2022-2023

NPDES MS4/TMDL Annual Report

Credit: Nettle Creek, Lake Oswego, OR (S. Johnson)

November 30, 2023

City of Lake Oswego

National Pollutant Discharge Elimination System
Municipal Separate Storm Sewer System
Annual Report

Covering

July 1, 2022 to June 30, 2023

Prepared for the Oregon Department of Environmental Quality

November 30, 2023

CITY OF LAKE OSWEGO

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) ANNUAL REPORT

JULY 1, 2022 – JUNE 30, 2023

I, the undersigned, hereby submit this National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm system (MS4) annual report in accordance with NPDES Permit Number 101348. 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 ensure 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 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 known violations.

Martha Bennett, City Manager
City of Lake Oswego

Nov 20, 2023
Date

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ABBREVIATIONS

ACEC	American Council of Engineering Companies
ACWA	Association of Clean Water Agencies
APWA	American Public Works Association
AWWA	American Water Works Association
ALT Text	Alternative Text (used for individuals with visual or auditory disabilities)
CCTV	Closed Circuit TV (used for video inspections)
CIP	Capital Improvement Program
CRC	Clean Rivers Coalition
CWA	Clean Water Act
DEQ	Oregon Department of Environmental Quality
DMA	Designated Management Agency
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOGAMI	Oregon Department of Geology and Mineral Industries
DSL	Department of State Lands
E. Coli	Escherichia coli
ESC	Erosion and Sediment Controls
ESU	Equivalent Service Unit
FY	Fiscal Year starting July 1, e.g. FY2223 means July 1, 2022 to June 30, 2023
GI	Green Infrastructure
GIS	Geographic Information System
HEP	Habitat Enhancement Program
I/I	Inflow and Infiltration
IDDE	Illicit Discharge Detection and Elimination
IPM	Integrated Pest Management

KPTV	Portland Metro TV station
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
LiDAR	Laser Imaging, Detection, and Ranging
LOFD	Lake Oswego Fire Department
LU	Land Use Case
M-IBI	Macroinvertebrate Index of Biological Integrity
MS4	Municipal Separate Storm Sewer System
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge and Elimination System
O&M	Operations and Maintenance
OAR	Oregon Administrative Rule
ODA	Oregon Department of Agriculture
OERS	Oregon Emergency Response System
PFA/PFOA	Per- and polyfluoroalkyl chemicals and perfluorooctanoic acid chemicals
PLRE	Pollutant Load Reduction Evaluation
PREDATOR	Predictive Assessment Tool for Oregon
PSA	Public Service Announcement
PW	Public Works
QA/QC	Quality Assurance/Quality Control
R-5/ R-7.5	Residential lot zoning: 5,000 sq ft and 7,500-sq ft
RCCRS	Regional Coalition for Clean Rivers and Streams
SDC	System Development Charge
SFR	Single Family Residential
SSO	Sanitary Sewer Overflow
SWMM	Stormwater Management Manual
SWMP	Stormwater Management Plan

TCLP	Toxic Characteristics Leaching Procedure
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
TVF&R	Tualatin Valley Fire and Rescue
UIC	Underground Injection Control
UGB	Urban Growth Boundary
USB	Urban Services Boundary
USACE	US Army Corp of Engineers
USEPA	US Environmental Protection Agency
USGS	US Geological Survey
VSS	Volatile Suspended Solids
WLA	Wasteload Allocation
WO	Work Order
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
WY	Water Year

1 INTRODUCTION

The Clean Water Act (CWA) was enacted in 1972 to ***"restore and maintain the chemical, physical, and biological integrity of the Nation's waters".*** After point sources such as industrial facilities and wastewater treatment plants were regulated as part of the National Pollutant Discharge Elimination System (NPDES) program, the USEPA found that the nation's rivers and streams were still not providing sufficient water quality to meet their assigned beneficial uses. As a consequence, the NPDES Municipal Separate Storm Sewer System (MS4) Phase I permit program was implemented in 1990 to regulate stormwater discharges from municipalities, counties, and other entities that met the MS4 permit thresholds of a population of 100,000 people or in an urbanized area. While the City of Lake Oswego (hereafter "City") had a 1995 population of 34,000 people, it was considered part of an urbanized area and subject to the NPDES program.

The City received its first NPDES MS4 Phase I permit (hereafter "MS4 permit") from the Oregon Department of Environmental Quality (DEQ) in 1995 as a co-permittee of the Clackamas County permit (#101348). It includes the jurisdictions of Clackamas County, Gladstone, Happy Valley, Johnson City, Lake Oswego, Milwaukie, Oak Lodge Sanitary District, Oregon City, Rivergrove, West Linn, and Wilsonville.

DEQ issued a new MS4 permit in September 2021 and the City's Stormwater Management Plan (SWMP), which shows how the City will implement the permit, was approved by DEQ in February 2023. Because the SWMP was approved in the middle of the reporting year (July 1 to June 30), there may be metrics which will not be tracked until the annual report due December 1, 2024.

The SWMP, permit, annual reports, and other documents can be viewed on the City's website.

2 TOPOGRAPHY AND HYDROLOGY

The City is bounded by I-5 on the west, the Willamette River on the east, a north ridge, and a south ridge. The highest elevations range from approximately 1,000 ft in the north to over 700 ft along the south ridge. Between these two ridges lies Oswego Lake which is kept at an elevation of 98 ft by the Oswego Lake dam. The elevation of property next to the Willamette River is less than 10 ft whereas property next to the Tualatin River (south of the southern ridge) is approximately 100 ft. The west side of the City ranges from 150 ft in the southwest to 200ft in the northwest.

Several scarp lines and historic landslides are within the City's urbanized area. According to a DOGAMI study (Burns et.al., 2013), 7% of the City's area is at high risk for shallow landslide activity and 2% is at high risk for deep landslide activity. These geological characteristics have implications for stormwater management within the City.

The City's jurisdictional boundary (11.5 sq miles) encompasses portions of the Willamette River and Tualatin River basins. For the purposes of this report, the Willamette River is further broken into four minor watersheds: Tryon Creek (a sub-watershed discharging directly to the Willamette River), Springbrook Creek (discharging to Oswego Lake), Oswego Lake, and the remaining Willamette River watershed area. The Tualatin River is broken into three minor watersheds: Ball Creek, Carter Creek, and the remaining Tualatin River watershed area. The Lost Dog watershed, primarily referenced in the water-quality section of the report, is a sub-watershed of Oswego Lake and is included in discussions of the Oswego Lake watershed unless specifically indicated in the report. Ball Creek and Carter Creek, primarily referenced in the water-quality section of the report, are sub-watersheds of the Tualatin River and are included in discussions of the Tualatin River watershed unless specifically indicated in the report.

3 ADAPTIVE MANAGEMENT

Adaptive management is allowed by the MS4 permit and is defined in the permit as a method for refining and improving stormwater programs (see Table 1). The changes range from clarifications to removing duplicative metrics.

4 STORMWATER FUNDING

The City's stormwater program is funded primarily through monthly stormwater fees and is based on the number of equivalent service units (ESU) assessed for a property. An ESU is the average impervious area for residential properties and, in 1992, was determined to be 3,030 sq ft. A single-family residential (SFR) property is assessed at 1 ESU and properties which are not zoned as single-family residential are assessed using the amount of impervious area on their property. For example, a non-SFR property with 6,060 sq ft of impervious area is assessed at the rate of 2 ESUs per month. The monthly stormwater fee per ESU was $20.19 in FY2223 and is $21.60 for FY2324.

Stormwater system development charges (SDCs) are used to alleviate capacity issues but, since the City is largely developed, they comprise a small portion of the total stormwater budget. SDCs were $180 for FY2223 and are $190 for FY2324 for SFR projects. Non-SFR projects are based on the number of ESUs multiplied by the SFR rate.

Since FY1819, the City has spent an average of $5.5 million annually on stormwater operations and management, capital projects, parks facilities, and natural resource management (Backyard Habitat program and public/private restoration). In FY2223, the City spent $2.6 million dollars for improvements in its parks and natural areas and $2.8 million dollars on capital projects and stormwater operations and maintenance (see Table 2). An additional $140,000 was spent on private natural resources management.

Table 1. Adaptive management (redlines/strikeouts), FY2324 implementation

Minimum Measure	Goal	Tracking Measure	Reason
Program Management	Provide funding to properly meet the NPDES MS4 requirements.	Track the amount of funds targeting stormwater ~~or habitat restoration~~ education that were disbursed to external ~~regional~~ groups. ~~(such as Backyard Habitat, RCCRS, or CRC) or through City grants.~~	Funds are provided to watershed councils in addition to regional education groups.
Construction Site Runoff	City contractors with erosion control responsibilities will have a certified erosion control professional on staff	Track the number of City-initiated projects with a certified ESC Professional ~~Inspector~~ and whether the project is completed or under construction	Clarification
Construction Site Runoff	Developers of subdivisions, business, or commercial projects must retain a certified ESC professional to submit plans and provide inspections	Track the number of ESC Plans submitted by a certified ESC Professional ~~inspector~~ for developers of complicated projects.	Clarification
Construction Site Runoff	Instream projects will apply for and obtain a DSL jurisdictional decision.	Track number of applications required to submit a DSL application, ~~the DSL decision,~~ and the affected watershed.	The DSL decision is not relevant to this metric.
IDDE	Provide a complaint hotline number	Track the number of complaints received through the hotline number~~. Track the number of valid spills~~	In addition to spill complaints, the hotline is also used for other complaints such as flooding. Staff have found it difficult to separate the spill complaints from the non-spill complaints.
IDDE	Respond to 100% of valid spill complaints within 24 hours ~~if it is a threat to human health or the environment. Respond to 100% of all other valid spill complaints~~ and within 2 to 4 working days for all others. ~~Open an investigation into illicit discharges with no identified source and which require a water sample~~.	1. Track the number of spills responded to by City staff. 2. Track the number of spills reported to DEQ and their OERS numbers. 3. Track the number of ~~investigations opened~~. events where TVF&R was contacted for assistance. ~~4. Track the actions taken~~ Summarize resolutions and number of citations issued.	Clarifications. Already tracking the number of events that involve TVF&R.

Minimum Measure	Goal	Tracking Measure	Reason
Training	Provide programs that meet current industry standards	Track the number of staff trained in spill response. ~~Track the number of discrete employees receiving spill response training during the permit term.~~	Staff have found it does not add value to track which employees have had at least one training during the permit term in addition to yearly training. Most training is done in large groups.
Industrial/ Commercial Program	Reduce potential pollutants of concern from entering waterways	1. Track the number of projects with construction plan review, and the affected watersheds. 2. Track the number of projects completed and the stormwater facilities constructed.	Already tracking these metrics.
Industrial/ Commercial Program ~~Post-Construction Site Runoff~~	~~Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.~~ Reduce potential pollutants of concern from entering waterways	~~1. Track the number of subdivisions that were reviewed and the affected watershed.~~ 2. Track the number of commercial projects that were reviewed and the affected watershed. 3. Track the number of industrial projects that were reviewed and the affected watershed.	Split off from existing Post-Construction Site Runoff metric.
Post-Construction Site Runoff	~~Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.~~ Reduce potential pollutants of concern from entering waterways	1. Track the number of subdivisions that were reviewed and the affected watershed. ~~1. Track the number of commercial projects that were reviewed and the affected watershed.~~ 2. ~~Track the number of industrial projects that were reviewed and the affected watershed.~~	See previous Industrial/Commercial program metric.
Training (Industrial/ Commercial)	Provide programs that meet current industry standards	Track the number of certified staff or certified contractors for industrial/commercial inspectors. ~~Track the number of discrete staff that have received training during the permit term.~~	Staff have found it does not add value to track which employees have had at least one training during the permit term in addition to yearly training.

Minimum Measure	Goal	Tracking Measure	Reason
Pollution Prevention	Review and update, as necessary, the Emergency ~~Response procedures~~ Operations Plan every 5 years that affect stormwater (due June 2026). Provide a summary of any changes in the Emergency Response procedures that affect stormwater, e.g. Winter Events.	Provide a summary of any changes in the Emergency ~~Response procedures~~ Operations Plan that affect stormwater, e.g. Winter Events.	Clarification
Pollution Prevention	~~Review and update, as necessary, the procedures for inspecting and maintaining City-owned bridges at least once per permit term.~~ Provide stormwater programs that meet industry standards	~~Provide a summary of any changes.~~ Review, update, and summarize changes to the inspection and maintenance procedures for City-owned bridges at least once per permit term.	Clarification.
Pollution Prevention	~~Review and update, as necessary, the procedures and criteria for inspecting and cleaning the stormwater conveyance infrastructure and non-vegetated stormwater treatment infrastructure at least once per permit term.~~ Prove stormwater programs that meet industry standards	~~Provide a summary of any changes.~~ Review, update, and summarize changes to the inspection and maintenance procedures for conveyance structures and non-vegetated stormwater treatment facilities at least once per permit term.	Clarification.
Pollution Prevention	Maintain the stormwater system inventory.	1. Track the number of structures, by type, that are City-owned, e.g. catch basins, manholes, detention tanks, vaults, water-quality vaults, ~~infiltration trenches, infiltration galleries~~, etc. 2. Track the number of feet of stormline, ditches, and culverts that are City-owned. 3. Track the number of vegetated stormwater facilities that are City-owned.	The strike-out facilities are UICs and covered under the UIC permit.

Minimum Measure	Goal	Tracking Measure	Reason
Pollution Prevention	Properly dispose 100% of the debris from street sweeping.	Track the number of ~~curb~~ lane miles swept and the disposal method for the collected debris.	Clarification – not all sweeping routes have curbed streets.
Pollution Prevention	Properly dispose 100% of the debris from street sweeping.	Track the estimated ~~volume~~ tonnage of debris that is sent to the landfill and whether any was sent to a hazardous waste landfill. ~~Track the volume of any debris sent to a hazardous waste landfill.~~ Track the estimated volume of debris that is composted.	Debris is more easily tracked by weight.
Pollution Prevention	~~Properly dispose o100% of the debris from asset cleaning.~~	~~Track the volume of litter and trash removed by staff~~	Staff remove trash from public receptacles three times a week. It is combined with other trash and staff have found that it is difficult to separate out.
Pollution Prevention	Balance road safety and water-quality during winter storm events.	1. Track the number of gallons of magnesium chloride and the number of cubic yards of sand that are used annually for winter events. 2. Track the number of 12-hr shifts requiring winter event activities. 3. Track the number of lane miles where magnesium chloride was used (for in-truck GPS units). ~~Track which priority routes were affected by each storm.~~	Almost all winter storm events include all of the priority routes.
~~Training~~	~~Provide programs that meet current industry standards~~	~~Track the number of employees involved in winter event, litter, or trash activities. Track the number of employees receiving training each year and the subject matter of the training (sanding, de-icing, litter, trash).~~	Duplicative - covered under general training metric.
Pollution Prevention	~~Review and update, as necessary the Integrated Pest Management Manual every 5 years~~ Provide stormwater programs that meet current industry standards.	~~Provide a summary of any changes.~~ Review, update, and summarize changes to the Integrated Pest Management Plan at least once per permit term.	Clarification

Minimum Measure	Goal	Tracking Measure	Reason
Training	Provide ~~or require~~ training for Employees applying ~~and contractors completing~~ pesticide~~applications~~s. ~~A copy of the ODA certification of contracted staff to be provided to City prior to contract execution.~~	Track the number of staff and contractors who have current pesticide licenses. ~~trained versus the total number of staff and contracted staff applying pesticides~~.	Contracts require that all contractors have experience and the appropriate licenses in order to procure the contract.
~~SWMP Resources~~ Program Management	~~Review and update municipal code, as necessary, by December 1, 2024 to reflect the permit requirements and current industry standards.~~ Provide stormwater programs that meet current industry standards.	Review and update the municipal code to comply with the 2021 permit. 1. Track progress and adoption date of revised code sections. 2. Provide summary of changes. 3. Track the number of public comments received.	Clarification
~~SWMP Resources~~ Post-Construction Site Runoff	~~Review and update, as needed, engineering standards and standard drawings that affect stormwater at least once every 5 years to reflect current industry practices~~ Provide stormwater programs that meet current industry standards.	Review, update, and summarize modifications to the engineering design standards and standard drawings that affect stormwater at least once per permit term. ~~or erosion and sediment control~~	Clarification. Code changes affecting ESC is covered under the construction site runoff measure.
Post-Construction Site Runoff	~~Review and update the SWMM by December 1, 2024.~~ Provide stormwater programs that meet current industry standards.	Review and update the SWMM by December 1, 2024. Provide a summary of the changes.	Clarification

Minimum Measure	Goal	Tracking Measure	Reason
Post-Construction Site Runoff	~~Review and update LID/GI prioritization strategy by December 1, 2023~~. Provide stormwater programs that meet current industry standards.	Review and update LID/GI prioritization strategy by December 1, 2023. Provide a summary of the changes.	Clarification
Post Construction Site Runoff	~~Every five years, or when LiDAR data become available, complete an impervious area analysis.~~ Monitor changes in impervious area.	When new LiDAR data becomes available, complete an impervious analysis. Report on the amount of impervious area within the City and within the UGB that was derived from the updated LiDAR data.	Clarification
Post-Construction Site Runoff	Reduce TSS 80% prior to discharge offsite for 95% of the projects that exceed stormwater thresholds.	1. Track the number of projects with an offsite discharge. 2. Track the ~~types of~~ stormwater facilities constructed to treat stormwater before discharge offsite~~. to reduce TSS by 80% and the affected watershed.~~	Clarification
Post-Construction Site Runoff	Inspect at least 50% of the private stormwater facilities constructed during the permit term.	Track the number of ~~facilities~~ properties that were inspected; categorized by construction year ~~and type (planter, raingarden, infiltration trench, etc.~~. Track the impervious area treated by the inspected facilities by watershed.	Many properties contain more than one facility, i.e. water-quality vaults and filtration planters. Tracking by property and watershed provides similar information.
Post-Construction Site Runoff	Provide a report to the property owner outlining deficiencies within 90 days of the inspection and require repairs or corrections.	1. Track the number of ~~inspections~~ properties that required follow-up. 2. Track the number of ~~inspections~~ properties that required enforcement and whether a citation was issued. 3. Track the number of inspections that required no follow-up.	Some properties require multiple inspections. Tracking by the number of properties provides similar information.
Post-Construction Site Runoff	~~Map, or otherwise document, the locations of 100% stormwater facilities within 2 years of construction.~~	~~Track the number of public stormwater facilities accepted by the City annually.~~ ~~Track the number of private stormwater facilities that have been constructed.~~	Duplicative – covered under a separate item in Post-Construction Site Runoff.

Minimum Measure	Goal	Tracking Measure	Reason
Post-Construction Site Runoff	~~Upgrade 50% of existing catchbasins in capital improvement projects to sumped and snouted catch basins (whenever feasible) with percentages based on the permit term)~~ Retrofit public catchbasins whenever feasible.	1. Track number of catch basins converted for all capital improvement projects. 2. Track the number of new sumped and/or new sumped and/or snouted catchbasins.	Clarification
~~Retrofit/ Hydromod~~	~~Retrofit under-functioning stormwater facilities and structures.~~	~~1. Track the number of structures retrofit, not including catchbasins, outfalls, or ditches.~~ ~~2. Track how the retrofit increased water quality (see Retrofit Assessment 2015).~~	Duplicative – covered under a separate Post-Construction Site Runoff metric.
Public Education	Educate businesses about stormwater ~~Provide information about stormwater education to professionals.~~	Track the type and number of messages sent to businesses. ~~professionals/contractors e.g. classes on erosion control or vegetated stormwater facility construction and maintenance.~~	Clarification to allow maximize options for education to businesses.
~~Public Education~~	~~Provide information on proper fertilizer, herbicide, or pesticide storage and application.~~	~~Track the message subjects and the outreach types, e.g. social media~~	Duplicative – covered under outreach with partner groups.
Training	Provide programs that meet current industry standards.	Track the number of staff new to stormwater that received training. ~~Track the number of discrete employees that have been assigned stormwater responsibilities and received training during the permit term.~~	Staff have found it does not add value to track which employees have had at least one training during the permit term in addition to yearly training. Most training is done in large groups or at conferences/webinars.
~~Training~~	~~Require training of at least 50% of contractors with stormwater responsibilities. Track the number of discrete contract staff that have received training.~~	~~Track the number of discrete contract staff that have received training. Track the number of contract staff with stormwater responsibilities that have received training versus the total number of contract staff with stormwater responsibilities.~~	Contracts require that all contractors have experience and the appropriate licenses to procure the contract.

Minimum Measure	Goal	Tracking Measure	Reason
~~Training~~	Provide programs that meet current industry standards. ~~Provide training to Employees who are new to litter and trash pickup or to winter event activities within 60 days of assignation.~~	~~1. Track the number of employees involved in winter event, litter, or trash activities.~~ ~~2.~~ Track the number of employees receiving training each year and the subject matter of the training ~~(sanding, de-icing, litter, trash).~~ ~~3. Track the number of discrete employees that have received training during the permit~~ ~~term (do not count a person more than once during the permit year).~~ ~~4. Track the number of discrete employees that have received training for winter event, litter, or trash activities during the permit term.~~	Strike-outs are covered under other training metrics.

Table 2 does not include the funds from related programs such as the Planning Department's Urban Forestry programs and code enforcement; and the Park and Recreation Department's Master Plans, and park maintenance (not related to natural resource management). These programs positively affect water quality and are used for stormwater education as well as other objectives.

Table 2. Historical and Forecasted Stormwater Budgets, FY1819 to FY2324

Budget Component	FY1819 Actual[1]	FY1920 Actual[1]	FY2021 Actual[1]	FY2122 Actual[1]	FY2223 Actual[1]	FY2324 Budgeted[1]
PW Program Operations	$ 901,000	$ 875,000	$ 918,000	$1,209,000	$ 1,033,000	$ 1,130,000
PW Program Management	$1,421,000	$1,336,000	$1,224,000	$1,213,000	$ 1,183,000	$ 1,405,000
PW Capital Projects	$1,707,000	$2,243,000	$ 603,000	$ 978,000	$ 628,000	$ 2,150,000
Parks Capital Projects[3]	$1,933,000	-	$1,626,000	$2,316,000	$2,377,000[2]	$42,098,000[2]
Public Riparian Restoration	$ 313,000	$ 278,000	$ 189,000	$ 183,000	$ 226,000	$320,000[4]
Private Riparian Restoration (Watershed Councils)	$ 32,000	$ 91,000	$ 127,000	$ 102,000	$ 89,000	See Public Restoration[4]
Sensitive Land Reviews	-	-	-	-	$ 4,000	$ 40,000[5]
Backyard Habitat Program	$ 38,000	$ 38,000	$ 42,000	$ 44,000	$ 47,000	$ 47,000
Total	$6,345,000	$4,861,000	$4,729,000	$6,045,000	$ 5,583,000	$47,190,000

1 - These numbers are approximate only and not used for auditing purposes; 2 – Paid through Parks Bonds; 3 – Includes funds spent on utilities and structures not providing stormwater management; 4 – This includes public and private restoration; 5 – This budget item is on-call/as-needed; PW=Public Works

5 IMPERVIOUS AREA

Impervious area can be changed through legislation, annexations, and land-use cases in addition to construction. There were no changes in the Urban Services Boundary (USB) nor are any expected in FY2324.

5.1 IMPERVIOUS AREA ANALYSIS (2019)

In 2021, the City categorized its impervious area using the LiDAR data flown in 2019. The data show a total impervious area of 2,847 acres for 2019. The Oswego Lake watershed had the greatest amount of impervious area and Lost Dog Creek had the smallest amount of impervious area (See Figure 1). Buildings and plazas constitute 39% of the impervious area in the city with transportation-related impervious area (bridges, railroads, and streets) a close second at 25%. Graveled areas, such as alleys, constituted the least amount of impervious area at 0.7%.

The City expects to complete another impervious area analysis using the LiDAR data from the 2024 flight.

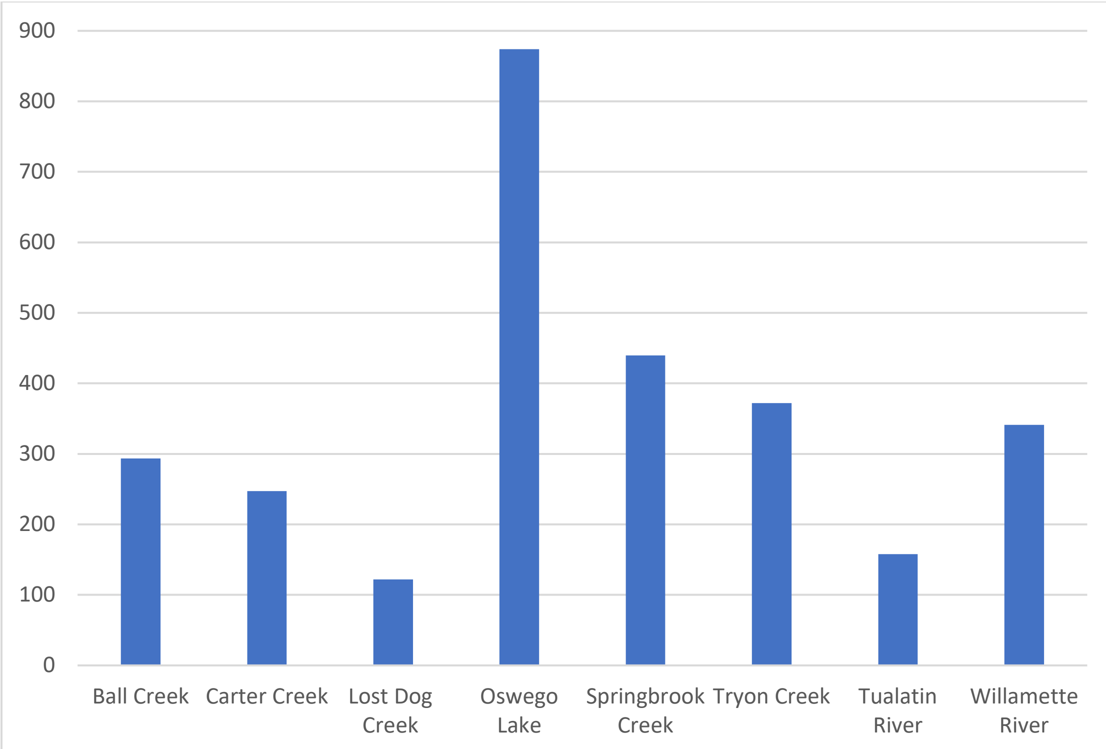


Figure 1. Impervious Area by Watershed, as calculated from 2019 LiDAR data

5.2 Legislative Changes

The City adopted Ordinance 2892, effective July 7, 2022, to comply with House Bill 2001. The bill required cities to allow duplexes, triplexes, quadplexes, and cottage clusters in single-family residential zones. The effect of the bill will increase the amount of impervious area and require additional capacity of the public system to avoid flooding and other hydromodification effects created by increased stormwater volumes and velocities.

The City adopted Ordinance 2908 on June 6, 2023 (effective July 6, 2023). The ordinance changed the development chapter of the municipal code (Chapter 50) to require public improvements for projects that were previously exempt, primarily in response to the State Legislature's requirement to allow denser housing options on properties that were formerly only zoned for single-family residential uses.

5.3 Annexations

The City has approximately 13 sq miles within its urban service area and 11.5 sq miles within its jurisdiction. Five properties (6 lots) were annexed into the City in FY2223 (see Table 3) with a connection to the public wastewater system being the most cited reason for annexation. Two property owners also indicated a potential for re-development which will result in an increase in impervious area. None of the annexed properties included a sensitive-lands overlay on the property.

Table 3. Annexations in Lake Oswego, FY2223.

Property	Area (acres)	Watershed	Potential Lots		Reason	Effect
			Pre-annexation	Post-Annexation		
16607/16667 Boones Ferry	0.60	Oswego Lake	2	9	Connection to public wastewater and develop the property	Increased impervious area
5375 Oakridge	0.23	Springbrook	1	1	Connection to public wastewater	Likely none
13611 Birdshill	0.98	Tryon Creek	1	4	Connection to public wastewater	Potential increase in impervious area
13237 Knaus	0.90	Tryon Creek	1	4	Connect to public wastewater and develop the property	Potential increase in impervious area
5807 Benfield	0.23	Tualatin River	1	1	Connection to public wastewater	Likely none
Total	2.94		6	19		

Based on the applications received by September 1, there are expected to be at least three properties annexed in FY2324 (5.8 acres). Two were initiated to connect to the public wastewater system and one was to connect to the City public water system.

From FY1617 to FY2223, an average of 8.6 properties have been annexed each year with an average area of 6.8 acres (see Table 4).

Table 4. History of Annexations in Lake Oswego, FY1617 to FY2324

Year	Number of Annexations	Acres Annexed	Year	Number of Annexations	Acres Annexed
FY2324[1]	3	5.8	FY1920	8	8.2
FY2223	5	2.9	FY1819	13	6.6
FY2122	8	8.4	FY1718	9	4.0
FY2021	12	10.8	FY1617	11	6.6

1 - As of 9/1/23.

5.4 Land-Use Review

In FY2223, there were 18 applications for variances, partitions, and lot line adjustments affecting 19 acres (see Table 5). The potential number of lots that could be created in the future remained the same (78 lots) due to zoning changes and lot line adjustments, however the general effect of the changes will be to increase impervious area.

Table 5. Effect of Land-Use on Impervious Area

LU Case	Watershed	Acreage	Potential Number of Lots		Change	Impervious Area Effect
			Previous	Current		
LU 22-0013	Oswego Lake	0.20	1	1	Increase lot coverage	Increase
LU 22-0014	Oswego Lake	1.57	6	7	2-Lot Partition	Increase
LU 22-0026	Oswego Lake	0.84	4	3	3-Lot Partition	Increase
LU 22-0028	Oswego Lake	0.83	4	4	3-Lot Partition	Increase
LU 22-0050	Oswego Lake	0.59	3	2	2-Lot Partition	Increase
LU 22-0055	Oswego Lake	0.44	2	2	2-Lot Partition	Increase
LU 22-0057	Oswego Lake	0.14	1	1	Increase lot coverage	Increase
LU 22-0058	Oswego Lake	0.79	6	4	Zone Change (R-5 to R-7.5)	Decrease
LU 22-0065	Oswego Lake	0.68	3	3	Lot line adjustment	No Effect
LU 22-0001	Springbrook	0.66	7	9	Lot line adjustment	Increase
LU 23-0012	Springbrook	0.90	3	3	2-Lot Partition	Increase
LU 22-0034	Tryon Creek	0.60	2	2	Lot line adjustment	No Effect
LU 22-0041	Tryon Creek	0.08	1	1	Increase lot coverage	Increase
LU 22-0045	Tryon Creek	0.43	3	3	2-Lot Partition	Increase
LU 22-0048	Tryon Creek	0.88	2	3	Lot line adjustment	Increase
LU 22-0049	Tryon Creek	2.25	6	6	3-Lot Partition	Increase
LU 22-0063	Tryon Creek	6.99	22	22	Lot line adjustment	No Effect
LU 22-0043	Willamette River	0.23	2	2	Lot line adjustment	No Effect
	Total	**19.1**	**78**	**78**		

There were 57 applications for development that went through the land-use review process and 34 were reviewed for stormwater management requirements. Most were for SFR projects, however there were five multi-family/mixed use projects, five institutional projects (schools), one commercial project (golf course), and one project on property zoned as industrial (bus barn). The industrial project may qualify for DEQ's industrial stormwater permit when it is constructed because of its fleet maintenance activities.

A majority of the projects required to go through the land-use process were located in the Oswego Lake watershed (17 projects). Projects in Tryon Creek watershed were a close second at 12 projects. The remaining five projects were located in the Springbrook Creek (3 projects) and the Willamette River (2 projects) watersheds.

6 STORMWATER FACILITIES

Stormwater facility design is governed by the Stormwater Management Manual (SWMM) and the Engineering Design Standards. Projects are submitted for compliance with these standards prior to construction.

While there is some overlap due to update schedules, the Engineering Design Standards primarily cover stormwater conveyance structures whereas the SWMM is the primary driver for stormwater management and treatment. There were no changes in FY2223 to the engineering design standards and detail drawings. The SWMM is currently being updated to comply with the 2021 MS4 permit and is expected to be implemented in Summer 2024.

A review and update of the LID/GI strategy was required as part of the 2021 MS4 permit and due December 1, 2023 (see Appendix C). In summary, the strategy requires infiltration of the 10-yr 24-hr storm event using all approved infiltration facilities as a first tier of stormwater management. The second tier of management requires filtration of all stormwater prior to discharging offsite. The filtration can be either through LID/GI or, for non-SFR projects, cartridge filters. The strategy will go into effect with the SWMM update in Summer 2024 pending DEQ approval. The outreach for the strategy included articles in the City's newsletters and social media platforms as well as an online comment form. The public comment period has not closed as of the writing of this report.

6.1 PRIVATE STORMWATER FACILITIES

Private development is governed by the Stormwater Management Manual (SWMM) and the Engineering Design Standards. Projects are submitted for compliance with these standards prior to construction.

6.1.1 Construction Plan Review

The SWMM requires onsite stormwater management for the 10-yr 24-hr design storm whenever technically feasible. Projects that create or replace 3,000 sq ft or more of impervious area are expected to meet flow requirements as well as water-quality requirements except for projects that 1) discharge directly, or through manmade infrastructure, to the Tualatin River, Oswego Lake, or the Willamette River and 2) are located in areas with no downstream capacity issues.

At the construction plan review stage, a draft operations and maintenance (O&M) plan must be submitted and, if approved, recorded with the County. Projects using infiltration trenches, infiltration galleries, and drywells are required to show that they have started the process for DEQ approval of their underground injection controls (UIC) when they submit construction plans for staff review.

In FY2223, staff reviewed 76 construction plans of which 65 were classified as large projects (3,000 sq ft or more of new and/or replaced impervious area). UICs were proposed for stormwater management in 34 projects. Vegetated facilities were used for 34 projects. The remainder used non-vegetated facilities such as pavers, water-quality vaults, and sand filters. There is some overlap because some projects proposed more than one type of stormwater facility.

One subdivision in the Oswego Lake watershed was approved for construction as wells as 14 commercial projects located in the Tualatin River, Oswego Lake, and Willamette River watersheds. There were no industrial projects approved for construction in FY2223.

6.1.2 Construction

After a construction plan is approved, the private stormwater design engineer must inspect the construction of the facilities and provide a signed certification to the City at project completion stating that construction of the stormwater facility adhered to the design. Before the end of construction, a copy of DEQ's approval for all constructed UICs must be submitted to the City. At the end of construction, a copy of the recorded O&M plan must be provided to the City.

6.1.2.1 Stormwater Treatment by Watershed

Stormwater facilities were completed for three commercial (5.6 acres), one institutional (1.3 acres), and 27 SFR projects (2.5 acres) resulting in 9.4 acres of created or replaced impervious area (see Table 6). The non-SFR projects were located in the Springbrook Creek, Oswego Lake, and Willamette River watersheds. A majority of all projects were located in the Oswego Lake watershed. A majority of the treated impervious area was in the Springbrook Creek and Oswego Lake watersheds.

Table 6. Impervious Area Created or Replaced, FY2223[1].

Watershed	Number of Projects	Impervious Area, acres	Non-SFR[2], Acres	SFR[3], Acres
Oswego Lake	9	3.4	2.7	0.7
Springbrook Creek	8	3.4	2.9	0.5
Tryon Creek	7	0.7	-	0.7
Tualatin River	3	0.3	-	0.3
Willamette River	4	1.6	1.3	0.2
Total	31	9.4	6.9	2.5

1 – Does not include projects with < 1,000 sq ft of new impervious area or flatwork that does not require a building permit (pool decks, sport courts, large patios; 2 – SFR means single-family residential; 3 – non-SFR means all other projects

6.1.2.2 Stormwater Treatment by Facility Type

The City's SWMM emphasizes infiltration of the 10-yr 24-hr design storm event (3.2 inches). Because infiltration creates shallow groundwater (interflow) that replenishes streams during the dry summers, it is expected that continued emphasize on infiltration facilities and onsite stormwater treatment will greatly assist the City with attaining the Willamette River temperature TMDL which affects every watershed in the City's jurisdiction.

Stormwater facility types treating the most impervious area were infiltration trenches and water-quality vaults (combined 63%) primarily because of the commercial projects (see Table 7). Filtration planters and infiltration galleries treated 24% of the total.

The City's MS4 permit emphasizes green infrastructure (GI) as the preferred method of stormwater treatment. Development tends to use GI and UICs to comply with the SWMM requirements. In FY2223, 20% of the stormwater was treated using GI. Infiltration facilities were used to treat 50% of the impervious area.

Table 7. Impervious Area Treated by Private Stormwater Facilities

	Oswego Lake	Springbrook Creek	Tryon Creek	Tualatin River	Willamette River	Total by Facility Type	
Facility Type	**Acres**	**Acres**	**Acres**	**Acres**	**Acres**	**Acres**	**% of Total**
Raingarden, Infiltration		0.1	0.1			0.2	2.0%
Raingarden, Filtration							
Planter, Infiltration	0.1	0.1				0.2	2.3%
Planter, Filtration				0.1	1.1	1.2	12.4%
Permeable Pavers	0.01				0.01	0.02	0.2%
EcoRoof							
Bioswale		0.2				0.2	2.2%
Drywell	0.2	0.1	0.1			0.4	4.6%
Infiltration Trench	2.8					2.8	29.5%
Infiltration Gallery	0.2		0.5	0.1	0.2	1.0	11.2%
Water-Quality Vaults		2.9			0.3	3.2	33.7%
Sheet Flow			0.02			0.02	0.2%
Pond	-			0.1		0.1	1.0%
Untreated	0.03		0.03			0.1	0.6%
Total by Watershed, Acres	3.4	3.4	0.7	0.3	1.6	9.4	
% Green Infrastructure[1]	4%	12%	9%	62%	70%		20%
% Infiltration[2]	99%	10%	93%	38%	14%		50%

1 – Green Infrastructure includes planters, raingardens, porous pavers, pervious pavement, bioswales, and EcoRoofs; 2 – Infiltration facilities include infiltration raingardens, infiltration planters, permeable pavers, infiltration trenches, and infiltration galleries

6.2 PUBLIC STORMWATER FACILITIES

Public stormwater facilities are built either through public improvements required by land-use, the capital improvement program, and Park and Recreation improvements. The Capital Improvement Program (CIP) constructs facilities in areas with no stormwater system or to increase capacity of existing infrastructure. The Parks and Recreation improvement process is required to build stormwater facilities to manage runoff from impervious area.

Before accepting stormwater facilities, the City requires a video of the system be completed to ensure that it meets requirements for structural integrity. In FY2223, the City required video of 6,500 feet of stormline.

6.2.1 Parks and Recreation Projects

One Parks and Recreation project was completed in FY2223 that had a stormwater component (see Table 8). The Indoor Tennis Center included a water-quality vault to treat previously untreated impervious area in the Springbrook Creek watershed. Two projects continued into FY2324 – the Lake Oswego Aquatic Center will include a flow-through raingarden and pond to treat 4.7 acres of impervious area in the Lost Dog (Oswego Lake) watershed and the Rassekh Park project will include large infiltration raingardens to treat impervious area in the Tualatin River watershed.

The Indoor Tennis Center is a retrofit project but was not included in the 2015 Retrofit Assessment. The Rassekh Park project, because it has infiltration facilities, will mitigate hydromodification in the Tualatin River watershed.

6.2.2 Public Improvements

Proposed private developments must meet SWMM requirements and some projects are required to construct public stormwater facilities. In FY2223, there were no public stormwater facilities built by private development. One project was required to extend the stormwater system 175 ft and another project replaced a culvert after moving the original driveway.

6.2.3 Capital Improvement Program

Projects in the Capital Improvement Program (CIP) are often comprehensive in nature. Many projects will repair, replace, or upgrade wastewater, water, stormwater, and pavement within the same project in order to take advantage of common costs and reduce transportation delays for commuters. Many projects are delayed or fast-tracked depending on funding, right-of-way acquisition, infrastructure conditions, rate of deterioration, and the ability to provide multi-utility improvements.

Table 8. City-Initiated Projects Affecting Stormwater, FY2223

Status	Project	Watershed	Description	Water Quality Impact
Capital Improvement Projects				
Completed	10 St Pump Stn	Tryon Creek	Redevelopment of reservoir property. Constructed an infiltration raingarden to treat 1,700 sq ft of existing impervious area.	Reduced Sediment/Trash Increased Water Quality Reduced Hydromodification
Completed	2022 Pavement Rehab	Various	Replaced 28 catchbasins with new 3-ft sumped catchbasins. Replaced 9 catchbasins with 3-ft sump/snouted catchbasins.	Reduced Sediment/Trash Increased Water Quality
In Process	Blue Heron Trunk Line (WO 298/329)	Oswego Lake	Reducing I/I[1] by replacing a failing wastewater line. Replacing a failing stormwater pipe and outfall.	Increased Water Quality
In Process	Hallinan Pathway (WO 320.2)	Willamette River	Constructing sumped/snouted catchbasins.	Reduced Sediment/Trash Increased Water Quality Reduced Hydromodification
In Design	Jean Rd/Pilkington Intersection (WO 273)	Oswego Lake	Construction of stormwater planters, water-quality vaults, and sumped/snouted catchbasins.	Reduced Sediment/Trash Increased Water Quality Reduced Hydromodification
In Design	Oak/Dyer Rehabilitation (WO 336)	Oswego Lake	Replacement of failed outfall	Reduced Sediment/Trash
In Design	Lakeview Blvd Improvement (WO333)	Oswego Lake	Improve drainage, rehabilitate roadway, and provide pedestrian facilities.	Reduced Sediment/Trash Increased Water Quality
In Design	Daniel Way Restoration (WO 323)	Springbrook Creek	Riparian stabilization, velocity reduction, and riparian restoration.	Reduced Sediment/Trash Increased Water Quality Reduced Hydromodification
Parks and Recreation Projects				
Completed	Indoor Tennis Center	Springbrook	Water-quality vault to manage 2,785 sq ft of new impervious area and 1,375 sq ft of existing untreated impervious area.	Reduced Sediment/Trash Increased Water-Quality
In Process	Lake Oswego Aquatic Center	Oswego Lake	Flow-through raingarden and pond to treat 4.7 acres of impervious area.	Reduced Sediment/Trash Increased Water-Quality
In Process	Rassekh Park Phase I (WO 307.1)	Tualatin River	Constructing an infiltration raingarden.	Reduced Sediment/Trash Increased Water Quality Reduced Hydromodification

I/I – Infiltration and inflow; WO = Work Order

Two CIP projects were completed in FY2223 that had a stormwater component (see Table 8). One was located in the Tryon Creek watershed and the other had locations across the city. The projects included creation of an infiltration raingarden and retrofitting catchbasins with 3-ft sumps and snouts.

Two CIP projects continued into FY2324 – they are located in the Oswego Lake and the Willamette River watersheds. Four projects, located in the Oswego Lake and Springbrook Creek watersheds, are in the design process.

6.2.3.1 Retrofit Projects

The 2015 Retrofit Assessment identified several retrofit criteria including protection of private and public infrastructure, repair or maintenance of existing infrastructure, improvement of water quality or natural resources, regulatory requirements, or the ability to be combined with another CIP project (multi-utility).

Catchbasin retrofits and providing upstream pretreatment for UICs were part of the 2015 retrofit list. In FY2223, the City installed new catchbasins with 3-ft sumps and water-quality snouts for 13 catchbasins discharging to UICs and nine catchbasins discharging to the public stormwater system. The City replaced 28 catchbasins with new 3-ft sumped catchbasins. Providing sumped and snouted catch basins should result in a decrease in the amount of total suspended solids that reach the streams in the City's jurisdiction thereby helping the City meet its mercury requirements for the Willamette River Mercury Total Maximum Daily Load (TMDL) [DEQ, 2019].

The City has begun design for the Lakeview roadway project listed in the 2015 Retrofit Assessments. It will include 3-ft sumped/snouted catchbasins and may include treatment facilities.

Projects that are not on the 2015 Retrofit list but considered to be retrofits include the Blue Heron Outfall Reconstruction, Hallinan Pathway, the Oak/Dyer restoration, the 10th St Pump Station, and the Lakeview Blvd project. The Blue Heron and Oak/Dyer projects will provide improved conveyance and reduced sedimentation. The Hallinan Pathway project will reduce sedimentation and increase water-quality by replacing catchbasins along the pathway with new 3-ft sumped/snouted catchbasins. The 10th St Pump Station resulted in the treatment of 1,700 sq ft of previously untreated runoff, was a multi-utility project, protects private and public infrastructure and reduce hydromodification.

6.2.3.2 Hydromodification Projects

Hydromodification occurs as the volume and velocity of stormwater changes a waterway over time. Methods for mitigating hydromodification are to increase infiltration or reduce stormwater velocities. To a lesser extent, detention can address hydromodification because it reduces the peak velocity of the stormwater however it can increase hydromodification if stream velocities are at peak flows for an extended period of time. The extended peak flows result in cohesion fatigue of soil particles in the streambed and streambank which leads to erosion.

Three projects will reduce hydromodification of waterways in the Tryon Creek, Oswego Lake, and Springbrook Creek watersheds. The 10th St Pump Station project provided an infiltration raingarden to reduce stormwater volume from 1,700 sq ft of previously untreated runoff. The Jean Rd/Pilkington project will provide infiltration planters and sumped/snouted catchbasins to treat previously untreated impervious area. The Daniel Way project will improve outfall velocities, provide more gradual slopes at the streambank, and improve stream sinuosity.

6.2.4 Retrofit/Hydromodification Assessment Update

The 2021 MS4 permit required an update of the 2015 Retrofit and Hydromodification Assessments including an updated prioritized list of projects (see Appendix D). While the City did not complete all of the projects on the 2015 lists, it has received numerous awards for completed projects that were either on the lists or could be considered as retrofits and hydromodification improvements.

Two of the completed projects on the lists received an APWA award for Project of the Year (Boones Ferry Rd and D Avenue). The Rockinghorse Lane project received recognition from the American Council of Engineering Companies of Oregon (ACEC).

While not on the 2015 lists, the pavement program completes many catch basin retrofits in the city each year and was recognized by the ACEC. The City Hall renovation project received a first-place award from the Oregon Daily Journal of Commerce as did the WIZER project. The WIZER project received multiple other awards including the prestigious Gold Nugget from the Pacific Coast Builders Conference (Best Mixed-Use Project) and LEED Gold certification. The water treatment plan (WTP) renovation received an award for its protection of cultural resources from the American Cultural Resources Association and two awards from the American Water Works Association (AWWA) for Excellence in Engineering.

Communication strategies are key to a project's success and can determine whether it is perceived positively by the public during and after construction and have an impact on whether a project stays within budget. Outreach awards for projects completed through the retrofit and hydromodification assessments included the Boones Ferry project (Excellence Award for the "Shop Lake Grove" outreach) and the WTP renovation (AWWA for "Best Strategic Communications Plan").

The updated project list required by the 2021 MS4 permit includes 29 projects located in every major watershed in the city at an estimated total cost of $43M with stormwater funds comprising approximately half of the cost. Not included in the list of new priorities are the funding of private riparian restoration through the HEP and the Backyard Habitat programs, public restoration activities, and LORA projects. The City is committed to continuing to fund these activities in addition to the projects listed in Table 4.

With the revised mercury TMDL, the City committed to decreasing sediment loading through retrofitting, when feasible, ditches, catch basins, culverts, and outfalls. These retrofits should also decrease hydromodification and stabilize stream temperatures.

Finally, the City has committed to continue monitoring water quality through:

Geomorphology assessments at its gaging stations and during macro-invertebrate studies,

Using updated LiDAR data to monitor impervious area and effective shade,

Increasing stormwater service using infiltration facilities when possible and extended filtration when infiltration is not possible,

Requiring additional erosion controls for properties with steep slopes or which are disturbing riparian or riparian-adjacent land,

Requiring certified ESC professionals for private and public development on complex projects such as commercial development,

Regularly reviewing its programs to update them, when necessary, with currently accepted stormwater practices.

This multi-pronged approach of infiltration, reducing sediment movement, retrofitting structures to treat impervious area that was previously untreated, continued riparian restoration of private and public areas, and water-quality monitoring will leverage the City's funds while allowing it to remain compliant with its regulatory requirements and be protective of water-quality.

7 STORMWATER MANAGEMENT PLAN

The Stormwater Management Plan (SWMP) provides the framework for the City's implementation of the MS4 permit and contains the minimum measures required in the MS4 permit along with measurable goals and tracking measures to assess progress in meeting milestones and the requirements of the permit. Additional details regarding the minimum measures are found in Appendix A.

The City's SWMP was approved by DEQ in February 2023 in the middle of the reporting year. Therefore, there are some metrics that were not tracked or were partially tracked based on the approval date. All metrics will be tracked for the FY2324 report.

7.1 Illicit Discharge Detection and Elimination

The Illicit Discharge Detection and Elimination (IDDE) program includes an IDDE plan, spill response, and training. Thirty Public Works (PW) staff and 43 Lake Oswego Fire Department (LOFD) staff were trained in spill response or hazardous material response in FY2223.

The City conducts two Drug TakeBack events every year which decrease the amount of unwanted prescription drugs discarded in the trash or into the wastewater system. The October event collected 404 pounds from 276 vehicles and the April event collected 600 pounds from 352 vehicles. While seemingly small amounts are discarded per household, they have become a source of emerging contaminants of concern because wastewater treatment plants (WWTP) are not designed to remove them.

7.1.1 IDDE

The IDDE program includes outfall monitoring, cross-connection investigations, and decommissioning of septic systems. The City is in the process of documenting unwritten policies and procedures in the IDDE Plan. Implementation is expected in 2024.

7.1.1.1 Outfall Monitoring

With the implementation of the new SWMP, the City is required to inspect 17 priority outfalls on a 2-yr rotating basis. Staff inspected six priority outfalls in FY2223. Two were located in the Springbrook Creek watershed, one from the Carter Creek watershed, two in the Ball Creek watershed, and one in the Oswego Lake watershed. One of the outfalls had a discharge which was determined to be coming from residential car washing (a permitted exception to the IDDE regulations). Staff inspected nine non-priority outfalls but did not track locations with groundwater discharges.

There were no changes to the prioritization criteria in FY2223.

7.1.1.2 Cross-Connections and Septic System Decommissioning

There was one cross-connection (wastewater to stormwater) discovered in FY2223. The property owner was required to disconnect from the stormwater system and connect to the public wastewater system. During development review, 14 projects were required to connect to the wastewater system.

7.1.2 Spill Response

No changes were made to the City's Spill Response procedures or to the City's municipal code. PW staff and LOFD staff provide spill response and maintain the inventory of spill response materials.

There were only ten reported spills this year and they occurred throughout the city (see Table 9). There were three concrete discharges of which one created an OERS report. A mobile car wash was responsible for a washwater discharge in the Tualatin River watershed and an SSO occurred in the Willamette River watershed. There were two instances where it appeared that the cause was unsecured contractor materials. Automobiles and trucks were responsible for the remaining spills. Staff and/or the source cleaned up the spills.

Table 9. Spill Response

Month and Year	Watershed	Material	Potential Cause	OERS Rpt #
September 2022	Oswego Lake	Oil	Vehicle Leak	-
September 2022	Oswego Lake	Concrete Washwater	Contractor	-
October 2022	Oswego Lake	Paint	Contractor	-
January 2023	Oswego Lake	Fuel	Vehicle Fuel Tank Rupture	-
August 2022	Springbrook Creek	Concrete	Catch basin construction	-
February 2023	Tryon Creek	Unknown Fluid	Contractor	-
September 2022	Tualatin River	Concrete	Contractor	2022-2099
September 2022	Tualatin River	Sediment	Mobile Car Wash	-
December 2022	Willamette River	SSO	Private Property Malfunction	Wastewater permit report
Various	Various	Fluid Leaks	32 Automobile Crashes	-

OERS= Oregon Emergency Response System; SSO= Sewer System Overflow

Public education was used in the form of verbal warnings and social media posts to prevent future discharges. Staff created a new factsheet regarding mobile car washes and posted it on the website.

The Tualatin Valley Fire & Rescue (TVF&R) and LOFD have an agreement for consultation and incident response for hazardous material spills. There were no incidents requiring consultation or response by TVF&R in FY2223.

7.2 Industrial and Commercial Facilities

The industrial and commercial facility program includes monitoring development for inclusion in the DEQ Industrial Stormwater (1200-Z) program, conducting inspections of properties that are not part of the 1200-Z program but which are in commercial or industrial zones, and training. The City currently has one staff person who has experience with business inspections but none who hold current certifications.

7.2.1 Strategy Update

The City formalized the inspection and screening processes of its commercial and industrial inspection program in 2023. Municipal code changes were necessary and staff provided information about the program and the proposed municipal code changes to the City Council in November 2023.

All non-SFR properties were sent a letter asking for comment on the program after the strategy was placed on the City's website with an online comment form. Outreach consisted of articles in the City's two newsletters and multiple postings on the City's social media platforms. The City also reached out multiple times to the Chamber of Commerce for a question & answer session on the program but was unable to schedule it.

Six comments have been received as of the writing of this report. Two comments were about exemptions from the program, one was about the inspection process, and three were about the changes to the municipal code.

7.2.2 Development Review

Two land-use cases were submitted for commercial and industrial properties. Both were located in the Oswego Lake watershed. The industrial project, a bus barn, may qualify for DEQ's Industrial Stormwater permit because of the fleet maintenance involved at the project.

Construction plan review was completed on 14 commercial projects but no industrial projects (see Table 10). Four of the projects were in the Willamette River watershed, two were in the Tualatin River watershed, and eight were in the Oswego Lake watershed. A majority of the impervious area (13 acres) was proposed to be treated by raingardens and filtration planters followed by infiltration galleries (5.9 acres), and a sand filter (5.8 acres).

7.2.3 Construction

Two commercial projects and one institutional project were completed but no industrial projects were completed in FY2223. The commercial projects were located in the Springbrook Creek watershed. They used filtration planters and water-quality vaults to treat stormwater. The institutional project, a new City Hall, used filtration planters and water-quality vaults to treat impervious area that had primarily been previously untreated.

Table 10. Treatment of Impervious Area for Commercial and Industrial Projects

Facility Type	Oswego Lake acres	Springbrook Creek acres	Tryon Creek acres	Tualatin River acres	Willamette River acres	Total, Acres
Raingarden	1.4	-	-	4.3	0.7	6.4

Filtration Planter	5.1	-	-		1.2	6.3
Infiltration Gallery	4.9	-	-	0.7	0.3	5.9
Water-Quality Vault	-	-	-	-	0.1	0.1
Sand Filter	5.8	-	-	-	-	5.8
Total	**17.2**	**-**	**-**	**5.0**	**2.3**	**24.5**

7.2.4 Inspections and Notifications

No DEQ 1200-Z notifications were sent to businesses in FY2223. No industrial or commercial projects were identified as potential sources of high-pollutant loading and no inspections were conducted in FY2223.

7.3 Construction Site Runoff Control

Construction site runoff control, or erosion and sediment control (ESC), is an important program for reducing total suspended solids in streams and other waterways. The City currently has a 500-sq ft soil disturbance threshold for ESC permits and also requires a permit for projects that are within 50 ft of a lake or waterway. The program consists of reviewing plans, inspecting projects, and training.

There were 11 City-initiated projects with certified ESC professionals as part of the project team in FY2223. Seven of the projects were completed in FY2223, three are under construction, and one is in design.

7.3.1 Regulatory Changes

There were no changes to the municipal code regarding erosion and sediment control nor were there changes to the ESC requirements for wet weather. Check dams and temporary berms were removed from the City's list of approved erosion and sediment controls and biobags are have been banned for use as a control measure. Straw wattles are now required (previously an option) as a perimeter control in tree protection areas instead of sediment fences primarily due to the damage of fence installation on tree roots. Sediment fences are required for all other areas.

To assist with mercury and suspended solids reductions, the City started requiring coir matting in riparian projects and started tracking the number of projects needing DSL/USACE jurisdictional decisions or which had slopes greater than 15%. In FY2223 three projects in riparian areas were required to provide matting, six needed DSL approval or waivers, and three had steep slopes. Most of the projects were in the Oswego Lake watershed.

7.3.2 Plan Review

There are four PW staff who are certified ESC professionals. In FY2223, the City started requiring a certified ESC professional to submit ESC plans for complex projects, e.g. non-SFR projects, to reduce suspended solids. In FY2223, five ESC plans were submitted by certified ESC professionals. The City issued 176 ESC permits in FY2223 with a majority of the permits classified as single-family residential projects.

7.3.3 Inspections and Enforcement

Staff conducted 241 initial inspections and 172 final inspections for construction projects. Starting in January 2023, the City increased the number of inspections for projects that had been in process for 6 months or longer. There were 34 additional inspections completed from January 2023 to June 2023.

Two stop-work orders were issued in FY2223; one was in the Oswego Lake (Lost Dog) watershed and one was in the Tryon Creek watershed. No projects received more than one stop work order. Citations were issued for a project in the Willamette River watershed and the Oswego Lake (Lost Dog) watershed.

7.4 PUBLIC EDUCATION AND OUTREACH

The City is a member of several regional stormwater outreach groups including the Regional Coalition of Clean Rivers and Streams (RCCRS), the state-wide Clean Rivers Coalition (CRC), and the Clean Water Partners. In addition, staff provide stormwater education and outreach through social media (Facebook, Twitter, and Instagram), newsletters (HelloLO and LO Down), and water audits. Stormdrain marking is available for private groups as a volunteer option.

7.4.1 City Outreach

The City primarily uses newsletters and social media to educate the public about stormwater. In FY2223, staff started using ALT text on social media to provide assistance to those with disabilities.

The City has over 6,000 followers on both Twitter and Facebook. Instagram posts by the City reach over 9,000 followers and Nextdoor posts reach almost 23,000 people. Social media messages included native habitat, pesticide/herbicide use, illicit discharges, leaf removal from catchbasins, and pet waste.

The City featured three articles in the Hello LO and LO Down newsletters in FY2223 covering dock maintenance, lawn care, and recruiting public comment for the City’s stormwater management plan and monitoring plan. In September 2022 and January 2023, the City provided a newsletter to 52 commercial establishments along the newly renovated Boones Ferry Road with information on maintaining private stormwater facilities and how to report spills and illicit dischargers.

In FY2223, staff started refreshing the website content including removing redundant content and creating a new webpage for business outreach in preparation for the 2021 permit requirements for education. Staff created factsheets on catchbasin cleaning, dock maintenance, carpet cleaners, and mobile car washers; they also updated the "Report a Spill" webpage and placed it on the "How Do I" drop down list featured on the City's main webpage.

The City offers free hose timers, rain sensors, soil test kits, soil moisture probes, and spray bottles for natural weed control as well as several brochures providing information on natural gardening, hazards in the home, and safe disposal of household chemicals and medicines. All of the items and brochures are accessible to the public by requesting them through the telephone, email, or at the reception area.

Manuals, permits, annual reports, and other stormwater-related documents are available to the public through the City's website or by requesting them through telephone or email. There were four comments on the documents located on the City's website in FY2223.

7.4.2 Stormwater Education Partnerships

The City partners with several regional stormwater education groups to provide consistent messaging. The RCCRS has provided stormwater messaging on a variety of topics to residents of the tri-county Portland metropolitan area (estimated population of 1.8 million) for over 25 years. The CRC has over 60 partners across Oregon and Washington with a mission is to build a bridge between clean water and healthy communities and provide consistent messaging across Oregon and southwest Washington. The Clean Water Partners work with a local TV station, KPTV, to provide public service announcements (PSAs).

7.4.3 Regional Coalition of Rivers and Streams

The RCCRS currently uses a variety of social media platforms (Twitter, Facebook, Instagram) and its website to educate the public on issues such as uncollected pet waste, proper fertilizer and pesticide use, proper disposal of hazardous substances such as oil and solvents, and the connection between personal choices and their effect on our rivers and streams. They started working with Clearing Magazine in FY2223 to promote the Honoring Our River program which is a student art and writing program.

Social media (Facebook and Instagram) reached 570,000 people and paid ads reached 350,000 people. The RCCRS continues to attract followers on social media: it saw an increase on all platforms. It has over 2,600 followers on Facebook, close to 1,000 followers on Instagram, and over 1,600 followers on Twitter. Their YouTube channel received 11, 243 views.

7.4.4 Clean Rivers Coalition

The CRC has a website and a presence on Facebook, YouTube, Twitter, and Instagram. They partnered with Northwest Center for Alternatives to Pesticides to launch outreach, training, and video in Spanish. Key messages included pesticide and herbicide use, stormwater planter education, riparian habitat, and 6-ppd quinone's effect on salmon.

7.4.5 Clean Water Partners

In FY2223, PSAs by the Clean Water Partners included messages on water conservation, herbicide and fertilizer use, car washing, good practices for fall maintenance, and keeping leaves out of the public stormwater system. Information regarding leaf disposal and keeping catchbasins free of leaves were run as part of the campaign throughout the wet weather season.

The PSAs were broadcast on KPTV over 500 times during the year and were viewed by an average 820,000 people each month. KPTV provides banners on its website and, in FY2223, they reached an average of 392,000 people each month. Facebook posts reached an average 3,400 viewers each month.

7.5 Public Involvement

The City works with volunteer groups through its Friends of Parks program and the Habitat Enhancement Program. In FY2223, the City sponsored 30 volunteer work parties (approximately 2,000 volunteer hours) to remove invasive plants and install native plants.

The 2021 MS4 permit required 30-day public comment on the stormwater management plan and the monitoring plan. The City used social media and newsletters to reach citizens who might be interested in providing comments. Four comments on the plans.

7.6 Pollution Prevention for Municipal Operations

The MS4 permit requires the City to inspect and maintain its stormwater infrastructure including repair or replacement of non-functioning components. The City is also required to report on street sweeping, winter maintenance, inflow/infiltration (I/I), pesticide use on City-owned property, and emergency response.

7.6.1 Conveyance Infrastructure Maintenance

The City's public stormwater system contains over 132 miles of stormline, 52 ditches, 28 culverts, over 4,400 catch basins, and approximately 3,100 manholes. There were no changes in the City's bridge inspection procedures nor to the inspection and maintenance procedures for the stormwater conveyance system.

Staff cleaned and inspected 1,645 catchbasins in FY2223. Staff inspected 194 manholes and cleaned 23 of them; none needed repair or replacement. No stormline was repaired or replaced, however 706 feet were inspected and 1,197 feet were cleaned. Staff cleaned 500 feet of ditches and inspected 175 ft of culverts.

Staff collected 1,200 cu yd of debris through the stormwater infrastructure maintenance program. The debris is sent to the Wasco County landfill after passing a toxicity (TCLP) analysis.

7.6.2 Street Sweeping

In general, commercial streets are swept every week while major commuter routes are swept once a month. Curbed residential areas are swept four to six times per year. Approximately 4,500 lane miles were swept in FY2223. Debris is combined with the conveyance system debris before being sent to the Wasco County landfill.

The City's canopy cover exceeds 50% (with an effective shade of 88.6%) which presents challenges in regard to flooding caused by leaves blocking inlets and catch basin grates. Staff removed approximately 893 cu yd of leaves in FY2223 as part of the street sweeping program.

7.6.3 Winter Maintenance

Elevations in the City range from approximately 1,000 ft in the northern section (Nansen Summit) to 98 ft at Oswego Lake in the middle of the city, to over 700 ft in the southern section of the city (Cook's Butte and Crestline Drive). During winter weather, these elevation changes create challenging public safety situations. The City uses gravel and magnesium chloride to increase safety on the streets when ice and/or snow are forecast. After a storm event, staff sweeps the streets to remove as much sand as possible from the event.

In FY2223, there were several winter events and all priority routes were affected by one or more events. Staff worked four 12-hour shifts and applied 80 cu yds of sand and 17,400 gallons of magnesium chloride in response to the events. Lane miles for magnesium chloride were not tracked in FY2223.

7.6.4 Wastewater Infrastructure

Staff repaired 35 wastewater mainlines, five service laterals, and 19 wastewater manholes in FY2223 at a cost of $243K. Three CIP projects involved I/I reduction - they affected the Tualatin River, Oswego Lake, and the Willamette River watersheds. Approximately $2.5M was spent on the projects in FY2223.

7.6.5 Pesticides

Parks & Recreation staff reviewed the Integrated Pest Management (IPM) plan in January 2023. Staff removed two pesticides (Velista and AquaNeat) and added one (Prophesy) to its list of approved pesticides and provided a presentation before the Parks Board.

The City employs 15 staff who are certified pesticide applicators and 3 contractors. Training on the changes to the IPM Plan were provided to all certified staff.

7.6.5.1 Pesticide Use

The City uses a range of pesticides along the Willamette Trolley line, in City parks and natural areas, and in street medians. In FY2223, it used approximately 56 gallons and 36 pounds of pesticides (see Table 11). The pesticides used most frequently were glyphosate, triclopyr, and trifluralin.

The amount of pesticides used is dependent on the efficacy of the pesticide but also the weather, total rainfall, and many other factors that are not within the City's control. However, staff used less pesticide use in FY2223 than the previous 5 years (average of 131 gallons and 220 pounds).

7.6.5.2 Reduction in Pesticide Use

To reduce the amount of pesticides used on City-owned property, the City's Parks and Recreation and the Operations/Maintenance departments use a combination of mulch, hand weeding, irrigation system improvements, and a vinegar solution for vegetative maintenance in addition to pesticides. As another avenue for reducing pesticides, the City is pursuing a designation as a Bee City which includes a commitment to 1) reducing pesticide use, 2) creating or enhancing pollinator habitat, 3) incorporating pollinator-conscious practices into city policies, and 4) hosting pollinator-awareness events.

Table 11. Pesticides Used on City-Owned Property

Pesticide Name	Active Ingredient	Quantity Used		Department[1]
		Gallons	Pounds	
Advion	Indoxacarb	0.01		F
Aquaneat	Glyphosate	24.31		P
Garlon 3A	Triclopyr	0.23		P
Generation Blue Max	Difethialone	0.73		F
Poast	Sethoxydim	0.05		P
Rodeo	Glyphosate	7.81		P
Roundup	Glyphosate	1.55		PW
Select Max	Clethodim	0.84		P
Snapshot	Trifluralin		36	P

Sureguard	Flumioxazin	0.25	0.08	P
Transline	Clopyralid	0.44		P
Vastlan	Triclopyr	20.10		P
Velista	Penthiopyrad	0.15		P
	Total	**56.46**	**36.08**	

1 – P=Parks and Recreation, PW=Public Works, F=Fire

7.6.6 Emergency Response Procedures

The City's Emergency Operations Plan was updated in 2017 and is currently undergoing a review and revision. The City's Natural Hazards Mitigation Plan was updated in 2019 and is currently undergoing a review and revision. Expected implementation dates for both are in FY2324.

With the increased scrutiny of per- and polyfluoroalkyl substances (PFAs and PFOAs), the City reviewed its firefighter training and foam usage. The LOFD does not conduct outdoor firefighting training within the City’s regulatory jurisdiction and its fire-fighting foam is certified free of PFAs and PFOAs.

7.7 Stormwater Facility Maintenance

The City inspects and maintains public stormwater facilities and requires private owners to maintain private facilities. Public stormwater facilities are added to the GIS (LO Maps) when as-builts are submitted at project completion.

7.7.1 Public Stormwater Facilities

Public stormwater facility maintenance by Parks and Recreation staff primarily consists of removal of invasive species and debris. Filter vaults and vegetated stormwater facilities are maintained by an outside contractor for Public Works.

In FY2223, 23 water-quality vaults were inspected and cleaned with 35 cartridges replaced in the vaults. Stormwater planters are located throughout the city with a majority discharging to Oswego Lake (see Table 12). The City had 124 planters inspected but only one (1) of the planters required replanting. Two detention/retention ponds were inspected in FY2223. None required restoration. There are four bioswales located along a street in the Springbrook Creek watershed; they were replanted in FY2223.

Raingardens, swales, and a detention pond are located throughout the city in parks and natural areas. None needed repairs or restoration.

7.7.2 Private Stormwater Facilities

In FY1819, the City updated its policies and procedures and began routine inspections of private stormwater facilities in FY1920. The City has placed a higher priority on educating property owners about their stormwater facilities and keeping the most recently completed facilities functioning properly.

Table 12. Public Vegetated Stormwater Facilities

Location	Watershed	Type	Facilities Inspected/ Maintained	Restoration
Public Works Facilities				
Meadowcreek	Ball Creek	Planter	4	N
Westlake	Ball Creek	Planter	2	N
Boone's Ferry	Oswego Lake	Planter	43	Y (replaced dead plants)
West Bay/Virginia	Oswego Lake	Planter	14	N
Second Street	Oswego Lake	Planter	10	N
Leonard Street	Oswego Lake	Planter	1	N
Jean Rd/Bryant	Oswego Lake	Planter	11	N
Jean/Lakeview	Oswego Lake	Detention Pond	1	N
Pilkington	Oswego Lake	Detention Pond	1	N
Knaus Road	Springbrook	Bioswale	4	Y (replaced dead plants)
Kerr Pkwy	Springbrook	Planter	2	N
D Ave	Tryon Creek	Planter	29	N
Tenth St	Tryon Creek	Planter	8	N
Park and Recreation Facilities				
Luscher Farms	Oswego Lake	Detention Pond	1	N
Hazelia Park	Oswego Lake	Swale	1	N
Sundeleaf Plaza	Oswego Lake	Infiltration Raingardens	3	N
Iron Mtn Park	Springbrook Creek	Flow-through Raingardens	2	N
Brock Property	Tualatin River	Swale	1	N

There were 52 residential and 2 commercial property inspections in FY2223. Twenty of the properties were first-time inspections. Only one visit was needed for 36 of the 54 properties. No citations were issued in FY2223.

The majority (79%) of the inspected facilities were constructed between 2018 and 2020 (no facilities newer than 2020 were inspected) and a majority (43%) of the inspected facilities were in the Oswego Lake watershed.

The total impervious area treated by the inspected facilities was 6.5 acres with commercial properties comprising approximately 0.9 acres. Four acres was treated by facilities categorized as green infrastructure. A little over 3 acres was treated by infiltration facilities. There is some overlap between green infrastructure and infiltration facilities.

8 ENVIRONMENTAL MONITORING PROGRAM

The City's monitoring plan includes instream monthly sampling at six sites and stormwater sampling at two sites (see Figure 2). The City also maintains continuous monitoring (gaging) stations at Lost Dog Creek and Springbrook Creek. Instrumentation at the stations collect discharge and field data.

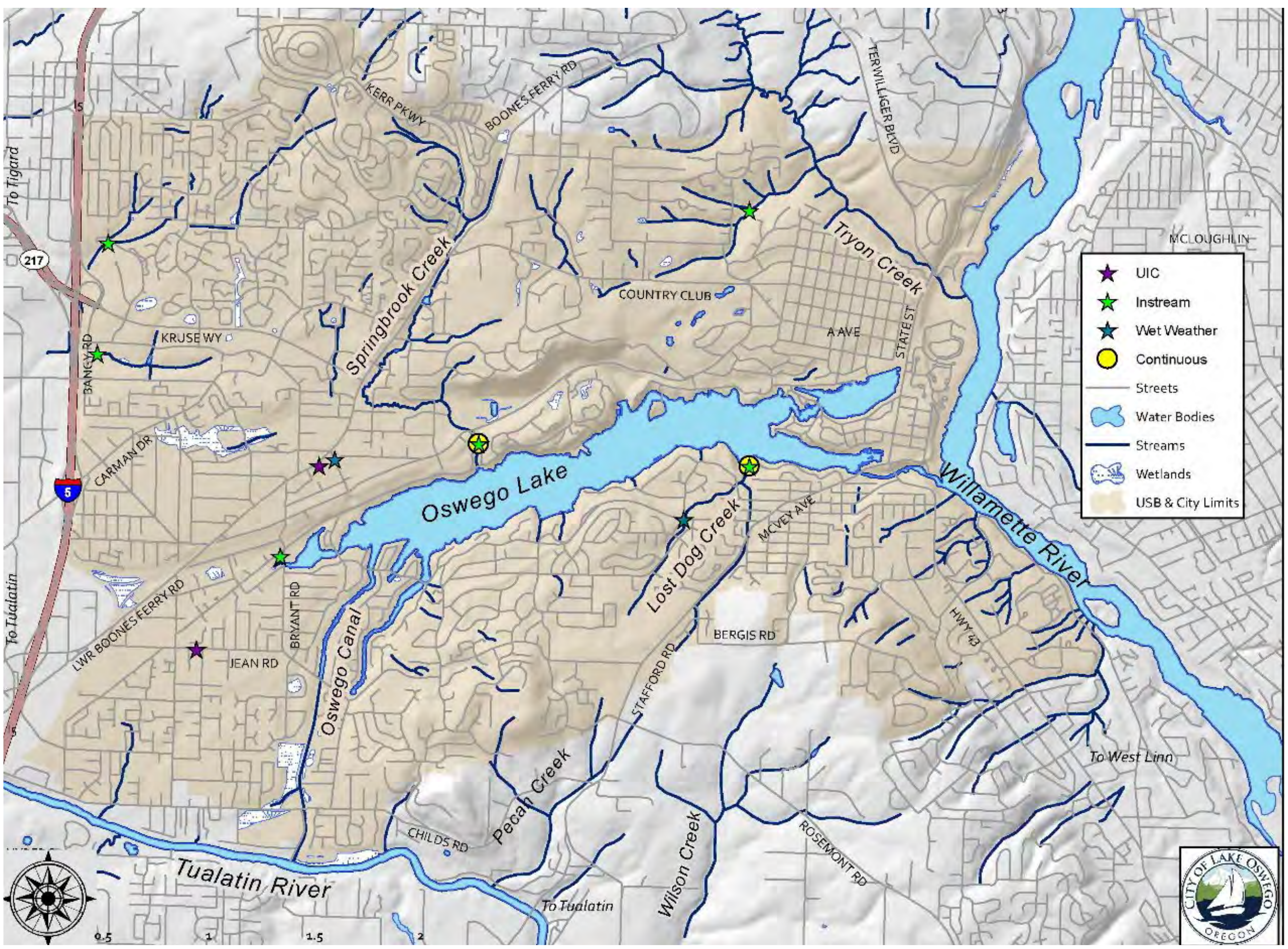


Figure 2. Wet Weather and In-Stream Monitoring Sites in Lake Oswego

The City provided $2,100 to the US Geological Survey (USGS) in FY2223, in collaboration with other permittees, to operate and maintain the USGS hydrological station (#14207500 - Tualatin River @ West Linn).

8.1 Monitoring Plan Changes

The City was required to update its monitoring plan to comply with the 2021 MS4 permit. It received DEQ approval of the revised plan in June 2023. The new plan revised the stormwater monitoring locations and added pesticides as a regular monitoring activity for stormwater sampling. Instream sampling changes include:

- Removal of biological oxygen demand and turbidity
- Removal of total organic carbon from quarterly sampling
- Addition of total iron to quarterly sampling
- Addition of field blanks for quality control
- Dissolved organic carbon was changed from quarterly to monthly sampling;
- Volatile suspended solids (VSS) were changed from monthly to quarterly sampling

While not required by the permit, VSS was kept in the instream sampling suite because of the dissolved oxygen TMDLs for Fanno Creek and its tributaries. Iron was added to the instream sampling suites because of its 303(d) listing in the Tualatin watershed and the historical iron mining in the area.

Regular mercury sampling, required as part of the 2021 MS4 permit, will be completed by staff from Water Environment Services. Discussions that include these changes will occur with the FY2324 report.

8.2 Wet Weather Monitoring

Each year, the City collects stormwater samples from two sites in the Oswego Lake watershed during rain events that provide at least 0.1 inches of precipitation. The wet weather site on Reese Road is in an urbanized area with many commercial businesses. It receives runoff from Boones Ferry Rd, a major arterial street in the City, which finished a major reconstruction in FY2122. The wet weather site on South Shore is primarily residential with schools, Luscher Farms, and a golf course in its watershed.

Water samples are collected at each site for a variety of parameters such as metals, nutrients, hardness and bacteria. Field measurements include pH, dissolved oxygen, temperature, and conductivity.

8.2.1 Boones Ferry at Reese Rd

Temperatures in FY2223 were above the historical median (FY1718-FY2122) and the June event equaled the historical maximum (see Table 13). pH was higher than the historical median for both sampling events. The concentrations for total zinc met the historical maximum in the June 2022 samples. While there were no concentrations less than the historical minimum concentrations, all of the metals (total and dissolved) were less than the historical medians for the October 2022 event. Lead concentrations (total and dissolved) in the June event were less than the historical median.

Table 13. Stormwater Monitoring.

	Precipitation[1] (inches)	Water Temp (°C)	pH	Dissolved Oxygen	E Coli[4] (MPN/100mL)	Ammonia (mg/L)	Nitrate (mg/L)	Tot Phos (mg/L)	O-Phos (mg/L)	Tot Copper (mg/L)	Diss Copper (mg/L)	Tot Lead (mg/L)	Diss Lead (mg/L)	Tot Zinc (mg/L)	Diss Zinc (mg/L)	TSS[2] (mg/L)
Boones Ferry																
FY2223																
10/28/22[3]	1.02	12.7	7.28	8.98	451	0.53	0.25	0.262	0.20	0.0094	0.0060	0.0012	0.00020 J	0.092	0.058	22.0
6/19/23[3]	0.58	19.1	7.26	6.71	239	0.81	0.42	0.490	0.13	0.0193	0.0129	0.0026	0.00027 J	0.159	0.102	68.7
Historical (FY1718-F2122)																
Maximum	0.72	19.1	7.89	10.90	>2420	1.40	0.63	0.520	0.21	0.0400	0.0150	0.0079	0.00055	0.159[5]	0.102[5]	207.0
Median	0.33	11.5	7.04	7.78	367	0.32	0.17	0.295	0.08	0.0121	0.0060	0.0036	0.00030 J	0.129	0.070	52.0
Minimum	0.10	8.5	6.39	4.23	<1	0.04	0.01	0.246	0.01	0.0047	0.0026	0.0005	0.00010 J	0.088	0.039	27.0
Lost Dog at South Shore																
FY2223																
10/28/22[3]	1.02	11.5	7.1	11.2	>2420	0.03	0.33	0.136	0.09	0.0140	0.0115	0.0007	0.00010	0.172	0.167	10.5
6/19/22[3]	0.58	13.3	7.4	10.3	1327	0.08	0.72	0.303	0.11	0.0683	0.0565	0.0031	0.00071	0.319	0.221	66.5
Historical (FY1718-FY2122)																
Maximum	0.72	17.7	7.60	11.86	>2420	0.17	1.55	0.362	0.15	0.0190	0.0116	0.0026	0.00076	0.362	0.211	67.0
Median	0.33	10.45	6.91	10.11	1132	0.04	0.58	0.114	0.05	0.0073	0.0058	0.0008	0.00007 J	0.039	0.030	23.5
Minimum	0.10	8.3	5.88	6.23	28	<0.0084	0.23	0.049	0.01	0.0040	0.0026	0.0002	0.00004 J	0.023	0.013	6.5

1 – Antecedent 24-hr precipitation = 0.00 for both FY2223 storm events; 2 – Results are from a method for which the laboratory is not accredited: 3 – Results are the median of the grab samples for the storm event except for E. Coli which is the geomean of the event; 4 – For Lost Dog bel South Shore results, non-field parameters are the average of the composited sample and its replicate; 5 – The zinc data for April 2022 is flagged as an outlier and not used for statistical analyses

J – estimated concentration (below the reporting limit but above the method detection limit); Diss – Dissolved; Phos – Phosphorous; Tot – Total; TSS – Total Suspended Solid

The field blank collected for the October 2022 event had a small amount of contamination for nitrate (0.01 mg/L versus the detection limit of 0.005 mg/L). The result for the regular sample was 0.42 mg/L however, and was likely not biased by the field blank.

8.2.2 Lost Dog at South Shore

Dissolved oxygen concentrations, where higher concentrations are preferred, were above the historical median concentration for both storm events. The June sampling event saw concentrations greater than the historical maximum (FY1718-FY2122) for *E. Coli,* dissolved copper, total lead, and dissolved zinc. The October event showed concentrations less than the historical median for ammonia, nitrate, total lead, and total suspended solids.

8.3 INSTREAM MONITORING

The City collects monthly instream water samples from six sites. Three of the sites discharge to Oswego Lake, two discharge to Fanno Creek (a Tualatin River tributary), and one discharges to Tryon Creek (a Willamette River tributary).

Water samples are collected at each site for a variety of parameters such as metals, nutrients, hardness, and bacteria. Each quarter, the City collects information on organic carbon, cations, and anions. Field measurements include pH, dissolved oxygen, stream temperature, and conductivity. Samples from storm events (wet weather) are collected for the same parameters as the monthly locations. The data collected at these sites is discussed in more detail with the discussion on TMDLs and water-quality limited streams (Sections 9.6 and 9.7, respectively).

8.4 CONTINUOUS MONITORING STATIONS

The City upgraded the equipment at its continuous monitoring stations in 2018 and 2019. In 2018, both stations received new submersible pressure transducers to measure stage and new YSI EXO-3 sondes to measure dissolved oxygen, turbidity, pH, conductivity, and temperature.

Crest-stage gages were installed in Springbrook Creek in 2018 and in Lost Dog Creek in 2019 to verify peak flows. A new staff gage was installed in October 2019 at Lost Dog Creek and relocated downstream of the original gage to provide better data quality.

Gaging station data is analyzed by water year (WY); the following discussion is related to water quality and discharge data collected during WY22 (October 2021 to September 2022).

8.4.1 Lost Dog Creek

Lost Dog Creek drains an urbanized area of 0.66 sq mi with an average slope of 7%. It is composed of three branches which start at Bergis Rd, Luscher Farms, and the Lake Oswego

Public Golf Course. Two branches join within the first 1,300 ft but the third branch joins approximately 500 ft before Lost Dog discharges into Oswego Lake. The Bergis Rd and Luscher Farms branches daylight in and out of piped areas that are either undeveloped or have residential and institutional uses (churches, golf courses, and schools).

The stream channel near the gaging station is moderately entrenched with cascading pools, steep banks, and little vegetation in the channel. The streambed near the gaging station is composed primarily of gravel and cobbles with some boulders.

Discharge during WY22 ranged from 0.04 cfs to an estimated 36.5 cfs. The maximum discharge occurred on January 3, 2022 when a storm dropped 1-inch of rain during a 3-hr window. This marks the third year in a row where a majority of the precipitation from a storm has fallen in 2-3 hours.

The median temperature for WY22 was generally the same for the historical instream measurements (FY1718 to FY2122), the gaging station measurements and the instream measurements for WY22 (see Figure 3).

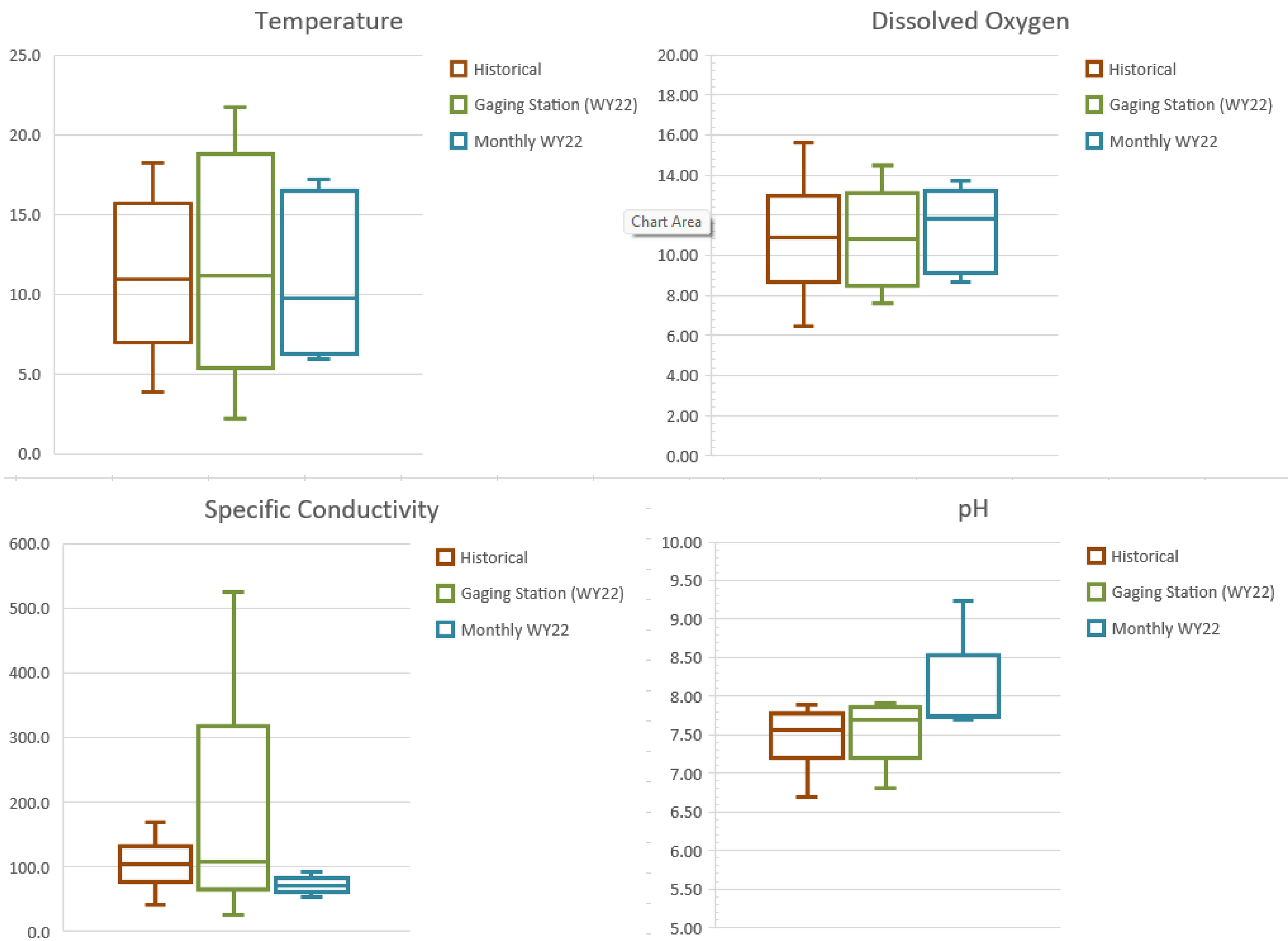
Dissolved oxygen concentrations were slightly higher for the instream sampling but the historical instream measurements and the gaging station measurements were similar. Specific conductivity and pH outliers were more pronounced at the gaging station and the pH measurements taken during for instream monthly visits. The specific conductivity spike at the gaging station may have been due to the use of magnesium chloride during a winter event.

8.4.2 Springbrook Creek

Springbrook Creek drains an urbanized area of 1.98 sq mi with an average slope of 4.5%. It is largely unconfined and composed of approximately nine branches, three of which drain a majority of the watershed which contains a mixture of uses.

The stream channel in the area of the gaging station is trapezoidal with steep banks and very little vegetation in the channel. The streambed is composed of fines and gravel with cobbles and boulders on top. Discharge measurements in WY22 ranged from 0.39 cfs on September 14, 2021 to an estimated 145 cfs on May 2, 2022. The maximum discharge occurred during a 0.9-inch storm event where 0.6 inches fell within a 2-hr period.

Water-quality measurements at the Springbrook gaging station were rated as fair to poor due, in part, to a malfunctioning sonde and corresponding lack of data recorded from October 4, 2021 to December 1, 2021. Because the data are rated as fair to poor, there is no discussion of the water-quality measurements for this report.



Historical = Instream monthly measurements from July 1, 2016 to June 30, 2021; WY21 = October 1, 2020 to September 30, 2021. Temperature is measured in °C, dissolved oxygen is measured in mg/L, specific conductivity is measured in µS/cm, pH is a standard dimensionless unit.

Figure 3. Lost Dog Water-Quality Field Parameters

8.4.3 Precipitation Analysis

The City partnered with a consultant to complete a precipitation analysis in FY2122 based, in part, on precipitation records from five weather stations located throughout the City. The analysis found that, with the exception of 2015, the largest 24-hr storm was during 2021 for all but the Westlake Fire Station (WEST, 2022). It also found that the 10-yr 24-hr storm was 3.30 inches. The bankfull storm (1.2-yr recurrence interval), is defined as the storm causing streams to overtop their banks; it was 2.19 inches.

The average annual precipitation over the last 30 years was found to be 43.0 inches in the City which is a little more than the widely-accepted annual average of 42 inches (see Table 14).

Table 14. Precipitation for 24-hour Return Events and the Average Annual Precipitation

Weather Station	30-year Annual Average, inches	24-hour Return Event			
		1.2-year[1], inches	2-yr, inches	10-yr, inches	25-yr, inches
City Hall	43.9	1.96	2.35	3.17	3.69
Marylhurst	43.9	1.94	2.33	3.14	3.66
Municipal Golf Course	43.9	2.08	2.49	3.35	3.89
Nansen Summit	44.1	2.15	2.57	3.45	4.01
Westlake Fire Station	43.6	2.12	2.54	3.42	3.98
City-Wide	43.0	2.19	2.45	3.30	3.84

1 – Typical return period for the bankfull discharge in the Pacific Northwest.
Source: WEST Consultants, 2022

8.5 Macroinvertebrate Assessment

To assess biological communities and the long-term water-quality of its streams, the City partners with Clackamas County co-permittees to conduct an assessment every 3 to 4 years. The summer of 2021 was especially hot with record-breaking temperatures in late June to mid-July. The extraordinary heat, combined with the previous dry winter, resulted in severe drought conditions, low streamflow throughout most of the summer and fall, and adverse effects on aquatic populations.

The City normally collects macroinvertebrate samples from ten sites located throughout the city (see Table 15) during the June 1st to October 15th sampling index period (DEQ, 2022). In the Fall 2021 assessment, one of the ten sites, Lost Dog Creek nr Aspen Ct, was dry due to the drought conditions and not included in the sampling effort.

Table 15. Macroinvertebrate Sampling Sites

Name	Latitude	Longitude	Watershed	Land Use					Assessments	
				NA	R	MF	I	C	First Year	Times Assessed
Nettle Creek at Atwater Rd	45.4246	-122.6814	Tryon Creek		X				2004	6
Tryon Creek abv State St	45.4243	-122.6613	Tryon Creek	X	X	X	X	X	2007	5
Springbrook abv Boones Way	45.4140	-122.7151	Springbrook/ Oswego Lake	X	X	X	X	X	2004	6
Springbrook at Iron Mtn[1]	45.4142	-122.7078	Springbrook/ Oswego Lake	X	X	X	X	X	2004	6
Lost Dog nr Aspen Ct	45.4025	-122.6806	Oswego Lake		X		X		2007	5
Lost Dog at Municipal Golf Course	45.4006	-122.6891	Oswego Lake		X		X		2004	6
Lost Dog at Lake Front[1]	45.4100	-122.6782	Oswego Lake		X		X		2004	6
Oswego Creek bel State St	45.4107	-122.6625	Oswego Lake	X	X	X			2007	5
Ball Creek bel Kruse Oaks[1]	45.4245	-122.7403	Tualatin River	X	X		X		2007	5
Carter Creek abv Bangy[1]	45.4170	-122.7403	Tualatin River		X	X		X	2007	5

1 – At or near instream monitoring site

NA – Natural Area, R – Residential, MF – Muti-Family Residential, I – Institutional, C - Commercial

8.5.1 Results

Results were analyzed using the multi-metric macroinvertebrate-based index of biological integrity (DEQ, 2003) and the Predictive Assessment Tool for Oregon (Hubler, 2008). The multi-metric macroinvertebrate-based index of biological integrity (M-IBI) is a matrix of ten attributes that have been shown to have an effect on the macroinvertebrate community such as the number and types of sensitive taxa present. The Predictive Assessment Tool for Oregon (PREDATOR) is based on the observed populations at the sample site versus the expected populations based on a relatively pristine environment (Marine Western Coastal Forest).

8.5.1.1 PREDATOR Scores

As shown in Table 16, all ten sites were severely impaired under the PREDATOR method. Ball Creek showed a slight decline in the quality of aquatic habitat; however, Oswego Creek and

Nettle Creek showed a steady increase in aquatic habitat quality. Springbrook abv Boones Way showed improvement in habitat quality since 2013 but appears to be in stasis at the moment.

8.5.1.2 M-IBI Scores

Seven of the ten sites were severely impaired with the remaining sites showing moderate impairment under the M-IBI method (see Table 16). Oswego Creek, Ball Creek, and Carter Creek all showed slight improvements since 2013. Tryon Creek and Springbrook abv Boones Way showed a progressive decline since 2013.

8.5.2 Stressors

Temperatures above 18.4°C indicate a likely shift in the composition of the macroinvertebrate community from cool to warm water taxa. Seven of the ten sites assessed in 2021 were experiencing stress from temperatures.

Fine sediment in streambeds in excess of 19% indicates a likely shift in the composition of the macroinvertebrate community from pollution-sensitive taxa to taxa that are more tolerant of degraded conditions. Six of the ten sites indicate stress from fine sediment, however three of those sites experienced less sediment-induced stress since 2013. One site (Lost Dog at Lake Front) dipped below the threshold for sediment-induced stress for the first time since 2013. None of the sites showed an increasing trend in stress from fine sediment.

8.6 TOTAL MAXIMUM DAILY LOADS

Within the City's MS4 jurisdiction are several streams, monitored and unmonitored, that are affected by Total Maximum Daily Loads (TMDLs). All of the TMDLs, except for temperature, have a wasteload allocation (WLA). For the purposes of this report, the following discussion focuses on TMDLs affecting streams that are part of the City's instream monitoring program in order to provide adequate data for the discussion. The discussion uses medians, as opposed to averages, because they are less sensitive to outliers. Geomeans are used for bacterial analyses because of the volatility of the results even between two replicate samples.

Table 16. Physical and Biological Characteristics of Selected Streams in Lake Oswego, 2021

	PREDATOR Score[1]			M-IBI Score[2]			Temperature Score °C			Fine Sediment Score %			Aquatic Habitat %		
Site	**2013**	**2018**	**2021**	**2013**	**2018**	**2021**	**2013**	**2018**	**2021**	**2013**	**2018**	**2021**	**Riffle**	**Glide**	**Pool**
Nettle Creek at Atwater Rd	0.34	0.44	0.48	18	20	18	16.8	17.3	16.8	22	25	15	0	80	20
Tryon Creek abv State St	0.48	0.39	0.44	24	22	20	21.2	23.0	22.3	18	19	18	35[5]	60	5
Springbrook abv Boones Way	0.39	0.58	0.53	20	18	16	21.2	21.7	22.7	37	36	36	39	59	2
Springbrook at Iron Mtn[3]	0.44	0.49	0.39	16	18	12	22.1	22.1	24.0	39	30	32	40	45	15
Lost Dog nr Aspen Ct[4]	0.44	0.34	NA	18	18	NA	16.8	17.0	NA	50	37	NA	NA	NA	NA
Lost Dog at Municipal Golf Course	0.24	0.29	0.19	10	18	14	19.3	17.9	20.2	43	30	48	0	100	0
Lost Dog at Lake Front[3]	0.29	0.24	0.44	16	14	20	15.9	16.9	17.7	32	26	17	56	40	41
Oswego Creek bel State St	0.19	0.29	0.34	14	16	16	26.3	25.9	24.0	54	45	40	40	45	15
Ball Creek bel Kruse Oaks[3]	0.44	0.39	0.39	18	18	24	20.6	19.4	19.7	43	30	27	45	45	10
Carter Creek abv Bangy[3]	0.39	0.29	0.34	16	18	18	21.9	20.8	20.8	-	42	44	0	50	50

1 – Scores range from <0.75 (severe impairment) to >0.90 (no impairment). 2 – Scores range from < 20 (severe impairment) to >39 (no impairment 3 – At or near an instream monitoring site; 4 – Not included in the 2021 assessment due to lack of water; 5 – includes 5% rapids

PREDATOR=Predictive Assessment Tool for Oregon; M-IBI=Multimetric Macroinvertebrate-based Index of Biological Integrity; °C=degrees Celsius

8.6.1 Bacteria

Bacterial sources include animal waste, wastewater system overflows, failing septic systems, and illegal dumping. For the City, bacterial TMDLs have been set for the Willamette River, the Tualatin River (all tributaries and ephemeral streams), and Springbrook Creek (see Table 17).

Table 17. Bacterial Wasteload Allocations for Streams in Lake Oswego

Waterbody	Affected Stream	Parameter and Year	Season/Target	Wasteload Allocation
Tualatin River[1] (all streams)	Carter Creek Ball Creek	Bacteria (2001)	Maximum Summer Stormwater Winter Stormwater	406 Col/100 mL 12,000 Col/100 mL 5,000 Col/100 mL
Springbrook Creek[2]	Springbrook Creek	Bacteria (2006)	Maximum 80% Reduction[3]	406 Col/100 mL Winter Geomean/Median: 208/172 Winter Min/Max: 13/2,419 Summer Geomean/Median: 365/388 Summer Min/Max: 34/2,420
Willamette River[2] (all tributaries)	Nettle Creek Lost Dog Creek Boones Ferry	Bacteria (2006)	Maximum 78% Reduction[4]	406 Col/100 mL Dependent on Stream

1- Summer=May 1-Oct 31, Winter=Nov 1 to Apr 30; 2 – Summer=June 1-Sept 30, Winter=Oct 1 to May 31; 3 – Based on 1997-2003 data; 4 – Based on 1996-2002 data

8.6.1.1 Tualatin River

Monitoring sites affected by the Tualatin River bacteria TMDL are Carter Creek and Ball Creek (see Table 18). Maximum concentrations for Ball Creek and Carter Creek were above the 406 col/100 mL threshold for the winter and summer. Geomean concentrations were below the 406 col/100mL threshold.

Table 18. E. Coli Concentrations in Ball Creek and Carter Creek.

	Ball Creek			Carter Creek		
Threshold	1997-2003 (Col/100mL)	FY1718-FY2122 (Col/100mL)	FY2223 (Col/100mL)	1997-2003 (Col/100mL)	FY1718-FY2122 (Col/100 mL)	FY2223 (Col/100mL)
Winter Maximum	2,300	>2,420	613	>2,420	>2,420	1,414
Winter Geomean	190	96	53	277	89	96
Summer Maximum	>2,420	>2,420	435	2,200	1,200	1,986
Summer Geomean	418	283	140	119	163	238

8.6.1.2 Springbrook Creek

Based on data collected by the City from 1997 to 2003, DEQ determined that bacterial concentrations in Springbrook Creek must be reduced to 80% of their 1997 to 2003 concentrations (see Table 19). Bacterial reductions of 80% were met for summer maximums and the geomean. Bacterial reductions were 62% and 77% for the winter maximum and geomean concentrations, respectively.

Table 19. E Coli. Concentrations in Springbrook Creek.

Threshold	1997-2003 Col/100mL)	80% Reduction Target (Col/100 mL)	Historical[1] Concentration (Col/100mL)	FY2223 (Col/100 mL)
Summer Maximum	2,420	484	>2,420	99
Summer Geomean	365	73	133	53
Summer Minimum	34	7	19	11
Winter Maximum	2,419	484	>2,420	921
Winter Geomean	208	42	145	47
Winter Minimum	13	3	10	14

1 - Historical is from FY1718 to FY2122

8.6.1.3 Willamette River Tributaries

One monitoring site (Nettle Creek) is in the Tryon Creek watershed. Two other monitoring sites (Boones Ferry @ Bryant and Lost Dog Creek) discharge to Oswego Lake which should act as a settling area for loads coming from those sites.

The Willamette River TMDL for bacteria requires a 78% reduction of the E Coli concentrations from 1997 to 2002. As shown in Table 20, the E. Coli concentrations at Nettle Creek were reduced only a little from the 1997-2002 concentrations. The sites at Boones Ferry and Lost Dog Creek showed promising reductions of 80% for the geomean concentrations and 95% for the maximum concentrations.

Table 20. E. Coli concentrations in Nettle Creek, Lost Dog Creek, and the Boones Ferry sampling site.

Threshold	Nettle Creek		Lost Dog		Boones Ferry	
	1997-2002	FY2223	1997-2002	FY2223	1997-2002	FY2223
Maximum	>2,420	>2,420	2,420	124	2,420	115
Geomean	297	244	144	29	84	18
Minimum	21	18	2	6	1	2

8.6.2 Dissolved Oxygen

The 2001 dissolved oxygen (DO) WLA for Fanno Creek and its tributaries required a minimum concentration of 6.5 mg/L and a 50% decrease from pre-1998 concentrations for total suspended solids (TSS) and total volatile suspended solids (VSS) from May 1st to October 31st. Because the City's monitoring data starts in 1997, the following analysis assumes the baseline TSS conditions are from July 1997 to June 1999. VSS baseline data is the first two years of monitoring (August 2012 to July 2014).

Ball Creek and Carter Creek, as tributaries of Fanno Creek, are covered under the Fanno Creek's WLA. The minimum concentration of 6.5 mg/L for DO was met for Ball Creek in FY2223 but not for Carter Creek (see Table 21). A measure of the longer-term DO concentration experienced by macroinvertebrates is the median DO concentration. The threshold concentration of 6.5 mg/L for the median DO concentration was met in both Ball Creek and Carter Creek for FY2223.

Table 21. Dissolved Oxygen, TSS, and VSS concentrations in Ball Creek and Carter Creek

Time Period	DO, mg/L		TSS, mg/L		VSS, mg/L	
	Minimum	Median	Maximum	Median	Maximum	Median
Ball Creek						
Baseline[1]	7.9	9.8	100.0	7.0	57	41
FY1718-FY2122	8.7	9.5	21.5	3.0	80	34
FY2223	10.6	9.7	4.5	2.5	42	36
Change[2]	+34%	-1%	-96%	-64%	-26%	-12%
Carter Creek						
Baseline[1]	5.4	8.6	80.0	9.5	70	45
FY1718-FY2122	4.5	7.0	20.0	5.0	58	37
FY2223	5.5	9.1	9.5	6.0	41	37
Change[2]	+2%	+6%	-88%	-37%	-41%	-18%

1 – Baseline is Jul 1997-Jun 1999 for TSS and DO and, for VSS, from Aug 2012 to Jul 2014; 2 - % change is calculated between baseline and FY2223 concentrations

DO=dissolved oxygen; TSS=total suspended solids; VSS=volatile suspended solids

Ball Creek saw a 96% reduction in the maximum TSS concentration and a 64% reduction in the median TSS concentration. The maximum VSS concentration was only 26% less than the baseline concentrations and the median VSS concentration only saw a 12% reduction from baseline concentrations.

Carter Creek saw an 88% reduction in TSS from the baseline concentrations and a 37% reduction in median concentrations. The reduction for VSS at Carter Creek was 41% for maximum concentrations and 18% for median concentrations.

8.6.3 Chlorophyll α and pH

Chlorophyll α and pH TMDLs were set in the 2001 Tualatin River TMDL and revisited, in 2012, for Oswego Lake and its tributaries (see Table 22). Total phosphorous is used as a surrogate measure for pH and chlorophyll α. Monitoring sites affected by the TMDL include Ball Creek, Carter Creek, Springbrook Creek, Lost Dog Creek, and Boones Ferry at Bryant.

Table 22. Chlorophyll α and pH Wasteload Allocations for Streams in Lake Oswego

Waterbody	Applicable Lake Oswego Monitoring Sites	Parameter[1]	Season/Target[2]	Wasteload Allocation
Fanno Creek (all tributaries)	Carter Creek Ball Creek	pH (2001) Clorophyll α (2001)	Summer Median Phosphorous Summer Max Phosphorous pH Range	0.13 mg/L 0.46 mg/L 6.5 – 8.5
Tualatin River (all tributaries and ephemeral streams)	No monitoring sites	pH (2001) Clorophyll α (2001)	Summer Median Phosphorous Summer Max Phosphorous pH Range	0.14 mg/L 0.49 mg/L 6.5 – 8.5
Oswego Lake (all tributaries and ephemeral streams)	Springbrook Creek Lost Dog Creek Boones Ferry	Total phosphorous (2001 and 2012)	Summer Baseflow Conc Summer Baseflow Load Summer Stormwater Load Winter Baseflow Conc Winter Baseflow Load Winter Stormwater Load	0.09 mg/L 272 lbs/season 139 lbs/season 0.15 mg/L 986 lbs/season 858 lbs/season

8.6.3.1 Fanno Creek Tributaries

The maximum summer phosphorous concentration for the Tualatin River watershed was determined by DEQ to be 0.46 mg/L with a median of 0.13 mg/L (see Table 23).

Table 23. Total Phosphorous Concentrations and pH at Ball Creek and Carter Creek

	pH Range, Summer	Total Phosphorous, Summer Maximum (mg/L)	Total Phosphorous, Summer Median (mg/L)
WLA	6.5 – 8.5	0.46	0.13
Ball Creek			
Historical (FY1718-FY2122)	7.0 – 8.4	0.23	0.10
FY2223	7.4 – 8.0	0.13	0.10
Carter Creek			
Historical (FY1718-FY2122)	6.4 – 8.2	0.50	0.12
FY2223	7.2 – 7.4	0.13	0.12

1 – Summer is from May 1 to October 31

Ball Creek met the pH range and was below the median and maximum phosphorous WLAs. Ball Creek has seen a 43% reduction in the maximum summer phosphorous concentration from historical levels.

Carter Creek met the pH range and was below the median and maximum phosphorous WLAs. Carter Creek has seen a 74% reduction from historical concentrations for the maximum summer phosphorous concentration.

8.6.3.2 Oswego Lake

The maximum summer concentration for total phosphorous in the Oswego Lake watershed was set by DEQ in 2001 to 0.09 mg/L with a maximum winter concentration of 0.15 mg/L (see Table 24). Monitoring sites within the Oswego Lake watershed include Springbrook Creek, Lost Dog Creek, and the Boones Ferry at Bryant location.

Table 24. Total Phosphorous Concentrations and pH in the Oswego Lake Watershed

	pH Range	Total Phosphorous, Summer Maximum (mg/L)	Total Phosphorous, Winter Maximum (mg/L)
WLA	6.5 – 8.5	0.09	0.15
Lost Dog Creek			
Historical (FY1718-FY2122)	6.7 – 7.9	0.10	0.08
FY2223	7.4 – 9.2	0.06	0.05
Springbrook Creek			
Historical (FY1718-FY2122)	6.3 – 8.0	0.26	0.64
FY2223	6.4 – 7.2	0.13	0.11
Boones Ferry at Bryant			
Historical (FY1718-FY2122)	6.3 – 8.1	0.16	0.15
FY2223	6.6 – 7.1	0.10	0.11

1 – Summer is from May 1 to October 31; 2 – Winter is from November 1 to April 30

Lost Dog Creek was well below the phosphorous WLA for the winter and summer maximums. Concentrations were 40% below historical concentrations for the summer and winter. The maximum pH was exceeded in February only.

Springbrook Creek was above the WLA for the summer maximum phosphorous concentration but below the winter maximum concentration. The summer maximum concentration shows a 50% reduction and the winter maximum concentration shows an 83% reduction from the historical levels. The minimum pH for FY2223 was slightly less than the required minimum.

The monitoring site at Bryant was close to meeting the target maximum phosphorous for summer and met the WLA for the winter maximum. The pH range was within WLA range.

8.6.4 Biocriteria

The threshold for biocriteria is a ***sufficient (water) quality to support aquatic species without detrimental changes in the resident biological community*** (DEQ, 2022). Water bodies that have biocriteria impairment include Fanno Creek and Tryon Creek. Tributaries to these streams that are within the City's jurisdiction include Ball Creek, Carter Creek, and Nettle Creek. All three are part of the City's instream monitoring network.

The City partnered with Water Environment Services, a co-permittee, to complete a macroinvertebrate assessment in the Fall of 2021. A detailed discussion of the assessment results for Ball Creek, Carter Creek, and Nettle Creek is available in Section 9.5.

8.7 WATER-QUALITY LIMITED STREAMS

Section 303(d) of the CWA requires DEQ to determine if a water body is no longer providing its designated beneficial uses due to impaired water quality. Beneficial uses for the Willamette River and its tributaries (including the Tualatin River) include fishing, drinking water, recreation, industrial water supply, irrigation, livestock watering, aquatic life, wildlife, boating, aesthetic quality, and hydropower. The mainstem of the Willamette River also includes commercial navigation and transportation.

The current 303(d) list (see Table 25) was approved by EPA in September 2022. While only Oswego Lake and Oswego Creek were specifically listed in the 2022 assessment, an impaired stream may include all of the tributaries to the stream or the City may have public outfalls discharging to the affected stream segment.

8.7.1 Algal Blooms and Aquatic Weeds

Algal blooms were listed for the Tualatin River (from McFee Creek to the Willamette River) and Oswego Lake. Aquatic weeds were listed for Fanno Creek and its tributaries. The criteria used to list algal blooms and aquatic weeds is the statewide prohibition on ***"deleterious or injurious effects on aquatic and human beneficial uses from biological growths"*** (DEQ, 2022).

Streams that may be affected by the 303(d) listing include Carter Creek and Ball Creek in the Fanno Creek watershed, tributaries to Oswego Lake, and Tualatin River tributaries on the south side of the City. Instream monitoring locations providing data for this listing include Lost Dog Creek at Lake Front, Springbrook Creek at Iron Mountain, Boones Ferry at Bryant, Ball Creek bel Kruse Oaks, and Carter Creek abv Bangy.

Algal blooms and aquatic weeds may be caused, in part, by elevated nutrients with phosphorous known as the limiting factor for plant growth. There are currently TMDLs in place for the tributaries of Fanno Creek and Oswego Lake and the discussion of these TMDLs is found in Section 9.6.

Table 25. Designated 303(d) Streams and Tributaries, 2022

Stream	Affected Stream Reach	Tributary Stream	Parameter	Time Period	Threshold
Fanno Creek	Carter Creek to Tualatin River	Carter Creek	Dieldrin[1] TTCE[1]	Not Specified	Table 40, OAR 340-041-8033
Fanno Creek	Carter Creek to Tualatin River	Carter Creek	Total Iron[1] Copper	Not Specified	Table 30, OAR 340-041-8033
Fanno Creek	Carter Creek to Tualatin River	Carter Creek	Dissolved Oxygen	Spawning (Cool Water)	
Fanno Creek	1st through 4th order streams	Carter Creek Ball Creek	Dissolved Oxygen	Spawning (Cool/Cold Water)	
Fanno Creek	1st through 4th order streams	Carter Creek Ball Creek	Biocriteria, Aquatic Weeds[4] Chromium VI[1], Zinc[3]	Not Specified	Table 30, OAR 340-041-8033 (Cr and Zn only)
Oswego Lake	Lake	Lost Dog Creek Springbrook Creek Boones Ferry	Algal Blooms	Not Specified	
Oswego Creek	1st through 4th order streams	Lost Dog Creek Springbrook Creek Boones Ferry	Temperature[3]	Spawning Year Round	
Oswego Creek	1st through 4th order streams	Lost Dog Creek Springbrook Creek Boones Ferry	Biocriteria Zinc[3] Copper[2,4]	Spawning Year Round	Table 30, OAR 340-041-8033 (Zn and Cu only)
Oswego Creek	1st through 4th order streams	Lost Dog Creek Springbrook Creek Boones Ferry	Benz(a)anthracene[1,4] Benzo(a)pyrene[1,4] Benzo(b)fluoranthene 3,4[1,4] Benzo(k)fluoranthene[1,4] Chrysene[1,4] Indeno(1,2,3-cd)pyrene[1,4]	Not Specified	Table 40, OARS 340-041-8033
Tryon Creek	Palantine Hill Creek to Willamette River	Nettle Creek	Dissolved Oxygen	Spawning Oct 15–May 15	DO > 9 mg/L (OAR 340-041-016)
Tualatin River	McFee Creek to Willamette River	Streams on City's south side	Dissolved Oxygen[3]	Spawning (Cool Water)	
Tualatin River	McFee Creek to Willamette River	Streams on City's south side	Biocriteria, Harmful Algal Blooms, Total Iron[1]	Not Specified	Table 30, OAR 340-041-8033 (Iron Only)
Tualatin River	McFee Creek to Willamette River	Streams on City's south side	Dieldrin[1,3]	Not Specified	Table 40, OAR 340-041-8033
Willamette River	Clackamas River to Johnson Creek	Streams on City's east side	Biocriteria; Cyanide[1]; Temperature	All Year (Temp)	Table 30, OAR 340-041-8033 (Cyanide Only)
Willamette River	Clackamas River to Johnson Creek	Streams on City's east side	Ethylbenzene[1], PAHs[1], PCBs[1]; Hexachlorobenzene[1]; Aldrin[1]; Dieldrin[1]; DDE 4,4[1]; DDT 4,4[1]	Not Specified	Table 40, OAR 340-041-8033

1 – No Monitoring Requirement; 2 - Samples were mostly in the Tryon Creek watershed; 3 – New for 2022; 4 – New for 2018

8.7.2 Biocriteria

OAR 340-041-0011 specifically addresses biocriteria: "***Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities."*** (DEQ, 2022). Biological monitoring is required by the MS4 permit at least once per permit term and is generally conducted by the City every 3-4 years.

Biocriteria was listed for Fanno Creek and its tributaries, Oswego Creek and its tributaries, the Tualatin River (from McFee Creek to the Willamette River), and the Willamette River (from the Clackamas River to Johnson Creek). Streams that may be affected by this listing include streams on the City's south side, Carter Creek, and Ball Creek in the Fanno Creek watershed; Lost Dog Creek and Springbrook Creek in the Oswego Creek/Oswego Lake watershed; and Nettle Creek and streams on the City's east side. All ten of the City's macroinvertebrate monitoring sites could be affected by these listings.

In the Fall of 2021, the City partnered with Water Environment Services to conduct a macroinvertebrate assessment which included the City's ten macroinvertebrate monitoring sites. A discussion of the 2021 assessment can be found in Section 9.5.

8.7.3 Dissolved Oxygen

OAR 340-041-0016 specifically addresses DO. Water bodies listed as spawning areas must provide a minimum of 9.0 mg/L (or 95% saturation). Cold-water aquatic habitat must have DO concentrations of at least 6 mg/L, a rolling 30-day floating average of the daily mean concentration of 8 mg/L or a minimum 6.5 mg/L when calculated as the minimum 7-day rolling average. Cool-water aquatic habitat must provide a minimum of 4.0 mg/L, a minimum of 5.0 mg/L when calculated as the minimum 7-day rolling average, or a rolling 30-day floating average of the daily mean concentration of 6.5 mg/L.

DO was listed for Fanno Creek and its tributaries (cool and cold-water classes), Tryon Creek (Palantine Hill Creek to the Willamette River), and the Tualatin River (McFee Creek to the Tualatin River). Streams potentially affected by this listing include Ball Creek, Carter Creek, Nettle Creek, and streams on the south side of the City. Instream monitoring sites that could provide information regarding this listing include Ball Creek bel Kruse Oaks, Carter Creek abv Bangy, and Nettle Creek abv Tryon. Carter Creek and Ball Creek are included in the Tualatin River TMDL for DO and a discussion of their WLAs is in in Section 9.6.

DO levels for Nettle Creek ranged from 8.83 mg/L to 13.96 mg/L in FY2223. During the spawning period (Oct 15 to May 15), the levels ranged from 11.93 mg/L to 13.96 mg/L. These concentrations exceed the minimum DO criteria of 9.0 mg/L required by OAR 340-041-0016.

8.7.4 Temperature

Temperature is covered by a TMDL for the Willamette River and its tributaries including all of the streams within the City's jurisdiction. A detailed discussion of the temperature data at the City's instream monitoring sites is usually available in the annual report of the City's TMDL Implementation Plan however this year a report is not required due to the requirement to provide a review of the previous 5 years and a revision of the current Plan.

In summary, the temperature TMDL for all of the sampling sites was met with the exception of Lost Dog and Carter Creek. Lost Dog reached 18.4°C in August during flows that were in the bottom 25% for the year. Carter Creek reached 18.0°C in July (below average flow) and 19.4°C in August (bottom 25% of the year's flow). The Carter Creek watershed has the lowest canopy cover of the City. It is primarily privately-owned and has a major commercial/multi-family element, e.g. large parking lots and buildings in the lower watershed where the sampling site is located.

8.7.5 Metals

Fanno Creek was listed in the 303(d) assessment for iron (total), copper, chromium^{+6}, and zinc. Copper was listed only for the segment from Carter Creek to the Tualatin River. Oswego Creek was listed for copper and zinc. The Tualatin River from McFee Creek to the Willamette River was listed for iron (total). All listings were for aquatic life criteria.

Streams potentially affected by the Fanno Creek listings include Carter Creek and Ball Creek; the copper listing potentially affects only Carter Creek.

The listing for Oswego Creek stated that it was for all tributaries; therefore, as a conservative analysis, the potential streams affected by the Oswego Creek listing are those that discharge to Oswego Lake. Instream monitoring sites on Lost Dog Creek, Springbrook Creek, and at Boones Ferry at Bryant which can provide information on copper and zinc.

The Tualatin River listing for total iron potentially affects Carter Creek, Ball Creek, and streams on the south side of the City. The City started collecting total iron on a quarterly basis in FY2223 but does not have enough water-quality data to support an analysis of the 303(d) listing.

8.7.5.1 Copper

The City uses the Biotic Ligand Model (BLM) to determine the copper (Cu) threshold given specific parameters such as anions, cations, hardness, and dissolved organic carbon (DOC) which are collected quarterly at the City's monitoring stations (hardness is collected monthly). The model uses these inputs to determine the acute and chronic thresholds for copper and assigns them a toxicity unit (TU). A TU greater than one (1) indicates a likely exceedance of the threshold.

The median concentrations appeared to be well below the chronic and acute concentration thresholds for Carter Creek and Lost Dog Creek, however the monitoring site at Bryant appears to be have an elevated range for the chronic threshold (see Table 26).

Almost all of the dissolved copper concentrations at the Boones Ferry sampling site are estimated concentrations (e.g. less than the reporting limit of 2 ug/L). The chronic TU was exceeded only for the month of July during a time of minimal flows (estimated 0.1 cfs). The low flows at this site seen during sample collection would not likely support macro-invertebrates and definitely could not support salmonids.

Table 26. Copper Concentrations for Selected Streams in Lake Oswego

Monitoring Station	WQ-Limited Stream	Median Concentration (µg/L)	Median Acute Threshold (µg/L)	Median Chronic Threshold (µg/L)	Acute Toxicity Unit Range	Chronic Toxicity Unit Range
Carter Creek abv Bangy	Fanno Creek	1.30	9.15	5.68	0.1 - 0.3	0.1 – 0.4
Boones Ferry@ Bryant	Oswego Creek	1.05	1.97	1.23	0.2 – 0.7	0.4 – 1.0
Lost Dog Creek @ Lake Front	Oswego Creek	1.05	8.48	5.27	0.1 – 0.1	0.2 - 0.2
Springbrook Creek @ Iron Mtn	Oswego Creek	1.00	2.52	1.57	0.2 – 1.4	0.3 –2.2

The Springbrook Creek site exceeded the acute range for July and exceeded the chronic range for July and October. Concentrations at the site were estimated in October and barely above the reporting limit (2.2 vs 2.0 ug/L) for July. Estimated flows during sample collection for these months were below average (estimated 1.7 cfs in July) and near the minimum (1.1 cfs in October) for the year. While the estimated flows may have supported macro-invertebrates, the October flow during sample collection at this site was unlikely to support salmonids.

8.7.5.2 <u>Zinc</u>

The acute and chronic thresholds for dissolved zinc are calculated via an equation from Table 30 in OAR 340-041-8033 and are based on hardness.

As shown in Table 27, the concentrations at all instream monitoring sites were below the chronic thresholds and all sites were below the acute thresholds except for Ball Creek. Interestingly, the acute threshold for Ball Creek were exceeded for only one month (July 2022). The next highest dissolved zinc concentration for Ball Creek (38.8 µg/L) was in January 2023 and was only 52% of the acute threshold.

Table 27. Zinc Concentrations of Selected Streams in Lake Oswego.

Monitoring Site	Hardness, mg/L	Maximum Dissolved Zinc (µg/L)	Acute Threshold (µg/L)		Hardness, mg/L	Median Dissolved Zn (µg/L)	Chronic Threshold (µg/L)
Ball Creek	64.9	99.0	81.2		72.0	22.2	89.4
Carter Creek	86.5	45.9	103.6		104.0	9.2	122.1
Lost Dog	32.7	34.9	45.4		30.9	17.0	43.7
Springbrook Creek	63.0	39.6	79.4		56.5	10.4	73.1
Boones Ferry	59.0	40.7	75.1		57.3	22.0	74.0

9 REFERENCES

Burns, W.J., Mickelson, K.A., Jones, C.B., Pickner, S.G., Hughes, K.L.B., and Sleeter, R., ***Landslide hazard and risk study of northwestern Clackamas County, Oregon,*** Oregon Department of Geology and Mineral Industries, OFR O-13-08.

City of Lake Oswego, 2020, ***Stormwater Management Manual.***

City of Lake Oswego, 2022, ***Stormwater Management Plan.***

City of Lake Oswego, 2023, **Stormwater Monitoring Plan.**

Hubler, S., 2008, ***PREDATOR: Development and use of RIVPACS-type macroinvertebrate models to assess the biotic condition of wadeable Oregon streams***, unpublished report prepared by Oregon Department of Environmental Quality - Watershed Assessment Section.

Huff, D.D., Hubler, S.H., Pan, Y., and Drake, D.L., 2008, ***Detecting shifts in macroinvertebrate assemblage requirements: implicating causes of impairment in streams.*** Oregon Department of Environmental Quality – Laboratory and Environmental Assessment Division.

Oregon Department of Environmental Quality, 2000, ***Tualatin River TMDL and Water Quality Management Plan***

Oregon Department of Environmental Quality, 2000, ***Willamette River Basin TMDL and Water Quality Management Plan***

Oregon Department of Environmental Quality, 2003, ***Benthic Macroinvertebrate Protocol for Wadeable Rivers and Streams***, unpublished methods manual.

Oregon Department of Environmental Quality, 2009, ***Water Monitoring and Assessment Mode of Operations Manual, v3.2.***

Oregon Department of Environmental Quality, 2012, ***Tualatin River TMDL and Water Quality Management Plan.***

Oregon Department of Environmental Quality – Water Quality Division, 2018, ***Methodology for Oregon's 2018 Water Quality Report and List of Water Quality Limited Waters,*** Water Quality Assessment Program

Oregon Department of Environmental Quality, 2019, ***Final Revised Willamette Basin Mercury Total Maximum Daily Load***.

Oregon Department of Environmental Quality, 2021, ***NPDES MS4 Phase I Permit.***

Oregon Department of Environmental Quality – Water Quality Division, 2022, ***Methodology for Oregon's 2022 Water Quality Report and List of Water Quality Limited Waters,*** Water Quality Assessment Program

WEST Consultants, 2022, Technical Memorandum, ***Precipitation data analyses and unit hydrograph development.***

APPENDIX A SWMP IMPLEMENTATION STATUS, FY2223

Table A.1. SWMP Implementation Progress

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Program Management	Mercury Bacteria Chlorophyll α DO pH Temperature	Provide funding to properly meet the NPDES MS4 requirements.	Track the funds used for the reporting fiscal year and the expected fund disbursement for the subsequent fiscal year.	In FY2223, the City spent $2.6 million dollars for improvements in its parks and natural areas and $2.8 million dollars on capital projects and stormwater operations and maintenance. An additional $140,000 was spent on private natural resources management. In FY2324, the City has budgeted close to $5.1M for stormwater activities and has encumbered up to $42M for Parks and Recreation lands and work with properties with a sensitive-lands overlay.
Program Management	Mercury Chlorophyll α DO pH Temperature	Provide funds to partners who provide stormwater education.	Track the amount of funds targeting stormwater ~~or habitat restoration~~ education that were disbursed to external ~~regional~~ groups ~~(such as Backyard Habitat, RCCRS, or CRC) or through City grants.~~	The City provided $6,000 to regional stormwater education groups, $47K to the Backyard Habitat Program, and $89K to the local watershed councils for private restoration and stormwater education.
Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH	Review and update, if necessary, the ESC manual and procedures for inspection and plan review at least once every 5 years.	Summarize changes to the wet weather requirements, municipal code, and ESC Manual	There were no changes to the municipal code regarding erosion and sediment control nor were there changes to the wet weather requirements. Check dams and temporary berms were removed from the City's list of approved erosion and sediment controls and biobags may not be used for protection of catchbasins and other inlets. Straw wattles are now required (previously an option) as a perimeter control in tree protection areas instead of sediment fences primarily due to the damage of fence installation on tree roots. Sediment fences are required for all other areas.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Construction Site Runoff	Mercury Chlorophyll α DO pH	100% of City staff with erosion control responsibilities will be certified professionals.	Track the number of City staff that are certified ESC professionals.	There are four staff who are currently certified professionals in erosion and sediment control plan review and inspections.
Construction Site Runoff	Mercury Chlorophyll α DO pH	100% of City contractors associated with City-initiated projects with a stormwater component will have a certified erosion control professional on staff.	Track the number of City-initiated projects with a certified ESC Professional ~~Inspector~~ and whether the project is completed or under construction	There were 11 projects with certified ESC professionals as part of a CIP project team in FY2223. Seven of the projects were completed in FY2223, three are under construction, and one is in design.
Construction Site Runoff	Mercury Chlorophyll α DO pH	Require 100% of developers of subdivisions, business, or commercial projects to retain a certified ESC professional to submit ESC plans and provide inspections.	Track the number of ESC Plans submitted by a certified ESC Professional ~~inspector~~ for developers of complicated projects.	In FY2223, five ESC private development plans were submitted by certified ESC professionals.
Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH	100% of construction sites and professional landscaping projects disturbing 500 sq ft or more of soil will provide erosion controls.	1. Track the number of ESC permits issued. 2. Track the number of pre-construction inspections (inspection code 6010) and the number of final inspections (inspection code 6050). 3. Track the number of additional inspections for projects exceeding a duration of 6 months.	The City issued 176 ESC permits in FY2223. Staff conducted 241 initial inspections and 172 final inspections. There were 34 additional inspections completed from January 2023 to June 2023.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	100% of instream projects will apply for and receive Department of State Lands (DSL) jurisdictional decision. and approval.	Track number of applications required to submit a DSL application, ~~the DSL decision,~~ and the affected watershed.	In FY2223, six projects were required to obtain DSL approval or waivers. Most of the projects were in the Oswego Lake watershed.
Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	100% of construction sites with steep slopes will provide coconut coir matting or hydroseeding for final stabilization.	Track the number of construction sites with slopes > 15% and the watersheds affected.	In FY2223 three projects had steep slopes. Most of the projects were in the Oswego Lake watershed.
Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	100% of all riparian or riparian-adjacent projects will provide coconut coir matting or hydroseeding for final stabilization.	Track the number of riparian or riparian-adjacent projects required to use coconut coir blankets and the watersheds affected.	In FY2223 three projects in riparian areas were required to provide matting. Most of the projects were in the Oswego Lake watershed.
Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH Temperature	Maintain an escalating enforcement program for the ESC program.	1. Track the number of stop work orders and violations issued; categorize by watershed. 2. Track the number of projects with more than 1 stop work order or violation and the affected watershed.	Two stop-work orders were issued in FY2223; one was in the Oswego Lake (Lost Dog) watershed and one was in the Tryon Creek watershed. No projects received more than one stop work order. Citations were issued for a project in the Willamette River watershed and the Oswego Lake (Lost Dog) watershed.
IDDE	Mercury Bacteria Chlorophyll α DO pH	Review and update, as necessary, the IDDE manual at least once per permit term.	Summarize any changes to the IDDE manual and the implementation date of the changes.	This metric is not due until Dec 1, 2025

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
IDDE	Mercury Bacteria Chlorophyll α DO pH	Review and update, as necessary, the spill response procedures every 2 years.	Summarize any changes to the Spill Response SOP.	There were no changes to the Spill Response SOP in FY2223.
IDDE	Mercury Bacteria Chlorophyll α DO pH	Provide a complaint hotline number.	1. Track the number of complaints received through the hotline number. ~~2. Track the number of valid spills.~~	The City provides a complaint hotline on its website under its stormwater webpage. It is also available under the "How do I" banner on the City's home page.
IDDE	Mercury	Reduce potential pollutants of concern from entering waterways.	Track the number of Drug TakeBack events and the pounds of drugs that were collected.	The City conducts two Drug TakeBack events every year which decrease the amount of unwanted prescription drugs discarded in the trash or into the wastewater system. The October event collected 404 pounds from 276 vehicles and the April event collected 600 pounds from 352 vehicles.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
IDDE	Mercury Bacteria Chlorophyll α DO pH	Respond to 100% of valid spill complaints within 24 hours if it is a threat to human health or the environment and ~~Respond to 100% of all other valid spill complaints~~ within 2 to 4 working days of all others. ~~Open an investigation into illicit discharges with no identified source and which require a water sample.~~	1. Track the number of spills responded to by City staff. 2. Track the number of spills reported to DEQ and their OERS numbers. 3. Track the number of ~~investigations opened~~. Events where TVF&R was contacted for assistance. 4. ~~Track the actions taken~~ Summarize resolutions and number of citations issued	There were three concrete discharges in the City in FY2223 of which one created an OERS report (#2022-2099). A mobile car wash was responsible for a washwater discharge in the Tualatin River watershed and an SSO occurred in the Willamette River watershed. There were two instances where it appeared that the cause was unsecured contractor materials. Automobiles and trucks were responsible for 34 spills. Either staff or the sources cleaned up the spills and public education was used in the form of verbal warnings and social media posts to prevent future discharges. Staff created a new factsheet regarding mobile car washes and posted it on the website.
IDDE	Bacteria Chlorophyll α DO pH	Reduce number of active septic systems and illicit connections.	1. Track number of properties that decommissioned their septic system and connected to the wastewater system. Track the affected watershed. 2. Track the number of cross-connections discovered and the actions taken (warnings, enforcement, abandonment, or re-connection). Track the affected watershed.	During development review, 14 projects were required to connect to the wastewater system. There was one cross-connection (wastewater to stormwater) discovered in FY2223. The property owner was required to disconnect from the stormwater system and connect to the public wastewater system.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
IDDE	Mercury Bacteria Chlorophyll α DO pH Temperature	Using a rotational inspection schedule, inspect each outfall at least once during permit term and inspect each priority outfall at least once every 2 years.	1. Track the number of outfalls and priority outfalls inspected during dry weather (72-hr antecedent dry period) and the affected watersheds. 2. Track the number of inspected outfalls and priority outfalls with groundwater discharges. 3. Track the number of outfalls and priority outfalls with a discharge that was determined to not be groundwater.	The City inspected six priority outfalls in FY2223. Two were located in the Springbrook Creek watershed, one from the Carter Creek watershed, two in the Ball Creek watershed, and one in the Oswego Lake watershed. One of the outfalls had a discharge which was determined to be coming from residential car washing (a permitted exception to the IDDE regulations). Staff inspected nine non-priority outfalls but did not track whether there was a groundwater discharge.
Industrial / Commercial Program	Mercury Chlorophyll α DO pH	Review and update, as necessary, the strategy for the Industrial and Commercial Inspection program once per permit term.	Summarize changes to the strategy and the implementation date.	The City is updating its strategy to comply with the 2021 MS4 permit. Implementation is expected to occur in 2024.
Industrial / Commercial Program	Bacteria Chlorophyll α DO pH	Reduce potential pollutants of concern from entering waterways.	Track the number of approved Land Use applications, their case numbers, and the affected watersheds for commercial and industrial projects.	Two land-use cases were submitted for commercial and industrial properties. Both were located in the Oswego Lake watershed. The industrial project, a bus barn, will likely qualify for DEQ's Industrial Stormwater permit because of the fleet maintenance involved at the project.
Industrial/ Commercial Program	Mercury Chlorophyll α DO pH	Reduce potential pollutants of concern from entering waterways	1. Track the number of projects with construction plan review and the affected watersheds. 2. Track the number of projects completed and the stormwater facilities constructed.	New for FY2324.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Industrial / Commercial Program	Mercury Chlorophyll α DO pH	Reduce potential pollutants of concern from entering waterways.	Track the number of businesses required to contact DEQ regarding their industrial stormwater(1200-Z) program and the affected watershed.	No businesses were required to contact DEQ in FY2223.
Industrial / Commercial Program	Mercury Chlorophyll α DO pH	Reduce potential pollutants of concern from entering waterways.	Track the number of completed inspections, the facility categories, a summary of the inspection results, and the affected watershed.	There were no inspections in FY2223.
Pollution Prevention	Chlorophyll α DO pH	Review and update, as necessary, the Emergency ~~Response procedures~~ Operations Plan every 5 years ~~that affect stormwater~~.	Provide a summary of any changes in the Emergency ~~Response procedures~~ Operations Plan that affect stormwater, e.g. Winter Events.	The City's Emergency Operations Plan was updated in 2017 and is currently undergoing a review and revision. The City's Natural Hazards Mitigation Plan was updated in 2019 and is currently undergoing a review and revision. Expected implementation dates for both are in FY2324.
Pollution Prevention	DO pH	Control or prevent materials from fire training activities from entering the stormwater system.	1. Review and update, if necessary, the procedures for controlling or preventing training materials from entering the stormwater system. Summarize any changes in procedure and the implementation date. 2. Track the number of fire training events within the City's jurisdiction and their location.	With the increased scrutiny of per- and polyfluoroalkyl substances (PFAs and PFOAs), the City reviewed its firefighter training and foam usage. The LOFD does not conduct outdoor firefighting training within the City’s regulatory jurisdiction and its fire-fighting foam is certified free of PFAs and PFOAs.
Pollution Prevention	Mercury Bacteria Chlorophyll α DO pH	~~Review and update, as necessary, the procedures for inspecting and maintaining City-owned bridges at least once per permit term.~~ Provide stormwater programs that meet industry standards.	~~Provide a summary of any changes.~~ Review, update, and provide a summary of any changes to the inspection and maintenance procedures for City-owned bridges at least once per permit term.	Inspection procedures were updated in 2020. Next revision due in 2026.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Pollution Prevention	Mercury Bacteria Chlorophyll α DO pH Temperature	~~Review and update, as necessary, the procedures and criteria for inspecting and cleaning the stormwater conveyance infrastructure and non-vegetated stormwater treatment infrastructure at least once per permit term.~~ Provide stormwater programs that meet industry standards.	~~Provide a summary of any changes.~~ Review, update, and summarize any changes to the inspection and maintenance procedures for conveyance structures and non-vegetated stormwater treatment facilities at least once per permit term.	There were no changes for FY2223. Metric is due in 2026.
Pollution Prevention	Mercury Bacteria Chlorophyll α DO pH Temperature	Maintain the stormwater system inventory.	1. Track the number of structures, by type, that are City-owned, e.g. catch basins, manholes, detention tanks, vaults, water-quality vaults, ~~infiltration trenches, infiltration galleries~~, etc. 2. Track the number of feet of stormline, ditches, and culverts that are City-owned. 3. Track the number of vegetated stormwater facilities that are City-owned.	The City's public stormwater system contains over 132 miles of stormline, 52 ditches, 28 culverts, over 4,400 catch basins, and approximately 3,100 manholes.
Pollution Prevention	Mercury Bacteria Chlorophyll α DO pH Temperature	Conduct a rotational inspection schedule such that 100% of the public catch basins are inspected and cleaned at least once during the permit term.	Track the number of catch basins that are inspected and cleaned each year.	Staff cleaned and inspected 1,645 catchbasins in FY2223.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Pollution Prevention	Mercury Bacteria Chlorophyll α DO pH Temperature	Conduct a rotational inspection and cleaning schedule of the public stormwater conveyance system.	1. Track the number of feet of City-owned stormline, ditches, and culverts that are inspected and cleaned each year. 2. Track the number of detention tanks, vaults, water-quality vaults, and other non-vegetated water quality structures that are inspected and maintained each year.	Staff inspected 194 manholes and cleaned 23 of them; none needed repair or replacement. No stormline was repaired or replaced, however 706 feet were inspected and 1,197 feet were cleaned. Staff cleaned 500 feet of ditches and inspected 175 culverts. Staff inspected and cleaned 23 water-quality vaults and replaced 35 filters.
Pollution Prevention	Mercury Bacteria Chlorophyll α DO pH Temperature	Properly dispose 100% of the debris from street sweeping.	Track the number of ~~curb~~ lane miles swept and the disposal method for the collected debris.	Approximately 4,500 lane miles were swept in FY2223. Debris is combined with the conveyance system debris before being sent to the Wasco County landfill.
Pollution Prevention	DO pH	Balance road safety and water quality during winter storm events.	Track the number of gallons of magnesium chloride and the number of cubic yards of sand that are used annually for winter events. 2. Track the number of 12-hr shifts requiring winter event activities. 3. Track the number of lane miles where magnesium chloride was used (for in-truck GPS units). ~~4. Track which priority routes were affected by each storm.~~	In FY2223, there were several winter events and all priority routes were affected by one or more events. Staff worked four 12-hour shifts and applied 80 cu yds of sand and 17,400 gallons of magnesium chloride in response to the events. Lane miles for magnesium chloride were not tracked in FY2223.
~~Pollution Prevention~~	~~Bacteria~~ ~~DO~~	~~Properly dispose 100% of the debris from asset cleaning.~~	~~Track the volume of litter and trash removed by staff.~~	Staff remove trash from public receptacles three times per week.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Pollution Prevention	Mercury Bacteria Chlorophyll α DO pH	Properly dispose 100% of the debris from asset cleaning.	1. Track the estimated ~~volume~~ tonnage of debris that is sent to the landfill and whether 2. ~~Track the volume of~~ any debris is sent to a hazardous waste landfill. 3. Track the estimated volume of debris that is composted.	Staff collected 1,200 cu yd of debris through the stormwater infrastructure maintenance program. The debris is sent to the Wasco County landfill after passing a TCLP analysis Approximately 650 cu yd were composted.
Pollution Prevention	Mercury Bacteria Chlorophyll α DO pH	Reduce illicit discharges from wastewater.	1. Track wastewater basins inspected as part of the I/I program. 2. Track the watersheds where repairs were needed and the funds required for the repairs. 3. Track the funds spent on the total program (inspections and repairs) annually.	Public Works repaired 35 wastewater mainlines, five service lateral repairs, and 19 wastewater manhole repairs in FY2223 at a cost of $243K. Three CIP projects involved I/I reduction - they affected the Tualatin River, Oswego Lake, and the Willamette River watersheds. Approximately $2.5M was spent on the projects in FY2223.
Pollution Prevention	Mercury Chlorophyll α DO pH	~~Review and update, as necessary the Integrated Pest Management Manual every 5 years~~ Provide stormwater programs that meet current industry standards.	~~Provide a summary of any changes.~~ Review, update, and summarize changes to the Integrated Pest Management plan at least once per permit term.	The Parks Department reviews the IPM plan every January and updates it as necessary. In FY2223, the city removed two pesticides (Velista and AquaNeat) and added one (Prophesy) to its list of approved pesticides and provided a presentation before the Parks Board. The City employs 15 staff who are certified pesticide applicators and 3 contractors.
Pollution Prevention	Mercury Chlorophyll α DO pH	Monitor pesticide use.	Track the pesticides (by active ingredient and quantity) used on City-owned property.	The City uses a range of pesticides along the Willamette Trolley line, in City parks and natural areas, and in street medians. In FY2223, it used approximately 56 gallons and 36 pounds of pesticides. The pesticides used most frequently were glyphosate, triclopyr, and trifluralin.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
~~SWMP Resources~~ Program Management	Mercury Bacteria Chlorophyll α DO pH Temperature	~~Review and update municipal code, as necessary, by December 1, 2024 to reflect the permit requirements and current industry standards.~~ Provide stormwater programs that meet current industry standards.	1. Review and update the municipal code to comply with the 2021 permit. 2. Track progress and adoption date of revised code sections. 3. Provide summary of changes. 4. Track the number of public comments received.	The City is currently reviewing the municipal code and expects to be adopting any revisions by December 2024.
~~Post Construction Site Runoff~~ Program Management	Mercury Chlorophyll α DO Temperature	Monitor impervious area.	Summarize municipal code changes that affected sensitive lands, increased density, or increased impervious area.	The City adopted Ordinance 2892 to comply with House Bill 2001 which required cities to allow duplexes, triplexes, quadplexes, and cottage clusters in single-family residential zones. The effect of the bill will increase the amount of impervious area and require additional capacity of the public system to avoid flooding and other hydromodification effects created by increased stormwater volumes and velocities. The City adopted Ordinance 2908 which changed the municipal code (Chapter 50) to require public improvements for projects that were previously exempt, primarily in response to the State Legislature's requirement to allow denser housing options.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
~~SWMP Resources~~ Post-Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Provide stormwater programs that meet current industry standards. ~~Review and update, as needed, engineering standards and standard drawings that affect stormwater at least once every 5 years to reflect current industry practices~~.	Review, update, and summarize modifications to the engineering design standards and standard drawings that affect stormwater at least once per permit term. ~~or erosion and sediment control.~~	There were no changes to the engineering standards or standard drawings in FY2223.
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	~~Review and update the SWMM by December 1, 2024.~~ Provide stormwater programs that meet current industry standards.	Review and update the SWMM by December 1, 2024. Provide a summary of the changes	The City is currently reviewing the SWMM for compliance with the 2021 MS4 permit. Revisions will be implemented in 2024.
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	~~Review and update LID/GI prioritization strategy by December 1, 2023~~. Provide stormwater programs that meet current industry standards.	Review and update LID/GI prioritization strategy by December 1, 2023. Provide a summary of the changes.	The City changed its strategy by requiring onsite retention of the 10-yr 24-hr storm as a first tier and extended filtration as the 2nd tier for stormwater facility selection.
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.	1. Review and update, as necessary, the technical feasibility criteria for stormwater treatment. Summarize the criteria and provide the implementation date. 2. Track the number of projects that do not provide stormwater treatment due to technical infeasibility, the affected watershed, and the reason for the exception.	The City is reviewing the current technical requirements for its stormwater facilities. Revisions will be implemented in 2024.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Post Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH Temperature	~~Every five years, or when LiDAR data become available, complete an impervious area analysis.~~ Monitor changes in impervious area.	When new LiDAR data becomes available, complete an impervious analysis. Report on the amount of impervious area within the City and within the UGB that was derived from the updated LiDAR data.	The City analyzed the LiDAR data flown in 2019. The next LiDAR flight is expected in 2024.
Post Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH Temperature	Monitor changes in impervious are.	Track the number, acreage, and affected watershed for annexed properties.	Five properties (5.8 acres) were annexed into the City in FY2223. Two of the properties were in the Tryon Creek watershed. The Oswego Lake, Springbrook Creek, and Tualatin River watersheds each had one property annexed into the City.
Post Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH Temperature	Monitor changes in impervious area.	1. Track changes in the UGB boundary and the planned zoning for the changes. 2. Track the number and type of approved changes in zoning and the affected watershed 3. Track the number of approved land use requests and the affected watershed.	In FY2223, there were 18 applications for variances, partitions, and lot line adjustments affecting 19 acres. The potential number of lots that could be created in the future remained the same (78 lots) however the general effect of the changes will be to increase impervious area. Nine of the property changes were in the Oswego Lake watershed, two were in the Springbrook Creek watershed, six were in the Tryon Creek watershed, and one was in the Willamette River watershed. One property's zoning changed from R-7.5 to R-5 which should result in less impervious area. There were no changes in the UGB.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.	Track the number of land-use applications reviewed, the number required to manage stormwater, and the affected watersheds.	There were 57 applications for development that went through the land-use review process and 34 were reviewed for stormwater management requirements. A majority of the projects undergoing the land-use process in FY2223 were located in the Oswego Lake watershed (17 projects). Projects in Tryon Creek watershed were a close second at 12 projects. The remaining five projects were located in the Springbrook Creek (3 projects) and the Willamette River (2 projects) watersheds.
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Review 100% of construction plans that require public stormwater improvements.	1. Track the number of projects requiring public stormwater improvements 2. Track the status of public improvements, e.g. in review, in construction, in warranty period, accepted by City.	In FY2223, there were no public stormwater facilities built by private development however one project was required to extend the stormwater system 175 ft and another project replaced a culvert after moving the original driveway.
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.	1. Track the number of subdivisions that were reviewed and the affected watershed. ~~2. Track the number of commercial projects that were reviewed and the affected watershed.~~ ~~3. Track the number of industrial projects that were reviewed and the affected watershed.~~	One subdivision in the Oswego Lake watershed was approved for construction as wells as 14 commercial projects located in the Tualatin River, Oswego Lake, and Willamette River watersheds. There were no industrial projects approved for construction in FY2223.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.	1. Track the number of construction plans reviewed. 2. Track the number of construction projects that re-developed 3,000 sq ft or more of impervious area. 3. Track the number of stormwater facilities, by type, that were approved for construction.	In FY2223, staff reviewed 76 construction plans of which 65 were classified as large projects (3,030 sq ft or more of impervious area). UICs were proposed for stormwater management in 34 projects and 34 proposed vegetated facility management. The remainder used non-vegetated facilities such as pavers, water-quality vaults, and sand filters.
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Reduce TSS 80% prior to discharge offsite for 95% of the projects that exceed stormwater thresholds.	1. Track the number of projects with an offsite discharge. 2. Track the ~~types of~~ stormwater facilities constructed to treat stormwater before discharge offsite~~. to reduce TSS by 80% and the affected watershed.~~	Offsite discharges are common for stormwater facilities that do not provide onsite retention. There were 2 properties (1 commercial) that used a filtration planter, 3 properties that used a swale, 1 property that used an existing detention pond, and 1 project that used sheetflow dispersion. While they would have an offsite discharge, all but the properties using the detention pond and sheetflow dispersion would have reduced TSS by 80%.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.	Track the amount of impervious area treated by constructed private stormwater facilities; categorize the stormwater facilities by watershed and type, e.g. planter, infiltration trench, etc.	3.2 acres were treated with water-quality vaults which are only approved for non-SFR projects. Infiltration trenches and galleries treated 3.8 acres. Drywells treated 0.4 acres and filtration planters treated 1.2 acres. Infiltration planters and raingardens each treated 0.2 acres. The remaining 0.7 acres were treated by permeable pavers, sheet flow dispersion, or detention ponds, or were 0.1 acres were untreated. Most of the projects were in Oswego Lake (3.4 acres) with the majority treated by infiltration trenches (2.8 acres). Springbrook Creek saw treatment of 3.4 acres with a majority (2.9 acres) treated by water-quality vaults which are only approved for non-SFR properties. Properties in the Willamette River watershed treated 1.6 acres with a majority of the treatment (1 acre) provided by filtration planters. The Tryon Creek watershed had 0.7 acres treated primarily with infiltration galleries (0.5 acres). The Tualatin River watershed had 0.3 acres treated primarily with infiltration trenches (0.1 acres) and a detention pond (0.1 acre).
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.	Report the number of City-initiated projects that included a stormwater component. Include its phase (in design, under construction, or completed) and the affected watershed.	Three CIP projects were completed in FY2223 that had a stormwater component. One project was located in the Tryon Creek watershed, one was located in the Springbrook Creek watershed, and the other had locations across the City. Four CIP projects continued into FY2324 – they are located in the Oswego Lake, Willamette River and Tualatin River watersheds. Four projects are in design – they are located in the Oswego Lake and Springbrook Creek watersheds

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Ensure stormwater treatment for 95% of construction projects exceeding stormwater thresholds.	Track the number of stormwater facilities constructed, the type (planter, infiltration trench, etc.), impervious area treated, and the affected watersheds for new public stormwater facilities.	Two City-initiated projects were completed in FY2223. Stormwater facilities included an infiltration raingarden to treat 1,700 sq ft of existing impervious area in the Tryon Creek watershed and water-quality vaults to treat 2,785 sq ft of new impervious area and 1,375 sq ft of existing impervious area in the Willamette River watershed.
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Require CCTV of all new pipe systems at substantial completion of the project to ensure proper connections.	Track the amount of new pipe inspected (in linear feet) and categorize as either part of a public improvement or a capital improvement project.	FY2223, the City required video of 6,500 feet of stormline for a project in the Oswego Lake watershed.
~~Post Construction Site Runoff~~	~~Mercury~~ ~~Bacteria~~ ~~Chlorophyll α~~	~~Map, or otherwise document, the locations of 100% stormwater facilities within 2 years of construction.~~	~~1. Track the number of public stormwater facilities accepted by the Cityannually.~~ ~~2. Track the number of private stormwater facilities that have been constructed.~~	This metric was not tracked in FY2223.
Post Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH Temperature	Review and update, as necessary, the procedures and criteria for inspecting stormwater facilities at least once per permit term.	1. Summarize changes to current procedures and criteria for inspected stormwater facilities. 2. Track the implementation month/year.	There were no changes to the procedures and criteria for inspection of stormwater facilities.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Post Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH Temperature	Annually inspect 90% of the public stormwater vegetated facilities.	Track the number and type of each public vegetated stormwater facility that was inspected, the affected watershed, and if repair or restoration was required.	Six filtration planters were maintained in the Ball Creek watershed, 79 filtration planters and two detention ponds were maintained in the Oswego Lake watershed, 4 bioswales and 2 filtration planters were maintained in the Springbrook Creek watershed, and 37 filtration planters were maintained in the Tryon Creek watershed. 43 of the planters in the Oswego Lake and 4 bioswales in the Springbrook Creek watershed required new plantings.
Post Construction Site Runoff	Mercury Bacteria Chlorophyll α DO pH Temperature	Inspect at least 50% of the private stormwater facilities constructed during the permit term.	1. Track the number of ~~facilities~~ properties that were inspected; categorized by construction year and ~~type (planter, raingarden, infiltration trench, etc.~~ Track the impervious area treated by the inspected facilities by watershed.	There were 52 residential and 2 commercial properties with inspected stormwater facilities. Four acres were treated by facilities considered green infrastructure and 3.3 acres were treated with infiltration facilities. There was a 0.85-acre overlap of infiltration facilities with green infrastructure facilities (acreage would have been counted twice). Facilities built in 2019 and 2020 comprised the majority of the inspected facilities (2.0 and 1.7 acres, respectively). Facilities built in 2018 comprised 1.4 acres of the inspected impervious area. Facilities built prior to 2018 comprised the rest of the inspected impervious area (1.4 acres) The total impervious area treated was 283,048 sq ft (6.5 acres) with commercial properties comprising approximately 39,000 sq ft (0.9 acres) of the total.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Post Construction Site Runoff	Mercury Chlorophyll α DO pH Temperature	Provide a report to the property owner outlining deficiencies within 90 days of the inspection and require repairs or corrections.	1. Track the number of ~~inspections~~ properties that required follow-up. 2. Track the number of ~~inspections~~ properties that required enforcement and whether a citation was issued. 3. Track the number of inspections that required no follow-up.	Even though 20 of the 52 inspected properties were first-time inspections, only 32 of the properties required follow-up inspections. There were no citations issued.
Retrofit/ Hydromodification	Mercury Chlorophyll α DO pH Temperature	Reduce hydromodification through City-initiated projects.	Track the number and location of CIP and Parks projects that provide a reduction in stormwater volume or velocity, e.g. infiltration facilities (see Hydromodification Assessment 2015).	The 10th St Pump Station project provided an infiltration raingarden to reduce stormwater volume from 1,700 sq ft of previously untreated runoff. The Rassekh Park project will include a large infiltration raingarden. The Jean Rd/Pilkington project will provide infiltration planters and sumped/snouted catchbasins. The Daniel Way project will improve outfall discharge velocities, reduced streambank slopes, and improve sinuosity of the stream.
Retrofit/ Hydromodification	Mercury Chlorophyll α DO pH Temperature	Provide velocity reduction for 10% of existing ditches and 75% of newly constructed conveyance ditches through longitudinal slope reduction and broadening of side slopes (whenever feasible) with percentages based on the permit term.	1. Track number of linear feet of retrofit conveyance ditches. 2. Track the linear feet of new conveyance ditches constructed using the velocity reduction criteria.	There were projects meeting this metric in FY2223.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Retrofit/ Hydromodification	Mercury Chlorophyll α DO pH Temperature	Provide velocity reduction for 10% of existing major outfalls and 75% of newly constructed outfalls (whenever feasible) with percentages based on the permit term.	1. Track number of outfalls retrofitted. 2. Track number of new outfalls constructed with erosion protection.	There were projects meeting this metric in FY2223
Retrofit/ Hydromodification	Mercury Bacteria Chlorophyll α DO pH Temperature	Retrofit public catchbasins whenever feasible. ~~Upgrade 50% of existing catch basins in capital improvement projects to sumped and snouted catch basins (whenever feasible with percentages based on the permit term).~~	1. Track number of catch basins converted for all capital improvement projects. 2. Track the number of new and/or sumped and snouted catchbasins.	The City retrofit 9 catchbasins in FY2223 with sumped/snouted catchbasins and 28 catchbasins with 3-ft sumps.
~~Retrofit/ Hydromodification~~	~~Mercury~~ ~~Bacteria~~ ~~Chlorophyll α~~ ~~DO~~ ~~pH~~	~~Retrofit under-functioning stormwater facilities and structures.~~	~~1. Track the number of structures retrofit, not including catchbasins, outfalls, or ditches.~~ ~~2. Track how the retrofit increased water quality (see Retrofit Assessment 2015).~~	There were no replaced stormwater facilities in FY2223.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Public Education	Mercury Chlorophyll α DO pH Temperature	Educate professionals and the general public about City projects.	1. Track the number of CIPs with a stormwater component that included public comment. 2. Track the type of outreach avenues such as newsletters, meetings, and social media types	Four projects located in the Oswego Lake watershed used public meetings, mailings, newsletters, social media, door hangers and the projects' webpages for public outreach. One project located in the Tualatin River watershed included public comment, neighborhood meetings, Hello LO articles, social media posts, project webpage, project advisory committee meetings, and public hearings to encourage public comment. Two projects (Rassekh Park and CIP Plan) included presentations to the City Council. The Council meetings included the option for public comment.
Public Education	Mercury Chlorophyll α DO pH	Educate businesses about stormwater. ~~Provide information about stormwater education to professionals.~~	Track the type and number of messages sent to businesses. ~~professionals/contractors e.g. classes on erosion control or vegetated stormwater facility construction and maintenance.~~	There was no outreach to professionals/contractors for erosion control or vegetated stormwater facility construction and maintenance.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Public Education	Mercury Bacteria Chlorophyll α DO pH Temperature	Work with partners who provide stormwater education.	1. Track the message subjects of funded groups and outreach types 2. Track the number of funded HEP projects that include stormwater education	The Regional Coalition of Rivers and Streams (RCCRS) provides stormwater messaging to residents of the tri-county Portland metropolitan area (estimated population of 1.8 million). The group currently uses a variety of social media platforms and its website to educate the public on issues such as uncollected pet waste, proper fertilizer and pesticide use, proper disposal of hazardous substances such as oil and solvents, and the connection between personal choices and their effect on our rivers and streams. The CRC has over 60 partners. Their mission is to build a bridge between clean water and healthy communities. They partnered with Northwest Center for Alternatives to Pesticides to launch outreach, training, and video in Spanish. Key messages included pesticide and herbicide use, stormwater planter education, riparian habitat, and 6-ppd quinone's effect on salmon. The City partners with other jurisdictions and KPTV to provide public service announcements (PSAs). In FY2223, the PSAs included messages on water conservation, herbicide and fertilizer use, car washing, good practices for fall maintenance, and keeping leaves out of the public stormwater system. Information regarding leaf disposal and keeping catchbasins free of leaves were run as part of the campaign throughout the wet weather season.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
~~Public Education~~	~~Mercury Chlorophyll α DO~~	~~Provide information on proper fertilizer, herbicide, or pesticide storage and application.~~	~~Track the message subjects and the outreach types, e.g. social media~~	The City's partnerships with KPTV, CRC, and RCCRS included messaging on proper use of herbicides and pesticides. See the main body of the report for more information.
Public Participation	Mercury Bacteria Chlorophyll α DO pH Temperature	Review the stormwater webpages annually.	Summarize changes made to the website.	In FY2223, staff started refreshing the website content including removing redundant content and creating a new webpage for business outreach in preparation for the 2021 permit requirements for education. Staff created factsheets on catchbasin cleaning, dock maintenance, carpet cleaners, and mobile car washers; they also updated the "Report a Spill" webpage and placed it on the "How Do I" drop down list featured on the City's main webpage.
Public Participation	Mercury Bacteria Chlorophyll α DO pH Temperature	Maintain general email contact and USPS address for stormwater questions.	Track number and subject matter of comments received.	There was no progress on this metric in FY2223.
Public Participation	Mercury Bacteria Chlorophyll α DO pH Temperature	Educate stakeholders about the City's stormwater efforts by posting the SWMP, SWMM, and annual reports on the website.	Track number and subject matter of comments received.	The City posted the SWMP, SWMM, and annual reports on the website. There were four comments on the SWMP however only one (a mapping correction) was directed at credible changes of the SWMP.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Public Participation	Mercury Bacteria Chlorophyll α DO pH Temperature	Provide 30 days of public comment for the municipal code changes required by the MS4 permit prior to submittal to DEQ.	Track number and subject matter of comments received.	The City expects to provide a 30-day public comment period in 2024 for any changes in the municipal code.
Public Participation	Mercury Bacteria Chlorophyll α DO pH	Provide 30 days of public comment for the revised SWMP prior to submittal of permit renewal package.	Track number and subject matter of comments received.	This metric is due in 2026
Public Participation	Mercury Chlorophyll α DO pH	Provide 30 days of public comment for the Industrial and Commercial Program Strategy prior to submittal to DEQ.	Track number and subject matter of comments received.	This metric is due 12/1/23
Public Participation	Mercury Chlorophyll α DO pH Temperature	Provide 30 days of public comment for the LID/GI prioritization strategy prior to submission to DEQ.	Track number and subject matter of comments received.	This metric is due 12/1/23
Public Participation	Mercury Chlorophyll α DO pH Temperature	Work with neighborhood groups, i.e. Friends Groups, to restore natural habitat.	Track the number of volunteer events.	There were 30 volunteer work parties (1,980 volunteer hours) in FY2223.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
Training	Mercury Bacteria Chlorophyll α DO pH Temperature	Provide training to Employees with stormwater responsibilities. Inform or train staff when changes in stormwater policy and procedures are implemented.	1. Track the number of current employees with stormwater responsibilities. 2. Track the number of employees with stormwater responsibilities that received training in the reporting year. 3. Track the number of employees with stormwater responsibilities that have been trained in policy changes and procedures.	There are 65 staff in the City who are involved with stormwater report metrics. Within the Engineering program, there are 8 staff with stormwater responsibilities. Two staff received training on aspects of floodplain management and one staff member participated in the APWA conference and the ACWA Stormwater Summit. Within the Public Works Maintenance department, there are 7 staff with stormwater responsibilities. They were trained in practices for preventing heat-related conditions, confined space training, and fall protection training; three staff also attended a Snowfighters Conference where presentations covered salt management, material application techniques, and determining what material to use during an event. In the Planning Department, 5 staff have stormwater responsibilities but did not receive training in FY2223. In the LOFD, 43 members participated in hazardous material training. There are 2 staff from Parks that have stormwater responsibilities; they did not receive training in FY2223.
Training	Mercury Bacteria Chlorophyll α DO pH Temperature	Provide training to Employees that are new to stormwater within 60 days of assignation.	1. Track the number of staff new to stormwater that received training. ~~2. Track the number of discrete employees that have been assigned stormwater responsibilities and received training during the permit term.~~	There was one person in Public Works Maintenance and 14 LOFD staff that had new stormwater responsibilities. The Public Works staff received training in heat-related conditions and the LOFD staff were trained in hazardous material training. There were no Parks, Engineering, or Planning staff new to stormwater responsibilities.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
~~Training~~	~~Mercury~~ ~~Bacteria~~ ~~Chlorophyll α~~ ~~DO~~ ~~pH~~	~~Require training of at least 50% of contractors with stormwater responsibilities. Track the number of discrete contract staff that have received training.~~	~~Track the number of contract staff with stormwater responsibilities that have received training versus the total number of contract staff with stormwater responsibilities.~~	This metric was not tracked for FY2223.
Training	Mercury Bacteria Chlorophyll α DO pH	Provide stormwater programs that meet current industry standards. ~~training to Employees with spill response duties at least once every 2 years~~.	1. Track the number of staff trained in spill response. 2. ~~Track the number of discrete employees receiving spill response training during the permit term~~.	Thirty Public Works staff and 43 LOFD staff were trained in spill response or hazardous material response in FY2223. Two of the LOFD staff completed the full NFPA hazardous material training.
Training	Mercury Chlorophyll α DO pH	Provide certified training to Employees with commercial industrial inspection responsibilities.	1. Track the number of certified staff or contracted staff. ~~2. Track the number of discrete staff that have received training during the permitterm.~~	One staff member has inspection experience but is no longer certified.

Minimum Measure	Affected TMDL	Goal	Tracking Measure	Progress
~~Training~~	~~Bacteria~~ ~~DO~~	~~Provide training to Employees who are new to litter and trash pickup or to winter event activities within 60 days of assignation.~~	~~1. Track the number of employees involved in winter event, litter, or trash activities.~~ ~~2. Track the number of employees receiving training each year and the subject matter of the training (sanding, de-icing, litter, trash).~~ ~~3. Track the number of discrete employees that have received training during the permit~~ ~~term (do not count a person more than once during the permit year).~~ 4. ~~Track the number of discrete employees that have received training for winter event, litter, or trash activities during the permit term~~.	This metric was not tracked in FY2223
Training	Mercury DO pH	Provide ~~or require~~ training for Employees ~~and contractors completing~~ applying pesticides. ~~applications. A copy of the ODA certification of contracted staff to be provided to City prior to contract execution.~~	Track the number of staff and contractors trained ~~versus the total number of staff and contracted staff applying pesticides~~.	Fifteen staff and three contractors were certified for pesticide application. Staff were trained in the changes to the IPM.

APPENDIX B TMDL IMPLEMENTATION PLAN ANNUAL REPORT

TMDL IMPLEMENTATION PLAN
ANNUAL REPORT COVERING
JULY 1, 2022 TO JUNE 30, 2023

Prepared for the Oregon Department of Environmental Quality

December 1, 2023

ACRONYMS

CWA	Clean Water Act
CWR	Cold Water Refugia
DEQ	Oregon Department of Environmental Quality
DMA	Designated Management Agency
HEP	Habitat Enhancement Program
LA	Load Allocation
M-IBI	Macroinvertebrate Index of Biological Integrity
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
PLRE	Pollutant Load Reduction Evaluation
PREDATOR	Predictive Assessment Tool of Oregon
SWMP	Stormwater Management Plan
USEPA	US Environmental Protection Agency
USGS	US Geological Survey
WQMP	Water Quality Management Plan
WLA	Wasteload Allocation

B.1 INTRODUCTION

The Clean Water Act (CWA) was enacted in 1972 to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters". After point sources such as industrial facilities and wastewater treatment plants were regulated as part of the National Pollutant Discharge Elimination System (NPDES) program, the USEPA found that the nation's rivers and streams were still not providing sufficient water quality to meet their assigned beneficial uses. As a result, the NPDES Municipal Separate Storm Sewer System (MS4) Phase I permit program was implemented in 1990 to regulate stormwater discharges from municipalities, counties, and other entities that met the MS4 permit thresholds of a population of 100,000 people or in an urbanized area. The City of Lake Oswego (City) was issued a Phase I permit, known as the Clackamas Permit, in 1995.

Under Section 303(d) of the CWA, the Oregon Department of Environmental Quality (DEQ) must identify watersheds that do not have sufficient water quality to meet their strictest beneficial use. DEQ determines the total maximum daily load (TMDL) that each watershed can carry for all parameters that are keeping the watershed from achieving its beneficial uses. Entities which have discharges into a water-quality limited waterway are designated as management agencies (DMAs) for these parameters. The City of Lake Oswego (City) was determined to be a DMA for several parameters in the watersheds under its jurisdiction (See Table B.1).

Table B.1 Watersheds affected by TMDLs of which the City is a Designated Management Agency

TMDL Basin	Issue Date	Parameter[1]
Tualatin River Basin	2001	Added: • Temperature (surrogate – effective shade) • Bacteria
	1988/ 2012	Updated 1988 Parameters: • pH • Chlorophyll *a* (surrogate – total phosphorous) • DO (surrogates – TSS and VSS)
Lower Willamette River including the Tualatin River Basin	2006 and 2012	• Bacteria • Mercury • Temperature (surrogate – effective shade) • pH • Chlorophyll *a* (surrogate – total phosphorous) • DO (surrogates – TSS and VSS)
Lower Willamette River including the Tualatin Basin	2019	Updated: • Mercury (surrogate – TSS)

1 – All parameters except temperature have wasteload allocations and are covered under the City's NPDES MS4 Phase I permit; TSS=total suspended solids; VSS=total volatile suspended solids)

B.2. TMDL Implementation Plan Revisions

The Willamette River and Tualatin River have Water Quality Management Plans (WQMPs) associated with their TMDLs. These WQMPs provide guidance for reducing the parameters that have TMDLs and require a revision of the City's TMDL Implementation Plan ("Plan") every five years.

In FY1819, the City revised its Plan in response to DEQ's realignment of the Willamette River and Tualatin River WQMP timelines. The City submitted its revised TMDL Implementation Plan to DEQ in October 2018 for their review and received approval in May 2020. In response to the revised mercury TMDL issued in 2019, the City submitted a mercury minimization plan in August 2022 and received approval of the plan in February 2023.

The City is currently revising its Plan as part of the regular update required by law with an expected submittal date to DEQ by December 1, 2023.

B.3 Program Management

The City uses funds from Planning and the Parks and Recreation Department (Parks) to fund many of the activities required in its Plan. Two programs, the Habitat Enhancement Program (HEP) and the Backyard Habitat Program, are directly funded by the City in support of habitat restoration and preservation on private property. In FY2223, the City disbursed approximately $88,549 through the HEP to local watershed councils. The City disbursed $46,639 through the Backyard Habitat Program.

In addition to providing funds for private property restoration, the Parks Department maintains a robust public property restoration program through invasive removal and habitat enhancement. The City disbursed approximately $226K for restoration of City-owned property.

The City provides access to its Plan, Hydromodification Assessment, and annual reports on its website. The City received no comments on these documents in FY2223.

B.4 TMDLs & Stormwater Management

All of the constituents identified as needing a TMDL, except stream temperature, are regulated through the City's Phase I NPDES MS4 permit and have waste load allocations (WLAs). The City's stormwater management plan (SWMP) contains actions the City takes to meets its regulatory obligations under its MS4 permit. The following actions in the SWMP address the TMDL parameters assigned to the City (See Table B.2):

- Implementation of an erosion control program to reduce bacteria, phosphorous, and mercury while increasing dissolved oxygen and stabilizing pH and temperature.

- Implementation of a development review program to reduce stormwater volume and streambank erosion thereby reducing bacteria, phosphorus, and mercury while increasing dissolved oxygen and stabilizing pH and stream temperatures.
- Maintenance of the public stormwater conveyance and water-quality structures to reduce bacteria, phosphorus, and mercury while increasing dissolved oxygen and stabilizing pH and stream temperature.
- Implementation of a cross-connection program to reduce bacteria.
- Implementation of an illicit discharge program to reduce bacteria, phosphorus, and mercury while increasing dissolved oxygen and stabilizing pH and stream temperature.
- Implementation of an inspection program for industrial and commercial properties to reduce bacteria, phosphorous, and mercury while increasing dissolved oxygen and stabilizing pH.
- Implementing a public education and public involvement program to reduce bacteria, phosphorous, and mercury while increasing dissolved oxygen and stabilizing pH.

Additional information regarding these programs is provided in the City's annual NPDES MS4 report.

Table B.2. TMDL Parameters and City Activities related to the NPDES MS4 Permit

Minimum Measure (MS4 Permit)	TMDL Parameter (and Surrogate)					
	Bacteria	Dissolved Oxygen (TSS/VSS[1])	pH	Chlorophyll α (Phosphorus)	Mercury	Temperature (Effective Shade)
Construction Site Runoff	√	√	√	√	√	√
Post-Construction Site Runoff	√	√	√	√	√	√
Pollution Prevention in Municipal Operations[2]	√	√	√	√	√	√
Illicit Discharge Program[3]	√	√	√	√	√	
Industrial and Commercial Program	√	√	√	√	√	
Public Education and Public Participation	√	√	√	√	√	√

1 TSS = Total Suspended Solids, VSS=Volatile Suspended Solids; 2 – includes street sweeping and pesticide reduction; 3 – includes cross-connections

B.5 WASTELOAD ALLOCATIONS

Historical progress towards attaining the WLAs is found in the City's 2016 Pollution Load Reduction Evaluation (PLRE) and 2016 WLA Assessment. An analysis of the City's progress towards meeting its WLAs and a discussion regarding constituents listed in the 303(d) list are provided each year in the City's NPDES MS4 report. The following analysis is a summary of the FY2223 water-quality data.

B.5.1 Bacteria

Bacterial TMDLs have been set for the Tualatin River (all tributaries and ephemeral streams), Springbrook Creek and the Willamette River (all tributaries).

Monitoring sites affected by the Tualatin River bacteria TMDL are Carter Creek and Ball Creek. Maximum concentrations for Ball Creek and Carter Creek were above the 406 col/100 mL threshold for the winter and summer. Geomean concentrations were below the 406 col/100mL threshold.

Based on data collected by the City from 1997 to 2003, DEQ determined that bacterial concentrations in Springbrook Creek must be reduced to 80% of their 1997 to 2003 concentrations. Bacterial reductions of 80% were met for summer maximums and the geomean. Bacterial reductions were 62% and 77% for the winter maximum and geomean concentrations, respectively.

One monitoring site (Nettle Creek) discharges into the Willamette River via Tryon Creek. Two other monitoring sites (Boones Ferry at Bryant and Lost Dog Creek) discharge to Oswego Lake which acts as a sink for the loads coming from those sites.

The Willamette River TMDL for bacteria requires a 78% reduction of the *E. Coli* concentrations from 1997 to 2002. *E. Coli* concentrations at Nettle Creek were not reduced much from the 1997-2002 concentrations. The sites at Boones Ferry and Lost Dog Creek showed promising reductions of 80% for the geomean concentrations and 95% for the maximum concentrations.

B.5.2 Dissolved Oxygen

The 2001 dissolved oxygen (DO) WLA for Fanno Creek and its tributaries required a minimum concentration of 6.5 mg/L and a 50% decrease from pre-1998 concentrations for total suspended solids (TSS) and total volatile suspended solids (VSS) from May 1st to October 31st.

Ball Creek and Carter Creek, as tributaries of Fanno Creek, are covered under the dissolved oxygen WLA. The minimum concentration of 6.5 mg/L for dissolved oxygen was met for Ball Creek in FY2223 but not for Carter Creek. A measure of the longer-term dissolved oxygen concentration experienced by macroinvertebrates would be the median dissolved oxygen concentration. The threshold concentration of 6.5 mg/L for the median dissolved oxygen concentration was met in both Ball Creek and Carter Creek for FY2223.

Ball Creek saw a 96% reduction in the maximum TSS concentration and a 64% reduction in the median TSS concentration. The maximum VSS concentration was only 26% less than the baseline concentrations and the median VSS concentration only saw a 12% reduction from baseline concentrations.

Carter Creek saw an 88% reduction in TSS from the baseline concentrations and a 37% reduction in median concentrations. The reduction for VSS at Carter Creek was 41% for maximum concentrations and 18% for median concentrations.

B.5.3 Chlorophyll α and pH

Chlorophyll α and pH TMDLs were set in the 2001 Tualatin River TMDL and revisited, in 2012, for Oswego Lake and its tributaries. Total phosphorous is used as a surrogate measure for pH and chlorophyll α. Water-quality data on total phosphorous and pH covered by this TMDL include stream samples taken from the instream monitoring sites at Ball Creek, Carter Creek, Springbrook Creek, Lost Dog Creek, and Boones Ferry at Bryant.

The maximum summer phosphorous concentration for the Tualatin River watershed was determined by DEQ to be 0.46 mg/L with a median of 0.13 mg/L. Ball Creek met the pH range and was below the median and maximum phosphorous WLAs. Carter Creek met the pH range and was below the median and maximum phosphorous WLAs.

The maximum summer concentration for total phosphorous in the Oswego Lake watershed was set by DEQ in 2001 to 0.09 mg/L with a maximum winter concentration of 0.15 mg/L. Monitoring sites within the Oswego Lake watershed include Springbrook Creek, Lost Dog Creek, and the Boones Ferry at Bryant location.

Springbrook Creek was above the WLA for the summer maximum phosphorous concentration but below the winter maximum concentration. Lost Dog Creek was well below the phosphorous WLA for the winter and summer maximums. The monitoring site at Bryant was close to meeting the target maximum phosphorous for summer and met the WLA for the winter maximum.

B.5.4 Biocriteria

The threshold for biocriteria is "***a sufficient (water) quality to support aquatic species without detrimental changes in the resident biological community"*** (DEQ, 2022). Water bodies that have biocriteria impairment include Fanno Creek and Tryon Creek. Tributaries to these streams that are within the City's jurisdiction include Ball Creek, Carter Creek, and Nettle Creek.

The City partnered with Water Environment Services, a co-permittee, to complete a macroinvertebrate assessment in the Fall of 2021. Results were analyzed using the multi-metric macroinvertebrate-based index of biological integrity (M-IBI) and the Predictive Assessment Tool for Oregon (PREDATOR).

All of the sites were severely impaired under the PREDATOR assessment. Ball Creek showed a slight decline in aquatic habitat quality; however, Oswego Creek and Nettle Creek showed a steady increase in aquatic habitat quality. Springbrook abv Boones Way showed improvement in habitat quality since 2013 but appears to be in stasis at the moment. The M-IBI method indicated that seven of the ten sites were severely impaired with the remaining sites showing moderate impairment. Oswego Creek, Ball Creek, and Carter Creek all showed slight improvements since 2013. Tryon Creek and Springbrook abv Boones Way showed a progressive decline since 2013.

Temperatures above 18.4°C indicate a likely shift in the composition of the macroinvertebrate community from cool to warm water taxa. Seven of the ten sites assessed in 2021 were experiencing stress from temperatures.

Fine sediment in streambeds in excess of 19% indicates a likely shift in the composition of the macroinvertebrate community from pollution-sensitive taxa to taxa that are more tolerant of degraded conditions. Six of the ten sites indicate stress from fine sediment, however three of those sites experienced less sediment-induced stress since 2013. One site (Lost Dog at Lake Front) dipped below the threshold for sediment-induced stress for the first time since 2013. None of the sites showed an increasing trend in stress from fine sediment.

B.6 Temperature

Stream temperatures are affected by the amount of summer baseflow, stream channel widening due to erosion caused by short-term high-volume runoff, stormwater temperature, removal of riparian vegetation, and reduced diversity of riparian canopy. Of these causes, stormwater temperature is the least harmful because the maritime climate in the Willamette Valley defines our mild rainy winters and hot dry summers which result in very few rain events when air and stream temperatures are at their highest.

B.6.1 Temperature TMDLs

Temperature maximums are set based on whether the stream is used for salmonid rearing, migration, or spawning. The monitored sites within the City’s jurisdiction are cool-water habitat which requires a maximum temperature of 17.8°C except for Nettle Creek, a tributary of Tryon Creek, which has a maximum temperature of 13.0°C in the spawning season.

As shown in Table B.3, four of the six monitoring sites met the temperature TMDL. Lost Dog Creek and Carter Creek both exceeded their maximum temperatures. The current summer maximum temperatures at Carter Creek, however, decreased slightly from the previous 5 years.

Table B.3. Stream Temperatures at Selected Sites in Lake Oswego, FY2223 and FY1617-FY2122

Stream	Target Temperature °C	Summer Maximum,	
		FY2223	FY1718-FY2122
Ball Creek	17.8	17.0	17.1
Carter Creek	17.8	19.4	20.6
Boones Ferry site	17.8	15.7	16.3
Lost Dog Creek	17.8	18.4	18.2
Springbrook Creek	17.8	14.7	16.0
Nettle Creek	13.0 (Oct 15-May 15) 17.8 (May 16-Oct 14)	10.0 16.8	13.0 17.0

B.6.2 Temperature Mitigation

The City addresses temperature loading through the following metrics:

A. Preservation of existing riparian habitat through code enforcement of the sensitive lands Resource Protection overlay.

B. Enhancement of existing riparian habitat by funding restoration of public and private properties and protecting or enhancing areas of cold-water refuge.

C. Monitoring tree canopy and effective shade through an analysis of LiDAR data

D. Enhancement and protection of existing shade in riparian corridors through enforcement of the City's municipal code and by educating the public on the value of shade and trees.

E. Enhancement of cold water refugia

B.6.2.1 Preservation of Riparian Habitat

The City's sensitive lands designation overlays 120 acres and encompasses most of the riparian corridors within its jurisdiction. In FY2223, there were 18 applications for variances, partitions, and lot line adjustments affecting 19 acres. The potential number of lots that could be created in the future remained the same (78 lots) however the general effect of the changes will be to increase impervious area. There was one change in zoning from R-5 to R-7.5; it is likely to result in less impervious area than if the zoning designation remained as R-5.

Seven land-use cases and ten building permits were approved within 50ft of streams or affected sensitive lands. There were 10 riparian delineations in FY2223.

Just under 11,000 sq ft of property designated as Sensitive Lands were disturbed by unavoidable crossings such as utilities, driveways, etc. Over 36,000 sq ft of sensitive lands was mitigated or enhanced as a result. There were two Sensitive Lands violations. One violation, located in the Tryon Creek watershed, resulted in a citation.

Another way that the City protects riparian habitat is through modifications to municipal code. In FY2223, there were no modifications to the municipal code that affected sensitive lands however the adoption of HB 2001 (Affordable Housing) by the State Legislature created a requirement to increase density, and likely impervious area, within the City. The City adopted Ordinance 2892, effective July 7, 2022, to comply with HB 2001. The ordinance allows increased density for all properties zoned as single family residential. These properties can now be developed as duplexes, triplexes, quadplexes, and cottage clusters. It is a very high likelihood that it will result in an increase in impervious area with a corollary decrease in available capacity of the existing public stormwater system and an increase in stream erosion and stream temperatures.

B.6.2.2 Enhancement of Riparian Habitat

The City enhances riparian habitat through 1) restoration of City-owned properties, 2) restoration of private riparian areas through the Habitat Enhancement Program (HEP) and the Audubon Society's Backyard Habitat Program, and 3) providing technical expertise to the three local watershed councils operating within the City's jurisdiction, and 4) the Parks and Recreation Department's Master Plans.

B.6.2.2.1 Public Property Restoration

The City contains numerous parks and recreational areas which are maintained by the Parks Department; 460 acres are natural lands and 185 acres are developed parks. Many of these areas are adjacent to or include streams and directly-connected upland habitat that undergo periodic restoration by staff. The City is actively restoring 370 acres of public land and has spent approximately $1,215,000 on restoration of City-owned land from FY1718 to FY2122. In FY2223, the Parks Department spent approximately $226,000 on restoration of public lands.

B.6.2.2.2 Private Property Restoration

The City uses the HEP to provide funds to local watershed councils for projects that enhance privately-owned riparian habitat and provide public education. Applications are prioritized according to the amount of riparian habitat enhanced, connectivity to City projects or past projects, public education hours, and whether the project is in an area undergoing severe hydromodification as determined by the 2015 Hydromodification Assessment (City of Lake Oswego, 2015). Approximately 0.9 stream miles are under active restoration through the HEP program.

The City actively supports the Backyard Habitat Certification Program which is a partnership between the Columbia Land Trust and the Audubon Society of Portland. The program provides site visits and advice from professionals on transforming properties into areas with native habitat. It is a very well-received program by Lake Oswego citizens and, in 2018, the City was 3rd in the region for program participation. Approximate 29 acres of private property in the City's jurisdiction are participating in the Backyard Habitat program. Of that, over 17 acres are within 50 feet of a stream or are in a Sensitive Lands designation.

Overall, the City has spent $597K on direct restoration of private habitat from FY1718 to FY2122 through the HEP and the Backyard Habitat Program. In FY2223, the City spent $136K through these programs.

B.6.2.2.3 Master Plans

The City created a Natural Areas Habitat Management Plan that was adopted by the City Council in December 2022. The plan provides a framework to support the long-term health and resiliency of the City's natural areas. The plan has eight objectives which range from noxious weed control to the enhancement of hydrologic functions in riparian areas.

Rassekh Park in the Oswego Lake watershed is being planned as a multi-use area including a skate park. Current plans for the park include walking areas, an athletic field, and a play area. Stormwater will be managed by two infiltration raingardens to protect the downstream Pecan Creek watershed. The Lake Oswego Recreation and Aquatic Center will be co-located with the newly re-designed Golf Course in the Oswego Lake watershed. The aquatic center received land-use approval in May 2022.

B.6.2.3 Canopy Cover

The City retained a consultant to analyze the LiDAR data flown in 2019 (received by the City in 2020). The LiDAR data is combined with aerial maps and layers from the City’s LO Maps to create a snapshot of the city-wide canopy coverage.

The 2019 data shows an increased tree canopy city-wide (+5%) from 2014 to 2019 even with the increased population and subsequent development experienced by the City during the same period (Parametrix, 2021). The increase appears to be primarily from increased tree growth such as trees reaching the minimum 10-ft tree height required by the modeling program and trees experiencing horizontal growth of their canopy (see Figure B.1). For example, the light-green areas in Figure B.1 without adjacent dark green areas are likely trees that reached a minimum 10-ft height since it is unlikely, but not impossible, that a newly planted tree in 2014 would reach the 10-ft minimum height.

Areas with the greatest increase in canopy cover (more than 20%) occurred in the Foothills, Evergreen, and Lakewood neighborhoods (City of Lake Oswego, 2009). Areas with the largest amount of canopy cover (more than 60%), however, were in the Lakeview and Forest Hills neighborhoods. Interestingly, the canopy coverage increased by 54 acres from 2014 for right-of-way areas in the City. This is likely due to the 10-ft minimum scenario discussed in the previous paragraph.

Within areas designated for recreation and conservation, such as parks, golf courses, or schools, the greatest increase was seen at schools (10% increase). While parks and other natural areas saw a small increase (2%), the increase in canopy acreage was substantial (15 acres). Golf courses (primarily at the Lake Oswego Country Club) saw a decrease in canopy cover.

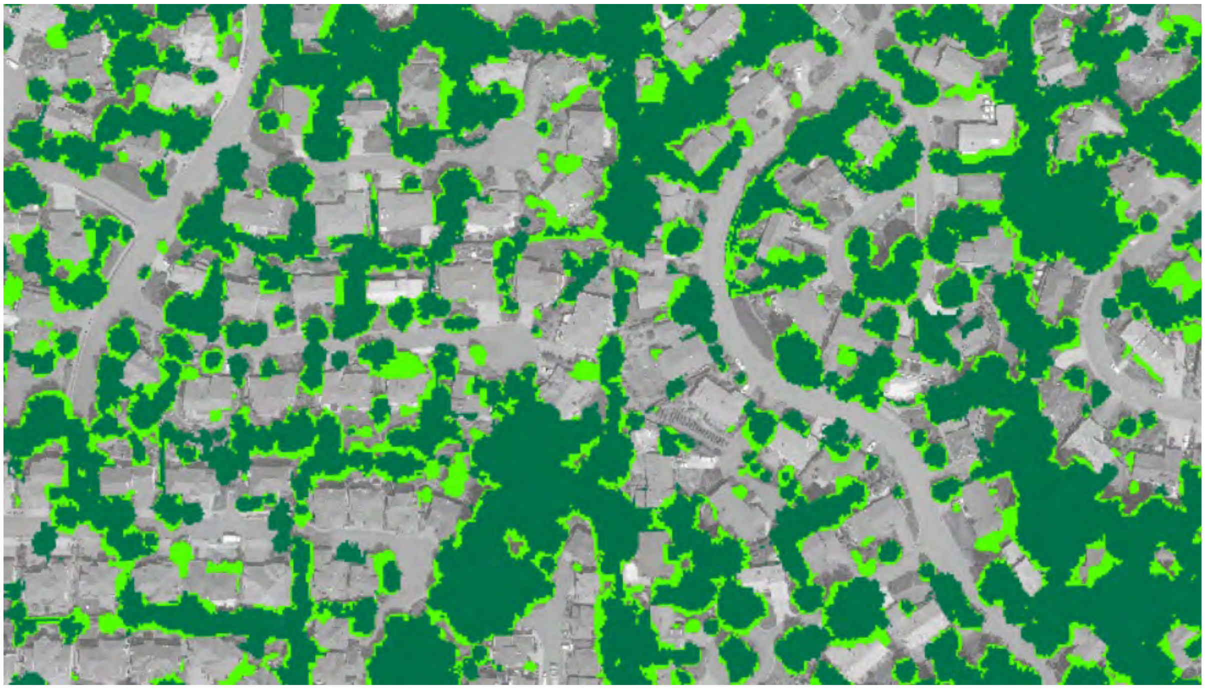


Figure B.1. Canopy growth between 2014 canopy (dark green) and 2019 (bright green).
Source: Parametrix, 2021

Canopy coverage was 89% (+2% from 2014) in areas with a sensitive-lands overlay which indicates that the protections placed on these areas in 2016 may be having an impact. The greatest increase was in the riparian protection areas (+21 acres), which has the most protection, as opposed to the resource conservation (+2 acres) or habitat benefit areas (+1 acre).

B.6.2.4 Effective Shade

Channel morphology and near-stream vegetation characteristics influence the amount of shade that can be used to stabilize stream temperatures. For instance, a large tree near a stream is more effective than a tree 20 ft away but is less effective than 15 smaller trees with interweaving canopies near a stream. The City completed analyses for the riparian areas throughout the City and for riparian areas protected by the City's sensitive lands buffers (Parametrix, 2021).

B.6.2.4.1 Effective Shade Targets

As shown in Figure B.2, the City met the effective shade targets in 2019 only in the Tryon Creek watershed and only when all riparian areas, protected and unprotected, were included in the analysis. The largest difference between the effective shade target and the actual effective shade in all riparian areas continues to be in the Tualatin River (-9%). The smallest difference is in the Springbrook Creek watershed (-0.7%).

When the results are confined to the protected riparian areas with a sensitive lands designation, the effective shade targets were not met in any of the watersheds. Differences between the target and the actual effective shade in the protected areas ranged from -0.5% in the Tryon Creek watershed to close to -14% in the Oswego Lake and Tualatin River watersheds.

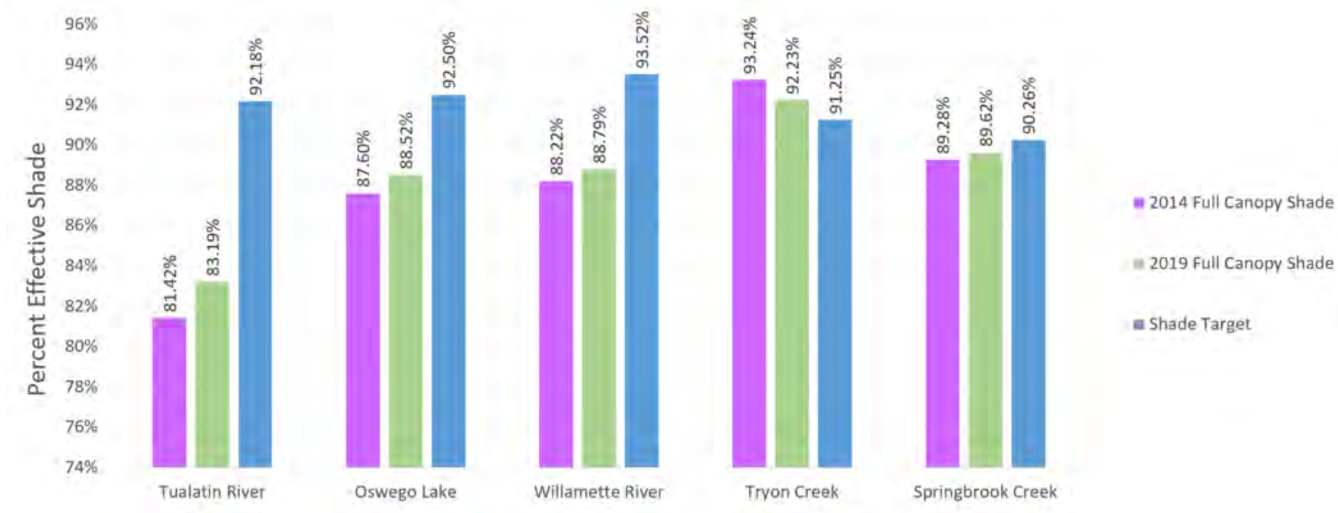


Figure B.2. Effective Shade (Protected and Non-Protected Areas) by Watershed.
Source: Parametrix, 2021

B.6.2.4.2 Historical Comparison

The effective shade in all riparian areas increased incrementally from 2014 with the exception of the Tryon Creek watershed (see Figure B.3). The Tryon Creek watershed saw a slight decrease (1%). The Tualatin River watershed saw the largest increase (1.8%) across the watersheds.

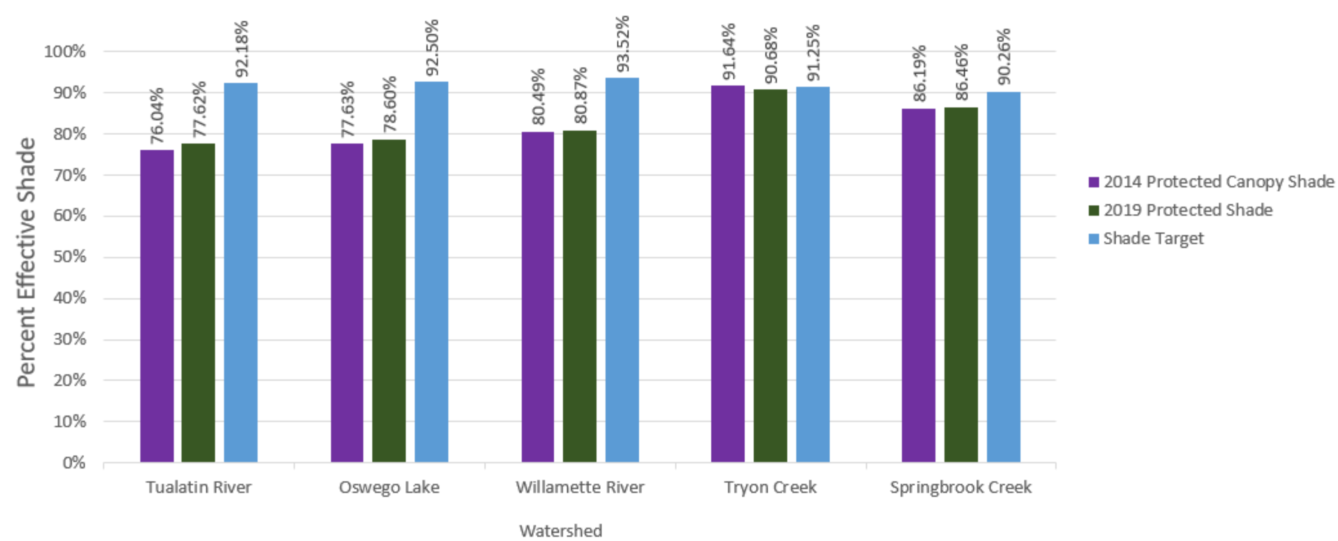


Figure B.3. Effective Shade in Sensitive Lands by Watershed, 2014 and 2019.
Source: Parametrix, 2021

When the results are confined just to the protected riparian areas (those with a sensitive lands designation), both Oswego Lake and the Tualatin River watersheds saw increases greater than 1%; the Tyron Creek watershed still saw a 1% decrease.

In both the 2014 and 2016 effective shade analyses, there was a 5% difference, on average, between the effective shade in areas protected by the sensitive lands overlay and the effective shade for all riparian areas (see Table B.4). This difference is due primarily to open channels which are not covered under the City's municipal code for sensitive lands but which are actually historical stream segments that have been channelized and/or otherwise changed significantly by development. In other words, the City's effective shade progress would be greater if there was protection for these areas especially in the Oswego Lake watershed.

Table B.4. Effective Shade Comparison between Protected and Non-Protected Riparian Areas.

Watershed	2014 Effective Shade			2019 Effective Shade		
	Sensitive Lands	All Riparian Areas	Difference	Sensitive Lands	All Riparian Areas	Difference
Tualatin River	76.0%	81.4%	5.4%	77.6%	83.2%	5.7%
Oswego Lake	77.6%	87.6%	10.0%	78.6%	88.5%	9.9%
Willamette River	80.5%	88.2%	7.7%	80.9%	88.8%	7.9%
Tryon Creek	91.7%	93.2%	1.5%	90.7%	92.2%	1.5%
Springbrook Creek	86.2%	89.3%	2.9%	86.5%	89.6%	2.9%
Average	82.4%	87.9%	5.5%	82.9%	88.5%	5.6%

B.6.2.5 Existing Shade Protection

The City uses public education and enforcement of its tree code to stress the importance of tree canopy on stream temperature. The Planning Department reported that there were no changes in the municipal code that affected tree canopy. Staff investigated 19 violations of the tree code resulting in the planting of 19 trees as mitigation. No citations were issued.

B.6.2.6 Cold Water Refugia

The City worked with the USGS, City of Wilsonville, Meyer Memorial Trust, and Benton County Soil and Water Conservation District to map cold-water refugia (CWR) along the mainstem of the Willamette River in 2016 and 2017 (Mangano et.al, 2018). Four sites within the City's jurisdiction were monitored for water temperature: Tryon Creek, Oswego Creek, Glenmorrie Dr seep, and Arbor Creek seep. Two sites, Tryon Creek and the seep at Glenmorrie Dr, showed some promise as cold-water refugia with temperatures between 15 and 17° C from June to mid-September (see Figure B.4).

The seep at Arbor Creek, while somewhat cooler than the Willamette River, neared or exceeded 20°C several times between June and mid-September. Because seeps do not provide a large volume of water for cold-water refugia, especially in comparison to the Willamette River's volume, the City's best option for protecting CWR is Tryon Creek. The City currently works with the Tryon Creek Watershed Council on riparian restoration and preservation through its Habitat Enhancement Program.

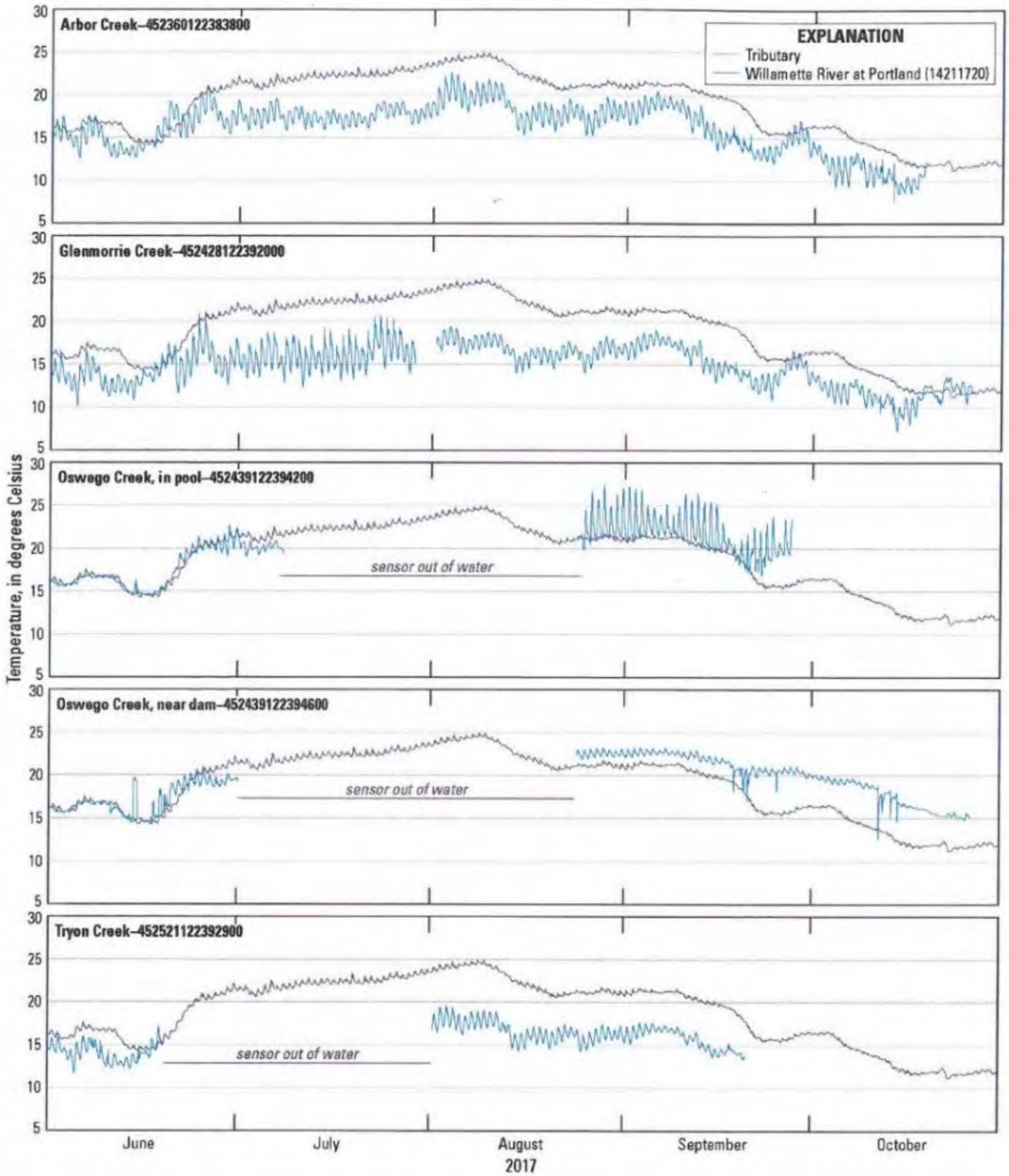


Figure B.4. Temperatures of Potential Cold-Water Refugia, June 2016 to September 2016
Source: Mangano, et. al., 2018

Another avenue for protecting CWR is to increase summer baseflows. The City's SWMM requires developers and City-initiated projects to infiltrate, if technically feasible, the 10-yr 24-hr storm (3.2 inches).

B.3 ADAPTIVE MANAGEMENT

The City is currently revising the TMDL Implementation Plan as part of the regular update required by law. The updated Plan will be submitted to DEQ in December 2023.

B.4 OTHER ACTIVITIES

This report and the NPDES MS4 report contain almost all of the information regarding the City's activities to reduce TMDL parameters for which it has been appointed a DMA. Other activities that have not been previously discussed in these reports are listed in Table B.5.

Table B.5. Metrics for TMDL Management of Stream Temperatures

Measure	Goal	Tracking Measure	FY2223 Activities
Prog Mgmt TMDL	Provide funding to properly meet the TMDL requirements.	Track the amount of funds spent on private development delineations	The City provided $4,300 on reviews associated with its Sensitive Lands.
Riparian Habitat Quality	Enhance and protect tree canopy	Update the Urban Forestry Report every 5 years or when new LiDAR becomes available. Track changes in canopy coverage.	The Urban Forestry Report was completed in December 2022. The analysis showed a 4.86% increase of city-wide tree canopy from 2014 to 2019.
Riparian Habitat Quality	Enhance and protect riparian buffers	Continue habitat restoration efforts on City-owned riparian buffers. Track the number of stream miles restored	The number of stream miles was not tracked for FY2223.
Riparian Habitat Quality	Enhance and protect riparian buffers	Track changes made to the application process or prioritization of projects funded through the Habitat Enhancement Program	There were no changes made to the Habitat Enhancement Program
O&M	Properly dispose 100% of the debris from street sweeping.	Track the estimated amount of leaf debris collected from streets	Staff collected 893 cu yards of leaf debris in FY2223.
Monitoring	Document effects of stormwater program	Using historical and recent monitoring data, determine if mercury, TSS, and stream temperatures are being reduced or stabilizing.	Paired suspended solids/mercury sampling starts in FY2324.
Public Education	Provide stormwater education to the general public.	Track the number of messages regarding the effect of temperature on streams or lakes and the type of outreach used (e.g. social media).	The City's State of the Urban Forest Report contained information regarding tree canopy and its effect on temperature.
Public Involvement	Provide stormwater education to the public.	Track the number of messages and whether any dropoff bins for leaf collection were provided by the City.	Three neighborhoods requested 20-yard dropoff bins from the City in FY2223. Two were used for removing leaves and one was used for restoration activities in a local natural area.

B.5 References

City of Lake Oswego, 2009, ***Lake Oswego's State of the Urban Forest Report.***

City of Lake Oswego, 2015, ***Hydromodification Assessment.***

Mangano, JF, Piatt, DR, Jones, KL, and Rounds, SA, 2018, ***Water temperature in tributaries, off-channel features, and main channel of the lower Willamette River, northwester Oregon, summers 2016 and 2017***, USGS OFR 2018-1184.

Parametrix, 2021, ***Effective Stream Shade in Lake Oswego***, Internal Technical Memorandum.

APPENDIX C LID/GI STRATEGY

Prioritization Strategy for Green Infrastructure

December 2023

INTRODUCTION

The City is a co-permittee of the Oregon Department of Environmental Quality's (DEQ's) National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase I permit ("MS4 permit") issued to Clackamas County (Permit #101348, File #108016, as amended May 4, 2023). As such, it is required to ***"review and update or develop and begin implementation of a strategy to require to the maximum extent feasible, the use of Low Impact Development and Green Infrastructure (LID/GI) design, planning, and engineering of stormwater discharge and the discharge of pollutants in stormwater runoff from development and redevelopment projects.......In development of this strategy, the*** (City) ***must review ordinance and development code for opportunities to reduce the volume of discharge by design, engineering, and planning methods that prioritize onsite retention, infiltration, and evapotranspiration and the option of reuse where feasible, in order to make LID/GI the preferred and commonly used approach to site development. The*** (City) ***may include evapotranspiration and reuse of stormwater in accounting for retention volumes but are not required to exhaust those options prior to allowing treatment or offsite options as described below. Where LID/GI controls that infiltrate or otherwise retain stormwater onsite are infeasible, extended filtration shall be required."***

CURRENT STORMWATER MANAGEMENT

Stormwater management is required by the City's Stormwater Management Manual (SWMM) when a project creates at least 1,000 sq ft of new impervious area or 3,000 sq ft of new and/or redeveloped impervious area. Projects not exceeding the thresholds singularly but which cumulatively exceed them within 3 years are required to provide stormwater management, i.e., if a 2017 project for a property was 900 sq ft and a 2020 project for the same property was 500 sq ft, the stormwater management requirements would be triggered because the impervious area created for the previous 3 years (1,400 sq ft) exceeds the 1,000-sq ft threshold.

Projects must retain stormwater generated from the 10-yr 24-hr storm (3.2 inches). If onsite retention is not feasible due to high groundwater tables, slopes greater than 15%, or native infiltration rates lower than 0.5 inches/hour, then the project must provide treatment of the water-quality storm (1 inch in 24 hours).

Detention is required for projects creating and/or replacing 3,000-sq ft of impervious area. Post-development flow rates must meet or be less than the pre-development flow rates for the 2-yr, 5-yr, and 10-yr 24-hour design storm. Projects providing onsite retention of the 10-yr 24-hr design storm event or which discharge through manmade conveyance structures to the Tualatin River, Oswego Lake, and the Willamette River are exempt from detention requirements.

Low Impact Development and Green Infrastructure

DEQ defines LID as a "***stormwater management approach that seeks to mitigate the impacts of increased runoff and stormwater pollution using a set of planning, design and construction approaches and stormwater management practices that promote the use of nature and reuse of rainwater.....Low impact development is a comprehensive land planning and engineering design approach to stormwater management with a goal of mimicking the pre-development hydrologic regime of urban and developing watersheds."***

DEQ defines GI as a "***stormwater control using vegetation, soils, and natural processes to manage stormwater. At the neighborhood or site*** (level) ***green infrastructure refers to stormwater management systems designed to mimic nature by reducing and/or storing stormwater through infiltration, evaporation, and transpiration. At the site level, such measures may include the use of plant or soil systems., permeable pavement, or other pervious surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters. At the scale of city or county, green infrastructure refers to the patchwork of natural areas that provides flood protection and natural processes that remove pollutants from stormwater."***

The impetus in the 2000s for introducing Low Impact Development (LID) and Green Infrastructure (GI) as stormwater management techniques was to encourage more infiltration and stormwater treatment closer to its origin. At the time it was introduced, regional stormwater ponds were the primary method for stormwater treatment and the stormwater professionals were finding that it caused urban stream hydromodification.

Hydromodification is greatly reduced in urban areas with a high degree of stormwater infiltration resulting in streambanks that are more resistant to erosion and increased stream depth which can help to increase dissolved oxygen. Infiltration results in increased summer baseflows for streams resulting in lower summer stream temperatures and stabilized dissolved oxygen concentrations for the aquatic community. Reducing hydromodification and stabilizing stream temperatures is extremely important for cities, such as Lake Oswego, that have streams with temperature thresholds.

LID/GI Stormwater Facilities

The City allows stormwater techniques meeting DEQ's definitions of LID and GI such as infiltration planters, infiltration raingardens, permeable pavers/pavement, rainwater harvesting, and filter strips (see Table 1). Other LID/GI methods such as disconnected impervious area, disconnected downspouts, tree credits, and building clustering were considered by the City in 2016 but not adopted because the City found they required a large staff effort to document and enforce after construction.

Table C.1. LID/GI Techniques Approved for Use in the City of Lake Oswego

Facility Type	Definition	Onsite Retention	Water-Quality Treatment	Flow Control	Other Names
Infiltration planter	Vegetated concrete boxes with an open bottom that capture and infiltrate stormwater.	Y	Y	Y	Bioretention Facility
Filtration Planter	Lined concrete boxes that filter stormwater before discharging to the public system	N	Y	Y	Flow-Through Planter
Infiltration Raingarden	Vegetated depression with a flat bottom that captures and infiltrates stormwater.	Y	Y	Y	Bioretention facility
Filtration Raingarden	A lined vegetated depression with a flat bottom that filters stormwater before discharging to the public system	N	Y	Y	Flow-through Raingarden
Permeable Pavers	Pavers that deflect stormwater towards the underground rock layer for infiltration.	Y	Y	Y	Interlocking pavements or pavers
Pervious Pavement	Pavements designed with a concrete or asphalt mix that allows infiltration of the rain that falls on it.	Y	Y	Y	Porous asphalt or concrete
Swales	A long, linear channel that removes pollutants through sedimentation and filtration. They are different from ditches through their incidental infiltration capacity and the lower longitudinal and bank slopes.	N	Y	N	Infiltration swale, Bioswale
Green Roofs	A low-pitched roof with vegetation that filters stormwater before discharge to the public stormwater system.	N	N	N	EcoRoofs or vegetated roofs
Rainwater Harvesting	Tanks or cisterns that store stormwater for landscape irrigation and other non-potable water uses.	Y	N	N	Cistern
Vegetated Filter Strip	A vegetated strip receiving stormwater from an adjacent impervious surface that removes pollutants through filtration or infiltration	Y	Y	N	Sheetflow dispersion

NON-LID/GI INFILTRATION FACILITIES

The City allows infiltration facilities such as infiltration galleries, trenches, and drywells that are not considered LID/GI (see Table 2). These facilities retain the 10-yr 24-hr storm event thereby reducing hydromodification. These facilities also provide groundwater interflow necessary to augment summer baseflows and stabilize stream temperatures during the summer. Because they reduce hydromodification and stabilize stream temperatures, staff believe they are as valuable as infiltrating LID/GI facilities for water-quality and perhaps more valuable than LID/GI facilities that do not infiltrate.

Table C.2. Non-LID/GI Infiltration Facilities Approved for Stormwater Management

Facility Type	Definition	Onsite Retention	WQ Treatment	Flow Control
Drywell	An underground concrete cylinder with perforations for infiltrating stormwater. Inlet is underground (no aboveground infiltration).	Y	N	Y
Infiltration Trench	A linear rock-filled trench that infiltrates stormwater. Inlet is underground (no aboveground infiltration) .	Y	N	Y
Infiltration Gallery	A series of connected infiltration trenches that infiltrates stormwater. Inlet is underground (no aboveground infiltration).	Y	N	Y
Constructed Wetlands	Artificial wetlands with irregular shapes and shallow water that varies in depth throughout the facility.	N	Y	Y
Sand Filter	Sand or gravel bed used to collect, filter, and infiltrate stormwater. Can be vegetated or non-vegetated.	N	Y	N
Infiltration Pond	A pond that retains and infiltrates stormwater.	Y	Y	Y
Retention Pond	A pond with a permanent pool of standing water.	Y	Y	Y

HISTORIC PREFERENCES FOR STORMWATER TREATMENT IN LAKE OSWEGO

The City has tracked stormwater facility preferences of developers and property owners since 2018 (see Tables 3 and 4). To clarify why the percentages do not add up to 100%, there is some overlap in Table 3 between LID/GI and infiltration facilities. Infiltration planters, infiltration raingardens, pervious pavement, and porous pavers are included in the percentage calculations for both LID/GI and infiltration facilities.

The driving force behind stormwater management in the City is to retain the 10-yr 24-hr design storm onsite if infiltration capacity is sufficient at the property. Because the median impervious area of single-family residential properties has risen to over 4,000 sq ft (considered a large project), the developer has to build a stormwater facility plus match pre- and post-construction flow rates if onsite retention is not possible.

On average, 39% of the impervious area created and/or replaced since 2018 has been treated using green infrastructure. Infiltration facilities have been built to treat 55% of the impervious area. Other facility types such as existing regional ponds, water-quality vaults, or eco-roofs were used to treat 15% of the impervious area created and/or replaced since 2018.

Table C.3. Percentage of Impervious Area Treated by Stormwater Facilities, 2018 to 2023[1]

Year	Impervious Area Treated by Green Infrastructure[2]	Impervious Area Treated by Infiltration Facilities[3]	Impervious Area Treated by Other Facility Types
2018	62%	47%	5%
2019	26%	79%	4%
2020	30%	62%	15%
2021	46%	51%	16%
2022	34%	10%	57%[4]
2023	30%	71%	5%
Average[5]	39%	55%	15%

1 – January 1, 2018 to June 30, 2023; 2 – Green Infrastructure= planters, raingardens, porous pavers, bioswales, pervious pavement, and EcoRoofs; 3 – Infiltration facilities= infiltration raingardens, infiltration planters, permeable pavers, porous pavement, infiltration trenches, drywells, and infiltration galleries; 4 – Primarily due to filter vaults for a commercial project; 5 – Average is calculated from raw data

Infiltration galleries, drywells, infiltration raingardens, and infiltration trenches are chosen most often for properties with adequate infiltration capacity. Filtration planters and swales are chosen most often for properties with low infiltration rates.

Table C.4. Acreage of Impervious Area Treated by Stormwater Facilities, 2018 to 2023[1].

Facility Type	Year						
	2018, Acres	2019, Acres	2020, Acres	2021, Acres	2022, Acres	2023, Acres	Total, acres
Infiltration Galleries	2.77	11.41[2]	1.67	2.02	0.51	0.52	18.90
Filtration Planters	2.13	2.79	1.45	1.75	3.24	1.07	12.44
Drywells	1.72	1.58	2.07	0.79	0.11	0.32	6.60
Swales	5.13	0.10	-	0.16	-	0.21	5.60
Infiltration Raingardens	1.51	1.24	0.23	0.76	0.16	0.12	4.02
Infiltration Trenches	0.44	0.02	-	0.18	0.24	2.65	3.53
Filter Strips/Sheetflow	0.63	0.33	0.05	0.03	0.03	-	1.06
Pervious Pavers and Pavement	0.53	0.22	0.13	0.11	0.02	-	1.01
Filtration Raingardens	-	0.23	0.10	0.63	-	-	0.97
Infiltration Planters	-	0.21	0.15	0.10	-	0.22	0.69
Eco-Roofs	-	-	0.03	-	0.04	-	0.06
Rainwater Harvesting	-	-	-	-	-	-	-

1 – January 1, 2018 to June 30, 2023; 2 – Primarily due to the redevelopment of Marylhurst University campus (5.3 acres) plus assorted other large non-SFR projects (3.8 acres)

STRATEGY

The 2021 MS4 permit requires the City to meet a numeric standard retention requirement (NSRR) or an alternative such as flow duration matching. The City has chosen the NSRR to comply with the permit and can meet this requirement through a volume-based method (e.g. 1 inch of rain), a storm event percentile-based method (e.g. the 90^{th} percentile storm event), or an annual average runoff-based method (e.g. 85% of the annual average runoff). The City, in 2016, chose to treat 80% of the annual average runoff which corresponds to the 10-yr 24-hr design storm and this choice complies with the requirements of the 2021 MS4 permit. Onsite retention is generally done through the use of infiltration facilities, rather than ponds, because of property values in the City.

The 2021 MS4 permit requires extended filtration ***"where LID/GI controls that infiltrate or otherwise retain stormwater onsite are infeasible"***. Extended filtration is defined in the permit as a facility ***"designed to promote ....filtration through natural or engineered media. The runoff is treated through physical, biological, and chemical processes as it filters through the media of the facility."***

The impetus for requiring extended filtration is to reduce suspended solids to the maximum extent possible before discharging stormwater offsite. Extended filtration in the City can be met through GI (filtration raingardens, filtration planters, filter strips) or through water-quality vaults (for non-SFR only).

The City will require vegetated filtration facilities prior to offsite discharge for all SFR projects. Water-quality vaults will be allowed only for non-SFR projects because of the increased maintenance complexity.

It is expected that using onsite retention as a first tier of stormwater management and extended filtration as a second tier will provide compliance with the 2021 MS4 permit while treating a majority of the stormwater created by future development and continuing to increase water-quality and stabilize stream temperatures.

IMPLEMENTATION TIMELINE

The City is updating its SWMM to comply with the 2021 MS4 permit and expects implementation of the SWMM in 2024. The requirements of the 2024 SWMM will be implemented on all new projects submitted after the revised SWMM has been posted to the website. Projects which have undergone land-use review, are under construction plan review, or which have already received approval, will be built in accordance with the requirements of the 2020 SWMM.

APPENDIX D RETROFIT/HYDROMODIFICATION UPDATE

City of Lake Oswego

Retrofit and Hydromodification Assessment Update

Prepared for the Oregon Department of Environmental Quality

November 30, 2023

ABBREVIATIONS

ACEC	American Council of Engineering Companies of Oregon
APWA	American Public Works Association
AWWA	American Water Works Association
City	City of Lake Oswego
DEQ	Oregon Department of Environmental Quality
DOGAMI	Oregon Department of Geology and Mineral Industries
ESC	Erosion and Sediment Control
HEP	Habitat Enhancement Program
LEED	Leadership in Energy and Environmental Design
LORA	Lake Oswego Redevelopment Agency
MS4	Municipal Separate Storm Sewer System
NCEI	National Centers for Environmental Information
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Service
ODOT	Oregon Department of Transportation
Parks	City of Lake Oswego Parks and Recreation Department
SWMM	Stormwater Management Manual
TMDL	Total Maximum Daily Load
WTP	Water Treatment Plant

D.1 BACKGROUND

In 2009, the City completed the Clean Streams Plan. Its objectives were to promote public safety, minimize property damage, protect water quality, and preserve aquatic and wildlife habitat. Similar to a stormwater master plan, it prioritized stormwater capital improvement projects, however it also provided recommendations for implementing public outreach, changing city stormwater programs, and recommended municipal code changes to achieve compliance with the City's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit.

In 2015, the City completed an assessment of its topography, geology, and hydrology to determine areas prone to hydromodification. The assessment included mapping areas of erosive soils, steep slopes, and unstable soil using information from the Oregon Department of Geology and Mineral Industries (DOGAMI) and the National Resources Conservation Service (NRCS). Hydrologic information from the 2009 Clean Streams Plan was used to determine pathways for soil to reach streams and the effects of sediment transport and stormwater on the City's streams.

Using the hydromodification information, the City prioritized capital improvement projects for stormwater retrofits in 2015. The strategies were to increase water-quality through increased use of green infrastructure and support protection and restoration of riparian habitat. The City's Habitat Enhancement Program (HEP) was created, in part, to accomplish the goals of the retrofit strategy.

D.2 PURPOSE

The City's 2021 NPDES MS4 permit requires an update on the 2015 Retrofit and Hydromodification Assessments. Specifically, this update must include:

- An assessment of the use and implementation of the 2015 Hydromodification Assessment and Stormwater Retrofit Strategy;
- Progress toward the completion of identified projects and a qualitative assessment of the benefits of those projects;
- A description of actions taken as a result of the Hydromodification Assessment and a rationale for those actions;
- A narrative describing progress toward addressing informational gaps identified in the hydromodification assessment information; and
- New goals, tools, priorities, and planned or potential projects for 1) addressing ongoing hydromodification and/or water-quality impacts resulting from historical development/infrastructure, and 2) improving retrofit planning.

D.3 HYDROMODIFICATION STRATEGIES

Hydromodification is defined as the modification of streams through channel straightening, channel shaping, or large changes in stream velocity and flow (Henshaw and Booth, 2000). It is increased by development, dredging and fill projects, canals, and flood control projects such as dams. Private property owners inadvertently increase hydromodification by reducing native riparian undergrowth or by armoring streambanks in an effort to stop erosion. Changing weather patterns impact hydromodification through increased storm intensities and large variations in temperatures from historic averages. Stormwater systems cause hydromodification by quickly routing stormwater from streets and private properties to streams. These systems also provide a more rapid movement of fine-grained sediments through a watershed than a natural system (MacRae, 1997).

D.3.1 EFFECT

Development increases impervious area which decreases infiltration and increases stormwater volumes and velocities. As impervious area increases and creates more stormwater, it is sent to the streams where velocities are increased and they start to erode and reduce floodplain connectivity. When a stream loses its floodplain connectivity, it results in further streambed degradation and channelization as velocities increase in the now-constrained stream channel.

Increased peak flows result in the enlargement of stream channels which results in a lower stream depth for summer baseflows. A lower stream depth during the summer baseflow is more sensitive to temperature increases which is detrimental to aquatic life. Increased peak flows result in more sediment movement through a watershed which can cover macroinvertebrate habitat and disrupt aquatic food chains. Peak flows result in the erosion of streambanks and streambeds which reduces riparian vegetation, reduces areas of slower flows during peak flows, and reduces tree canopy through root dislodgement from streambank failure. As erosion continues, it will straighten the stream channel and lower the streambed which disconnects the stream from its floodplain. Floodplain disconnection creates higher stream velocities which restarts the cycle of stream channel changes.

D.3.2 REDUCING HYDROMODIFICATION

Retrofits can reduce modification through the use of infiltration facilities and green infrastructure as opposed to detention facilities and through protecting and restoring riparian areas (see Table 1). The City adopted a Sensitive Lands ordinance as part of Oregon's statewide planning goals that protect natural resources and open spaces. It amended the municipal code in 2014/2015 to further protect riparian areas and, to a lesser extent, upland areas from development. In 2015, the City created the HEP in 2015 which provides funds to the local watershed councils to restore riparian and adjacent upland areas on private property.

The City's Stormwater Management Manual (SWMM) requires projects creating or redeveloping 3,000 sq ft or more of impervious area to match pre- and post-construction peak flows. When the SWMM is revised in 2024, it will include a hierarchy that retains the 10-yr 24-hr design storm as well as requiring extended filtration before discharging stormwater offsite. The extended filtration will reduce sediment transport to nearby streams and provide some decrease in peak flows in the streams through detention.

Table D.1. Effects of Stormwater Practices on Hydromodification

	Stormwater Practices				
Hydromodification Strategies	**Infiltration Facilities**	**Green Infrastructure**	**Detention Facilities**	**Riparian Protection**	**Riparian Restoration**
Decrease Peak Flow Velocity	√√	√√	√√		
Decrease Peak Flow Duration	√√	√			
Decrease Sediment Transport	√√	√√	√	√	√
Increase Baseflow	√√	√			
Decrease Impervious Area	√	√√			
Decrease Bank Slopes				√	√√
Increase Floodplain Connection				√√	√√
Increase Stream Sinuosity				√	√√

D.4 PHYSIOGRAPHY

Physiography plays a key role in the types of stormwater management that can be adopted in the city. It is located between a ridgeline to the north and a ridgeline to the south which affect the hydrology and climate for the city. For example, many storms are shunted to the north or south resulting in rain for the Portland metropolitan area but not in the city. In addition, the Missoula floods were highly influential in shaping the soil profiles in the city today.

D.4.1 Soil Profiles

According to the NRCS, much of the soil present in the city are silt loams in hydrologic groups C and D (see Figure 1). These groups generally have low infiltration rates and are considered highly erodible in nature.

While the City does not require a soil classification to be completed for capital projects or development, it does require an infiltration test which can shed light on the soil type. Infiltration rates at the project level show soils capable of infiltrating from 0 inches/hr to over 50 inches/hr. Many of the tests near 0 inches/hr are adjacent to wetlands, the lake, or are underlain by basalt or bedrock. However, there may be more areas with soils in the hydrologic groups of A and B than indicated by the NRCS designation which, as its website states, are

"mapped at the 1:20,000 (scale).... The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale."

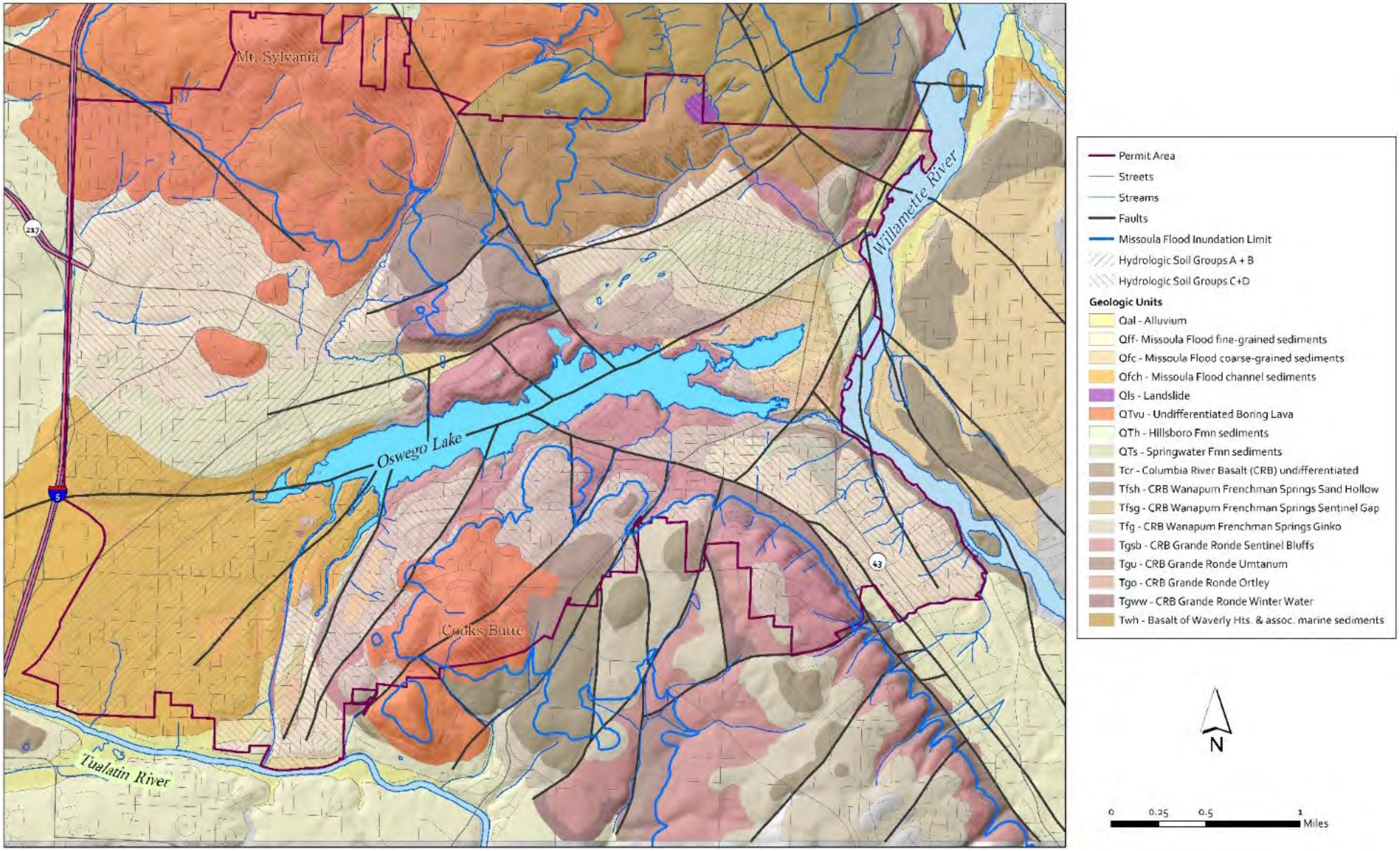


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Figure D.1. Soil Map of Lake Oswego (City of Lake Oswego, 2015a)

In other words, many of the projects that provide a bulk of the City's development (1/4 acre or less) should not use the NRCS soil survey to determine infiltration capacity because of a scale incompatibility acknowledged by the NRCS.

D.4.2 Hydrology

Most of the northeastern portion of the city drains to the Willamette River through Tryon Creek. While approximately two-thirds of the city drains to Oswego Lake, the remainder drains west to Fanno Creek (a tributary of the Tualatin River) through Carter Creek and Ball Creek, south directly to the Tualatin River (Pecan Creek and Wilson Creek), and east to the Willamette River (small drainages such as Glenmorrie Creek). Oswego Lake drains to the Willamette River via Oswego Creek.

Small headwater streams, which can be ephemeral, drain most of the City with the exception of Springbrook Creek, Tryon Creek, Ball Creek, Carter Creek, and Lost Dog Creek. Tryon Creek and Springbrook Creek are the largest streams within the City's jurisdiction.

D.4.2.1 Precipitation Analysis

The City completed a precipitation analysis in 2022 (West Consultants, 2022) using data from its four weather stations and augmenting the period of record with regional precipitation data from the National Centers for Environmental Information (NCEI, 2021). The analysis showed that the bankfull storm event (1.2-yr 24-hr recurrence interval) for the Lost Dog and Springbrook Creek watersheds was a 2.2-inch 24-hr storm event.

The bankfull, or channel-shaping, storm is the storm where hydromodification can be extensive. It is when stream velocities are at a peak because they are still constrained within the stream channel. Once the bank is breached, stream velocities are reduced as the stream uses its floodplain. Within the Lost Dog and Springbrook Creek watersheds, there are incised areas where floodplain connectivity is lost, however there are areas where floodplain connectivity is still present. This is true for many of the City's streams.

D.4.2.2 Storm Response

The City maintains continuous gaging stations at the mouth of Lost Dog Creek and Springbrook Creek. While the period of record for both stations is approximately 12 years, maintenance at the stations was intermittent until 2017.

The City completed a unit hydrograph for Lost Dog Creek and Springbrook Creek which showed quick responses to storm events in both watersheds (2 hours and 3 hours, respectively). Both watersheds are similarly developed with areas of greenspace and parks however the average slope of Lost Dog Creek is 7% whereas the average slope of Springbrook Creek is 4.5%.

Discharges for a 3-yr 24-hr storm (2.7 inches) were 71 cfs for the Lost Dog Creek watershed and 189 cfs for Springbrook Creek (WEST, 2022). These flow rates correlate to 107 cfs/sq mi and 95 cfs/sq mi, respectively. In other words, Lost Dog Creek will experience higher flow rates per unit area than Springbrook Creek for the same storm event. This correlates well with the steeper gradient in the Lost Dog Creek watershed.

In the 2015 hydromodification assessment, the 5-yr 24-hr storm event showed estimated values of 90 cfs and 200 cfs based on the Tryon Creek continuous gaging station maintained by the USGS while the 2-yr 24-hr storm event was calculated to be 50 cfs and 55 cfs, respectively. Given that the 3-yr storm was more aligned with the estimated 5-yr storm, it could be extrapolated that more intense storms are occurring in the Portland metro area. This is corroborated by the precipitation collected by the City's weather stations. Over the last three years, an intense storm has occurred each year where the majority of the precipitation has occurred within two to three hours resulting in flooding and stream modification. Mitigation will become more important as these storm events become more common.

D.5 HYDROMODIFICATION AND RETROFIT PRIORITIES

The 2012 MS4 permit required an examination of the hydromodification impacts caused by development in the city and the public stormwater system including "***erosion, sedimentation, and alteration to stormwater flow, volume, and duration that may cause or contribute to water-quality degradation.***" (DEQ, 2012). The 2012 permit also required a retrofit strategy that prioritized City-initiated projects based on impacts to water-quality and progress toward meeting Total Maximum Daily Load (TMDL) wasteload allocations.

D.5.1 HYDROMODIFICATION ASSESSMENT

The 2015 Hydromodification Assessment (City of Lake Oswego, 2015a) identified three ways whereby the City could address current hydromodification: city code revisions, a stormwater manual update, and capital improvement projects. A new chapter in the City's municipal code (Chapter 38.25) was added to specifically address stormwater management, a major revision of the stormwater manual was completed in 2016 with a minor update in 2020, municipal code protections for riparian buffers and adjacent uplands (Chapter 50.05.010) were amended in 2015, the City started prioritizing restoration of public riparian areas, and the City created the HEP to address restoration of private riparian and riparian-adjacent areas.

The hydromodification assessment identified 14 capital improvement projects which could decrease hydromodification at an estimated cost of $7.8M (see Appendix A). The City has completed five of the projects (see Table 2).

Table D.2. Completed Projects, 2015 to 2023

Project Name	Responsible Department[1]	Watershed	R/H[2]	Impervious Area Treated[3] (sq ft)	2015 Estimated Cost	Stormwater Fund Cost	Project Cost	Completed Improvements/ Notes
Catch Basin Retrofits[5]	E	City-Wide	R	Various	$ 243,000	$2,177,000	$ 32,551,000	Partial Completion: Replace/constructed catch basins with 3-ft sumps/snouts.
Water Reservoir Disconnect[3,5]	E	City-Wide	R,H	Various	$ 721,000	$ -	$ 11,596,000	Partial Completion: Tualatin River: 2 Detention Ponds at Waluga Reservoir; Tryon Creek: 1 infiltration raingarden at 10th St
Boones Ferry Road in Lake Grove area[3]	E	Oswego Lake	R	128.4	$ -	$ -	$ 30,970,000	Added 18 sumped/snouted catch basins, 41 infiltration planters, and 2 detention tanks
Lakeview Drainage[4]	E	Oswego Lake	R,H	NA	$ -	$ 56,000	$ 56,000	Installed pervious pavers
Lakeview Blvd/ Jean Rd[4]	E	Oswego Lake	R,H	0.2	$ -	$ -	$ 741,000	Constructed an infiltration pond
Maintenance Center Upgrade[3]	E	Oswego Lake	R,H	4.9	$ -	$1,602,000	$ 13,237,000	Constructed 3 flow-through raingardens and refurbished a detention pond
Indoor Tennis Center[4]	P	Springbrook Creek	R	0.1	$ -	$ -	$ 2,377,000	Constructed a water-quality vault
Iron Mtn Park[4]	P	Springbrook Creek	H	0.6	$ -	$ -	$ 2,316,000	Enhanced stream and wetlands Constructed 2 flow-through raingardens.
Wembley Park/Crest Drive[3]	E	Springbrook Creek	R,H	8.0	$ 215,000	$2,371,000	$ 5,842,000	Added 6 water-quality and 5 flow-control manholes, 7 water-quality vaults, 4 detention tanks, 2 outfalls, and constructed/replaced 33 sumped/snouted catch basins.
Kerr Parkway Rehabilitation[3]	E	Springbrook Creek/ Tualatin River	R,H	8.3	$3,200,000	$ 354,000	$ 4,272,000	Ball Crk Watershed: Constructed/replaced 8 sumped/snouted catch basins. Installed 2 flowspreaders to reduce velocity. Constructed 1 infiltration swale. Springbrook Watershed: Constructed/replaced 15 sumped/snouted catch basins. Constructed 6 infiltration planters/swales. Restored 300 ft of a grass ditch to include a 1-ft flat bottom and 1 outfall.
Knaus Rd Pathway[4]	E	Springbrook Creek/ Tryon Creek	R	0.4	$ -	$ -	$ 819,000	Constructed 2 filtration swales and 2 sumped/snouted catch basins.

Project Name	Responsible Department[1]	Watershed	R/H[2]	Impervious Area Treated[3] (sq ft)	2015 Estimated Cost	Stormwater Fund Cost	Project Cost	Completed Improvements/ Notes
D Avenue[3]	E	Tryon Creek	R,H	3.3	$ 802,000	$ 802,000	$ 1,725,000	Constructed 40 raingardens
Nettle Crk Bridge[4]	E	Tryon Creek	H	NA	$ -	$ -	$ 718,000	Replaced wooden bridge with fish-friendly steel bridge. Moved piers to out of the OHW mark. Revegetated riparian buffer with native species and coir matting
Rockinghorse Lane[3]	E	Tryon Creek	R	7.9	$ 660,000	$1,061,000	$ 1,061,000	Stabilized slope, extended pipe downslope and provided outfall with energy dissipation to rehabilitated channel.
Woodmont Park[4]	P	Tryon Creek	H	NA	$ -	$ -	$ 1,237,000	Restored native habitat and plants. Added 2 bioswales
Fosberg Rd[4]	E	Tualatin	R	NA	$ -	$1,000,000	$ 1,000,000	Replaced/installed 2 sumped/snouted catch basins
WTP Upgrade[4]	E	WEST LINN	H	2.99	$ -	$ -	$ 81,736,000	Constructed 6 infiltration basins, 1 green roof, 3 infiltration swales, and 1 infiltration raingarden. Cost represents the building, processes, and stormwater improvements
City Hall Upgrade[4]	L	Willamette	R	1.4	$ -	$ -	$ 4,300,000	Added a filtration planter and 2 water-quality vaults
Laurel St[3,5]	E	Willamette	R,H	0.9	$ -	$ 313,000	$ 3,062,000	Replaced 3 existing CBs with sumped/snouted CBs. Added 2 sumped/snouted CBs. Installed 3 detention tanks. Added 3 modular wetland structures.
Marylhurst Pump Stn[4]	E	Willamette	R,H	0.1	$ -	$ -	$ 2,332,000	Added pervious pavers to parking area
Trolley Station[4]	L	Willamette	H	0.1	$ -	$ -	$ 354,000	Add an infiltration swale and pavers in parking lot
WIZER Block[4]	L	Willamette	H	0.3	$ -	$ -	$ 375,000	Add Stormwater planters, paver parking areas, sumped/snouted CBs
Roehr Park[4]	P	Willamette	H	NA	$ -	$ -	$ 389,000	Replace/widen 1,600 ft of pathway, replace a pedestrian bridge, removed 2 pedestrian bridges. Sheet flow dispersion. Provided energy dissipation (riprap pad/embankment fortification) at 3 culverts under 3 bridges
			Total	**167.9[6]**	**$5,841,000**	**$9,736,000**	**$202,066,000**	

1 –E=Engineering, P=Parks and Recreation, L=LORA; 2 – R=retrofit, H=hydromodification; 3=On 2015 Hydromodification list and on 2015 Retrofit List; 4= Not on either 2015 List; 5 Partial completion of a project on one or both of the 2015 lists; 6 – Estimated

D.5.2 Retrofit Assessment

The 2015 retrofit assessment (City of Lake Oswego, 2015b) identified two methods of reducing hydromodification: 1) capital improvement projects and 2) restoration of public and private riparian habitat.

Forty capital improvement projects were identified as candidates for retrofits at an estimated cost of $16.7M (See Appendix B). The assessment scored the capital improvement projects according to the following criteria:

- Public Infrastructure Protection
- Private Infrastructure Protection from Public Infrastructure
- Flood and landslide Risk Reduction
- Federal and State Regulatory Compliance
- Natural Resource Enhancement
- Water-Quality Improvement
- Existing Infrastructure Repair
- Preventative Maintenance

Specific areas where retrofits were prioritized included commercial corridors adjacent to arterial streets (see Figure 2), areas of older development such as the downtown area, areas of slope instability, City facility redevelopment, and areas of high value natural resources such as Tryon Creek. The City completed 9 of the projects in the 2015 retrofit project list (see Appendix B).

D.6 PROGRESS

The City has limited funds which must be allocated across competing needs such as implementing new permit requirements, maintenance and repair of aging infrastructure, construction of new infrastructure, and upgrades of existing infrastructure. Engineering projects are funded by system development charges from private development and monthly utility fees from city residents. Parks projects are funded through system development charges from private development, demolition fees, and the general fund.

The Lake Oswego Redevelopment Agency (LORA) is a separate entity from the City with a mission to redevelop and improve the eastern commercial district of the city. While stormwater is not a priority of the agency, it constructs stormwater facilities as part of development and uses City funds.

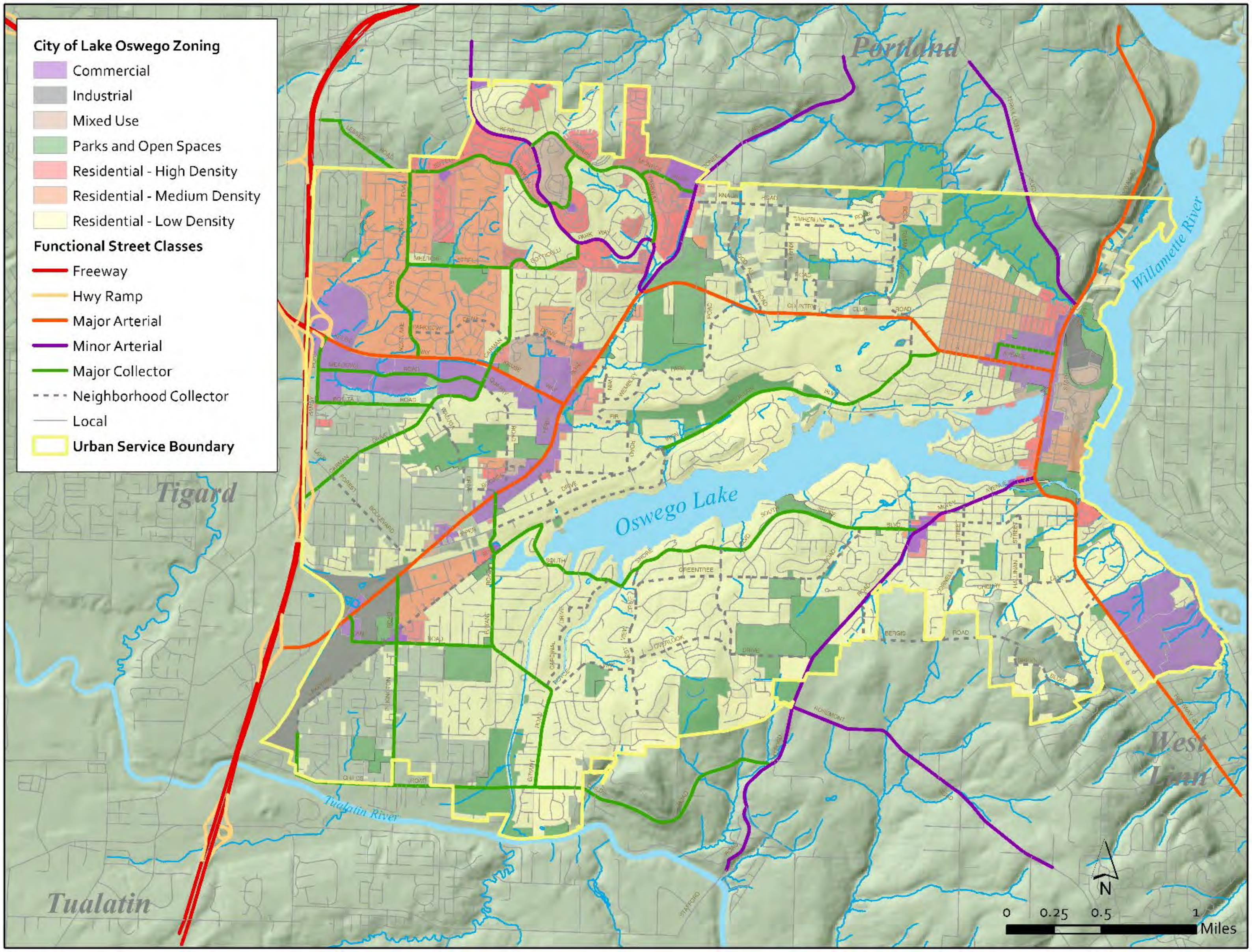

Figure D.2. Zoning and street classification in Lake Oswego.

D.6.1 Lake Oswego Redevelopment Agency

Projects undertaken by LORA are funded by a separate line item in the City budget. While there were no projects identified in the 2015 assessments, approximately $5M were disbursed for three retrofit projects that affected hydromodification. The new City Hall project included treatment of 1.4 acres of previously untreated impervious area through water-quality vaults and flow-through planters at a cost of $4.3M. The WIZER project included treatment of previously untreated impervious area through flow-through planters, pervious paver parking spots, and 3-ft sumped/snouted catch basins. The Willamette Trolley Station project added an infiltration swale and pervious pavers to infiltrate previously untreated stormwater.

D.6.2 Parks and Recreation Projects

The Parks and Recreation Department ("Parks") includes capital projects, and restoration of public and private riparian areas.

D.6.2.1 Parks Improvement Projects

While Parks projects were not included in the 2015 Assessments, five projects were completed since 2015 which could be considered retrofits or address hydromodification. The cost for the projects was $10.2M, however it is the cost for the entire project since the projects are funded by the general fund, and as such, can be difficult to separate the funds used to design and construct stormwater facilities from funds used to design and construct other infrastructure such as trails and sports fields.

The Indoor Tennis Center in the Springbrook Creek watershed was completed in FY2223 at a cost of $2.4M. It is treating 0.1 acres ft of new and existing impervious area created by the project. It will increase water-quality with the use of a water-quality vault but will not address hydromodification.

The Municipal Golf Course and the Lake Oswego Aquatic Center projects are co-located in the Lost Dog Creek watershed (Oswego Lake watershed) and is under construction as of FY2324. They will use flow-through raingardens and planters to treat 5.2 acres of new and existing impervious area. Cost of the projects is $3.9M. It is considered a retrofit project for the purposes of this assessment.

Iron Mountain Park in the Springbrook Creek watershed included stream and wetland enhancements in addition to treatment of existing and new impervious area (0.6 acres) by flow-through raingardens. It is classified as a retrofit project for the purposes of this assessment and was completed in FY2122 at a cost of $2.3M.

Woodmont Park in the Tryon Creek watershed was completed in FY2021 at a cost of $1.2M. Two bioswales were constructed to treat impervious area and assist with the effects of hydromodification.

Outfalls and a pedestrian bridge enlargement were completed at Roehr Park which is adjacent to the Willamette River. Cost of the project was only $400K but the energy dissipation at the outfalls and moving the bridge piers out of the ordinary high-water area will decrease hydromodification.

D.6.2.2 Restoration of Public Natural Areas

Riparian restoration has been ongoing for approximately 370 acres of park lands and natural areas. The work mostly consists of invasive removal and installation of native plants and it is important for increasing shade along riparian buffers and adjacent uplands. Staff use funds from the HEP to fund public restoration; since FY1819, approximately $1.2M has been spent on the restoration of public riparian habitat and adjacent uplands.

Parks Staff created the Natural Areas Habitat Management Plan in 2022 to prioritize restoration activities, improve climate resilience, enhance hydrologic function, and minimize habitat fragmentation. It is expected that the plan's implementation will decrease hydromodification and create some stream enhancements that may be able to stabilize or improve stream temperatures.

D.6.2.3 Restoration of Private Riparian Areas

Restoration of private riparian areas was identified as a potential retrofit strategy. Private property was identified as the primary deterrent to achieving large scale restoration of the City's riparian areas since "***most of the riparian corridors in the City are under private ownership***" (City of Lake Oswego, 2015b) with 93% of the private ownership consisting of private property as opposed to tracts of private open space. The HEP was created, in part, to address restoration of private riparian areas and reduce the effects of hydromodification. Three watershed councils (Tryon Creek Watershed Council, Tualatin River Watershed Council, and the Oswego Lake Watershed Council) submit HEP applications for restoring private riparian property and providing stormwater education. The program is funded by general funds and administered by the Parks and Recreation Department. Since FY1819, $440K have been disbursed to the watershed councils and 16 projects have been funded by the program.

D.6.3 Public Works

Public Works can impact hydromodification through private development and capital improvement projects. Requirements for private development are dictated by public improvements, floodplain requirements, the SWMM, and the Erosion and Sediment Control

(ESC) program. Public projects must follow Oregon Department of Transportation (ODOT) Construction Specifications, SWMM requirements, and floodplain requirements. They generally require a DEQ 1200-C permit for erosion control.

D.6.3.1 SWMM and ESC Program Updates

Since the hydromodification and retrofit assessments were completed, the City completed a major revision of the SWMM to require onsite retention of the 10-yr 24-hr storm event and included green infrastructure in its approved stormwater facilities. These requirements appear to have increased stream baseflows however these benefits may be offset by the increased storm intensities apparent over the past three years (see previous discussion of precipitation and hydrographs).

The City's ESC program has been updated to include additional inspections for construction sites that stay active longer than 6 months and a requirement for coconut coir blankets for steep slopes and riparian areas.

D.6.3.2 Public Improvements

Public improvements are sometimes required as part of private development. The City does not have many large-scale projects such as subdivisions so the public improvements tend to be small. As shown in Table 3, public improvements have been required for 12 projects over the past 5 years. They have provided treatment for 0.9 acres of previously untreated street runoff.

Table D.3. Public Improvements Completed, 2015 to 2023.

Year Completed	Facility Type	Watershed	Stormwater Source	Impervious Area Treated (sq ft)
FY1718	Bioswale (2)	Oswego Lake	Public Street	1,500
FY1819	Bioswale (2)	Oswego Lake	Public Street	4,695
FY1920	Raingarden (2)	Oswego Lake	Public Street	1,350
FY1718	Bioswale	Springbrook Creek	Public Street	1,045
FY2122	Filtration Planter	Springbrook Creek	Public Street	9,600
FY1819	Bioswale	Tryon Creek	Public Street	1,200
FY2021	Filtration Planter	Tryon Creek	Public Street	7,110
FY1920	Filtration Planter (2)	Tualatin River	Public Street	12,373
			Total	**37,793 (0.9 acres)**

D.6.3.3 City-Initiated Projects

In response to increased stormwater requirements through the 2021 MS4 permit and the 2019 revised mercury TMDL, staff made a policy decision to, whenever feasible:

Retrofit catchbasins with 3-ft sumps and water quality snouts, Replace undersized culverts,

Retrofit ditches with a 3:1 side slope, and

Retrofit outfalls with velocity reduction measures.

Nine of the projects on the 2015 retrofit list, estimated at a cost of $5.8M, have been completed with an actual cost of $8.7M (see Table 2). Part of the cost increase was normal inflation and part of it was the COVID-induced supply-chain disruptions that saw skyrocketing costs in labor and materials.

D.6.4 Summary of City-Initiated Projects

The City leverages its stormwater funds by incorporating stormwater projects into other utility projects that may have larger budgets or receive higher priorities by the City Council. Overall, of the completed projects from 2015 to 2022, the stormwater funds constituted 5% of the total project cost. More importantly, 168 acres of impervious area are now being treated that were not being treated in 2015.

The City has received numerous awards for completed projects that were either on the lists or could be considered as retrofits and hydromodification improvements. Two of the projects on the lists received an American Public Works Association (APWA) award for Project of the Year (Boones Ferry Rd and D Avenue). The Rockinghorse Lane project received recognition from the American Council of Engineering Companies of Oregon (ACEC).

While not on the 2015 lists, the pavement program completed many catch basin retrofits in the city and was recognized by the ACEC. The City Hall renovation project received a first-place award from the Oregon Daily Journal of Commerce as did the WIZER project. The WIZER project received multiple other awards including the prestigious Gold Nugget from the Pacific Coast Builders Conference (Best Mixed-Use Project) and LEED Gold certification. The water treatment plan (WTP) renovation received an award for its protection of cultural resources from the American Cultural Resources Association and two awards from the American Water Works Association (AWWA) for Excellence in Engineering.

Communication strategies are key to a project's success and can determine whether it is perceived positively by the public during and after construction and have an impact on whether a project stays within budget. Outreach awards for projects completed through the retrofit and hydromodification assessments included the Boones Ferry project (Excellence Award for the "Shop Lake Grove" outreach) and the WTP renovation (AWWA for "Best Strategic Communications Plan").

While the City may not have strictly followed the recommendations of the 2015 Assessments, the untreated acreage that is now being treated is a testimonial to the City's efforts to leverage its funds as much as possible to increase the water-quality of its streams and Oswego Lake. The awards it received for the completed projects shows that the City is committed to excellence in its project management.

D.7 UPDATED RECOMMENDATIONS AND PRIORITIES

A review of the 2015 project lists and current capital improvement projects results in an updated list of priorities for the future (see Table 4). The table lists 29 projects located in every major watershed in the city at an estimated total cost of $43M with stormwater funds comprising approximately half of the cost.

Not included in the list of new priorities are the funding of private riparian restoration through the HEP and the Backyard Habitat programs, public restoration activities, and LORA projects. The City is committed to continuing to fund these activities in addition to the projects listed in Table 4.

With the revised mercury TMDL, the City committed to decreasing sediment loading through retrofitting, when feasible, ditches, catch basins, culverts, and outfalls. These retrofits should also decrease hydromodification and stabilize stream temperatures.

Finally, the City has committed to continue monitoring water quality through:

1) Geomorphology assessments at its gaging stations and during macro-invertebrate studies,
2) Using updated LiDAR data to monitor impervious area and effective shade,
3) Increasing stormwater service using infiltration facilities when possible and extended filtration when infiltration is not possible,
4) Requiring additional erosion controls for properties with steep slopes or which are disturbing riparian or riparian-adjacent land,
5) Requiring certified ESC professionals for private and public development on complex projects such as commercial development,
6) Regularly reviewing its programs to update them, when necessary, with currently accepted stormwater practices.

This multi-pronged approach of infiltration, reducing sediment movement, retrofitting structures to treat impervious area that was previously untreated, continued riparian restoration of private and public areas, and water-quality monitoring will leverage the City's funds while allowing it to remain compliant with its regulatory requirements and be protective of water-quality.

Table D.4. 2023-2029 Project List

Department[1]	Expected Completion	Project Name	Hydromodification or Retrofit[2]	Funded/Unfunded[3]	CSP Project ID[4]	Estimated Cost	Cost - Stormwater Fund	Other Funds	Watershed	In 2015 Lists[5]	Flooding or Landslide Risk[5]	Improves Natural Resources[5]	Water Quality Improvement[5]	Hydromodification Benefit[5]	Multi-Utility[5]	Total Score	Proposed Improvements
E	FY2425	5th St/Lake Bay Improvements	R,H	F	WO346	$1,000,000	$1,000,000	$ -	Willamette	N	2	1	2	2		7	Potential for infiltration planters before discharging to lake
E	FY2728	ODOT/Hwy 43 Culvert Replacement	R	F		$500,000	$500,000	$ -	Willamette	N	2	1	2	2	1	8	Replace culvert from Ash St to Hwy 43
P		Rassekh Park	H	F	WO307	$3,540,000	$ -	$3,540,000	Tualatin	N	1	2	1	2	1	7	Infiltration raingardens to treat new and existing impervious area
E		Melrose St (Peters Rd to Westlake)	R,H	U		$500,000	$500,000	$ -	Tualatin	Y	2	1	1	2	1	7	Restore stream channel and riparian area
E		65th/Lakeview Blvd: McEwan to Jean Rd	R,H	U		$5,595,000	$1,250,000	$4,345,000	Tualatin	N	2	1	2	2	1	8	Industrial area mixing public/ private stormwater. Include bike lanes/sidewalks and decommission 3 UICs.
E	FY2425	E Ave/2nd St	R,H	F	WO350	$500,000	$500,000	$ -	Tryon Creek	N	1	1	1	1	2	6	Potential for infiltration planters
E	FY2627	Goodall Improvements	R	F		$500,000	$500,000	$ -	Tryon Creek	Y	2	1	1	1	2	7	Conveyance and water quality
E	FY2728	Andrews/Bayberry/ Rye Improvements	R	F		$300,000	$300,000	$ -	Tryon Creek	Y	2	1	1	1		5	Restore roadside swales
E	FY2829	Country Club nr Dolph Court	R,H	F		$825,000	$825,000	$ -	Tryon Creek	Y		1	1	2		4	Replace culvert under Country Club and under Dolph; restores detention pond and swale
E		Uplands Dr (Ridgecrest to Country Club)	R,H	U		$2,000,000	$2,000,000	$ -	Tryon Creek	N	2	2	2	2		8	Add sumped/snouted catch basins and GI with available ROW.

Department[1]	Expected Completion	Project Name	Hydromodification or Retrofit[2]	Funded/Unfunded[3]	CSP Project ID[4]	Estimated Cost	Cost - Stormwater Fund	Other Funds	Watershed	In 2015 Lists[5]	Flooding or Landslide Risk[5]	Improves Natural Resources[5]	Water Quality Improvement[5]	Hydromodification Benefit[5]	Multi-Utility[5]	Total Score	Proposed Improvements
E		Andrews/ Sunningdale Improvements	R,H	U		$800,000	$800,000	$ -	Tryon Creek	N	2	2	2	2		8	Retrofit outfall to Tryon Creek, decommission 1 UIC, and construct stormwater system
E	FY2425	Daniel Way	R,H	F	WO323	$956,000	$956,000	$ -	Springbrook	N	2	2	2	2		8	Restore stream sinuosity; retrofit outfalls; add rock weirs to control velocity
E		Oakridge/Trillium Woods	R,H	U		$500,000	$500,000	$ -	Springbrook	N	1	2	2	2	2	9	Decommissions UIC. Rebuild outfall into Waluga Park. Includes infiltration planters
E		Glen Eagles Improvements	R,H	U		$1,754,000	$1,500,000	$254,000	Springbrook	N	2	2	2	2		8	Major erosion and flooding. Includes pathway project (Wembley to Prestwick)
E	FY2425	Lakeview Blvd (Iron Mtn to South Shore)	R	F		$8,000,000	$1,500,000	$6,500,000	Oswego Lake	Y	1	1	1		2	5	Not including infiltration due to landslide potential
E	FY2526	Redfern Avenue Improvements	R	F		$1,250,000	$1,250,000	$ -	Oswego Lake	Y	1	1	2	1		5	Decommissions UIC
E	FY2627	Warren Court Improvements	R,H	F		$500,000	$500,000	$ -	Oswego Lake	N		2	1	1		4	Restoration of swales draining to detention pond
E	FY2627	Blue Heron Improvements	H	F		$900,000	$900,000	$ -	Oswego Lake	Y	1	1	2		2	6	
E	FY2728	Firwood Road Improvements	R,H	F		$750,000	$175,000	$ -	Oswego Lake	N	2	1	1	1		5	Potential for GI and new system

Department[1]	Expected Completion	Project Name	Hydromodification or Retrofit[2]	Funded/Unfunded[3]	CSP Project ID[4]	Estimated Cost	Cost - Stormwater Fund	Other Funds	Watershed	In 2015 Lists[5]	Flooding or Landslide Risk[5]	Improves Natural Resources[5]	Water Quality Improvement[5]	Hydromodification Benefit[5]	Multi-Utility[5]	Total Score	Proposed Improvements
E	FY2829	Upper Drive Improvements (west of Bryant)	R	F		$725,000	$725,000	$ -	Oswego Lake	Y	2	1	1	1		5	Major ponding - new system
E	FY2829	ODOT Detention Pond Retrofit	R	F		$600,000	$600,000	$ -	Oswego Lake	Y	1	1	2	1		5	Rebuild detention facility between Pilkington and railroad
P		Golf Course/LORAC	R	F	WO306	$3,900,000	$0	$3,900,000	Oswego Lake	N	1	1	2	2		6	Flow-through raingardens treat existing, new, and untreated street impervious area
E		Blue Heron/South Shore Sediment	H	F		$1,500,000	$1,500,000	$ -	Oswego Lake	Y		1	2		2	5	Sediment facility at end of South Shore prior to discharge to lake.
E		Blue Heron Outfall	R	F	WO329	$150,000	$150,000	$ -	Oswego Lake	N	2		1	1	2	6	Repair Outfall
E		Oakridge (Quarry to Boones Ferry)	R,H	U		$1,250,000	$250,000	$1,000,000	Oswego Lake	N	2	1	2	1	1	7	Road Improvement and decommission 2 UICs
E		Kelok Rd (Bryant to Southshore)	H	U		$2,877,000	$500,000	$2,377,000	Oswego Lake	N	2	2	2	1	1	8	1,000ft pathway and stormwater. Potential for GI
E		Hillside Dr Improvements (Palisades to Fernwood Cir)	H	U		$520,000	$250,000	$270,000	Oswego Lake	N	2	1	2	2	1	8	1,600 ft pathway and stormwater system tying into Greentree system. Steep road
E		Chandler Rd Improvements	R,H	U		$650,000	$650,000	$ -	Oswego Lake	N	2	1	2	2	1	8	Localized flooding occurs. Would decommission 3 UICs
E		Cedar Ct Improvements	R,H	U		$350,000	$350,000	$ -	Oswego Lake	N	2	1	2	2		7	Localized flooding occurs. Steep road.
					Total	$43,192,000	$20,431,000	$22,186,000									

1 – E=Engineering, P=Parks; 2 – R=Retrofit, H=Hydromodification Benefit; 3- F=Funded, U=Unfunded; 4 – Work Order (funded projects); 5 – Scoring: 1=some benefit, 2=major benefit; GI=green infrastructure, LORAC=Lake Oswego Recreational Aquatic Center, ODOT=Oregon Dept of Transportation, UIC=underground injection control

D.8 REFERENCES

City of Lake Oswego, 2015a, ***Hydromodification Assessment***

City of Lake Oswego, 2015b, ***Retrofit Strategy***

Henshaw, P.C., and D.B. Booth. 2000. ***Natural restabilization of stream channels in urban watersheds.*** *Journal of the American Water Resources Association*. 36(6): 1219-1236.

MacRae, C.R. 1997. ***Experience from morphological research on Canadian streams: is control of the two-year frequency runoff event the best basis for stream channel protection?*** In: L.A. Roesner (ed.) *Effects of Watershed Development and Management on Aquatic Ecosystems*. Proceedings of an Engineering Foundation Conference, ASCE, New York, NY. p. 144-162.

National Centers for Environmental Information (NCEI), (https://www.ncei.noaa.gov/maps/daily/, Daily Observational Data, 2021)

Oregon Department of Environmental Quality, 2012, NPDES MS4 Phase I permit.

West Consultants, 2022. Precipitation Data Analysis and Unit Hydrograph Development

APPENDIX A HYDROMODIFICATION PROJECT LIST

Project Name/Location	2015 Estimated Cost	Watershed	Reduce Risk of Flooding /Landslide	Improves Natural Resources	Water Quality Improvement	Hydromodification Score	Pollutants Targeted2	Notes
Cherry Crest Detention & Municipal Golf Course[1]	$615,000	Lost Dog			2	2	P, Hg, DO/TSS, HC, M, B	
Cornell/Laurel/ Bickner[1]	$210,000	Willamette	2		2	4	P, Hg, T, DO/TSS, HC, M, B	
Country Club Road near Dolph Court[1]	$435,000	Tryon		1	1	2	P, Hg, DO/TSS, B	Replaces pipe under Country Club and rehabilitates existing pond, assuming access is granted.
D Avenue	$802,000	Tryon	2	1	1	4	P, Hg, T, DO/TSS, HC, M, B	
Elizabeth M Gress Park (Mtn Park)[1]	$226,000	Springbrook	2		2	4	P, Hg, T, DO/TSS, HC, M	
Kerr Parkway Rehabilitation	$3,200,000	Tualatin & Springbrook	1	1	2	4	P, Hg, T, DO/TSS, HC, M	
Maintenance Center Upgrade	—	Oswego Lake			2	2	P, Hg, T, DO/TSS, HC, M	
Melrose Street[1]	$265,000	Ball	2	1	1	4	P, Hg, T, DO/TSS, M, B	Regrade channel and revegetate riparian area
Preakness Court[1]	$140,000	Springbrook	2	1	2	5	P, Hg, T, DO/TSS, HC, M	
Regional Facility at Bergis/Stafford[1]	$671,000	Lost Dog			2	2	P, Hg, DO/TSS, M	
Southwood Park[1]	$135,000	Ball	2	1	2	5	P, Hg, T, DO/TSS, HC, M	.
Tanglewood Drive[1]	$140,000	Springbrook	2		2	4	P, Hg, T, DO/TSS, HC, M	
Water Reservoir Disconnect	$721,000	City-Wide			1	1	P, Hg, DO/TSS, HC, M	Improve options for contingency overflows at 16 City reservoirs
Wembley Park /Crest Drive[1]	$215,000	Springbrook	2	1	2	5	P, Hg, DO/TSS	

1 – On 2015 Retrofit List; Completed Project

APPENDIX B RETROFIT PROJECT LIST

Project Name/Location	2015 Estimated Cost	Watershed	Flooding/Landslide Risk	Improves Natural Resource	Water Quality Improvement	Hydromodification Benefit	Retrofit Score3	Pollutants Targeted	Notes
Bayberry Road	$604,000	Tryon Creek	2		1	1	4	P, Hg, DO/TSS, HC, M	Rebuild roadside swales
Blue Heron Rd Rehab & Drainage	$547,000	Oswego Lake		1	2		3	P, Hg, DO/TSS	Focus on water quality not quantity; drains directly to Oswego Lake
Boones Ferry Road in Lake Grove area	—	Oswego Lake	2		2	1	5	P, Hg, T, DO/TSS, HC, M, B	
Bryant Road – frontage to Upper inc. Sunset	$175,000	Oswego Lake		1	1		2	P, Hg, DO/TSS, HC, M	Add conveyance and water quality. Space may be limited for quantity control
Catch Basin Retrofits	$243,000	City-Wide			1		1	P, Hg, DO/TSS, HC, M	
Cherry Crest Detention & Municipal Golf Course[1]	$615,000	Oswego Lake			2	2	4	P, Hg, DO/TSS, HC, M, B	Add parking lot/material management retrofit to CSP description
Churchill Downs (Mtn Park)	$53,000	Springbrook	2		1		3	P, Hg, T, DO/TSS, HC, M	
Cornell/Laurel/Bickner[1]	$210,000	Willamette	2		2	2	6	P, Hg, T, DO/TSS, HC, M, B	Tie to Laurel Pathway WO 191
Country Club Road near Dolph Court[1]	$435,000	Tryon Creek		1	1	2	4	P, Hg, DO/TSS, B	Replaces pipe under Country Club and rehabilitates existing pond
D Avenue Storm System[1]	$802,000	Tryon Creek	2	1	1	2	6	P, Hg, T, DO/TSS, HC, M, B	
Eena Road	$242,000	Oswego Lake			1	1	2	P, Hg, T, DO/TSS, HC, M	Local flooding and treatment solution
Elizabeth M Gress Park (Mtn Park)[1]	$226,000	Springbrook	2		2	2	6	P, Hg, T, DO/TSS, HC, M	
First Addition Catch Basins	$125,000	Tryon Creek	2		1		3	P, Hg, DO/TSS	Replace existing CBs with sumped/snouted CBs
Goodall Ditch Redesign	$300,000	Tryon Creek	2	1	1	1	5	P, Hg, TSS	Develop consistent management of conveyance and water quality along ROW
Kerr Parkway Rehabilitation[1]	$3,200,000	Tualatin & Springbrook	1	1	2	2	6	P, Hg, T, DO/TSS, HC, M	

Lakeview Blvd Roadway & Drainage	$637,000	Oswego Lake			1		2	P, Hg, DO/TSS, HC, M	Not including infiltration due to landslide potential; drains directly to Oswego Lake
Lower Boones Ferry - Lake Grove	$3,260,000	Oswego Lake			1	1	2	P, Hg, T, DO/TSS, HC, M, B	Add stormwater infrastructure upon annexation
Maintenance Center Upgrade[1]	—	Oswego Lake			2	2	4	P, Hg, T, DO/TSS, HC, M	
Melrose Street[1]	$265,000	Tualatin River	2	1	1	2	6	P, Hg, T, DO/TSS, M, B	Regrade channel and revegetate riparian area
Outfall Inventory & Restoration	$300,000	City-Wide	2	1	1	1	6	P, Hg, T, DO/TSS, M	Evaluate stability and potential for treatment on existing outfalls routed to ravines
Preakness Court Hammerhead (Mtn Park)[1]	$140,000	Springbrook	2	1	2	2	7	P, Hg, T, DO/TSS, HC, M	
Redfern Avenue Drainage	$193,000	Oswego Lake			2	1	3	P, Hg, T, DO/TSS, HC, M, B	
Regional Facility - Bergis/Stafford[1]	$671,000	Oswego Lake			2	2	4	P, Hg, DO/TSS, M	"Regional Storm Facility - Lost Dog"
ODOT Detention Pond Retrofit	$372,000	Oswego Lake			1	1	3	P, Hg, T, DO/TSS, HC, M, B	Rebuild of ODOT Facility
Rockinghorse Lane Drainage Improvements	$660,000	Tryon Creek	2	2	2	1	7	P, Hg, T, DO/TSS	
Sediment Basin Retrofits	$404,000	Various			1		2	P, Hg, DO/TSS, HC, M	Blue Heron Canal, Southshore/Cedar, and Mtn. Park
South Shore/Blue Heron Sediment Ctrl. Facil.	ND	Oswego Lake		1	2		2	P, Hg, T, DO/TSS, M	Install sediment sump at end of South Shore prior to discharge to Oswego Lake.
Southwood Park (Mtn Park)[1]	$135,000	Tualatin River	2	1	2	2	7	P, Hg, T, DO/TSS, HC, M	
Tanglewood Drive Open Space (Mtn Park)[1]	$140,000	Springbrook	2		2	2	6	P, Hg, T, DO/TSS, HC, M	
Touchstone Drive (Mtn Park)	$89,000	Springbrook	2		1		3	P, Hg, T, DO/TSS, HC, M	Evaluation for drainage improvements, catch basin upgrades
UIC Decommission / Pretreatment	$1,325,000	City-Wide			2	1	3	P, Hg, T, DO/TSS, HC, M	
Upper Drive - west of Bryant	$325,000	Oswego Lake		1	1	1	3	P, Hg, T, DO/TSS, HC, M, B	
Water Reservoir Disconnect[1]	$721,000	City-Wide			1	2	3	P, Hg, DO/TSS, HC, M	Options for overflows at 16 City reservoirs
Wembley Park/Crest Drive[1]	$215,000	Springbrook	2	1	2	2	8	P, Hg, DO/TSS	Incorporate treatment into road rebuild

1 – In 2015 Hydromodification List; Completed Project

LAKE OSWEGO

healthy watersheds

Stewardship for a Sustainable Future

THE RIVER STARTS HERE