Industrial and Commercial Facilities Stormwater Strategy

September 2024

1. Introduction

Clean Water Services (CWS) is a county service district that serves the urban portion of Washington County and small portions of Clackamas, Multnomah, and Yamhill counties. CWS owns and operates four water resource recovery facilities (WRRFs) in the Tualatin River basin and works in partnership with its co-implementers — the 12 cities in the service area and Washington County. The WRRFs and the municipal separate storm sewer system (MS4) are permitted by the Oregon Department of Environmental Quality (DEQ) under CWS' watershed-based National Pollutant Discharge Elimination System (NPDES) permit.

Consistent with Schedule A.14.c.vii of its NPDES permit, CWS must implement and develop a program to control pollution in stormwater from industrial and commercial facilities. This document outlines CWS' industrial and commercial stormwater program.

CWS implements its commercial and industrial stormwater program through using Stormwater Management Plan (SWMP) best management practices (BMPs) and other program elements. In April 2024, CWS submitted an updated SWMP consistent with the condition in Schedule A.14.b.iii in the NPDES permit. CWS is working on further updates to the SWMP with a greater focus on adaptive management. CWS has maintained a multifaceted, adaptive management approach to its industrial and commercial stormwater strategy that addresses diverse pollutant loads to its MS4 through strategic initiatives and collaborative efforts with CWS' co-implementers. The U.S. Environmental Protection Agency (EPA) notes as part of its integrated planning for stormwater that successful, long-term stormwater planning also relies on an adaptive management approach, in which communities establish processes to evaluate performance and modify approaches based on lessons learned.

CWS uses adaptive management to proactively respond to changing conditions in the MS4. Changes in type, frequency, and source of pollutants to the MS4 require robust investigation and innovative strategies. New threats, such as emerging contaminants, require new approaches. Through adaptive management, CWS monitors the most up-to-date data and responds with appropriate action.

2. Permit Language

Section 2 presents language in Schedule A.14.c.vii. Industrial and Commercial Facilities in CWS' NPDES permit:

> The permittee must continue to implement a program to reduce pollutants in stormwater discharges to the MS4 from industrial & commercial facilities including, at a minimum: sites the permittee has identified as being subject to the DEQ-issued 1200-Z industrial stormwater NPDES general permit; hazardous waste treatment, disposal and recovery facilities; industrial facilities that are subject to section 313 of title III of the Superfund Amendments and Reauthorization Act of 1986; facilities subject to Section 313 of the Emergency Planning and Community Right-to-Know Act, 42 U.S.C. 11023; sites flagged by a pretreatment program or

Industrial User Survey as potentially contributing, or housing activities that may contribute, pollutants to the MS4; and facilities or activities that have been identified by the permittee as potentially contributing a significant pollutant load to the MS4. Screening for industrial & commercial sites and activities may be conducted in conjunction with industrial pretreatment program activities or a business licensure program as long as stormwater and MS4 considerations are added to the Industrial User Survey or other questionnaire, or may be conducted separately under a program developed solely for MS4 purposes.

(A) Screening for Industrial Stormwater Permitting

The permittee must continue to screen existing and new industrial facilities to assess whether they may be subject to the DEQ-issued 1200-Z industrial stormwater NPDES general permit or have the potential to contribute a significant pollutant load to the MS4. The screening must be done on a routine basis, and in no case may screening for new facilities take place less often than once a year. Within 30 days after determining a facility may be subject to a DEQ-issued industrial stormwater permit, the permittee must notify the industrial facility and DEQ.

(B) Strategy to Reduce Pollutants from Industrial & Commercial Facilities

The permittee must by November 1, 2024, at minimum, review and update as appropriate the Industrial/Commercial Facilities Strategy developed under the previous permit term and include it in the SWMP Document directly or by reference. The Strategy must be posted on the permittee's website for public comment for a minimum of 30 days prior to submission to DEQ for approval and incorporation into the SWMP Document. If the Strategy Document is completed early, wholly incorporated into the SWMP Document, and submitted to public review with the initial SWMP Document, this suffices for the public review requirement. The Strategy document must include, at a minimum: 1) The facility types or activities, rationale, and priorities for entities that the permittee has determined may have high potential to discharge pollutants of concern to the MS4, 2) Inspection procedures, documentation standards, and frequency of inspections; and 3) Description of the assessment and tracking of compliance with municipal ordinances related to discharges to the MS4 at industrial & commercial facilities that are potential sources of pollutants in stormwater runoff.

(C) Commercial & Industrial Facility Inspection Staff Training

The permittee must ensure that staff responsible for inspecting and evaluating Commercial and Industrial facilities, evaluating compliance with municipal ordinances related to discharges to the MS4, or ensuring pollution prevention at facilities through inspections and/or provision of educational materials on stormwater management, are trained or otherwise

qualified to conduct such activities, and training strategies, and frequencies for staff must be described in the SWMP Document.

(D) Tracking and Assessment

The permittee must maintain records of activities conducted to meet the requirements of the Commercial & Industrial Facilities program requirements and include a descriptive summary of their activities in the corresponding Annual Report, as well as relevant metrics or tracking measures. Each annual report should include a list of entities referred to DEQ based on permittee screening activities, a list of categories of facilities inspected, and an overview of the results of inspections.

3. Review of Current Strategy to Reduce Pollutants from Industrial and Commercial Facilities

Paragraph (B) referenced above and in Schedule A.14.c.vii of the NPDES permit, requires CWS to, at a minimum, review and update as appropriate the Industrial and Commercial Facilities Strategy developed under the previous permit term. This document is in response to this NPDES permit requirement. As required by the NPDES permit, CWS will also post the document to its public website for public comment for 30 days before submitting it to DEQ by November 1, 2024.

CWS' implements several programs and activities to reduce pollutants to the MS4 from industrial and commercial facilities. CWS' strategic approach includes acting as DEQ's agent and permitting 1200-Z facilities, issuing no-exposure certifications (NECs), and inspecting 1200-Z permitted facility's private water quality facility (PWQFs). Per its adaptive management approach, CWS conducts extensive data analytics work to better understand where pollutants of concern are discharged. CWS' programmatic work includes the EcoBiz program, the fats, oils, and grease (FOG) program, the mercury minimization program (MMP), discharge authorizations, and wash water permits. In addition, CWS conducts robust education and outreach that targets the mitigation of specific pollutants of concern in the industrial and commercial sectors.

Per paragraph (B) of Schedule A.14.c.vii of the NPDES permit, CWS must provide:

1) The facility types or activities, rationale, and priorities for entities that the permittee has determined may have high potential to discharge pollutants of concern to the MS4,

2) Inspection procedures, documentation standards, and frequency of inspections; and

3) Description of the assessment and tracking of compliance with municipal ordinances related to discharges to the MS4 at industrial & commercial facilities that are potential sources of pollutants in stormwater runoff.

The following sections describe the information required in paragraph (B) of Schedule A.14.c.vii for the CWS industrial and commercial stormwater programs and activities. The pertinent permit language is bolded.

3.1 1200-Z Permitted Facilities

3.1.1 Facilities Identified as Having Potential to Contribute Pollutants to MS4

CWS implements the industrial stormwater program for the entire MS4 service area. CWS initially determines whether an industrial facility has the potential to contribute a significant pollutant load to the MS4 based on the facility's Standard Industrial Classifications (SIC) code. CWS also responds to site-specific information, such as what might be gained in investigating a complaint or an illicit discharge, considers the nature of materials and wastes stored at the facility, the condition and location of storage structures, the protective measures in place (including personnel training, spill response plans, and inspection programs), and the history of actual releases. CWS inspects all facilities where there is credible information suggesting the potential to contribute a significant pollutant load to the MS4.

Sites with known releases are prioritized for inspection. Facilities with SIC codes requiring 1200-Z coverage are brought into the 1200-Z program. Where inspection confirms the potential to contribute a significant pollutant load to the MS4, CWS works with the owner or operator to implement practices designed to eliminate the potential. If this technical assistance is not effective, CWS may bring an enforcement action under CWS' Ordinance 27 to compel compliance. CWS may request that DEQ take appropriate action that may include requiring the facility to obtain coverage under a 1200-Z general permit pursuant to 40 CFR 122.26(a)(9)(i)(D) or may take other action as appropriate.

3.1.2 Inspection Procedures

CWS performs the following inspection procedures for 1200-Z facilities:

1. Identifies facilities requiring industrial stormwater permits.
2. Reviews industrial stormwater permit applications.
3. Reviews Stormwater Pollution Control Plans.
4. Provides technical assistance.
5. Inspects facilities.
6. Reviews industrial Discharge Monitoring Reports.
7. Coordinates with DEQ on enforcement matters.

CWS identifies and contacts industrial facilities either through the Sewer Use Information Card survey program or the industrial users survey available on the CWS website. Industrial facilities identified through the survey are then classified by SICs. CWS directs the facility operators to apply for the 1200-Z permit as necessary.

3.1.3 Frequency of Inspections

CWS inspects 1200-Z permitted facilities based on a system that prioritizes inspections, so the frequency of inspection is proportional to the risk associated with the discharges of pollutants, past noncompliance, and the period since the last inspection. In prioritizing

inspections, CWS considers the complexity of the facility, its compliance history, and benchmark exceedances. Regardless of risk, CWS inspects every 1200-Z permitted facility at least once every five years consistent with the permit cycle. CWS provides technical assistance inspections at facilities that need additional help.

Industrial facilities with 1200-Z permits in the CWS service area must submit to CWS monitoring results for pollutants specified in the permit every quarter. CWS evaluates this information for accuracy and completeness and compares it to the quality assurance and quality control laboratory data that is submitted per requirements of the 1200-Z permit. CWS also identifies potential illicit discharges to stormwater at industrial facilities through its pretreatment program. CWS coordinates dual inspections with pretreatment and stormwater staff and has incorporated stormwater regulatory questions into the pretreatment industrial inspection form.

3.1.4 Documentation Standards

CWS uses a business management application, iPACS, to manage data related to 1200-Z and NEC facilities. CWS stores information related to commercial and industrial facilities that may need technical assistance or occasional oversight but do not require a 1200-Z permit. CWS uses Lucity asset management software, which is integrated with CWS' geographic information system (GIS), to track the location of known releases of pollutants and illicit discharges, complaints, referrals, investigation activities, actions taken to eliminate the discharge, and resolution, including dates.

3.1.5 Assessment and Tracking

Staff members working for CWS' industrial stormwater program implement local ordinances and act under a memorandum of agreement as the DEQ agent for the 1200-Z permit. CWS provides technical assistance, conducts routine inspections, reviews discharge monitoring reports, processes permit applications, and undertakes enforcement as needed. All information is tracked in iPACS.

3.2 No-Exposure Certifications (NECs)

1200-Z permit coverage is not required at facilities that do not discharge stormwater from an industrial operation and can certify a "no exposure" condition exists. According to the EPA's June 2000 "Guidance Manual for Conditional Exclusion from Storm Water Permitting Based on 'No Exposure' of Industrial Activities to Storm Water" a no-exposure certification is viable for facilities with "industrial activities and materials [that] are completely sheltered" (p.2). CWS staff **inspection procedures** for new industrial facilities, facilities certifying no exposure, or for reissuing no-exposure certification include identifying facilities that require permitting, reviewing applications, conducting inspections, identifying corrective actions, and issuing certifications. **Inspection frequency** occurs every five years during the year that the certification expires to determine if a status of no exposure is still applicable. Applicants for a no-exposure certification must complete any corrective actions that disqualify them from certification within 60 days. If a facility fails to complete corrective actions within 60 days, the facility must submit a 1200-Z application**. Facilities identified, documentation**

standards, assessment, and tracking for the NEC are the same as the 1200-Z standards identified in paragraphs 3.1.4 and 3.1.5 above.

3.3 Private Water Quality Facilities (PWQFs) Associated with 1200-Z Permitted Facilities

PWQFs are required by local ordinance and must be designed to meet Total Maximum Daily Load (TMDL) wasteload allocations (WLAs). In addition to CWS' broader PWQF program that includes public and private PWQFs throughout the basin, CWS and its co-implementers work with industrial facilities to ensure their PWQFs are in good or better operating conditions. CWS provides technical assistance and inspections to 30 industrial sites with PWQFs over a four-year period, working with a quarter of the total number of sites each year. CWS provides technical assistance, including corrective actions, to help industries transition out-of-compliance facilities into compliance. CWS staff track and store information for the 1200-Z PWQF program in the Lucity database.

3.4 EcoBiz Program

CWS participates with Oregon DEQ in the Eco-Logical Business program (EcoBiz). CWS helped found EcoBiz in 1999 with the **rationale** to provide technical assistance on pollution prevention to commercial facilities with **high potential to discharge pollutants to the MS4**. CWS contracted with Pacific Northwest Pollution Prevention Resource Center (PPRC), a nonprofit organization that provides pollution prevention information. PPRC has provided outreach and technical support for EcoBiz for automotive services and landscaping services in Washington County since November 2008. The EcoBiz program certifies commercial facilities that meet statewide standards set by the Pollution Prevention Outreach Team (P2O Team), which includes members from DEQ, Metro, and Oregon municipalities. Commercial facilities must comply with environmental laws and implement BMPs to reduce the environmental impact of their operations.

Regarding **inspection procedures**, CWS conducts verification inspections that confirm whether a commercial facility meets the BMP requirements outlined in the EcoBiz checklist. CWS' **documentation standards** include logging the status of a business in CWS' files and in iPACS. The verification **inspection frequency** of EcoBiz businesses is three years after a business is certified, then every five years. **Assessment** of the EcoBiz program occurs through CWS' participation in the P2O Team. **Tracking** of businesses has occurred through metrics, which have been reported annually by PPRC and included in CWS' Stormwater Annual Report.

Currently, EcoBiz is supported by Oregon DEQ. CWS remains an active participant in the P2O Team and supports outreach and collaboration surrounding pollution prevention. Consistent with CWS' adaptive management approach, CWS has expanded laboratory capabilities to analyze stormwater for emerging pollutants including 6PPD-quinone and PFAS. This will allow CWS to expand its internal stormwater program by focusing on commercial sources of emerging contaminants and pollutants. This work will be quantitatively and qualitatively driven through internal sampling efforts and research to measure the program's outcomes. Adaptive management of the internal program will occur as needed.

3.5 Fats, Oils, and Grease (FOG) Program

CWS and its co-implementers have established FOG control programs to limit the discharge of FOG to both the sanitary sewer system and the MS4. Food service establishments (FSEs) are a primary source of FOG; when FOG goes down drains it can clog pipes and lead to sanitary sewer overflows (SSOs) that can reach the MS4. FOG control programs focus on technical assistance and education. Effective pretreatment and regular maintenance schedules can help keep FOG out of the sanitary sewer system and the MS4. Structural elements such as trash enclosure roofs can reduce illicit discharges from FOG stored outside. CWS and co-implementer staff follow up on complaints regarding grease and oil entering the MS4 and provide technical assistance to FSEs storing FOG outside.

CWS **documents** FOG data including FSEs, SSOs, and illicit discharges in the Lucity database. To date, CWS is **tracking** over 2,500 FSEs in its jurisdiction. **Inspection procedures** include technical assistance and enforcement as needed. During inspections, CWS staff and co-implementers educate FSE management and staff about the impact of FOG on the sanitary and stormwater systems. **Inspection frequency** is dependent on a facilities' needs. Due to this historic programmatic work, approximately 40% of FSEs that are permanent structures in the CWS service area have upgraded to effective pretreatment of FOG. The FOG program has helped keep FOG out of the sanitary system; of the seven SSOs CWS responded to from September 1, 2023, to August 31, 2024, only two were caused by FOG in the sanitary system.

To mitigate FOG issues in commercial and residential areas, CWS staff distributed educational door hangers and booklets explaining FOG and the MS4 system, and grease trap kits to apartment complexes.

3.6 Mercury Minimization Plan (MMP)

Per Section D.14.c.iii of CWS' NPDES permit, CWS is responsible for the applicable WLAs included in the TMDL for mercury in the Willamette Basin and the implementation of requirements. Requirements include:

(A) Develop and submit a mercury minimization assessment with the annual report due November 1, 2024, that documents the current actions, such as BMPs implemented, that reduce the amount of solids discharged into and from the permitted MS4 system (similar to the actions currently required in Schedule A.12). If the assessment indicates that mercury and sediment reducing BMPs are fully incorporated into the SWMP, a report documenting the results as such is sufficient.

(B) Continued implementation of the BMPs and other actions described in the mercury minimization assessment that are effective for mercury reduction, along with documentation of implementation in each subsequent annual report.

CWS implements a mercury minimization strategy by **identifying facilities that have the potential to contribute mercury to CWS' sanitary sewer system and MS4** and ensuring there is pollution prevention and appropriate management of waste streams to keep mercury out of stormwater.

CWS conducts concurrent stormwater monitoring for TSS, total and dissolved mercury as required by Table B26 in Schedule B, Section 15 of the permit. Beyond the permit requirements, CWS monitors both stormwater and urban streams for mercury. This data will be assessed and incorporated into the implementation of the mercury minimization plan required by Schedule A.12.a.ii. of the NPDES permit. CWS is also evaluating this data as part of the mercury minimization assessment required by Schedule B.14.c.iii.(A) of the NPDES permit and will submit the assessment with the Stormwater Annual Report by November 1, 2024.

CWS' work to minimize mercury in the watershed began in the early 2000s. Most recently, in 2021, CWS updated an MMP, which identifies programs and activities that CWS implements to reduce the levels of mercury conveyed to CWS' water resource recovery facilities and prevent mercury discharges to stormwater. Key elements of CWS' MMP include screening significant industrial users for mercury; requiring specific industrial users to develop mercury minimization plans; implementing a dental amalgam program to control mercury discharges from dental offices; and targeting outreach to medical establishments, schools, and commercial laboratories. **Inspection procedures, frequency of inspections, assessment, and tracking measures for the specific target facilities are identified below.**

CWS has been conducting the dental amalgam inspection program since 2013. CWS inspects around 300 dental offices each permit cycle to ensure compliance with BMPs and amalgam separator installation and maintenance. CWS will inspect all dental offices that are out of compliance and provide them with technical assistance by the end of the current permit cycle. CWS determines that an office is in compliance if it properly disposes of amalgam and associated wastes, properly recycles amalgam, maintains its amalgam separator, and uses a compliant vacuum line cleaner. CWS estimates that the installation of amalgam separators and the implementation of BMPs have resulted in a 99% reduction in the amount of mercury waste from dental offices that reaches the sanitary sewer or stormwater conveyance system.

CWS is assessing how the four major hospitals in its service area approach mercury management. Each hospital completes a mercury minimization checklist that identifies mercury minimization laws and BMPs applicable to a hospital's waste stream. All documents are stored in CWS' file system. CWS conducts mercury minimization inspections with each hospital to verify and document their practices and provides technical assistance. All hospitals will be assessed by the end of the permit cycle. CWS' analysis of a hospital's mercury minimization work includes identifying whether any mercury could be discharged to the CWS sanitary or stormwater conveyance system.

The CWS MMP demonstrates the benefits of a pollution prevention program internal to CWS. The MMP promotes direct interaction with businesses, which encourages

collaboration on pollution prevention efforts. CWS is responsible for all outreach efforts, educational materials, and policies, and can adapt the program to the specific needs of the community as they arise. CWS' work on pollution prevention through the implementation of its MMP, along with the management of waste streams from the sectors identified in the MMP, are expected to help prevent mercury from reaching the MS4.

3.7 Illicit Discharge Detection and Elimination Program (IDDE)

Ordinance 27 is CWS' municipal ordinance that prohibits pollution from being discharged to the MS4. Enforcement occurs through the IDDE program, which began in 1993. CWS will implement illicit discharge protocols as described in the IDDE Program Description document. CWS and its co-implementers respond to complaints or other indicators of pollution discharges to the MS4. CWS **tracks** all investigations within its MS4 service area. Incident information is **tracked** in CWS' Lucity database. CWS offers training for CWS and co-implementer staff on recognition, response, and reporting illicit discharges and connections. Over the past year, CWS and co-implementers responded to well over 150 illicit discharges.

Water quality investigations and dry weather field screening inspections are methods used to identify illicit discharges.

The inspection procedures, inspection frequency, documentation standards, assessments, and tracking per program are outlined below.

3.7.1. Water Quality Investigations

CWS conducts water quality investigations as a procedure for evaluating and responding to elevated concentrations in stormwater runoff. If sampling shows an elevated concentration of monitored pollutants in stormwater runoff, CWS will follow up with strategies that may include outreach, further investigation, technical assistance, or enforcement if there is an illicit discharge.

CWS has established response procedures when stormwater discharge is found to be causing or contributing to an excursion from a water quality standard. CWS will determine if the illicit discharge response or Total Maximum Daily Load (TMDL) implementation plans are the appropriate mechanism for response. If greater action is needed, CWS will then develop a response plan that details the following information:

1. Investigation results.
2. Description of known or suspected causes or contributions to the exceedance.
3. Description of planned and completed corrective actions.

Future IDDE training will include a component on water quality investigations. An overview of CWS' response to water quality investigations is included in the Stormwater Annual Report and documented internally in the Lucity database.

3.7.2. Dry Weather Field Screening Inspections

CWS identified just over 200 significant stormwater outfalls inclusive of unincorporated areas and cities throughout the geographic area of the MS4. These outfalls are inspected once every permit cycle. The District does over 60 outfall inspections per year providing for multiple inspections at selected outfalls. The priority outfalls for multiple inspection were selected using multiple factors that may indicate higher risk of illicit discharges. A primary factor for the inclusion of these priority outfalls is that they receive less attention from maintenance staff who may encounter evidence of an illicit discharge during routine inspections because of age or limited presence of treatment from water quality manholes or water quality facilities. In general, areas that do not include stormwater treatment are areas containing older infrastructure. The land use type and drainage area size associated with the stormwater discharged from the outfall were additional factors included in the selection process for the priority outfalls. **Field screening inspection frequency** occurs annually. CWS will select a subset of approximately 60 priority locations to inspect. CWS' Field Operations personnel will perform the field screening inspections. **Field screening inspection procedures** include making general visual observations and noting the presence of flow, turbidity, oil sheen, trash, debris, or scum; condition of the conveyance system or outfall; color, odor, and other observations to potential illicit discharges. Field Operations personnel **document** inspections through the IDDE Dry Weather Field Screening form. **Documents** are maintained in both hard copy and electronic formats.

If observations suggest the presence of an illicit discharge and the source is unknown, staff will then conduct an inspection to identify the source of the unknown substance. A sample can be collected for analysis that can assist in identifying the source of the illicit discharge.

As required by Section A.14.c.iii.(E) of the NPDES permit, CWS has reviewed and included updated Dry Weather Field Screening prioritization criteria in its IDDE Program Description document, which is posted on CWS' public website.

3.8 Discharge Authorizations

CWS implements a Discharge Authorization program for identifying and establishing controls for industrial facilities not regulated by the 1200-Z permit and commercial facilities. These authorizations provide practices to minimize washwater generated from equipment washing to CWS' MS4 by requiring that operations be discharged to the sanitary. The discharge authorization program builds on the wash water program by helping facilities that previously had discharged wash water directly to the MS4 disconnect from the storm system and connect their wash water operation discharge to the sanitary sewer system. Discharge authorizations do not have an expiration date and therefore do not have routine **inspection frequencies**. Discharge authorizations are **documented** in iPACS. Since 2023, CWS has regulated over 100 discharge authorizations. CWS may continue to utilize the washwater permit as a control mechanism, as applicable.

The discharge authorization **inspection procedures** are as follows:

1. Identify facilities that discharge process water to the MS4. New facilities are required to complete a 'new industrial users' questionnaire' on the CWS public website. Facilities are then inspected to determine whether they qualify for discharge authorization.
2. Provide technical assistance to eliminate these discharges to the MS4. CWS supports industrial facilities in understanding compliance regulations.
3. Issue temporary discharge authorization letters with conditions and necessary controls for discharges to the sanitary sewer.

3.9 Education and Outreach

CWS and the co-implementers employ a public education and outreach program that informs and educates the public, business and industry representatives, and government staff about the causes of stormwater pollution, the effects on local streams and rivers, and the need for stormwater management. These BMP elements encourage appropriate behaviors to protect water quality, reduce discharges of pollutants from the MS4, and promote the health of the Tualatin River Watershed. Outreach to commercial and industrial facilities is provided through technical assistance inspections, outreach materials, and specific communication. Initiatives include:

1. CWS and co-implementer training on illicit discharge response, construction site inspection, and water quality facility design.
2. Targeted outreach in sub-watersheds that have elevated contamination levels for zinc, copper, and E. Coli.
3. Billing messages, electronic newsletters, websites, and social media about watershed protection and enhancement, proper disposal practices, and reporting information for illicit discharges and water quality impacts.
4. Regional Coalition for Clean Rivers and Streams activities address a range of surface water contaminants including nutrients and toxins from fast-releasing synthetic fertilizers and pesticides applied to yards and lawns; pollutant loads from car washing soaps, metals, and other toxins from vehicles; E. coli from pet waste; turbidity from eroded soils; and other contaminants from illicit discharges.

4. Commercial Stormwater Program Adaptive Management

4.1 CWS' Adaptive Management Strategy

The following sections describe the information required in paragraph (B) of Schedule A.14.c.vii for the CWS industrial and commercial stormwater programs and activities. The pertinent permit language is bolded.

4.1.1. Stormwater Monitoring

CWS updated the Stormwater Monitoring Plan, which went into effect with the 2023 reissued permit. CWS is evaluating its stormwater monitoring sites as part of the adaptative management of the stormwater program.

4.1.2 Heat Map

CWS is developing a heat map that incorporates multiple geospatial characteristics within the MS4 service area, offering unique insights into the drainage areas at various points in the stormwater conveyance system. The heat map considers physical features such as impervious surfaces, traffic volume, development age, and zoning and social factors like population density and socioeconomic status, ensuring diverse sector representation. CWS and the co-implementers will use insights from the heat map and supporting stormwater monitoring to enhance data collection, validate the heat map's accuracy, and apply any necessary or dynamic adjustments.

4.1.3 Zinc and Copper

Zinc and copper are frequently observed in stormwater monitoring data at levels comparable to water quality criteria. Because of their prevalence in stormwater, zinc and copper may be used to guide outreach and determine the effectiveness of the EcoBiz efforts. Through the EcoBiz program, one of CWS's focused areas for pollution prevention efforts is the automotive sector due to the sector's high pollution potential of contaminants of concern. In automotive shops, zinc is present in used tire piles and wheel weights (Davis et al. 2001; City of Gresham and PPRC 2018). Copper from commercial sources can be attributed to brake pads and vehicle degradation (Department of Ecology 2017).

The construction industry can also be a significant commercial contributor of zinc and copper stormwater runoff. Zinc, which is often used to protect metals from corrosion, might be used in a building's rainwater systems. Likewise, copper is often used in roofing, guttering, and pipework (Copper Sustainability Partnership 2024).

CWS will continue its work with commercial sectors that contribute zinc and copper to mitigate exposure to the MS4 by investigating and adapting the program to new sources. CWS is looking to work with other MS4 permit holders on commercial outreach efforts. Focus areas include the construction, automotive, and autobody sectors, and landscaping. CWS' sector-specific outreach material and checklists will include BMPs for zinc, and copper and concurrently provide information on PFAS for appropriate facilities.

BMPs in the **automotive industry** might include properly covering or moving piles of tires, providing secondary containment, spill kits, and other measures to ensure that spills are contained, and substituting materials that contain copper and zinc for feasible alternatives. In the **construction sector,** BMPs may include substituting roofing materials composed of galvanized metals with alternative materials.

4.1.4 Addressing Emerging Contaminants and Pollutants of Concern

CWS' adaptive management strategy will include evaluating, developing, and implementing a strategic monitoring program to better understand commercial and industrial source contributions to pollutants of emerging concern. Pollutants include PFAS as measured by the EPA Method 1633, which includes the compounds PFOS and PFOA for which EPA has proposed water quality criteria. Pollutants also include 6PPD-

quinone, a pollutant associated with byproducts of tire wear and toxicity to fish, particularly the coho salmon.

CWS proposes that, in continued collaboration with EcoBiz, CWS will expand its commercial stormwater program by strategically tracking and mitigating sources of emerging contaminants and pollutants of concern in the commercial sector. The goal of this work is to reduce pollutants in stormwater discharges to the MS4 from commercial facilities by addressing sites or activities that could contribute a significant pollutant load to the MS4. This work will benefit from:

a. Developing a stormwater sampling plan to identify geographical areas and commercial sectors contributing to emerging contaminants and pollution loads.
b. Direct engagement between CWS and the business community. As described by CWS' MMP in Section 4.2, direct engagement allows CWS to cater its approach to address the specific issues and barriers that commercial facilities experience in adopting BMPs.
c. Targeted outreach materials, goals, and metrics.
d. Specialization from CWS staff. In-house experts will create or review varying aspects of the program, such as educational materials, document formatting, and technical assistance.
e. Adaptive management in response to challenges, barriers, and opportunities.

4.1.5 PFAS and 6PPD Quinone

CWS' commercial stormwater program will focus on mitigating the introduction of emerging contaminants including PFAS into the MS4 through monitoring and directed outreach. In addition, CWS' commercial stormwater program will identify whether there are opportunities to effectively and efficiently address sources of 6PPD-quinone through monitoring. CWS will identify and instruct identified commercial facilities on sector-specific BMPs to reduce their pollution potential to the MS4. Program staff members also will collaborate with co-implementers to ensure the highest efficiency of pollutant reduction.

As part of this review, in July 2024, CWS reviewed research articles that identified the commercial sectors that contain the highest amount of PFAS in their products and practices and analyzed whether those commercial sectors might introduce PFAS to the MS4. Staff members analyzed 67 independent sources and identified 15 sectors with high potential for PFAS exposure. Of these sectors, staff identified eight commercial sectors with high potential to discharge to the MS4. A summary of the "PFAS Literature Review" and potential best management practices is listed in Appendix A.

The commercial sectors identified with high potential PFAS exposure to CWS' MS4 include:

1. Autobody and painting
2. Automotive
3. Aviation

4. Car wash
5. Cleaning companies
6. Construction
7. Fire departments
8. Landscaping

4.1.6 Inspection Procedures

Inspection procedures will include identifying facilities, developing outreach materials, providing outreach and technical assistance, sampling, and highlighting businesses' work.

a. Identify Facilities

Commercial facilities in the CWS service area that fall into the eight commercial sectors will be identified through historical records, business licenses, desktop screenings, drive-by screenings, and GIS. CWS will prioritize contacting EcoBiz-certified commercial facilities first as they are leaders in pollution prevention and are the most likely to have internal commercial stormwater programs.

CWS' anticipates this program to mature through adaptive management over the next several years. CWS will solicit feedback from industrial and commercial representatives include EcoBiz-certified commercial facilities on BMPs and other programmatic requirements to inform the effectiveness of the PFAS program.

Outreach materials and technical assistance will be available to any facilities in the MS4 boundary. Sites with known releases will be prioritized for inspection.

b. Develop Outreach Materials

CWS will design sector-specific outreach materials for each of the eight commercial sectors identified. Outreach materials will be updated as new research emerges.

c. Provide Outreach and Technical Assistance

Outreach will be conducted by CWS staff through phone calls, emails, and site visits to inform commercial facilities about PFAS and targeted pollutants. Outreach will be considered successful when it results in a commercial facility requesting technical assistance including CWS staff conducting site visits, supporting facilities in completing the brief checklists, and identifying necessary modifications to practices.

d. Sample

CWS will conduct recurring sampling at selected commercial facilities depending upon the initial results and literature review. CWS will use sampling data to determine where to prioritize outreach.

e. Highlighting Businesses

CWS is considering a recognition program for commercial facilities that complete BMPs as part of the adaptive management of the commercial stormwater program. This may include highlighting qualified businesses on CWS' public website.

4.1.7. Documentation Standards and Frequency of Inspections

Business interactions will be logged in a CWS database and GIS system. CWS' outreach and technical assistance will occur as needed to address the specific needs of a commercial facility.

5. Commercial and Industrial Facility Inspection Staff Training

All relevant CWS staff will acquire training on the industrial and commercial stormwater program and their respective roles to ensure uniformity in the program. Policies and procedures, in addition to those outlined in this document, will be documented as standard operating practices and stored in CWS' file system. Additionally, CWS staff overseeing the workload for this program will conduct training for relevant CWS and co-implementer staff on the program's objectives, successes, and learning opportunities. The training will include updated information on sector-specific pollutants and PFAS BMPs. CWS will also provide training to the co-implementers and CWS staff through regularly scheduled co-implementer meetings.

6. Tracking and Assessment of CWS' Industrial and Commercial Stormwater Strategies

CWS documents the implementation of the NPDES permit requirements for the commercial and industrial business BMPs in the Stormwater Annual Report submitted to DEQ by November 1 every year. In each annual report, CWS reports on activities conducted by CWS and the co-implementers to meet the metrics and tracking measures related to the implementation of the commercial and industrial stormwater programs and plans for adaptive management of the programs for the following year. The metrics or tracking measures from the 2020 DEQ-approved SWMP are outlined below.

Measurable goals and tracking measures:

a. Goal: Identify industrial facilities that need a 1200-Z stormwater general permit.

Tracking Measure: Number of newly permitted 1200-Z facilities in the service area.

b.(1) Goal: Conduct all of the priority 1200-Z facility inspections scheduled for the reporting year in the service area.

Tracking Measure: Number of priority 1200-Z permitted facility inspections scheduled for the reporting year; number of scheduled priority 1200-Z facility inspections conducted during the reporting year.

b.(2) Goal: Inspect 20 percent of 1200-Z permitted facilities annually during permit administrative extension.

Tracking Measure: Total number of 1200-Z permitted facilities; number inspected.

c. Goal: Provide technical assistance if requested by owner/operator of a facility.

Tracking Measure: Number of technical assistance inspections performed in response to owner/operator requests.

d. Goal: Issue "No Exposure" certifications to facilities that are determined to meet DEQ qualifying criteria.

Tracking Measure: Number of "No Exposure" certifications issued.

e. Goal: Review monitoring reports from all 1200-Z facilities.

Tracking Measure: Number of monitoring reports submitted and number reviewed.

f. Goal: Identify facilities subject to section 313 of SARA Title III and not already covered by 1200-Z or other stormwater discharge permit and determine their potential to contribute a substantial pollutant loading to the MS4.

Tracking Measure: Number of unpermitted facilities identified through the annual review of the TRI.

Tracking Measure: Number of unpermitted facilities identified through the TRI review that were inspected, number determined to have potential to discharge a substantial pollutant loading, action taken.

g. Goal: Reduce pollutants in stormwater discharges from facilities other than those with SIC codes requiring 1200-Z general permit coverage.

Tracking Measure: Number of facilities (other than those with 1200Z-qualifying SIC codes) where site-specific information leads to a facility inspection, number of facilities determined to be contributing a significant pollutant load to the MS4, action taken.

For pollutants of emerging concern (PFAS and 6PPD-quinone), CWS will focus on education and outreach to customers and staff, identification of products with PFAS in a sector's inventory, and then substitution, containment, or coverage of respective product and the development of a monitoring program. Further goals and tracking measures will be developed through adaptive management.

Appendix A.

Commercial Sources of PFAS Literature Review

Clean Water Services
Ara Vickers
July 8, 2024

Abstract

Per- and polyfluoroalkyl substances (PFAS) are emerging contaminants which threaten human health and natural resources. Clean Water Services is leading an innovative strategy to address PFAS within its jurisdiction. Work is underway to effectively minimize PFAS at an industrial level and opportunity exists to address PFAS contamination of stormwater from commercial sectors. This literature review identifies commonplace commercial sectors with the highest PFAS contamination potential. Commercial sources were analyzed and included based on their potential output of PFAS contamination, regardless of their potential exposure to stormwater, in order to provide a thorough overview of the commercial sector as a whole. However, for the purposes of the commercial stormwater program, potential stormwater exposure to PFAS is analyzed. 12 commercial sources are identified in this literature review from highest to lowest potential stormwater exposure, based on a qualitative analysis of each sector. Among all sources identified, the automotive sector, the autobody sector, the Fire Department, and the landscaping sector are of the highest concern regarding the potential disbursement of PFAS into the stormwater system from commercial sources.

Summary

Please see a summary below of commercial sources of PFAS.

Autobody and Painting

Paints and coatings have a significant concentration of polymers and fluoropolymers compared to other products. They contain the highest concentration of PFAS next to electronic manufacturers. Teflon coatings are frequently used in the autobody sector. These coatings last six months to a year, and require reapplication, increasing the likely amount of polytetrafluoroethylene (PTFE) degraded into the environment. PFAS contamination into stormwater is likely through the application of paints and coatings.

Automotive

The automotive industry has some of the greatest numbers of products containing PFAS (Cousins et al. 2020). PFAS is present throughout the automotive sector production line, including each of the automotive lubricant oils that were analyzed in the United States (Kannan and Zhu 2020). Automotive businesses are especially susceptible to oil spills and improper clean-ups, given the transportation of oil within a shop. Automobiles are constantly exposed to the elements; therefore, they pose a considerable threat to stormwater quality.

Aviation

From 1988 to 2022, the Federal Aviation Administration (FAA) required the use of aqueous film-forming foam (AFFF) at airports (Gutierrez and Makarious 2023). As of December 2022, the FAA is required by Congress to move away from all AFFF firefighting foam (FAA 2022). AFFF "can leach into soil and water at airports and spread from the initial contamination site to surface water and groundwater in surrounding communities." While a major source, AFFF is not the only PFAS contributor at airports. PFAS is in products used to clean spills and conduct equipment testing (Environmental Law Group 2024). Given that airplane fuel spills generally happen outdoors, the potential storm exposure of airplanes is high.

Car Wash

In a study of PFAS in popular Japanese commercial products, the highest concentration of PFAS existed in car wash chemicals (Masunaga, Ye, and Zushi 2015). Commercial car washing facilities discharge to the sanitary sewer system. However, when car washes do not follow discharge guidelines significant PFAS contamination of local groundwater can occur. In New York, PFAS groundwater sampling data showed that groundwater next to a car wash had twice the amount of PFAS in the nearby groundwater compared to the state's average (Ropeik 2018). There might be an opportunity to eliminate a potential, high-concentration source by working with car washes to switch the chemicals used.

Cleaning

Certain cleaners are mostly composed of PFAS (Gaines 2022). Gaines notes that 95-99% of the Novec contact cleaner's weight is PFAS. Potential PFAS exposure through the cleaning sector is most likely for businesses conducting outdoor and mobile cleaning. Glass cleaners and mobile carpet cleaners may be a high priority for a commercial stormwater program.

Construction

One study shows 88% of building materials analyzed in construction activities contained at least one form of PFAS, including wood products (Bečanová 2016). Waste streams from construction sites are also high sources of PFAS in landfills. The Danish Environmental Protection Agency (2024) led a study categorizing and analyzing the leaching ability of materials from different building types and time periods. They collected over 350 samples; PFAS was identified in 217 materials.

Fire Departments

Anderson et al. (2020) found that 3-6% of the total weight of AFFF used for firefighting is composed of PFAS. AFFF firefighting foam has contained PFAS since the early 1960s (Buck et al. 2018). Ackerman et al. (2024) analyzed PFAS data for 45,000 global surface and groundwater samples. About 60-80% of the groundwater and surface water sites contaminated with firefighting foam exceeded the EPA's drinking water standard for perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA). Comparatively, the groundwater and surface water with no known PFAS sources exceeded the EPA's regulations by 15-30%. This difference exemplifies the high potential of PFAS contamination in firefighting foam. Ackerman et al. (2024) also note that "Australia has no PFAS manufacturing facilities but has highly contaminated PFAS sites from firefighting activities." Gaines et al. (2022) determined that firefighters have some of the highest exposure of all workers.

Landscaping

Between 2015 and 2020, 70% of pesticides operating in the United States contained PFAS (Wilcox 2022). Out of agricultural pesticides tested in the United States, three in seven contain high levels of PFAS (Bennett 2023). The amount of PFAS within pesticides is significant. For example, in malathion 5EC, a common insecticide, PFOA levels are 100,000 times higher than the drinking water regulations of 4 parts per trillion. Cousins et al. (2022) found a prevalence of PFAS in many insecticides and pesticides. In addition to pesticides, turf contains significant PFAS levels. A 2024 study by the Public Employees for Environmental Responsibility found that soccer players had increased PFAS on their skin after playing a game on artificial turf (Bennett 2023). The contamination of stormwater through landscaping is likely given that pesticides are applied outside.

Available Best Management Practices

Sector-specific PFAS BMPs will focus on education to customers and staff, identification of products with PFAS in a sector's inventory, and then substitution, containment, or coverage of respective products. CWS may develop a recognition program for commercial businesses that complete BMPs. CWS also recognizes that especially for small, family-owned commercial facilities, some financial and BMPs are challenging to implement. CWS seeks to be a partner to commercial facilities that operate in its service area.

BMPs will be assessed and updated as new opportunities for PFAS mitigation emerge. In the **automotive and autobody and painting sectors,** BMPs might include switching products to non-PFAS or reduced-PFAS alternatives, covering equipment with high PFAS concentrations, halting outdoor painting, and ensuring that spills are adequately addressed onsite. BMPs in the **car wash sector** might include substituting chemicals and ensuring action plans.

In the **cleaning sector,** several certifications ensure cleaning products are PFAS-free. The Green Seal Certification eliminated all PFAS products from its directory in 2022. EPA's Safer Choice Program no longer accepts PFAS as an ingredient in cleaning products (Responsible Purchasing Network for MA Operational Services Division 2023). Opportunity exists to promote these programs' products to businesses through educational materials and to educate cleaning companies on the effects of PFAS in their products. There are documented instances of mobile cleaning vehicles illicitly discharging contaminated wastewater from their cleaning operations into the stormwater conveyance system within CWS' service area, thus resulting in illicit discharges. Therefore, it is evident that a substantial opportunity for education on proper disposal of wastewater exists.

Landscaping BMPs would likely focus on pesticide and insecticide substitutions, as well as recommending alternatives to turf and educating customers. BMPs in the **aviation sector** would require airports to identify PFAS in their inventory and possible substitutions. In the **construction sector**, PFAS is present in a wide range of products and practices, from cleaning masonry tools to power tools and hinges. Therefore, BMPs would likely focus on containment and coverage of materials and proper waste management for PFAS mitigation.

Multiple opportunities exist for **fire departments** to reduce PFAS exposure to the MS4 through firefighting foam. CWS could suggest alternatives to foams that contain PFAS. Fortunately, alternative foams to combat class B fires are effective and widely used. Nonsynthetic, protein foams "spread more slowly but have the advantage of being more heat resistant and more durable during a fire" (Clean Water Action 2024). They contain hydrocarbon fires through a foam blanket that smothers vapors from the fuel (Interstate Technology and Regulatory Council). In a study of fluorine-free firefighting foam, Jiang et al. (2020) determined that fluorine-free foam containing silicone surfactant of OFX-5211 outperformed AFFF foam in "fire extinguishing and burn-back performance."

Introduction

Per- and polyfluoroalkyl substances (PFAS) have been utilized in the United States since the 1940's and have a wide-range of uses (U.S. Food and Drug Administration 2024). In this literature review, PFAS chemicals are defined[1] as "any member of the class of fluorinated organic chemicals containing at least one fully fluorinated carbon atom" (Amarelo 2023). Over 14,000 chemicals are classified as PFAS by the Environmental Protection Agency (United States Environmental Protection Agency 2024). PFAS are nicknamed "forever chemicals" due to their resistance to breaking down in natural environments. Just like its uses, the health effects of PFAS in humans and the environment are wide-ranging. In humans, PFAS has been found to cause thyroid disease and cancer, kidney disease, insulin issues, birth defects and reproductive issues, miscarriages, immune system complications, and additional kinds of cancer (Boobis 2020). PFAS accumulates in human blood over time (National Institute of Environmental Health Sciences 2024) and takes years to break down in the human body (Bellio et al. 2020). Humans are exposed to PFAS through "contaminated water or food, using products made with PFAS, or breathing air containing PFAS" (National Institute of Environmental Health Sciences 2024).

[1]Notably, there is ongoing debate on the definition, and subsequent grouping, of PFAS when it comes to regulatory work. Gurney et al. (2022) highlights how shifting definitions can result in missed opportunities for regulation.

PFAS enters the air, water, food, and soil through contaminated products, waste streams, and materials (United States Environmental Protection Agency 2018).

In April 2024, the Biden-Harris Administration required the amount of PFAS in drinking water to be under 4 parts per trillion (ppt) (United States Environmental Protection Agency 2024). As of this literature review's creation date, there has yet to be water quality standards set for publicly owned treatment works (POTWs). In order to protect the human health and natural resources within its jurisdiction, Clean Water Services' (CWS) is conducting a multi-faceted, strategic approach to address PFAS. CWS' Environmental Services Specialists are in the process of working with our industrial partners to establish PFAS management plans in order to stop PFAS from entering CWS' treatment plants. A recent sampling analysis of the groundwater within CWS' jurisdiction indicates some PFAS present is uncorrelated with industrial activity. As regional innovators, CWS seeks to address PFAS within its stormwater and groundwater by identifying potential commercial sources for PFAS present. This literature review analyzes the current scope of work on commercial sources of PFAS in order to identify which sectors are potential PFAS contamination sources within CWS' jurisdiction.

Methodology

This literature review analyzes commercial sources for their respective PFAS exposure under a similar methodology conducted by Adamsky et al. (2021). Commercial sectors' potential PFAS exposure were identified by (a) ingredients or components of products that contain PFAS, (b) practices conducted by the commercial sector that use PFAS, (c) resulting PFAS contamination from degrading products or PFAS precursors. PFAS precursers are chemicals that can be converted into PFAS through common processes such as wastewater treatment (United States Environmental Protection Agency 2023).

In this literature review, 12 commercial sectors were identified over 65 articles. Articles incorporated in this literature review include (1) comprehensive literature reviews, (2) third-party, PFAS sampling studies, and (3) government databases. All sources identified in this literature review were cross-referenced or verified by a secondary, peer-reviewed source. The commercial sectors with the highest PFAS potential are challenging to identify since the United States Environmental Protection Agency (EPA) did not begin requiring industries to disclose their PFAS use until October 2023, with a final reporting deadline of May 2025 (United States Environmental Protection Agency 2024). Therefore, an official or definitive list of products that contain PFAS in the United States does not currently exist. Current knowledge of PFAS-containing materials relies on third party studies, data from foreign countries, and data from self-disclosing industries. Due to this, certain PFAS data specific to the United States may not be captured in this literature review. In addition, given the lack of conclusive data regarding quantitative concentrations of PFAS within each sector, sectors are defined as sources with high PFAS-exposure on an individual qualitative and quantitative basis. An estimate for the amount of potential PFAS contamination caused by specific sectors within CWS' jurisdiction is not within the scope of this literature review.

Literature Review

Automotive Sector. Out of 64 analyzed industrial and commercial sectors, Cousins et al. (2020) determined that the automotive industry is one of the sectors with the greatest number of

products to contain PFAS. Their literature review draws primarily from the US Toxic Substances Control Act's chemical data reporting, patents, market reports, and data from a substance monitoring database in Nordic countries called the Substances in Preparations in Nordic Countries (SPIN). It is possible that certain sectors that operate in the United States are not captured in SPIN's data. However, the European Union (EU) has been targeting and collecting data on PFAS in industries since 2008 and therefore provides some of the most robust data available (European Chemicals Agency 2024). Cousins et al. (2020) identified PFAS in automotive waxes, windshield wiper fluid, car body coatings, engine sealants and bearings, car electronics, brake pad additives, steel hydraulic brake tubes, dirt repellent carpets and seats, cables and wires, and in cylinder head coatings. Gaines' (2022) conducted a literature review, reviewed manufacturer's Safety Data Sheets (SDS), analyzed EPA's Chemicals Dashboard to determine PFAS sources in products. She identifies PFAS in automobile waxes, automotive finishes, and anti-mist film on the glass of automotive windshields and headlights.

Kannan and Zhu (2020) conducted a lab analysis and identified PFAS in 18 automotive lubricant oils in the United States. The purpose of PFAS in lubricant oils is to "reduce surface tension, prevent fires and evaporation". Long-chain perfluoroalkyl carboxylic acids (PFCAs) were the primary type of PFAS present in these lubricants. The authors analyzed the lubricants before and after oxidation and deduced that the lubricants likely had a notable amount of PFAA precursors as well.

Potential exposure to stormwater through the automotive sector is highly likely. Automotive businesses are especially susceptible to oil spills and improper clean-ups, given the constant transportation of oil within a shop. Automobiles are constantly exposed to the elements. If coated with PFAS, they pose a considerate threat to stormwater quality. There is a reasonable ability for automotive shops to reduce their PFAS exposure on-site and through their practices. Actions from the automotive sector to reduce PFAS might include switching products, providing education to customers and staff, and ensuring that spills are adequately addressed on-site. Given the high use of PFAS in the automotive sector and Clean Water Services' historic work with the automotive sector through its prior commercial stormwater program, this is a high-priority sector for the commercial stormwater program.

Autobody and Painting Sector. Cousins et al. (2020) found that paints and coatings have a significant concentration of polymers and fluoropolymers compared to other products. In fact, in their analysis, coatings and paints contain the highest amount of PFAS next to electronic manufacturers. Notably, their analysis specifically looked at the production of paints and coatings. However, PFAS contamination is present through the application of paints and coatings and their degradation in the environment. The Organisation for Economic Co-operation and Development's (OECD) 2022 report identified aerosol spray cans to contain Polytetrafluoroethylene (PTFE), as shown in **Figure I.** PTFE, otherwise known as Teflon, is non-wetting and therefore is commonly used for car coatings (Palla 2022). Teflon coatings only last from 6 months to a year, and therefore require reapplication.

FIGURE I

	OECD Product Categories	Applications	Use examples	Fluoropolymers	Other PFASs (Non-polymeric PFAS)
Coatings	Powder coatings	Architectural	Exterior surfaces of bridges, buildings	PTFE, PVDF, ECTFE, FEVE, FEP	None identified
		Chemical industry	Lining of reaction vessels, metal surface coating		None identified
	Radiation curable coatings	Electronics	Phone and tablet screens	PTFE, PVDF	Perfluoropoly-ether and polyurethane blend
	Other coatings	Cable and wiring	Commercial indoor local area network (LAN) cables, cables in aircraft	PTFE, FEP, PFAECTFE and ETFE	None identified
		Anti-reflective coatings	Coating for semi-conductors	FP with a short fluoroalkyl side chain which is less than C4	PFOA, PFOS*
		Ant-graffiti coatings	Walls, public transport, bridges	PTFE has been used	None identified
		Renewable Energy	Solar panels, wind turbine blades	FEP, ETFE, FEVE, ECTFE	Formulations of fluoro- sulphonamides
Paints	Aerosol spray paints	Automotive paints	Car coatings	PTFE	None identified
		Architectural, Chemical industry	Architecture: bridges, construction Chemical: metal surface protection	PVDF, PTFE, FEVE	None identified
	Water-based paints	Architectural, Chemical industry, Domestic	Architecture: bridges, construction Chemical: lining of vessels, metal surface protection Domestic: doors, walls	PVDF, FEVE, ECTFE, PTFE, FEP	C4-PFBS and C4-fluorinated ethers**, C6-based PFAS
	Solvent-based paints				
Varnishes	Floor and surface finishes/ lacquers and stains	Domestic, Construction Printing	Protection for stone and tiles, work surfaces, floor polishes, table-top waxes, night-reflective road, pavement and traffic signs and reflective sheeting, printing inks, wood and cellulose shrinkage/swelling protectors	None identified	C4-based PFAS e.g. PBSF, fluorinated polyethers**, short-chain PFAS mixtures with silicone†. None identified for printing inks. Wood protectors: fluorinated hydrocarbons, fluorinated acrylic or methacrylic acid esters, fluoroalkane sulfonic acids and salts of fluorinated carboxylic acids

Paints and coatings that contain PFAS pose a threat to stormwater, given that paints and coatings with PFAS are degraded in outdoor environments. The feasibility of addressing practices that occur indoors due to their later effects through a commercial stormwater program must be assessed if this sector is worked with from a regulatory standpoint. In tandem with the automotive sector, the autobody sector is a high priority sector given the high use of PFAS in its practices as well as Clean Water Services' historic work with the autobody sector.

Fire Departments. Anderson et al. (2020) found that 3-6% of the total weight of aqueous film-forming foam (AFFF) used for firefighting is composed of PFAS. AFFF firefighting foam has contained PFAS since the early 1960's (Buck et al. 2018). AFFF contains primarily perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) (Anderson et al. 2020). Based on a 2011 analysis, the average amount of AFFF stored in the United States is around 1

million gallons (Darwin 2011)[2]. AFFF foam is used to suppress class B fires, or flammable liquid fires (Clean Water Action 2024). PFOS and PFOA reduce the surface tension of firefighting foam so that the foam can more quickly and efficiently suppress a fire. Firefighting foam containing PFAS are not commonly used on class A fires, which encompass structural fires and wildfires.

Ackerman et al. (2024) analyzed PFAS data for 45,000 global surface and groundwater samples. 60 - 80% of the groundwater and surface water sites contaminated with firefighting foam exceeded the EPA's drinking water standard for perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA). Comparatively, the groundwater and surface water with no known PFAS sources exceeded the EPA's regulations by 15 - 30%. This difference exemplifies the high potential of PFAS contamination in firefighting foam. Ackerman et al. (2024) also note that "Australia has no PFAS manufacturing facilities but has highly contaminated PFAS sites from firefighting activities".

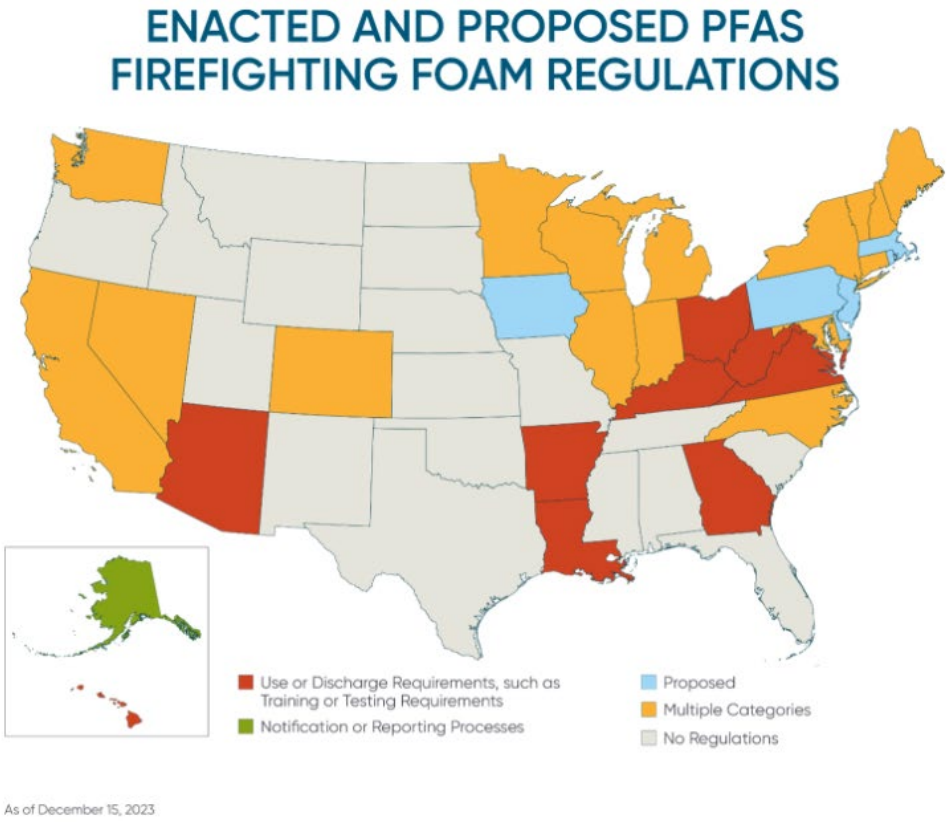
PFAS prevalence in firefighting foam places a significant health risk on firefighters. In their analysis of PFAS levels in workplaces, Gaines et al. (2022) determined that firefighters have some of the highest exposure of all workers. In fact, firefighters "may be exposed to several different PFAS at levels often similar to or higher than levels among fluorochemical plant workers and individuals in communities with PFAS-contaminated drinking water". In addition to firefighting foam, the International Association of Firefighters (2024) posits that PFAS-lined protective gear contributes to firefighter's exposure to PFAS. Firefighters have significantly higher rates of cancer, especially testicular cancer, compared to other groups (Norman and Kime 2023). PFAS has been linked to multiple cancers, including kidney, testicular, and thyroid cancer (National Cancer Institute).

Fortunately, alternative foams to combat class B fires are effective and widely used. Non-synthetic, protein foams "spread more slowly but have the advantage of being more heat resistant and more durable during a fire" (Clean Water Action 2024). They contain hydrocarbon fires through a foam blanket which smothers vapors from the fuel (Interstate Technology and Regulatory Council). In a study of fluorine-free firefighting foam, Jiang et al. (2020) determined that fluorine-free foam containing silicone surfactant of OFX-5211 outperformed AFFF foam in "fire extinguishing and burn-back performance than AFFF".

While no ban on PFAS foam has occurred in the United States as a whole, as of January 2023 the United States Department of the Defense requires all purchased firefighting foams treating class B fires to be PFAS-free (U.S. Fire Administration). Previously in 2015, the United States Department of Defense replaced longer-chain PFAS' C8-AFFF with short chain C6-AFFF PFAS, which was a common practice across industries (Burdick et al. 2021). It was commonly and incorrectly believed that shorter chained PFAS were benign. In fact, until recently the EPA's definition of PFAS only included longer PFAS chains (Wilcox 2022). Twenty four states have set bans or restrictions on PFAS containing firefighting foam (The Washington Post 2023). However, as seen in **Figure II**, Oregon has no ban on firefighting foam containing PFAS.

[2]A more recent analysis for the amount of PFAS foam currently stored in the United States was not identified in this research.

Figure II



Firefighting foam is especially challenging to address since the effectiveness of firefighting foam is the difference between life and death. However, multiple opportunities exist to reduce PFAS-exposure through firefighting foam to CWS' stormwater. Clean Water Services' conducted work in 2018 to coordinate with firefighting agencies to be knowledgeable of where they are spraying foams in relation to our stormwater conveyance system. While there is no evidence of the continuation of that work, opportunity still exists to coordinate with the fire departments in CWS' jurisdiction when they use foam in order to appropriately remove the foam before the majority can move into local waterways. Currently, the scope of firefighting foam containing PFAS within CWS' jurisdiction is unclear. As addressed in the Recommendations portion of this literature review, it may be beneficial to identify what PFAS is being used by Fire Department's throughout CWS' jurisdiction to understand the potential threat posed by firefighting operations to stormwater quality.

Landscaping. Between 2015 - 2020, around 70% of pesticides operating in the United States contained PFAS (Wilcox 2022). As of 2023, more than 1400 pesticides that contain PFAS were banned by the State of Maine (The Environmental Working Group 2023)[3]. Out of agricultural pesticides tested in the United States, 3 in 7 contain high levels of PFAS (Bennett 2023). The amount of PFAS within pesticides is significant. For example, in Malathion 5EC, a common insecticide, PFOA levels are 100,000 times higher than the drinking water regulations of 4 ppt. Cousins et al. (2022) found a prevalence of PFAS in many insecticides and pesticides. They

[3] It may be beneficial to cross-reference this data with CWS' pesticide inventory.

identified that primary purposes of PFAS in these formulas were to suffocate insects, ensure anti-foaming of the product, and increase the rate at which plants and insects absorb the product. In addition to pesticides, turf contains significant PFAS levels. A 2024 study by the Public Employees for Environmental Responsibility found that soccer players had increased PFAS on their skin after playing a game on artificial turf (Bennett 2023).

The contamination of stormwater through landscaping is likely given that the application of pesticides is conducted in the natural environment. Landscaping is therefore of particular concern for PFAS exposure and this sector could be a focus of the commercial stormwater program.

Aviation Industry. From 1988 to 2022, the Federal Aviation Administration (FAA) required the use of AFFF at airports (Gutierrez and Makarious 2023). As of December 2022, the FAA is required by Congress to move away from all AFFF firefighting foam (Federal Aviation Administration 2022). While a major source, AFFF is not the only contributor of PFAS at airports. PFAS is prevalent in the aviation industry to clean up spills and conduct equipment testing (Environmental Law Group 2024). Cousins et al. (2022) identifies PFAS in aviation hydraulic fluid as an anti-erosion additive, in airplane metal surfaces, aircraft countermeasures flares, throughout civilian airports, in aircraft wings and landing gears, and automotive tubing. No work has been conducted to analyze the potential run-off effects of PFAS from airplane parts and jet fuel. However, the effects of AFFF used at airports are substantial. AFFF "can leach into soil and water at airports and spread from the initial contamination site to surface water and groundwater in surrounding communities". AFFF dispensed to put out fires at Chicago's O'Hare and Midway airports has contaminated the groundwater beneath the city (Chase 2023).

The Hillsboro airport is the only public airport and National General Aviation Airport by the FAA within CWS' jurisdiction (Port of Portland 2024). Therefore, any work conducted with the aviation industry would be focused on this single source. Given the outdoor nature of airplanes, the potential storm exposure of airplanes is high. It may be beneficial to sample around the airport to determine PFAS contamination potential.

Construction. Bečanová (2016) identified the concentrations of PFAS in building materials and additional consumer products. They analyzed over 126 samples of random products and found that 88% of materials analyzed contained at least one form of PFAS. According to the authors, this was the first study to find wood materials to contain PFAS. The authors assessed PFAS levels based on potential exposure to humans through contact and determined that building materials "play an important role in human exposure to PFAS". The Green Science Policy Institute (2024) identifies PFAS in a variety of building materials. They report that PFAS is present in seismic damping systems, wires and cables, and flooring. PFAS is also present in grout and concrete and surface sealers for stone, in order to resist oil, water, and stains.

Gaines (2022) identified PFAS in cement tiles, concrete mixtures, glass in windows, house doors, house siding, roofing, roof fabrics all to contain PFAS. PFAS is not only present in the materials used on construction sites but in the cleaning process as well. According to Gaines, PFAS is also present in the cleaning of masonry tools, power tools and equipment, rollers, hinges, and more within the construction sector.

Waste streams from construction sites are also high sources of PFAS in landfills. The Danish Environmental Protection Agency (2024) led a study categorizing and analyzing the leaching ability of materials from different building types and time periods. They collected over 350 samples, of which PFAS was identified in 217 materials. PFAS was discovered in products across building type, material classification, and time periods. The highest levels of PFAS, and subsequent leaching ability, was identified in paint, vinyl flooring, linoleum flooring, carpets, and parquet.

Stormwater at construction sites is addressed through the 1200-C permit within Clean Water Services' jurisdiction. Therefore, addressing PFAS contamination from construction practices and materials may not be feasible from a commercial stormwater perspective. However, it is still notable given the high exposure of construction materials to the public and to stormwater.

Cleaning Companies. Certain cleaners are mostly composed of PFAS (Gaines 2022). Gaines notes that 95-99% of the Novec contact cleaner's weight is composed of PFAS. The Novec contact cleaner is produced by 3M, the primary manufacturer of PFAS in the United States. Additional cleaners produced by 3M have a remarkable amount of PFAS by weight, including the Novec electronic degreaser (15 - 35% PFAS), the Novec flux remover (25 - 24% PFAS), and the commercial carpet cleaner. While 3M is set to halt production of all fluorinated fluids, fluoropolymers, and PFAS-based additive products in 2025 (3M Company 2024), countless cleaners still contain PFAS.

Carpets and their cleaners are a major source of PFAS exposure. The Green Science Policy Institute (2018) worked with the producers of over 90% of the carpets in the United States. Like many other industries, when certain PFAS chemicals were reported as harmful, the carpet industry supplemented them with shorter PFAS chains. The Green Science Policy Institute claims that they were able to successfully educate major carpet producers on the shifting containment of PFAS in carpets. But, PFAS within carpets still remain. According to California's Department of Toxic Substances Control (2021), carpets and rugs are "potential long-term sources of widespread human and ecological exposures". Boor et al. (2020) found high levels of PFAS in various childcare facilities. They believe that this is due to floor cleaning products. Cousins et al. (2020) identified PFAS in floor waxes, glass cleaners, air fresheners, and aerosol cans.

Fortunately, there are several certifications that ensure cleaning products are PFAS-free. The Green Seal Certification eliminated all PFAS products from its directory in 2022 and PFAS is no longer accepted by US EPA's Safer Choice Program as an ingredient in cleaning products (Responsible Purchasing Network for MA Operational Services Division 2023). Of all Safer Choice products, only floor finishes were permitted to contain PFAS prior. Opportunity exists to promote these programs' products to businesses through educational materials as well as to educate cleaning companies on the effects of PFAS in their products. Potential PFAS-exposure through the cleaning sector is most likely for businesses conducting outdoor and mobile cleaning. Therefore, glass cleaners and mobile carpet cleaners may be of high priority for a commercial stormwater program.

Medical Facilities. PFAS is used throughout the healthcare industry, primarily on medical devices and materials. Cahill et al. (2023) analyzed fluorotelomer ethoxylates (FTEO) in 37

samples of wastewater and 15 dust samples. Fluorotelomer ethoxylates are theorized to be a "nonionic PFAS that have also been used as an alternative in some applications of anionic PFAS". According to Cahill et al. (2023), FTEOs have yet to be observed in the natural environment. However, they do exist in commercial products. Studies indicate that, like PFAS, FTEO has low levels of degradation and is likely to pose detrimental effects to human and environmental health. In their study, Cahill et al. identified FTEOs to be highest in the dust within medical facilities and the wastewater from laundry mats that process healthcare worker uniforms.

Cousins et al. (2020) state that out of 64 analyzed sectors, "medical utensils, the semiconductor industry, and the automotive industry" had the highest use for PFAS. PFAS-containing medical utensils that they identified include electronic devices such as pacemakers, x-rays, eye drops, contact lenses, anesthesia, catheters, stents, needles, surgical patches, tubing, and filters. Chemours, a PFAS manufacturer that has contaminated groundwater in North Carolina (Bruggers 2024), uses PFAS to make COVID-19 testing and treatment, insulators, and several additional medical products (Chemours). A Duke University Study found that anti-fogging sprays and cloths contain significant concentrations of PFAS (2022). The study identified "up to 20.7 milligrams of PFAS per millimiter of solution".

Medical groups such as the American Chemistry Council (2023) are concerned that restrictions in PFAS could jeopardize the effectiveness of life-saving technologies. They state that "without PFAS, devices could be at a higher risk of implant failure or clogging". Notably, the chemical manufacturers of PFAS for these life-saving medical devices, Chemours,was associated with drinking water contamination of up to 100,000 parts per trillion PFAS levels (2022). The local population has a staggeringly high number of thyroid cancer cases (Greenfield 2021).

The potential stormwater exposure from hospitals is low, given that all listed practices occur indoors, under cover. However, medical facilities are notable given the potential PFAS exposure to patients and CWS' historic and innovative work successfully addressing mercury exposure within healthcare facilities from pollution prevention.

Dental Offices. Out of 39 kinds of floss from different brands, 13 contained "detectable levels of organic fluoride", indicating that they used PFAS (Mamavation 2022). Some flosses tested could be composed of up to 24% PFAS. In a qualitative analysis of 765 cosmetic products, Catherine et al. (2024) identified PFAS throughout toothpaste products. Cousins et al. (2020) identified PFAS in dental floss and toothpaste, as well as uv-hardened dental restorative materials. This is of special note given Clean Water Services' historic work to conduct mercury minimization inspections at dental facilities. However, the vast majority of PFAS exposure from dental floss and toothpaste most likely occurs at the domestic level rather than within dental offices. Like medical facilities, dental offices' exposure to stormwater is relatively low and therefore not likely a high priority for the commercial stormwater program.

Restaurants. Specific food packaging can contain high levels of PFAS. Barbosa-Pereira et al.'s (2021) literature review identified PFAS in a variety of food packaging, including fast food packaging, muffin wrappers, cups for hot drinks, pizza boxes, and popcorn bags. The authors note that PFAS in food packaging creates heightened exposure to humans due to food contamination. Oregon DEQ concluded that this may be a potential effect, stating that "PFAS

may transfer to food items that come into contact with coatings on food wrappers, packaging, and bags" (Oregon DEQ 2024). Fortunately, the sale of food packaging that contains PFAS will be banned in Oregon beginning January, 2025 (Oregon State Legislature 2023). Through the littering of food packaging, PFAS has the potential to become distributed into the stormwater conveyance system through discarded food packaging. However, the 2025 ban on PFAS-containing food packaging should limit the distribution of PFAS-containing products all-together. Moreover, restaurants do not have control over where customers decide to place their food packages.

Car Washes. In a study of PFAS in popular Japanese commercial products, the highest concentration of PFAS existed in car wash chemicals (Masunaga, Ye, and Zushi 2015). They note that PFAS is used in car wash cleaners due to its ability to deter grime. Masunaga, Ye, and Zushi analyzed popular products across 32 categories. Gaines (2022) identified PFAS in car wash products in her analysis as well. Notably, several popular car wash soaps are manufactured by 3M. Commercial car washing facilities discharge to the sanitary sewer system. However, when car washes do not follow discharge guidelines significant PFAS contamination of local groundwater can occur. In New York State, PFAS groundwater sampling data showed that groundwater next to a car wash had twice the amount of PFAS in the nearby groundwater compared to the States' average (Ropeik 2018). There might be an opportunity to eliminate a potential, high-concentration source by working with car washes to switch the chemicals used.

Dry Cleaning. A 2019 study sponsored by the Florida Department of Environmental Protection found that, out of 15 groundwater sites in Florida exposed to dry cleaners, significant levels of PFAS were determined at 14 sites (Barnes et al. 2021). Cahill et al. (2023) identified some of the highest concentrations of PFAS in "linen cleaning services for healthcare workers and uniforms".

Recommended Next Steps

- Determine commercial sectors within CWS' jurisdiction.
- Develop commercial sector outreach material.
- Overlap PFAS sampling data heat map with commercial sectors of concern.
- Ensure predecessors of PFAS, such as FTEOs, are addressed.
- In order to ensure internal minimization of PFAS exposure to stormwater, it may prove beneficial to conduct an analysis of pesticides used at CWS and note whether they are necessities for our use or if appropriate alternatives exist.

Conclusion

Among all sources identified, the automotive sector, the autobody sector, the Fire Department, and the landscaping sector are of the highest concern regarding the potential disbursement of PFAS into the stormwater system from commercial sources.

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