FY 2021

CITY OF PORTLAND | BUREAU OF ENVIRONMENTAL SERVICES

Annual CSO and CMOM Report

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

ENVIRONMENTAL SERVICES
CITY OF PORTLAND

working for clean rivers

Annual CSO and CMOM Report - FY 2021

September 2021

Report prepared for the
Oregon Department of Environmental Quality
Portland, Oregon

Acknowledgments

Risk Assessment Division, CSO Technical Team

Arnel Mandilag
Nick McCullar
Mike Szwaya
Kevin Tran

CBWTP Operations

Rob George

Maintenance Engineering

Randy Hess
Jeremiah Hess
Gary Irwin

FOG Program

Ali Dirks
John Holtrop

Support

Adrienne Aiona
Dan Ashney
Diane Dulken
Joshua Ernst
Sam Gould
Michael Hauser
Fardad Kordmahaleh
Danny Kapsch
Tim Kurtz
Jason Law
Nishant Parulekar
Kevin Ramey
Grant Wright

Senior Review

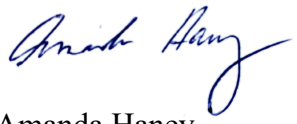
Jane Bacchieri
Steve Behrndt
Scott Clement
Matthew Criblez
Amanda Haney
Marveita Redding
Shannon Reynolds
Paul Suto

For More Information

Arnel Mandilag
503-823-7256
arnel.mandilag@portlandoregon.gov
1120 SW 5th Ave, Suite 613
Portland, OR 97204-1912

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



Amanda Haney
NPDES Duly Authorized Representative
City of Portland, Oregon
Bureau of Environmental Services

Contents

Tables

Figures

Glossary

AGCA. Accelerated Grease Cleaning Area

BLM. The Biotic Ligand Model, used for the Oregon DEQ standard for copper criteria. The BLM is a metal bioavailability model that uses grab sample water characteristics to develop site-specific instantaneous water quality criteria.

BOD. Biochemical Oxygen Demand

CBWTP. Columbia Boulevard Wastewater Treatment Plant

CCTV. Closed-circuit Television

CEPT. Chemically Enhanced Primary Treatment

CIP. Capital Improvement Program

CIPP. Cured-In Place Pipe

CMMS. Computerized Maintenance Management System

CMOM. Capacity, Management, Operation, and Maintenance

COOP. Continuity of Operations Plan

CSCC. Columbia Slough Consolidation Conduit

CSO. Combined Sewer Overflow, especially as it pertains to discharge events. Note that during the CSO Program's implementation, "CSO's" were being captured into the new facilities such as the Willamette CSO Tunnels and the CSCC. Technically, CSOs are no longer being "captured" after the implementation completed—rather, the water that used to produce those events is now controlled within the augmented combined sewer system, and the term *CSO* is limited once again to discharges from the combined system to receiving waters.

CSS. Combined Sewer System

DEQ. Oregon's Department of Environmental Quality

DMR. Discharge Monitoring Report

DO. Dissolved Oxygen

EPA. Environmental Protection Agency

EMC. Event Mean Concentration

EWWPT. Enhanced Wet Weather Primary Treatment

FM. Force Main

FOG. Fats, Oils, and Grease

FSE. Food Service Establishment

FY. Fiscal Year (FY 2021 is July 1, 2020, through June 30, 2021)

I&I. Inflow and Infiltration

IPS. Influent Pump Station

IWQC. Instantaneous Water Quality Criteria

MAO. Mutual Agreement and Order

MGD. Million Gallons per Day

MG. Million Gallons

NFAA. No Feasible Alternatives Analysis

NMC. Nine Minimum Controls

NPDES. National Pollutant Discharge Elimination System. This report addresses NPDES permit #101505.

PIO. Public Information Officer

PUMA. BES Pump Station Operations & Maintenance section

PWB. Portland Water Bureau

RDII. Rainfall Derived (also, Dependent) Inflow and Infiltration

SICSO. Swan Island CSO Pump Station

SPCR. Spill Protection and Citizen Response

SRRP. Sewer Release Response Plan

SSO. Sanitary Sewer Overflow

Summer Season. Defined in NPDES permit #101505 as May 1 to October 31.

SWMM. Stormwater Management Manual

TCWTP. Tryon Creek Wastewater Treatment Plant

TSS. Total Suspended Solids

Winter Season. Defined in NPDES permit #101505 as November 1 to April 30

WWTF. Wet Weather Treatment Facility

Section 1 Introduction

The Annual CSO and CMOM Report for fiscal year 2021 (FY 2021: July 1, 2020, through June 30, 2021) provides a comprehensive review of Portland's integrated combined sewer overflow (CSO) system and the Capacity, Management, Operation, and Maintenance (CMOM) Program during FY 2021. This report provides updates to the previous report submitted for FY 2020.

1.1 Major Changes from FY 2020 Report

This report includes an update to the CSO Public Notification program.

1.2 Programs

CSO Program. The City of Portland (City) completed its CSO long-term control plan implementation in 2011. The City is currently proceeding with implementing its *Post-2011 Combined Sewer Overflow Facilities Plan*, published in 2010. This plan looked at ways to cost-effectively exceed the level of control specified in the 1994 Amended Stipulation and Final Order agreement with Oregon's Environmental Quality Commission. This additional work is necessary to handle the pressure on the combined sewer system (CSS) facilities' capabilities to control CSOs due to increased population and development.

CMOM Program. Over several years, the City of Portland has implemented a CMOM program to reduce the likelihood of sewer releases by improving the overall reliability of the sanitary and combined sewer collection systems. The *CMOM Program Report* that was submitted to DEQ on June 28, 2013, explains BES's strategies and activities for the development, reinvestment, operation, and maintenance of the system. The report was developed to comply with NPDES permit #101505, Schedule D, Condition 3.b.

The CMOM program specifically addresses proper operation and regular maintenance of the collection system (Nine Minimum Controls, or NMC, #1). The City's wastewater collection system includes mainlines, trunk lines, interceptors, pump stations, and force mains. The City is generally responsible for service laterals from the sewer main up to the curb line, while the building or private sewer laterals extending behind the curb are the responsibility of the property owner. Portland's

sewer collection system consists of a network of 2,647 miles of collection system piping (1,007 miles of sanitary sewer including force mains, 913 miles of combined sewer, and 727 miles of sewer laterals) and 41,272 sewer maintenance holes.

The system also maintains two wastewater treatment plants and 98 pump stations. There are 95 City-owned and operated pump stations and three pump stations owned by other public agencies that are operated and maintained by the City under satellite or easement agreements. Ten privately-owned septic tank effluent pumping systems are maintained by the City under agreements with the property owners.

This annual update for FY 2021 provides a review of CMOM program actions and key performance indicators, and an evaluation of the effectiveness of BES's risk-based asset management approach to collection system operation and maintenance.

1.3 Summary of CSO and CMOM Performance

1.3.1 CSO Program Performance

FY 2021 was a year with below average total rainfall depth, with very few intense periods of rainfall. An average of 35.4 inches fell over the combined service area. Normally, 36-43 inches fall over the city in any given year. Only two CSOs were recorded, which met the permit's requirements for storm return periods during CSO events.

For most wet weather events, effluent limits were met. However, an extraordinary filamentous outbreak combined with a national hypochlorite supply shortage led to TSS exceedances in June 2021. For this fiscal year, maximum 7-day concentrations were 20 mg/L (winter) and 31 mg/L (summer) for BOD and 22 mg/L (winter) and 67 mg/L (summer) for TSS; 45 mg/L is the permitted effluent limitation. Similarly, there was also an exceedance for TSS for the maximum 30-day limits: 14 mg/L (winter) and 29 mg/L (summer) for BOD and 16 mg/L (winter) and 41 mg/L (summer) for TSS were calculated, and 30 mg/L is the permitted limitation. The proper prioritization of using the at-risk supplies of the hypochlorite towards disinfecting effluent versus limiting the outbreak in the return activated sludge prolonged the problem and caused a washout of treatment microbiology.

The Wet Weather Treatment Facility (WWTF) with Chemically Enhanced Primary Treatment (CEPT) continues to operate well, contributing to the plant meeting the minimum average monthly percent removal efficiencies indicated in the permit (at least 85% efficiency during the summer—May 1 to October 31—and 65% efficiency during the winter—November 1 to April 30—for both BOD and TSS). BOD removal

efficiencies were 90% in the summer and 87% in the winter, and TSS removal efficiencies were 86% in the summer and 90% in the winter. The filamentous outbreak was the main cause of the drop in performance, which occurred in the summer season from May to June 2021.

Higher rainfall this fiscal year (but still below average) led to a higher volume of flow captured by the Willamette and Columbia Slough storage facilities of about 5.6 billion gallons. Operators managed the integrated collection system to treat 61% of this volume through the secondary system, with 39% treated through the WWTF. There were 35 events in which flows were sent through the WWTF. The average WWTF event lasted 16 hours and discharged 62 million gallons from the WWTF. During the events, the average flow rate treated by the dry weather/secondary system was 111 MGD, slightly exceeding the 110 MGD minimum required in the NPDES permit.

1.3.2 CMOM Program Performance

Portland's CMOM program was designed to ensure that components of the collection system are cleaned and inspected at the right frequency and that preventive maintenance and repairs are performed to cost-effectively reduce the number of sewer releases, extend the useful life of the City's sewer infrastructure, and properly manage collection system operations. CMOM program accomplishments in FY 2021 include:

- Inspection of 0.90 million feet (170 miles) of sewer pipe, or about 8.9% of the mainline sewer system
- Cleaning of 1.27 million feet (241 miles) of sewer pipe, or about 12.5% of the mainline sewer system
- Completion of mainline sewer maintenance repairs on 10,898 feet of pipe; 38% of the repairs were in response to collection system problems
- Repair of 692 service laterals totaling about 9,317 feet of pipe; 47% of those repairs were in response to discovered problems
- Treatment of nearly 251,424 feet (48 miles) of sewer pipe for roots using chemical root foaming
- Completion of 515 inspections of maintenance holes considered to be at greatest risk of failure (Tier 2—see Section 3.1.5).

- Completion of 10 Capital Improvement Program (CIP) projects repairing and rehabilitating portions of the sanitary and combined collection system during the 2020 calendar year, resulting in an estimated risk reduction of $21.3 million. Maintenance activity on mainlines and service laterals also resulted in an estimated risk reduction of $4.8 million.[1]

The number of sewer releases from the City-maintained sanitary and combined sewers decreased slightly in FY 2021. The number of sewer releases per 100 miles of sewer was 6.0 in FY 2021, which fell short of BES's target of 5.0 or fewer releases per 100 miles.

Sewer emergency response crews arrived on site within the City's 2-hour response time target 97% of the time during FY 2021.

[1] Risk reduction values in this bullet are reported on a calendar year basis due to reporting lag times.

Section 2 Integrated CSO System Performance for FY 2021

The integrated CSO system consists of the combined sewer collection system; the CSO collection, storage, and pumping system; and the CBWTP treatment system. This section reports on the performance of the overall integrated CSO system during FY 2021.

2.1 Rainfall Patterns for the Past Fiscal Year

FY 2021 was a dry rainfall year for the City of Portland. The area weighted average rainfall for the Willamette CSO area measured 35.4 inches over the year, 96% of the average annual rainfall of 37 inches for Portland.

During this period, no summer storms were large enough to have caused a permitted CSO, and no CSOs occurred.

Six winter storms were large enough to have caused a permitted CSO, and two of those storms generated CSO discharge.

- November 12-16, 2020 – Winter storm event
- December 18-22, 2020 – Winter CSO event
- December 31, 2020 – January 4, 2021 – Winter storm event
- January 11-12, 2021 – Winter CSO event
- January 29 – February 3, 2021 – Winter storm event
- February 14-15, 2021 – Winter storm event

The winter storm of December 18-22, 2020, was a moderate-to-strong atmospheric river event lasting 4 days and resulting in discharge from nine Willamette River CSO outfalls. The Willamette River CSO area exceeded the 4-per-winter design storm for durations between two to 48 hours and exceeded the 1-per-winter design storm for the 12–24-hour durations.

The winter storm of January 11-12, 2021, was a moderate-to-strong atmospheric river event lasting 40 hours and resulting in discharge from six Willamette River CSO outfalls. The Willamette River CSO area exceeded the 4-per winter design storm for

all durations between one to 48 hours and exceeded the 1-per-5-winters design storm for the 3- and 6-hour durations.

2.1.1 Winter Storm Review

The six storms that exceeded the 4-per-winter NPDES Permit design depths are shown graphically in Figure 1. This graph is a "Depth-Duration" chart that displays the maximum depth of rainfall that occurred for the range of storm durations, from 1-hour to 48- hours. The observed rainfall events are compared to the Willamette NPDES Winter Design Storms (4-per-) shown with a blue line. The two storms that exceeded the 4-per-winter design storm and resulted in CSOs are shown in red. The four storms that exceeded the 4-per-winter design storm but did not result in CSOs are shown in dark grey. Details for the rainfall for the winter rainfall events is provided in Table 1 below.

Figure 1 FY 2021 CSO Winter Storms Compared to NPDES Winter Storms

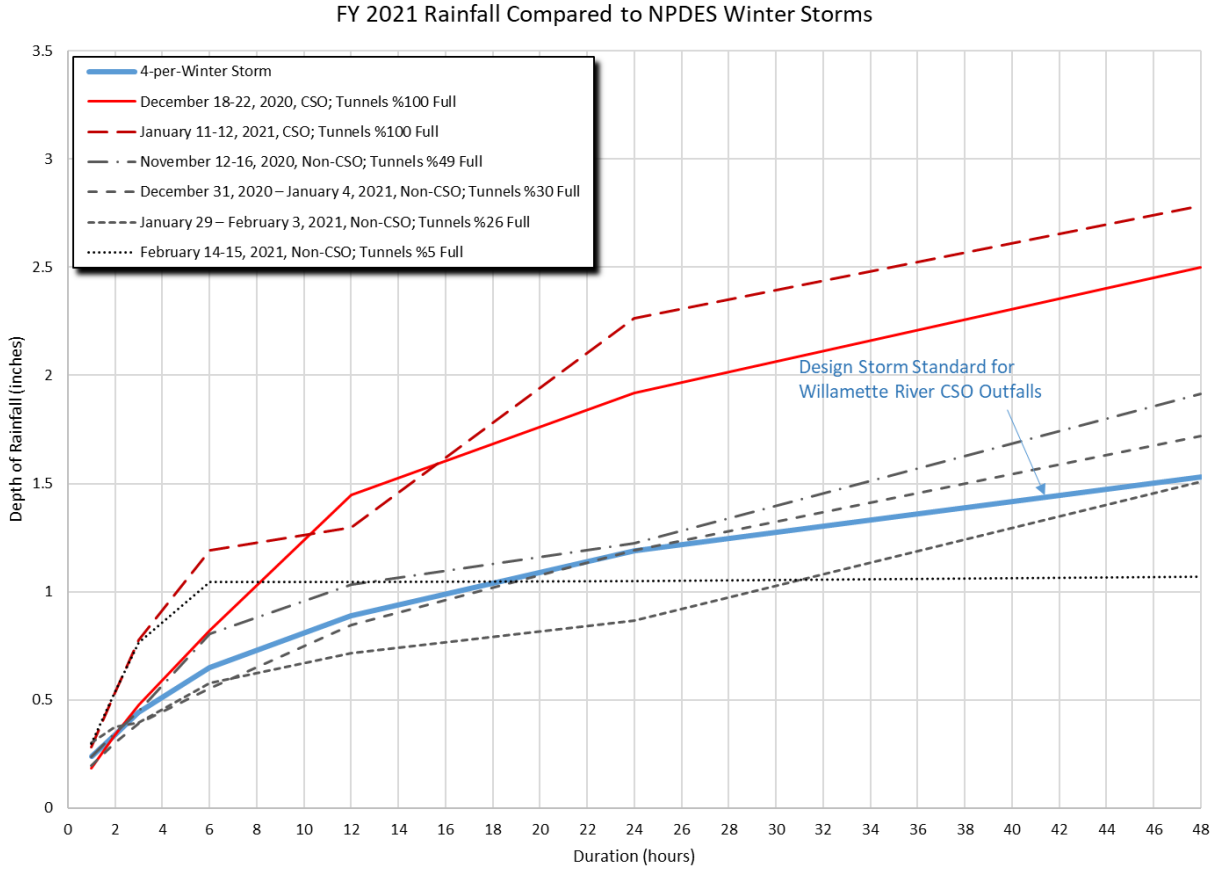


Table 1 FY 2021 Winter Storm Comparisons

Storm	Duration (hours)						Notes
	1	3	6	12	24	48	
Willamette River Winter Design Storm (inches)							
4-per-Winter Design Storm	0.24	0.44	0.65	0.89	1.19	1.53	
FY 2021 Winter Storms - Average Rainfall over Willamette CSO Basin (inches)							
November 12-16, 2020	0.24	0.45	0.81	1.03	1.22	1.92	Exceeds 4-per-winter design storm for 1-48 hour durations. No CSO event.
December 18-22, 2020	0.22	0.49	0.85	1.44	1.93	2.50	Exceeds 4-per-winter design storm for 2-48 hour durations. CSO event.
December 31, 2020 – January 4, 2021	0.20	0.39	0.55	0.85	1.19	1.72	Exceeds 4-per-winter design storm for 24-48 hour durations. No CSO event.
January 11-12, 2021	0.30	0.80	1.24	1.37	2.30	2.83	Exceeds 4-per-winter design storm for 1-48 hour durations. CSO event.
January 29 – February 3, 2021	0.30	0.40	0.58	0.71	0.87	1.51	Exceeds 4-per-winter design storm for 1 hour duration. No CSO event.
February 14-15, 2021	0.30	0.76	1.05	1.05	1.05	1.07	Exceeds 4-per-winter design storm for 1-12 hour durations. No CSO event.

2.1.2 Summer Storms Review

No summer storms exceeded the NPDES Permit 3-year Summer Storm.

2.2 CSO Discharges into the Willamette River and Columbia Slough

2.2.1 Discharge Events

In FY 2021, there were two winter CSO discharge events to the Willamette River and none to the Columbia Slough. Please consult the compliance letters submitted to DEQ for details on the circumstances and validation of these events as allowed by the NPDES permit for CBWTP.

- **December 20, 2020.** 12.3 MG discharged over a total of 3.4 hours from six (6) Willamette River outfalls. The storm that led to the overflow was caused primarily by a 3-day atmospheric river event that produced steady moderate-to-heavy rainfall to the Portland area. Rainfall depths exceeded 1-per-winter design storm levels at multiple rain gauges for the 12- to 24-hour durations.

- **January 12-13, 2021.** 138 MG discharged over a total of 5.9 hours from nine (9) Willamette River outfalls. The storm that led to the overflow was caused primarily by an atmospheric river event that brought heavy rainfall to the Portland area. Rainfall depths exceeded 1-per-winter design storm totals at multiple rain gauges for the 3- to 6-hour durations.

The entire historical record of CSOs discharged from the City's CSO facilities is provided in Appendix A.

2.2.1.1 How Well Were CSO Events Controlled?

System rainfall was below average during the reporting period. The system experienced two (2) winter overflows out of a total 54 distinct storm events. Approximately 1,864 MG were stored in the CSO tunnels during these events.

Total CSO discharge for the year was 150.9 MG from the Willamette CSO system, which was less than 2.6% of the wet weather volume handled by the combined and sanitary collection systems. This equates to 97.4% volume control, exceeding the 94% level of control expected from the Willamette CSO system.

2.2.1.2 Were Wet Weather Flows Maximized to the Plant?

In general, flow was maximized to the treatment plant to the greatest extent possible while preserving plant processes.

It was noted in the December 20, 2020, and January 12, 2021, Letters of Compliance to DEQ that permissible flow to the plant was reduced during these high inflow events in response to unexpected surcharging around the Outfall 2.1 structure. Plant maintenance and engineering investigated the root cause of surcharging. Internal pipe inspections on outfall pipes attached to the structure were in progress as of mid-August 2021. A polymerized sealant was applied to the structure to coat and prevent leakage during surcharge events at this location.

2.2.1.3 Was System Storage Maximized?

The CSO System discharged after the tunnels were filled and the rainfall intensity exceeded permit levels. For all non-CSO sized storm events (less intense than 4-per-winter and 1-per-3 summers), tunnel storage levels did not exceed more than 30% capacity. For the CSO-sized events that the system managed *without* overflow, tunnel storage peaked at 49% capacity.

2.2.2 Dry Weather Overflow Events

No dry weather overflow events from the combined system outfalls were recorded in FY 2021.

2.2.3 Control of Floatables and Debris

City maintenance crews inspect and clean the bar screen within the Sheridan overflow structure (OF07B) following CSO discharge events when conditions allow. Other bar screens are cleaned when CSOs are discharged through them, but no such discharges occurred in FY21. Table 2 provides information on CSO events requiring floatables control cleaning.

Table 2 CSO events with floatables control activity

CSO Event Date(s)	Maint. Date	Location	Description of Maintenance
December 20, 2020, and January 12-13, 2021	06/24/2021	Sheridan Bar Screens	Twenty (21) 1-gallon buckets of sticks, leaves, and mud. Bar screens were not cleaned immediately after these events due to river levels preventing safe access.

2.3 Wet Weather Treatment Performance and Effluent Quality

2.3.1 CSO Facilities Operations

The CSO System configuration experienced no major changes for most of FY 2021. In May 2021, as part of the Secondary Treatment Expansion Program, two of the aeration basins were taken offline for rehabilitation. The system experienced a below average year in terms of total rainfall, having received about 35.4 inches. Influent volumes to CBWTP increased by 3.4% from FY 2020, and the percentage treated by the secondary system decreased from 94% to 91%. The percentage of captured CSO treated via secondary dropped from 65% in FY 2020 to 61% in FY 2021. For FY 2021, Overall BOD and TSS removal efficiencies continue to exceed 90% at the plant's two outfalls, OF001 and OF003. BOD and TSS removal efficiencies dropped marginally from last year's 94%, reaching a high of 93%. These numbers indicate that the plant reliably exhibits satisfactory performance year over year, with some variation occurring due to the changes currently in progress with the expansion.

Table 3 shows the total volume pumped from the two major CSO pump stations in the system, Swan Island CSO pump station (SICSO), which drains the Willamette

River system, and the Influent Pump Station (IPS), which drains the Columbia Slough system. About 5,600 MG of captured CSO reached the plant (see Table 5). About 5,394 MG of tunnel flow was pumped, representing 95% of that captured volume.

Table 3 Volume pumped from CSO tunnels

CSO Tunnel Pumping	Total Pumped Volume (MG)
Swan Island CSO Pump Station	
Force main 1 (Peninsular Dry Weather)	1,438
Force main 2 (Peninsular Wet Weather)	252
Force main 3 (Portsmouth Wet Weather)	1,433
Swan Island CSO Pump Station Subtotal	3,122
Influent Pump Station Total	2,272
Total Volume Pumped to CBWTP from Tunnels	5,394

2.3.2 Annual Treatment Performance for CBWTP

2.3.2.1 Annual CSO Treatment Characteristics

Key parameters for the treatment system's annual performance are derived from the NPDES permit for the CBWTP, which specifies seasonal percent removal efficiencies at the plant[2]. Table 4 summarizes this aspect, and the minimum efficiency limits for BOD and TSS were met for both seasons. Annual percent removal efficiencies for the wet weather system were based on Portland's 2009 No Feasible Alternative Analysis (NFAA) report.

Table 4 Combined OF001/003 minimum average 30-day removal efficiency

System	Season	Efficiency Target	BOD Removal Efficiency	TSS Removal Efficiency
Combined OF001/OF003	Summer	85% or more	90%	86%
	Winter	65% or more	87%	90%

[2] NPDES Permit #101505 Schedule A, Condition 1.a.i (Table A1)

Table 5 summarizes the main annual treatment performance measures for the CBWTP systems. This table provides a comparison of the performance against the average year model and permit values. Key parameters are in blue text. For FY 2021:

- Secondary treatment was maintained at 111 MGD, 1% higher than the 110 MGD minimum required by the permit after FY 2014.
- Percent of wet weather volume treated through secondary exceeded the model target level (61% compared to 54%).
- Secondary flows were lowered significantly in June 2021 to protect the plant's treatment capacity due to the following conditions:
    - Rehabilitation of two aeration basins, resulting in a 25% reduction in biological secondary treatment capacity, as part of construction during the plant's Secondary Treatment Expansion Program.
    - All flows during dry weather received secondary treatment. During wet weather, Operations used storage in the collection system and wet weather clarifiers to maximize secondary treatment as much as possible.
    - An extraordinarily challenging filamentous outbreak in the secondary system. This was compounded with regional and national shortages of sodium hypochlorite that eventually led to a force majeure declaration from the provider and high risks of running out of chemical supply. Instead of applying the sodium hypochlorite to the return activated sludge to fully address the outbreak, the chemical was prioritized for effluent disinfection. The outbreak was therefore prolonged.
    - The filamentous outbreak led to washouts of microbiology due to poor settling.
    - Unprecedented heat prevented gas from being fully in solution, allowing the outbreak to continue proliferating.
    - This event's challenges are currently being documented for future operational use, including information related to the circumstances as well as options attempted while addressing the outbreak.

When evaluating wet weather treatment, BES asks three questions:

- **Were wet weather flows treated to a high quality?** Yes. This is according to the observed numbers in comparison with permit requirements. See Section 2.3.2.2.
- **Were flows to secondary treatment maximized?** Yes. See Section 2.2.1.2. Flows were maximized cautiously to protect treatment capacity, given the filamentous bacteria outbreak that occurred throughout May and June 2021.
- **Were effluent limits achieved at OF001 and OF003?** Effluent limits were met throughout the year except for TSS exceedances in June 2021. While Table 4 indicates that the system is producing the proper annual treatment results overall, Table 6-Table 9 show that concentration limits were exceeded for TSS during the maximum 30-day and 7-day loadings that occurred in June 2021. Wet weather treatment was in proper order throughout the year. However, the filamentous outbreak in the secondary system and supply chain challenges were the main reasons for the exceedances. TSS concentrations were also higher in the secondary effluent than the wet weather effluent initially during the strong June 2021 rainfall event leading to these exceedances.

Examination of the annual results indicates that the CSO system operations strategy continues to sustain desired performance and can handle various conditions throughout the year, even with large changes in rainfall amounts year over year. Portland's use of CEPT continues to keep BOD and TSS discharges from the Wet Weather Treatment Facility at consistently reduced levels.

Table 5 CBWTP annual treatment performance data[3]

CBWTP Annual Treatment Performance												
Annual Treatment Characteristics	**Average Year Model / Permit**	*No CEPT* **FY 2012**	*With CEPT* **FY 2013**	*With CEPT* **FY 2014**	*With CEPT* **FY 2015**	*With CEPT* **FY 2016**	*With CEPT* **FY 2017**	*With CEPT* **FY 2018**	*With CEPT* **FY 2019**	*With CEPT* **FY 2020**	*With CEPT* **FY 2021**	**Trend**
Annual Rainfall Depth (inches/year)	37	46.8	40.2	40.0	33.9	53.4	59.5	37.6	30.5	33.2	35.4	
Flows to CBWTP												
Influent Volume (MG/Year)	28,300	28,800	26,625	26,549	25,760	30,665	33,544	26,844	23,763	22,528	23,305	
Dry Weather Sanitary Volume (MG/Year)	22,100	20,200	19,496	19,471	19,609	20,179	22,358	21,635	20,037	18,624	17,657	
Captured CSO Flow - Volume (MG/Year)	6,200	8,600	7,129	7,078	6,151	10,485	11,187	5,209	3,726	3,904	5,648	
Total Volume Treated Thru Secondary (MG)	25,443	25,662	24,197	24,002	23,221	26,301	28,765	24,947	22,173	21,176	21,129	
% of Plant Flow Treated Through Secondary System	90%	89%	91%	90%	90%	86%	86%	93%	93%	94%	91%	
WWTF (EWWPT) Events												
Rate to DW / Secondary During EWWPT (MGD)	100	120	126	112	112	117	119	117	118	111	111	
Number of Events / Year	32	29	22	27	27	39	41	37	35	37	35	
WWTF Volume / Year	2,857	3,138	2,429	2,546	2,540	4,363	4,779	1,897	1,590	1,352	2,175	
Amount of Captured CSO Treated via Secondary (%)	54%	64%	66%	64%	59%	58%	57%	64%	57%	65%	61%	
Duration of WWTF Events (hours)	919	706	668	904	591	1241	1333	602	387	338	556	
Calendar Days of WWTF Discharges (days)	---	66	50	65	51	92	99	65	52	53	52	
Blended Effluent (OF001 & 003) Treatment												
BOD Loading (pounds / year)	2,510,000	4,000,000	2,957,783	3,472,307	4,176,834	3,871,106	4,554,872	3,046,966	2,786,772	2,925,285	3,014,266	
BOD Average Concentration (mg/l)	27	16.6	13.3	15.7	19.4	15.1	16.3	13.6	14.1	15.6	15.5	
Total Plant BOD Removal Efficiency (%)	---	93%	95%	94%	93%	93%	92%	95%	95%	94%	93%	
TSS Loading (pounds / year)	2,440,000	5,050,000	3,585,748	4,055,479	4,413,412	4,910,264	5,248,619	3,738,873	3,237,714	2,962,541	3,276,139	
TSS Average Concentration (mg/l)	27	21.0	16.1	18.3	20.5	19.2	18.8	16.7	16.3	15.8	16.9	
Total Plant TSS Removal Efficiency (%)	---	92%	94%	93%	92%	92%	92%	94%	95%	94%	93%	

[3]* The permit average for "Rate to DW/Secondary During EWWPT (MGD)" rose to 110 MGD from 100 MGD in 2014 (applicable for FY 2015 and onwards).

2.3.2.2 CBWTP Max-Month and Peak-Week Treatment Performance

Table 6 provides maximum 30-day treatment results for BOD and TSS for the winter season (November 2020-April 2021) and Table 7 provides results for the summer season (July-October 2020 and May-June 2021). While the permit requires reporting of maximums on a calendar month basis, this evaluation uses a more stringent moving 30-day window analysis. Maximum 30-day concentrations and loadings for both BOD and TSS at the outfalls for the maximum 30-day period year-round (ending February 2, 2020, for BOD5 and January 29, 2020, for TSS) were below the permit's maximum monthly limits during the winter. However, for the summer, the BOD maximum almost met the 30 mg/L limit, but for TSS, it was exceeded (41 mg/L compared to the 30 mg/L limit). This exceedance was caused by the filamentous outbreak described above in Section 2.3.2.1.

Table 6 Wet weather max-month (30-days maximum solids loading) treatment performance – winter season

Parameters	Maximum Monthly (30-Day)						
	Avg Concentration During Maximum Month for Mass Loading			Mass Loading			
	Permit Monthly (mg/l)	Max 30-Day (mg/l)	30-Day Avg Flow (MGD)	Permit Monthly (lbs/day)	Max 30-Day (lbs/day)	Date of 30th Day	Notes
Columbia Boulevard WWTP - Outfalls 001 and 003 Effluent Quality							
BOD5	30	14	122	45,000	14,557	2021-01-13	11.7 inches of rain in 30d
TSS	30	16	123	45,000	16,843	2021-01-14	

Table 7 Wet weather max-month (30-days maximum solids loading) treatment performance – summer season

Parameters	Maximum Monthly (30-Day)						
	Avg Concentration During Maximum Month for Mass Loading			Mass Loading			
	Permit Monthly (mg/l)	Max 30-Day (mg/l)	30-Day Avg Flow (MGD)	Permit Monthly (lbs/day)	Max 30-Day (lbs/day)	Date of 30th Day	Notes
Columbia Boulevard WWTP - Outfalls 001 and 003 Effluent Quality							
BOD5	30	29	54	45,000	13,225	2021-06-18	2.5 inches of rain in 30d
TSS	30	41	54	45,000	18,659	2021-06-20	

Table 8 provides peak 7-day treatment results for BOD and TSS for the winter season and Table 9 provides results for the summer. Similar to the previous discussion for the 30-day analysis, the permit requires reporting of peaks on a calendar week (Sunday to Saturday) basis. However, this analysis uses a more stringent moving 7-day window. Concentrations and loading for both 7-day BOD and TSS for the maximum period during the winter were below the permit's maximum weekly limits. However, while the BOD maximum was below the limit during the summer, the TSS maximum exceeded the limit (67 mg/L compared to the 45 mg/L limit). As with the 30-day exceedance, this exceedance was due to the filamentous outbreak in the latter months of the fiscal year.

Table 8 Wet weather peak-week (7-days maximum solids loading) treatment performance – winter season

Parameters	Peak Week (7-Day)						
	Avg Concentration During Peak Mass Loading Week			Mass Loading			
	Permit Weekly (mg/l)	Max 7-Day (mg/l)	7-Day Avg Flow (MG)	Permit Weekly (lbs/day)	Max 7-Day (lbs/day)	Date of 7th Day	Notes
Columbia Boulevard WWTP - Outfalls 001 and 003 Effluent Quality							
BOD5	45	20	145	118,800	24,446	2021-02-21	2.2 inches of rain in 7d (2021-02)
TSS	45	22	136	118,800	24,531	2020-11-19	3.9 inches of rain in 7d (2020-11)

Table 9 Wet weather peak-week (7-days maximum solids loading) treatment performance – summer season

Parameters	Peak Week (7-Day)						
	Avg Concentration During Peak Mass Loading Week			Mass Loading			
	Permit Weekly (mg/l)	Max 7-Day (mg/l)	7-Day Avg Flow (MG)	Permit Weekly (lbs/day)	Max 7-Day (lbs/day)	Date of 7th Day	Notes
Columbia Boulevard WWTP - Outfalls 001 and 003 Effluent Quality							
BOD5	45	31	71	118,800	18,117	2021-06-17	1.3 inches of rain in 7d
TSS	45	67	71	118,800	39,859	2021-06-17	

2.4 Wet Weather Treatment Performance for Enhanced Wet Weather Primary Treatment (EWWPT) Events

Wet weather treatment performance is best evaluated by examining the events in which the WWTF discharged treated effluent. These events are called Enhanced Wet

Weather Primary Treatment (EWWPT) events to underscore that the wet weather flow diverted from the secondary system receives CEPT.

An EWWPT event begins when the WWTF starts discharging effluent, and ends after either of the following:

- WWTF discharge has ended AND the plant inflow remains below 80 MGD for 6 hours OR
- WWTF discharge has ended and no subsequent WWTF discharge occurs for 48 hours. This condition may occur when low level rainfall keeps plant inflows up, but Operations is able to send all inflows through secondary treatment.

Table 10 summarizes the WWTF events for FY 2021 (required by the permit, Schedule A, Condition 2.f). The full, detailed list of the events is in Table 11.

Table 10 Enhanced wet weather primary treatment events summary

		CBWTP Flows		WWTF Flows				WWTF Effluent			
	Events	Avg Influent During EWWPT (MGD)	Avg Secondary Flow During EWWPT (MGD)	Avg WWTF Flow (MGD)	WWTF Discharge Volume (MG)	Duration of WWTF Discharge (hrs)	Calendar Days WWTF Discharge Occurred	Event BOD Load Discharged (lbs)	Event TSS Load Discharged (lbs)	EMC BOD (mg/L)	EMC TSS (mg/L)
Total	**35**				**2,175**	**556**	**52**	**792,905**	**578,215**		
Average/Event		**200**	**111**	**79**	**62**	**15.9**	**1.5**	**22,654**	**16,520**	**51**	**38**

Table 11 Enhanced wet weather treatment events - detailed information

		CBWTP Flows		WWTF Flows				WWTF Effluent			
Date & Time Bypass Event Started	Event #	Avg Influent During EWWPT (MGD)	Avg Secondary Flow During EWWPT (MGD)	Avg WWTF Flow (MGD)	WWTF Discharge Volume (MG)	Duration of WWTF Discharge (hrs)	Calendar Days WWTF Discharge Occurred	Event BOD Load Discharged (lbs)	Event TSS Load Discharged (lbs)	EMC BOD (mg/L)	EMC TSS (mg/L)
9/18/20 8:00	1	120	103	12	6	11.8	1	6,073	3,012	124	62
9/23/20 18:30	2	222	110	100	38	9.0	2	17,588	12,930	56	41
9/25/20 10:15	3	210	114	84	44	12.5	1	26,600	22,704	73	62
10/10/20 4:45	4	247	111	125	53	10.3	1	19,027	13,503	43	30
10/11/20 1:30	5	154	110	36	2	1.5	1	792	547	43	29
10/12/20 0:00	6	150	104	35	9	6.3	1	792	547	10	7
10/13/20 11:30	7	223	128	80	10	3.0	1	2,896	1,903	35	23
11/3/20 14:15	8	152	110	31	6	4.8	1	4,139	3,066	81	60
11/5/20 15:45	9	213	109	93	49	12.5	2	37,350	31,993	92	79
11/13/20 5:00	10	209	110	89	64	17.3	1	54,730	47,502	103	89
11/14/20 17:45	11	246	115	118	54	11.0	2	28,142	25,548	63	57
11/18/20 8:15	12	238	111	115	118	24.5	2	44,612	30,222	45	31
11/24/20 21:15	13	170	109	51	11	5.0	2	4,580	3,354	52	38
12/9/20 0:45	14	238	111	108	15	3.3	1	6,471	4,762	53	39
12/11/20 14:30	15	256	117	127	50	9.5	1	20,445	11,683	49	28
12/13/20 9:30	16	214	109	85	12	3.3	1	2,312	2,312	24	24
12/16/20 15:45	17	244	114	116	30	6.3	1	11,107	6,911	44	27
12/19/20 22:30	18	281	119	154	312	48.5	3	91,301	60,671	35	23
12/25/20 22:00	19	248	110	122	40	7.8	2	11,533	8,273	35	25
12/30/20 13:15	20	278	114	154	59	9.3	1	23,249	19,292	47	39
1/1/21 17:45	21	192	109	72	16	5.3	1	6,798	5,599	52	43
1/2/21 10:15	22	203	113	83	208	60.3	3	65,448	52,993	38	31
1/6/21 17:00	23	266	109	147	78	12.8	1	23,735	13,087	37	20
1/8/21 8:00	24	169	109	39	5	3.0	1	968	744	24	19
1/11/21 21:45	25	289	117	162	365	54.0	3	100,742	96,336	33	32
1/15/21 8:00	26	141	108	11	1	1.5	1	151	314	26	55
1/24/21 17:15	27	136	109	25	7	6.5	1	3,886	2,665	69	47
2/1/21 12:15	28	199	109	84	173	49.5	3	46,174	35,309	32	25
2/15/21 4:15	29	191	110	75	213	68.5	3	75,622	23,009	42	13
2/18/21 14:15	30	159	110	41	54	31.5	2	24,629	17,465	55	39
2/22/21 17:15	31	222	110	99	24	5.8	1	10,006	6,278	50	32
2/26/21 8:15	32	121	107	8	3	8.8	1	905	839	38	36
3/18/21 20:30	33	125	108	9	0.28	0.8	1	97	99	42	43
5/25/21 12:15	34	131	104	15	5	7.8	1	4,069	2,242	103	57
6/13/21 3:00	35	155	100	47	45	23.0	1	15,935	10,502	43	28
Total	**35**				**2,175**	**556**	**52**	**792,905**	**578,215**		
Avg/Event		**200**	**111**	**79**	**62**	**16**	**1.5**	**22,654**	**16,520**	**51**	**38**

Key aspects for this year's WWTF performance include:

- Volume of EWWPT events was 2.2 billion gallons. This is about 9% of the total volume received at the CBWTP for the year (23.3 billion gallons; see Table 5).
- An EWWPT event was in progress during the year for about 556 hours (6% of the year) and 52 calendar days (about 1 day per week).
- The minimum flow to the CBWTP at the onset of any EWWPT event throughout the year was 122 MGD, above the minimum 110 MGD required in the permit (Schedule A, Condition 2.d). Usage of the WWTF was always under conditions when flows to the plant exceeded 110 MGD (Schedule A, Condition 2.g).
- The average event mean concentrations (EMC) for BOD of 51 mg/L and 38 mg/L for TSS is a decrease in performance over FY 2020 but is comparable to other slightly dry years, such as FY 2018, and with expected values for the CEPT system.
- Operators maintained an average of 111 MGD of flow through secondary treatment during EWWPT events, compared to the permit requirement of 110 MGD. This rate is 56% of the average flow rate reaching the plant during an EWWPT event (200 MGD).
- EWWPT events lasted just under 16 hours on average and typically occurred across 1.5 days. This is similar to slightly dry years such as FY 2018 (which had 17 hours and 1.8 calendar days average EWWPT statistics).

BOD and TSS removal efficiencies compared to event volume are shown in Figure 2 (BOD) and Figure 3 (TSS). Small events tend to have higher BOD and TSS concentrations, and larger volume events have lower concentrations. The CEPT system achieves better than 50% BOD and 70% TSS removal efficiencies on an overall basis. Most wet weather events this fiscal year placed above the target efficiencies, as seen on the charts. The few sporadic events with lower efficiencies tend to happen during drier years.

Figure 2 WWTF BOD removal efficiency vs. event volume

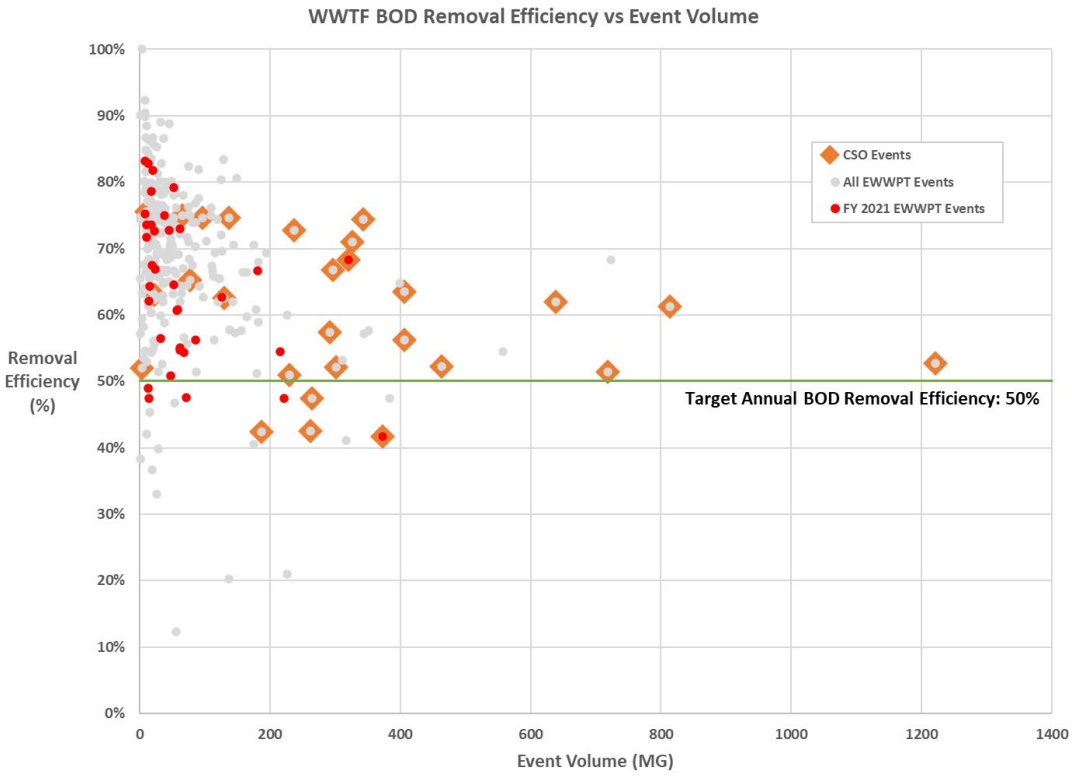
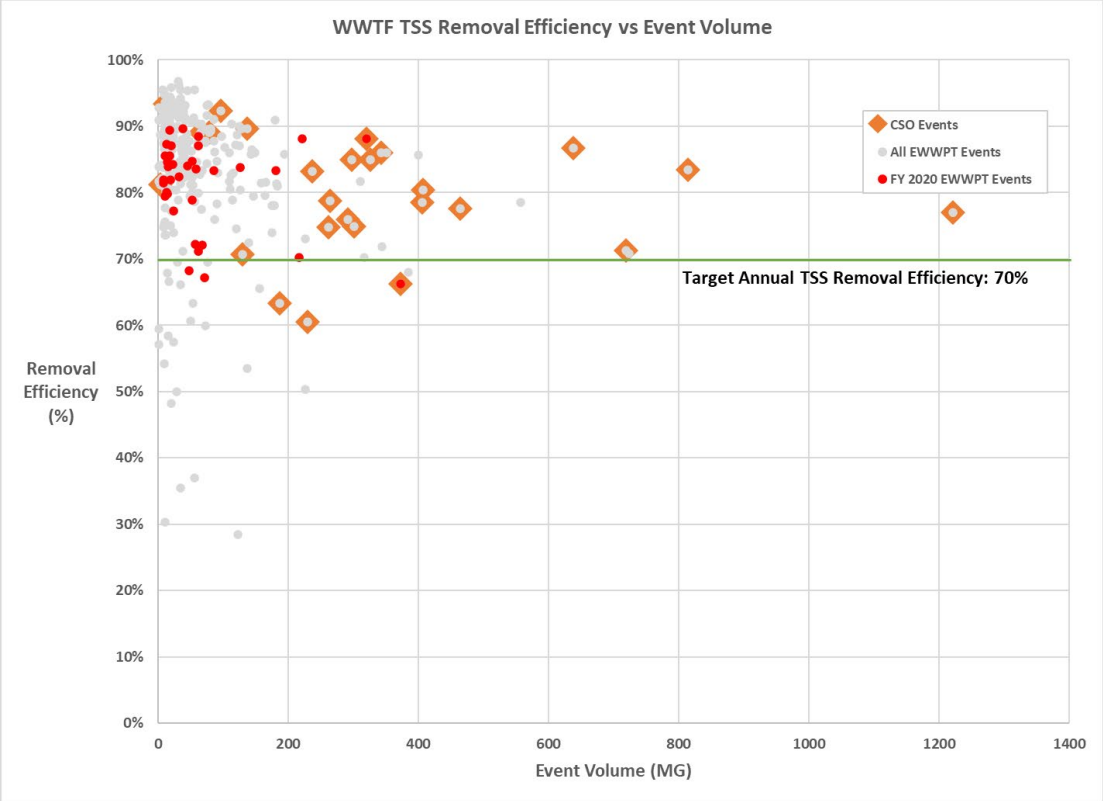


Figure 3 WWTF TSS removal efficiency vs. event volume



2.5 CSO System and Water Quality Monitoring

2.5.1 CSO Discharge Sampling

The CBWTP NPDES permit requires opportunity-based sampling of CSO discharges from the Willamette CSO Tunnel system. The purpose of this sampling is to confirm that CSO discharges protect beneficial uses and provide for attainment of the Willamette River water quality standards (Schedule A, Condition 5.b.iii). The City reports results of the sampling in this section for each year in which viable samples are collected.

The 2020 NPDES permit modifies the CSO sampling program dictated by the 2010 permit by requiring analysis for Total Dissolved Copper plus biotic ligand model (BLM) parameters instead of just Total Dissolved Copper. Otherwise, the discharge sampling is identical to that reported in the FY 2015 Annual CSO/CMOM report.

Portland obtained its first two samples for the current NPDES permit, of which five are required for the current cycle, per Schedule A, Condition 5.b.iii.(A). Figure 4 and

Figure 5 show the laboratory analysis reports for the December 18-22, 2020, and January 11-12, 2021, events. Both of these grab samples were collected near Outfall 36 (Alder).

Figure 4 December 20, 2020, CSO Discharge Water Quality Sample Result - OF 36

City of Portland
Water Pollution Control Laboratory
6543 N. Burlington Ave. / Portland OR 97203 (503) 823-5600 fax (503) 823-5656
ORELAP Certification ID 4023

LABORATORY ANALYSIS REPORT

Project:	**CSO Permit**	Client:	Operations and Maintenance
Work Order:	**W20L181**	Project Mgr:	Amanda Haney
Received:	12/20/20 12:46		
Submitted By:	Field Operations		

Sample	Laboratory ID	Matrix	Type	Sample Collection Date Start	End	Qualifier
CSO36	W20L181-01	Stormwater	Grab	12/20/20 11:50	12/20/20 11:50	

Case Narrative

********** AMENDED REPORT **********

A report was first issued for this workorder on 1/6/21. This report contains additional results: total Al, and dissolved Ca, Mg, K, Na as requested on 2/2/21.

Analyte	Result	Units	MRL	Dil.	Batch	Prepared	Analyzed	Method	Qualifier
CSO36 : W20L181-01									
Field Parameters									
pH*	**6.7**	pH Units		1	B20L325	12/20/20 11:50	12/20/20	FO SOP 1.01a	
Temperature*	**11.5**	°C		1	B20L325	12/20/20 11:50	12/20/20	FO SOP 1.05a	
Microbiology									
E. coli	**>240000**	MPN/100 mL	100	1	B20L317	12/20/20 14:09	12/21/20	Colilert QT	
General Chemistry									
Dissolved organic carbon	**9.20**	mg/L	3.00		B21A029	01/04/21	01/04/21	SM 5310B	
Alkalinity	**13.9**	mg CaCO3/L	1.0		B20L384	12/24/20	12/24/20	SM 2320B	
Total suspended solids	**32**	mg/L	3		B20L371	12/24/20	12/24/20	SM 2540D	
Nutrients									
Chloride	**2.54**	mg/L	1.00	1	B20L318	12/21/20	12/21/20	EPA 300.0	
Sulfate	**3.72**	mg/L	1.00	1	B20L318	12/21/20	12/21/20	EPA 300.0	

Total Metals

Total Metals by ICPMS							
Aluminum	**0.590** mg/L	0.100	1	B20L323	12/21/20	12/22/20	EPA 200.8
Copper	**6.62** ug/L	0.400	1	B20L323	12/21/20	12/22/20	EPA 200.8
Lead	**4.36** ug/L	0.200	1	B20L323	12/21/20	12/22/20	EPA 200.8
Potassium	**2.07** mg/L	0.200	1	B20L323	12/21/20	12/22/20	EPA 200.8
Sodium	**3.91** mg/L	0.200	1	B20L323	12/21/20	12/22/20	EPA 200.8
Hardness by calculation							
Hardness	**13.0** mg CaCO3/L	0.456	1	[CALC]	12/21/20	12/22/20	SM 2340B
Calcium	**3.44** mg/L	0.100	1	B20L323	12/21/20	12/22/20	EPA 200.8
Magnesium	**1.07** mg/L	0.050	1	B20L323	12/21/20	12/22/20	EPA 200.8

Dissolved Metals

Dissolved Metals by ICPMS							
Copper, dissolved	**2.85** ug/L	0.212	1	B20L341	12/22/20	12/22/20	EPA 200.8
Calcium, dissolved	**3.03** mg/L	0.053	1	B20L341	12/22/20	12/22/20	EPA 200.8
Magnesium, dissolved	**0.814** mg/L	0.026	1	B20L341	12/22/20	12/22/20	EPA 200.8
Potassium, dissolved	**2.00** mg/L	0.106	1	B20L341	12/22/20	12/22/20	EPA 200.8
Sodium, dissolved	**3.56** mg/L	0.106	1	B20L341	12/22/20	12/22/20	EPA 200.8

Figure 5 January 12, 2021, CSO Discharge Water Quality Sample Result - OF 36

City of Portland
Water Pollution Control Laboratory
6543 N. Burlington Ave. / Portland OR 97203 (503) 823-5600 fax (503) 823-5656
ORELAP Certification ID 4023

LABORATORY ANALYSIS REPORT

Project:	**CSO Permit**	Client:	Operations and Maintenance
Work Order:	**W21A108**	Project Mgr:	Amanda Haney
Received:	1/12/21 23:57		
Submitted By:	Field Operations		

Sample	Laboratory ID	Matrix	Type	Sample Collection Date Start	End	Qualifier
CSO36	W21A108-01	Stormwater	Grab	01/12/21 23:19	01/12/21 23:19	

Analyte	Result	Units	MRL	Dil.	Batch	Prepared	Analyzed	Method	Qualifier
CSO36 : W21A108-01									
Field Parameters									
pH*	**7.4**	pH Units		1	B21A178	01/12/21 23:19	01/12/21	FO SOP 1.01a	
Temperature*	**14.5**	°C		1	B21A178	01/12/21 23:19	01/12/21	FO SOP 1.05a	
Microbiology									
E. coli	**73000**	MPN/100 mL	100	1	B21A175	01/13/21 07:12	01/14/21	Colilert QT	
General Chemistry									
Dissolved organic carbon	**3.40**	mg/L	1.00		B21A278	01/21/21	01/21/21	SM 5310B	
Alkalinity	**7.9**	mg CaCO3/L	1.0		B21A234	01/15/21	01/15/21	SM 2320B	
Total suspended solids	**50**	mg/L	3		B21A216	01/14/21	01/15/21	SM 2540D	
Nutrients									
Chloride	**1.14**	mg/L	1.00	1	B21A190	01/13/21	01/13/21	EPA 300.0	
Sulfate	**1.37**	mg/L	1.00	1	B21A190	01/13/21	01/13/21	EPA 300.0	
Total Metals									
Total Metals by ICPMS									
Aluminum	**1.02**	mg/L	0.100	1	B21A184	01/13/21	01/14/21	EPA 200.8	
Copper	**7.72**	ug/L	0.400	1	B21A184	01/13/21	01/14/21	EPA 200.8	
Lead	**8.79**	ug/L	0.200	1	B21A184	01/13/21	01/14/21	EPA 200.8	
Potassium	**1.20**	mg/L	0.200	1	B21A184	01/13/21	01/14/21	EPA 200.8	
Sodium	**1.42**	mg/L	0.200	1	B21A184	01/13/21	01/14/21	EPA 200.8	
Hardness by calculation									
Hardness	**9.74**	mg CaCO3/L	0.456	1	[CALC]	01/13/21	01/14/21	SM 2340B	
Calcium	**2.78**	mg/L	0.100	1	B21A184	01/13/21	01/14/21	EPA 200.8	
Magnesium	**0.676**	mg/L	0.050	1	B21A184	01/13/21	01/14/21	EPA 200.8	
Dissolved Metals									
Dissolved Metals by ICPMS									
Copper, dissolved	**2.71**	ug/L	0.211	1	B21A183	01/14/21	01/14/21	EPA 200.8	
Calcium, dissolved	**2.18**	mg/L	0.053	1	B21B049	02/04/21	02/04/21	EPA 200.8	
Magnesium, dissolved	**0.410**	mg/L	0.026	1	B21B049	02/04/21	02/04/21	EPA 200.8	
Potassium, dissolved	**0.997**	mg/L	0.106	1	B21B049	02/04/21	02/04/21	EPA 200.8	
Sodium, dissolved	**1.48**	mg/L	0.106	1	B21B049	02/04/21	02/04/21	EPA 200.8	

BLM and Oregon Copper Rule. Table 12 compares the instantaneous water quality criteria (IWQC) calculated using the copper BLM with the grab samples above. For the December 20, 2020, event, the CSO sample of 2.85 µg/L exceeded the IWQC for chronic criteria (CCC) of 2.24 µg/L at the end of pipe. For the January 12, 2021, event, the CSO sample of 2.71 µg/L did not exceed any IWQC calculated for the event. NPDES Permit #101505, Schedule A, Condition 3.b grants a regulatory mixing zone (RMZ) for the SE Alder outfall with a 10:1 dilution for total copper. Applying the dilution, the December 20, 2021, discharge event does not have reasonable potential to exceed the water quality criteria.

Table 12 Copper BLM comparison

	Ambient Values					Event Comparison	
Event	Final Acute Value (µg/L)	CMC (µg/L)	CCC (µg/L)	Cu (µg/L)	Acute Toxic Units (µg/L)	CSO Sample (µg/L)	CSO Sample > CCC?
12/20/2020	7.2125	3.6062	**2.2399**	0.759	0.2105	**2.85**	Yes
1/12/2021	10.5613	5.2807	**3.2799**	0.884	0.1674	**2.71**	No

2.5.2 Willamette River Instream Water Quality Sampling

Figure 6 through Figure 10 show the water quality trends along the Portland stretch of the Willamette River for five parameters: zinc, lead, copper, TSS, and *E. coli*. These metals and bacteria parameters are the pollutants of concern for Portland CSO discharges. The sampling results indicate continued similar performance as previous recent fiscal years.

Figure 6 Willamette River monitoring results for zinc

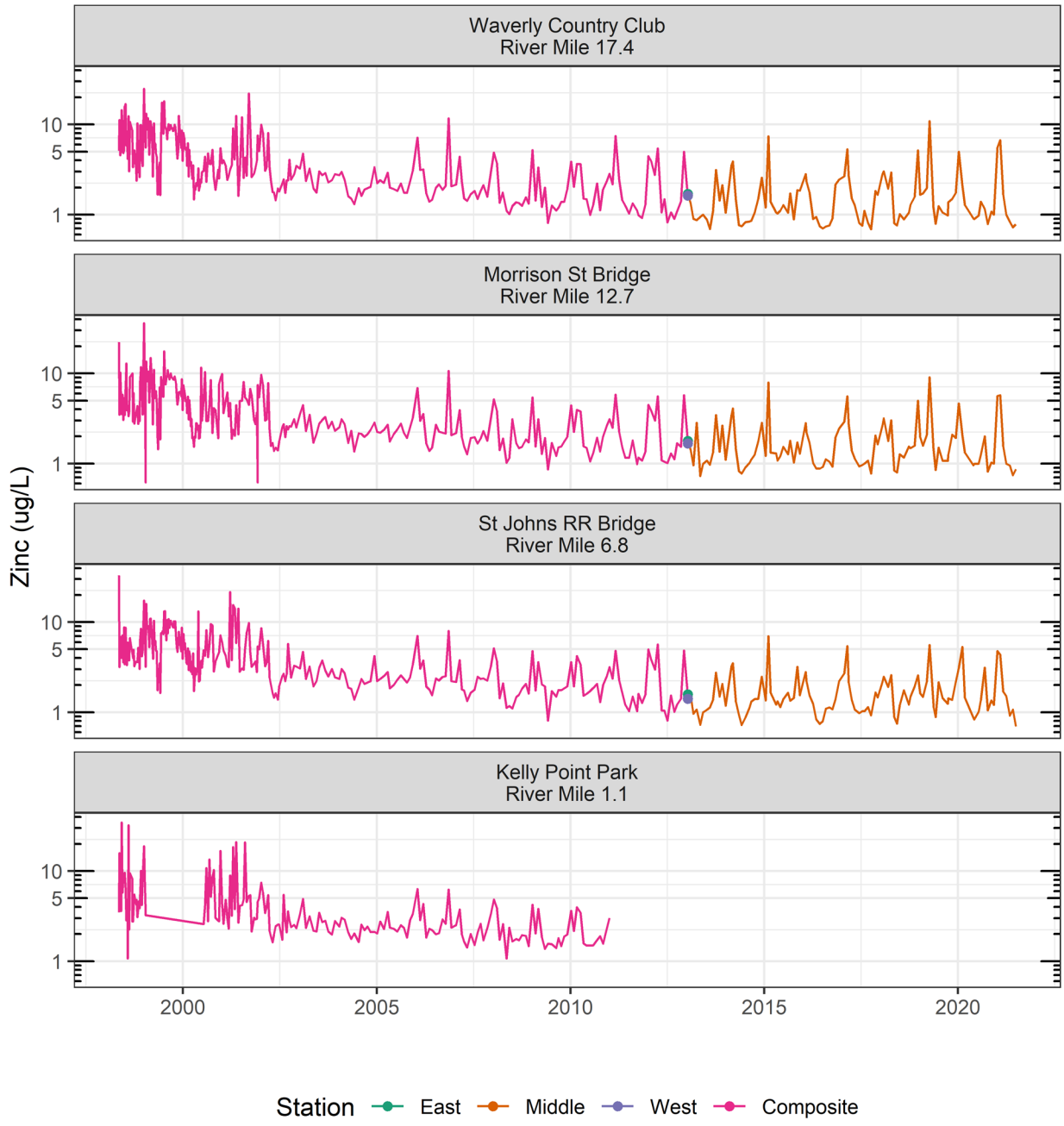


Figure 7 Willamette River monitoring results for lead

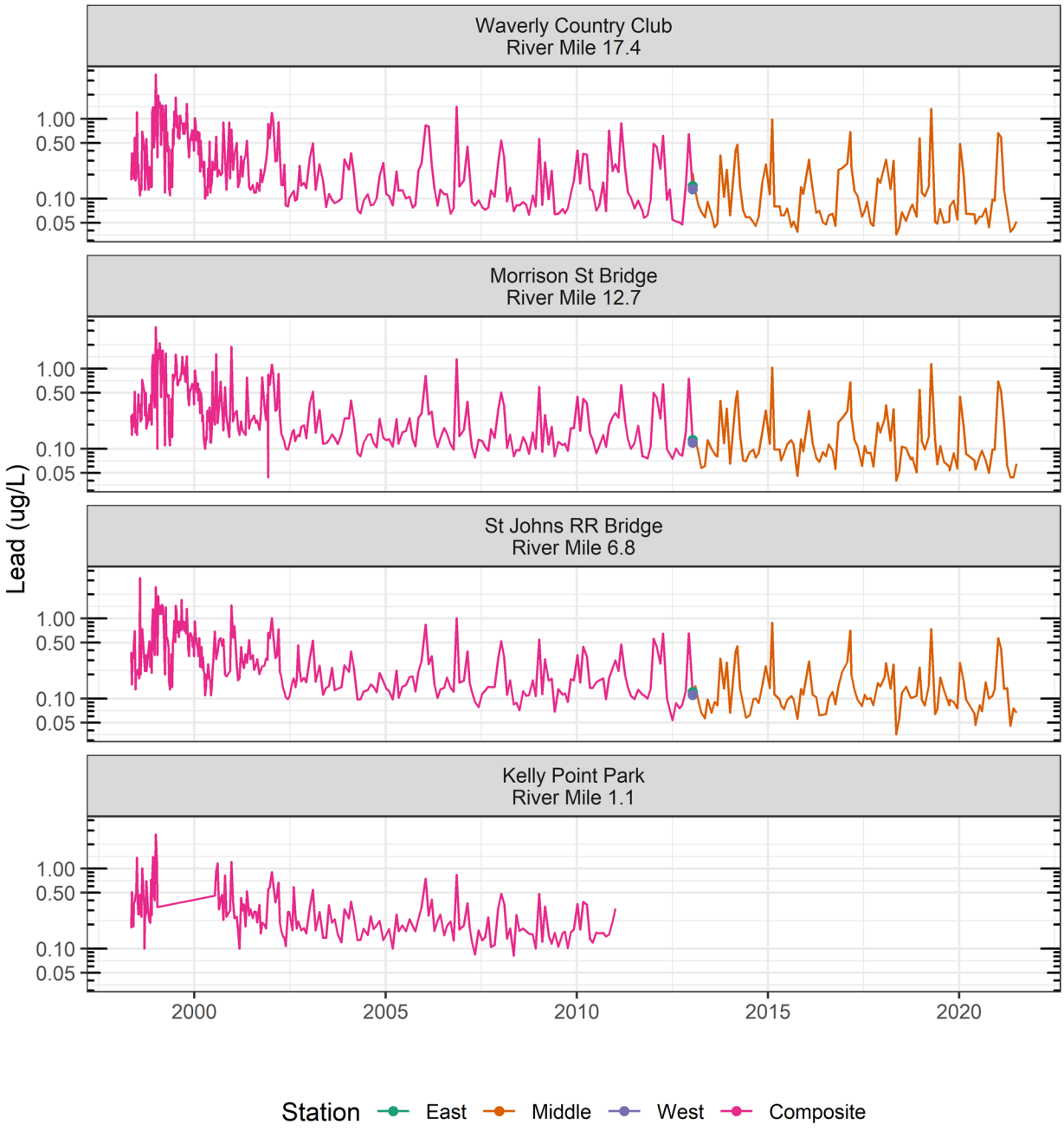


Figure 8 Willamette River monitoring results for copper

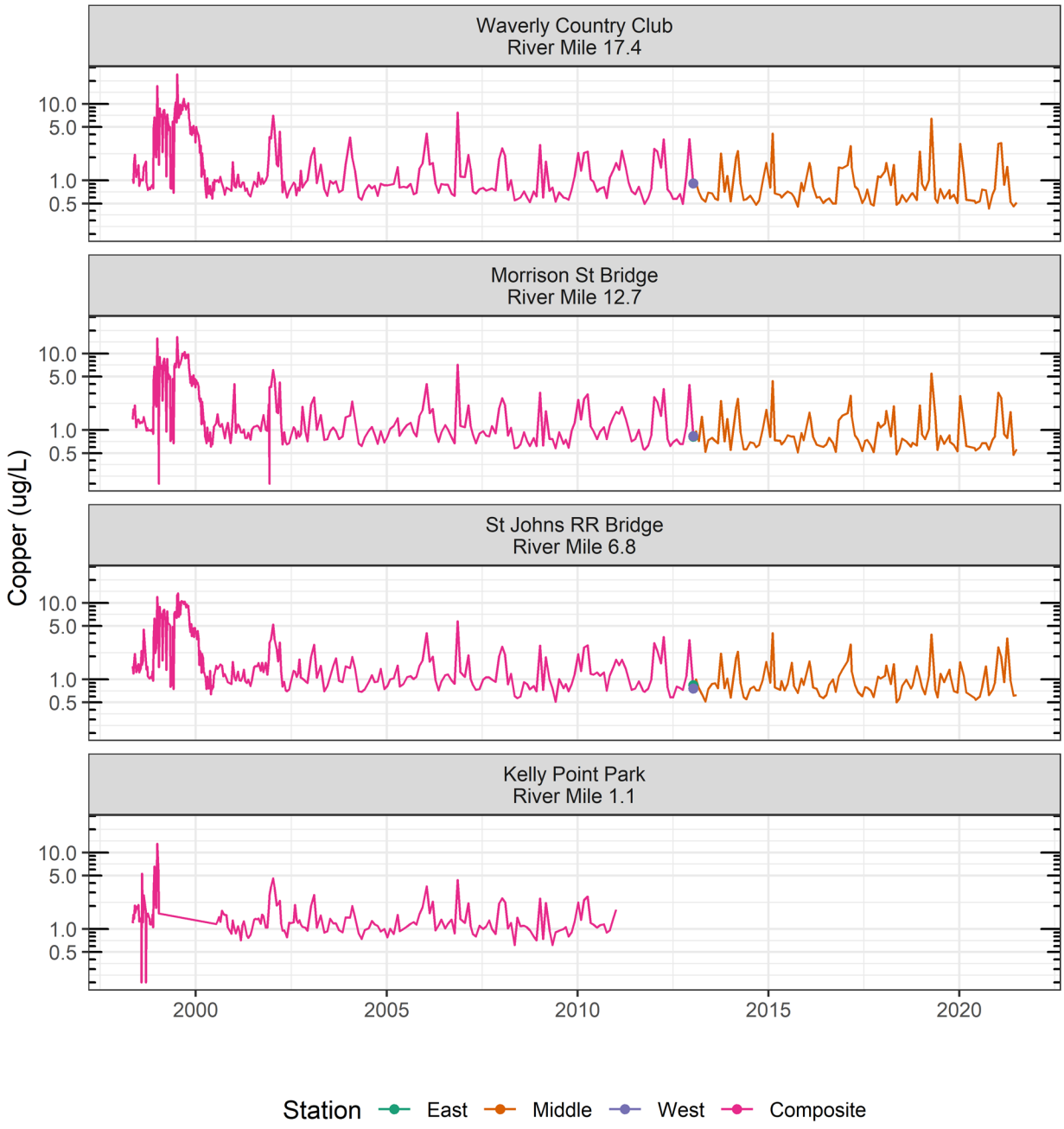


Figure 9 Willamette River monitoring results for TSS

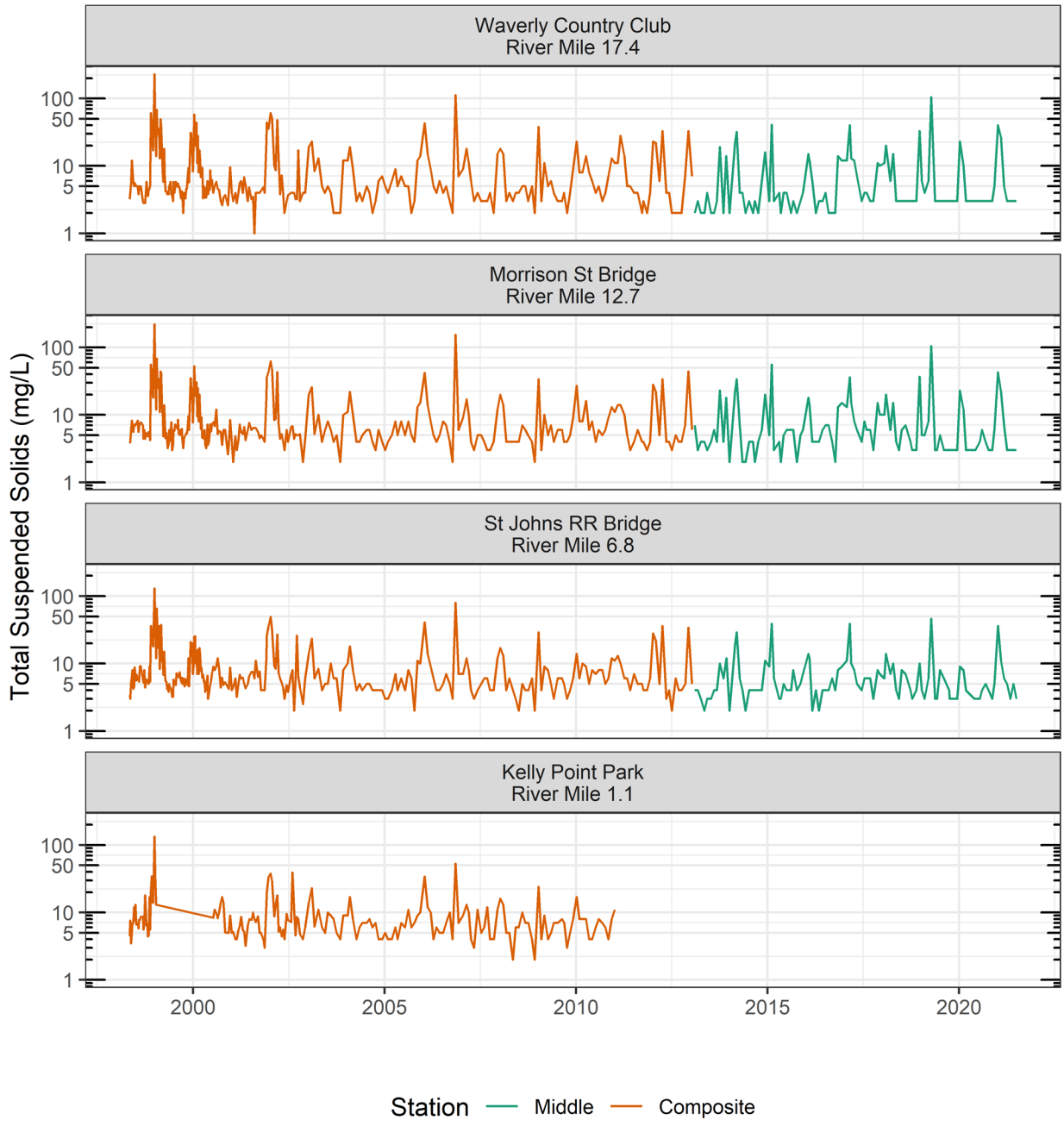
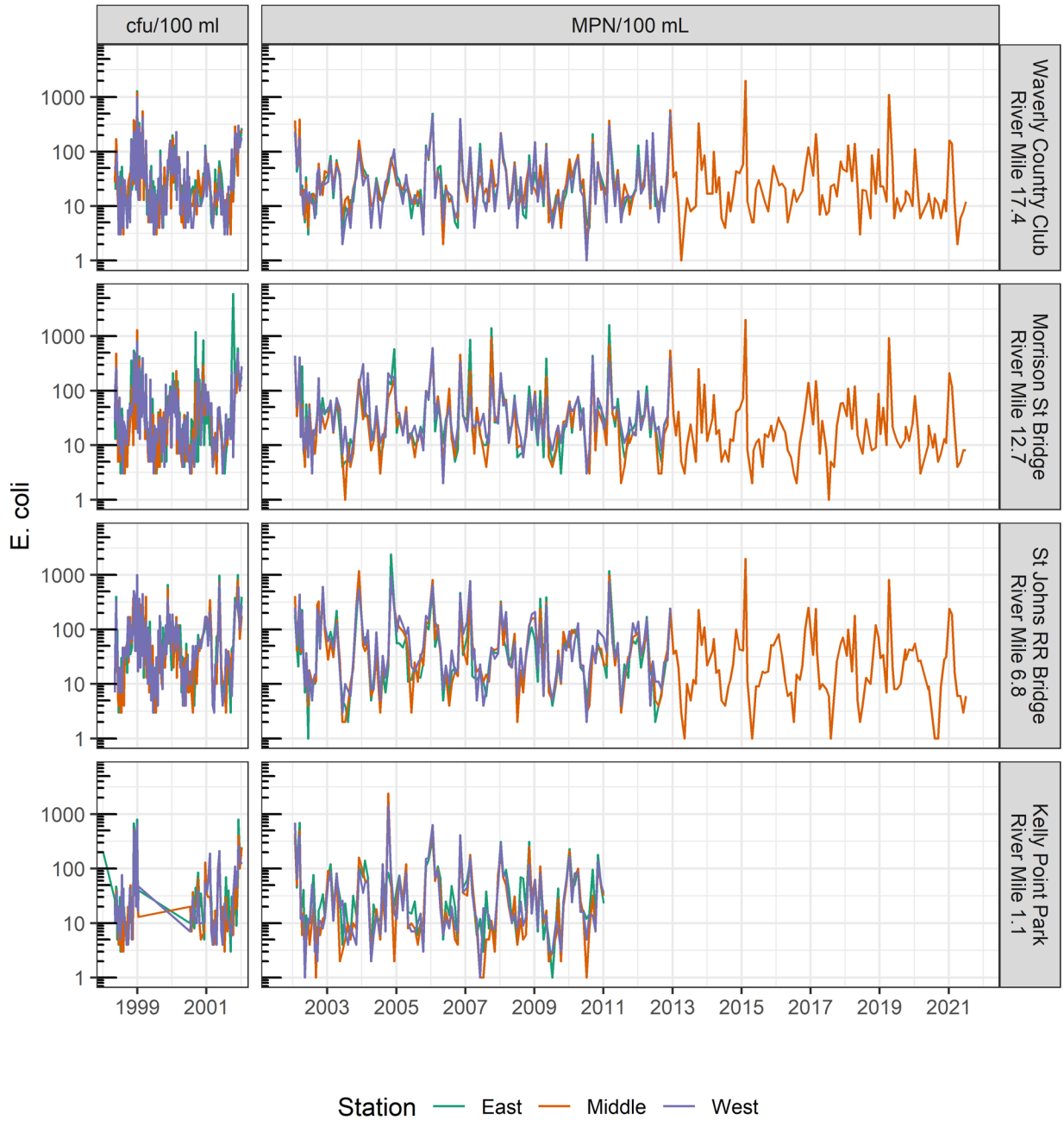


Figure 10 Willamette river monitoring results for *E. coli*



Section 3 CMOM Program Implementation

The City of Portland's CMOM program is designed to ensure that components of the collection system are cleaned and inspected at the right frequency and that preventive maintenance and repairs are performed to cost-effectively reduce the number of sewer releases, extend the useful life of the City's sewer infrastructure, and properly manage collection system operations. This annual summary for FY 2021 provides a brief overview of collection system operation and maintenance programs and practices as context for evaluation of the effectiveness of CMOM activities. Section 4 of this report includes sewer release analysis and performance.

3.1 Collection System – Gravity Sewers Operation and Maintenance

BES has programs in place to ensure that gravity sewers and maintenance holes are properly inspected, cleaned, and repaired. Closed-circuit television (CCTV) inspection activities are key for an accurate determination of the structural and operational condition of collection system assets. Cleaning helps maintain asset condition and hydraulic capacity, enhances the effectiveness of inspections, and helps to control odors. Repairing structural deterioration protects the community's infrastructure investment, can extend an asset's useful life, and reduces the potential for catastrophic failures.

3.1.1 Sewer Inspections and Cleaning

The *Collection System Inspection and Cleaning Plan* submitted to DEQ in December 2012 provides detailed information about the City's "needs-based" maintenance strategy for prioritizing maintenance, inspection and cleaning activities and expenditures. The inspection and cleaning programs contain both preventive maintenance and unplanned work.

In FY 2021, the sewer inspection program inspected 898,537 lineal feet (170 miles) of mainline sewer pipe, which corresponds to approximately 8.9% of the mainline sewer system. Sewer mainlines are inspected for general preventive maintenance, special investigations in support of the chemical root and grease management programs, in response to sewer problems, and to support asset reinvestment

projects through the CIP. In FY 2021, approximately 94% of the work orders in the mainline inspection program were considered planned work, including general preventive maintenance and support of the City's CIP Sewer Rehabilitation Program. The CCTV inspection program provides the pipeline condition assessment information that is instrumental to the risk prioritization process used to drive the CIP Rehabilitation Program work. In addition to mainline sewer inspections, the City performed service lateral inspections on 588 assets in FY 2021.

In FY 2021, the sewer cleaning program cleaned 1,275,057 feet (241 miles) of sewer pipe, which corresponds to approximately 12.5% of mainline sewer system. The sewer cleaning program includes preventive maintenance, accelerated cleaning in grease management areas, support for the root treatment program, special investigations related to collection system problems, and support of CIP projects.

In FY 2021, 97% of mainline cleaning work orders were considered planned maintenance; that is, the cleaning was performed for general preventive maintenance, to support a planned CCTV inspection, cleaning of grease management areas, and cleaning to support root treatment activities.

In support of BES's integrated approach towards overall watershed health, Maintenance Engineering and Watershed Services staff typically conduct stream walks and data analysis to assess external factors that might affect sewer pipes near streams. No stream walks were conducted in FY 2021 due to the limitations and restriction from the COVID pandemic, which resulted in reduced staffing and only essential field activities.

BES is planning on resuming stream walks in FY 2022 and will continue to evaluate all the stream walk data collected to assess the usefulness of external visual inspection and observations of site conditions in conjunction with other preventive maintenance activities and to develop a standardized, repeatable condition assessment approach for this type of inspection moving forward.

3.1.2 Sewer Assessment and Repairs

Maintaining the wastewater collection system in good repair is a core service BES provides to its ratepayers. The City has a well-established sewer and maintenance hole repair program. Priority codes in Hansen[4] are assigned when work orders are created. The priority codes are used when scheduling and assigning work and to help manage the backlog of open work orders to ensure that repairs are completed

[4] *Hansen* refers to Infor Public Sector, © 2017 Infor. All rights reserved. www. infor.com

according to their relative risk and consequence of failure (e.g., top priority is given to Sanitary Sewer Overflow (SSO) and hazard-related repairs). The *CMOM Program Report* includes descriptions of sewer repair maintenance activities and equipment.

During FY 2021, for minor urgent or emergency repairs BES relied preferentially on services from City crews for sewer cleaning, investigation, inspection, and repair. However, for larger urgent or emergency projects BES Maintenance Engineering coordinated closely with BES Engineering Services to conduct work under the Maintenance Capital Contract Program or emergency CIP projects.

City maintenance crews completed mainline sewer repairs totaling 10,898 lineal feet. Approximately 38% of these repairs were considered unplanned. Repairs are considered unplanned if the work is in direct response to a collection system problem, such as a sewer release or surface cavity, or if the severity of the problem is significant enough to warrant the deployment of repairs within a week. The majority of planned repairs occur either from defects identified by the preventive maintenance CCTV inspection program or when additional repairs on a line are made in conjunction with an unplanned repair. Repairs on mainline sewers are typically localized spot repairs where pipe sections are excavated and replaced or renewed using cured-in-place pipe (CIPP) liners.

City crews completed 692 service lateral repairs totaling approximately 9,317 lineal feet. Approximately 47% of these repairs were unplanned. Unplanned service lateral repairs are typically in response to a sewer system problem such as a sewer backup or a positive dye test from a sewer investigation. Planned service lateral repairs generally occur in conjunction with adjacent repairs on mainline sewers. Service lateral repairs typically involve the complete replacement or renewal of the lateral and the addition of a cleanout at the curb for improved future maintenance.

3.1.3 Root Management and Control Actions

Portland is renowned for its urban forest and must balance the need to protect both trees and sewer infrastructure. During FY 2021, BES Maintenance Engineering continued to manage the chemical root control program using third-party service providers who apply dense herbicidal foam that kills roots on contact without harming trees or surface vegetation. The City's Root Control Program uses a priority ranking system so that sewers with the greatest need for chemical root treatment are addressed first. During FY 2021, 251,424 lineal feet (48 miles) of mainline sewer were chemically treated for roots. In addition to chemical root foaming, City crews cleaned approximately 15,000 lineal feet of sewer to locally remove roots using root

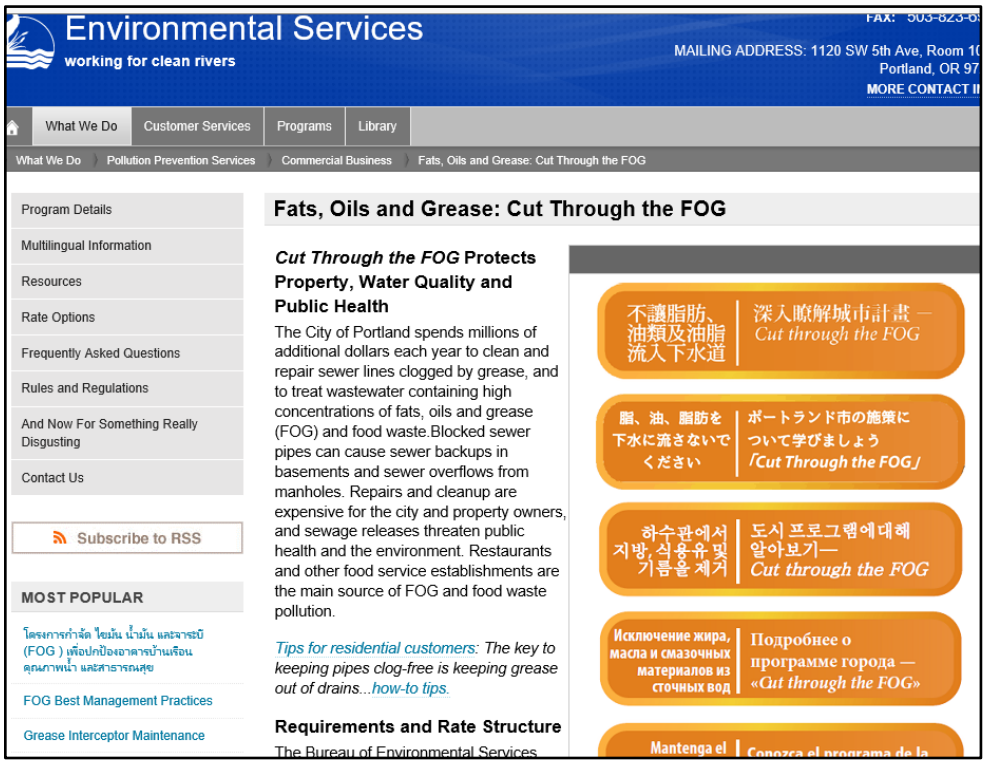
saws and conventional cleaning in support of sewer inspection activities as well as in response to sewer system problems.

3.1.4 Grease Management and Control Actions

In FY 2021, one sewer release from the City-maintained sewer system was attributable to grease. This low number emphasizes the effectiveness of the Portland's program to control fats, oils, and grease (FOG), which was described in the *City of Portland Grease Management and Control Program* document that was included in the *CMOM Program Report*.

The *Cut Through the FOG Program* has developed and maintains outreach and educational materials to more equitably and effectively inform food service customers impacted by our program. The *Cut Through the FOG* web page (https://www.portlandoregon.gov/bes/54538, Figure 11) has program fact sheets and three educational videos in seven languages in addition to English. The videos are intended to educate food service employees on the proper way to clean a grease trap, kitchen best management practices, and how to manage their sewer costs. They also contain information on how FOG can negatively impact the sewer system and what food service customers need to do to prevent its discharge and stay in compliance.

Figure 11 Cut Through the FOG website



Areas of the collection system vulnerable to FOG buildup and blockages are managed on a more frequent preventive maintenance and cleaning cycle (AGCA – Accelerated Grease Cleaning Area). In FY 2021, there was 27,880 lineal feet (5.3 miles) of Accelerated FOG-related sewer lines. During FY 2021, 16,820 lineal feet of cleaning was completed in accelerated cleaning areas, and 1,680 lineal feet of mainline sewer received FOG-related CCTV inspections in accelerated cleaning areas.

The FOG management program has continued to proactively inspect food service establishments in the City of Portland and the City of Lake Oswego to ensure that grease interceptors are installed correctly, in a proper state of repair, and are cleaned at the proper frequency. FOG staff completed two program educational outreach inspections at food service establishments (FSE), 205 grease interceptor cleaning inspections, and 645 CCTV inspections of FSE sewer laterals in FY 2021. FOG enforcement actions in FY 2021 are summarized in Table 13.

Table 13 FOG Enforcement Activities in FY 2021

Description	Number	Requirement
Warning Notice	50	Increase grease removal device cleaning frequency
	14	Repair or replace grease removal devices
Notice of Violation with Civil Penalties/ Cost Recovery	0	Plumb all fixtures to a grease interceptor
	0	Service grease interceptor at prescribed cleaning frequency
	0	Make required grease interceptor repairs
	0	Escalated enforcement for failing to meet compliance dates for original NOV

The FOG Coordination Team continues to meet three times a year to improve FOG-related activities performed by work groups responsible for FOG inspection and compliance, maintenance engineering, sewer cleaning and maintenance, pump station operations and maintenance, and asset management and data management. Based on CCTV inspection results and similar information, the FOG Coordination Team determines areas that are cleaned at an accelerated frequency.

The BES Plan Review Section is an important component of BES's control of FOG. In FY 2021, the work of the Plan Review Section resulted in the FOG program adding 83 FSEs with grease interceptors installed to current Oregon Plumbing Specialty Code due to new development, redevelopment, or enforcement requirements.

3.1.5 Maintenance Hole Inspection

BES continued the second tier of the risk-based maintenance hole inspection in FY 2021. As described in the *Collection System Inspection and Cleaning Plan* submitted to DEQ in December 2012, Tier 2 maintenance hole inspections are more detailed in nature than the routine Tier 1 maintenance hole inspections performed during inspection of associated mainline sewers. The Tier 2 maintenance hole inspections focus on the maintenance holes considered to be at the greatest risk of failure, prioritized by age and material. The Tier 2 maintenance holes are primarily those constructed of brick and monolithic concrete. In FY 2021, 515 maintenance hole inspections were completed. Inspections identified the need for some minor repairs but in general the maintenance hole inspections have shown that the maintenance holes are predominantly in good condition. The majority of defects found have been maintenance hole cover/frame damage and light to medium deterioration of the

bench/channel. Two maintenance holes were found to have missing bricks and needed total replacement. Of the Tier 2 maintenance holes inspected in FY 2021, seven were identified for repair and work orders have been completed for the majority of those repairs.

Section 4 Sewer Release Analysis and Performance

The City of Portland's *Sewer Release Response Plan* (SRRP), submitted to the Oregon Department of Environmental Quality (DEQ) in December 2011 and adopted on January 1, 2012, establishes the process for responding to sewer releases from the City's combined and sanitary sewer system and reporting to DEQ as required by the National Pollutant Discharge Elimination System (NPDES) permit. The *CMOM Program Report* further describes the organizational structure for implementing the SRRP.

BES has a long history of implementing best management practices for collection system operation and maintenance to reduce the number and severity of sewer releases. Under the CMOM program, additional emphasis is placed on understanding why releases have occurred and how to prevent future releases.

4.1 Sewer Release Tracking and Reporting

The BES Spill Protection and Citizen Response (SPCR) Section is responsible for coordination of the overall response to sewer release events, maintaining official City sewer release records, and reporting releases to DEQ. BES SPCR routinely provides SRRP training to ensure that every report of a sewer release is dispatched for immediate response and investigation, reported as required by the NPDES permit, and documented completely and accurately. Each month, SPCR prepares the report of sewer releases that is submitted to DEQ with the monthly discharge monitoring report for the Columbia Boulevard Wastewater Treatment Plant.

BES maintains sewer release data within the Hansen computerized maintenance management system (CMMS), allowing service call information to be connected with follow-up actions and work history of assets. Better data controls have been added to help manage work orders, such as more specific problem codes and standardization of planned and unplanned maintenance work types. Well-defined work order priority codes are used to ensure that work related to sewer releases receives top priority. The resources the City uses for operation and maintenance planning are explained in the *CMOM Program Report*.

BES has developed a standardized list of causes to facilitate tracking and analysis of sewer releases, as shown in Table 14. BES further categorizes weather-related sewer releases, as shown in Table 15, to more directly associate these releases with the City's levels of service established through the BES Asset Management Improvement Program.

Table 14 Sewer Release Cause Descriptions

Sewer Release Cause	Description
Structural Defect	Release caused by a physical failure of the pipeline
Equipment Failure	Release directly resulting from equipment failure typically either at a pump station or during a bypass pump around
Maintenance	Release caused by a City-related maintenance activity
Weather Event	Release caused by hydraulic capacity issues associated with weather (there are three subcategories described in Table 15)
Grease	Release caused by a blockage due primarily to grease
Debris	Release caused by a soft blockage due to sediment or other material
Roots	Release caused by a blockage due primarily to roots
Surcharge	BES collection system surcharging but not weather event related
Cause Unknown	A release where the investigation does not identify a specific cause

Table 15 Weather-related Sewer Release Terminology

Term	BES Definition
Hydraulically overloaded system	Rainfall less than or equal to the 5-year, 24-hour storm (the BES level of service is to prevent sewer releases to surface waters for all storm events up to a 5-year frequency)
Extreme weather	Rainfall in excess of the 5-year, 24-hour storm but less than or equal to the 25 year, 6-hour storm
Force majeure	Rainfall exceeds 25-year storm (the BES level of service is to convey sewer to prevent releases to buildings or streets up to a 25-year storm frequency)

4.2 Sewer Release Key Performance Indicators

Striving for continuous improvement is a cyclical process of evaluating current practices, identifying needed improvements, and measuring performance. BES has

developed a set of key performance indicators to gauge the effectiveness of the CMOM program.

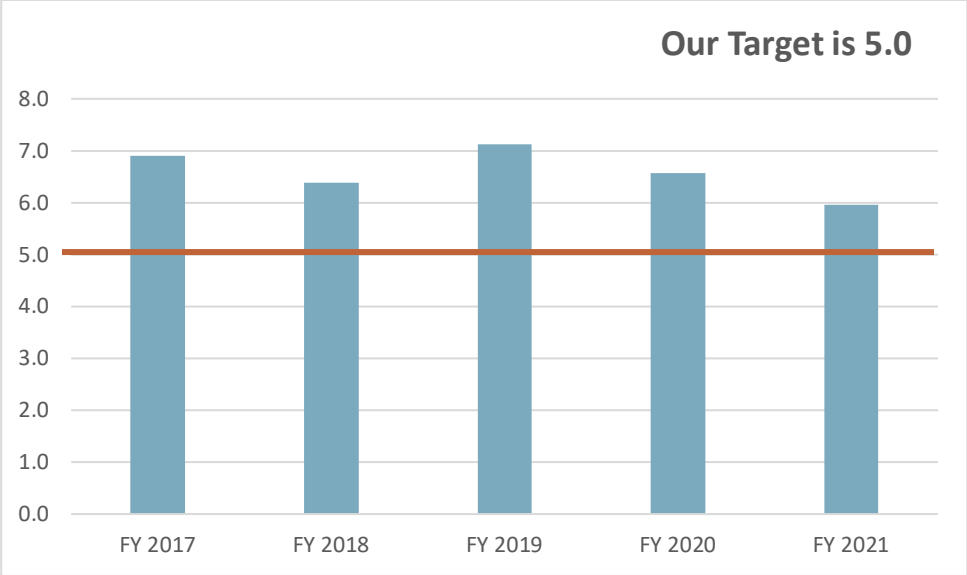
4.2.1 SSOs per Hundred Miles of Pipe

SSOs provide a good measure of the overall effectiveness of maintenance programs for controlling roots, fats, oils, and grease, structural failures, and pump station performance. By tracking SSOs per 100 miles of sewer, BES has a succinct metric for gauging overall success toward minimizing SSOs.

As of the end of FY 2021, BES owned and maintained approximately 1,920 miles of mainline sanitary and combined sewers, and 727 miles of sewer laterals. The City is typically responsible for maintaining the portion of the service lateral extending from the main sewer to the curb. During FY 2021, the City experienced 159 sewer releases over the 2,647 miles of collection system, which is approximately 6.0 releases per 100 miles of sewer.

Sewer release data is updated by BES SPCR as more complete information becomes available and investigations are conducted, and thus totals in this report reflect current records and may not match previous years' reports and/or monthly discharge monitoring report submittals. A comparison with previous fiscal years is shown in Figure 12.

Figure 12 SSOs per 100 miles of sewer (lower numbers are better)



4.2.2 Response to Urgent Health and Safety-Related Service Requests

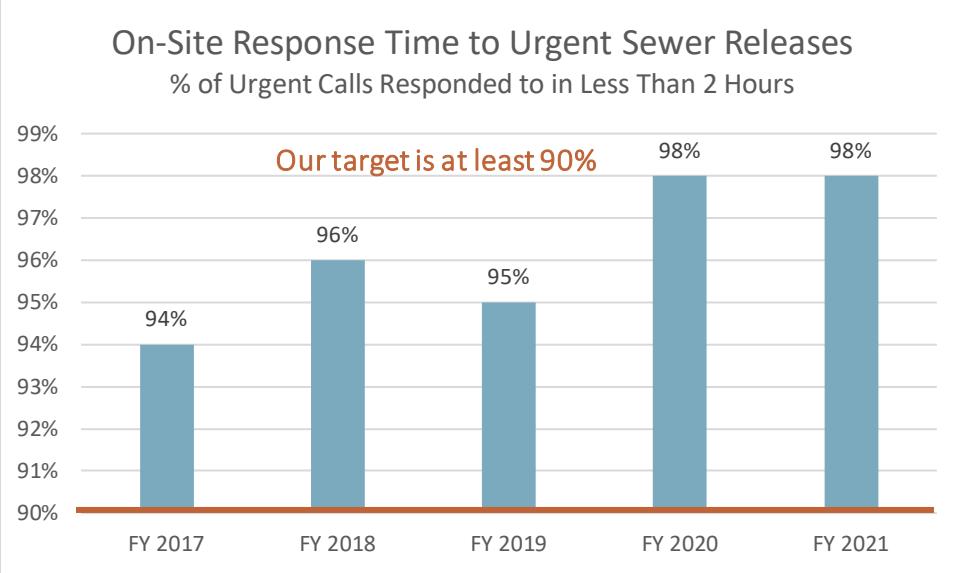
The City's goal is for a sewer emergency crew to be on site within 2 hours of receiving the initial call reporting an urgent sewer release. BES SPCR is responsible for maintaining electronic records of sewer releases, and their records are used to assess the response time of the on-site emergency crew. Under certain circumstances, such as when the caller is reporting a release that occurred in the past or is requesting to meet the City crew at a prearranged time, a sewer release is considered non-urgent, and the 2-hour on-site response goal does not apply.

Response time performance for FY 2021 is shown in Table 16. A comparison with previous fiscal years is shown in Figure 13. Sewer emergency response crews arrived on site within the City's 2-hour response time target 98% of the time during FY 2021.

Table 16 SSO Response Time and Counts for FY 2021

FY 2021 Total Urgent Calls Sewer Release Calls	Number of Calls	Percent of Total
Urgent Calls with Response Time Less Than 2 Hours	350	97%
Urgent Calls with Response Time 2 Hours or More	9	3%
Total	359	100%

Figure 13 SSO response time comparison (higher numbers are better)



4.3 Analysis of Causes and Locations of Sewer Releases

During FY 2021, the City experienced 159 releases from the sanitary and combined sewer systems. There were no weather-related release events in FY 2021 that exceeded the design capacity of the collection system (referred to as *force majeure*). However, there were four releases related to pump station equipment failures during wet weather storm events. There were 70 mainline sewer releases, which equates to 3.6 releases per 100 miles of mainline sewer.

A chart comparing the causes of releases in FY 2017 through FY 2021 is shown in Figure 14. The release data shown are for releases due to problems in the City-

maintained portion of the collection system (excluding releases due to causes resulting from problems in privately-owned sewers or laterals). The locations of the sewer releases in FY 2021 are shown on the map in Figure 15.

Figure 14 Comparison of causes of sewer releases in FY 2017 through FY 2021

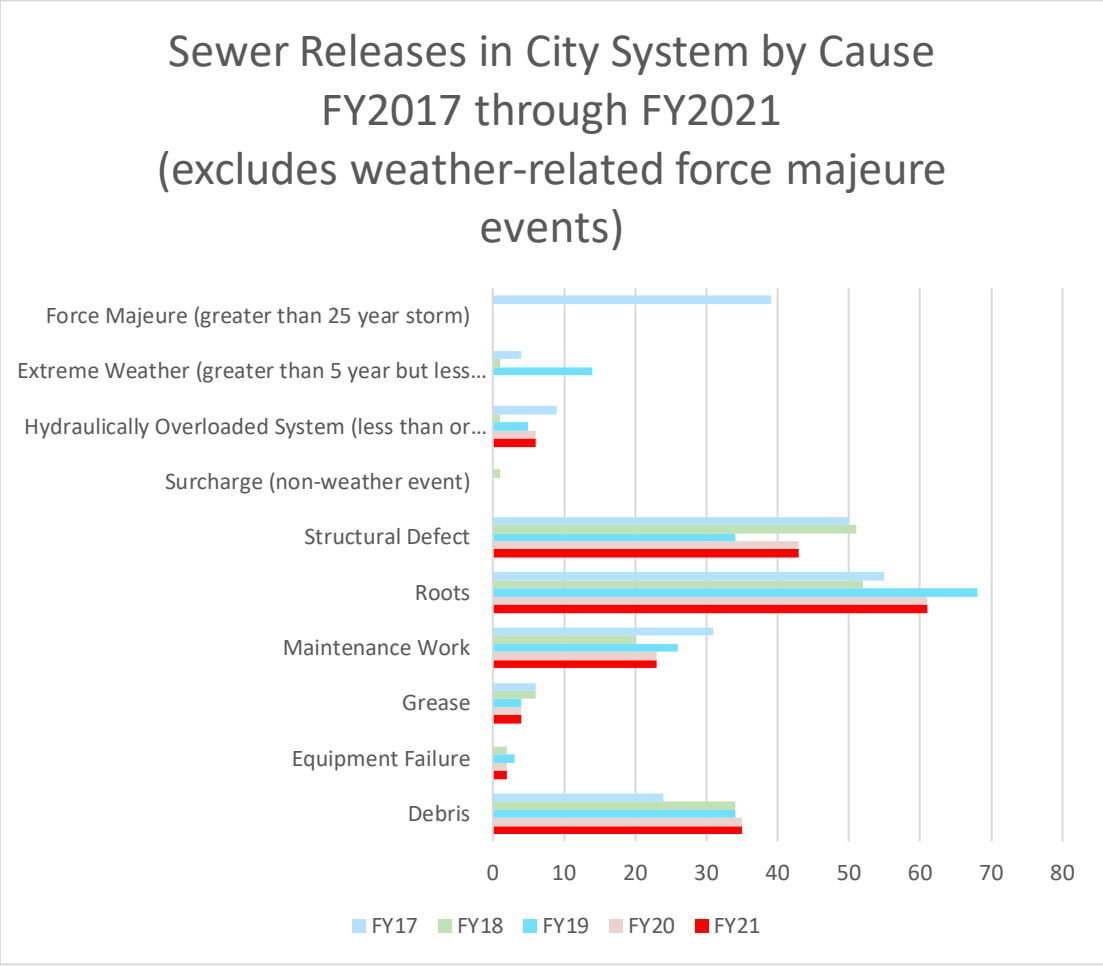
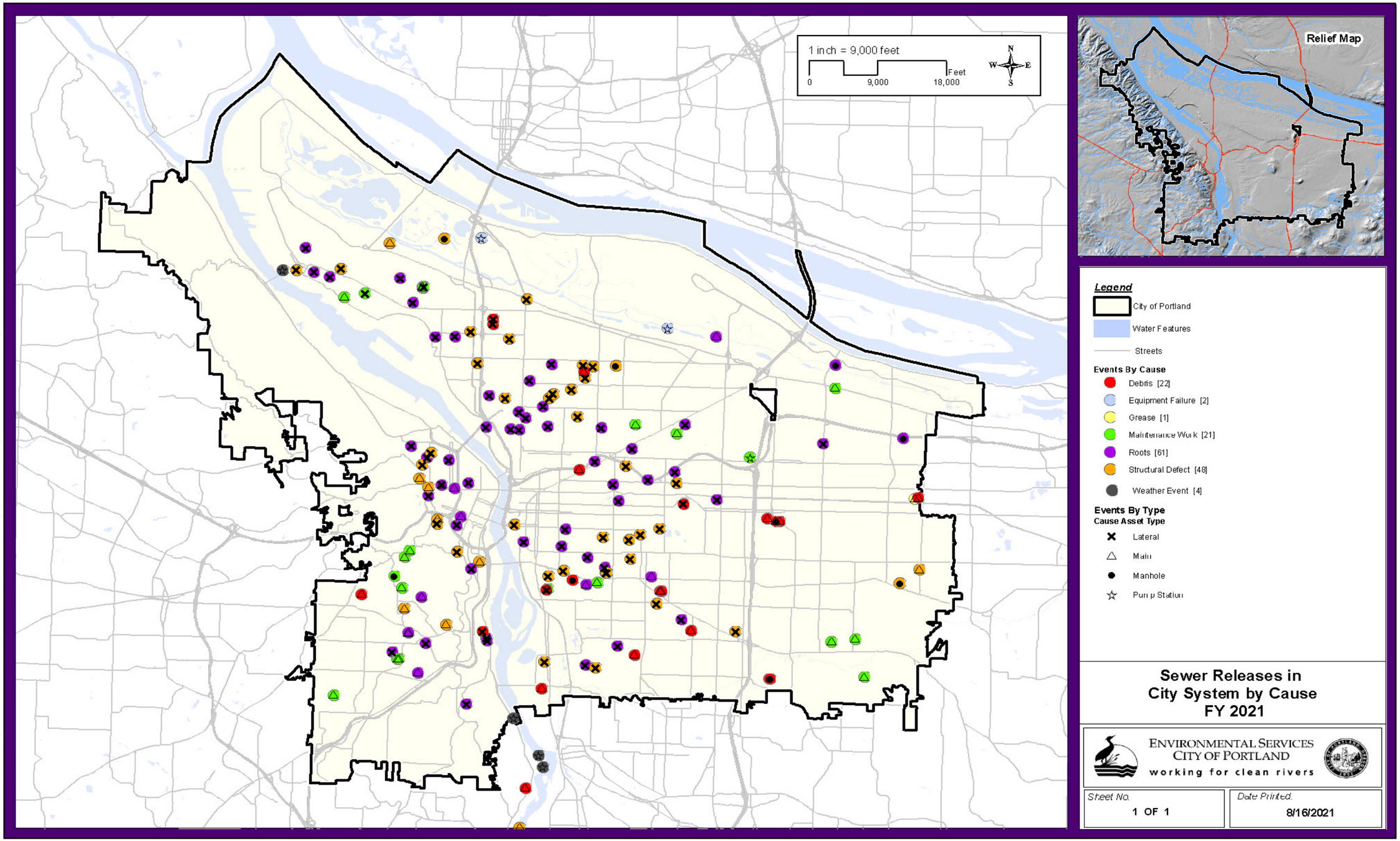


Figure 15 FY 2021 sewer release map



In addition to the rigorous investigatory research conducted by BES SPCR to determine the cause of sewer releases, improvements have been made to facilitate the use of the Hansen CMMS to track initial and actual problem codes on work orders. This enhanced capability provides a clearer understanding of the underlying reasons why a problem occurred or why work on (or near) an asset was required. For example, a work order may have an initial problem code "REL" for a release, or "SBU" for a sewer backup such as a plugged line. An actual problem code such as "GRS" (for grease) or "ROOTS" is also recorded on the work order and is typically based on the findings of the field crew, supervisor, or engineer.

These problem codes supplement the City's customized coding system used to characterize CCTV operators' observations and the degrees of severity (for structural defect, debris, roots, grease, etc.), as explained in the *CMOM Program Report* and the *Collection System Inspection and Cleaning Plan*. This broader array of information sources will become more useful over time as asset histories can be more closely aligned with system performance.

Structural Defects. There were 48 releases caused by structural defects in FY 2021: 12 were from mainline sewers, 33 associated with defective laterals, and three from maintenance holes. As part of the City's CIP sewer rehabilitation program, poor condition mainline sewers are identified for repair. The laterals connecting to those pipes are inspected during the design process and included for replacement or rehabilitation if structurally deficient. The risk of releases associated with structural defects should decrease as the large number of sewer repair, rehabilitation, and replacement CIP projects currently in design or under construction are completed.

Roots. During FY 2021, of the 61 releases caused by roots, 10 were in sewer mainlines, 49 were in service laterals, and two were from maintenance holes. To reduce the risk of future root intrusion, City crews installed CIPP liners or excavated and replaced the majority of laterals where releases occurred in FY 2021.

Maintenance. In FY 2021, there were 21 releases associated with maintenance activities: 19 of the occurrences were associated with mainlines and two were associated with laterals. Fourteen releases were associated with sewer cleaning operations; many of these releases were "bowl water" from toilets and the volume was less than 10 gallons (two of these releases were attributed to BES contractors). While precautions are taken to prevent these "blow back" occurrences, some private plumbing systems lack adequate venting, and the configuration of some City sewers makes it very challenging for cleaning equipment operators to work in some locations. Special precautions, such as using cleaning nozzles with steeper jet angles and running lower pressures, are taken in areas prone to blow back.

Two maintenance-related releases were associated with either sewer repairs or sewer construction projects. Three releases involved installation of CIPP liners, each as a result of maintenance performed by City crews.

Debris. There were 22 releases caused by debris in FY 2021, 13 of which were associated with mainlines, five from service laterals, and four from maintenance holes. In addition to accumulation of debris during normal system operation, introduction of foreign objects and debris into the system by third parties resulted in sewer releases in FY 2021. While the source of debris and vandalism is difficult to trace, enforcement action is being pursued in response to utility contractors who bored through public sewers at several locations. BES continues to conduct "what not to flush" public outreach, as disposable wipes were a significant contributor to the increase in debris-related sewer releases in FY 2021.

4.3.1 Sewer Releases to Surface Water in FY 2021

Sewer releases to surface water occurred at nine locations in FY 2021. The circumstances of these release events are described below. Although volume estimates are not always available, they are included in each event below when possible. Public notifications were made following each release, as required by the permit and the City's SRRP.

4710 SW Hamilton (release to a tributary of Fanno Creek). At 11:30 AM on July 31, 2020, a citizen reported that Bridlemile Creek near the address of 4710 SW Hamilton Street smelled of sewage. A city emergency crew responded to the site, observed the impacted creek, and began an investigation.

The crew observed that a sanitary sewer maintenance hole near Bridlemile Elementary School was surcharging. Subsequent CCTV video of a downstream sewer main identified root intrusions located 165 feet downstream from the maintenance hole. City crews cleared the root intrusions and stopped the release at 2:00 PM. The release discharged an estimated 600 gallons to Bridlemile Creek just south of SW Hamilton Street via a nearby storm drainage pipe. Bridlemile Creek flows southwest from that location for approximately 1/3 of a mile and then reaches Fanno Creek near SW Beaverton Hillsdale Highway. CCTV inspections also identified that a nearby sanitary sewer main, owned by the Portland School District, was structurally defective. When that sanitary sewer main surcharged, sewage leaked from the main to the surrounding underground soils. From there, the released sewage found a subsurface pathway to a nearby storm sewer main, AQS100-ACB610.

The City-owned portion of the sewer system that had the root intrusions has been placed in the root control program for monitoring and future treatment. The sewer main owned by the Portland School District was repaired by local contractor.

5015 SW Dosch Park Lane (release to a tributary of Fanno Creek). On November 11, 2020, a citizen reported a sewer odor near the address of 5015 SW Dosch Park Lane. A city emergency crew responded to the site and detected sewer odor and observed sewage running down the hillside into an unnamed tributary of Trillium Creek.

At this location, the sewer main is elevated and crosses a ravine. The investigation identified a structural defect in the sewer main where the pipe transitions from being elevated to being buried on the south side of the ravine. Following identification of the defect, investigation crews identified a root blockage in a sewer main downstream that was restricting flow and causing sewage to back up to the location of the structural defect where flow was able to leave the sewer system. The vactor truck was partially successful in removing portions of the root blockage and stopped the release later that day, and the release volume was estimated at 48,000 gallons.

The City completed repairs to correct the structural defect in the main sewer where the release occurred, and the upstream end of the pipe has also been lined. The downstream sewer, where the root mass was observed, was cleaned a second time.

7945 SW Capitol Hill Road (release to Tryon Creek). At 2:10 PM on December 28, 2020, BES was notified by the Portland Water Bureau (PWB) of sewage coming from a maintenance hole near the address of 7945 SW Capitol Hill Road.

On December 26, 2020, PWB had been notified of water coming out of the ground at this location and was investigating a possible water main leak. They were unsuccessful in finding a leak that day. PWB returned on December 28, 2020, and discovered that the water was actually sewage coming from buried maintenance hole ACX615 and contacted BES.

An emergency crew responded immediately and confirmed that sewage was being released from ACX615. The released material was observed flowing onto the nearby school running track and into a private storm drain at that location. The crew investigated the nearby sanitary sewer main and located a root blockage 183 feet upstream of maintenance hole ACX268. That blockage was cleared, and the release was stopped at 4:45 PM that day. The release volume was estimated to be 8,625 gallons.

The private storm sewer on school property leads to the City storm sewer system downstream of the school. The storm sewer ultimately reaches Tryon Creek approximately 3,000 feet downstream. The emergency crew placed signs and barrier tape in the areas where the release occurred, and the school conducted cleanup of the released material on their property.

The root mass in ACX267-ACX268 has been removed entirely and the portion of the main with the heaviest roots was CIPP-lined. That main was added to the root control treatment program and will be monitored to help protect the rest of the main.

195 Foothills Road (possible release to Tryon Creek). On January 22, 2021, a routine inspection of the sewer main leading to the Tryon Creek Wastewater Treatment Plant (TCWTP) revealed that the maintenance hole lid ADN156 was unseated and slightly askew. Additional site reconnaissance was conducted between January 22 and January 26. The investigation found that the ground underneath ADN156 had been scoured, likely by material released from that maintenance hole.

Due to ground topography, the sewer main at this location is elevated approximately 13 feet above ground and is supported by concrete support columns. The area is steeply sloped, highly vegetated, and not accessible to the general public.

Observations from the subsequent investigation indicated that a sewage release had occurred at ADN156 sometime in the recent past. Consequently, DEQ was notified of a sewage release on January 26, 2021. OERS was notified that same day and issued incident number 2021-0275. Due to the proximity of Tryon Creek, *E. coli* samples were collected from Tryon Creek on January 27.

Because the release was not observed, a review of flow data at the TCWTP and of rainfall data from nearby rain gauges was conducted to determine when a sewage release may have occurred. Rain gauges show that on January 12-13, 2021, a large rainfall event occurred in Portland. The rainfall peak intensities observed at two of the nearby gauges exceeded a 5-year, 6-hour storm event. That falls within the "extreme weather event" storm category.

Further analysis by BES concluded that a sewer release most likely occurred between 9:00 PM on January 12, 2021, and 4:00 AM on January 13, 2021. The most plausible cause of the sewage release would be a backwater condition at the TCWTP Headworks. It is not known whether this was due to a temporary blockage or a result of hydraulic losses at the plant headworks. It should be noted that the City

observed evidence of human activity in the area, and it is possible the lid was tampered with by a third party.

Due to the lack of information available regarding the start and stop times, it was not possible to estimate the volume of the release. While Tryon Creek is nearby, there is no definitive evidence that the release reached surface water. However, the City elected to still include this event on the list for reporting purposes. As mentioned previously, samples were collected in Tryon Creek on January 27. *E. coli* levels were found to be at background levels at that time.

The City has reviewed the design of the elevated sewer and made improvements to bolt down a series of maintenance hole covers just upstream of the TCWTP.

2757 NE Pacific (release to the Willamette River). At 4:30 PM on February 8, 2021, a city employee noticed sewage running along the south side of Interstate 84 near the NE 28th Avenue overpass.

A city emergency crew immediately responded and found that the nearby combined sewer system was surcharged. Further investigation found a blockage 4' upstream of maintenance hole ABH145. A vactor truck then cleared the blockage and flow was restored at 6:45 PM that day. Crew suspected that the hard blockage encountered in the sewer main may have been a result of vandalism.

An investigation was conducted at that time. Flow of sewage in the system was partially blocked near ABH145. Sewage likely leaked through an abandoned, but uncapped, sewer lateral and found a preferential subsurface pathway to the east embankment of nearby Interstate 84. Sewage was observed coming out of the hillside and running down the side of the freeway until it reached storm system at inlet AQF662.

From AQF662, the storm system leads to the Willamette River at ODOT outfall WR-525 located approximately 1.5-miles downstream of the release. An E. coli sample was collected that evening just prior to the outfall and returned a value of >240,000 MPN/100mL. That result suggests that released material reached the Willamette River. The volume of the release was estimated to be 2,100 gallons.

An *E. coli* sample was collected from the ODOT storm sewer downstream on February 8, 2021, and *E. coli* samples were collected from the Willamette River two days after the event on February 10, 2021. Those samples documented a return to baseline conditions.

The City repaired the main sewer by lining 80 feet of the main towards the hillside, including lining over the lateral cap where the sewage was suspected of releasing from.

St Johns Pump Station at 8690 N Bradford, Riverview Pump Station at 9825 S Riverside Drive, Beebe Pump Station at 11370 S Riverwood, and Elk Rock Pump Station at 11875 S Riverwood (four releases to the Willamette River). During the first week of February, the City of Portland was notified by our weather consultant that a large mass of cold air was coming to the Portland area that could result in severe snow and ice conditions. The City prepared for this by holding pre-event planning meetings, adding additional staff on standby, and staging road crews with snowplows and sanders to ensure that essential routes stayed open.
When the weather event arrived on February 11, the city had very cold temperatures, freezing rain, snow, and ice. The icy precipitation adhered to trees which resulted in branches and whole trees falling on power lines and causing widespread power outages. At one point, over 200,000 people were without power in the Portland area.

On February 14 and 15, 2021, approximately 20 pump stations within the city of Portland lost electrical power due to this weather event. As a result, four of these pump stations overflowed to the Willamette River:

- St. Johns Pump Station (73,350 gallons)
- Riverview Pump Station (810 gallons)
- Beebe Pump Station (15,370 gallons)
- Elk Rock Pump Station (400,500 gallons)

The pump station maintenance and operations work crew, PUMA, had planned for this weather event, including holding pre-event discussions, ensuring generators were fueled, and placing additional technicians on standby to address power outages and other call-out issues the storm may have presented. However, due to extraordinary levels of hazardous road conditions, which were impassable at times throughout most of the city, the pump station crews were unable to reach these four pump stations. Because of those conditions, backup generators ran out of fuel and portable generators were unable to be delivered to these locations. Without electrical power, the wet wells of these four pump stations filled and eventually discharged sewage through their emergency overflow outfalls to the Willamette River.

In response to these releases, BES is procuring a smaller four-wheel drive response vehicle to improve mobility during significant weather events. Existing PUMA

vehicles will be equipped with additional traction devices for enhanced mobility. Additionally, these stations will be evaluated for permanent onsite backup generators during their next pump station upgrades.

4.4 Conclusions and Follow-Up Actions for Sewer Release Reduction

The City of Portland's CMOM program is being fully implemented. Shifting toward risk-based operation and maintenance of the collection system should, over time, result in a positive trend toward planned, proactive maintenance and fewer sewer releases. The City is also implementing a force main condition assessment program to create a framework by which the force main network assets can be assessed and managed. The intent is to develop a long-term, systematic maintenance plan for preventative activities such as inspection, cleaning, and repairs. BES continues to develop and improve the Hansen CMMS to facilitate work prioritization and asset management in the gravity collection system. BES's CMOM program effectively incorporates the essential elements and best management practices for proper operation and maintenance of the collection system.

BES continues to evaluate ways to improve the overall effectiveness of the sewer mainline cleaning program, specifically focusing on ways to reduce sewer releases related to operational problems such as grease, roots, and debris. As part of this work, BES continues to reassess the thresholds for placing pipes into the chemical root treatment program and/or the mid-cycle cleaning program. When a mainline sewer release occurs due to roots or debris, our new practice is to place that pipe into an enhanced monitoring program. Although operational issues continue to challenge the daily operations of the collection system, it should be noted that the number of mainline sewer releases associated with grease, debris, and roots was 1.56 per 100 miles of mainline for FY2021.

Mainline sewer releases associated with structural defects total 15 for FY21 or 0.78 per 100 miles of mainline sewer. During the last two years, the majority of mainline sewer repair work orders have transitioned from unplanned to planned, which is a positive step for the maintenance program. Increasing the number of planned repairs means we are able to identify and fix more problems before they manifest as service interruptions. Significant annual project reinvestments within the Capital Improvement Program to renew and replace structurally deteriorated sewers is starting to positively impact the maintenance and repair program. These projects to replace, repair, and rehabilitate collection system assets that pose the highest risk and consequence of failure are positioning the City to provide more proactive rather than reactive maintenance. The methodology used for risk-based prioritization of

CIP projects was presented in the *Collection System Assessment and Rehabilitation Plan* that was submitted to DEQ in December 2012.

Service laterals continue to challenge the daily operation of the collection system and are where most sewer releases originate from. Similar to mainline repairs, the service lateral maintenance program has started to see an increase in the percentage of planned repairs over the last two years. The Bureau's two primary methods for addressing poor condition laterals are through the maintenance and mainline sewer rehabilitation projects in the Capital Improvement Program.

Structurally defective laterals where releases occurred in FY 2021 have been repaired by City crews using CIPP liners or were excavated and replaced. Additionally, to proactively prevent sewer releases from laterals, CIP projects for replacement, repair, and rehabilitation of sewer mainlines also include inspection and repair/replacement of service laterals based on the risk of structural or operational failure. The City will continue to utilize opportunities for making cost-effective improvements to laterals.

Overall, continued implementation of the *BES System Plan—Combined and Sanitary Sewer Elements*, dated March 2012, will address condition and capacity risks in both the combined and separated sanitary sewer systems. The System Plan's consolidated system-wide approach for prioritizing reinvestment and business risk reduction through CIP projects should also reduce the potential for sewer releases.

Section 5 Maximization of Storage in the Collection Systems

One of the Nine Minimum Controls, *Maximization of Storage in the Collection Systems,* ensures that combined sewage is kept within the sewer system using existing in-system storage. This optimizes the volume sent to enhanced wet weather treatment, increasing the volume treated by the biological secondary processes and reducing the number and volume of CSO events. While this control originally focused on keeping sewers free of blockages, removing relatively clean stormwater from the collection system also contributes to maximizing available storage and conveyance capacity. The programs documented here also have the added benefits of increased visibility of these efforts and public education opportunities.

5.1 Private Development and Redevelopment

BES's Stormwater Management Manual (SWMM) applies to all development and redevelopment proposals that create or redevelop over 500 square feet of impervious area.

In FY 2021, implementation of the SWMM in combined sewer basins led to construction of stormwater facilities at 483 properties, managing 68 acres of private impervious area onsite, thereby reducing stormwater volume into the combined system.

City staff are implementing a newly revised SWMM that went into effect December 2020.

5.2 Private Property Retrofit Program

Installation of stormwater facilities on private property continues in the Private Property Retrofit Program (PPRP). Guided by BES's 2012 *System Plan—Executive Report: Combined and Sanitary Sewer Elements* and its Capital Improvement Program, this program implements opportunities with private property owners to voluntarily retrofit or install on-site stormwater infiltration facilities such as rain gardens, drywells and pervious pavers to keep runoff out the combined sewers.

Eliminating runoff helps reduce local sewer capacity problems and CSO volumes. For more information, see previous Annual CSO and CMOM reports (FYs 2014 and 2015).

Installation season started in October of 2020 and lasted through the end of June 2021. During that time, 1.9 acres of impervious surfaces were managed through 64 private property stormwater retrofit projects in the City's Eastside CSO area. Examples of retrofits are shown in Figure 16-Figure 19 below.

Figure 16 Example retrofit #1, SE Richmond area rain garden

Figure 17 Example retrofit #2, SE Richmond 28" x 5' drywell installation

Figure 18 Example retrofit #3, SE Richmond ROW Rain Garden in action

Figure 19 Example retrofit #4, Established FY2021 Multi-family residential Courtyard Rain garden

5.3 Ecoroofs

Ecoroofs replace conventional roofing with a layer of vegetation over a growing medium on top of a synthetic, waterproof membrane. An ecoroof significantly decreases stormwater runoff, saves energy, reduces pollution and erosion, absorbs carbon dioxide, and reduces heat island effects.

The City of Portland strongly supports the installation of ecoroofs through Central City requirements, the City's Green Building Policy, SWMM, and developer floor area ratio bonuses in specific portions of the city.

As of June 2021, Portland has 552 ecoroofs installed throughout the city, managing over 38.4 acres of roof. Approximately 434 of those ecoroofs are in the combined sewer area. During FY 2021, 18 new ecoroofs were installed in the combined sewer area, managing approximately 1.9 acres of roof. This roof area represents 1.9 million gallons of rainfall to the combined system annually, and Portland's monitoring data

indicate that approximately 950,000 gallons are retained by the roofs and returned to the atmosphere through evapotranspiration.

5.4 Public Right-of-Way Development and Redevelopment

As of June 2021, Portland has implemented over 2,500 green streets in the right-of-way, with approximately 1,105 in the combined sewer area. The Post-2011 Combined Sewer Overflow Facilities Plan identifies specifically how Portland will continue to implement both public and private stormwater controls to further reduce stormwater entering the combined sewer system and thereby increase the storage available for capturing CSO discharges.

During FY 2021, five new green street facilities were installed in the combined sewer area. The facilities were implemented by a BES CIP project. Collectively, these facilities manage approximately 0.8 acres of impervious area that generate 800,000 gallons of stormwater to the combined sewer system annually. Based on the City's performance monitoring of green street facilities, these facilities will remove approximately 570,000 gallons of runoff annually from the combined sewer system through infiltration and evapotranspiration.

Section 6 System Reinvestment and Risk Reduction

The City of Portland, Bureau of Environmental Services' asset management program is founded on strategically reducing risk through cost effective investments. The City has improved its methods for calculating risk and making cost effective decisions to reduce risk through investment activities. This section discusses how the City is valuing existing risk in the collection system and how its investments reduce risk to meet levels of service.

6.1 FY 2021 Reporting Methodology, Changes, and Improvements

Risk in mainline pipes and pump stations are generally determined by inspections and hydraulic modeling.

Pipe inspections provide the condition data used to determine the risk of structural failure. The inspections include routine maintenance inspections to determine the structural condition of the pipes, and post-repair acceptance inspections to ensure that repairs meet designated standards and/or contract specifications. Structural risk of laterals is assumed based on quantity of lateral repaired.

Hydraulic modeling is done to determine the risk of capacity failure, specifically to determine the likelihood of basement and surface flooding with respect to the Bureau's adopted levels of service.

Likewise, pump station inspections also provide condition data used to determine the risk associated with operational failure of the critical assets within a pump station. Hydraulic modeling is done to determine the risk of capacity failure, specifically to determine the likelihood of overflows.

System risks change over time as a result of the following:

1. **Capital Improvement Program:** Capital projects repair or rehabilitate existing assets or introduce new ones to reduce capacity (level of service) risk and structural (mortality) risk in the system.

2. **Maintenance:** Maintenance work orders seek to reduce structural risk in the system by applying targeted repairs and rehabilitation on high-risk assets.

3. **Change in pipe condition due to aging:** Inspections provide more accurate information about pipe condition than simple age-based assumptions. Changes in risk can be due to actual aging as indicated by consecutive inspections, or due to the inspection-based condition of pipes varying from the age-based assumed condition. Since actual pipe condition can be better than the age-based assumed condition, risks can decrease for a particular pipe when it is first inspected.

4. **Unexpected changes to hydrologic conditions:** In general, future development conditions are modeled to allow BES to provide sufficient capacity to meet anticipated hydrologic conditions in the future. Future conditions are largely defined by the City's currently adopted Comprehensive Plan. In some instances, development may occur that is different than was set in the Comprehensive Plan. These changes may have a positive or negative effect on capacity risk.

Items 1 and 2, above, are the focus of this section.

The City of Portland has been working diligently over the past fiscal year on developing a risk reporting methodology for pipe rehabilitation. The methodology relies on existing internally developed asset management and project tracking systems. These systems underwent significant changes and upgrades over the past year, but they need to be further adjusted to enhance risk reduction reporting.

The City is in the process of improving risk calculations for large diameter (36-inch or larger vertical and/or horizontal dimension) pipe assets. The risks for large diameter assets assume different failure scenarios and rehabilitation methods, compared to smaller diameter pipes. Results presented in this report apply to smaller diameter pipes (less than 36-inch diameter).

The City also completed its *Pump Station System Plan* in 2020. The plan developed a process to implement a data-driven risk analysis process for determining necessary pump station investment. To promote consistency in decision-making, the asset management approach developed for the pipe collection system was tailored for use in evaluating pump station assets. Characterization to identify condition, capacity, and level of service deficiencies among pump station assets is used to quantify risk with the goal of identifying corrective actions. These actions meet the BES core mission by protecting public health, water quality, and the environment in a manner that optimizes the return on investment for the rate paying customer.

6.2 FY 2021 Activity for Risk Reduction

Risk reduction is the present value of the cost of repairing or replacing infrastructure, thereby deferring failure, and its related consequences, to the expected life of the repair or replacement.

Risk reduction for capital work is now reported on a calendar year basis as fiscal year reporting is delayed due to construction during the summer and end of the fiscal year. Risk is not reported for investments in correcting non-conforming sewers (e.g. sewers not constructed to current standards).

6.2.1 Risk Change Due to Capital Improvements and Inspections

Capital improvement projects are designed and installed to resolve capacity and structural risk. Resolution of both types of risk are included in the risk reduction calculations. The changes in capacity and structural risk due to rehabilitation is summarized in Table 17. This data is currently incomplete, and the actual risk reduction is likely much higher. BES is continuing to work on improving the data systems required to develop these risk reductions more accurately.

Table 17 Risk change due to capital improvement projects with available data

Type	Value
Total Risk Reduction Due to CIP Investment in Repaired/Replaced Gravity and Pressurized Assets	$21,300,000

The Capital Improvement Program completed 10 projects in the sanitary and combined collection system during the 2020 calendar year. These projects repaired and rehabilitated 225 sanitary and combined sewer gravity mains and one pump station.

6.2.2 Risk Change Due to Maintenance Activity

Maintenance repairs reduce risk in the collection system and involve localized repairs on sewers and the replacement of service laterals. Planned maintenance

activities included approximately 6,764 lineal feet of repair and lining work on sewer main assets and 333 laterals which were replaced or lined.

Table 18 Risk change due to maintenance activity with available data

Type	Value
Total risk reduction due to maintenance activity	$4,846,000

Section 7 Inflow and Infiltration

Inflow and Infiltration (I&I) activities for the City of Portland are now limited to planned local capacity improvements. In the past, the City made concerted efforts to study and mitigate problems caused by I&I. Significant historical improvements to the collection system and CBWTP, as well as the City's execution of its Nine Minimum Controls, means the City no longer needs a widespread I&I program to improve the CBWTP's ability to treat all the wastewater and stormwater reaching it.

7.1 Burlingame Basin/Hillsdale Subbasin Program Areas

The northern portion of the Burlingame Basin is known as the Hillsdale Crest Subbasin. Sanitary flow from the Hillsdale Crest Subbasin is collected and conveyed downstream in the Hillsdale Trunk line. The Upper Hillsdale High Flow Relief is an elevated 6-inch pipe in a shallow maintenance hole that diverts flows from the Hillsdale Trunk to the Fanno Creek Basin when surcharge occurs.

The Hillsdale Trunk continues south into the Middle Hillsdale Subbasin. Repeated sewage releases onto the surface of SW DeWitt Street near SW 25th Avenue resulted in the decision to construct a temporary sanitary sewer overflow (SSO) to the storm system that drains to Fanno Creek at SW Kanan and SW 25th Avenue (identified as the SW Kanan Constructed SSO). The Hillsdale Trunk continues to flow south from the constructed SSO and discharges to the Burlingame Trunk for treatment at CBWTP.

On November 9, 2011, BES entered into a Mutual Agreement and Order (MAO) with DEQ that stipulated a three-phase approach to alleviate SSOs at this location. On June 29, 2017, BES submitted Technical Memo 10.4 "Fanno-Burlingame Alternatives Analysis" to DEQ. In a letter dated July 5, 2017, Michael Pinney of DEQ accepted Technical Memo 10.4 as the final deliverable necessary for successful completion and termination of the DeWitt MAO.

Technical Memo 10.4 summarized the alternatives analysis that was done to evaluate options for achieving SSO control at the SW Kanan Constructed SSO (also referred to as the DeWitt SSO), as well as for improving system reliability of the Hillsdale Trunk. The implementation schedule for final design and construction of the recommended alternative, which includes CIPP lining of upper reaches of the

Burlingame Basin (the Hillsdale Crest Subbasin), is shown in Table 19. Construction on this project began in September 2020 and is expected to be complete before the end of 2021. Pending completion of this work, BES will continue aggressive root control as an interim measure. Maintenance work performed in 2020 to minimize the potential for overflows at the DeWitt SSO is summarized in Table 20.

One of the key analysis tools that BES used to develop and evaluate options for resolving SSO risk at the DeWitt maintenance hole was a hydraulic and hydrologic model of the sanitary collection system that serves the entire Fanno Creek and Burlingame sewer basins. This model was calibrated to system flow monitoring data collected at multiple locations throughout the system and so serves as a tool for making predictions about system flows and water levels with a high level of confidence.

Table 19 Implementation schedule for DeWitt SSO Control Project (also known as Hillsdale Crest RDII)

Phase	Timeline	Activity/Milestones
Alternatives Analysis	completed	
30% Design	June 2017 – February 2018	Field survey, environmental assessment sampling/ characterization, geotechnical, public outreach and involvement and 30% design documents
60% Design	February 2018 – June 2018	Review & respond to 30% comments. Complete field survey, environmental assessment, and geotechnical analysis, investigate permitting & easements requirements, continued public outreach and involvement, initiate easements acquisition, and prepare 60% construction documents
90% Design	June 2018 – November 2019	Review & respond to 60% design comments, prepare 90% construction documents and conduct public outreach and involvement
Final Design	November 2019 – February 2020	Review & respond to 90% design comments, prepare final construction documents, Final Design Report and conduct public outreach
Construction Bidding	February 2020 – August 2020	Prepare construction bid documents, complete procurement process, award contract and notice to proceed
Construction	September 2020 – December 2021	Mobilization, erosion control, traffic control, excavation, pipe lining/installation
Close Out	December 2021 – January 2022	Close out project and prepare Final Project Report

Table 20 Maintenance activities for main lines, service laterals, and maintenance holes in 2020

Activity	Fanno Creek Basin and Hillsdale RDII Program Areas	
	Number of Assets Affected	Lineal Feet (when appropriate)
Sewer Main Lines		
Cleaning	151	37,829
Closed circuit TV inspections	150	30,702
Investigations	6	N/A
Repairs	19	590
Root Control Treatment	56	11,983
Service Laterals		
Cleaning	3	77
Closed circuit TV inspections	9	238
Investigations	9	N/A
Repairs	25	376
Maintenance Holes		
Cleaning	1	N/A
Investigations	3	N/A
Repairs	5	N/A

Monitoring and Identification. BES has updated and recalibrated the Fanno Creek Basin hydrologic and hydraulic model. The 2014-15 flow monitoring data were used to refine the model calibration. The calibrated model was used to evaluate the effectiveness of Hillsdale RDII projects. Flow monitoring for 2016-17 was done for the three proposed Fanno and Burlingame project areas to isolate the highest areas of RDII in the project areas and to provide additional pre-project baseline data.

One of the long-term monitoring sites is the constructed sanitary sewer overflow on the Hillsdale Trunk of the Burlingame Basin at SW Kanan and SW 25th Avenue.

Depth and flow monitoring at the site provides real time data that can be accessed via the internet and sends an alarm text message when depth of flow reaches preset levels.

Benefit-Cost Analysis. BES has recalibrated the Fanno Creek Basin hydrology and hydraulic model to better characterize sewer catchments with high RDII. *The Recommended Plan for Fanno Creek and Burlingame Sanitary Basins* (Fanno-Burlingame Plan), completed in March 2012, identified the Fanno Creek Interceptor as a basin constraint. The Fanno-Burlingame Plan recommended priority projects for Phase 1 RDII reduction to resolve predicted local flooding risk and established prioritized objectives for management of sanitary flows, along with actions to achieve these objectives. The recalibrated model made some adjustments to RDII rates but confirmed that local flooding risk is present.

The model was applied to simulate scenarios that would resolve the local flooding risk by increasing local pipe capacity. These scenarios confirmed that increasing local pipe capacity would cause increased surface flooding risk in the Fanno Creek Interceptor. For this reason, capacity increases were rejected. Projects to reduce the surface flooding through RDII reduction have been submitted for funding.

Collection System Replacement, Repair, and Rehabilitation Projects. As a part of the RDII Program, and in accordance with the SW DeWitt and SW 25th Avenue MAO, the Upper Hillsdale RDII Pilot Project and the Middle Hillsdale RDII Pilot Projects were constructed in 2013-14. The Upper Hillsdale Project rehabilitated 8,377 feet of 8-inch mainline sewer pipe in the ROW and 142 laterals in the ROW, with 134 rehabilitated all the way to the house. The Middle Hillsdale Project rehabilitated 11,344 feet of 8-inch mainline sewer pipe. The RDII Program also completed the Pendleton and 45th RDII Pilot Project during 2015; this project rehabilitated 39 private laterals.

Construction on the "Middle Hillsdale RDII Pilot Project – Laterals" project was completed in December 2018. The project rehabilitated 211 laterals including the portion on private property.

Pre-design and design work will continue in 2021 on the upcoming project "Vermont RDII Reduction." The construction schedules for these projects are tentatively set for 2022 to 2023. Also, pre-design for the upcoming project "Council Crest Integrated RDII" is scheduled to continue well into 2021.

The implementation schedule for the upcoming DeWitt SSO Control Project (also known as the Hillsdale Crest RDII project) is shown in Table 19 on page 74.

7.2 Other FY 2021 Activities

Flow monitoring for three sanitary basins, Burlingame, Council Crest, and Fanno, have been in progress since FY 2019. Data from these monitoring efforts will inform pre-construction modeling work and design requirements, as well as provide the basis for evaluating project effectiveness after construction. For FY 2021, monitoring progressed as scheduled.

Council Crest is currently undergoing a wider, integrated planning effort that includes addressing I&I issues. Solving I&I issues in West Hills areas where there is currently no dedicated storm or combined system requires more comprehensive stormwater planning to strategically handle the flows that used to enter the sanitary system. For FY 2021, risk assessment was conducted, including pipe capacity and resiliency analysis. This project also coordinated with the bureau's Non-Conforming Sewers program to resolve services not currently meeting legal connection requirements according to City rules.

7.3 Other Planned FY 2022 Activities

The City will continue with its integrated planning effort for Council Crest.

Construction for the Hillsdale Crest RDII project is expected to end in fall 2021.

Other local I&I projects in the Burlingame and Fanno basins have been recommended to be delayed to FY 2025 (Burlingame) and FY 2026 (Fanno) to address CBWTP Secondary Treatment Expansion Program (STEP) budget requirements.

7.4 SSOs Summary

See Section 4.3.1, Sewer Releases to Surface Water in FY 2021.

Section 8 Update of the Public Notification Program

The goals of the CSO public notification program are to:

1. Make the public aware that the City has a combined sewer system that can overflow.
2. Explain what a CSO is and how it impacts water quality and can threaten public health.
3. Inform the public when a CSO has occurred and warn against contact with the receiving waters.
4. Raise public awareness of the benefits to the community of the City's investment in CSO Control.

When the CSO Policy was adopted, this element of the NMC, Public Notification, focused mostly on outreach through brochures and public meetings and posting warnings at public access points on the Willamette River and Columbia Slough. Changing communication technology provides additional tools for public notification.

Portland's CSO notification procedures changed with completion of its CSO implementation program in December 2011. Throughout the 20-year program, the City relied on its HYDRA system to measure rainfall and trigger the CSO notification process. As of December 2011, all combined sewer outfalls that can discharge are monitored and public notification takes place when an overflow is measured at a specific location.

8.1 Changes in the Public Notification/River Alert Program

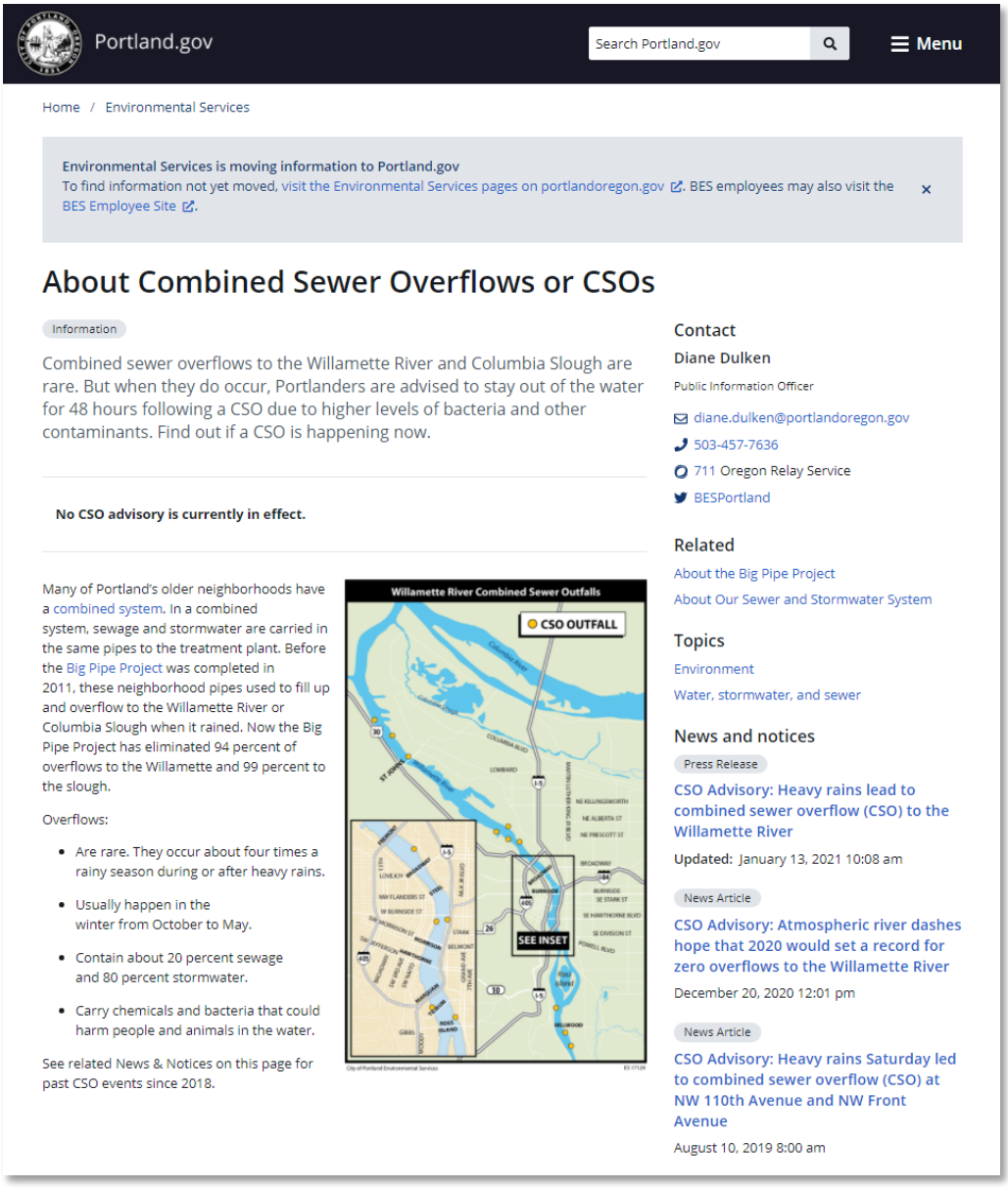
The program continues to use these communications tools:

- CSO advisories sent to the news media when incidents occur.

- Website postings of those CSO media advisories, along with explanations of what a CSO is: https://www.portland.gov/bes/about-csos (updated link; see below).
- Twitter postings of the CSO media advisories.
- CSO warning signage at eight public access points along the river.

Two new changes were in progress during this year:

1. The City of Portland is migrating to a new website, so CSO information is now found at https://www.portland.gov/bes/about-csos.



Portland.gov

Search Portland.gov

Menu

Home / Environmental Services

Environmental Services is moving information to Portland.gov
To find information not yet moved, visit the Environmental Services pages on portlandoregon.gov. BES employees may also visit the BES Employee Site.

About Combined Sewer Overflows or CSOs

Information

Combined sewer overflows to the Willamette River and Columbia Slough are rare. But when they do occur, Portlanders are advised to stay out of the water for 48 hours following a CSO due to higher levels of bacteria and other contaminants. Find out if a CSO is happening now.

No CSO advisory is currently in effect.

Many of Portland's older neighborhoods have a combined system. In a combined system, sewage and stormwater are carried in the same pipes to the treatment plant. Before the Big Pipe Project was completed in 2011, these neighborhood pipes used to fill up and overflow to the Willamette River or Columbia Slough when it rained. Now the Big Pipe Project has eliminated 94 percent of overflows to the Willamette and 99 percent to the slough.

Overflows:

- Are rare. They occur about four times a rainy season during or after heavy rains.
- Usually happen in the winter from October to May.
- Contain about 20 percent sewage and 80 percent stormwater.
- Carry chemicals and bacteria that could harm people and animals in the water.

See related News & Notices on this page for past CSO events since 2018.

Contact
Diane Dulken
Public Information Officer
diane.dulken@portlandoregon.gov
503-457-7636
711 Oregon Relay Service
BESPortland

Related
About the Big Pipe Project
About Our Sewer and Stormwater System

Topics
Environment
Water, stormwater, and sewer

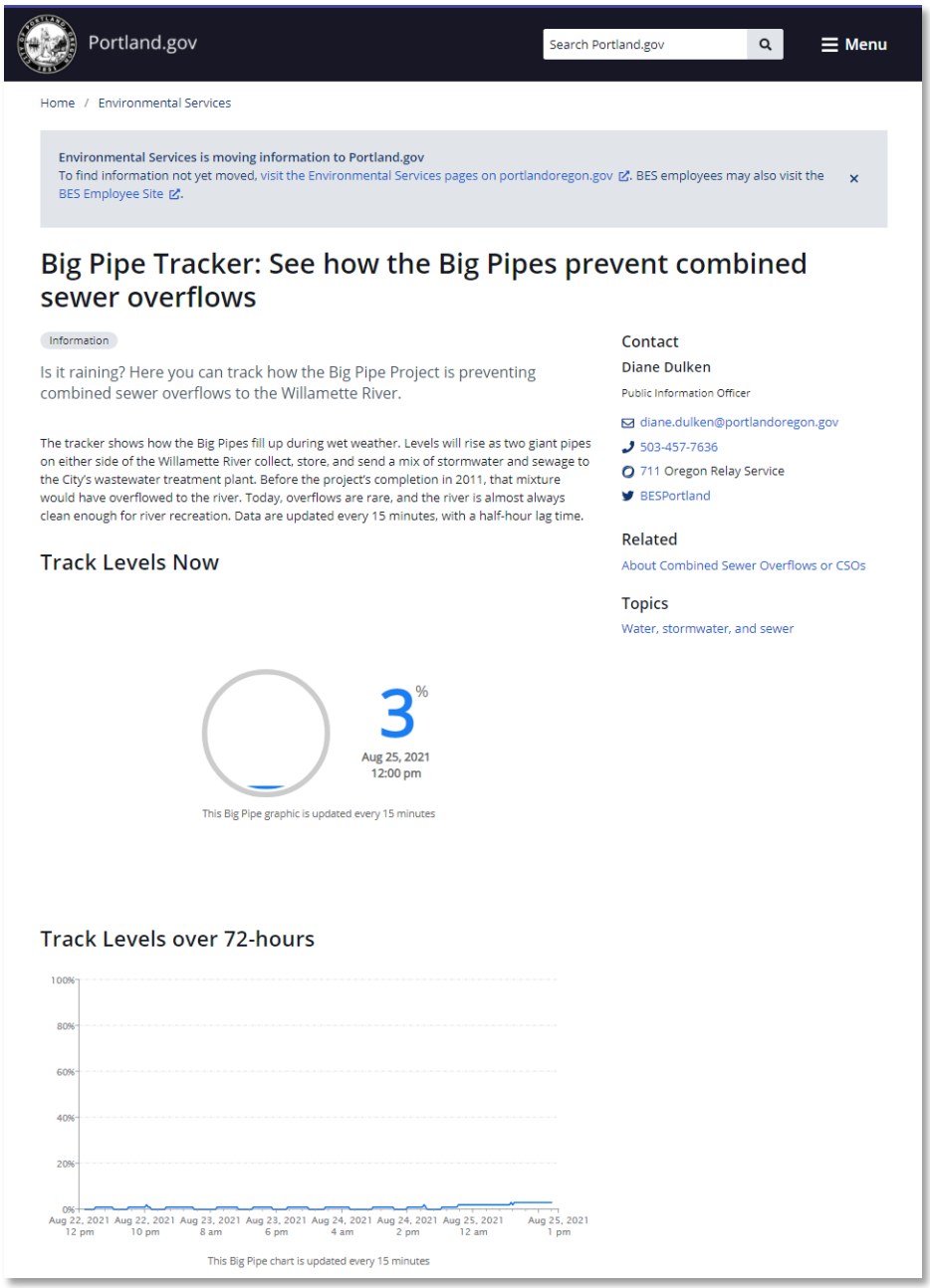
News and notices

Press Release
CSO Advisory: Heavy rains lead to combined sewer overflow (CSO) to the Willamette River
Updated: January 13, 2021 10:08 am

News Article
CSO Advisory: Atmospheric river dashes hope that 2020 would set a record for zero overflows to the Willamette River
December 20, 2020 12:01 pm

News Article
CSO Advisory: Heavy rains Saturday led to combined sewer overflow (CSO) at NW 110th Avenue and NW Front Avenue
August 10, 2019 8:00 am

2. Environmental Services is launching an additional public information tool for the Big Pipes (the common euphemism for the CSO storage tunnels) along the Willamette River: an online Big Pipe Tracker that allows the public to see a visualization of how the Big Pipe is keeping the Willamette River sewage-free. The tracker also serves as an additional visualization tool in case CSOs occur. See https://www.portland.gov/bes/big-pipe-tracker.



Appendix A CSO Event History

When reporting on *how the Portland CSO system has performed*, the City of Portland usually refers to the number of events and the size of overflows that have occurred since the system became fully operational in December 2011. From that standpoint, BES has validated and reported 29 permitted events from the Willamette River and Columbia Slough facilities.

Prior to December 2011, the Amended Stipulation and Final Order from DEQ required the City of Portland to eliminate most overflows to the Columbia Slough by December 1, 2000. Another 16 outfalls (represented by a mix of outfalls from the West Side and East Side of the Willamette River) were controlled by December 1, 2006.

Columbia Slough CSO Events since October 2000

This table presents the CSO events to the Columbia Slough since the Columbia Slough CSO system became fully operational in October 2000. There were no CSO events to the Columbia Slough in FY 2021. Winter events are shaded in green, and summer events are shaded in yellow. All events were permitted under the NPDES permit at the time.

Table 21 Columbia Slough CSO events since October 2000

CSO Discharge Events			Storm Characteristics			System Totals		West Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
1	May 26, 2012	> 100-year, 30-minute storm	-	-	-	0.022	0.20	0.022	0.20
2	December 5-13, 2015	25-year, 3-6 hour storm	2.04	2.61	3.19	0.01	0.15	0.01	0.15

Willamette River CSO Events from December 2006 to December 2011

This table presents the CSO events to the Willamette River since the West Side Willamette River CSO Tunnel became fully operational in December 2006 until the full Willamette system became operational in December 2011. Winter events are shaded in green, and summer events are shaded in yellow. All events complied with the requirements of the NPDES permit and the 1994 Amended Stipulation and Final Order in effect at the time.

Table 22 Willamette River CSO events, December 2006-December 2011

CSO Discharge Events*			Storm Characteristics			System Totals		West Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
1	Dec 14, 2006	4-per-Winter Storm	0.82	1.17	1.60	66.85	18.37	66.85	18.37
2	Jan 3, 2007	4-per-Winter Storm	0.69	1.04	1.54	5.15	4.35	5.15	4.35
3	Dec 2-3, 2007	> 5-year 24-hour Winter Storm	0.97	1.76	3.09	154.5	26.85	154.5	26.85
4	Nov 12, 2008	4-per-Winter Storm	0.76	1.02	1.38	8.1	4.1	8.1	4.1
5	Jan 1-2, 2009	5-year Winter Storm	1.12	1.52	2.73	122.60	21.58	122.60	21.58
6	May 4, 2009	3-year Summer Storm (3-6 hr duration)	0.94	1.02	1.18	5.26	1.05	5.26	1.05
7	Nov 7, 2009	2-per-Winter Storm	0.93	1.22	1.51	9.60	2.92	9.60	2.92
8	June 6, 2010	3-year Summer Storm	1.07	1.25	1.43	26.02	3.08	26.02	3.08
9	Nov 17, 2010	1-per-Winter Storm	1.03	1.56	1.77	11.48	5.58	11.48	5.58
10	Dec 8-12, 2010	5-year Winter Storm	1.43	1.52	2.34	41.82	8.92	41.82	8.92
11	Dec 28, 2010	2-per-Winter Storm	0.57	0.89	1.58	6.85	5.50	6.85	5.50
12	Jan 15-16, 2011	1-per-Winter Storm	0.94	1.21	2.13	26.27	8.92	26.27	8.92
13	Feb 27-Mar 4, 2011	1-per-Winter Storm	1.15	1.70	2.41	75.98	28.25	75.98	28.25
14	Nov 21-23, 2011	5-year Winter Storm	1.44	1.66	2.24	115.96	6.25	115.96	6.25

Willamette River CSO Events since December 2011

This table presents the CSO events to the Willamette River since the Willamette River CSO Tunnel system became fully operational in December 2011. FY 2021's events are listed in the bold box below. Winter events are shaded in green, and summer events are shaded in yellow. All events were permitted under the NPDES permit at the time.

Table 23 Willamette River CSO events, December 2011 to June 2019

CSO Discharge Events			Storm Characteristics			System Totals		West Side Totals		East Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
1	January 17-21, 2012	> 5-year 12-hour Winter Storm	1.48	2.15	2.32	304.90	10.30	86.40	10.30	218.50	10.30
2	May 26, 2012	> 100-year, 30-minute Storm	-	-	-	0.17	0.42	-	-	0.17	0.42
3	November 17-21, 2012	5-year, 24-hour Winter Storm	1.22	1.65	2.44	176.40	9.50	44.00	9.50	132.40	9.30
4	November 24, 2012	3-per Winter, 24-hour Storm	0.61	1.09	1.49	0.50	0.80	0.50	0.80	-	-
5	May 23, 2013	3-year, 12-hour Summer Storm	0.90	1.22	1.50	26.30	2.30	11.90	2.30	14.40	1.80
6	September 27-30, 2013	10-year, 24-hour Summer Storm	1.20	1.41	2.08	88.50	7.00	27.00	7.00	61.50	5.40
7	March 25-30, 2014	2-per Winter, 12-hour Storm	0.89	1.26	1.53	43.10	3.00	14.30	3.00	28.70	3.00
8	June 15-16, 2014	3-year, 30-minute Summer Storm	-	-	-	0.03	0.20	-	-	0.03	0.20
9	October 22-23, 2014	10-year, 24-hour Summer Storm	1.42	1.68	2.11	69.4	3.92	13.41	3.50	56.00	3.92

CSO Discharge Events			Storm Characteristics			System Totals		West Side Totals		East Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
10	December 4-6, 2014	5-year, 3-hour Winter Storm	0.95	1.37	1.56	1.6	1.57	0.05	0.27	1.52	1.57
11	January 17-18, 2015	1-per Winter, 24-hour Storm	0.97	1.50	2.04	91.6	7.98	15.15	6.75	76.43	7.98
12	March 14-15, 2015	1-per Winter, 48-hour Storm	1.05	1.80	2.41	78.9	6.48	16.61	5.92	62.31	6.48
13	October 30-November 2, 2015	50-year, 2-hour storm	1.94	1.98	2.55	190.5	6.35	30.24	4.88	160.05	6.35
14	November 16-17, 2015	1-per Winter, 1-hour storm	0.80	0.85	1.37	0.03	0.17	-	-	0.03	0.17
15	December 5-13, 2015	25-year, 3-6 hour storm	2.04	2.61	3.19	638.7	15.60	134.86	13.33	503.83	15.60
16	December 16-19, 2015	1-per Winter, 3-48 hour storm	1.11	1.56	2.37	145.8	11.00	26.79	9.70	118.99	10.30
17	May 19, 2016	3-year, 30-minute Summer Storm	-	-	-	0.02	0.18	-	-	0.02	0.18
18	October 13-17, 2016	> 100-year, 1-2 hour storm	1.56	1.81	2.09	0.92	0.63	0.89	0.63	0.03	0.33
19	November 22-25, 2016	5-year winter, 3-hour storm	1.20	1.81	2.47	210.5	17.00	49.36	16.10	161.15	16.60
20	January 17-18, 2017	2-per-winter, 1-day storm	0.61	1.03	1.78	93.5	8.90	20.82	7.50	72.70	8.90
21	February 3-6, 2017	5-year winter, 1-day storm	0.81	1.48	2.53	206.0	12.10	53.07	11.5	152.95	12.1
22	February 7-10, 2017	4-per-winter, 1-day storm	0.51	0.82	1.36	0.0035	0.17	0.0035	0.17	-	-
23	February 15-16, 2017	1-per-winter, 1-2 day storm	0.80	1.25	1.98	89.6	6.4	25.61	5.8	63.98	5.8

CSO Discharge Events			Storm Characteristics			System Totals		West Side Totals		East Side Totals	
Event #	Dates of Storm / Overflow Events	Description	6-Hour Rainfall (inches)	12-Hour Rainfall (inches)	24-Hour Rainfall (inches)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)	Overflow (MG)	Duration (hours)
24	May 12-14, 2017	>10-year summer, 15 minute storm	0.43	0.68	0.75	0.0051	0.20	0.0051	0.20	-	-
25	September 17-20, 2017	10-year summer, 15-minute - 2-hour storm	0.76	1.18	1.58	0.097	0.63	-	-	0.097	0.063
26	October 19-22, 2017	10-year summer, 24-hour storm	0.96	1.64	2.29	70.5	6.17	19.82	4.92	50.68	6.00
27	April 6-8, 2018	1-per-winter, 12-48 hour storm	0.74	1.29	1.94	24.7	2.55	4.71	2.32	19.95	2.52
28	October 25-29, 2018	25-year, 10-minute - 2-hour storm	1.46	2.06	2.12	0.0037	0.17	-	-	0.0037	0.17
29	August 10, 2019	100-year: 5-minute - 3-hour storm	1.93	1.93	1.93	0.060	0.38	0.060	0.38	-	-
30	December 18-22, 2020	1-per-winter, 12-24 hour storm	0.85	1.44	1.93	12.3	3.42	1.2	1.40	11.1	3.42
31	January 11-12, 2021	5-year winter, 3-6 hour storm	1.24	1.37	2.30	138.6	5.85	39.9	4.82	98.7	5.85

The City of Portland ensures meaningful access to City programs, services, and activities to comply with Civil Rights Title VI and ADA Title II laws and reasonably provides: translation, interpretation, modifications, accommodations, alternative formats, auxiliary aids, and services. To request these services, call 503-823-7740, City TTY 503-823-6868, Relay Service: 711.

Traducción e Interpretación | Biên Dịch và Thông Dịch | अनुवादन तथा व्याख्या | 口笔译服务 | Устный и письменный перевод | Turjumaad iyo Fasiraad | Письмовий і усний переклад | Traducere și interpretariat | Chiaku me Awewen Kapas **503-823-7740**

SEP2020