run: 02 **Date:** November 17, 2016

Run Start Manhole: 14055 Latitude Longitude 45.33687 122.58646

Run End Manhole: 13169 45.33631 122.59029

Comments: Additional: 12075 Lat: unable to locate

Long: unable to locate

Run: 03 **Date:** November 17, 2016

 Run Start Manhole:
 11709
 Latitude 45.33864
 Longitude 122.59423

 Run End Manhole:
 11711
 45.33895
 122.59238

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 5



Run: 04 **Date:** November 17, 2016

Run Start Manhole: 11709 Latitude 45.33864 Longitude 45.33864

Run End Manhole: 11712 45.33887 122.59252

Comments:

Run: 05 **Date:** November 17, 2016

Run Start Manhole: 11326 Latitude Longitude 45.33832 122.59187

Run End Manhole: 10828

Comments: Additional: 14050 Lat: 45.33986

Long: 122.59254

Run: 06 **Date:** November 17, 2016

Run Start Manhole: 10828 Latitude Longitude

Run End Manhole: 11725 45.34221 122.59164

Comments: Additional: 11719 Lat: 45.34042

Long: 112.59373

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 5



Run: 07 **Date:** November 17, 2016

Run Start Manhole: 13597 Latitude 45.34293 122.59509

Run End Manhole: 10804 45.34372 122.59124

Comments: Additional: 11725 Lat: 45.34221

Long: 122.59164

Run: 08 **Date:** November 17, 2016

Run Start Manhole: 13990 Latitude Longitude 45.34283 122.58285

Run End Manhole: 13989 45.34167 122.58312

Comments: Additional: 11680 Lat: unable to locate

Long: unable to locate

Run: 09 **Date:** November 17, 2016

 Run Start Manhole:
 11691
 Latitude 45.34380
 Longitude 122.58608

 Run End Manhole:
 11685
 45.34288
 122.58239

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 5



Run: 10 **Date:** November 17, 2016

Run Start Manhole: 12720 Latitude 45.34461 Longitude 122.58570

Run End Manhole: 11434 45.34608 122.58498

Comments: Additional: 12717 Lat: 45.34430

Long: 122.58327

Run: 11 **Date:** November 17, 2016

Run Start Manhole: 11434 Latitude Longitude 45.34608 122.58498

Run End Manhole: 11430 45.34628 122.58742

Comments: Additional: 11431 Lat: 45.34664

Long: 122.58514

Run: 12 **Date:** November 17, 2016

Run Start Manhole: 11667 Latitude 45.34481 L22.58633

Run End Manhole: 11435 45.34610 122.58633

Comments: Additional: 12074 Lat: 45.34533

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 5

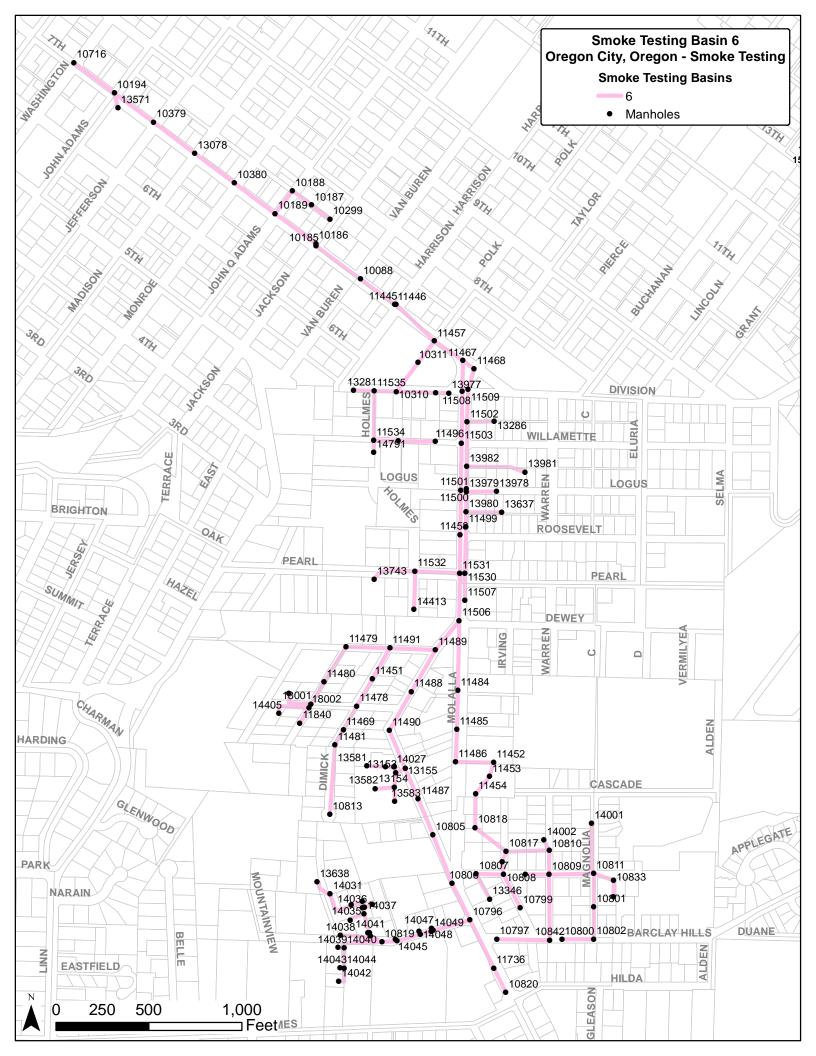


Run: 13 Date: November 17, 2016

> Latitude Longitude Run Start Manhole: 14003

Run End Manhole: 11668 45.34517 122.58807

Additional: 14725 Lat: unable to locate Long: unable to locate Comments:



Runs Project

Project: U16-143 Oregon City-Smoke Test

SFE GLOBAL

Basin: Basin 6

Run: 01 **Date:** November 01, 2016

 Run Start Manhole:
 14037
 Latitude 45.34415
 Longitude 122.59840

 Run End Manhole:
 10819
 45.34358
 122.59818

Comments: UTL all manholes except the three identified above, suspect that some of the manholes on the m

may be storm instead of sewer.

Run: 02 **Date:** November 01, 2016

 Run Start Manhole:
 10819
 Latitude 45.34358
 Longitude 122.59818

 Run End Manhole:
 10796
 45.34386
 122.59637

Comments:

Run: 03 **Date:** November 01, 2016

 Run Start Manhole:
 10819
 Latitude 45.34358
 Longitude 122.59818

Run End Manhole: 14042

Comments: UTL any of the manholes on this run (except for SM loc.). Suspect that the manholes on the map

may be storm system instead of sewer.

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 6



Run:	04	Date:	November 01, 2016
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 Run Start Manhole:
 11840
 Latitude 45.34673
 Longitude 122.60004

 Run End Manhole:
 11479
 45.34787
 122.59912

Comments: Additional: 14405 Lat: unable to locate Long: unable to locate

Run: 05 **Date:** November 01, 2016

 Run Start Manhole:
 10813
 Latitude 45.34541
 Longitude 122.59927

 Run End Manhole:
 11491
 45.34792
 122.59819

Comments:

Run: 06 **Date:** November 01, 2016

 Run Start Manhole:
 11479
 Latitude 45.34787
 Longitude 122.59912

 Run End Manhole:
 11506
 45.34832
 122.59675

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 6



Run: 07 Date:	November 01, 2016
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Latitude Longitude Run Start Manhole: 13155 45.34611 122.59775 Run End Manhole: 11489 45.34789 122.59718

Comments:

Run: 08 **Date:** November 01, 2016

> Latitude Longitude Run Start Manhole: 10806 45.34443 122.59673 Run End Manhole: 13155 45.34611 122.59775

Comments:

Run: 09 **Date:** November 02, 2016

> Latitude Longitude Run Start Manhole: 10800 45.34370 122.59438 Run End Manhole: 10809 45.34462 122.59468

Additional: 14001 Lat: unable to locate Comments:

Long: unable to locate

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 6



Run: 10 **Date:** November 02, 2016

Run Start Manhole: 10797 Latitude Longitude 45.34365 122.59575

Run End Manhole: 10810 45.34496 122.59470

Comments: Additional: 14002 Lat: unable to locate Long: unable to locate

Run: 11 **Date:** November 02, 2016

 Run Start Manhole:
 10799
 Latitude 45.34412
 Longitude 122.59531

Run End Manhole: 11486 45.34623 122.59679

Comments: Additional: 13346 Lat: unable to locate

Long: unable to locate

Run: 12 **Date:** November 02, 2016

Run Start Manhole: 11496 Latitude 45.35096 L22.59735

Run End Manhole: 11535 45.35171 122.59863

Comments: Additional: 14791 Lat: unable to locate

Long: unable to locate

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 6

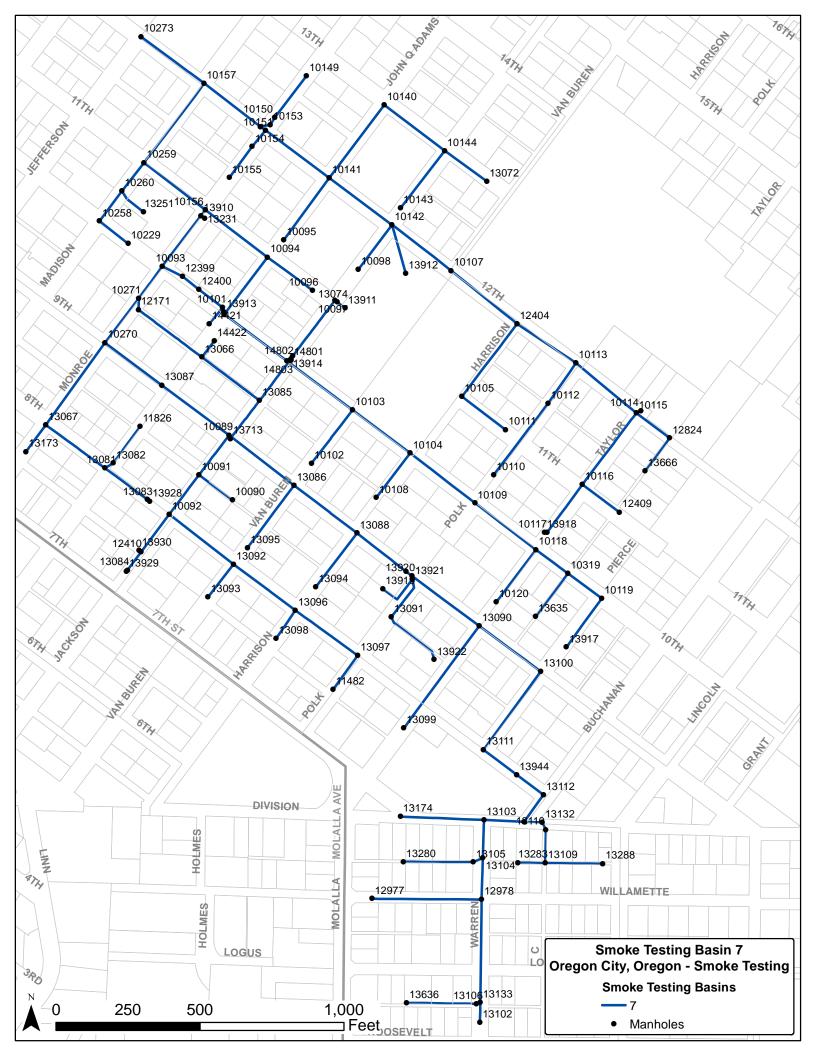


Run: 13 Date: November 02, 2016

> Latitude Longitude Run Start Manhole: 13281 45.35171 122.59905

Run End Manhole: 11457 45.35244 122.59744

Additional: 11508 Lat: 45.35168 Long: 122.59702 Comments:



Project: Oregon City

Basin: Basin 7



Run: 01 **Date:** October 12, 2016

Run Start Manhole: 10142 Latitude 45.35734 L22.59628

Run End Manhole: 10140 45.35847 122.59644

Comments: Additional: 13072 Lat: 45.35780

Long: 122.59505

Run: 02 **Date:** October 12, 2016

 Run Start Manhole:
 10151
 Latitude 45.35826
 Longitude 122.59803

Run End Manhole: 10273 45.35903 122.59974

Comments:

Run: 03 **Date:** October 12, 2016

Run Start Manhole: 10155 Latitude 45.35778 L22.59852

Run End Manhole: 10151 45.35826 122.59803

Comments: Additional: 10149 Lat: 45.35871

Project: Oregon City

Basin: Basin 7



Run: 04 **Date:** October 12, 2016

Run Start Manhole: | 13912 | Latitude | Longitude

Run End Manhole: 10154 45.35826 122.59803

Comments: Additional: 10098 Lat: 45.35686

Long: 122.59665

Run: 05 **Date:** October 12, 2016

Run Start Manhole: 10140 Latitude Longitude 45.35847 122.59644

Run End Manhole: 10141 45.35787 122.59715

Comments: Additional: 10095 Lat: 45.35718

Long: 122.59779

Run: 06 **Date:** October 12, 2016

 Run Start Manhole:
 12404
 Latitude 45.35649
 Longitude 122.56458

 Run End Manhole:
 10142
 45.35734
 122.59628

Project: Oregon City

Basin: Basin 7



Run: 07 **Date:** October 12, 2016

 Run Start Manhole:
 10111
 Latitude 45.35542
 Longitude 122.59472

 Run End Manhole:
 12404
 45.35649
 122.56458

Comments:

Run: 08 **Date:** October 12, 2016

 Run Start Manhole:
 10114
 Latitude 45.35561
 Longitude 122.59295

 Run End Manhole:
 12404
 45.35649
 122.56458

Comments:

Run: 09 **Date:** October 12, 2016

 Run Start Manhole:
 10110
 Latitude 45.35498
 Longitude 122.59487

 Run End Manhole:
 10113
 45.35606
 122.59374

Project: Oregon City

Basin: Basin 7



Run: 10 **Date:** October 12, 2016

Run Start Manhole: 13918 Latitude Longitude 45.35446 122.59410

Run End Manhole: 10114 45.35561 122.59295

Comments: Additional: 12409 Lat: unable to locate

Long: unable to locate

Run: 11 **Date:** October 12, 2016

Run Start Manhole: 10229 Latitude Longitude 45.35708 122.59985

Run End Manhole: 10157 45.35862 112.59885

Comments: Additional: 13251 Lat: 45.35731

Long: 122.59960

Run: 14 **Date:** October 12, 2016

Run Start Manhole: 14803 Latitude 45.35602 L22.59766

Run End Manhole: 10093 45.35690 122.59937

Comments: Additional: 14421 Lat: unable to locate

Long: unable to locate

Project: Oregon City

Basin: Basin 7



Run: 15 **Date:** October 12, 2016

Run Start Manhole: 10104 Latitude 45.35516 Lacitude 45.35599

Run End Manhole: 14803 45.35602 122.59766

Comments: Additional: 10102 Lat: 45.35506

Long: 122.59742

Run: 16 **Date:** October 12, 2016

Run Start Manhole: 10120 Latitude Longitude 45.35377 122.59472

Run End Manhole: 10104 45.35516 122.59599

Comments: Additional: 10108 Lat: 45.35477

Long: 122.59641

Run: 17 **Date:** October 12, 2016

Run Start Manhole: | 13917 | Latitude | Longitude

Run End Manhole: 10118 45.35428 122.59424

Comments: Additional: 13635 Lat: 45.35363

Project: Oregon City

Basin: Basin 7



Run: 18 **Date:** October 24, 2016

 Run Start Manhole:
 14803
 Latitude 45.35602
 Longitude 122.59766

 Run End Manhole:
 12171
 45.35604
 122.59882

Comments:

Run: 19 **Date:** October 24, 2016

 Run Start Manhole:
 13086
 Latitude
 Longitude

 45.35486
 122.59753

 Run End Manhole:
 10270
 45.35615
 122.60014

Comments: Additional: 13085 Lat: 45.35571

Long: 122.59808

Run: 20 **Date:** October 11, 2016

 Run Start Manhole:
 13921
 Latitude 45.35403
 Longitude 122.59591

 Run End Manhole:
 13086
 45.35486
 122.59753

Comments: Additional: 13095 Lat: 45.35426

Project: Oregon City

Basin: Basin 7



Run: 21 Date: October 11, 2016

> Latitude Longitude Run Start Manhole: 13922

Run End Manhole: 13921 45.35403 122.59591

Comments: Additional: 13919 Lat: 45.35387

Long: 122.59628

Run: 22 Date: October 11, 2016

> Longitude Latitude Run Start Manhole: 13100 45.35314 122.54410

Run End Manhole: 13921 45.35403 122.59591

Additional: 13099 Lat: 45.35257 Comments:

Long: 122.59592

Run: 23 Date: October 11, 2016

> Latitude Longitude Run Start Manhole: 13107 45.35169 122.59426 Run End Manhole: 13110 45.35315 122.59410

Additional: 13112 Lat: 45.35197 Comments:

Project: Oregon City

Basin: Basin 7



Run: 24 **Date:** October 11, 2016

 Run Start Manhole:
 13173
 Latitude 45.35513
 Longitude 122.60121

 Run End Manhole:
 10270
 45.35615
 122.60014

Comments:

Run: 25 **Date:** October 11, 2016

 Run Start Manhole:
 13928
 Latitude 45.35472
 Longitude 122.59959

 Run End Manhole:
 13067
 45.35513
 122.60094

Comments: Additional: 11826 Lat: 45.35537

Long: 122.59962

Run: 26 **Date:** October 11, 2016

 Run Start Manhole:
 13084
 Latitude 45.35396
 Longitude 122.59976

 Run End Manhole:
 10089
 45.35531
 122.59841

Comments: Additional: 10090 Lat: 45.35470

Project: Oregon City

Basin: Basin 7



Run: 27 **Date:** October 11, 2016

Run Start Manhole: 13096 Latitude 45.35364 Longitude 45.35364

Run End Manhole: 10092 45.35452 122.59924

Comments: Additional: 13093 Lat: 45.35376

Long: 122.59863

Run: 28 **Date:** October 11, 2016

Run Start Manhole: Latitude Longitude 45.35282 122.59708

Run End Manhole: 13096 45.35364 122.59747

Comments: Additional: 13098 Lat: 45.35340

Long: 122.29775

Run: 29 **Date:** October 11, 2016

Run Start Manhole: 13109 Latitude 45.35131 L22.59402

Run End Manhole: 13174 45.35169 122.59601

Comments: Additional: 13132 Lat: 45.35163

Project: Oregon City

Basin: Basin 7



Run: 30 **Date:** October 11, 2016

Run Start Manhole: 13288 Latitude Longitude 45.35130 122.59328

Run End Manhole: 13109 45.35131 122.59402

Comments: Additional: 13104 Lat: unable to locate Long: unable to locate

Run: 31 **Date:** October 11, 2016

Run Start Manhole: 12977 Latitude Longitude 45.35091 122.59637

Run End Manhole: | 13103

Comments: Additional: 13280 Lat: unable to locate

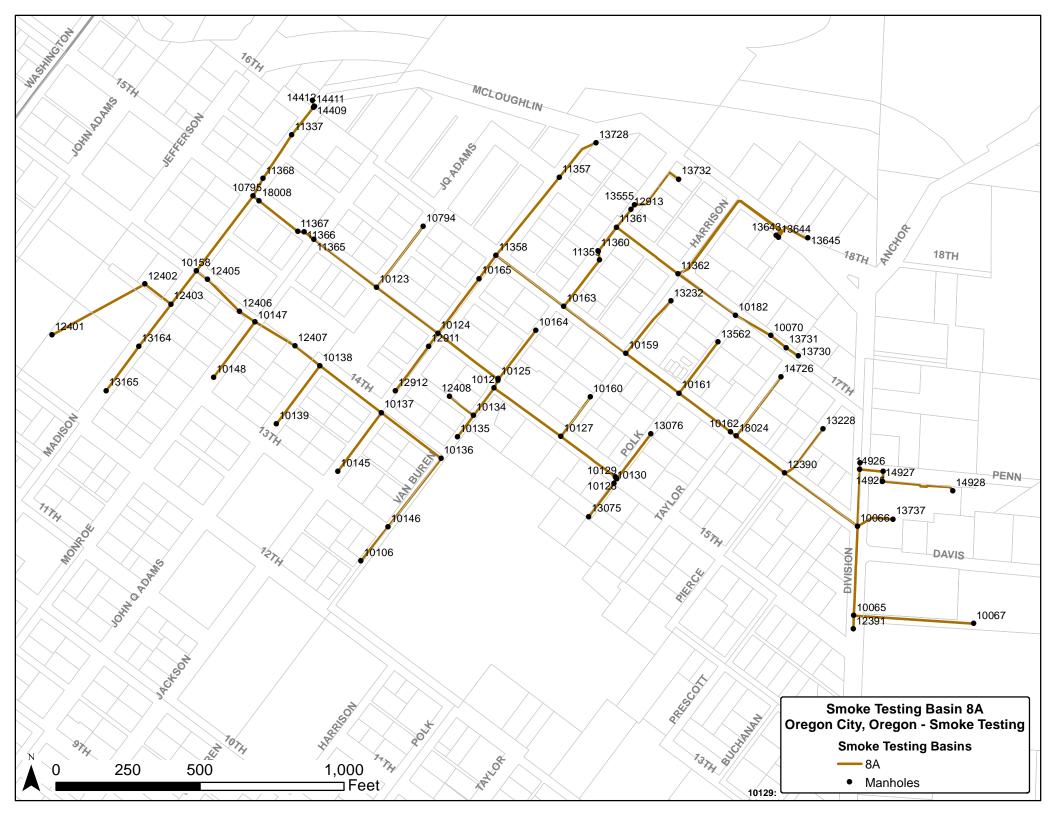
Long: unable to locate

Run: 32 **Date:** October 11, 2016

Run Start Manhole: 13102 Latitude 45.34978 122.59484

Run End Manhole: 12978 45.35092 122.59492

Comments: Additional: 13636 Lat: 45.34996



Runs	Proje
Kuns	170

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8A



Run: 01	Date:	October 26, 2016	3	
Run Start Manhol	e: 11412		Latitude 45.36167	<i>Longitude</i> 122.59585
Run End Manhol	e: 10795		45.36085	122.59669
Comments:				

Date:

		Latitude	Longitude
Run Start Manhole: 10	795	45.36085	122.59669
Run End Manhole: 13	165	45.35898	122.59856

October 26, 2016

Comments:

Run: 02

 Run:
 03
 Date:
 October 26, 2016

 Run Start Manhole:
 12401
 Latitude
 Longitude

 Run End Manhole:
 12403
 45.35981
 122.59773

RunsProject: U16-143 Oregon City-Smoke Test

Basin: Basin 8A

) SFE

Run: 04 **Date:** October 26, 2016

Run Start Manhole: 12407 Latitude Longitude

Run End Manhole: 10158 45.36009 122.59740

Comments: Additional: 10148 Lat: 45.35911

Long: 122.59710

Run: 05 **Date:** October 25, 2016

Run Start Manhole: Latitude Longitude 45.36048 122.59431

Run End Manhole: 10795 45.36085 122.59669

Comments:

Run: 06 **Date:** October 26, 2016

 Run Start Manhole:
 10136
 Latitude 45.35837
 Longitude 122.59403

Run End Manhole: 12407

Comments: Additional: 10139 Lat: 45.35872

Runs	
ILUIUS	

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8A



Run: 07	Date:	October 26, 2016
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 Run Start Manhole:
 10106
 Latitude 45.35738
 Longitude 122.59505

 Run End Manhole:
 10136
 45.35837
 122.59403

Comments:

Run: 08 **Date:** October 25, 2016

 Run Start Manhole:
 10120
 Latitude 45.35915
 Longitude 122.59327

 Run End Manhole:
 10123
 45.35999
 122.59493

Comments:

Run: 09 **Date:** October 25, 2016

 Run Start Manhole:
 11358
 Latitude 45.36032
 Longitude 122.59331

 Run End Manhole:
 12912
 45.35903
 122.59465

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8A



Run: 10 **Date:** October 25, 2016

 Run Start Manhole:
 13728
 Latitude 45.36143
 Longitude 122.59200

 Run End Manhole:
 11358
 45.36032
 122.59331

Comments:

Run: 11 **Date:** October 25, 2016

Run Start Manhole: 13732 Latitude Longitude

Run End Manhole: 10163 45.35988 122.59240

Comments:

Run: 12 **Date:** October 25, 2016

Run Start Manhole: 10135 Latitude 45.35843 L22.59396

Run End Manhole: 10125 45.35925 122.59341

Comments: Additional: 12408 Lat: 45.35891

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8A



Run: 13 **Date:** October 25, 2016

 Run Start Manhole:
 10129
 Latitude 45.35820
 Longitude 122.59168

 Run End Manhole:
 10120
 45.35915
 122.59327

Comments:

Run: 14 **Date:** October 25, 2016

Run Start Manhole: 13076 Latitude Longitude 45.35871 122.59124

Run End Manhole: 10129 45.35820 122.59168

Comments: Additional: 13075 Lat: 45.35789

Long: 122.59200

Run: 15 **Date:** October 25, 2016

Run Start Manhole: 13645 Latitude 45.36061 L22.58915

Run End Manhole: 11362 45.36025 122.59088

Comments: Additional: 13643 Lat: 45.36062

Long: 122.58951

(line is a pump system did not smoke)

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8A



Run: 16 **Date:** October 25, 2016

 Run Start Manhole:
 13730
 Latitude 45.35949
 Longitude 122.58921

 Run End Manhole:
 11361
 45.36061
 122.59167

Comments:

Run: 18

Run: 17 **Date:** October 25, 2016

 Run Start Manhole:
 10161
 Latitude 45.35907
 Longitude 122.59081

 Run End Manhole:
 11358
 45.36032
 122.59331

Comments: Additional: 13232 Lat: 45.35995 Long: 122.59092

Date:

Run Start Manhole: 13562 Latitude 45.35995 122.59032

October 25, 2016

Run End Manhole: 18024 45.35870 122.59012

Comments: Additional: 14726 Lat: 45.35876

Runs	Project:	U16-143 Oregon
	Basin:	Basin 8A



Run: 19 Date: October 25, 2016

> Latitude Longitude Run Start Manhole: 10066 45.35784 122.58836 Run End Manhole: 18024 45.35870 122.59012

City-Smoke Test

Comments: Additional: 14726 Lat: 45.35876

Long: 122.58891

Run: 20 Date: October 25, 2016

> Longitude Latitude Run Start Manhole: 10067 45.35700 122.58697 Run End Manhole: 10066 45.35784 122.58836

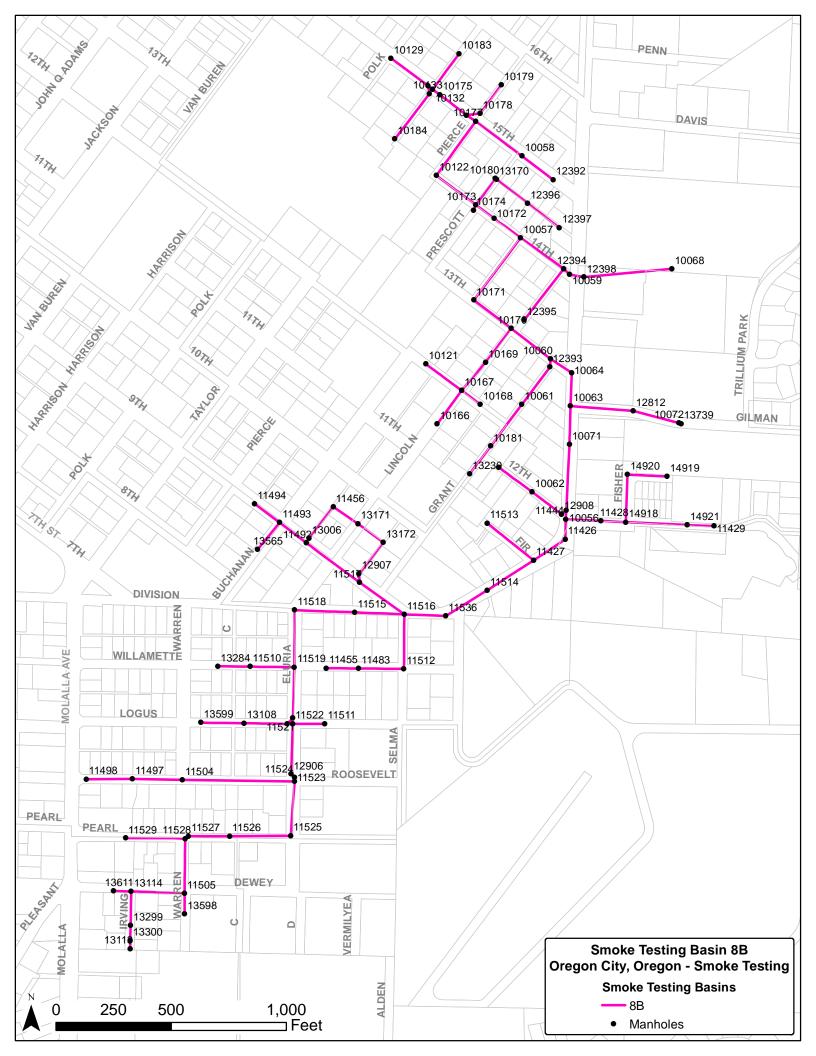
Comments:

Date: **Run:** 21 October 25, 2016

> Latitude Longitude Run Start Manhole: 14928

Run End Manhole: 14926

Did not smoke this line because one manhole was plugged. Comments:



Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8B



Run: 01 **Date:** December 01, 2016

Run Start Manhole: 13113 Latitude Longitude 45.34760 122.59564

Run End Manhole: 11505 45.34822 122.59471

Comments: Additional: 13611 Lat: unable to locate

Long: unable to locate

Run: 02 **Date:** December 01, 2016

Run Start Manhole: 11505 Latitude Longitude 45.34822 122.59471

Run End Manhole: 11525 45.34893 122.59300

Comments: Additional: 11529 Lat: 45.34890

Long: 122.59576

Run: 03 **Date:** December 01, 2016

Run Start Manhole: 11498 Latitude 45.34960 L22.59643

Run End Manhole: 11523 45.34960 122.59293

Comments: Additional: 11525 Lat: 45.34893

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8B



Run: 04 Date: December 01, 2016

> Latitude Longitude Run Start Manhole: 13599 45.35034 122.59457

Run End Manhole: 11511 45.35032 122.59243

Additional: 11523 Lat: 45.34960 Comments:

Long: 122.59293

Run: 05 **Date:** December 01, 2016

> Latitude Longitude Run Start Manhole: 13284

> Run End Manhole: 11518 45.35164 122.59302

Additional: 11521 Lat: 45.35031 Comments:

Long: 122.59301

Date: December 01, 2016 **Run:** 06

> Latitude Longitude Run Start Manhole: 11455 45.35097 122.59246 Run End Manhole: 11536 122.59043

45.35163

Additional: 11518 Lat: 45.35164 Comments:

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8B



Run: 07 **Date:** December 01, 2016

Run Start Manhole: 11494 Latitude 45.35291 L22.59371

Run End Manhole: 11516 45.35163 122.59115

Comments: Additional: 13565 Lat: 45.35240

Long: 122.59356

Run: 08 **Date:** December 01, 2016

 Run Start Manhole:
 11536
 Latitude
 Longitude

 45.35163
 122.59043

Run End Manhole: 12908 45.35292 122.58844

Comments:

Run: 09 **Date:** December 01, 2016

Run Start Manhole: N/A Latitude Longitude 45.35339 122.58963

Run End Manhole: 10071 45.35370 122.58847

Comments: Additional: 12908 Lat: 45.35292

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8B



Run: 10 **Date:** December 01, 2016

Run Start Manhole: 11429 Latitude Longitude

Run End Manhole: 12908 45.35292 122.58844

Comments: Additional: 14919 Lat: 45.35332

Long: 122.58678

Run: 11 **Date:** December 01, 2016

Run Start Manhole: 13739 Latitude Longitude 45.35402 122.58664

Run End Manhole: 10064 45.35456 122.58844

Comments: Additional: 10071 Lat: 45.35370

Long: 122.58847

Run: 12 **Date:** December 02, 2016

Run Start Manhole: 13230 Latitude Longitude 45.35336 122.59009

Run End Manhole: 10060 45.35472 122.58882

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8B



Run: 13 **Date:** December 02, 2016

Run Start Manhole: 10166 Latitude 45.35384 Longitude 45.35384

Run End Manhole: 10064 45.35456 122.58844

Comments: Additional: 10168 Lat: 45.35413

Long: 122.58997

Run: 14 **Date:** December 02, 2016

Run Start Manhole: 10170 Latitude Longitude 45.35509 122.58945

Run End Manhole: 10057 45.35613 122.58937

Comments: Additional: 12395 Lat: unable to locate

Long: unable to locate

Run: 15 **Date:** December 02, 2016

Run Start Manhole: Latitude 45.35613 L22.58937

Run End Manhole: 10174 45.35658 122.59017

Comments: Additional: 12397 Lat: 45.35629

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 8B



Run: 16 **Date:** December 02, 2016

> Latitude Longitude Run Start Manhole: 10174 45.35658 122.59017 Run End Manhole: 10177 45.35756 122.59035

Comments:

Run: 17 **Date:** December 02, 2016

> Longitude Latitude Run Start Manhole: 10179 45.35794 122.58975

Run End Manhole: 10129 45.35820 122.59164

Comments:

Long: 122.59048

Date: December 02, 2016 **Run:** 18

> Latitude Longitude Run Start Manhole: 12392 45.35682 122.58884 Run End Manhole: 10177 45.35756 122.59035

Project: U16-143 Oregon City-Smoke Test

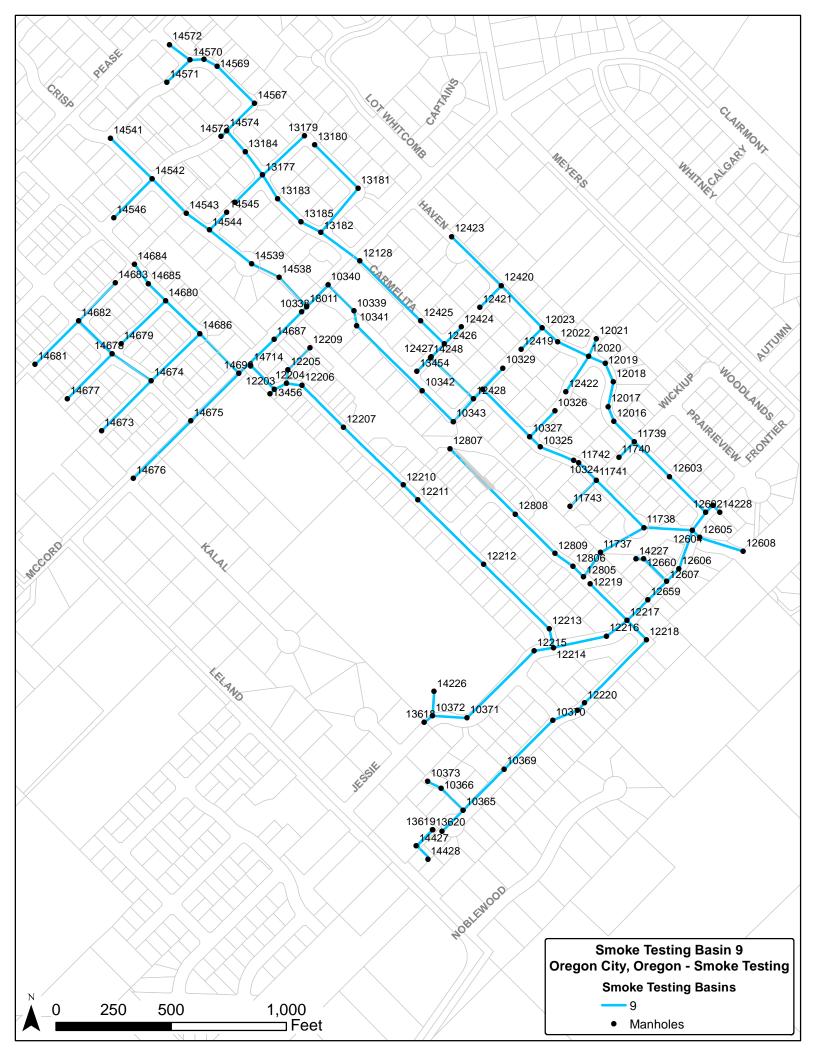
Basin: Basin 8B



Run: 19 Date: December 02, 2016

> Latitude Longitude Run Start Manhole: 10068 122.58675 45.35594 Run End Manhole: 12394 45.35575 122.58855

Several manholes near the hospital were smoking (not on map) but 10068 will not smoke, possib on pump because it is located so far below grade. Comments:



Project: U16-143 Oregon City-Smoke Test

Basin: Basin 9



Run: 01 **Date:** November 29, 2016

Run Start Manhole: 14681 Latitude 45.32491 122.61024

Run End Manhole: 14678 45.32505 122.60892

Comments: Additional: 14683 Lat: 45.32590

Long: 122.60892

Run: 02 **Date:** November 29, 2016

Run Start Manhole: 14678 Latitude 45.32505 L22.60892

Run End Manhole: 14686 45.32531 122.60756

Comments:

Run: 03 **Date:** November 29, 2016

Run Start Manhole: 14684 Latitude 45.32610 Lacitude 45.32610 Lacit

Run End Manhole: 14696 45.32488 122.60683

Comments: Additional: 14679 Lat: 45.32514

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 9



Run: 04 **Date:** November 29, 2016

Run Start Manhole: 14714 Latitude 45.32495 122.60662

Run End Manhole: 12211 45.32342 122.60371

Comments: Additional: 12209 Lat: 45.32515

Long: 122.60562

Run: 05 **Date:** November 29, 2016

Run Start Manhole: 14676 Latitude 45.32358 Lacitude 45.32358 122.60853

Run End Manhole: 10340 45.32593 122.60529

Comments:

Run: 06 **Date:** November 29, 2016

Run Start Manhole: 14541 Latitude 45.32761 L22.60905

Run End Manhole: 18011 45.32566 122.60567

Comments: Additional: 14546 Lat: 45.32669

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 9



Run: 07 **Date:** November 29, 2016

Run Start Manhole: 14572 Latitude 45.32873 L22.60809

Run End Manhole: 13177 45.32788 122.60648

Comments: Additional: 14571 Lat: 45.32827

Long: 122.60812

Run: 08 **Date:** November 29, 2016

Run Start Manhole: 14545 Latitude Longitude 45.32687 122.60695

Run End Manhole: 12128 45.32624 122.60477

Comments: Additional: 13179 Lat: 45.32768

Long: 122.60578

Run: 09 **Date:** November 29, 2016

Run Start Manhole: 12423 Latitude 45.32650 L22.60314

Run End Manhole: 12020 45.32516 122.60089

Comments: Additional: 12419 Lat: 45.32521

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 9



Run: 10 Date: November 29, 2016

> Latitude Longitude Run Start Manhole: 12422 45.32472 122.60126

Run End Manhole: 12603 45.32375 122.59945

Additional: 12021 Lat: 45.32536 Comments:

Long: 122.60076

Run: 11 **Date:** November 29, 2016

> Latitude Longitude Run Start Manhole: 14228 45.32334 122.59863

> Run End Manhole: 12659 122.59979 45.32229

Additional: 11738 Lat: 45.32316 Comments:

Long: 122.59991

Date: November 26, 2016 **Run:** 12

> Latitude Longitude Run Start Manhole: 12128 45.32624 122.60477 Run End Manhole: 12428 45.32463 122.60281

Additional: 12426 Lat: 45.32546 Comments:

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 9



Run: 13 **Date:** November 29, 2016

 Run Start Manhole:
 10340
 Latitude 45.32593
 Longitude 122.60529

 Run End Manhole:
 10329
 45.32500
 122.60234

Comments:

Run: 14 **Date:** November 30, 2016

 Run Start Manhole:
 12428
 Latitude 45.32463
 Longitude 122.60281

 Run End Manhole:
 11738
 45.32316
 122.59991

Comments: Additional: 10326 Lat: 45.32446

Long: 122.60146

Run: 15 **Date:** November 30, 2016

 Run Start Manhole:
 12807
 Latitude 45.32398
 Longitude 122.60320

 Run End Manhole:
 11738
 45.32316
 122.59991

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 9



Run: 16 **Date:** November 30, 2016

 Run Start Manhole:
 12211
 Latitude 45.32342
 Longitude 122.60371

 Run End Manhole:
 12214
 45.32167
 122.60134

Comments:

Run: 17 **Date:** November 30, 2016

 Run Start Manhole:
 10370
 Latitude 45.32084
 Longitude 122.60130

 Run End Manhole:
 12214
 45.32167
 122.60134

Comments: Additional: 12219 Lat: 45.32244

Long: 122.60075

Run: 18 **Date:** November 30, 2016

 Run Start Manhole:
 13620
 Latitude
 Longitude

 45.31946
 122.60308

 Run End Manhole:
 10370
 45.32084
 122.60130

Comments: Additional: 10373 Lat: 45.32004

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 9

Run: 19 Date: October 25, 2016

> Latitude Longitude Run Start Manhole: 14428

Run End Manhole: 13619 45.31948 122.60323

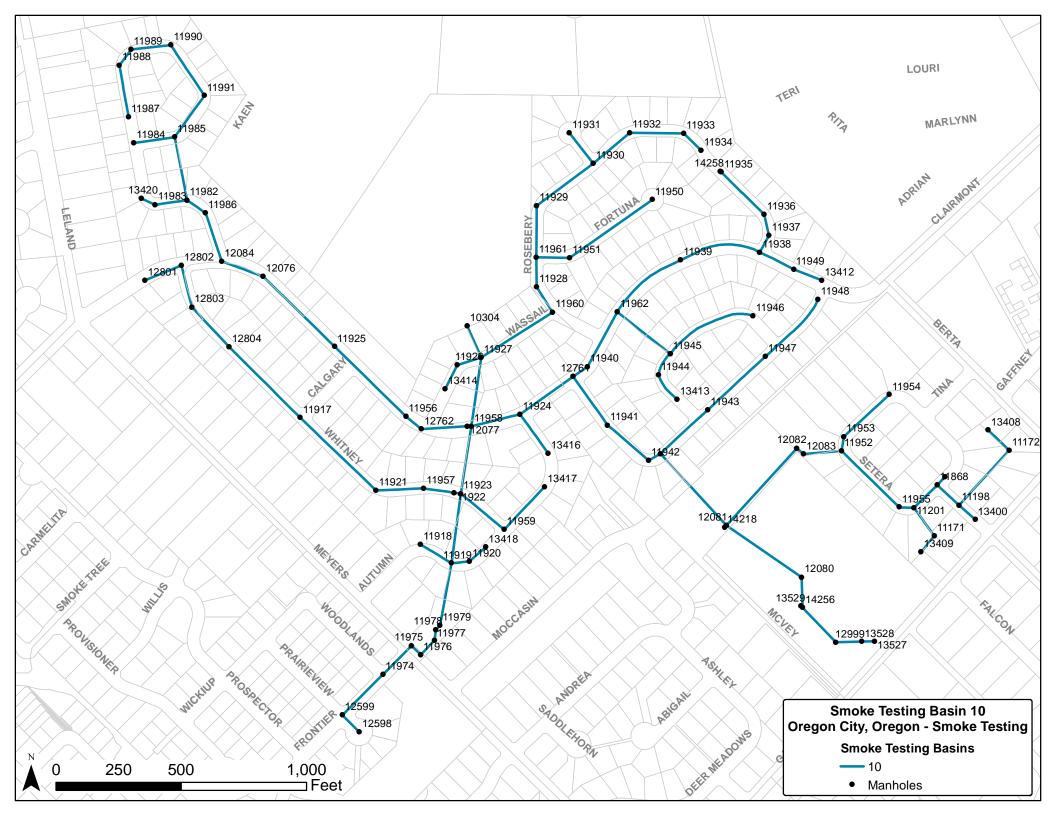
Comments: UTL any manholes on this line, did not smoke test.

Run: 20 **Date:** November 30, 2016

> Longitude Latitude Run Start Manhole: 12214 45.32167 122.60134

Run End Manhole: 13618 45.32070 122.60352

Additional: 14226 Lat: 45.32113 Comments:



Project: U16-143 Oregon City-Smoke Test

Basin: Basin 10



Run: 01 **Date:** November 04, 2016

 Run Start Manhole:
 11987
 Latitude 45.33029
 Longitude 122.60178

 Run End Manhole:
 11984
 45.33001
 122.60172

Comments:

Run: 02 **Date:** November 04, 2016

 Run Start Manhole:
 11985
 Latitude 45.33006
 Longitude 122.60107

 Run End Manhole:
 11917
 45.32777
 122.59855

Comments: Additional: 13420 Lat: 45.32933

Long: 122.60130

Run: 03 **Date:** November 04, 2016

 Run Start Manhole:
 12801
 Latitude 45.32853
 Longitude 122.60146

 Run End Manhole:
 11921
 45.32628
 122.59772

Comments:

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 10



Run: 04 **Date:** November 04, 2016

 Run Start Manhole:
 11921
 Latitude 45.32628
 Longitude 122.59772

 Run End Manhole:
 11923
 45.32625
 122.59660

Additional: 13417 Lat: 45.32633 Long: 122.59518

Run: 05 **Date:** November 04, 2016

Run Start Manhole: 11923 Latitude 45.32625 Longitude 45.32625

Run End Manhole: 11976 45.32445 122.59705

Comments: Additional: 11918 Lat: 45.32568

Long: 122.59710

Run: 06 **Date:** November 04, 2016

 Run Start Manhole:
 11976
 Latitude 45.32445
 Longitude 122.59705

 Run End Manhole:
 12598
 45.32362
 122.59793

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 10



Run: 07 **Date:** November 04, 2016

Run Start Manhole: 11925 Latitude Longitude

Run End Manhole: 11958 45.32696 122.59634

Comments: Additional: 12761 Lat: 45.32757

Long: 122.59483

Run: 08 **Date:** November 04, 2016

Run Start Manhole: 11928 Latitude Longitude 45.32853 122.59537

Run End Manhole: 11927 45.32774 122.59624

Comments: Additional: 13414 Lat: 45.32738

Long: 122.59679

Run: 09 **Date:** November 16, 2016

Run Start Manhole: Latitude 45.33009 L22.59290

Run End Manhole: 11928 45.32853 122.59537

Comments: Additional: 11931 Lat: 45.33028

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 10



Run: 10 **Date:** November 16, 2016

 Run Start Manhole:
 11950
 Latitude 45.32954
 Longitude 122.59367

 Run End Manhole:
 11961
 45.32888
 122.59542

Comments:

Run: 11 **Date:** November 16, 2016

 Run Start Manhole:
 11946
 Latitude 45.32826
 Longitude 122.59208

 Run End Manhole:
 12761
 45.32757
 122.59483

Comments: Additional: 13413 Lat: 45.32734

Long: 122.59316

Run: 12 **Date:** November 16, 2016

 Run Start Manhole:
 11935
 Latitude 45.32981
 Longitude 122.59260

 Run End Manhole:
 11939
 45.32887
 122.59315

Comments: Additional: 13412 Lat: 45.32872

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 10



Run: 13 **Date:** November 16, 2016

Run Start Manhole: 11943 Latitude 45.32723 L22.59261

Run End Manhole: 12761 45.32757 122.59483

Comments: Additional: 12082 Lat: 45.32680

Long: 122.59132

Run: 14 **Date:** November 16, 2016

Run Start Manhole: 11948 Latitude 45.32850 Longitude 45.32850

Run End Manhole: 11943 45.32723 122.59261

Comments:

Run: 15 **Date:** November 16, 2016

Run Start Manhole: 13527 Latitude Longitude 45.32472 122.58998

Run End Manhole: 12081 45.32596 122.59232

Project: U16-143 Oregon City-Smoke Test

Basin: Basin 10



Run: 16 **Date:** November 16, 2016

Run Start Manhole: 11954 Latitude Longitude 45.32747 122.58988

Run End Manhole: 12082 45.32680 122.59132

Comments: Additional: 11201 Lat: 45.32623

Long: 122.58943

Run: 17 **Date:** November 16, 2016

Run Start Manhole: 13400 Latitude Longitude 45.32612 122.58852

Run End Manhole: 11201 45.32623 122.58943

Comments: Additional: 13408 Lat: unable to locate

Long: unable to locate



Appendix 2

Smoke Test Incident Reports



Smoke Test Incidents Report Basin 1



Basin: Basin 1 Run: 02

Incident: 01

Incident Location: 166 Av Davis

Lat: 45.33993 *Long*: 122.60783

Upstream Manhole: 10893 Lat: 45.34015 Long: 122.60835

Result: Positive Leak Source: Smoke inside

Leak Type: O
Leak Size: NA

Leak Surface Cover: PB



Comments: Smoke coming from crawlspace vent

Basin: Basin 1 **Run:** 02

Incident: 01

Incident Location: 166 Av Davis

Lat: 45.33993 *Long:* 122.60783

Result: Positive **Leak Source:** Smoke inside

Leak Type: O
Leak Size: NA

Leak Surface Cover: PB

Observations:

Comments: Smoke coming from crawlspace vent



Basin 1 Run 2 Leak 1 B



Basin 1 Run 2 Leak 1 A



Basin: Basin 1 **Run:** 10

Incident: 02

Incident Location: 115 Park

Lat: 45.34467 *Long:* 122.60548

Upstream Manhole: 13756 Lat: Long:

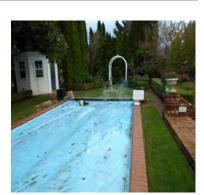
Downstream Manhole: 10864 **Lat:** 45.34526 **Long:** 122.60431

Result: Positive **Leak Source:** N/A

Leak Type: SPD

Leak Size: c

Leak Surface Cover: Pool



Basin 1 Run 10 Leak 1 B

Observations:

Comments: Leak type is unknown, smoke coming from edge of pool. Apparently connected to Sanitary

Basin: Basin 1 **Run:** 10

Incident: 02

Incident Location: 115 Park

Lat: 45.34467 *Long:* 122.60548

Upstream Manhole: 13756 Lat: Long:

Result: Positive Leak Source: N/A

Leak Type: SPD

Leak Size: c

Leak Surface Cover: Pool



Basin 1 Run 10 Leak 1 A

Observations:

Comments: Leak type is unknown, smoke coming from edge of pool. Apparently connected to Sanitary



Basin: Basin 1 **Run:** 10

Incident: 03

Incident Location: 152 Harding

Lat: 45.34550 *Long*: 122.60487

Upstream Manhole: 13755 Lat: Long:

Downstream Manhole: 10864 **Lat:** 45.34526 **Long:** 122.60431

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB Leak Size: E

Leak Surface Cover: A

Observations: Heavy smoke from Stormwater catch basin

Comments:

Basin: Basin 1 **Run:** 10

Incident: 03

Incident Location: 152 Harding

Lat: 45.34550 *Long:* 122.60487

Upstream Manhole: 13755 Lat: Long:

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A

Observations: Heavy smoke from Stormwater catch basin



Basin 1 Run 10 Leak 2 B



Basin 1 Run 10 Leak 2 A



Basin: Basin 1 Run: 14

Incident: 04

Incident Location: 135 Valley View

Lat: 45.34289 *Long*: 122.60798

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: T



Basin 1 Run 14 Leak 1 B

Observations:

Comments: Smoke coming from a rodent hole in the front yard.

Basin: Basin 1 Run: 14

Incident: 04

Incident Location: 135 Valley View

Lat: 45.34289 *Long:* 122.60798

Upstream Manhole: 13352 *Lat:* 45.34311 *Long:* 122.60827

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: T



Basin 1 Run 14 Leak 1 A

Observations:

Comments: Smoke coming from a rodent hole in the front yard.



Basin: Basin 1 **Run:** 17

Incident: 05

Incident Location: 845 Linn

Lat: 45.34327 *Long:* 122.60497

Upstream Manhole: 10867 *Lat*: 45.34265 *Long*: 122.60497

Result: Positive Leak Source: Main Sewer

Leak Type: O
Leak Size: E

Leak Surface Cover: D

Observations:

Comments: Smoke coming from a water meter hatch.

Basin: Basin 1 **Run:** 17

Incident: 05

Incident Location: 845 Linn

Lat: 45.34327 *Long:* 122.60497

Result: Positive Leak Source: Main Sewer

Leak Type: O
Leak Size: E

Leak Surface Cover: D

Observations:

Comments: Smoke coming from a water meter hatch.



Basin 1 Run 17 Leak 1 B



Basin 1 Run 17 Leak 1 A



Smoke Test Incidents Report Basin 2



Basin: Basin 2 **Run:** 01

Incident: 01

Incident Location: 302 Madison

Lat: 45.35205 *Long:* 122.60540

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: O
Leak Size: B

Leak Surface Cover: D

Observations:

Comments: Cracks in sidewalk, uknown source

Basin: Basin 2 Run: 01

Incident: 01

Incident Location: 302 Madison

Lat: 45.35205 *Long:* 122.60540

Result: Positive Leak Source: Cracked Concrete

Leak Type: 0
Leak Size: B

Leak Surface Cover: D

Observations:

Comments: Cracks in sidewalk, uknown source



Basin 2 Run 1 Leak 1 B



Basin 2 Run 1 Leak 1 A



Basin: Basin 2 **Run:** 01

Incident: 02

Incident Location: 820 3rd St

Lat: 45.35206 *Long*: 122.60587

Upstream Manhole: 12111 Lat: 45.35152 Long: 122.60601

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Downspouts at N corner of house.

Basin: Basin 2 **Run:** 01

Incident: 02

Incident Location: 820 3rd St

Lat: 45.35206 *Long:* 122.60587

Upstream Manhole: 12111 *Lat:* 45.35152 *Long:* 122.60601

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Downspouts at N corner of house.



Basin 2 Run 1 Leak 2 A



Basin 2 Run 1 Leak 2 B



Basin: Basin 2 **Run:** 02

Incident: 03

Incident Location: 718 Spring

Lat: 45.35167 *Long*: 122.60790

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: O
Leak Size: A

Leak Surface Cover: CD

Observations:

Comments: Leak at end of driveway/sidewalk. Unknown Source

Basin: Basin 2 **Run:** 02

Incident: 03

Incident Location: 718 Spring

Lat: 45.35167 *Long:* 122.60790

Result: Positive Leak Source: Cracked Concrete

Leak Type: O
Leak Size: A

Leak Surface Cover: CD

Observations:

Comments: Leak at end of driveway/sidewalk. Unknown Source



Basin 2 Run 2 Leak 1 A



Basin 2 Run 2 Leak 1 B



Basin: Basin 2 **Run:** 02

Incident: 04

Incident Location: 121 Jefferson

Lat: 45.35186 *Long*: 122.60790

Upstream Manhole: 13305 Lat: Long:

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: E

Observations:

Comments: Hole in tree at E corner of property. Unknown Source

Basin: Basin 2 **Run:** 02

Incident: 04

Incident Location: 121 Jefferson

Lat: 45.35186 *Long:* 122.60790

Upstream Manhole: 13305 Lat: Long:

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: E

Observations:

Comments: Hole in tree at E corner of property. Unknown Source



Basin 2 Run 2 Leak 2 A



Basin 2 Run 2 Leak 2 B



Basin: Basin 2 **Run:** 02

Incident: 05

Incident Location: 121 Jefferson

Lat: 45.35186 *Long*: 122.60790

Upstream Manhole: 13306 Lat: Long:

Result: Positive **Leak Source:** Foundation Drain

Leak Type: 0
Leak Size: A

Leak Surface Cover: G



Comments: Black drainage pipe along back side of property.

Basin: Basin 2 **Run:** 02

Incident: 05

Incident Location: 121 Jefferson

Lat: 45.35186 *Long*: 122.60790

Upstream Manhole: 13306 Lat: Long:

Result: Positive **Leak Source:** Foundation Drain

Leak Type: 0
Leak Size: A

Leak Surface Cover: G

Observations:

Comments: Black drainage pipe along back side of property.



Basin 2 Run 2 Leak 3 A



Basin 2 Run 2 Leak 3 B



Basin: Basin 2 **Run:** 02

Incident: 06

Incident Location: 213 Jefferson

Lat: 45.35232 *Long*: 122.60707

Upstream Manhole: 13306 Lat: Long:

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: G



Comments: Leak from stone wall at SW side of property.

Basin: Basin 2 **Run:** 02

Incident: 06

Incident Location: 213 Jefferson

Lat: 45.35232 *Long*: 122.60707

Upstream Manhole: 13306 Lat: Long:

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: G

Observations:

Comments: Leak from stone wall at SW side of property.



Basin 2 Run 2 Leak 4 A



Basin 2 Run 2 Leak 4 B



Basin: Basin 2 **Run:** 02

Incident: 07

Incident Location: 210 Jefferson

Lat: 45.35209 *Long*: 122.60671

 Upstream Manhole:
 12108
 Lat:
 45.35186
 Long:
 122.60703

 Downstream Manhole:
 12110
 Lat:
 45.35218
 Long:
 122.60668

Result: Positive Leak Source: Cracked Concrete

Leak Type: O
Leak Size: A

Leak Surface Cover: D



Basin 2 Run 2 Leak 5 B

Observations:

Comments: Smoke from edge of sidewalk at N corner. Unknown Source

Basin: Basin 2 Run: 02

Incident: 07

Incident Location: 210 Jefferson

Lat: 45.35209 *Long*: 122.60671

 Upstream Manhole:
 12108
 Lat:
 45.35186
 Long:
 122.60703

 Downstream Manhole:
 12110
 Lat:
 45.35218
 Long:
 122.60668

Result: Positive Leak Source: Cracked Concrete

Leak Type: 0
Leak Size: A

Leak Surface Cover: D



Basin 2 Run 2 Leak 5 A

Observations:

Comments: Smoke from edge of sidewalk at N corner. Unknown Source



Basin: Basin 2 **Run:** 03

Incident: 08

Incident Location: 616 3rd St.

Lat: 45.35306 *Long*: 122.60748

Upstream Manhole: 12119 *Lat*: 45.35300 *Long*: 122.60728

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: T



Basin 2 Run 3 Leak 1 A

Observations:

Comments: Smoke coming from garden at N corner of property. Unknown Source

Basin: Basin 2 **Run:** 03

Incident: 08

Incident Location: 616 3rd St.

Lat: 45.35306 *Long:* 122.60748

Downstream Manhole: 12120 **Lat:** 45.35312 **Long:** 122.60772

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: A

Leak Surface Cover: T



Basin 2 Run 3 Leak 1 B

Observations:

Comments: Smoke coming from garden at N corner of property. Unknown Source



Basin: Basin 2 Run: 04

Incident: 09

Incident Location: 614 2nd St

Lat: 45.35232 *Long*: 122.60828

Upstream Manhole: N/A Lat: Long:
Downstream Manhole: 12123 Lat: Long:

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: E



Comments: Smoke coming from rock wall. Unknown Source

Basin: Basin 2 Run: 04

Incident: 09

Incident Location: 614 2nd St

Lat: 45.35232 *Long:* 122.60828

Upstream Manhole: N/A Lat: Long:
Downstream Manhole: 12123 Lat: Long:

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: E

Observations:

Comments: Smoke coming from rock wall. Unknown Source



Basin 2 Run 4 Leak 1 A



Basin 2 Run 4 Leak 1 B



Basin: Basin 2 Run: 05

Incident: 10

Incident Location: 100 High St

Lat: 45.35279 *Long:* 122.61107

Upstream Manhole: 10719 *Lat:* 45.35350 *Long:* 122.61060

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Downstream Manhole: 12091

Comments: Leak at N corner of 100 High St.

Basin: Basin 2 **Run:** 05

Incident: 10

Incident Location: 100 High St

Lat: 45.35279 *Long:* 122.61107

Upstream Manhole: 10719 Lat: 45.35350 Long: 122.61060

Downstream Manhole: 12091 **Lat:** 45.35277 **Long:** 122.61137

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Leak at N corner of 100 High St.



Basin 2 Run 5 Leak 1 A



Basin 2 Run 5 Leak 1 B



Basin: Basin 2 Run: 05

Incident: 11

Incident Location: 401 3rd St

Lat: 45.35421 *Long:* 122.60950

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Downspout at S corner of property.

Basin: Basin 2 **Run:** 05

Incident: 11

Incident Location: 401 3rd St

Lat: 45.35421 *Long:* 122.60950

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Downspout at S corner of property.



Basin 2 Run 5 Leak 2 A



Basin 2 Run 5 Leak 2 B



Basin: Basin 2 Run: 05

Incident: 12

Incident Location: 104 High St.

Lat: 45.35279 *Long*: 122.61107

Downstream Manhole: 12091 **Lat:** 45.35277 **Long:** 122.61137

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Downspout at W corner of house.

Basin: Basin 2 **Run:** 05

Incident: 12

Incident Location: 104 High St.

Lat: 45.35279 *Long:* 122.61107

Upstream Manhole: 10719 Lat: 45.35350 Long: 122.61060

Downstream Manhole: 12091 **Lat:** 45.35277 **Long:** 122.61137

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout at W corner of house.



Basin 2 Run 5 Leak 3 B



Basin 2 Run 5 Leak 3 A



Basin: Basin 2 Run: 06

Incident: 13

Incident Location: 204 S High St

Lat: 45.35170 *Long*: 122.61211

 Upstream Manhole:
 12094
 Lat:
 45.35203
 Long:
 122.61214

 Downstream Manhole:
 13101
 Lat:
 45.35165
 Long:
 122.61247

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Downspout at W corner of house.

Basin: Basin 2 **Run:** 06

Incident: 13

Incident Location: 204 S High St

Lat: 45.35170 *Long:* 122.61211

 Upstream Manhole:
 12094
 Lat:
 45.35203
 Long:
 122.61214

 Downstream Manhole:
 13101
 Lat:
 45.35165
 Long:
 122.61247

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout at W corner of house.



Basin 2 Run 6 Leak 2 A



Basin 2 Run 6 Leak 2 B



Basin: Basin 2 **Run:** 06

Incident: 14

Incident Location: 122 S Center

Lat: 45.35117 *Long*: 122.61108

Upstream Manhole: 14099 *Lat:* 45.35117 *Long:* 122.61108

Downstream Manhole: 11609 **Lat:** 45.35157 **Long:** 122.61119

Result: Positive **Leak Source:** Driveway Drain

Leak Type: CB
Leak Size: D

Leak Surface Cover: CD

Observations:

Comments: Wash pit appears to be connected to Sani

Basin: Basin 2 **Run:** 06

Incident: 14

Incident Location: 122 S Center

Lat: 45.35117 *Long:* 122.61108

Upstream Manhole: 14099 Lat: 45.35117 Long: 122.61108

Downstream Manhole: 11609 **Lat:** 45.35157 **Long:** 122.61119

Result: Positive **Leak Source:** Driveway Drain

Leak Type: CB
Leak Size: D

Leak Surface Cover: CD

3 **3**

Observations:

Comments: Wash pit appears to be connected to Sani



Basin 2 Run 6 Leak 3 A



Basin 2 Run 6 Leak 3 B



Basin: Basin 2 Run: 06

Incident: 15

Incident Location: 122 S Center

Lat: 45.35157 *Long:* 122.61119

 Upstream Manhole:
 14099
 Lat:
 45.35117
 Long:
 122.61108

 Downstream Manhole:
 11599
 Lat:
 45.35157
 Long:
 122.61214

Result: Positive **Leak Source:** Storm Manhole

Leak Type: MHC ST

Leak Size: A

Leak Surface Cover: A



Basin 2 Run 6 Leak 4 A

Observations:

Comments: Storm MH near MH #11599 smoking. Need to verify that this is Storm line. Possible manhole lid mis-

label.

Basin: Basin 2 **Run:** 06

Incident: 15

Incident Location: 122 S Center

Lat: 45.35157 *Long*: 122.61119

 Upstream Manhole:
 14099
 Lat: 45.35117
 Long: 122.61108

 Downstream Manhole:
 11599
 Lat: 45.35157
 Long: 122.61214

Result: Positive **Leak Source:** Storm Manhole

Leak Type: MHC ST

Leak Size: A

Leak Surface Cover: A



Basin 2 Run 6 Leak 4 B

Observations:

Comments: Storm MH near MH #11599 smoking. Need to verify that this is Storm line. Possible manhole lid mis-

label.



Basin: Basin 2 **Run:** 07

Incident: 16

Incident Location: 122 S Center

Lat: 45.35175 *Long*: 122.61093

Upstream Manhole: 14096 *Lat:* 45.35170 *Long:* 122.61090

Downstream Manhole: 11608 **Lat:** 45.35178 **Long:** 122.61089

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A



Comments: Storm drian in parking lot appears to be connected to Sani

Basin: Basin 2 **Run:** 07

Incident: 16

Incident Location: 122 S Center

Lat: 45.35175 *Long:* 122.61093

Downstream Manhole: 11608 **Lat:** 45.35178 **Long:** 122.61089

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A

Observations:

Comments: Storm drian in parking lot appears to be connected to Sani



Basin 2 Run 7 Leak 1 A



Basin 2 Run 7 Leak 1 B



Basin: Basin 2 **Run:** 07

Incident: 17

Incident Location: 112 S Center

Lat: 45.35206 *Long*: 122.61055

Upstream Manhole: 11608 *Lat:* 45.35178 *Long:* 122.61089

Downstream Manhole: 12089 **Lat:** 45.35228 **Long:** 122.61036

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: O
Leak Size: A

Leak Surface Cover: T



Basin 2 Run 7 Leak 2 A

Observations:

Comments: Smoke coming from edge of sidewalk, Unknown Source.

Basin: Basin 2 **Run:** 07

Incident: 17

Incident Location: 112 S Center

Lat: 45.35206 *Long:* 122.61055

 Upstream Manhole:
 11608
 Lat:
 45.35178
 Long:
 122.61089

 Downstream Manhole:
 12089
 Lat:
 45.35228
 Long:
 122.61036

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: 0
Leak Size: A

Leak Surface Cover: T



Basin 2 Run 7 Leak 2 B

Observations:

Comments: Smoke coming from edge of sidewalk, Unknown Source.



Basin: Basin 2 **Run:** 07

Incident: 18

Incident Location: 1st + Center

Lat: 45.35230 *Long*: 122.61057

Upstream Manhole: 12089 Lat: 45.35228 Long: 122.61036

Downstream Manhole: 12091 **Lat:** 45.35277 **Long:** 122.61137

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB Leak Size: E

Leak Surface Cover: A



Basin 2 Run 7 Leak 3 B

Observations:

Comments: All storm drains at 1st + Center have smoke coming out, 4 storm drains

Basin: Basin 2 **Run:** 07

Incident: 18

Incident Location: 1st + Center

Lat: 45.35230 *Long:* 122.61057

 Upstream Manhole:
 12089
 Lat:
 45.35228
 Long:
 122.61036

 Downstream Manhole:
 12091
 Lat:
 45.35277
 Long:
 122.61137

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A



Basin 2 Run 7 Leak 3 A

Observations:

Comments: All storm drains at 1st + Center have smoke coming out, 4 storm drains



Basin: Basin 2 Run: 07

Incident: 19

Incident Location: 1st + High

Lat: 45.35272 *Long*: 122.61146

Upstream Manhole: 12125 *Lat*: 45.35305 *Long*: 122.60966

Downstream Manhole: 12091 **Lat:** 45.35277 **Long:** 122.61137

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A



Basin 2 Run 7 Leak 4 A

Observations:

Comments: All storm drains at 1st + Center have smoke coming out, 4 storm drains

Basin: Basin 2 **Run:** 07

Incident: 19

Incident Location: 1st + High

Lat: 45.35272 *Long*: 122.61146

 Upstream Manhole:
 12125
 Lat:
 45.35305
 Long:
 122.60966

 Downstream Manhole:
 12091
 Lat:
 45.35277
 Long:
 122.61137

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A



Basin 2 Run 7 Leak 4 B

Observations:

Comments: All storm drains at 1st + Center have smoke coming out, 4 storm drains



Basin: Basin 2 **Run:** 07

Incident: 20

Incident Location: 2nd + Center

Lat: 45.35301 *Long*: 122.60989

Upstream Manhole: 12125 *Lat:* 45.35305 *Long:* 122.60966

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A



Basin 2 Run 7 Leak 5 A

Observations:

Comments: All storm drains at 2nd + Center have smoke coming out, 4 storm drains

Basin: Basin 2 **Run:** 07

Incident: 20

Incident Location: 2nd + Center

Lat: 45.35301 *Long:* 122.60989

 Upstream Manhole:
 12125
 Lat:
 45.35305
 Long:
 122.60966

 Downstream Manhole:
 12126
 Lat:
 45.35285
 Long:
 122.60989

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A



Basin 2 Run 7 Leak 5 B

Observations:

Comments: All storm drains at 2nd + Center have smoke coming out, 4 storm drains



Basin: Basin 2 **Run:** 08

Incident: 21

Incident Location: 122 S Center

Lat: 45.35133 *Long*: 122.61075

Upstream Manhole: 14098 Lat: Long:

Downstream Manhole: 11599 **Lat:** 45.35157 **Long:** 122.61214

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: C

Leak Surface Cover: PB



Comments: Leaks from gutters and downspouts at city shop

Basin: Basin 2 **Run:** 08

Incident: 21

Incident Location: 122 S Center

Lat: 45.35133 *Long:* 122.61075

Upstream Manhole: 14098 Lat: Long:

Downstream Manhole: 11599 **Lat:** 45.35157 **Long:** 122.61214

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Leaks from gutters and downspouts at city shop



Basin 2 Run 8 Leak 1 A



Basin 2 Run 8 Leak 1 B



Basin: Basin 2 **Run:** 08

Incident: 22

Incident Location: 122 S Center

Lat: 45.35133 *Long:* 122.61075

Upstream Manhole: 14098 Lat: Long:

Downstream Manhole: 11599 **Lat:** 45.35157 **Long:** 122.61214

Result: Positive **Leak Source:** Catch Basin

Leak Type: CB

Leak Size: E

Leak Surface Cover: A



Comments: 3 catch basins in city shop parking

Basin: Basin 2 **Run:** 08

Incident: 22

Incident Location: 122 S Center

Lat: 45.35133 *Long:* 122.61075

Upstream Manhole: 14098 Lat: Long:

Downstream Manhole: 11599 **Lat:** 45.35157 **Long:** 122.61214

Result: Positive **Leak Source:** Catch Basin

Leak Type: CB

Leak Size: E

Leak Surface Cover: A

Observations:

Comments: 3 catch basins in city shop parking



Basin 2 Run 8 Leak 2 B



Basin 2 Run 8 Leak 2 A



Smoke Test Incidents Report Basin 3



Basin: Basin 3 **Run:** 12

Incident: 01

Incident Location: 510 Monroe

Lat: 45.35340 *Long:* 122.60268

Upstream Manhole: 10705 Lat: 45.35357 Long: 122.60274

Result: Positive Leak Source: Cleanout

Leak Type: CCB

Leak Size: A

Leak Surface Cover: T



Comments: Broken CB at corner of house

Basin: Basin 3 **Run:** 12

Incident: 01

Incident Location: 510 Monroe

Lat: 45.35340 *Long:* 122.60268

Upstream Manhole: 10705 Lat: 45.35357 Long: 122.60274

Downstream Manhole: 10703 **Lat:** 45.35321 **Long:** 122.60306

Result: Positive Leak Source: Cleanout

Leak Type: CCB

Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Broken CB at corner of house



Basin 3 Run 12 Leak 1 B



Basin 3 Run 12 Leak 1 A (edited)



Basin: Basin 3 **Run:** 12

Incident: 02

Incident Location: 516 Monroe

Lat: 45.35350 *Long:* 122.60249

Upstream Manhole: 10705 *Lat:* 45.35357 *Long:* 122.60274

Result: Positive Leak Source: Cleanout

Leak Type: CCB

Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Leaking cleanout

Basin: Basin 3 **Run:** 12

Incident: 02

Incident Location: 516 Monroe

Lat: 45.35350 *Long:* 122.60249

Upstream Manhole: 10705 Lat: 45.35357 Long: 122.60274

Downstream Manhole: 10703 **Lat:** 45.35321 **Long:** 122.60306

Result: Positive Leak Source: Cleanout

Leak Type: CCB

Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Leaking cleanout



Basin 3 Run 12 Leak 2 A



Basin 3 Run 12 Leak 2 B



Basin: Basin 3 Run: 14

Incident: 03

Incident Location: 804 4th St.

Lat: 45.35314 *Long*: 122.60516

Result: Positive Leak Source: Smoking Ground

Leak Type: 0

Leak Size: Moderate

Leak Surface Cover: T



Comments: Leak from below sign post and curb

Basin: Basin 3 **Run:** 14

Incident: 03

Incident Location: 804 4th St.

Lat: 45.35314 *Long:* 122.60516

Result: Positive **Leak Source:** Smoking Ground

Leak Type: 0

Leak Size: Moderate

Leak Surface Cover: T

Observations:

Comments: Leak from below sign post and curb



Basin 3 Run 14 Leak 1 A



Basin 3 Run 14 Leak 1 B



Basin: Basin 3 **Run:** 22

Incident: 04

Incident Location: 1012 Brighton Ave

Lat: 45.34958 *Long:* 122.60493

Upstream Manhole: 11554 Lat: 45.34972 Long: 122.60531

Downstream Manhole: 11576 *Lat*: 45.34966 *Long*: 122.60425

> Result: Positive Leak Source: Downspout

> > Leak Type: Downspout

Leak Size: Moderate

Leak Surface Cover: Flower Bed



Observations:

Comments: Leak-downspout at front corner of house.

Basin: Basin 3 **Run:** 22

Incident: 04

Incident Location: 1012 Brighton Ave

45.34958 *Long:* Lat: 122.60493

Upstream Manhole: 11554 *Lat*: 45.34972 *Long*: 122.60531

Downstream Manhole: 11576 *Lat:* 45.34966 *Long:* 122.60425

> Result: Positive Leak Source: Downspout

> > Leak Type: Downspout

Leak Size: Moderate

Leak Surface Cover: Flower Bed

Observations:

Comments: Leak-downspout at front corner of house.



Basin 3 Run 22 Leak 1 A



Basin 3 Run 22 Leak R1 A



Basin: Basin 3 Run: 22

Incident: 05

Incident Location: Bellevue Ave + Brighton Ave

Lat: 45.34966 *Long*: 122.60529

Upstream Manhole: 11838 *Lat:* 45.34923 *Long:* 122.60558

Result: Positive Leak Source: Storm Drain

Leak Type: CB

Lat: 45.34972 *Long:* 122.60531

Leak Size: E

Leak Surface Cover: A



Basin 3 Run 22 Leak 2 A

Observations:

Downstream Manhole: 11554

Comments: Storm drain near MH 11554

Basin: Basin 3 Run: 22

Incident: 05

Incident Location: Bellevue Ave + Brighton Ave

Lat: 45.34966 *Long:* 122.60529

 Upstream Manhole:
 11838
 Lat:
 45.34923
 Long:
 122.60558

 Downstream Manhole:
 11554
 Lat:
 45.34972
 Long:
 122.60531

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A



Basin 3 Run 22 Leak 2 B

Observations:

Comments: Storm drain near MH 11554



Basin: Basin 3 Run: 24

Incident: 06

Incident Location: 204 Linn St.

Lat: 45.34941 *Long*: 122.60120

Upstream Manhole: 11569 Lat: 45.34929 Long: 122.60160

Result: Positive Leak Source: Smoking Ground

Leak Type: O
Leak Size: B

Leak Surface Cover: L



Basin 3 Run 24 Leak 1 B

Observations:

Comments: Leak #1 was actually found during run #26, but is located within run #24. Leak suspected to be from"T' in the main getting replaced.

Basin: Basin 3 **Run:** 24

Incident: 06

Incident Location: 204 Linn St.

Lat: 45.34941 *Long:* 122.60120

 Upstream Manhole:
 11569
 Lat:
 45.34929
 Long:
 122.60160

 Downstream Manhole:
 11832
 Lat:
 45.3501
 Long:
 122.60102

Result: Positive Leak Source: Smoking Ground

Leak Type: 0 Leak Size: B

Leak Surface Cover: L



Basin 3 Run 24 Leak 1 A

Observations:

Comments: Leak #1 was actually found during run #26, but is located within run #24. Leak suspected to be from"T' in the main getting replaced.



Basin: Basin 3 Run: 24

Incident: 07

Incident Location: 235 Pearl

Lat: 45.34901 *Long:* 122.59948

Upstream Manhole: 11475 *Lat:* 45.34966 *Long:* 122.59958

Result: Positive Leak Source: Smoking Ground

Leak Type: O
Leak Size: B

Leak Surface Cover: D



Basin 3 Run 24 Leak 2B

Observations:

Comments: Several leaks from underneath sidewalk near MH 11476. Unknown Source

Basin: Basin 3 **Run:** 24

Incident: 07

Incident Location: 235 Pearl

Lat: 45.34901 *Long:* 122.59948

 Upstream Manhole:
 11475
 Lat:
 45.34966
 Long:
 122.59958

 Downstream Manhole:
 11476
 Lat:
 45.34909
 Long:
 122.60049

Result: Positive Leak Source: Smoking Ground

Leak Type: 0
Leak Size: B

Leak Surface Cover: D



Basin 3 Run 24 Leak 2 A

Observations:

Comments: Several leaks from underneath sidewalk near MH 11476. Unknown Source



Basin: Basin 3 Run: 24

Incident: 08

Incident Location: 216 Pearl

Lat: 45.34889 *Long*: 122.59978

Upstream Manhole: 11476 *Lat:* 45.34909 *Long:* 122.60049

Downstream Manhole: 11545 **Lat:** 45.34901 **Long:** 122.59946

Result: Positive Leak Source: Cleanout

Leak Type: CCD

Leak Size: A

Leak Surface Cover: G



Comments: Cleanout under front porch smoking

Basin: Basin 3 **Run:** 24

Incident: 08

Incident Location: 216 Pearl

Lat: 45.34889 *Long:* 122.59978

Downstream Manhole: 11545 **Lat:** 45.34901 **Long:** 122.59946

Result: Positive Leak Source: Cleanout

Leak Type: CCD

Leak Size: A

Leak Surface Cover: G

Observations:

Comments: Cleanout under front porch smoking



Basin 3 Run 24 Leak 3 A



Basin 3 Run 24 Leak 3 B



Basin: Basin 3 **Run:** 24

Incident: 09

Incident Location: 216 Pearl

Lat: 45.34889 *Long:* 122.59977

Upstream Manhole: 11476 *Lat:* 45.34909 *Long:* 122.60049

Downstream Manhole: 11545 *Lat:* 45.34901 *Long:* 122.59946

> Result: Positive Leak Source: Smoking Ground

> > Leak Type: 0

Leak Surface Cover: G





Comments: Smoke from hole in front yard. Unknown Source

Basin: Basin 3 **Run:** 24

Incident: 09

Incident Location: 216 Pearl

45.34889 *Long*: 122.59977 Lat:

Upstream Manhole: 11476 *Lat*: 45.34909 *Long*: 122.60049

Downstream Manhole: 11545 *Lat:* 45.34901 *Long:* 122.59946

> **Result:** Positive Leak Source: Smoking Ground

> > Leak Type: 0 Leak Size: A

Leak Surface Cover: G

Observations:

Comments: Smoke from hole in front yard. Unknown Source



Basin 3 Run 24 Leak 4 A



Basin 3 Run 24 Leak 4 B



Basin: Basin 3 Run: 24

Incident: 10

Incident Location: 204 Pearl

Lat: 45.34874 *Long*: 122.60048

Upstream Manhole: 11476 *Lat:* 45.34909 *Long:* 122.60049

Downstream Manhole: 11545 **Lat:** 45.34901 **Long:** 122.59946

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Downspouts on west side of house.

Basin: Basin 3 **Run:** 24

Incident: 10

Incident Location: 204 Pearl

Lat: 45.34874 *Long:* 122.60048

Downstream Manhole: 11545 **Lat:** 45.34901 **Long:** 122.59946

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Downspouts on west side of house.



Basin 3 Run 24 Leak 5 A



Basin 3 Run 24 Leak 5 B



Basin: Basin 3 Run: 24

Incident: 11

Incident Location: 221 Pearl

Lat: 45.34907 *Long:* 122.59977

Upstream Manhole: 11476 *Lat:* 45.34909 *Long:* 122.60049

Downstream Manhole: 11545 **Lat:** 45.34901 **Long:** 122.59946

Result: Positive Leak Source: Smoke inside

Leak Type: SI

Leak Size: A

Leak Surface Cover: PB



Comments: Attic vents smoking.

Basin: Basin 3 **Run:** 24

Incident: 11

Incident Location: 221 Pearl

Lat: 45.34907 *Long:* 122.59977

Downstream Manhole: 11545 **Lat:** 45.34901 **Long:** 122.59946

Result: Positive **Leak Source:** Smoke inside

Leak Type: SI
Leak Size: A

Leak Surface Cover: PB

Observations:

Comments: Attic vents smoking.



Basin 3 Run 24 Leak 6 A



Basin 3 Run 24 Leak 6 B



Basin: Basin 3 Run: 25

Incident: 12

Incident Location: 157 Hazel

Lat: 45.34856 *Long*: 122.60261

Upstream Manhole: 11566 *Lat:* 45.34871 *Long:* 122.60275

Result: Positive Leak Source: Cracked Concrete

Leak Type: 0
Leak Size: A

Lat: 45.34848 *Long:* 122.60227

Leak Surface Cover: D



Basin 3 Run 25 Leak 1 B

Observations:

Downstream Manhole: 11571

Comments: Smoke from hole in flower bed + crack in walkway. Unknown Source

Basin: Basin 3 Run: 25

Incident: 12

Incident Location: 157 Hazel

Lat: 45.34856 *Long:* 122.60261

 Upstream Manhole:
 11566
 Lat:
 45.34871
 Long:
 122.60275

 Downstream Manhole:
 11571
 Lat:
 45.34848
 Long:
 122.60227

Result: Positive Leak Source: Cracked Concrete

Leak Type: 0
Leak Size: A

Leak Surface Cover: D



Basin 3 Run 25 Leak 1 A

Observations:

Comments: Smoke from hole in flower bed + crack in walkway. Unknown Source



Smoke Test Incidents Report Basin 4

Smoke Test Incidents



Basin: Basin 4 Run: 06

Incident: 01

Incident Location: 639 Apperson

Lat: 45.34.. *Long*: 122.608..

Downstream Manhole: 11558 **Lat:** 45.34848 **Long:** 122.60880

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: T



Comments: Smoke coming from hole in yard.

Basin: Basin 4 **Run:** 06

Incident: 01

Incident Location: 639 Apperson

Lat: 45.34.. *Long*: 122.608..

Upstream Manhole: 11557 *Lat:* 45.34829 *Long:* 122.60819

Downstream Manhole: 11558 **Lat:** 45.34848 **Long:** 122.60880

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Smoke coming from hole in yard.



Basin 4 Run 6 Leak 1 B



Basin 4 Run 6 Leak 1 A

Smoke Test Incidents



Basin: Basin 4 Run: 11

Incident: 02

Incident Location: On Charman 250 ft W of Linn

Lat: 45.34702 *Long*: 122.60457

Upstream Manhole: 11593 *Lat*: 45.34717 *Long*: 122.60420

Downstream Manhole: 11594 **Lat:** 45.34704 **Long:** 122.60462

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: c

Leak Surface Cover: E



Basin 4 Run 11 Leak 1 B

Observations:

Comments: Medium to heavy smoke from unknown source down in ravine- no access.

Basin: Basin 4 **Run:** 11

Incident: 02

Incident Location: On Charman 250 ft W of Linn

Lat: 45.34702 *Long:* 122.60457

 Upstream Manhole:
 11593
 Lat:
 45.34717
 Long:
 122.60420

 Downstream Manhole:
 11594
 Lat:
 45.34704
 Long:
 122.60462

Result: Positive Leak Source: N/A

Leak Type: 0
Leak Size: 0

Leak Surface Cover: E



Basin 4 Run 11 Leak 1 A

Observations:

Comments: Medium to heavy smoke from unkown source down in ravine- no access.

Smoke Test Incidents



Basin: Basin 4 Run: 12

Incident: 03

Incident Location: 50 ft SW of Electric St

Lat: 45.34663 *Long*: 122.60458

Upstream Manhole: 11583 *Lat*: 45.34632 *Long*: 122.60339

Downstream Manhole: 11596 **Lat:** 45.34692 **Long:** 122.60461

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: D

Leak Surface Cover: E

Observations: Heavy smoke, blackberry bushes

Comments: In the valley of a drainage ravine that runs down to Electric St.

Basin: Basin 4 **Run:** 12

Incident: 03

Incident Location: 50 ft SW of Electric St

Lat: 45.34663 *Long:* 122.60458

Downstream Manhole: 11596 **Lat:** 45.34692 **Long:** 122.60461

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: D

Leak Surface Cover: E

Observations: Heavy smoke, blackberry bushes

Comments: In the valley of a drainage ravine that runs down to Electric St.



Basin 4 Run 12 Leak 1 B



Basin 4 Run 12 Leak 1 A

Smoke Test Incidents



Basin: Basin 4 Run: 13

Incident: 04

Incident Location: Barday + Harding

Lat: 45.34567 *Long:* 122.60614

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: E

Leak Surface Cover: A

Comments: 3 storm drains

Observations: Heavy smoke

Basin: Basin 4 **Run:** 13

Incident: 04

Incident Location: Barday + Harding

Lat: 45.34567 *Long:* 122.60614

 Upstream Manhole:
 13046
 Lat:
 45.34567
 Long:
 122.60614

 Downstream Manhole:
 13047
 Lat:
 45.34628
 Long:
 122.60612

Result: Positive Leak Source: Storm Drain

Leak Type: MHC ST

Leak Size: E

Leak Surface Cover: A

Observations: Heavy smoke

Comments: 3 storm drains



Basin 4 Run 13 Leak 1 B



Basin 4 Run 13 Leak 1 A

Smoke Test Incidents



Basin: Basin 4 Run: 13

Incident: 05

Incident Location: 205 Harding

Lat: 45.34621 *Long*: 122.60590

Downstream Manhole: 13045 **Lat:** 45.34628 **Long:** 122.60486

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: T

Observations: Light smoke

Comments: Holes in ground in front yard.

Basin: Basin 4 **Run:** 13

Incident: 05

Incident Location: 205 Harding

Lat: 45.34621 *Long:* 122.60590

Downstream Manhole: 13045 **Lat:** 45.34628 **Long:** 122.60486

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: A

Leak Surface Cover: T

Observations: Light smoke

Comments: Holes in ground in front yard.



Basin 4 Run 13 Leak 2 B



Basin 4 Run 13 Leak 2 A

Smoke Test Incidents



Basin: Basin 4 **Run:** 13

Incident: 06

Incident Location: 178 Harding

Lat: 45.34628 *Long*: 122.60486

Upstream Manhole: 13047 *Lat*: 45.34628 *Long*: 122.60612

Downstream Manhole: 13045 **Lat:** 45.34628 **Long:** 122.60486

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A

Observations: Heavy smoke

Comments: 2 storm drains near MH 13045

Basin: Basin 4 **Run:** 13

Incident: 06

Incident Location: 178 Harding

Lat: 45.34628 *Long:* 122.60486

Downstream Manhole: 13045 **Lat:** 45.34628 **Long:** 122.60486

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A

Observations: Heavy smoke

Comments: 2 storm drains near MH 13045



Basin 4 Run 13 Leak 3 B



Basin 4 Run 13 Leak 3 A



Smoke Test Incidents Report Basin 5



Basin: Basin 5 Run: 02

Incident: 01

Incident Location: 1318 Otter Ln

Lat: 45.33684 *Long*: 122.58829

Upstream Manhole: 12075 Lat: Long:

Downstream Manhole: 11294 **Lat:** 45.33681 **Long:** 122.58743

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: Unkown

Leak Surface Cover: Unknown



Comments: 11291 480 Hilltop Ave 45.33647 122.58922. Leak: unable to access leak-behind fence, no one home.

Possibly a cleanout.

Basin: Basin 5 **Run:** 02

Incident: 01

Incident Location: 1318 Otter Ln

Lat: 45.33684 *Long:* 122.58829

Upstream Manhole: 12075 Lat: Long:

Downstream Manhole: 11294 **Lat:** 45.33681 **Long:** 122.58743

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: Unkown

Leak Surface Cover: Unknown

Observations:

Comments: 11291 480 Hilltop Ave 45.33647 122.58922. Leak: unable to access leak-behind fence, no one home.

Possibly a cleanout.



Basin 5 Run 2 Leak 1 B



Basin 5 Run 2 Leak 1 A



Smoke Test Incidents Report Basin 6



Basin: Basin 6 Run: 04

Incident: 01

Incident Location: 420 Latourette St

Lat: 45.34705 *Long:* 122.5991

Upstream Manhole:18002Lat:Long:Downstream Manhole:18001Lat:Long:

Result: Positive **Leak Source:** Cleanout

Leak Type: CCB

Leak Size: A

Leak Surface Cover: T



Observations:

Comments: Old broken capped pipe.

Basin: Basin 6 Run: 04

Incident: 01

Incident Location: 420 Latourette St

Lat: 45.34705 *Long:* 122.5991

Upstream Manhole:18002Lat:Long:Downstream Manhole:18001Lat:Long:

Result: Positive Leak Source: Cleanout

Leak Type: CCB

Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Old broken capped pipe.



Basin 6 Run 4 Leak 1 A



Basin: Basin 6 Run: 07

Incident: 02

Incident Location: 411 Pleasant Ave

Lat: 45.34733 *Long*: 122.59746

Result: Positive Leak Source: Catch Basin

Leak Type: 0

Leak Size: A

Lat: 45.34789 *Long:* 122.59718

Leak Surface Cover: A

Observations:

Downstream Manhole: 11489

Comments: Smoke from Grease trap

Basin: Basin 6 **Run:** 07

Incident: 02

Incident Location: 411 Pleasant Ave

Lat: 45.34733 *Long:* 122.59746

 Upstream Manhole:
 11488
 Lat:
 45.34725
 Long:
 122.59746

 Downstream Manhole:
 11489
 Lat:
 45.34789
 Long:
 122.59718

Result: Positive **Leak Source:** Catch Basin

Leak Type: O
Leak Size: A

Leak Surface Cover: A

Observations:

Comments: Smoke from Grease trap



Basin 6 Run 7 Leak 1 B



Basin 6 Run 7 Leak 1 A



Basin: Basin 6 Run: 07

Incident: 03

Incident Location: 411 Pleasant

Lat: 45.34726 *Long*: 122.59750

Downstream Manhole: 11489 **Lat:** 45.34789 **Long:** 122.59718

Result: Positive **Leak Source:** Driveway Drain

Leak Type: CB
Leak Size: D

Leak Surface Cover: CD

Observations:

Comments: Smoke from Wash drain

Basin: Basin 6 **Run:** 07

Incident: 03

Incident Location: 411 Pleasant

Lat: 45.34726 *Long:* 122.59750

 Upstream Manhole:
 11488
 Lat:
 45.34725
 Long:
 122.59746

 Downstream Manhole:
 11489
 Lat:
 45.34789
 Long:
 122.59718

Result: Positive **Leak Source:** Driveway Drain

Leak Type: CB

Leak Size: D

Leak Surface Cover: CD

Observations:

Comments: Smoke from Wash drain



Basin 6 Run 7 Leak 2 B



Basin 6 Run 7 Leak 2 A



Basin: Basin 6 Run: 10

Incident: 04

Incident Location: 515 Mt-Hood St

Lat: 45.34466 *Long*: 122.59478

Downstream Manhole: N/A Lat: 45.35094 Long: 122.59808

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E
Leak Surface Cover: A

Observations:

Comments: Heavy smoke from this Storm Drain. Could not locate upstream manhole.

Basin: Basin 6 **Run:** 10

Incident: 04

Incident Location: 515 Mt-Hood St

Lat: 45.34466 *Long:* 122.59478

Upstream Manhole: 10809 Lat: 45.34462 Long: 122.59468

Downstream Manhole: N/A **Lat:** 45.35094 **Long:** 122.59808

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A

Observations:

Comments: Heavy smoke from this Storm Drain. Could not locate upstream manhole.



Basin 6 Run 10 Leak 1 B



Basin 6 Run 10 Leak 1 A



Basin: Basin 6 Run: 12

Incident: 05

Incident Location: 337 Willamttes St

Lat: 45.35102 *Long:* 122.59793

Upstream Manhole: 11496 *Lat*: 45.35096 *Long*: 122.59735

Downstream Manhole: N/A Lat: 45.35094 Long: 122.59808

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Holes in front yard. Unknown Source

Basin: Basin 6 **Run:** 12

Incident: 05

Incident Location: 337 Willamttes St

Lat: 45.35102 *Long:* 122.59793

Downstream Manhole: N/A **Lat:** 45.35094 **Long:** 122.59808

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Holes in front yard. Unknown Source



Basin 6 Run 12 Leak 1 B



Basin 6 Run 12 Leak 1 A



Basin: Basin 6 Run: 12

Incident: 06

Incident Location: 326 Willamette St

Lat: 45.35086 *Long*: 122.59750

Downstream Manhole: N/A Lat: 45.35094 Long: 122.59808

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Smoke from downspouts at this house

Basin: Basin 6 **Run:** 12

Incident: 06

Incident Location: 326 Willamette St

Lat: 45.35086 *Long:* 122.59750

Downstream Manhole: N/A **Lat:** 45.35094 **Long:** 122.59808

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Smoke from downspouts at this house



Basin 6 Run 12 Leak 2 B



Basin 6 Run 12 Leak 2 A



Smoke Test Incidents Report Basin 7

Smoke Test Incidents



Basin: Basin 7 **Run:** 01

Incident: 01

Incident Location: 13th + Jackson (South Corner)

Lat: 45.35798 *Long*: 122.59555

Downstream Manhole: 10140 **Lat:** 45.35847 **Long:** 122.59644

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A

Observations:

Comments:

Basin: Basin 7 Run: 01

Incident: 01

Incident Location: 13th + Jackson (South Corner)

Lat: 45.35798 *Long*: 122.59555

Downstream Manhole: 10140 **Lat:** 45.35847 **Long:** 122.59644

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A

Observations:

Comments:



Basin 7 Run 1 Leak 1 B



Basin 7 Run 1 Leak 1 A

Smoke Test Incidents



Basin: Basin 7 **Run:** 09

Incident: 02

Incident Location: 1018 Polk

Lat: 45.35514 *Long*: 122.59453

Upstream Manhole: 10110 *Lat*: 45.35498 *Long*: 122.59487

Result: Positive **Leak Source:** Service Lateral

Leak Type: SC

Leak Size: A
Leak Surface Cover: D

Observations:

Comments: Hole in sidewalk, possibly a lateral.

Basin: Basin 7 Run: 09

Incident: 02

Incident Location: 1018 Polk

Lat: 45.35514 *Long:* 122.59453

Result: Positive **Leak Source:** Service Lateral

Leak Type: SC

Leak Size: A

Leak Surface Cover: D

Observations:

Comments: Hole in sidewalk, possibly a lateral.



Basin 7 Run 9 Leak 1 A



Basin 7 Run 9 Leak 1 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 09

Incident: 03

Incident Location: 1112 Polk

Lat: 45.35554 *Long*: 122.59409

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: E

Observations:

Comments: Smoke from under bush at SW corner.

Basin: Basin 7 Run: 09

Incident: 03

Incident Location: 1112 Polk

Lat: 45.35554 *Long:* 122.59409

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: A

Leak Surface Cover: E

Observations:

Comments: Smoke from under bush at SW corner.



Basin 7 Run 9 Leak 2 A



Basin 7 Run 9 Leak 2 B

Smoke Test Incidents



Basin: Basin 7 Run: 09

Incident: 04

Incident Location:

Lat: Long:

Upstream Manhole: 10110 *Lat*: 45.35498 *Long*: 122.59487

Result: Positive Leak Source: Service Lateral

Leak Type: SC

Leak Size: A

Leak Surface Cover: D



Basin 7 Run 9 Leak 3 A

Observations:

Comments: Leak from sidewalk at frencepost + driveway, possibly a lateral.

Basin: Basin 7 Run: 09

Incident: 04

Incident Location:

Lat: Long:

 Upstream Manhole:
 10110
 Lat:
 45.35498
 Long:
 122.59487

 Downstream Manhole:
 10113
 Lat:
 45.35606
 Long:
 122.59374

Result: Positive **Leak Source:** Service Lateral

Leak Type: SC

Leak Size: A

Leak Surface Cover: D



Basin 7 Run 9 Leak 3 B

Observations:

Comments: Leak from sidewalk at frencepost + driveway, possibly a lateral.

Smoke Test Incidents



Basin: Basin 7 **Run:** 10

Incident: 05

Incident Location: 1613 11th St

Lat: 45.34581 *Long:* 122.59300

Upstream Manhole: 12409 Lat: Long:

Downstream Manhole: 13666 **Lat:** 45.35505 **Long:** 122.59280

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Smoke from Downspout and from ground near mailbox.

Basin: Basin 7 Run: 10

Incident: 05

Incident Location: 1613 11th St

Lat: 45.34581 *Long:* 122.59300

Upstream Manhole: 12409 Lat: Long:

Downstream Manhole: 13666 **Lat:** 45.35505 **Long:** 122.59280

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Smoke from Downspout and from ground near mailbox.



Basin 7 Run 10 Leak 1 A



Basin 7 Run 10 Leak 1 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 10

Incident: 06

Incident Location: 1108 Taylor

Lat: 45.35511 *Long*: 122.59330

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: D, T

Observations:

Comments: Lanscaping at front of house on both sides of sidewalk.

Basin: Basin 7 **Run:** 10

Incident: 06

Incident Location: 1108 Taylor

Lat: 45.35511 *Long:* 122.59330

Upstream Manhole: 10116 *Lat*: 45.35490 *Long*: 122.59367

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: D, T

Observations:

Comments: Lanscaping at front of house on both sides of sidewalk.



Basin 7 Run 10 Leak 2 B



Basin 7 Run 10 Leak 2 A

Smoke Test Incidents



Basin: Basin 7 **Run:** 10

Incident: 07

Incident Location: 1014 Taylor

Lat: 45.35457 *Long:* 122.59388

 Upstream Manhole:
 13918
 Lat:
 45.35446
 Long:
 122.59410

 Downstream Manhole:
 10116
 Lat:
 45.35490
 Long:
 122.59367

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: SC
Leak Size: A

Leak Surface Cover: D

Observations:

Comments:

Basin: Basin 7 **Run:** 10

Incident: 07

Incident Location: 1014 Taylor

Lat: 45.35457 *Long*: 122.59388

 Upstream Manhole:
 13918
 Lat:
 45.35446
 Long:
 122.59410

 Downstream Manhole:
 10116
 Lat:
 45.35490
 Long:
 122.59367

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: SC
Leak Size: A

Leak Surface Cover: D

Observations:

Comments:



Basin 7 Run 10 Leak 3 A



Basin 7 Run 10 Leak 3 B

Smoke Test Incidents



Basin: Basin 7 Run: 14

Incident: 08

Incident Location: 1001 JQ Adams

Lat: 45.35665 *Long*: 122.59846

Upstream Manhole: 10094 *Lat*: 45.35700 *Long*: 122.59797

Result: Positive **Leak Source:** Service Lateral

Leak Type: SC

Leak Size: A
Leak Surface Cover: D



Basin 7 Run 14 Leak 1 A

Observations:

Comments: Smoke from open pipe, unsure if it is a lateral or some sort of cleanout.

Basin: Basin 7 Run: 14

Incident: 08

Incident Location: 1001 JQ Adams

Lat: 45.35665 *Long:* 122.59846

Downstream Manhole: 13913 **Lat:** 45.35646 **Long:** 122.59848

Result: Positive **Leak Source:** Service Lateral

Leak Type: SC

Leak Size: A

Leak Surface Cover: D



Basin 7 Run 14 Leak 1 B

Observations:

Comments: Smoke from open pipe, unsure if it is a lateral or some sort of cleanout.

Smoke Test Incidents



Basin: Basin 7 **Run:** 17

Incident: 09

Incident Location: 909 Pierce

Lat: 45.35363 *Long*: 122.59424

Downstream Manhole: 10319 **Lat:** 45.35409 **Long:** 122.59380

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Downspout at NE corner of house.

Basin: Basin 7 **Run:** 17

Incident: 09

Incident Location: 909 Pierce

Lat: 45.35363 *Long*: 122.59424

Downstream Manhole: 10319 **Lat:** 45.35409 **Long:** 122.59380

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout at NE corner of house.



Basin 7 Run 17 Leak 1 A



Basin 7 Run 17 Leak 1 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 17

Incident: 09

Incident Location: 909 Pierce

Lat: 45.35363 *Long*: 122.59424

Downstream Manhole: 10319 **Lat:** 45.35409 **Long:** 122.59380

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Downspout at NE corner of house.

Basin: Basin 7 **Run:** 17

Incident: 09

Incident Location: 909 Pierce

Lat: 45.35363 *Long:* 122.59424

Downstream Manhole: 10319 **Lat:** 45.35409 **Long:** 122.59380

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout at NE corner of house.



Basin 7 Run 17 Leak 1 C



Basin 7 Run 17 Leak 1 D

Smoke Test Incidents



Basin: Basin 7 **Run:** 18

Incident: 10

Incident Location: 914 Jackson

Lat: 45.35591 *Long:* 122.59788

Downstream Manhole: 13085 **Lat:** 45.35571 **Long:** 122.59808

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout at SW side of house.

Basin: Basin 7 **Run:** 18

Incident: 10

Incident Location: 914 Jackson

Lat: 45.35591 *Long:* 122.59788

Downstream Manhole: 13085 **Lat:** 45.35571 **Long:** 122.59808

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout at SW side of house.



Basin 7 Run 18 Leak 1 A



Basin 7 Run 18 Leak 1 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 18

Incident: 11

Incident Location: 915 Jackson

Lat: 45.35577 *Long*: 122.59826

Upstream Manhole: 13085 *Lat*: 45.35571 *Long*: 122.59808

Downstream Manhole: 13066 Lat: Long:

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments:

Basin: Basin 7 **Run:** 18

Incident: 11

Incident Location: 915 Jackson

Lat: 45.35577 *Long:* 122.59826

Upstream Manhole: 13085 *Lat:* 45.35571 *Long:* 122.59808

Result: Positive Leak Source: Downspout

Leak Type: RWL

Long:

Leak Size: c

Leak Surface Cover: PB

Lat:

Observations:

Downstream Manhole: 13066

Comments:



Basin 7 Run 18 Leak 2 A



Basin 7 Run 18 Leak 2 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 19

Incident: 12

Incident Location: 908 Jackson

Lat: 45.35542 *Long:* 122.59808

Upstream Manhole: 13713 *Lat:* 45.35531 *Long:* 122.59841

Downstream Manhole: 13085 *Lat*: 45.35571 *Long*: 122.59808

> Result: Positive Leak Source: Service Lateral

> > Leak Type: sc Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Smoke from ground in line with service lateral.

Basin: Basin 7 **Run:** 19

Incident: 12

Incident Location: 908 Jackson

45.35542 *Long*: 122.59808 Lat:

Upstream Manhole: 13713 Lat: 45.35531 Long: 122.59841 Downstream Manhole: 13085

Lat: 45.35571 *Long:* 122.59808

Result: Positive Leak Source: Service Lateral

> Leak Type: sc Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Smoke from ground in line with service lateral.



Basin 7 Run 19 Leak 1 B



Basin 7 Run 19 Leak 1 A

Smoke Test Incidents



Basin: Basin 7 Run: 21

Incident: 13

Incident Location: 805 Taylor

Lat: 45.35328 *Long:* 122.59564

Upstream Manhole: 13922 Lat: Long:

Downstream Manhole: 13091 **Lat:** 45.35362 **Long:** 122.59615

Result: Positive **Leak Source:** Main Sewer

Leak Type: RWL, CB

Leak Size: c

Leak Surface Cover: PB, CD



Basin 7 Run 21 Leak 1 A

Observations:

Comments: Several issues going on in this section. Downspout and catch basin cross connected.

Basin: Basin 7 **Run:** 21

Incident: 13

Incident Location: 805 Taylor

Lat: 45.35328 *Long*: 122.59564

Upstream Manhole: 13922 Lat: Long:

Downstream Manhole: 13091 **Lat:** 45.35362 **Long:** 122.59615

Result: Positive **Leak Source:** Main Sewer

Leak Type: RWL, CB

Leak Size: c

Leak Surface Cover: PB, CD



Basin 7 Run 21 Leak 1 B

Observations:

Comments: Several issues going on in this section. Downspout and catch basin cross connected.

Smoke Test Incidents



Basin: Basin 7 Run: 21

Incident: 14

Incident Location: 805 Taylor

Lat: 45.35328 *Long*: 122.59564

Upstream Manhole: 13922 Lat: Long:

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: 0
Leak Size: A

Leak Surface Cover: CD



Comments: Smoke from cracks between road and wall.

Basin: Basin 7 Run: 21

Incident: 14

Incident Location: 805 Taylor

Lat: 45.35328 *Long*: 122.59564

Upstream Manhole: 13922 Lat: Long:

Downstream Manhole: 13091 **Lat:** 45.35362 **Long:** 122.59615

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: O
Leak Size: A

Leak Surface Cover: CD

Observations:

Comments: Smoke from cracks between road and wall.



Basin 7 Run 21 Leak 2 A



Basin 7 Run 21 Leak 2 B

Smoke Test Incidents



Basin: Basin 7 Run: 21

Incident: 15

Incident Location: 805 Taylor

Lat: 45.35328 *Long*: 122.59564

Upstream Manhole: 13922 Lat: Long:

Downstream Manhole: 13091 **Lat:** 45.35362 **Long:** 122.59615

Result: Positive **Leak Source:** Smoking Ground

Leak Type: 0
Leak Size: A

Leak Surface Cover: A, E

Observations:

Comments: Smoke from bushes and edge of wall.

Basin: Basin 7 **Run:** 21

Incident: 15

Incident Location: 805 Taylor

Lat: 45.35328 *Long:* 122.59564

Upstream Manhole: 13922 Lat: Long:

Result: Positive **Leak Source:** Smoking Ground

Leak Type: O
Leak Size: A

Leak Surface Cover: A, E

Observations:

Comments: Smoke from bushes and edge of wall.



Basin 7 Run 21 Leak 3 A



Basin 7 Run 21 Leak 3 B

Smoke Test Incidents



Basin: Basin 7 Run: 27

Incident: 16

Incident Location: 724 Van Buren

Lat: 45.35383 *Long*: 122.59808

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: C

Leak Surface Cover: PB



Comments: Downspouts appear to be cross connected

Basin: Basin 7 **Run:** 27

Incident: 16

Incident Location: 724 Van Buren

Lat: 45.35383 *Long:* 122.59808

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspouts appear to be cross connected



Basin 7 Run 27 Leak 1 A



Basin 7 Run 27 Leak 1 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 29

Incident: 17

Incident Location: 432 Division

Lat: 45.35151 *Long*: 122.59552

Downstream Manhole: 13103 Lat:

Result: Positive Leak Source: Downspout

Leak Type: RWL

Long:

Long:

Leak Size: c

Leak Surface Cover: PB



Comments: Downspouts appear to be cross connected

Basin: Basin 7 **Run:** 29

Incident: 17

Incident Location: 432 Division

Lat: 45.35151 *Long:* 122.59552

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: C

Leak Surface Cover: PB

Lat:

Observations:

Downstream Manhole: 13103

Comments: Downspouts appear to be cross connected



Basin 7 Run 29 Leak 1 B



Basin 7 Run 29 Leak 1 A

Smoke Test Incidents



Basin: Basin 7 Run: 30

Incident: 18

Incident Location:

Lat: Long:

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A

Observations:

Comments: Storm drain NE of MH 13109.

Basin: Basin 7 Run: 30

Incident: 18

Incident Location:

Lat: Long:

Downstream Manhole: 13109 **Lat:** 45.35131 **Long:** 122.59402

Result: Positive **Leak Source:** Storm Drain

Leak Type: CB

Leak Size: E

Leak Surface Cover: A

Observations:

Comments: Storm drain NE of MH 13109.



Basin 7 Run 30 Leak 1 A



Basin 7 Run 30 Leak 1 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 30

Incident: 19

Incident Location: 519 Willamette

Lat: 45.35126 *Long:* 122.59393

Upstream Manhole: 13288 *Lat:* 45.35130 *Long:* 122.59328

Result: Positive **Leak Source:** Smoking Ground

Leak Type: O
Leak Size: A

Leak Surface Cover: T





Observations:

Comments: Smoke from yard. Unknown source

Basin: Basin 7 Run: 30

Incident: 19

Incident Location: 519 Willamette

Lat: 45.35126 *Long:* 122.59393

Downstream Manhole: 13109 **Lat:** 45.35131 **Long:** 122.59402

Result: Positive **Leak Source:** Smoking Ground

Leak Type: O
Leak Size: A

Leak Surface Cover: T

Observations:

Comments: Smoke from yard. Unknown source



Basin 7 Run 30 Leak 2 A



Basin 7 Run 30 Leak 2 B

Smoke Test Incidents



Basin: Basin 7 Run: 30

Incident: 20

Incident Location: 115 Warren

Lat: 45.35130 *Long:* 122.59447

Upstream Manhole: 13104 Lat: Long:

Result: Positive **Leak Source:** Smoking Ground

Leak Type: 0
Leak Size: A

Leak Surface Cover: D



Basin 7 Run 30 Leak 3 A

Observations:

Comments: Smoke from underneath new deck. Possibly a covered manhole?

Basin: Basin 7 Run: 30

Incident: 20

Incident Location: 115 Warren

Lat: 45.35130 *Long:* 122.59447

Upstream Manhole: 13104 Lat: Long:

Downstream Manhole: 13109 **Lat:** 45.35131 **Long:** 122.59402

Result: Positive **Leak Source:** Smoking Ground

Leak Type: O
Leak Size: A

Leak Surface Cover: D



Basin 7 Run 30 Leak 3 B

Observations:

Comments: Smoke from underneath new deck. Possibly a covered manhole?

Smoke Test Incidents



Basin: Basin 7 Run: 31

Incident: 21

Incident Location: 418 Willamette

Lat: 45.35092 *Long*: 122.59595

Upstream Manhole: 12977 Lat: 45.35091 Long: 122.59637

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A



Comments: Smoke from catch basins. Cross connection observed

Basin: Basin 7 **Run:** 31

Incident: 21

Incident Location: 418 Willamette

Lat: 45.35092 *Long:* 122.59595

 Upstream Manhole:
 12977
 Lat:
 45.35091
 Long:
 122.59637

 Downstream Manhole:
 12978
 Lat:
 45.35092
 Long:
 122.59492

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A

Observations:

Comments: Smoke from catch basins. Cross connection observed



Basin 7 Run 31 Leak 1 A



Basin 7 Run 31 Leak 1 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 32

Incident: 22

Incident Location: 158 Warren

Lat: 45.34988 *Long:* 122.59489

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Smoke from drain, porch and downspout.

Basin: Basin 7 **Run:** 32

Incident: 22

Incident Location: 158 Warren

Lat: 45.34988 *Long:* 122.59489

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Smoke from drain, porch and downspout.



Basin 7 Run 32 Leak 1 A



Basin 7 Run 32 Leak 1 B

Smoke Test Incidents



Basin: Basin 7 **Run:** 32

Incident: 23

Incident Location: 505 Roosevelt

Lat: 45.34972 *Long:* 122.59473

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Downspout at SW corner.

Basin: Basin 7 Run: 32

Incident: 23

Incident Location: 505 Roosevelt

Lat: 45.34972 *Long:* 122.59473

Upstream Manhole: 13102 *Lat:* 45.34978 *Long:* 122.59484

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout at SW corner.



Basin 7 Run 32 Leak 2 B



Basin 7 Run 32 Leak 2 A



Smoke Test Incidents Report Basin 8A



Basin: Basin 8A **Run:** 02

Incident: 01

Incident Location: 1318 Madison

Lat: 45.35994 *Long:* 122.59744

Upstream Manhole: 10158 *Lat:* 45.36009 *Long:* 122.59740 Downstream Manhole: 12403 *Lat:* 45.35981 *Long:* 122.59773

> Result: Positive Leak Source: Service Lateral

> > Leak Type: sc Leak Size: B

Leak Surface Cover: E



Basin 8a Run 2 Leak 1 B

Observations:

Comments: Multiple leaks along lateral.

Basin: Basin 8A **Run:** 02

Incident: 01

Incident Location: 1318 Madison

45.35994 *Long*: 122.59744 Lat:

Upstream Manhole: 10158 *Lat*: 45.36009 *Long*: 122.59740 Downstream Manhole: 12403 *Lat:* 45.35981 *Long:* 122.59773

> Result: Positive Leak Source: Service Lateral

> > Leak Type: sc Leak Size: B

Leak Surface Cover: E

Observations:

Comments: Multiple leaks along lateral.



Basin 8a Run 2 Leak 1 A



Basin: Basin 8A **Run:** 04

Incident: 02

Incident Location: NE side of 1005 13th St

Lat: 45.35915 *Long:* 122.59695

Upstream Manhole: 10148 *Lat:* 45.35911 *Long:* 122.59710

Downstream Manhole: 10147 *Lat:* 45.35963 *Long:* 122.29658

> Result: Positive Leak Source: Cracked Concrete

> > Leak Type: 0 Leak Size: A

Leak Surface Cover: D



Basin 8a Run 4 Leak 1 B

Observations:

Comments: Unkown type, coming from sidewalk.

Basin: Basin 8A **Run:** 04

Incident: 02

Incident Location: NE side of 1005 13th St

45.35915 *Long*: 122.59695 Lat:

Upstream Manhole: 10148 *Lat:* 45.35911 *Long:* 122.59710

Downstream Manhole: 10147 *Lat:* 45.35963 *Long:* 122.29658

> Leak Source: Cracked Concrete Result: Positive

> > Leak Type: 0 Leak Size: A

Leak Surface Cover: D

Observations:

Comments: Unkown type, coming from sidewalk.



Basin 8a Run 4 Leak 1 A



Basin: Basin 8A Run: 05

Incident: 03

Incident Location: 1510 JQ Adams

Lat: 45.36029 *Long*: 122.59431

Upstream Manhole: 10794 *Lat*: 45.36048 *Long*: 122.59431

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Downspout on SW side of 1511 JQ Adams

Basin: Basin 8A **Run:** 05

Incident: 03

Incident Location: 1510 JQ Adams

Lat: 45.36029 *Long:* 122.59431

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Downspout on SW side of 1511 JQ Adams



Basin 8a Run 5 Leak 1 B



Basin 8a Run 5 Leak 1 A



Basin: Basin 8A Run: 06

Incident: 04

Incident Location: 1320 JQ Adams

Lat: 45.35910 *Long*: 122.59582

Upstream Manhole: 10139 *Lat*: 45.35872 *Long*: 122.59625

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: T



Basin 8a Run 6 Leak 1 B

Observations:

Comments: Unknown type and source, smoke coming from holes inground under bushes

Basin: Basin 8A Run: 06

Incident: 04

Incident Location: 1320 JQ Adams

Lat: 45.35910 *Long:* 122.59582

Upstream Manhole: 10139 Lat: 45.35872 Long: 122.59625

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: A

Leak Surface Cover: T

Basin 8a Run 6 Leak 1 A

Observations:

Comments: Unknown type and source, smoke coming from holes inground under bushes



Basin: Basin 8A Run: 09

Incident: 05

Incident Location: 1205 15th

Lat: 45.35955 *Long*: 122.59370

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Downspout located at front of house (front door)

Basin: Basin 8A **Run:** 09

Incident: 05

Incident Location: 1205 15th

Lat: 45.35955 *Long:* 122.59370

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout located at front of house (front door)



Basin 8a Run 9 Leak 1 A



Basin 8a Run 9 Leak 1 B



Basin: Basin 8A **Run:** 10

Incident: 06

Incident Location: 1616 Jackson

Lat: 45.36082 *Long*: 122.59331

Downstream Manhole: 11357 **Lat:** 45.36104 **Long:** 122.59247

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Smoke from Downspout at NE side.

Basin: Basin 8A **Run:** 10

Incident: 06

Incident Location: 1616 Jackson

Lat: 45.36082 *Long:* 122.59331

 Upstream Manhole:
 11358
 Lat:
 45.36032
 Long:
 122.59331

 Downstream Manhole:
 11357
 Lat:
 45.36104
 Long:
 122.59247

1001 - 10

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Smoke from Downspout at NE side.



Basin 8a Run 10 Leak 1 B



Basin 8a Run 10 Leak 1 A



Basin: Basin 8A **Run:** 10

Incident: 07

Incident Location: 1608 Jackson

Lat: 45.36049 *Long*: 122.59300

Upstream Manhole: 11358 Lat: 45.36032 Long: 122.59331

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Downspouts on front of house and on SW side of house both smoking.

Basin: Basin 8A **Run:** 10

Incident: 07

Incident Location: 1608 Jackson

Lat: 45.36049 *Long:* 122.59300

Upstream Manhole: 11358 Lat: 45.36032 Long: 122.59331

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Downspouts on front of house and on SW side of house both smoking.



Basin 8a Run 10 Leak 2 B



Basin 8a Run 10 Leak 2 A



Basin: Basin 8A **Run:** 11

Incident: 08

Incident Location: 1616 Van Buren

Lat: 45.36029 *Long*: 122.59184

Upstream Manhole: 11360 *Lat:* 45.36040 *Long:* 122.39197

Downstream Manhole: 11359 **Lat:** 45.36030 **Long:** 122.59192

Result: Negative **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: PB



Basin 8a Run 11 Leak 1 A

Observations:

Comments: No smoke from 13732 to 12913 possible sump pump system.

Basin: Basin 8A **Run:** 11

Incident: 08

Incident Location: 1616 Van Buren

Lat: 45.36029 *Long:* 122.59184

Downstream Manhole: 11359 **Lat:** 45.36030 **Long:** 122.59192

Result: Negative Leak Source: N/A

Leak Surface Cover: PB

Leak Type: 0

Leak Size: A



Comments: No smoke from 13732 to 12913 possible sump pump system.



Basin 8a Run 11 Leak 1 B



Basin: Basin 8A Run: 14

Incident: 09

Incident Location: 1508 Polk

Lat: 45.35871 *Long*: 122.59124

Upstream Manhole: 13076 Lat: 45.35871 Long: 122.59124

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A

Observations:

Comments: Smoke from stormwater catch basin

Basin: Basin 8A **Run:** 14

Incident: 09

Incident Location: 1508 Polk

Lat: 45.35871 *Long:* 122.59124

 Upstream Manhole:
 13076
 Lat:
 45.35871
 Long:
 122.59124

 Downstream Manhole:
 10129
 Lat:
 45.35820
 Long:
 122.59168

Result: Positive Leak Source: Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A

Observations:

Comments: Smoke from stormwater catch basin



Basin 8a Run 14 Leak 1 B



Basin 8a Run 14 Leak 1 A



Basin: Basin 8A **Run:** 18

Incident: 10

Incident Location: 1501 16th (16th + Polk)

Lat: 45.35908 *Long:* 122.59073

Upstream Manhole: 10162 Lat: Long:

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A



Comments: Storm drain at E corner of intersection.

Basin: Basin 8A **Run:** 18

Incident: 10

Incident Location: 1501 16th (16th + Polk)

Lat: 45.35908 *Long:* 122.59073

Upstream Manhole: 10162 Lat: Long:

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A

Observations:

Comments: Storm drain at E corner of intersection.



Basin 8a Run 18 Leak 1 A



Basin 8a Run 18 Leak 1 B



Basin: Basin 8A **Run:** 19

Incident: 11

Incident Location: 1701 16th (16th + Pierce)

Lat: 45.35839 *Long*: 122.58891

 Upstream Manhole:
 10066
 Lat:
 45.35784
 Long:
 122.58836

 Downstream Manhole:
 12390
 Lat:
 45.35834
 Long:
 122.58936

Result: Positive Leak Source: Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A



Basin 8a Run 19 Leak 1 B

Observations:

Comments: Storm drain at E corner of 16th + Pierce.

Basin: Basin 8A **Run:** 19

Incident: 11

Incident Location: 1701 16th (16th + Pierce)

Lat: 45.35839 *Long:* 122.58891

 Upstream Manhole:
 10066
 Lat:
 45.35784
 Long:
 122.58836

 Downstream Manhole:
 12390
 Lat:
 45.35834
 Long:
 122.58936

Result: Positive **Leak Source:** Storm Drain

Leak Type: MHC ST

Leak Size: D

Leak Surface Cover: A

Observations:

Comments: Storm drain at E corner of 16th + Pierce.



Basin 8a Run 19 Leak 1 A



Basin: Basin 8A **Run:** 19

Incident: 12

Incident Location: 1611 Pierce

Lat: 45.35860 *Long*: 122.58942

Upstream Manhole: 12390 *Lat:* 45.35834 *Long:* 122.58936

Downstream Manhole: 18024 **Lat:** 45.35870 **Long:** 122.59012

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: C
Leak Surface Cover: PB

Observations:

Comments: Downspout at S corner of 1611 Pierce.

Basin: Basin 8A **Run:** 19

Incident: 12

Incident Location: 1611 Pierce

Lat: 45.35860 *Long:* 122.58942

 Upstream Manhole:
 12390
 Lat:
 45.35834
 Long:
 122.58936

 Downstream Manhole:
 18024
 Lat:
 45.35870
 Long:
 122.59012

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Downspout at S corner of 1611 Pierce.



Basin 8a Run 19 Leak 2 B



Basin 8a Run 19 Leak 2 A



Basin: Basin 8A **Run:** 19

Incident: 13

Incident Location: 1701 16th (16th + Pierce)

Lat: 45.35839 *Long*: 122.58929

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: 0
Leak Size: A

Leak Surface Cover: D



Basin 8a Run 19 Leak 3 B

Observations:

Comments: Sidewalk crack at E corner of 16th + Pierce. Unknown Source

Basin: Basin 8A **Run:** 19

Incident: 13

Incident Location: 1701 16th (16th + Pierce)

Lat: 45.35839 *Long:* 122.58929

 Upstream Manhole:
 10066
 Lat:
 45.35784
 Long:
 122.58836

 Downstream Manhole:
 12390
 Lat:
 45.35834
 Long:
 122.58936

Result: Positive **Leak Source:** Cracked Concrete

Leak Type: 0
Leak Size: A

Leak Surface Cover: D



Basin 8a Run 19 Leak 3 A

Observations:

Comments: Sidewalk crack at E corner of 16th + Pierce, Unknown Source



Basin: Basin 8A **Run:** 19

Incident: 14

Incident Location: 1701 16th (16th +Pierce)

Lat: 45.35839 *Long:* 122.58929

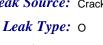
Upstream Manhole: 10066 Lat: 45.35784 Long: 122.58836

Downstream Manhole: 12390 *Lat:* 45.35834 *Long:* 122.58936

> Result: Positive Leak Source: Cracked Concrete

> > Leak Size: A

Leak Surface Cover: D



Observations:

Comments: Sidewalk crack at E corner of 16th + Pierce. Unknown Source

Basin: Basin 8A **Run:** 19

Incident: 14

Incident Location: 1701 16th (16th +Pierce)

45.35839 *Long*: 122.58929 Lat:

Upstream Manhole: 10066 *Lat*: 45.35784 *Long*: 122.58836 Downstream Manhole: 12390 Lat: 45.35834 Long: 122.58936

> Leak Source: Cracked Concrete Result: Positive

> > Leak Type: 0 Leak Size: A

Leak Surface Cover: D

Observations:

Comments: Sidewalk crack at E corner of 16th + Pierce. Unknown Source



Basin 8a Run 19 Leak 4 B



Basin 8a Run 19 Leak 4 A



Basin: Basin 8A **Run:** 19

Incident: 15

Incident Location: 1716 16th

Lat: 45.35795 *Long*: 122.58873

Result: Positive **Leak Source:** Service Lateral

Leak Type: SC Leak Size: A

Leak Surface Cover: D, E

Observations:

Comments: Suspected service lateral smoking.

Basin: Basin 8A **Run:** 19

Incident: 15

Incident Location: 1716 16th

Lat: 45.35795 *Long:* 122.58873

Downstream Manhole: 12390 **Lat:** 45.35834 **Long:** 122.58936

Result: Positive Leak Source: Service Lateral

Leak Type: SC
Leak Size: A

Leak Surface Cover: D, E

Observations:

Comments: Suspected service lateral smoking.



Basin 8a Run 19 Leak 5 B



Basin 8a Run 19 Leak 5 A



Basin: Basin 8A **Run:** 19

Incident: 16

Incident Location: 1716 16th St

Lat: 45.35775 *Long*: 122.58892

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Smoke from Downspout

Basin: Basin 8A **Run:** 19

Incident: 16

Incident Location: 1716 16th St

Lat: 45.35775 *Long:* 122.58892

Downstream Manhole: 12390 **Lat:** 45.35834 **Long:** 122.58936

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Smoke from Downspout



Basin 8a Run 19 Leak 6 A



Basin 8a Run 19 Leak 6 B



Basin: Basin 8A **Run:** 19

Incident: 17

Incident Location: 1714 16th St

Lat: 45.35781 *Long*: 122.58884

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Smoke from downspout

Basin: Basin 8A **Run:** 19

Incident: 17

Incident Location: 1714 16th St

Lat: 45.35781 *Long:* 122.58884

Downstream Manhole: 12390 **Lat:** 45.35834 **Long:** 122.58936

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB

Observations:

Comments: Smoke from downspout



Basin 8a Run 19 Leak 7 A



Basin 8a Run 19 Leak 7 B



Smoke Test Incidents Report Basin 8B



Basin: Basin 8B Run: 01

Incident: 01

Incident Location: 420 Dewey St

Lat: 45.35824 *Long*: 122.59555

Downstream Manhole: 11505 **Lat:** 45.34822 **Long:** 122.59471

Result: Positive **Leak Source:** Catch Basin

Leak Type: CB

Leak Size: D

Leak Surface Cover: A

Observations:

Comments: Catch basin at SE corner of Dewet St. + Irving St.

Basin: Basin 8B **Run:** 01

Incident: 01

Incident Location: 420 Dewey St

Lat: 45.35824 *Long:* 122.59555

Downstream Manhole: 11505 **Lat:** 45.34822 **Long:** 122.59471

Result: Positive **Leak Source:** Catch Basin

Leak Type: CB

Leak Size: D

Leak Surface Cover: A

Observations:

Comments: Catch basin at SE corner of Dewet St. + Irving St.



Basin 8B Run 1 Leak 1 B



Basin 8B Run 1 Leak 1 A



Basin: Basin 8B Run: 04

Incident: 02

Incident Location: 151 Warren St

Lat: 45.35022 *Long:* 122.59454

Upstream Manhole: 13599 Lat: 45.35034 Long: 122.59457

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: PB



Comments: Downspout at NE corner of house.

Basin: Basin 8B Run: 04

Incident: 02

Incident Location: 151 Warren St

Lat: 45.35022 *Long:* 122.59454

Upstream Manhole: 13599 Lat: 45.35034 Long: 122.59457

Downstream Manhole: 13108 **Lat:** 45.35031 **Long:** 122.59380

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

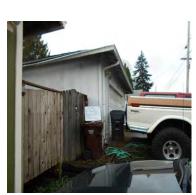
Leak Surface Cover: PB

Observations:

Comments: Downspout at NE corner of house.



Basin 8B Run 4 Leak 1 A



Basin 8B Run 4 Leak 1 B



Basin: Basin 8B Run: 05

Incident: 03

Incident Location: 532 Willamette St

Lat: 45.35031 *Long:* 122.59360

Upstream Manhole: 11510 Lat: 45.35097 Long: 122.59390

Downstream Manhole: 11519 **Lat:** 45.35096 **Long:** 122.59300

Result: Positive **Leak Source:** Smoking Ground

Leak Type: O
Leak Size: A

Leak Surface Cover: D



Basin 8B Run 5 Leak 1 A

Observations:

Comments: Hole on edge of sidewalk at NE corner of property. Unknown Source

Basin: Basin 8B **Run:** 05

Incident: 03

Incident Location: 532 Willamette St

Lat: 45.35031 *Long:* 122.59360

 Upstream Manhole:
 11510
 Lat:
 45.35097
 Long:
 122.59390

 Downstream Manhole:
 11519
 Lat:
 45.35096
 Long:
 122.59300

Result: Positive Leak Source: Smoking Ground

Leak Type: 0
Leak Size: A

Leak Surface Cover: D



Basin 8B Run 5 Leak 1 B

Observations:

Comments: Hole on edge of sidewalk at NE corner of property. Unknown Source



Basin: Basin 8B **Run:** 06

Incident: 04

Incident Location: 636 Division St

Lat: 45.35159 *Long:* 122.59145

Upstream Manhole: 11515 *Lat:* 45.35165 *Long:* 122.59196

Downstream Manhole: 11516 *Lat:* 45.35163 *Long:* 122.59115

> Result: Positive Leak Source: Smoking Ground

> > Leak Type: 0 Leak Size: B

Leak Surface Cover: D



Basin 8B Run 6 Leak 1 A

Observations:

Comments: Smoke from ground, Unknown Source. Likely service lateral

Basin: Basin 8B **Run:** 06

Incident: 04

Incident Location: 636 Division St

45.35159 *Long*: 122.59145 Lat:

Upstream Manhole: 11515 *Lat*: 45.35165 *Long*: 122.59196 Downstream Manhole: 11516 *Lat:* 45.35163 *Long:* 122.59115

> Result: Positive Leak Source: Smoking Ground

> > Leak Type: 0 Leak Size: B

Leak Surface Cover: D



Basin 8B Run 6 Leak 1 B

Observations:

Comments: Smoke from ground, Unknown Source. Likely service lateral



Basin: Basin 8B **Run:** 06

Incident: 05

Incident Location: 628 Division

Lat: 45.35165 *Long:* 122.59180

Upstream Manhole: 11515 *Lat:* 45.35165 *Long:* 122.59196

Downstream Manhole: 11516 *Lat:* 45.35163 *Long:* 122.59115

> Result: Positive Leak Source: Smoking Ground

> > Leak Size: B

Leak Surface Cover: D



Observations:

Comments: Smoke from ground, Unknown Source. Likely service lateral

Basin: Basin 8B **Run:** 06

Incident: 05

Incident Location: 628 Division

45.35165 *Long*: 122.59180 Lat:

Upstream Manhole: 11515 *Lat*: 45.35165 *Long*: 122.59196 Downstream Manhole: 11516 *Lat:* 45.35163 *Long:* 122.59115

> Result: Positive Leak Source: Smoking Ground

> > Leak Type: 0 Leak Size: B

Leak Surface Cover: D

Observations:

Comments: Smoke from ground, Unknown Source. Likely service lateral



Basin 8B Run 6 Leak 2 A



Basin 8B Run 6 Leak 2 B



Basin: Basin 8B Run: 07

Incident: 06

Incident Location: 1805 9th St

Lat: 45.35266 *Long*: 122.59258

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Downspout at E corner.

Basin: Basin 8B **Run:** 07

Incident: 06

Incident Location: 1805 9th St

Lat: 45.35266 *Long:* 122.59258

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Downspout at E corner.



Basin 8B Run 7 Leak 1 B



Basin 8B Run 7 Leak 1 A



Basin: Basin 8B Run: 08

Incident: 07

Incident Location: 749 Division St

Lat: 45.35226 *Long*: 122.58923

Upstream Manhole: 11514 *Lat:* 45.35192 *Long:* 122.58972

Result: Positive Leak Source: N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: D

Observations:

Comments: Water meter access panel.

Basin: Basin 8B Run: 08

Incident: 07

Incident Location: 749 Division St

Lat: 45.35226 *Long:* 122.58923

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: A

Leak Surface Cover: D

Observations:

Comments: Water meter access panel.



Basin 8B Run 8 Leak 1 B



Basin 8B Run 8 Leak 1 A



Basin: Basin 8B Run: 08

Incident: 08

Incident Location: 741 Division St

Lat: 45.35213 *Long*: 122.58949

Upstream Manhole: 11514 *Lat:* 45.35192 *Long:* 122.58972

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: A

Leak Surface Cover: D



Comments: Water meter access panel.

Basin: Basin 8B **Run:** 08

Incident: 08

Incident Location: 741 Division St

Lat: 45.35213 *Long*: 122.58949

Upstream Manhole: 11514 *Lat:* 45.35192 *Long:* 122.58972

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: A

Leak Surface Cover: D

Observations:

Comments: Water meter access panel.



Basin 8B Run 8 Leak 2 A



Basin 8B Run 8 Leak 2 B



Basin: Basin 8B **Run:** 09

Incident: 09

Incident Location: 1203 Division St

Lat: 45.35312 *Long*: 122.58891

Result: Positive Leak Source: Smoke inside

Leak Type: O
Leak Size: A

Leak Surface Cover: PB



Comments: Smoke coming from crawl space.

Basin: Basin 8B **Run:** 09

Incident: 09

Incident Location: 1203 Division St

Lat: 45.35312 *Long:* 122.58891

Result: Positive **Leak Source:** Smoke inside

Leak Type: O
Leak Size: A

Leak Surface Cover: PB

Observations:

Comments: Smoke coming from crawl space.



Basin 8B Run 9 Leak 1 A



Basin 8B Run 9 Leak 1 A



Basin: Basin 8B **Run:** 12

Incident: 10

Incident Location: 1208 Grant St

Lat: 45.35427 *Long*: 122.58912

Downstream Manhole: 12393 **Lat:** 45.35463 **Long:** 122.58876

Result: Positive **Leak Source:** Smoking Ground

Leak Type: 0
Leak Size: A

Leak Surface Cover: G



Comments: Smoke from ground, Unknown Source.

Basin: Basin 8B **Run:** 12

Incident: 10

Incident Location: 1208 Grant St

Lat: 45.35427 *Long:* 122.58912

Downstream Manhole: 12393 **Lat:** 45.35463 **Long:** 122.58876

Result: Positive Leak Source: Smoking Ground

Leak Type: O
Leak Size: A

Leak Surface Cover: G

Observations:

Comments: Smoke from ground, Unknown Source.



Basin 8B Run 12 Leak 1 A



Basin 8B Run 12 Leak 1 B



Basin: Basin 8B Run: 14

Incident: 11

Incident Location: 1901 14th St

Lat: 45.35624 *Long*: 122.58936

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Smoke from Downspouts

Basin: Basin 8B Run: 14

Incident: 11

Incident Location: 1901 14th St

Lat: 45.35624 *Long:* 122.58936

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Smoke from Downspouts



Basin 8B Run 14 Leak 1 A



Basin 8B Run 14 Leak 1 B



Basin: Basin 8B Run: 16

Incident: 12

Incident Location: 1713 14th St

Lat: 45.35672 *Long*: 122.59021

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Smoke from Downspouts

Basin: Basin 8B **Run:** 16

Incident: 12

Incident Location: 1713 14th St

Lat: 45.35672 *Long:* 122.59021

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Smoke from Downspouts



Basin 8B Run 16 Leak 1 A



Basin 8B Run 16 Leak 1 B



Basin: Basin 8B Run: 17

Incident: 13

Incident Location: 1601 15th St

Lat: 45.35806 *Long*: 122.59065

Upstream Manhole: 10179 *Lat:* 45.35794 *Long:* 122.58975

Downstream Manhole: 10129 **Lat:** 45.35820 **Long:** 122.59164

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB



Comments: Smoke from Downspouts

Basin: Basin 8B **Run:** 17

Incident: 13

Incident Location: 1601 15th St

Lat: 45.35806 *Long:* 122.59065

 Upstream Manhole:
 10179
 Lat:
 45.35794
 Long:
 122.58975

 Downstream Manhole:
 10129
 Lat:
 45.35820
 Long:
 122.59164

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: D

Leak Surface Cover: PB

Observations:

Comments: Smoke from Downspouts



Basin 8B Run 17 Leak 1 B



Basin 8B Run 17 Leak 1 A



Smoke Test Incidents Report Basin 9



Basin: Basin 9 **Run:** 14

Incident: 01

Incident Location: 19419 Provisioner Ln

Lat: 45.32408 *Long*: 122.60146

Result: Positive **Leak Source:** Main Sewer

Leak Type: O
Leak Size: B

Leak Surface Cover: A



Basin 9 Run 14 Leak 1 B

Observations:

Comments: MH 10325 has visible infiltration, leak source from ground water.

Basin: Basin 9 Run: 14

Incident: 01

Incident Location: 19419 Provisioner Ln

Lat: 45.32408 *Long:* 122.60146

 Upstream Manhole:
 10327
 Lat:
 45.32415
 Long:
 122.60188

 Downstream Manhole:
 11742
 Lat:
 45.32391
 Long:
 122.60109

Result: Positive Leak Source: Main Sewer

Leak Type: O
Leak Size: B

Leak Surface Cover: A



Basin 9 Run 14 Leak 1 A

Observations:

Comments: MH 10325 has visible infiltration, leak source from ground water.



Smoke Test Incidents Report Basin 10



Basin: Basin 10 **Run:** 03

Incident: 01

Incident Location: 19315 Whitney

Lat: 45.32684 *Long*: 122.59904

Upstream Manhole: 11917 *Lat*: 45.32777 *Long*: 122.59855

Result: Positive **Leak Source:** N/A

Leak Type: 0

Leak Size: B

Leak Surface Cover: CD



Comments: Two pipes in cement slab parking area NW of house.

Basin: Basin 10 **Run:** 03

Incident: 01

Incident Location: 19315 Whitney

Lat: 45.32684 *Long:* 122.59904

Upstream Manhole: 11917 *Lat:* 45.32777 *Long:* 122.59855

Result: Positive Leak Source: N/A

Leak Type: O
Leak Size: B

Leak Surface Cover: CD

Observations:

Comments: Two pipes in cement slab parking area NW of house.



Basin 10 Run 3 Leak 1 B



Basin 10 Run 3 Leak 1 A



Basin: Basin 10 Run: 14

Incident: 02

Incident Location: 13347 Eastborne Dr.

Lat: 45.32785 *Long:* 122.59181

Upstream Manhole: 11947 **Lat:** 45.32785 **Long:** 122.59181

Downstream Manhole: 11943 **Lat:** 45.32723 **Long:** 122.59261

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: c

Leak Surface Cover: T



Basin 10 Run 14 Leak 1 B

Observations:

Comments: Old downspout connection in front yard near driveway + walkway.

Basin: Basin 10 **Run:** 14

Incident: 02

Incident Location: 13347 Eastborne Dr.

Lat: 45.32785 *Long:* 122.59181

Downstream Manhole: 11943 **Lat:** 45.32723 **Long:** 122.59261

Result: Positive Leak Source: Downspout

Leak Type: RWL

Leak Size: C

Leak Surface Cover: T



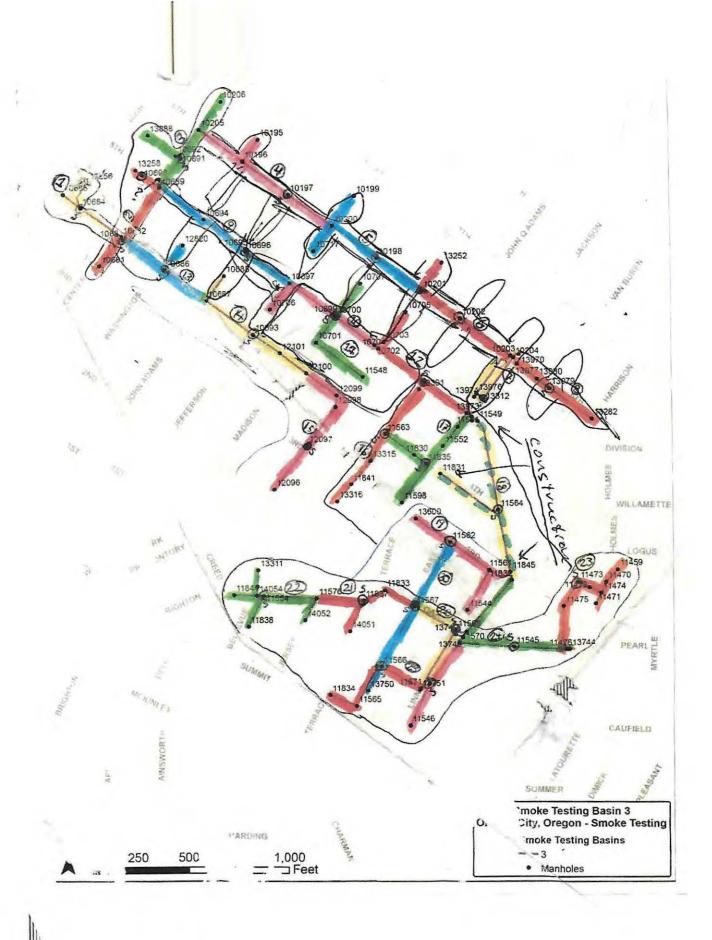
Basin 10 Run 14 Leak 1 A

Observations:

Comments: Old downspout connection in front yard near driveway + walkway.

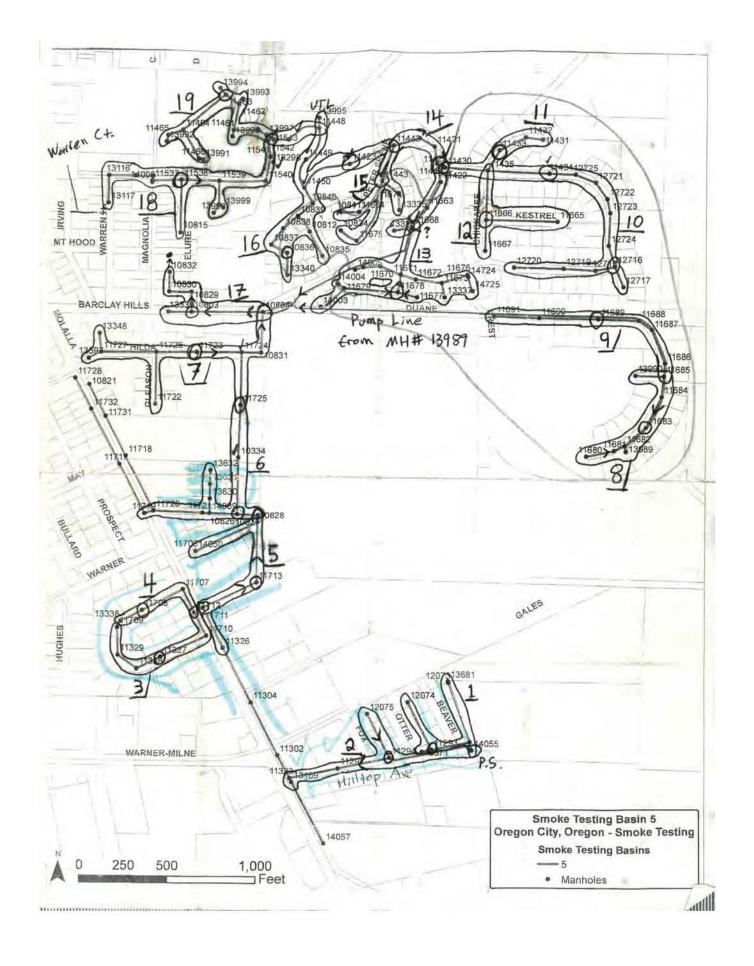
Attachment C: SFE Uninspected Sewer Data







Run Info			Basin #	3	
<u>Time</u> Date			_	Run Number Technician	18
Project #	U16-14	43		GPS model	
Client	Oreyor	n City	A	Weather	
Smoker Location	-		Manhole number	_	
Manhole # & GPS	Long			T	
Start Manhole #	Lat	Finish Manhole #	Lat	Additional #	Lat
11549	Long	110116	Long	11831	Long
Address Start		Address Finish		Address Additional 1	
Leak Report				1	
Leak #	_	Ar	ddress	\Rightarrow	GPS Coordinates Lat
Basin #				7	Long
Run#					
Upstream MH		_ =	GPS Coordinates Lat		
Downstream MH		⇒	Long GPS Coordinates Lat		
Leak Type		<u> </u>	Long		
Leak Source			Picture # Picture Time		5 7
Surface Cover					
Comments					





		Basin #	_ 5	
		_	Run Number	20
- 1117 (11)	,	-		_
016-14	5	-		
Uregon	City	-	weather	
Lat	x	Manhole number		
Long				
Lat		Lat	Additional #	Lat
Long	11720	Long		Long
	Address Finish		Address Additional 1	-
	A	ddress	\Rightarrow	GPS Coordinates Lat
			_	Long
	_ =>	GPS Coordinates Lat		
		Long		=77
-	_ =>	GPS Coordinates Lat		
	N. N.			-
		Picture # Picture Time		-
	_			
	Lat Long Lat	Long Lat Finish Manhole # 11720 Address Finish	Lat	Run Number Technician GPS model Weather Lat Manhole number Long Lat Finish Manhole # Lat Additional # Long Address Finish Address Address Finish Address GPS Coordinates Lat Long GPS Coordinates Lat Long Picture #



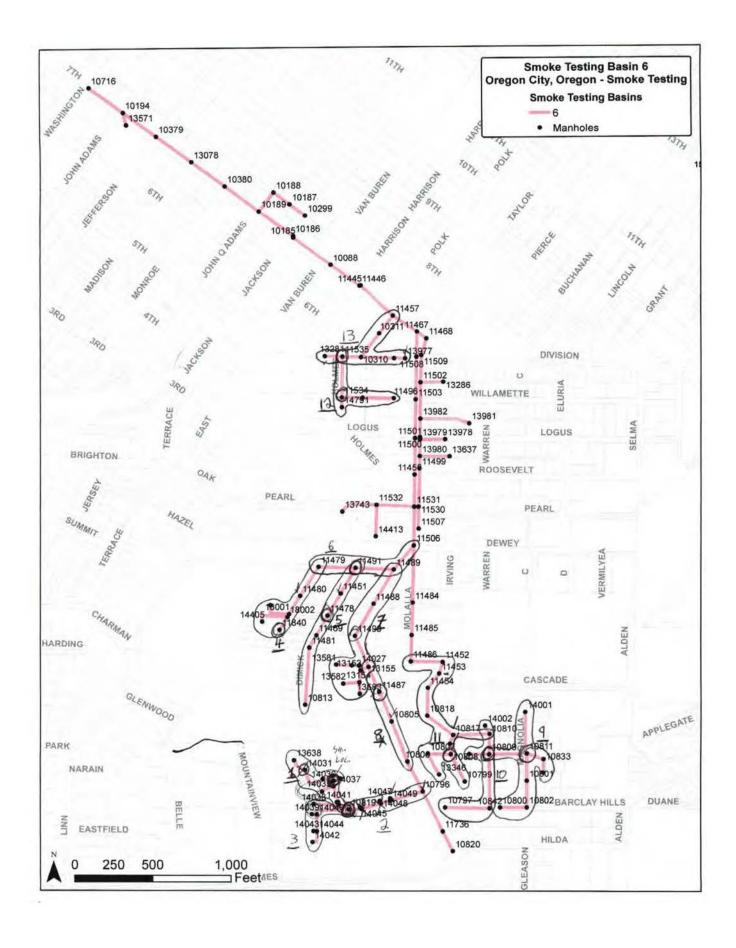
Run Info			Basin #	5	4
Time			-	Run Number	21
<u>Date</u>	- 1117 111	3		Technician	
Project #	016-14	5		GPS model	
Client	Oregon	City	•	Weather	-
Smoker Location	Lat	_	Manhole number		
	Long				
Manhole # & GPS Start Manhole #	Lat	Finish Manhole #	Lat	Additional #	Lat
11728	Long	11719	Long		Long
Address Start		Address Finish		Address Additional 1	
Leak Report					
Leak#		A	ddress	\Rightarrow	GPS Coordinates Lat
Basin #					Long
Run #					
Upstream MH	9	_ =>	GPS Coordinates Lat		_
			Long		_
Downstream MH			GPS Coordinates Lat		
Leak Type			Long		
Leak Type			Picture #		
eak Source		_	Picture Time		_
Surface Cover					
Comments					
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Run Info			Basin #	5	
Time				Run Number	22
Date				Technician	
Project #	016-	-143		GPS model	
Client	Ureg	gon City		Weather	
Smoker Location			Manhole number		
Manhole # & GPS	Long			_	
Start Manhole #	Lat	Finish Manhole #	Lat	Additional #	Lat
11326	Long	11333	Long		Long
Address Start		Address Finish		Address Additional 1	
Leak Report					
Leak #		Ac	ddress	\Rightarrow	GPS Coordinates Lat
Basin #					Long
Run #	-				
Upstream MH	,	_ =>	GPS Coordinates Lat Long		=
Downstream MH	-	_ ⇒	GPS Coordinates Lat Long		_
Leak Type			Picture #		
Leak Source			Picture Time		
Surface Cover					
Comments				-	
John Marie					



Run Info			Basin #	_ 5	
Time			_	Run Number	23
Date Date			-	Technician GPS model	
Project #	y16-	143	47	GPS model Weather	-
Client	Uregor	on City	-	Weather	-
Smoker Location			Manhole number	-	
-1 -1 - # º CDS	Long				
Manhole # & GPS Start Manhole #	Lat	Finish Manhole #	Lat	Additional #	Lat
11333	Long	14057	Long		Long
Address Start		Address Finish		Address Additional 1	
Leak Report		A	ddress	→	GPS Coordinates
Basin#		_		-	Long
Run#					
Upstream MH			GPS Coordinates Lat Long		
Downstream MH			GPS Coordinates Lat Long		_
Leak Type			Picture #		-
Leak Source			Picture Time	-	_
Surface Cover					
Comments					





Smoker Location Lat Long Lat Manhole # & GPS Start Manhole # Start Manhole # Lat Long 10380 Address Address	Manhole number Lat Long	Run Number Technician GPS model Weather Additional #	14
Project # Client VI6 - 143 Smoker Location Lat Long Long Manhole # & GPS Start Manhole # Start Manhole # Long Address Address	Lat	GPS model Weather	Lat
Smoker Location Lat Long Lat Manhole # & GPS Lat Start Manhole # Lat Long 10380 Address Address	Lat	Weather	Lat
Smoker Location Lat Long Manhole # & GPS Start Manhole # Lat Finish Manhole # 10716 Long 10380 Address Address	Lat		Lat
Long Manhole # & GPS Start Manhole # Lat Finish Manhole # 10716 Long 10380 Address Address	Lat	Additional #	Lat
Manhole # & GPS Start Manhole # Lat Finish Manhole # 10716 Long 10380 Address Address	A Section Control	Additional #	Lat
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	_	Address Additional 1	
Leak Report			
Leak# A	ddress	\Rightarrow	GPS Coordinates Lat
Basin#			Long
Run #			
Upstream MH	GPS Coordinates Lat Long		
Downstream MH	GPS Coordinates Lat Long		
Leak Type	Picture #		
Leak Source	Picture Time		=
Surface Cover			
Comments			



Smoker Location Long Manhole # & GPS Start Manhole # \[\lambda \) 280 \[\lambda \) Lat \[\lambda \) Lat \[\lambda \) Long Address Start Address Start Address Finish Address Finish Address Finish Address Finish Address GPS Coordinates Lat \[\lambda \) Long GPS Coordinates Lat \[\lambda \) Long Downstream MH GPS Coordinates Lat \[\lambda \) Long GPS Coordinates Lat \[\lambda \) Long GPS Coordinates Lat \[\lambda \) Long Picture #	Run Info			Basin #	_6_	
Project # Client				-		15
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Long Manhole # & GPS Start Manhole # Lat	Chen	- Olege	N CHY	-	VV Gauloi	0
Start Manhole # SGPS Start Manhole # Lat	Smoker Location			Manhole number	-	
Start Manhole # Lat Finish Manhole # Lat Additional # Lat Long Address Start Address Address Additional 1 Leak Report Leak # Address Address Additional 1 Basin # GPS Coordinates Lat Long Downstream MH Picture #	1 4 5 CDS					
Address Start Address Finish Address Additional 1 Leak Report Leak # Basin # Upstream MH Upstream MH Downstream MH Leak Type Address Finish Address Additional 1 Address GPS Coordinates Lat Long Picture #	Start Manhole #			Lat	Additional #	Lat
Start Finish	10380	Long	11446	Long		
Leak # Address GPS Coordinates Lat Long GPS Coordinates Lat Long Downstream MH GPS Coordinates Lat Long GPS Coordinates Lat Long Picture #	Address Start		Address Finish			
Basin # Lat Long	Leak Report					
Basin # Long	Leak #	-	Ar	ddress	\Rightarrow	GPS Coordinates Lat
Upstream MH GPS Coordinates Lat Long Downstream MH GPS Coordinates Lat Long Leak Type Picture #	Basin #		<u> </u>			7-2-2
Downstream MH GPS Coordinates Lat Long Leak Type Picture #	Run#					
Downstream MH GPS Coordinates Lat Long Picture #	Upstream MH		_ =>	Lat		
Leak Type Picture #	Downstream MH		_ =>	GPS Coordinates Lat		_
	Leak Type					_
	Leak Source					=
Surface Cover	Surface Cover	·				
Comments	Comments					



		Basin #	_ 6	_
			Run Number	16
1316-1	42	-		
05000	on City	-		
			11,333,141	
Lat		Manhole number	-	
Long				
Lat	Finish Manhole #	Lat	Additional #	Lat
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Long	11110	Long	13480	Long
	Address Finish		Address Additional 1	
	A	ddress	\Rightarrow	GPS Coordinates
				Long
	⇒	GPS Coordinates Lat Long		_
	_ =>	GPS Coordinates Lat Long		_
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		Picture # Picture Time		_
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Time Date Project # Client	U16-143			Run Number Technician	17
Project #	U16-143			Lechnician	
	016-193		-	GPS model	
Ollotte	Oregon Ci	+4	-	Weather	
	Ulegen C.	7	·	Trouble.	-
Smoker Location Lat			Manhole number		
Lor	ng				
Manhole # & GPS Start Manhole # Lat		Finish Manhole #	Lat	Additional #	Lat
11496 Lor		11531	Long	13743	Long
Address		Address		Address	
Start		Finish		Additional 1	\$
Leak Report					
Leak#		_ Ac	ddress	\Rightarrow	GPS Coordinates
Basin#				-	Long
Run #					
Upstream MH			GPS Coordinates		
			Lat Long		
Downstream MH			GPS Coordinates		
			Lat Long		
eak Type			Long		-
eak Source			Picture # Picture Time		
Surface Cover					



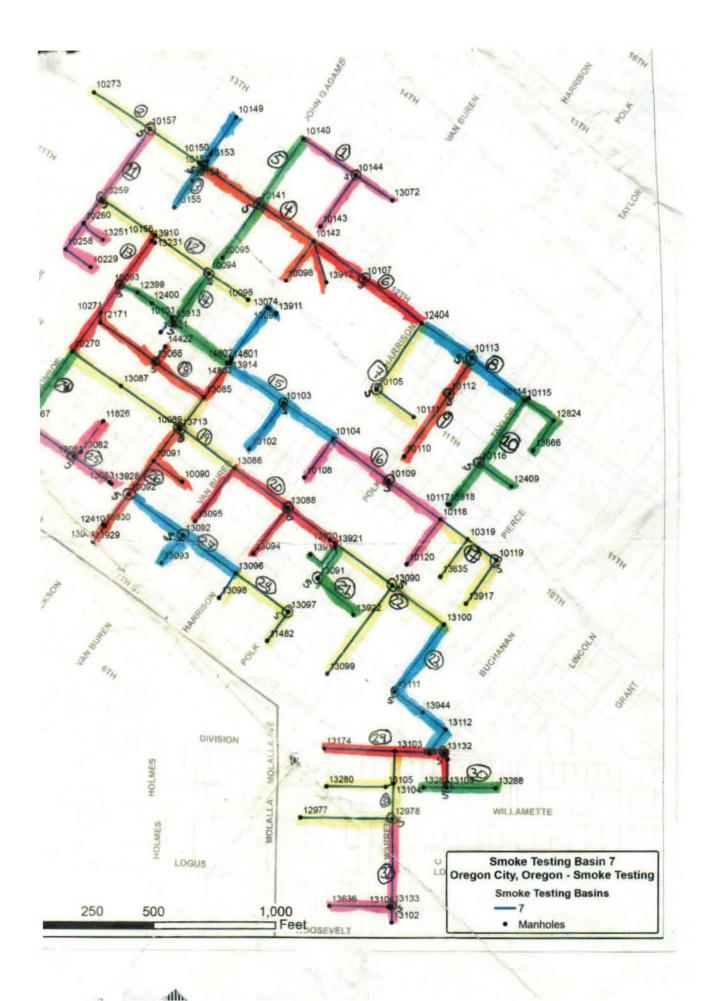
Run Info			Basin #	6	
Time				Run Number	18
<u>Date</u>			_	Technician	
Project #	016-14	3	4	GPS model	
Client	Oregon	City		Weather	-
Smoker Location			Manhole number	-	
	Long				
Manhole # & GPS Start Manhole #	Lat	Finish Manhole #	Lat	Additional #	Lat
11531	Long	11486	Long		Long
Address Start		Address Finish		Address Additional 1	
Leak Report	11				
Leak #	(Ac	ddress	\Rightarrow	GPS Coordinates Lat
Basin #				_	Long
Run#					
Upstream MH	-		GPS Coordinates Lat Long		_
Downstream MH	-	=>	GPS Coordinates Lat Long		- -
Leak Type	-				_
Leak Source			Picture # Picture Time		
Surface Cover					
Comments					
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Run Info			Basin #	_ 6	_
<u>Time</u> Date			-	Run Number Technician	_19
Project #	U16-143	}	-	GPS model	
Client	Oregon	City	_	Weather	
		/			
Smoker Location	Lat		Manhole number		
Manhole # & GPS	Long			_	
Start Manhole #	Lat	Finish Manhole #	Lat	Additional #	Lat
11502	Long	11530	Long	13981	Long
Address Start	-	Address Finish		Address Additional 1	
Leak Report					
Leak #		Ad	ddress	\Rightarrow	GPS Coordinates Lat
Basin #					Long
Run#					
Upstream MH		_ =>	GPS Coordinates Lat Long		_
Downstream MH		_ =>	GPS Coordinates Lat		_
Leak Type			Long		-
Leak Source		_	Picture # Picture Time		=
Surface Cover		_			
Comments add.	13978 13637 11507				



Run Info			Basin #	6	
<u>Time</u>				Run Number	20
Date	177	11.4	4	Technician	
Project # Client	016-	143	4	GPS model Weather	
Client	Ulego	on City	•	Weather	
Smoker Location			Manhole number	-	
	Long				
Manhole # & GPS Start Manhole #	Lat	Finish Manhole #	Lat	Additional #	Lat
10806	Long	10820	Long		Long
<u>Address</u> Start		Address Finish		Address Additional 1	
Leak Report					
Leak#		Ac	ddress	\Rightarrow	GPS Coordinates Lat
Basin#		_		_	Long
Run#					
Upstream MH			GPS Coordinates Lat Long		-
Downstream MH			GPS Coordinates Lat Long		_
Leak Type		97	Picture #		-
Leak Source			Picture Time	-	5
Surface Cover					





Smoke Testing Field Sheet

Run Info			Basin #	7	
Time Date Project # Client	016-143 Oregon Ci			Run Number Technician GPS model Weather	12
Smoker Location	Lat Long		Manhole number	-	
Manhole # & GPS Start Manhole # 1307 + Address		Finish Manhole #	Lat Long	Additional #	Lat Long
Start Leak Report Leak #		Finish	ddress	Additional 1	GPS Coordinates
Basin # Run # Upstream MH			GPS Coordinates		Lat Long
Downstream MH		_ ⇒	Lat Long GPS Coordinates Lat Long		
Leak Type Leak Source Surface Cover		_	Picture # Picture Time		
Comments					



Smoke Testing Field Sheet

Run Info			Basin #	7	
Time Date Project #	U16-143		_	Run Number Technician GPS model	1 3
Client	Oragon City			Weather	
Smoker Location			Manhole number		
Manhole # & GPS Start Manhole #		Finish Manhole #	Lat	Additional #	Lat
10270	Lat Long	13910	Lat	13231	Lat Long
Address Start		Address Finish		Address Additional 1	
Leak Report					
Leak #	A		ddress		GPS Coordinates Lat
Basin #		_			Long
Run#					
Upstream MH		_ =	GPS Coordinates Lat Long		_
Downstream MH		_ ⇒	GPS Coordinates Lat Long		_
Leak Type		<u> </u>	Picture #		-
Leak Source			Picture Time		_
Surface Cover		_			
Comments					



Community Development Relocation

Existing Location

Approximately 5,075 square feet Lease Expiration: April 21st, 2018

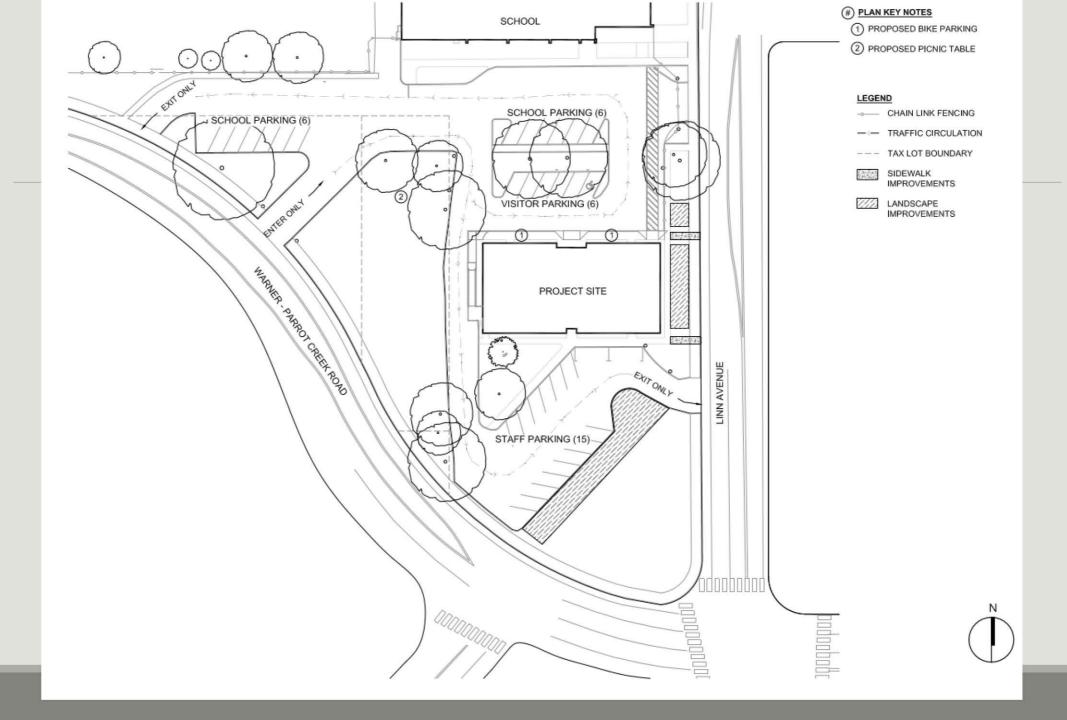




Mt. Pleasant Annex



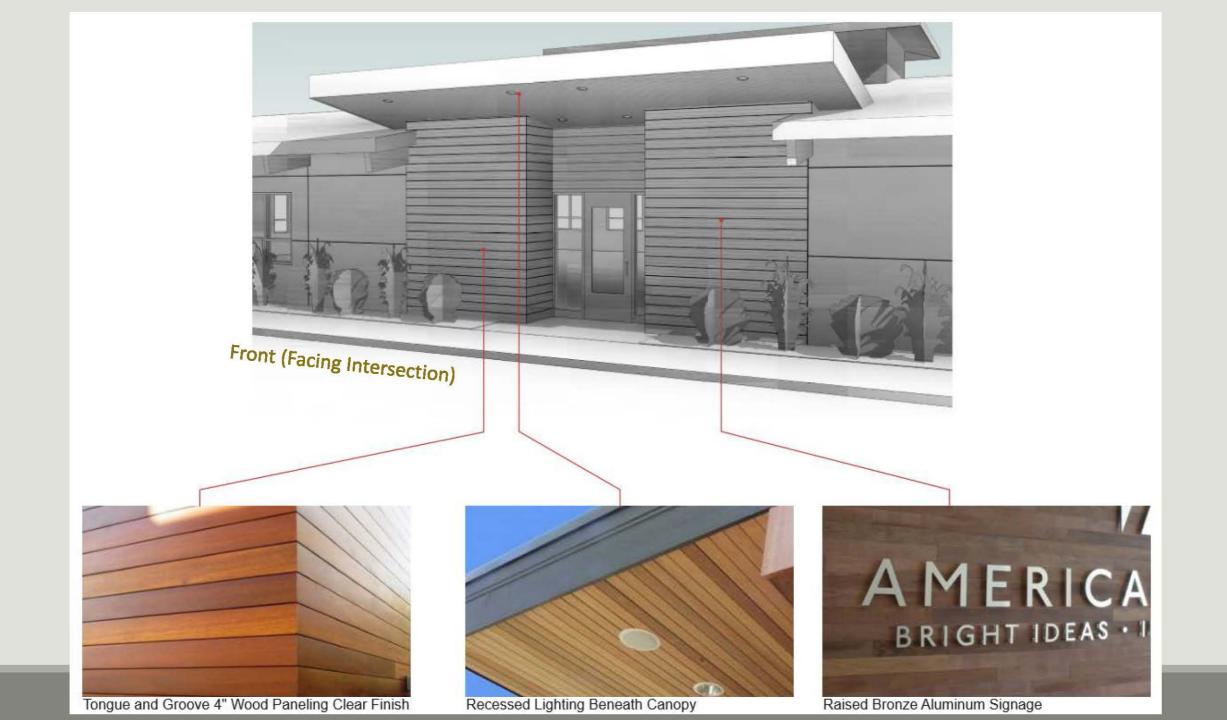












Existing General Layout



Note: Layout is not drawn to scale and does not depict all rooms, closets, bathrooms, mechanical rooms, etc.

Main Corridor

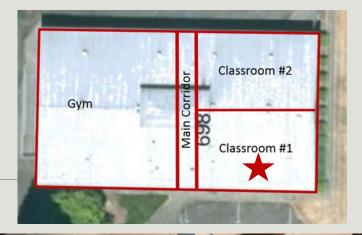






Restroom

Classroom #1







Classroom #2



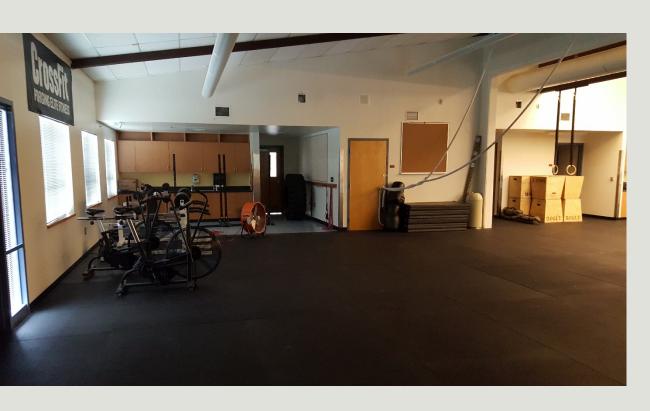




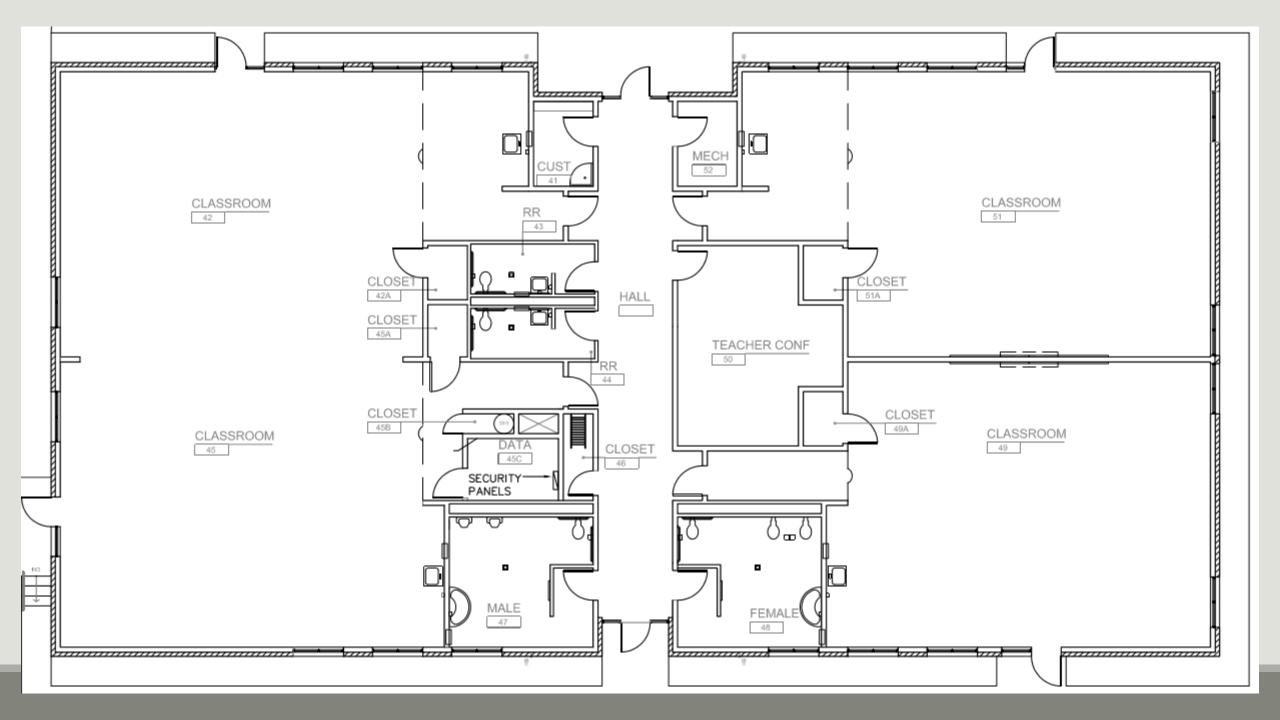


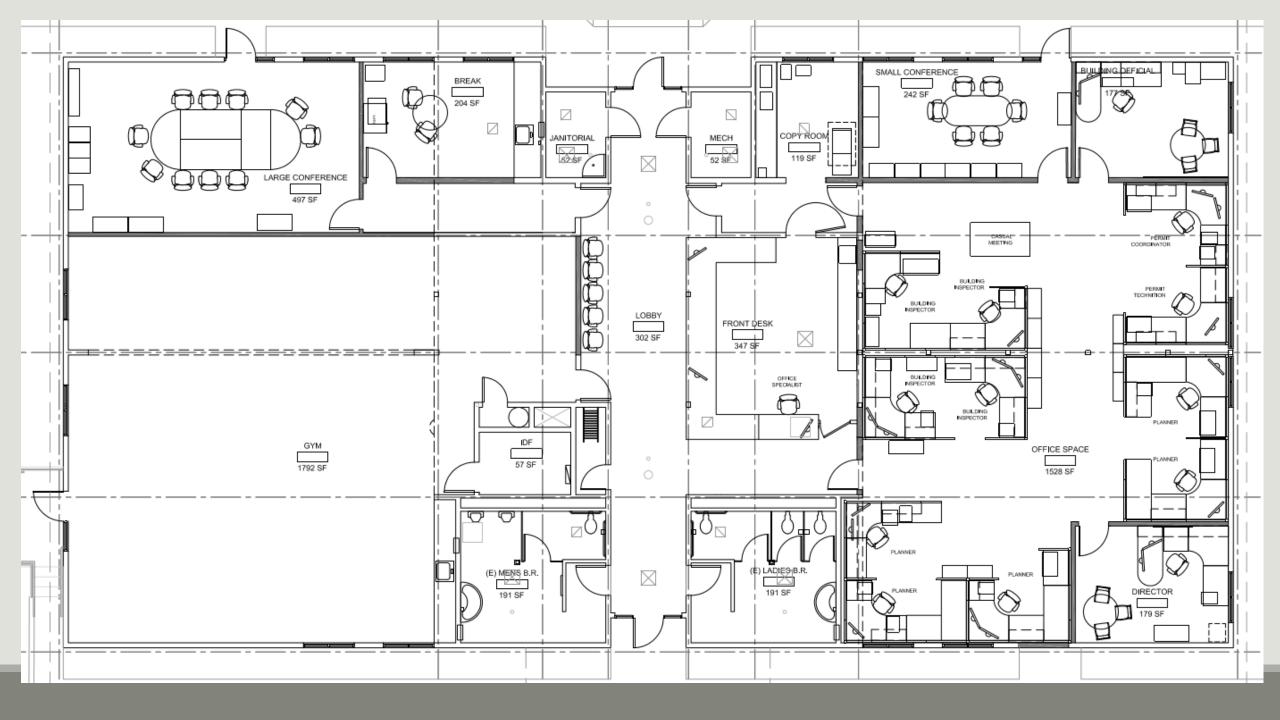
Gym



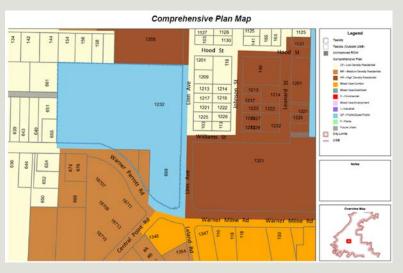








Planning Applications to Use the Site

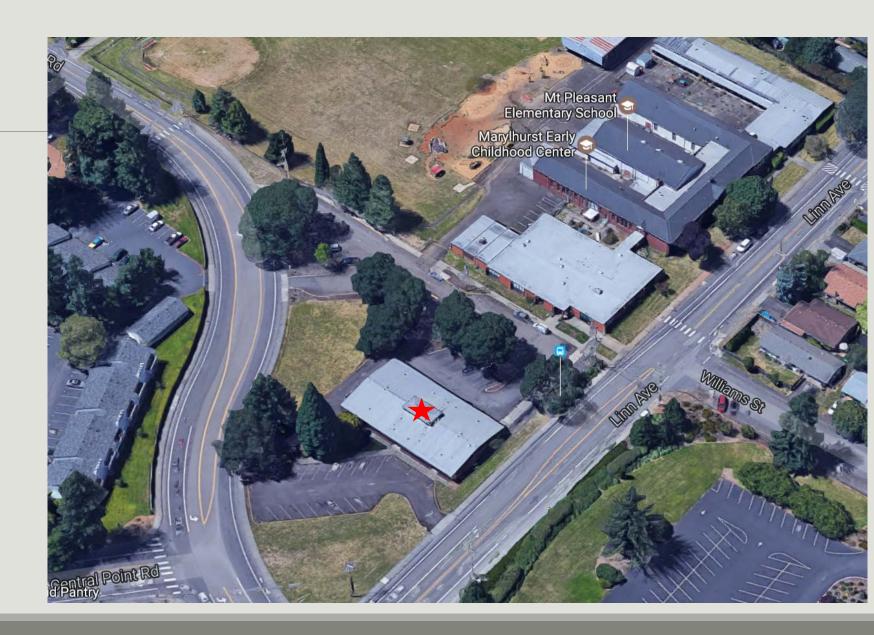


1200 | 1125 | 1126 | 1125 | 1126 | 1125 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 |

- Comprehensive Plan Amendment (Trip Cap)
- Zone Change (Trip Cap)
- Minor Site Plan and Design Review

Next Steps

Submit Land Use Application





Community Development Relocation

Existing Location

Approximately 5,075 square feet Lease Expiration: April 21st, 2018

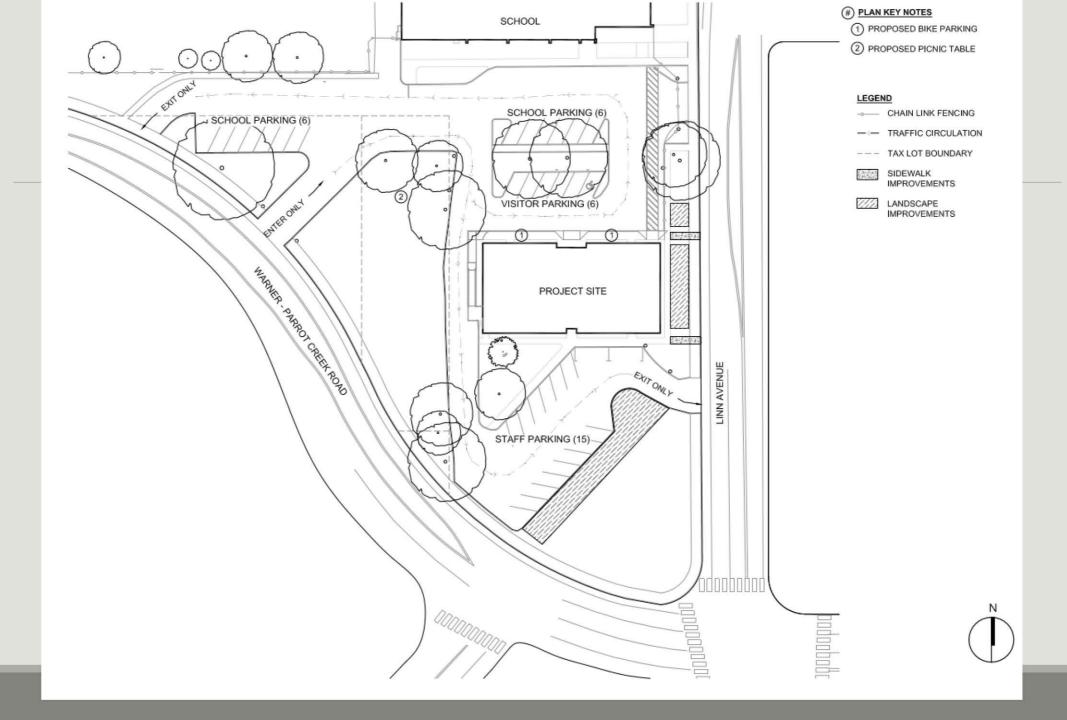




Mt. Pleasant Annex



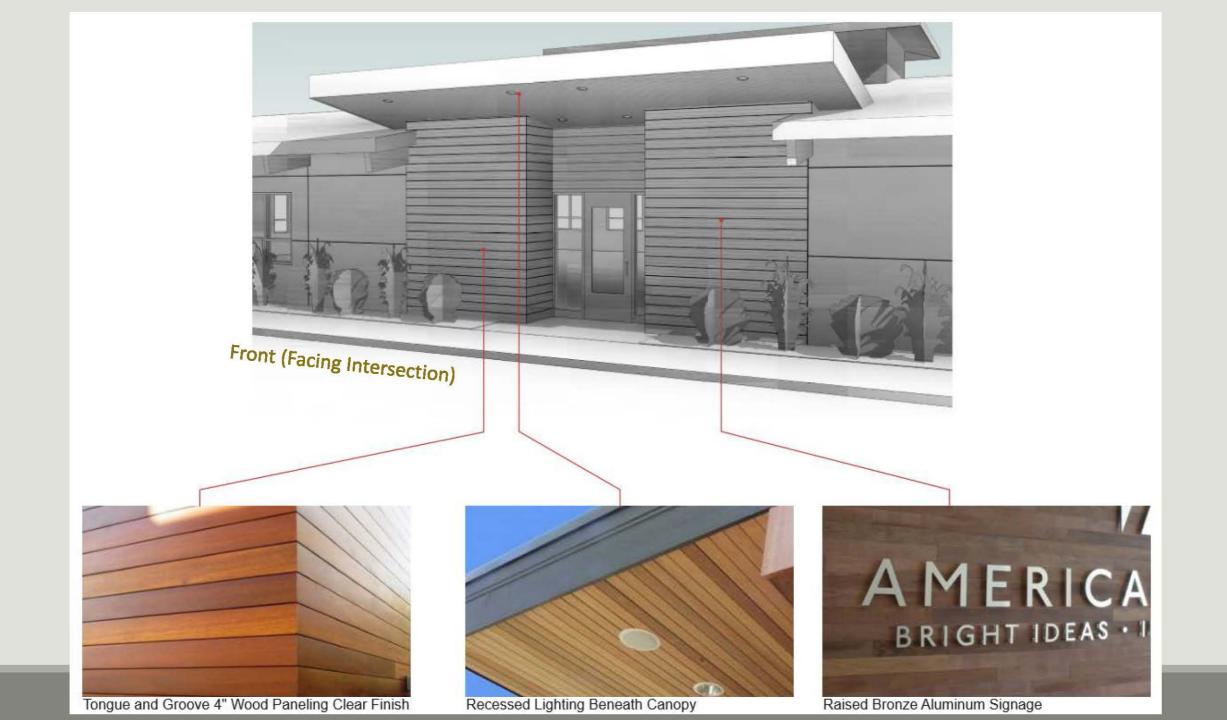












Existing General Layout



Note: Layout is not drawn to scale and does not depict all rooms, closets, bathrooms, mechanical rooms, etc.

Main Corridor

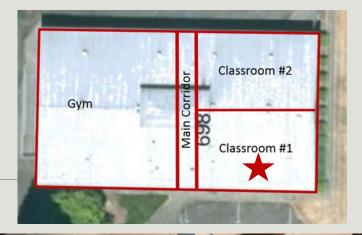






Restroom

Classroom #1







Classroom #2



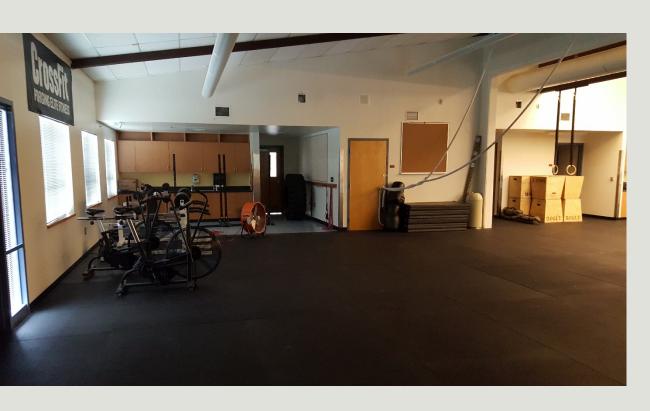




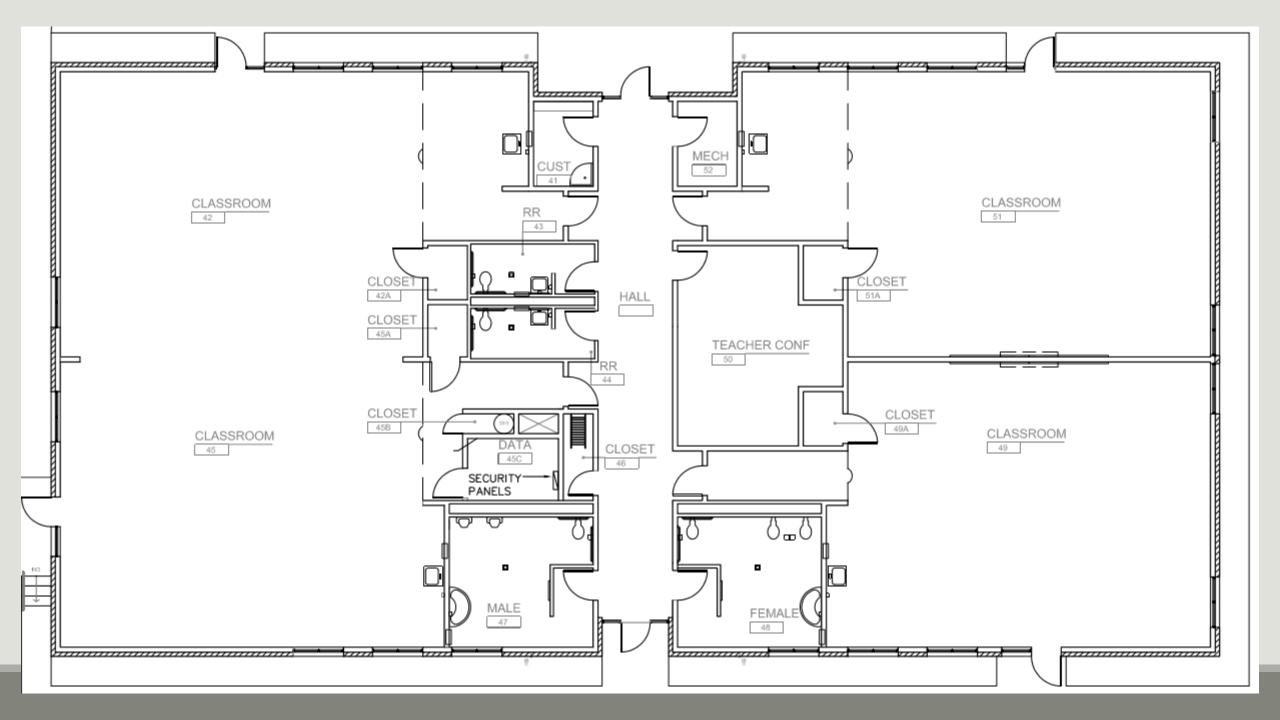


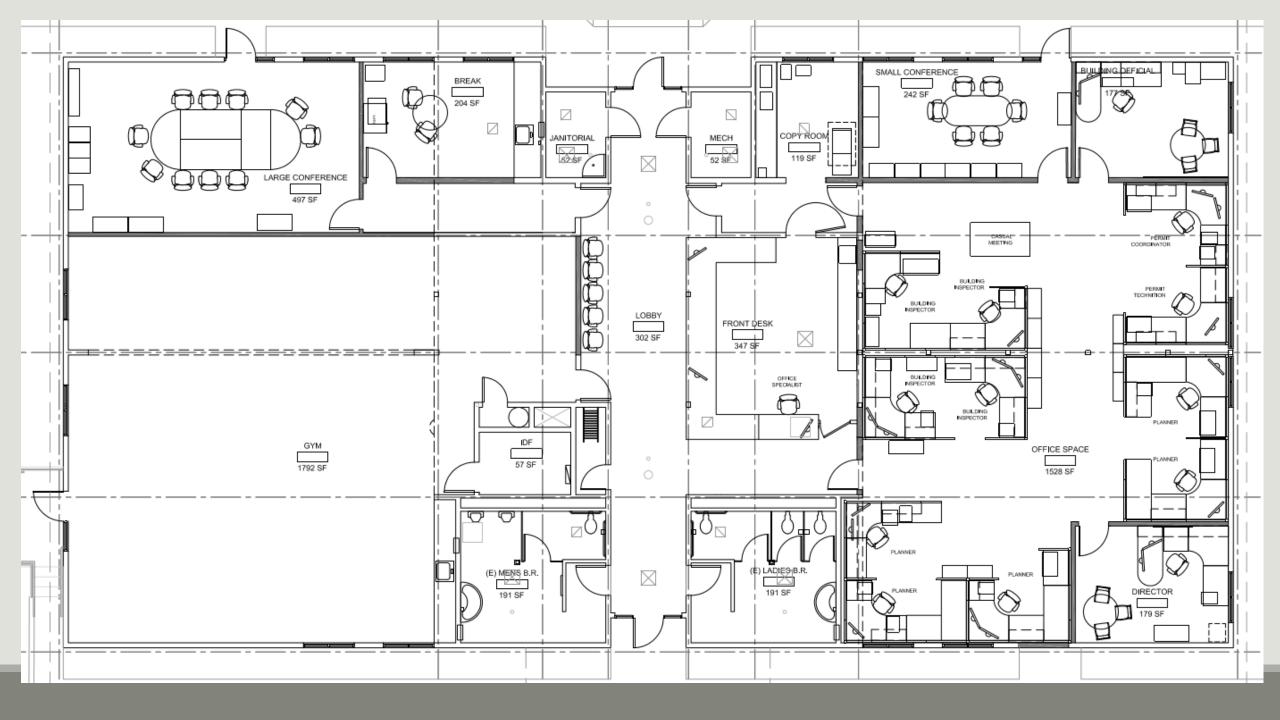
Gym



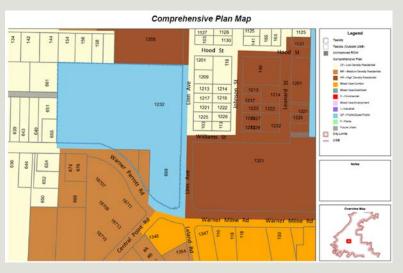








Planning Applications to Use the Site

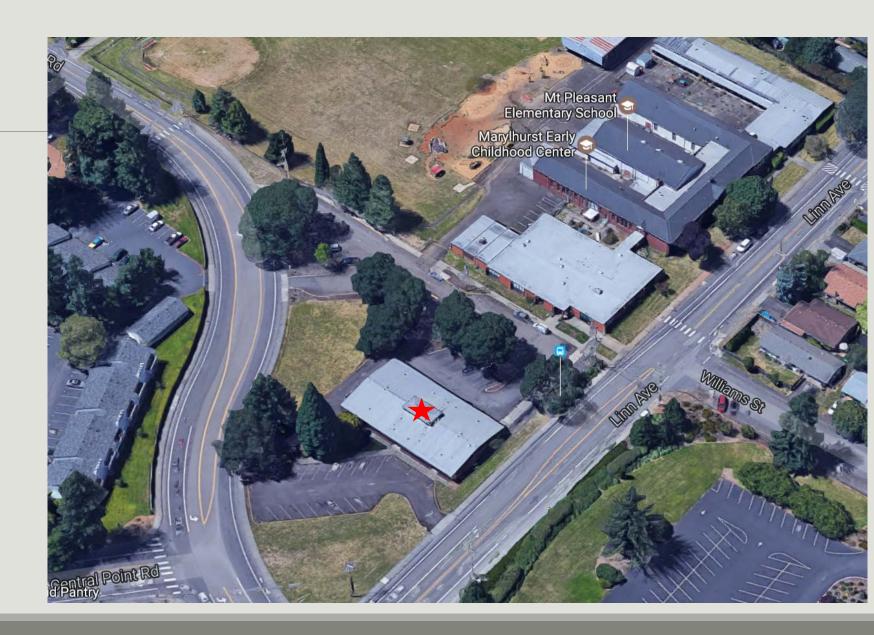


1200 | 1125 | 1126 | 1125 | 1126 | 1125 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 | 1126 |

- Comprehensive Plan Amendment (Trip Cap)
- Zone Change (Trip Cap)
- Minor Site Plan and Design Review

Next Steps

Submit Land Use Application



Clackamette Cove:

Water Quality and Habitat Improvement Feasibility Study





Date: 7/6/2016 Scale: 1 inch = 400 feet

Data Source: USGS, 2010; Oregon City GIS Data, 2016

Topography



Harmful Algal Blooms (HABS)



Blue-green Algae Health Advisory Trend: Lower Willamette Region

Location	Dominant Genus	Dates	# Days						
2016									
Ross Island, lower Willamette River	Not specified August 19 – Sept 1		13						
2015									
Ross Island, lower Willamette River	Microcystis, Dolichospermum and Cylindrospermopsis	July 9 - October 1	84						
Clackamette Cove	Anabaena planctonica	September 28 - November 4	37						
2014									
Ross Island, lower Willamette River	Microcystis	September 19 – October 2	16						

Steep Banks and Debris



Limited Shallow Water Habitats

- Key limiting factor for fish in the Lower Willamette
- Depths up to 18 feet (summer levels)
- Limited areas between 9 feet and 17 feet (NAVD88) for shallow water and emergent wetlands



Floodplain Vegetation





Conclusions

- The Cove is a regionally-important habitat area
- The Cove is a regionally-significant recreational resource
- The Cove is subject to water quality, human health, and visual issues related to algal blooms
- The Cove's water quality / algal blooms will need to improve (or have a plan to improve) before there can be habitat mitigation / restoration investments

Develop Sustainable Approaches to Improve Connectivity / Water Quality



Mitigation Bank Site?



Phase Restoration after Water Quality is Addressed



Wetland Creation



Stormwater

- Stormwater outfalls
- Find opportunities for retrofits

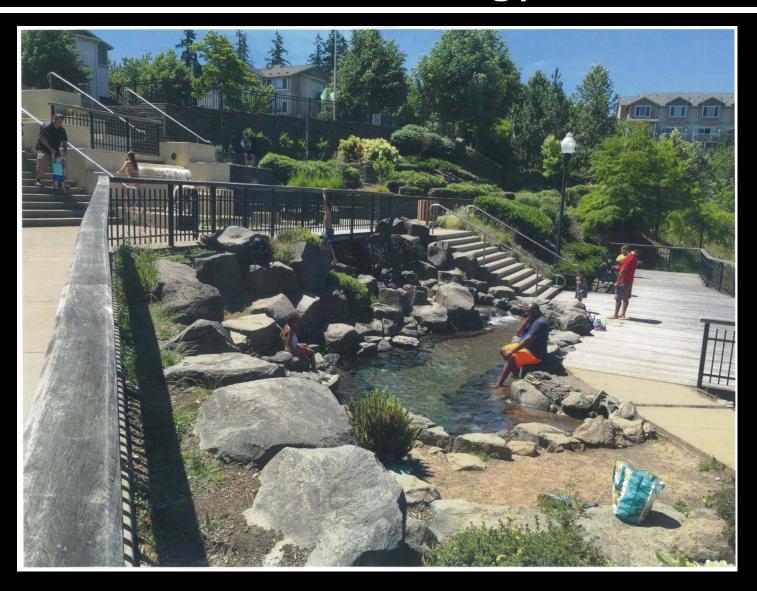


Recreation





Integrate Recreation / Human Access into Strategy





Recommended Next Steps

- Investigate stormwater retrofit / treatment
- Explore engineering feasibility for connectivity to the Clackamas River integrated with habitat restoration sceneries (e.g., where to place fill to direct flows)
- Investigate funding for comprehensive recreation plan and designs that are integrated with habitat restoration

Recommended Next Steps (continued)

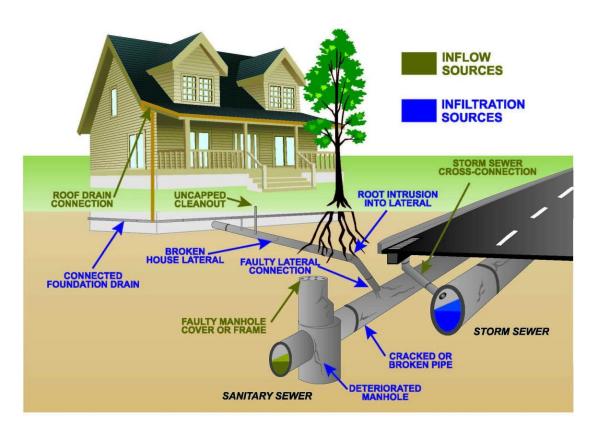
- Establish and implement water quality monitoring
 - Participate in Lower Willamette HAB Working Group
- Explore partnerships and funding opportunities with the Clackamas River Basin Council, Metro, and others
- Investigate mitigation bank funding options



City of Oregon City, Oregon

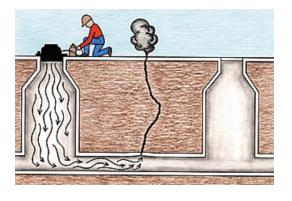
Oregon City I/I Abatement Program Update

July 17 | 2017



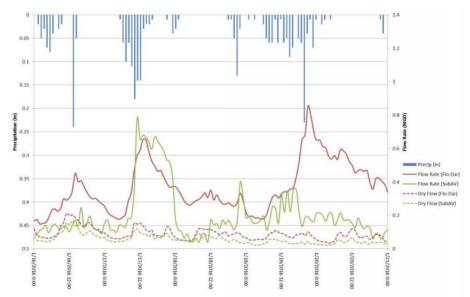






Agenda

- What is I/I
- Need for I/I reduction
- Objectives for program
- Progress to date
 - Review flow data analysis and findings/outcome
 - Summary of smoke testing
- Next steps



What is I/I

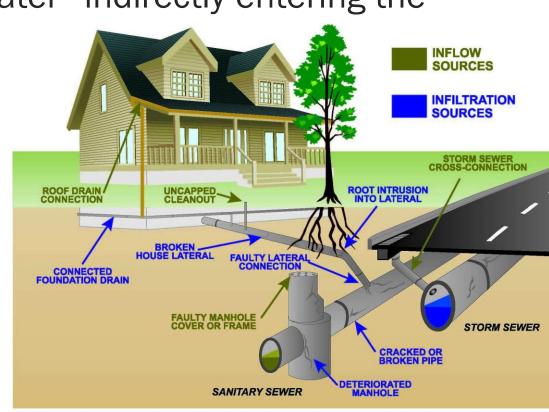
- Inflow and Infiltration
- Inflow = stormwater directly entering the sanitary system

Infiltration = "groundwater" indirectly entering the

sanitary system

Private property 50%

 Moves readily through gravel bedding/backfill



Need for I/I reduction

- Conveying and treating I/I is expensive
- I/I can have local impacts
 - Moratoriums
 - Overflows/backups
 - Erodes bedding/backfill support for sewers

Objectives for I/I program

- Remove the cost-effective portion of I/I
- Narrow the focus, prioritize
 - Leakiest basins
 - Direct inflow sources
 - Private property policy
 - Dual benefit of fixing sewers nearing end of useful life
- Measure/document benefit over time
- Build community understanding/support

2014 Sanitary Sewer Master Plan review

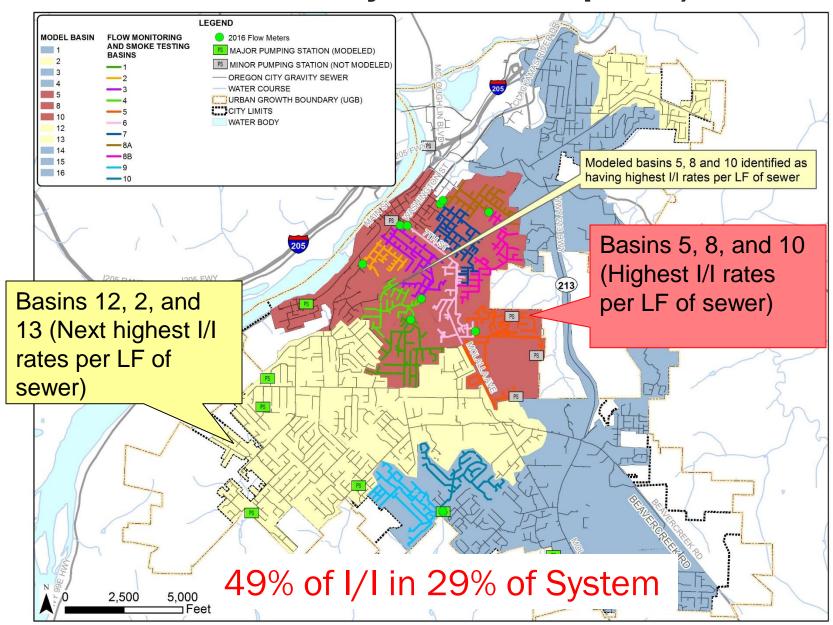
- Quantified I/I: peak wet weather flows range from 3x to 13x higher than average dry weather flows
- Estimated ongoing annual investment of \$1.3M to \$2.3M to address I/I and structural integrity
- Recommended developing private property I/I policy
- Prioritized basins for further field investigation

I/I Reduction Program

Completed as part of SSMP

- 1. Collect flow monitoring data for the major basins.
- 2. Construct and calibrate hydrologic and hydraulic models.
- 3. Predict current and future peak wet weather flows.
- 4. Rank Basins according to normalized peak I/I rates.
- 5. Perform further investigations to focus I/I reduction program.
- 6. Develop and implement I/I reduction projects that are manageable and measurable.
- 7. Perform post-rehabilitation monitoring/modeling to determine impact of projects so that any needed adjustments can be made to scope, budget, and schedule for future projects.

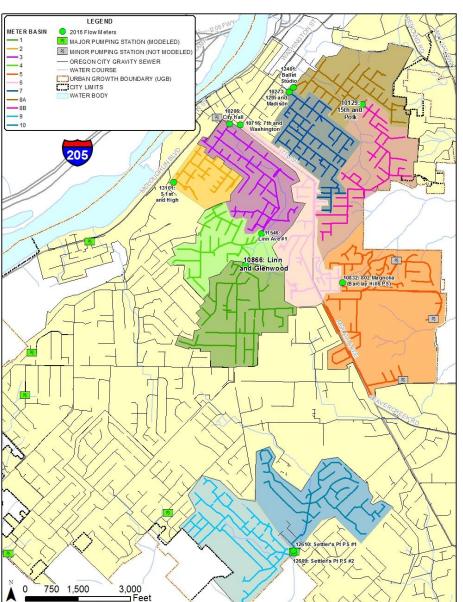
SSMP - Rank basins by normalized peak I/I rates



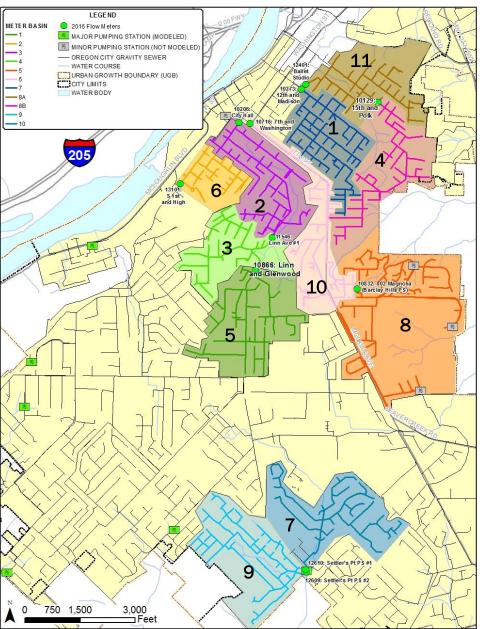
I/I Reduction Program

- Flow Monitoring
- 2. Smoke Testing
- 1. Collect flow monitoring data for the major basins.
- 2. Construct and calibrate hydrologic and hydraulic models.
- 3. Predict current and future peak wet weather flows.
- 4. Rank Basins according to normalized peak I/I rates.
- 5. Perform further investigations to focus I/I reduction program.
- Develop I/I reduction project that are manageable and measurable.
- 7. Perform post-rehabilitation monitoring/modeling to determine impact of projects so that any needed adjustments can be made to scope, budget, and schedule for future project.

Flow Monitoring - Selection of 11 higher resolution flow monitoring locations

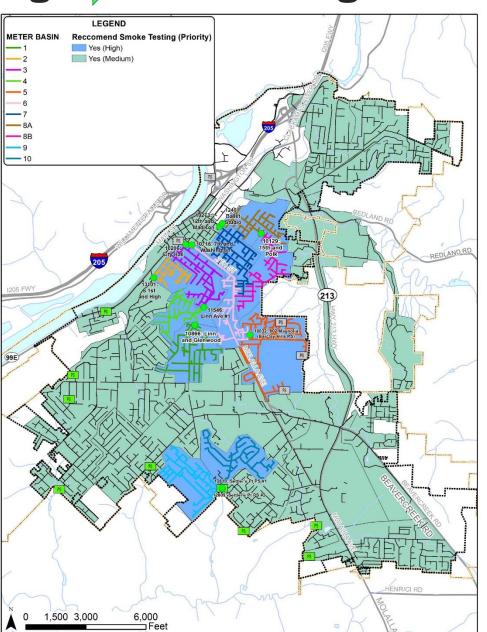


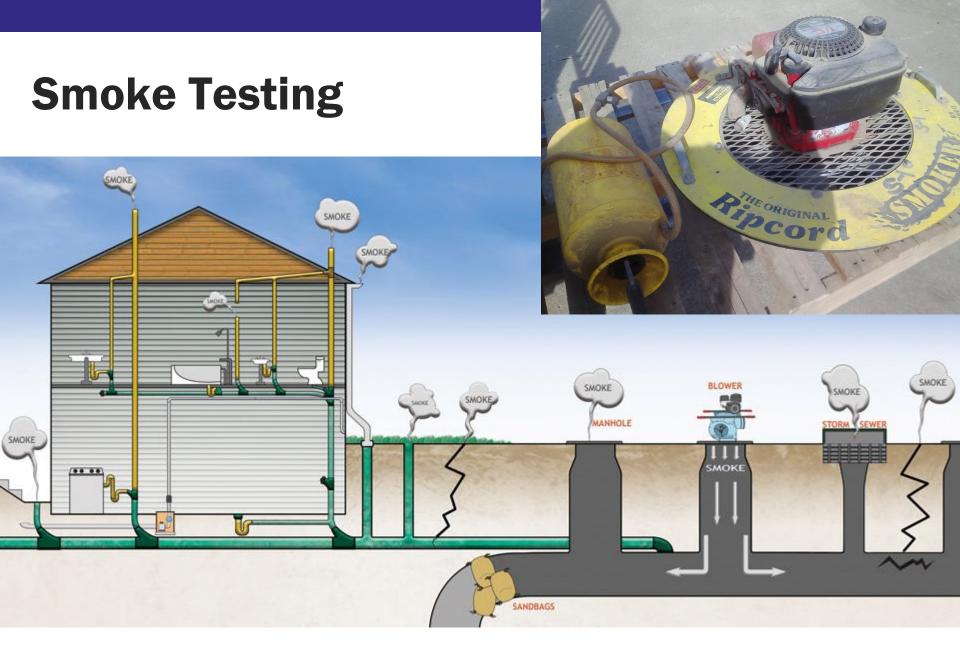
Flow monitoring – Prioritize basins by normalized peak I/I rates



49% of I/I occurs in 29% of System – Basins ranked 1, 2, 3.

Flow Monitoring Smoke Testing



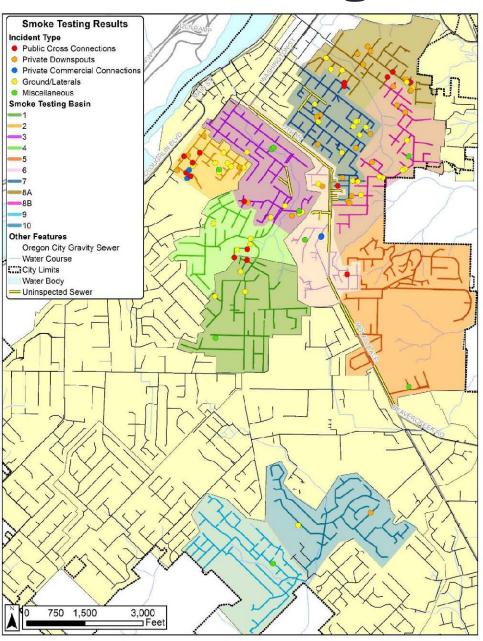


Purpose: Identify I/I sources to the sanitary system

Summary of smoke testing results

Summary of Smoke Testing Incidents by Type and Basin										
Basin	Incidents	Percentage of total incidents (%)	Incident type							
			Public cross- connections	Private downspouts	Private commercial connections	Ground/laterals	Miscellaneous			
1	5	4.6	1	-	-	3	1			
2	22	20.6	5	6	2	8	1			
3	12	11.2	1	2	-	5	4			
4	6	5.6	2	-	-	4	-			
5	1	0.9	-	-	-	-	1			
6	6	5.6	1	1	2	1	1			
7	23	21.5	4	8	-	11	-			
8A	16	15.0	3	7	-	6	-			
8B	13	12.1	1	5	-	6	1			
9	1	0.9	-	-	-	-	1			
10	2	1.9	-	1	-	1	-			
Total	107	100	18	30	4	45	10			

Summary of smoke testing results

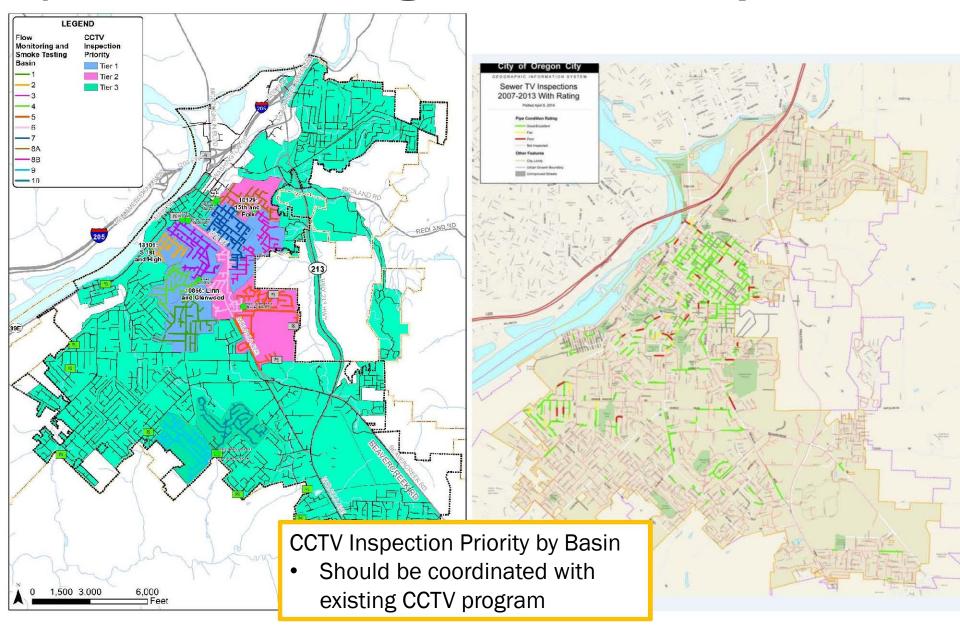


I/I Reduction Program - Next Steps

- 1. Collect flow monitoring data for the major basins.
- 2. Construct and calibrate hydrologic and hydraulic models.
- 3. Predict current and future peak wet weather flows.
- 4. Rank Basins according to normalized peak I/I rates.
- 5. Perform further investigations to focus I/I reduction program.
- Develop I/I reduction project that are manageable and measurable.
- 7. Perform post-rehabilitation monitoring/modeling to determine impact of projects so that any needed adjustments can be made to scope, budget, and schedule for future project.
 - 1. Complete smoke testing
 - 2. Dye Test
 - 3. CCTV Investigations

1. Disconnect direct connections from sanitary system

I/I Reduction Program - Next Steps



I/I Reduction Program - Next Steps

- 1. Collect flow monitoring data for the major basins.
- 2. Construct and calibrate hydrologic and hydraulic models.
- 3. Predict current and future peak wet weather flows.
- 4. Rank Basins according to normalized peak I/I rates.
- 5. Perform further investigations to focus I/I reduction program.
- 6. Develop I/I reduction projects that are manageable and measurable.
- 7. Perform post-rehabilitation monitoring/modeling to determine impact of projects so that any needed adjustments can be made to scope, budget, and schedule for future project.
 - 1. Disconnect public cross connections
 - 2. Coordinate with stormwater masterplan for Harding Neighborhood
 - 3. Develop policy for addressing private assets (downspouts, laterals, etc.)
 - 4. Develop projects based on CCTV inspections and condition assessment

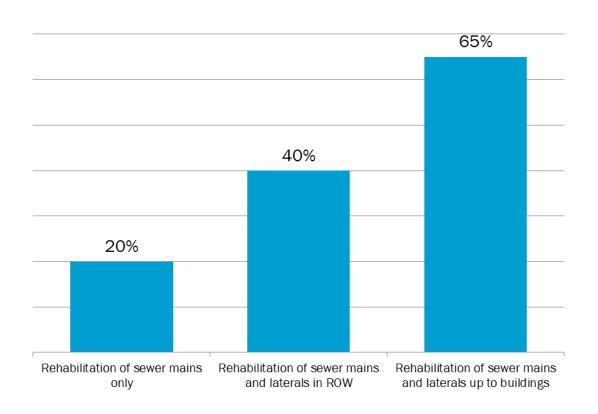
I/I Reduction Program-Future

- 1. Collect flow monitoring data for the major basins.
- 2. Construct and calibrate hydrologic and hydraulic models.
- 3. Predict current and future peak wet weather flows.
- 4. Rank Basins according to normalized peak I/I rates.
- 5. Perform further investigations to focus I/I reduction program.
- 6. Develop I/I reduction project that are manageable and measurable.
- Perform post-rehabilitation monitoring/modeling to determine impact of projects so that any needed adjustments can be made to scope, budget, and schedule for future projects.
 - 1. Flow monitoring post project rehabilitation
 - 2. Model update with new flow monitoring data
 - 3. Adjust approach based on results and update CIP budgets

I/I Reduction Program

Typical Reduction Percentage by Project Type

Direct inflow, sewer mains, laterals, specific locations





- I/I abatement is iterative
- Long term vs. short term
- Not easy to quantify
- Expensive: relative to measurable flow reduction per dollar spent

I/I Reduction Program Next Steps Summary

- 1. Complete smoke testing
- 2. Verify public cross connections dye test
- 3. Develop/implement project list to remove verified public cross connections
- 4. Develop CCTV program 7 to 10 year return cycle
- 5. Develop list of R&R projects resulting from CCTV
- 6. Develop private lateral/connection rehab policy
- 7. Regularly evaluate cost/benefit of allocating resources to R&R vs I/I study



QUESTIONS

Brown and Caldwell

I/I Abatement Program

- Flow monitoring
- Smoke testing
- Dye testing
- Maintenance record evaluation
- Modeling
- CCTV inspections





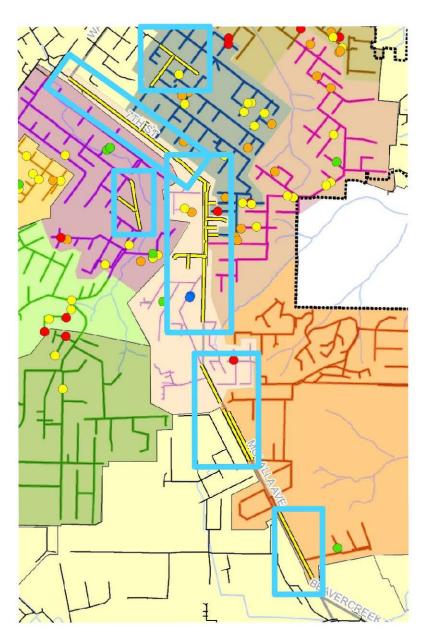


I/I Reduction Program - Next Steps



Brown and Caldwell

Summary of smoke testing results





Summary of smoke testing results

Public connections

- Stormwater catch basins (3)
- Storm drains or inlets (14)
- Storm manholes (1)

Private downspouts

Roofs drains from buildings (30).

Private commercial connections

- Wash pits (2)
- Area drains (1)
- Oil/water separators (1)

Ground/laterals

- Smoke observed coming out of the ground through:
 - Cracks in concrete pavement (10)
 - Above a suspected lateral (6)
 - Other ground locations (29)

Miscellaneous

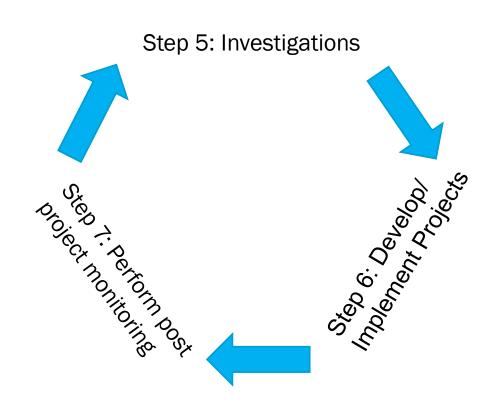
- Smoking cleanouts (5)
- Foundation drains (1)
- Smoke was observed inside of a house (3)



Basin 1 Run 10 Leak 2 A



Basin 2 Run 1 Leak 2 B



Completed as part of SSMP

- 1. Collect flow monitoring data for the major basins.
- 2. Construct and calibrate hydrologic and hydraulic models.
- 3. Predict current and future peak wet weather flows.
- 4. Rank Basins according to normalized peak I/I rates.
- 5. Perform further investigations to focus I/I reduction program.
- Develop I/I reduction project that are manageable and measurable.
- 7. Perform post-rehabilitation monitoring/modeling to determine impact of projects so that any needed adjustments can be made to scope, budget, and schedule for future project.

- 5. Perform further investigations
 - CCTV, smoke testing, dye testing, visual inspection, exfiltration testing
- 6. Develop/Implement Projects
 - Direct inflow, mainlines, laterals, specific locations
- 7. Perform post-rehabilitation monitoring
 - Flow metering/monitoring, exfiltration testing, modeling

I/I Reduction Program - Next Steps

			Summary of Sn	oke Testing Incident	s by Type and Basin						
Basin Incidents		Percentage of	Incident type								
	Incidents	total incidents (%)	Public cross- connections	Private downspouts	Private commercial connections	Ground/laterals	Miscellaneous				
1	5	4.6	1	-	-	3	1				
2	22	20.6	5	6	2	8	1				
3	12	11.2	1	2	-	5	4				
4	6	5.6	2	-	-	4	-				
5	1	0.9	-	-	-	-	1				
6	6	5.6	1	1	2	1	1				
7	23	21.5	4	8	-	11	-				
8A	16	15.0	3	7	-	6	-				
8B	13	12.1	1	5	-	6	1				
9	1	0.9	-	-	-	-	1				
10	2	1.9	-	1	-	1	-				
Total	107	100	18	30	4	45	10				

Next Steps

- 1. Dye Test
- 2. Disconnect from sanitary system

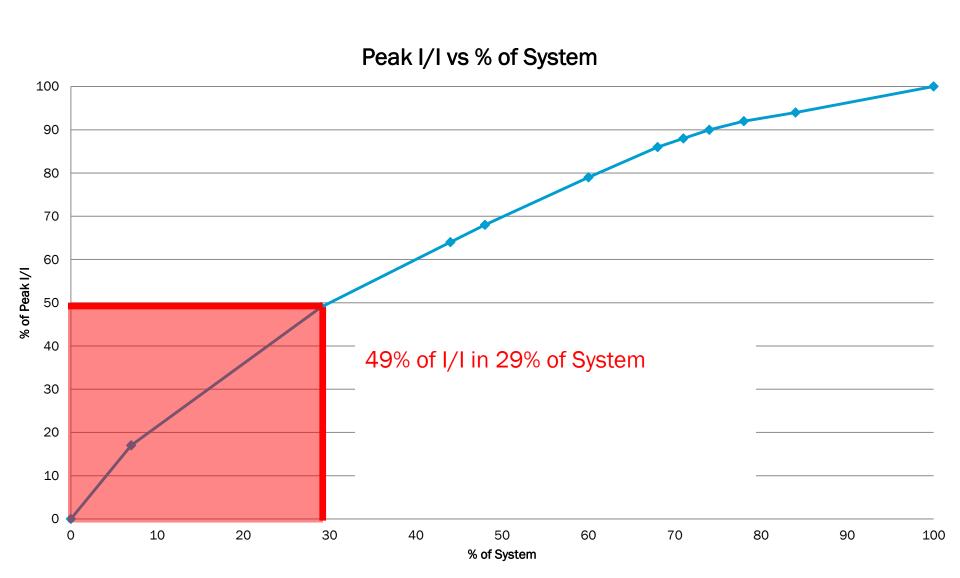
I/I Reduction Program - Next Steps

			Summary of S	moke Testing Incident	s by Type and Basin		
Basin Incide		Percentage of total incidents (%)					
	Incidents		Public cross- connections	Private downspouts	Private commercial connections	Ground/laterals	Miscellaneous
1	5	4.6	1	-	-	3	1
2	22	20.6	5	6	2	8	1
3	12	11.2	1	2	-	5	4
4	6	5.6	2	-	-	4	-
5	1	0.9	-	-	-	-	1
6	6	5.6	1	1	2	1	1
7	23	21.5	4	8	-	11	-
8A	16	15.0	3	7	-	6	-
8B	13	12.1	1	5	-	6	1
9	1	0.9	-	-	-	-	1
10	2	1.9	-	1	-	1	-
Total	107	100	18	30	4	45	10

Next Steps

1. Develop policy for addressing private laterals/assets

SSMP - % of Peak I/I vs % of System



Flow monitoring – Prioritize basins by normalized peak I/I rates

	·		·								
Meter MH	10273	10206	11546	10129	10866	13101	12610	10832	12609	10716	12401
Selected meter	SubAV	Flo-Dar	Flo-Dar	Flo-Dar	Flo-Dar	Flo-Dar	Both	Flo-Dar	SubAV	Flo-Dar	SubAV
Pipe length, feet	22,719	20,081	12,993	16,818	20,229	9,298	18,029	32,188	21,405	20,990	14,707
Pipe length, inch-miles	29	32	20	23	31	13	27	49	32	32	21
Percent of total pipe length, %	9	10	7	8	10	4	9	16	10	10	7
Peak I/I flow, mgd	1.55	1.49	0.72	0.75	0.96	0.22	0.32	0.57	0.35	0.25	0.02
Percent of total I/I flow, %	22	21	10	10	13	3	4	8	5	3	0
Normalized peak I/I flow, mgd/(inch-mile)	0.053	0.046	0.035	0.032	0.031	0.016	0.012	0.012	0.011	0.008	0.001
Ranking by normalized peak I/I flow	1	2	3	4	5	6	7	8	9	10	11
Previous Ranking	3	1	2	5	6	8	9	10	11	7	4

26% of total pipe length contributes ~53% of total peak I/I flow

COMMENT FORM

PLEASE PRINT CLEARLY

- SPEAK INTO THE MICROPHONE AND STATE YOUR NAME AND RESIDING CITY
- Limit Comments to <u>3 MINUTES</u>.
- Give to the Clerk in Chambers prior to the meeting.

,	Esas III
	OREGON
	CITY

Date of Meeting							
Item Number From Ag	genda						
	7) () ()						
NAME:	Cach Stokes						
ADDRESS:	Street: Com, Dev,						
	City, State, Zip:						
PHONE NUMBER:							
E-MAIL ADDRESS:							
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	COMMENT FORM						
 Limit Comments to 	NT CLEARLY*** MICROPHONE AND STATE YOUR NAME AND RESIDING CITY						
Date of Meeting	7-17-17						
Item Number From A	genda						
NAME:	RYAN RETZLATT & Jon Holland						
ADDRESS:	Street: I + I						
	City, State, Zip:						
PHONE NUMBER:							
E-MAIL ADDRESS:							
CICNATUDE.							

John Runyon

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