Stormwater Annual Report
for the City of Eugene, Oregon

Permit Year 2016 *July 1, 2015–June 30, 2016*

Submitted by: City of Eugene

Submitted to: Oregon Department of Environmental Quality

December 1, 2016

National Pollutant Discharge
Elimination System (NPDES)
Permit 101244

Year 2016 Stormwater Annual Report

Status Report for Permit Year 2016
(July 1, 2015 – June 30, 2016)

Submitted to:
Oregon Department of Environmental Quality

Submitted by:
City of Eugene

Submitted in Accordance with the
Requirements of National Pollutant
Discharge Elimination System (NPDES) Permit
Number 101244, File Number 107989

December 1, 2016

CITY OF EUGENE, OREGON
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
MUNICIPAL STORMWATER ANNUAL REPORT

The City hereby submits this Year 2016 Stormwater Annual Report in accordance with National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Discharge Permit number 101244, File Number 107989, issued December 30, 2010. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

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1 INTRODUCTION

Discharges from municipal stormwater systems into waters of the United States are regulated by the federal Clean Water Act and National Pollution Discharge Elimination System (NPDES) permit program. The City of Eugene has operated its stormwater system under a NPDES permit since it was first issued in November 1994. Annual reporting is a requirement of the NPDES permits, and this document is Eugene's twenty-first stormwater annual report. This report fulfills Schedule B, Item 5, of Eugene's third-term NPDES Permit (Number 101244, File Number 107989) issued December 30, 2010.

Section 1 includes background information and a history of Eugene's NPDES permit (Section 1.1), a brief summary of the permit requirements (Section 1.2) and an overview of the contents of this report including relevant permit conditions (Section 1.3).

1.1 Background and Eugene's NPDES Permit History

Discharges of industrial wastewater, municipal wastewater, and stormwater into waters of the United States are all regulated under the NPDES permit program which is authorized by Section 402 of the federal Clean Water Act. In the state of Oregon, the NPDES permit program is administered by the Oregon Department of Environmental Quality (DEQ) on behalf of the U.S. Environmental Protection Agency (EPA). With regards to stormwater specifically, NPDES permits are issued for discharges from Municipal Separate Storm Sewer Systems (MS4s) which are publicly owned or operated facilities including streets, curbs, gutters, catch basins, ditches, manmade channels and storm drains that are used for collecting and conveying stormwater. The permit is referred to herein as the "NPDES permit" or the "MS4 permit."

Sources that need to obtain a MS4 permit are classified as either "Phase I" or "Phase II." Phase I MS4s are those with populations greater than 100,000, while regulated Phase II (or "small") MS4s serve populations less than 100,000 and are located within Census Bureau-defined Urbanized Areas. Federal regulations also provide EPA and the states the discretion to require other MS4s outside of Urbanized Areas to apply for a permit.

In 1990, the EPA published its Phase I regulations. The City of Eugene and Oregon Department of Transportation (ODOT) were co-permittees on the City's first-term individual MS4 permit which was issued in November 1994. ODOT ceased to be a co-permittee with Eugene in April 1998, following a request to DEQ that ODOT be able to submit one state-wide annual report. The City's first-term MS4 permit was administratively by DEQ until the second-term MS4 permit was issued in March 2004. The second-term permit was administratively extended by DEQ until the third-term (and current) permit was issued in December 2010.

Accompanying the MS4 permit and incorporated by reference is a Stormwater Management Plan (SWMP) which describes the set of best management practices (BMPs) the City commits to implement to reduce pollutants to the maximum extent practicable and meet the requirements of its permit. Occasionally, as a result of program assessment and adaptive management, SWMP revisions are proposed and submitted to DEQ for approval.

The current permit is provided herein as Appendix D. Scheduled to expire on December 29, 2015, the NPDES permit was administratively extended pending DEQ action on a permit renewal. The City submitted its MS4 permit renewal application on December 28, 2015 including an updated proposed SWMP and Draft Monitoring Plan.

1.2 2010 NPDES Permit

Eugene's 2010 NPDES permit consists of Schedule A, B, C, D, and F, summarized as follows:

Schedule A lists controls and limitations for stormwater discharges. Specifically the City of Eugene must:

- Prohibit non-stormwater discharges into the MS4.
- Reduce the discharge of the pollutants from the municipal stormwater system to the maximum extent practicable.
- Implement and assess the effectiveness of the DEQ-approved SWMP which must include following program elements:
    - Illicit discharge detection and elimination
    - Industrial and commercial facilities
    - Construction site runoff control
    - Education and outreach
    - Public involvement and participation
    - Post-construction site runoff
    - Pollution prevention for municipal operations
    - Structural stormwater controls operations and maintenance activities
- Conduct a hydromodification assessment.
- Develop a stormwater quality retrofit strategy for developed and underserved areas.

Schedule B outlines monitoring and reporting requirements:

- Implement a monitoring program to support adaptive management and the evaluation of SWMP effectiveness in reducing pollutants.
- Develop and implement an approved Monitoring Plan, incorporating specific monitoring types, locations, frequencies, and pollutant parameters to be analyzed.
- Submit an annual report by December 1st of each year.
- Submit a permit renewal application package 180 days prior to the scheduled expiration of the current permit.

Schedule C, when used in a NPDES permit, includes compliance schedules and dates reflecting actions needed in order to bring a permittee back into permit compliance. Schedule C is not applicable to Eugene's permit.

Schedule D outlines Special Conditions:

- Maintain adequate legal authority to implement and enforce the permit conditions.
- Conduct an evaluation of 303(d) listed pollutants applicable to Eugene's MS4 discharges.
- Complete an assessment of applicable Total Maximum Daily Load (TMDL) wasteload allocation attainment.
- Evaluate progress towards reducing applicable TMDL pollutant loads.
- Establish TMDL pollutant load reduction benchmarks for the next (fourth) permit term.

- Follow and document an adaptive management process.
- Revise SWMP to incorporate specific changes to five BMPs.
- Definitions related to the NPDES permit.

Schedule F outlines the General Conditions of the permit including penalties for violations of the permit, operations and maintenance of pollution controls, procedures for conducting monitoring and managing data and records, general reporting requirements, and definitions of generally used terms.

1.3 Annual Report Contents and Relevant Permit Conditions

This Year 2016 Stormwater Annual Report provides information on the progress of the permit activities from July 1, 2015 through June 30, 2016, which coincides with the City's 2016 fiscal year, and is herein referred to as the "Annual Report." The report includes: this Introduction (Section 1); Overall Program Management, including program structure, the relationship of the MS4 permit to local policy and other local jurisdictions, financial summary, legal authority, summary of concept planning, land use changes and annexations, adaptive management, and public review (Section 2); Status of SWMP Implementation (Section 3); Monitoring Program results (Section 4), and Appendices A through G. Table 1-1 includes each annual report requirement outlined in Schedule B.5 of the NPDES permit, and where the information is located within this report.

The 2016 Annual Report and previous years' reports are posted on the City's stormwater web site at: www.eugene-or.gov/stormwater (see "Planning, Permits and Regulations" and select "NPDES Municipal Stormwater Permit").

Table 1-1. Annual Reporting Requirements and Location within this Report

Schedule B.5 Requirement	Report Section
a. The status of implementing the stormwater management program and each SWMP program element, including progress in meeting the measurable goals identified in the SWMP.	Section 3
b. Status or results, or both, of any public education program effectiveness evaluation conducted during the reporting year and a summary of how the results were or will be used for adaptive management.	Section 3.1.1
c. A summary of the adaptive management process implementation during the reporting year, including any proposed changes to the stormwater management program (e.g., new BMPs) identified through implementation of the adaptive management process.	Section 2.8 and Appendix F
d. Any proposed changes to SWMP program elements that are designed to reduce TMDL pollutants.	No proposed changes
e. A summary of total stormwater program expenditures and funding sources over the reporting fiscal year, and those anticipated in the next fiscal year.	Section 2.5
f. A summary of monitoring program results, including monitoring data that are accumulated throughout the reporting year and/or assessments or evaluations.	Section 4
g. Any proposed modifications to the monitoring plan that are necessary to ensure that adequate data and information are collected to conduct stormwater program assessments.	No proposed modifications
h. A summary describing the number and nature of enforcement actions, inspections, and public education programs, including results of ongoing field screening and follow-up activities related to illicit discharges.	Sections 3.3.1, 3.5.1, 3.5.3, 3.5.4, 3.7.1.
i. An overview, as related to MS4 discharges, of concept planning, land use changes and new development activities that occurred within the Urban Growth Boundary (UGB) expansion areas during the reporting year, and those forecast for the following year, including the number of new post-construction permits issued, and the estimate of the total new or replaced impervious surface area related to new development and redevelopment projects commenced during the reporting year.	Section 2.7
j. Results of ongoing field screening and follow-up activities related to illicit discharges.	Sections 3.3.1,3.3.3
k. In addition to the elements listed under Schedule B.5.a. through B.5.j., the annual report submitted by December 1, 2014 must include: i. The TMDL Pollutant Load Reduction Evaluation as described in Schedule D.3.c. ii. The Wasteload Allocation Attainment Assessment as described in Schedule D.3.b. iii. The 303(d) evaluation as described in Schedule D.2.	Previously submitted and not applicable to the Year 2016 Report

2 OVERALL PROGRAM MANAGEMENT

This section of the report provides information about how Eugene's stormwater program is managed (Section 2.1), an explanation of SWMP BMP coding and general BMP categories (Section 2.2), the relationship to local stormwater program policy (Section 2.3), the relationship to other local jurisdictions (Section 2.4), a financial summary (Section 2.5), a summary of the City's legal authority to implement the program (Section 2.6), a summary of concept planning, land use changes, and annexations within the urban growth boundary (Section 2.7), a summary of the City's adaptive management process and results (Section 2.8), and public review and comment (Section 2.9).

2.1 Program Structure

The Eugene Public Works Department has overall responsibility to implement the NPDES permit and SWMP. The SWMP elements are managed by five divisions in the department: Administration, Engineering, Maintenance, Parks & Open Space, and Wastewater, with two elements managed by the Planning & Development Department. Table 2-1 provides a summary of the general areas of responsibilities within the stormwater program.

Table 2-1. General Areas of Responsibility within the Stormwater Program

Department/Division	Areas of Responsibility
Public Works Administration Division	Stormwater outreach and education, graphics Financial management
Public Works Engineering Division	Standards for new development Erosion control and construction site management Capital improvement projects Storm system mapping & data management Stormwater planning NPDES permit management
Public Works Maintenance Division	Illicit connections/Illegal discharges Spill response Street sweeping Leaf pick-up Constructed system maintenance Regulation of private underground facilities
Public Works Parks & Open Space Division	Open channel and vegetated facility maintenance Vegetation management Litter pick up Volunteer programs Regulation of private vegetated facilities Bacteria pilot study coordination
Public Works Wastewater Division	Water quality sampling and data analysis Industrial stormwater program
Planning and Development Department	Recycling and waste prevention education Yard debris recovery program

Coordination of the various activities occurs through routine staff communication, and via several staff teams as shown in Table 2-2.

Table 2-2. Stormwater Program Policy, Management and Coordination Teams

Stormwater Program Team	Team Purpose
Stormwater Policy Team	Provides policy direction for the Stormwater Program.
Stormwater Management Team	Provides overall management for Stormwater Program. Oversees development of new policy for approval by Policy Team. Implements Policy Team direction.
Stormwater Operations Team	Shares information for on-going program coordination. Resource pool of key staff for specific tasks.
Stormwater Enforcement Coordination Team	Coordinates on code compliance incidents. Shares information on enforcement actions.
Stormwater Penalty Review Team	Reviews administrative civil penalties and makes determination. Provides inter-divisional coordination.

2.2 Stormwater Management Plan BMP Categories

Eugene's SWMP includes 24 best management practices (BMPs) designed to reduce the discharge of stormwater pollutants to the maximum extent practicable. Each BMP is given a code (for example, A1) for tracking and reporting purposes; the coding is based on the division within the Public Works Department or Planning & Development Department that has lead responsibility, as follows:

A = Administration Division of Public Works
B = Building Division of Planning and Development
E = Engineering Division of Public Works
M = Maintenance Division of Public Works
P = Parks and Open Space Division of Public Works
W = Wastewater Division of Public Works

The 24 BMPs fall into eight general categories: Public Education; Operations and Maintenance; Illicit Discharge Controls; Waste Management; Construction and New Development; Planning, Capital Improvements, and Data Management; Industrial Controls; and Permit Management. The grouping of BMPs and a general description of each category are described below. Table 2-3 includes the full list of BMPs by BMP number, title and category.

2.3 Public Education

The purpose of public education BMPs is to inform the public, the commercial/industrial sector, and in-house personnel about the sources and causes of stormwater pollution, its effect on the local receiving waters, and to encourage active involvement (e.g. behavioral changes, volunteerism, etc.) in the effort to reduce pollution. The following BMPs represent the public

education elements of the SWMP:

A1 Stormwater Education
P1 Educational Volunteer Program

2.3.1 Operations and Maintenance

The purpose of operations and maintenance BMPs is to maintain the publicly managed stormwater system (e.g. pipes, culverts, open waterways, water quality facilities), balancing flood control, drainage services, water quality, and natural resource protection needs, and to adaptively manage for continuous improvement of current operations and maintenance practices. Operations and maintenance BMPs are also focused on planning and performing other City services, such as landscape maintenance or road repair projects for example, in a manner that minimizes the potential for stormwater pollution from these activities. The following BMPs represent the operations and maintenance element of the SWMP:

M3 Street Sweeping Program and Leaf Pick-up
M4 Prevent Leaks and Spills from Municipal Vehicles and Equipment
M5 Public Stormwater System Cleaning Program – Piped System
M8 Winter Road Sanding and De-Icing Program
P3 Tree Planting and Information Programs
P4 Public Stormwater System Maintenance – Developed Parks and Rights-of-Way
P5 Public Stormwater System Maintenance – Open Waterways

2.3.2 Illicit Discharge Controls

The purpose of illicit discharge control BMPs is to become aware of, investigate, detect, mitigate, and enforce the elimination of illicit (non-stormwater) discharges and illegal dumping to the stormwater system. The following BMPs represent the illicit discharge control element of the SWMP:

M1 Management of Illicit Discharges to the Municipal Stormwater System
M2 Spill Response
M7 Systematic Stormwater Field Screening and Investigation
P7 Litter and Illegal Dumping Control

2.3.3 Waste Management

The purpose of the waste management BMPs is to educate the public, regulate waste management services, and to ensure that proper facilities are available in order to minimize the potential of negative stormwater impacts from solid waste collection, improper disposal of toxic materials, and illegal dumping of garbage and debris. The following BMPs represent the waste management element of the SWMP:

B1 Household Hazardous Waste Disposal
B2 Solid Waste Management

2.3.4 Construction and New Development

The purpose of the construction and new development BMPs is to ensure that appropriate control

measures are considered, implemented, and maintained during and after the planning, design, and construction phases for new public and private development and significant re-development projects. The following BMPs represent the new construction and new development related elements of the SWMP:

E2 Erosion Prevention and Construction Site Management Program
E4 Stormwater Development Standards
P6 Compliance Program for Maintenance of Privately Owned Vegetated Stormwater Facilities
M6 Regulation of Inspection, Maintenance and Reporting of Private Underground Stormwater Structures

2.3.5 Planning, Capital Improvements and Data Management

The purpose of planning, capital improvements and data management is to develop and implement comprehensive stormwater basin plans, evaluate potential sources of specific pollutants and related BMPs to address them, and maintain up to date data on the stormwater system. The following BMPs represent the planning, capital improvements and data management elements of the SWMP:

E1 Stormwater Capital Improvement Projects
E3 Stormwater System Mapping and Data Management
P2 Bacteria Pilot Study

2.3.6 Industrial Controls

The purpose of industrial controls is to provide oversight of stormwater discharges from industrial facilities, including screening, inspections, technical assistance, and response to spills at permitted facilities. The following BMP represents the industrial element of the SWMP:

W1 Industrial Stormwater Management Program

2.3.7 Permit Management

The purpose of permit management is to ensure effective permit management, coordination, and reporting. The following BMP represents the administrative element of the SWMP:

E5 Permit Management and Reporting

Table 2-3. December 2012 SWMP Best Management Practices

BMP ID	BMP Title	BMP Category
A1	Stormwater Education	Public Education
E1	Stormwater Capital Improvement Projects	Planning, Capital Improvements, Data Mgt.
E2	Erosion Prevention & Construction Site Management Program	Construction and New Development
E3	Stormwater System Mapping and Data Management	Planning, Capital Improvements, Data Mgt.
E4	Stormwater Development Standards	Construction and New Development
E5	Permit Management & Reporting	Permit Management
M1	Management of Illicit Discharges to the Municipal Stormwater System	Illicit Discharge Controls
M2	Spill Response	Illicit Discharge Controls
M3	Street Sweeping Program and Leaf Pick-up	Operations & Maintenance
M4	Prevent Leaks and Spills from Municipal Vehicles and Equipment	Operations & Maintenance
M5	Public Stormwater System Cleaning Program – Piped System	Operations & Maintenance
M6	Regulation of Inspection, Maintenance and Reporting of Private Underground Stormwater Structures	Construction and New Development
M7	Systematic Stormwater Field Screening and Investigation	Illicit Discharge Controls
M8	Winter Road Sanding and De-Icing Program	Operations & Maintenance
P1	Educational Volunteer Program	Public Education
P2	Bacteria Pilot Study	Planning, Capital Improvements, Data Mgt.
P3	Tree Planting and Information Programs	Operations & Maintenance
P4	Public Stormwater System Maintenance – Developed Parks and Rights-of-Way	Operations & Maintenance

BMP ID	BMP Title	BMP Category
P5	Public Stormwater System Maintenance – Open Waterways	Operations & Maintenance
P6	Compliance Program for Maintenance of Privately Owned Vegetated Stormwater Facilities	Construction and New Development
P7	Litter and Illegal Dumping Control	Illicit Discharge Controls
B1	Household Hazardous Waste Disposal	Waste Management
B2	Solid Waste Management	Waste Management
W1	Industrial Stormwater Management Program	Industrial Controls

2.4 Relationship to Comprehensive Stormwater Management Plan (CSWMP)

In 1993, the Eugene City Council adopted as a refinement to the Eugene-Springfield Metro Plan, the Comprehensive Stormwater Management Plan (CSWMP) which provides the policy framework for the City's stormwater program. The impetus for adopting CSWMP was in part the anticipated federal requirements of the NPDES permit, but it was also necessitated by concerns over open waterway management and the discovery, in the early 1990's, of an extensive concentration of wetlands in west Eugene. A major goal of adopting CSWMP was to address a variety of stormwater issues within a comprehensive management framework -- to manage each of the program areas so that they are coordinated and consistent, meet the requirements of federal law, meet the needs of the community, and meet multiple objectives. CSWMP policies cover four general areas:

- **Flood control** efforts are to be modified to maintain current levels of service while improving water quality and protecting natural resources.
- **Water quality** efforts are to be employed to reduce the discharge of pollutants to the maximum extent practicable.
- **Natural resources** that are related to the stormwater drainage and flood control system, such as conveyance corridors and adjoining wetland and riparian zones, are to be managed to benefit water quality and wildlife habitat.
- **Operations and maintenance** practices are to be modified to meet the objectives of flood control, water quality improvement, and related natural resources protection.

CSWMP incorporates the City's original (1994) NPDES permit SWMP BMPs, as well as other implementation measures to achieve CSWMP goals and objectives. Many of the NPDES-related BMPs overlap with other CSWMP objectives such as the use of native plants along water corridors for bio-filtration purposes and for wildlife habitat, and the restoration of local waterways for increased capacity, water quality improvement, and habitat enhancement.

Periodically, the Public Works Stormwater Policy Team reviews CSWMP to assess whether it still appropriately represents the appropriate policy basis for Eugene's stormwater program. CSWMP is available on the internet at: www.eugene-or.gov/stormwater (follow links to: Planning, Permits and Regulations > NPDES Municipal Stormwater Permit > CSWMP).

2.5 Relationship to Other Local Jurisdictions

EPA adopted rules to implement Phase II of the NPDES permit program in December 1999. Phase II expanded the MS4 permit program to include smaller communities located in United States census-defined Urbanized Areas, including Eugene's metro area partners: the City of Springfield and Lane County. Phase II rules require communities to develop, implement and enforce stormwater management programs that address six minimum measures:

- Public education and outreach
- Public participation/involvement
- Unlawful discharge detention and elimination
- Construction site runoff control
- Post-construction site runoff control
- Pollution prevention/good housekeeping

NPDES MS4 individual Phase II permits, including for the City of Springfield and Lane County were first issued in January 2007. NPDES Phase II permits, scheduled to expire on December 31, 2011, were administratively extended by DEQ pending action on new (second-term) permits. As of the date of this report, the public comment period for the draft Phase II general permit has closed and DEQ is working through its response to comments and any related revisions to the draft permit. The Phase II general permit will likely be issued by approximately mid-2017.

In April 2004, in anticipation of Lane County's first NPDES permit, and for the mutual benefit of both agencies and the customers we serve, Lane County and the City of Eugene established a stormwater intergovernmental agreement ("Stormwater IGA") to collaborate on certain stormwater services within the County's jurisdictional area outside of the Eugene city limits and within the Eugene urban growth boundary. Specific areas of collaboration include: long-term stormwater planning; education and outreach; erosion prevention and construction site management; illicit discharge detection and elimination; and stormwater development standards. The Stormwater IGA has been amended and extended twice, and currently runs through December 2017. It is likely that the Phase II general permit will necessitate some changes to the Stormwater IGA, the specifics of which will be determined once the permit is issued.

On an on-going basis, formally through the Stormwater IGA with Lane County and informally through participation in multi-agency efforts such as the Pollution Prevention Coalition, the cities of Eugene and Springfield and Lane County often collaborate on pollution prevention and stormwater education activities. Examples of collaborative efforts include working together on topical articles for the City of Eugene's Stormwater Connections newsletter and collectively hosting a booth at the Lane County Home Show. The focus of the 2016 spring home show booth was "Are you Playing a Game of Chance: Product choices and actions around the home and their impact on the environment?" The City actively participates in collaborative stormwater-related efforts with other agencies across Oregon, including under the auspices of the Oregon Association of Clean Water Agencies (ACWA).

2.6 Financial Summary - Actual (FY2016) and Projected (FY2017) Expenditures

Stormwater program activities are funded by a combination of public and private financing: stormwater user fees, stormwater systems development charges; assessments; state and federal funds; volunteer services; and partnerships (Youth Corps/Bureau of Land Management/The Nature Conservancy).

The two primary on-going funding sources for stormwater program activities are stormwater user fees and stormwater systems development charges:

- Stormwater user fees are monthly fees paid by all existing and new residents and businesses. User fees fund on-going operations and maintenance (including street sweeping, catch basin cleaning, litter pick-up, spill response, stormwater education and volunteer activities) and capital construction (including major system rehabilitation projects, retrofits of the existing system to address water quality, wetland and waterway restoration projects, and stormwater system components such as pipes, culverts, constructed wetlands, ponds, and swales). The amount of the fee is generally proportional to the amount of impervious surface area on the site. A flat rate is charged for small and medium residential users (less than 3,000 square feet of impervious area), based on an estimated average amount of impervious surface area. Large residential users (over 3,000 square feet of impervious area) and commercial / industrial users pay a fee calculated based upon the amount of impervious area on the site. Users can qualify for a reduced fee if the quantity of stormwater discharge to the public system is reduced through disconnecting impervious surfaces, or providing on-site retention or infiltration. Users can also quality for reduced fees if the applicant goes beyond the minimum required level of water quality management, essentially retrofitting the system to incorporate stormwater treatment for existing developed portions of a site.

- Systems development charges (SDCs) are one-time impact fees that are generally collected when expansion, new development, or an intensification of use occurs on property served by City infrastructure. These fees are used to fund the non-assessable portion of the infrastructure costs needed to support growth in the community and to recoup a portion of the community's investment in the infrastructure already in place. Small and medium residential development pay a flat rate based upon an estimated average impervious surface area specific to each category. All other development pays an amount proportional to the impervious surface area of the site. SDC credits (reductions) are given if the quantity of stormwater discharged to the public system is reduced or if the water quality treatment exceeds the minimum standards. An additional low impact development (LID) component to the SDC fee is charged when a development is unable to accommodate on-site post-construction LID stormwater management per Eugene Code. The LID component reflects the capital costs to provide off-site LID mitigation.

The City of Eugene's stormwater user fee and SDC rate structures thus have built-in financial incentives to reduce impervious area, reduce the quantity of stormwater runoff, and go beyond the minimum in terms of water quality management. More information about the City's stormwater charges is available on the web site at: http://www.eugene-or.gov and follow links to: Services > Stormwater > Fees and Charges.

The stormwater program-wide actual expenditures for fiscal year 2016 and projected expenditures for fiscal year 2017 are shown in Table 2-4. The MS4 permit reporting year aligns with the City's fiscal year. Expenditures reported include funding for MS4 permit related activities and for stormwater program activities which are not required by the MS4 permit, such as: system maintenance for conveyance and flood control and wetland program management.

Table 2-4

City of Eugene				
Public Works Department - Stormwater Funds (335, 531, 535)				
Actual expenditures FY16, Projected (Budget) Expenditures FY17				
(fiscal year is July 1 - June 30)				
October 4, 2016				
Fund		**Division**	**FY16 Actuals**	**FY17 Budget**
335	**Stormwater SDC**	93 - Engineering	$232,899	$1,613,717
335 Total			***$232,899***	***$1,613,717***
531	**Stormwater Utility - Capital**	93 - Engineering	$1,898,802	$7,010,894
531 Total			***$1,898,802***	***$7,010,894***
535	**Stormwater Utility - Operation**	87 - WWTP	$437,548	$502,154
		89 - Administration	$1,755,716	$1,938,438
		93 - Engineering	$1,617,723	$1,993,689
		94 - Maintenance	$4,520,756	$5,076,706
		96 - Parks and Open Space	$4,774,739	$5,470,183
		99 - Non Departmental	$1,080,000	$1,138,000
535 Total			***$14,186,481***	***$16,119,170***
Grand Total			**$16,318,182**	**$24,743,781**
a. FY17 budget includes $1.1 million carryover from FY16.				
b. FY17 budget includes $4.8 million carryover from FY16.				

2.7 Continued Legal Authority

Schedule D.1 of the NPDES permit requires that the City of Eugene maintain adequate legal authority through ordinance(s), interagency agreement(s) or other means to implement and enforce the provisions of the permit. Appendix E contains a summary of stormwater-related provisions and authority including specific Eugene Code sections and related Administrative Orders that the City of Eugene relies on to apply and enforce stormwater related regulations.

2.8 Planning, Land Use Changes, and Annexations within the UGB

For the reporting year, 3.11 acres of land was annexed to the City of Eugene from Lane County. Envision Eugene, the community's long range visioning and planning process, continued to work toward decisions regarding the best way to accommodate projected population and job growth for the next twenty years. Preliminary recommendations as of mid-2015 include focusing multi-family and commercial development along key corridors and core commercial areas within the existing urban growth boundary (UGB) and expanding the UGB in two areas north of Eugene for industrial development, park development, and school use. Final decisions have not yet been made and depend upon the outcome of Eugene Planning Commission and City Council

discussions and refinement. The status of the Envision Eugene process and recommendations can be found on the City's web site at: www.envisioneugene.org.

2.9 Adaptive Management Process

Schedule D.4 of the NPDES permit requires that the City of Eugene follow an adaptive management approach to assess and modify its SWMP to achieve reductions in stormwater pollution to the maximum extent practicable. This section describes the City of Eugene's adaptive management process and summarizes the results from the 2016 reporting period adaptive management assessment.

2.9.1 Introduction

Consistent with Schedule A.2 of its MS4 permit, the City of Eugene must reduce the discharge of pollutants from the stormwater system to the maximum extent practicable (MEP). The MEP requirement is met through compliance with the MS4 permit, specifically through implementation of a stormwater management program and associated Stormwater Management Plan (SWMP). Assessment and modification of the SWMP must follow an adaptive management approach, which is defined in Schedule D as:

> *A structured, iterative process designed to refine and improve stormwater programs over time by evaluating results and adjusting actions on the basis of what has been learned.*

The stormwater management program that is described in the City's current SWMP is the result of adaptively managing (e.g., implementing, evaluating, and adjusting) program activities since first being issued a MS4 permit in 1994. The history of this adaptive management approach may be found in Section 3.3 of the City's September 2008 NPDES MS4 Permit Renewal document which describes how the current Oregon Department of Environmental Quality (DEQ) approved SWMP meets the MEP requirement.

The purpose of this section is to describe the adaptive management approach that the City has committed to following through expiration of its current permit to routinely assess the stormwater program's effectiveness in addressing water quality and protection of beneficial uses. Ongoing adaptive management of the SWMP as discussed in the MS4 annual reports demonstrates that City is meeting the MEP requirement.

The adaptive management approach is divided into two distinct processes, as described below:

> 1) An *annual* adaptive management process to assist with best management practice (BMP) assessment and/or evaluation, in order to determine whether adjustments to BMPs are warranted and/or practicable to achieve reductions in stormwater pollutants to the MEP.
>
> 2) An MS4 *permit cycle* (5-year) adaptive management process to evaluate water quality monitoring results, assess the stormwater management program and overall effectiveness of the SWMP, in order to update the SWMP and associated measurable goals to achieve reductions in stormwater pollutants to the MEP.

2.9.2 Annual Adaptive Management Process

Following guidance in DEQ's Permit Evaluation Report and Fact Sheet for the City's NPDES MS4 permit, the annual adaptive management process involves an operational cycle for assessing BMPs, including the steps of: 1) BMP implementation, 2) data collection, 3) assessment, 4) identifying needs, and 5) BMP modification.

Throughout the duration of the current NPDES MS4 permit cycle, the City will *implement* BMPs identified in the DEQ-approved SWMP as part of its stormwater management program. Tracking measures are identified for each of the BMPs to assess progress toward achieving measurable goals outlined in the SWMP. *Data collected* during implementation of BMPs will be consistent with documented tracking measures (e.g., miles of streets swept, number of catch basins cleaned, etc.) and will allow for the assessment of BMP measurable goal attainment. Data collected as part of the environmental monitoring plan will also be reviewed and utilized, as applicable, during the assessment phase of the adaptive management process (e.g., identification of data anomalies or water quality standards exceedances).

The assessment *of BMPs* will occur annually during preparation of the City's MS4 annual report, to be submitted to DEQ by December 1 of each permit year. Among other reporting requirements, the MS4 annual report must contain (Schedule B.5) the following:

> *The status of implementing the stormwater management program and each SWMP program element, including progress in meeting the measurable goals identified in the SWMP.*

By providing a summary in the MS4 annual report of progress toward attaining BMP measurable goals (through data collection and tracking measures), the City both: 1) meets the aforementioned reporting requirement, and 2) facilitates a critical step in adaptively managing its stormwater program by assessing each BMP.

While preparing the MS4 annual report, the City will collect data and feedback from staff responsible for implementing/reporting on each BMP to facilitate the BMP assessment process. Factors considered during the assessment phase are reflected in the Adaptive Management BMP Evaluation Tool template provided in Appendix F. Key factors considered in the annual evaluation include but are not limited to:

- Was the BMP measurable goal attained? If not, describe circumstances why, and how progress will be made toward future attainment.
- For multi-year BMPs, were milestones or timelines met?
- Can we feasibly refine or improve the BMP to gain efficiency or effectiveness in removing stormwater pollutants?
- Are staffing/financial resources available to support such a BMP improvement or refinement?

In addition to assessing the implementation of each BMP, staff will weigh *resource availability and needs* related to the overall stormwater program, including consideration of budget/funding, training needs, new technology, or available equipment.

The aforementioned assessment phase will inform any alterations to the stormwater program or *modifications* to the SWMP. A summary of the adaptive management process including any proposed revisions to the SWMP will follow the requirements of Schedule B. 5 and Schedule D.5 of the NPDES MS4 permit.

Subsequent to implementing modifications, the annual adaptive management process will continue to include an assessment of whether the modifications are resulting in the predicted outcomes/efficiencies through an iterative feedback loop. Annual adaptive management will, therefore, ultimately contribute to the City's SWMP updates required by Schedule B. 6. of the NPDES MS4 permit for the permit renewal application package, including the modification, addition, and removal of BMPs, and associated measureable goals.

2.9.3 Permit Cycle Adaptive Management Process

In preparation of the NPDES MS4 permit renewal application as required by Schedule B. 6 of the permit, the City will assess each BMP described in its SWMP, its environmental monitoring program, environmental monitoring data, and results from the additional assessments or studies conducted in support of their MS4 permit compliance to evaluate the overall effectiveness of its stormwater management program in reducing pollutants to the MEP.

As described in Section 2, BMP implementation data collected and evaluated over the course of the permit cycle, as well as historical data (if applicable), will be reviewed during preparation of the NPDES MS4 permit renewal package. This review will help determine BMP refinements and improvements that should be proposed as part of the program modifications at the end of the permit cycle. This process supports the examination of factors including but not limited to:

- Do we have information about new technology or other information to improve or refine existing BMPs, identify alternative BMPs, or include additional BMPs?
- Have we set the appropriate measurable goals for existing BMPs or should they be changed?
- Are resources (funding, staff, equipment, etc.) available to change the BMP measurable goal, and does it make sense to change the goal?

Where applicable, the effectiveness of individual BMPs may also be evaluated by use of data collected through the City's environmental monitoring program. For example, pesticide monitoring data may be of use in identifying targeted outreach activities related to pesticide use, and possible refinement of appropriate outreach/education BMPs. Data collected through the environmental monitoring program will also contribute to the assessment of the overall stormwater management program.

In addition to BMP implementation data and environmental monitoring data analyses, specific deliverables in the MS4 permit will also facilitate the adaptive management process. Other required permit elements that will aid the SWMP evaluation include:

- Hydromodification assessment (Schedule A.5),
- Stormwater retrofit strategy (Schedule A.6),
- 303(d) list evaluation (Schedule D.2),
- Total Maximum Daily Load (TMDL) Wasteload Allocation Attainment Assessment
- TMDL Pollutant Load Reduction Evaluation and establishment of benchmarks.
- Public education program effectiveness evaluation (Schedule A. 4. d.), and
- Public involvement and participation (Schedule A. 4. e.)

Cumulatively, these deliverables will require the City to identify strategies to reduce the impact of stormwater discharges on receiving water bodies. Some of these deliverables will also require identification of priorities for stormwater control facility implementation (i.e., the hydromodification assessment and the stormwater retrofit strategy). Others will help identify opportunities for further refinement and improvement of its stormwater management program, particularly as related to 303(d) parameters and TMDL benchmarks. Objectives and strategies identified in these deliverables will be considered in context of existing BMPs, and be used to revise appropriate BMPs (and associated measurable goals) during the NPDES MS4 permit renewal process. Finally, the City will utilize all of the above described analysis to evaluate the adequacy of the SWMP in reducing pollutants from the MS4 to the MEP according to the permit requirements in Schedule B. 6. b.

2.9.4 Summary of Adaptive Management Process

The adaptive management approach described in this section identifies both annual and end of the NPDES MS4 permit cycle processes that will facilitate continuous improvement of the City's stormwater management program. Each of the five steps identified in DEQ's Permit Evaluation Report and Fact Sheet for an adaptive management approach were addressed, including: 1) BMP implementation, 2) data collection, 3) assessment, 4) identifying needs, and 5) BMP modification. Implementation of these processes and the adaptive management approach, will assure that the City continues to improve its stormwater management programs and reduce the discharge of pollutants to the maximum extent practicable.

2.9.5 Summary of Adaptive Management for 2016

The 2016 reporting year coincided with the timeframe within which the City completed its permit-cycle adaptive management review described in Section 2.8.3. The results of the comprehensive permit-cycle adaptive management review were used to identify proposed program modifications and a an updated proposed SWMP and Draft Monitoring Plan were submitted to DEQ in December 2015 as part of the City's permit renewal package. Approval of the proposed SWMP and Draft Monitoring Plan is pending DEQ's action on the City's permit renewal, as previously described in Section 1.1. Given the overlap in timeframes between the permit-cycle adaptive management process and the Year 2016 annual adaptive management process, as anticipated, the 2016 adaptive management review did not result in any additional substantive proposed changes to the SWMP beyond what the permit-cycle process identified.

2.10 Public Review and Comment

The draft 2016 Annual Report was made available to the general public for review and comment in electronic form on the City's web site and in printed form at the centrally located Public

Works Engineering office in downtown Eugene. See Appendix G for a copy of the public notice published in the local newspaper, the Register Guard. No comments were received on the draft 2016 Annual Report.

3 STATUS OF SWMP IMPLEMENTATION

This section summarizes the status of implementation of the SWMP in the form of measurable goals, tracking measures and highlights of other accomplishments for each BMP over the reporting year. A historical account of the program accomplishments may be found in prior annual reports, beginning with the Year 1 Annual Report (November 1995). Also included with each BMP report is a list of planned activities or activities under consideration for reporting year 2017. No additional revisions to the SWMP BMPs, beyond what was submitted with the permit renewal, are proposed at this time.

3.1 Status of Education BMPs

A1 Stormwater Education
P1 Educational Volunteer Program

3.1 Status of Education BMPs

3.1.1 A1 – Stormwater Education

Responsible Department/Division:	**BMP Contact:**
Public Works / Administration	Administration Division Director

BMP Description
Plan, develop, implement and revise as necessary a program to provide stormwater information and education to homeowners, school children, City and other agency staff and the general public about the impacts to stormwater quality and natural resource values from both point and non-point sources of pollution.

In addition, educate professional, commercial, and industrial businesses about best management practices that can help prevent and reduce stormwater quality impacts to the public stormwater system and local receiving waters.

Tasks
1. Update and improve upon educational materials through assorted print material, videos, web, audio and visual media.
2. Prepare and staff booths at special events to reach community members.
3. Develop on-going campaigns as appropriate to support projects, programs, special opportunities and targeted pollutants.

Measurable Goals	Status of Measurable Goals – FY16
• Conduct surveys every two years with Eugene residents to determine attitudes and opinions of residents about the stormwater management program.	• Survey due to be conducted in spring 2017.
• Provide SPLASH educational curriculum to teachers and administrators in local school districts.	• Work with teachers in 4J and Bethel School Districts to provide educational curriculum and supporting materials. • 90 teachers provided instruction. • 2,856 students received instruction.
• Develop and implement internal stormwater education to city staff through new employee orientation, “green team” presentations, work group presentations and audio/visual presentation.	• This year, a new electronic system is being integrated into the Human Resources Department. Although we encourage public works department staff to watch our internal stormwater training video we are unable to identify the number of people who used this system. • The video is also posted on the city’s website under public works video category.

• Increase catch basin markers with "dump no waste" messages and storm drain covers installed on public improvement projects.	• 311 stormwater manhole lids were installed this year.
• Work collaboratively on education campaigns with other local agencies.	• Water wise demonstration garden project, with multiple partners, is completed and available as a community resource. Project includes SMART control irrigation system, drought tolerant plants, multiple stormwater features and informational signage and take-away materials for site visitors. Participants in the sustainable landscape program received guided tours. • Provide educational support and handouts to the Lane County Extension Service for the Sustainable Landscape Program. • Partnership with the Long Tom Watershed Council and several other groups to reach out to the Latino community is temporarily on hold due to funding constraints. The purpose is to inform and educate families and people who work outdoors with chemicals and other products about ways they can protect their health and river health. The program is modeled after a successful program in Nampa, Idaho. • Through the Lane Pollution prevention Coalition (P2C) and the Stormwater Special Ops Group we have worked on joint outreach projects that include: print ads to promote fish-friendly car wash kits for fundraising groups, pressure wash booklets for mobile washers and for residents (English & Spanish) and informational postcards to property management companies. The P2C also has a website which lists agencies, links to their websites and upcoming events and pollution prevention tips. • Our primary focus at the 2016 spring home show was "Are you playing a game of chance: Product choices and actions around the home and their impact on the environment." Other pollution prevention information about air, water, land, waste and recycling was also on-hand.

	• We continued to promote our car wash kit program to school fundraiser groups and our website. In the spring of 2016, 17 middle school and high school teachers in Eugene received electronic notification about our fish-friendly car wash kits for fundraising programs. • At the Good Earth home show in January 2016, our booth focus was "healthy gardens for everyone". We provided tips about composting, soil, beneficial bugs and lawn care. • At a plant sale benefit with the Lane County Master Gardener Program in April 2016, we gave out 39 earth-friendly yard care booklets and 23 handouts about managing moss.

Tracking Measures	• Tracking Data – FY16
• Number of information materials (all media) prepared and distributed to the public.	• Newsletters mailed to Eugene residents: 86,250 issues in spring 2016. • 57 pressure wash brochures at rental /retail stores. • 62 paint brochures in English/Spanish put in public display racks. • Gave out 59 Grow Smart, Grow Safe booklets. • Provided 59 handouts of each of the following to the Sustainable Landscape Class participants: Alternatives to pavement, Stormwater Management Program – Eugene's water quality, Landscaping businesses, Harvesting rainwater, Turning over a new leaf (mulching), Sustainable gardening in Eugene, Pesticide use around your home, Stormwater-friendly lawn and garden care. • 30-second stormwater video spot run on TV and KEZI.com website. 75,975 impressions (views) occurred on the website and 189 click-throughs. • Mailed 20 brochures to garden centers and nurseries about clean water practices.
• Number of students and teachers who use SPLASH curriculum annually.	• 2,856 students received instruction. • 90 teachers provided instruction
• Number of attendees at public outreach events.	• 24,000 attendees at Good Earth Home Show. • 29,000 attendees at the Spring Home Show. • 1,300 attendees at plant sale event.

• Number of employees attending stormwater education sessions.	• Uncertain of sessions attended due to new electronic tracking system that took time to implement • 44 attendees at Sustainable Landscape Program
• Track quantity of installed catch basin markers and storm drain covers.	• 311 manhole covers installed
• Identify collaborative campaigns, target audience and summary of campaign.	• Continue fish-friendly car wash campaign to encourage fundraising groups to use kit that is designed to prevent runoff from vehicle washing from entering storm drain system. Instructive videos on the City's website show how to use the kit. Kits were checked out 14 times. Promoted campaign to teachers at 17 middle schools and high schools via school email. • Staffed an educational booth at the spring home show with P2C members. Target audience was area residents. Booth focus was "Are you Playing a Game of Chance: Product choices and actions around the home and their impact on the environment. Other pollution prevention information about air, water, land, waste and recycling was also on-hand. Purpose was to raise awareness about sources of pollution from products and activities and action that individuals can take by being informed. • Eco-biz program is in its 12th year and now has 16 shops and 4 government agencies. This "green" automotive program recognizes auto shop participants for taking extra pollution prevention steps in the way they run their businesses. Target audience is automotive businesses and vehicle owners. Campaign promotes extra steps taken by these businesses to "do the right thing" and lets citizens know about these shops.
• Documentation of stormwater survey responses.	• Next survey scheduled for spring 2017.

FY16 Activities and Accomplishments

- Spring issue of Stormwater Connections newsletter highlighted several City of Eugene programs that help protect water quality including city-installed rain gardens along city streets, how nurturing nature can improve gardening success, the results of water quality monitoring and improvements along Amazon Creek, and a pollution prevention calendar with tips for each season.
- Continue to update Public Works webpages and have a dedicated location for videos including many stormwater/clean river topics.
- Lane County Home Show focus was on "Are you Playing a Game of Chance: Product choices and actions around the home and their impact on the environment." Other handouts covered topics about water, air, waste and land pollution issues and positive actions that individuals can take.
- Continue Canines for Clean Water pledge-based program to address cleanup of pet waste and reward pet owners for their help. Distributed 24 display stands with pledge cards at local vet offices and retail pet stores. Received 60 pledges at local canine fundraiser event in May. Received 54 pledges via mail or electronically.
- Installed 16 pet waste stations in the downtown area.
- Eco-biz automotive program is now in its 12th year. To date we have certified 16 shops and 4 government agencies. In addition, there are 4 private businesses and 1 government agency preparing for certification.
- "Join the clean water team" video on the city's stormwater page: www.happyrivers.org was aired in May and June 2016. The video uses a football commentator –style of narration to show the "right" way to wash a car, clean up after fertilizing and where to direct runoff from pressure washing.
- New Happy Rivers video created and posted on stormwater web page in June 2016. Video focuses on correct actions that citizens can take to help protect local waterways.
- Presentations: Raindrop to River: Interactive power point with local Rotary Club about stormwater and river health. 47 members attended.
- Staffed informational tables at 3 neighborhood/community events.
- Mailed out informational handouts about clean water practices to local garden centers and nurseries.

Planned or Considered FY17 Activities

- Continue researching effective videos that portray stormwater information that we can link to our stormwater home page.
- Continue to work with local watershed council to provide information to Latino landscapers and yard care providers and their families about best management practices with yard chemicals to protect health and water quality.
- Continue to promote stormwater training video and stormwater information to city staff.
- Look for speaking opportunities or other venues to share information with community members.
- Partner with other municipalities in Oregon to develop shared messaging and outreach strategies

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP A1.

3.1.2 P1 – Educational Volunteer Program

Responsible Department/Division:
Public Works / Parks & Open Space

BMP Contact:
Parks and Open Space Division Director

BMP Description
Manage and support the City's Stream Team volunteer program and other community volunteer programs that promote stormwater education. Provide opportunities to involve citizens of all ages and socio-economic backgrounds in meaningful, hands-on and educationally oriented stormwater related projects. Such projects are aimed at providing both physical benefits and participant awareness related to protecting stormwater quality, fostering citizen stewardship of the City's water resources, promoting the use of native-vegetation, and enhancing fish and wildlife habitat within the local urban watershed.

Tasks
1. Recruit, support, and coordinate activities for groups or organizations to adopt portions of the City's stormwater system, such as creeks, ponds, and drainage channels.
2. Investigate inclusion of publicly owned vegetated stormwater facilities within developed parks and right of way into the volunteer program.
3. Advertise, coordinate and conduct periodic work parties for regular and drop-in volunteers aimed at waterway clean-up, invasive species removal, native vegetation salvage and native vegetation planting in riparian areas.
4. Partner with local agencies, organizations, businesses and/or corporate sponsors to plan, promote, coordinate and implement annual large scale waterway clean-up volunteer events.
5. Inform the public about the purpose of the volunteer program through public presentations, distribution of program information materials, event related press releases and news media articles and news stories. Include in the communication the challenges and benefits of managing stormwater properly.

Measurable Goals	Status of Measurable Goals – FY16
• As attrition occurs continue to recruit replacement adoption groups to maintain current levels of participation.	• On-going
• Conduct one volunteer work party annually that will address maintenance needs at publicly owned vegetated stormwater facilities with developed parks or the right of way.	• Complete
• On average, conduct 12 volunteer work parties per year.	• Complete
• Conduct at least one partnership based large-scale water resource clean-up or enhancement volunteer project per year.	• Complete

• Correspond with the city's stormwater education program coordinator on a regular basis to determine if there are opportunities to better inform the public regarding the challenges and benefits of stormwater management.	• On-going

Tracking Measures	Tracking Data – FY16
• Number of adoption groups that are retained and continue to participate in the volunteer program. Track number of new adoption groups brought into the program.	• Four new adoption groups were brought into the program for a total of 53 current adoption groups participating with Eugene Outdoors.
• Number of volunteer work parties conducted that involve maintenance of publicly owned vegetated stormwater facilities and number of volunteer participants.	• Four volunteer work parties were held at West University and Amazon Park. Both parks have vegetated stormwater facilities. A total of 46 volunteers participated in these events.
• Number of work parties conducted and number of volunteer participants.	• Eugene Outdoors (formerly Eugene Park Stewards) hosted 39 work parties with 737 volunteers.
• Document annual large-scale project(s), participating partners and number of volunteer participants.	• 9 large scale events with a total of 915 volunteers • In Alton Baker Park we partnered with Nearby Nature and SOLV to remove trash and care for habitat along the Willamette River for a total of 3 events with 301 volunteers • At Hendricks Park we partnered with the Friends of Hendricks Park, the National Community Conservation Corps and the University of Oregon to host 2 habitat enhancement projects with 142 volunteers • At Wild Iris Ridge we partnered with the Churchill Area Neighbors, the Obsidians and the National Community Conservation Corps to bring 77 volunteers together to perform habitat maintenance, trash removal and trail work. • In the Whilamut Natural Area of Alton Baker we partnered with Nearby Nature to host a large scale tree planting and care project for 334 volunteers.

		• Partnered with the Willamette Riverkeepers to host the 7th Annual Great Willamette River Clean-up along the banks of the river in Eugene. • Annual Arbor Day planting on March 1, 2016 with 61 fourth graders from a local school planted 54 trees in Filbert Meadows Park.
• Document annually efforts to educate the public about the city's volunteer programs and the protection of water quality as it relates to stormwater.		• We participated in 8 outreach events throughout Eugene and Portland • Hendricks Park: Mother's Day Celebration • Trails Master Plan and volunteer outreach • Tugman, Washington and Hendricks Parks: Parks and Recreation planning Pop-up • Tugman Park: STEM teacher training • OCCU: Community Fair • Delta Ponds: Clear Lake Elementary School Tours for 2 classes of youth • Portland, OR: ORPA conference Presentation • Re-vamped the Eugene Outdoors (formerly Eugene Park Stewards) website to highlight projects, education and garner volunteers for waterway stewardship. • Wrote an article for Clean Water Connections on Amazon Creek and its benefits, highlighting the work of volunteers and how people can get involved.

FY16 Activities and Accomplishments

- Implementation of the ESRI Collector Application to track tree plantings and associated data.
- Utilized social media (Instagram and Facebook) to provide information about upcoming projects, stormwater education and to help with volunteer retention.

Planned or Considered FY17 Activities

- Continue to provide educational tours to youth about waterways and stormwater at Delta Ponds Natural Area.
- Eugene Outdoors will begin supporting our Stormwater Infrastructure Maintenance (SWIM) Team in a "Greenstreets" initiative to get neighbors to adopt City of Eugene owned vegetated stormwater facilities adjacent to their property.
- Eugene Outdoors will continue with a newly developed system of an annual schedule of monthly events throughout the Parks and Open Space system including a major event highlighting stormwater.
- Eugene Outdoors is planning to partner with Urban Forestry Operations to plant, inventory and provide education about trees in the right-of-way with low income neighborhood volunteers that lost much of their canopy in a wind event during the previous winter. Over 40 sites have been identified as potential locations to improve canopy cover in this neighborhood.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP P1.

3.2 Status of Operations and Maintenance BMPs

M3 Street Sweeping and Leaf Pick-up
M4 Prevent Leaks and Spills from Municipal Vehicles and Equipment
M5 Public Stormwater System Cleaning Program – Piped System
M8 Winter Road Sanding and De-Icing Program
P3 Tree Planting and Information Programs
P4 Public Stormwater System Maintenance – Developed Parks and Rights-of-Way
P5 Public Stormwater System Maintenance – Open Waterways

3.2 Status of Operations and Maintenance BMPs

3.2.1 M3 – Street Sweeping and Leaf Pick-up

Responsible Department/Division:
Public Works / Maintenance

BMP Contact:
Maintenance Division Director

BMP Description
Undertake both mechanical brush and vacuum sweeping of publicly maintained roads, bike paths, and parking lots in accordance with the Stormwater Operations and Maintenance Manual. Monitor and evaluate new technology and methods related to street sweeping, and make appropriate adjustments to the current sweeping program when feasible to maximize water quality benefits.

Tasks
1. Follow sweeping frequencies as outlined in the Stormwater Operation and Maintenance Manual.
2. Collect sweeping data such as amount of debris swept, curb miles swept, streets and/or areas swept.
3. Conduct annual curbside pickup of leaves on City streets.

Measurable Goals	Status of Measurable Goals – FY16
Follow sweeping frequencies **as outlined in the Stormwater Operation and Maintenance Manual**, more specifically described as follows:	
• Sweep downtown core twice per week.	• Minimum once a week as outlined in the current Stormwater O&M Manual, updated November 2015 to adjust nighttime sweeping of the area. Sweeping resources shifted to arterials.
• Sweep university and industrial areas once per week.	• Goal met
• Sweep arterial streets every 2 weeks.	• Goal met & exceeded
• Sweep residential streets every 6-8 weeks.	• Goal met
• Sweep bike paths and improved alleys twice per year.	• Goal met & exceeded

• Coordinate and manage two seasonal opportunities for the citizen's leaves to be picked up and managed by the SW operations crew.	• Goal met

Tracking Measures	Tracking Data – FY16
• Lane miles swept.	• Swept 42,131 lane miles.
• Amount of debris collected.	• Collected 13,561 yards of debris.
• Amount of leaves picked up.	• Collected 13,887 cubic yards of leaves during the 2015-2016 leaf collection season.

FY16 Activities and Accomplishments

- Continue to review and update sweeping routes. The purpose of the review is to gauge the effectiveness and efficiency of the sweeping program in meeting the community's needs and producing equivalent workloads.
- Updated Stormwater O&M Manual November 2015, including an adjustment to the frequency of sweeping in the downtown core area based on sweeping needs and in response to noise complaints from residents. Sweeping resources shifted to arterials.
- Successfully completed another the City of Eugene's 2015-2016 curbside "Leaf Pick-up Program".
- Respond to 235 emergency sweep requests, such as vehicle accidents and spills.
- Provided 24/7 emergency coverage.
- Purchased a new mechanical street sweeper.

Planned or Considered FY17 Activities

- Analyze street sweeping operations on a continual basis and make modifications as necessary to ensure maximum water quality benefits.
- Perform sweeping operations during eighteen of a possible twenty-one work shifts per week.
- Sweep behind City leaf pick-up crews to remove remaining debris.
- Continue to evaluate street sweeping technologies and equipment.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP M3.

3.2.2 M4 – Prevent Leaks and Spills from Municipal Vehicles and Equipment

Responsible Department/Division:	**BMP Contact:**
Public Works / Maintenance	Maintenance Division Director

BMP Description
Undertake preventive maintenance program for all municipal vehicles and equipment in order to prevent or correct sources of vehicle fluid leaks. Implement employee education practices and field operations procedures to detect and report leaks and to prevent incidences of fluid and material spills from municipal vehicles. Equip municipal trucks and large mechanized equipment with renewable spill response kits.

Tasks
1. Maintain training competencies for Fleet Services employees.
2. Maintain a preventative maintenance schedule for all vehicles and equipment.
3. Maintain a supply of spill kit materials for designated vehicles and equipment.

Measurable Goals	Status of Measurable Goals – FY16
• Include a spill procedure card in all City vehicles and equipment by December 1, 2011.	• Spill procedure cards were installed in all City vehicles and equipment by December 1, 2011.
• Perform preventative maintenance service on all City vehicles and equipment annually, at a minimum.	• Performed annual preventative maintenance service on 90% of City of Eugene vehicles in the reporting year, in accordance with preventative maintenance schedules. Preventative maintenance schedules, generally on a 12-month basis, results in some instances of preventative maintenance falling outside of the reporting year.
• During the repair/clean-up process, analyze the type and cause of the spills associated with the repairs conducted by Fleet staff, and evaluate whether operator training maybe helpful with spill minimization.	• Goal was met

Tracking Measures	Tracking Data – FY16
• Track the number of spill procedure cards issued annually.	• Vehicles are checked at time of service inspection to verify that spill procedure card is in the vehicle and replaced if damaged or missing.

• Track the number of vehicle related leaks repaired annually.	• Fleet Services completed 1,387 scheduled preventative maintenance inspections in FY16 and 1,187 17-point safety inspections on scheduled and non-scheduled work.
• Track the percentage of vehicles which receive preventative maintenance service annually.	• Performed annual preventative maintenance service on 90% of City of Eugene vehicles in the reporting year, in accordance with preventative maintenance schedules. 1,387 preventative maintenance inspections occurred during FY16 on the City of Eugene's 697 pieces of equipment.

FY16 Activities and Accomplishments

- Fleet Services renewed its EcoBiz certification, being recognized for the implementation of best management practices and protection of the environment.
- Fleet staff received annual training for hazardous waste and spill response.

Planned or Considered FY17 Activities

- All municipal vehicles and large equipment are inspected and serviced on a routine and frequent basis.
- Vehicles found with fluid leaks or with worn/frayed hydraulic lines are either repaired immediately or taken out of service until necessary repairs can be made.
- Staff replenish materials in spill response kits in the Fleet Services shop as necessary.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP M4.

3.2.3 M5 – Public Stormwater System Cleaning Program – Piped System

Responsible Department/Division:	**BMP Contact:**
Public Works / Maintenance	Maintenance Division Director

BMP Description
Undertake frequent, systematic cleaning of the components of the public stormwater system such as catch basins, pipes, culverts, inlets, and stormwater quality devices in accordance with the adopted Stormwater Operations and Maintenance (O&M) Manual. Document quantities of material removed from each structure. Using the maintenance management system, refine the regular cleaning schedule for pipes, catch basins and stormwater quality devices. Research and monitor developments in maintenance technology and operations and maintenance methods for the closed systems which will further increase the effectiveness of our cleaning practices and water quality improvement practices.

Tasks
1. Follow cleaning procedures as outlined in the Stormwater O&M Manual.
2. Collect loading information for individual structures and facilities.

Measurable Goals	Status of Measurable Goals – FY16
• Clean 50% of the all of the public catch basins and inlet structures annually unless increased efficiencies are shown through adaptive management.	• Goal was met. • 8,489 catch basin and inlet structures were cleaned, approximately 56%
• Clean all of the public underground stormwater quality structures as outlined in the Stormwater O&M Manual.	• Goal was met

Tracking Measures	Tracking Data – FY16
• Track the number of structures cleaned.	• Cleaned 8,489 catch basin/curb inlet structures.
• Track the amount of debris recovered.	• Removed 685 tons of debris from the piped stormwater system through a systematic catch basin and mainline cleaning program.
• Track the lineal footage of stormwater lines cleaned.	• Cleaned 34,627 linear feet of piped stormwater lines.

FY16 Activities and Accomplishments

- Continued to utilize operational crews across all 15 available weekday shifts. This includes 2 jet/vac trucks dedicated to stormwater maintenance and 1 stormwater field lead worker. These crews provide O&M functions to the piped system, including manholes, proprietary stormwater devices, sediment traps and inlets, and 24/7 response to emergency needs.
- Continue to track sump depth of catch basins/curb inlets, and sediment levels prior to cleaning. This information is used to help determine cleaning frequencies, and the need for catch basin/curb inlet repair or replacement.
- Continued stormwater line cleaning and performing Closed Circuit Television (CCTV) inspection and assessment of stormwater lines and inlets in advance of Pavement Preservation Projects. This work identifies conveyance problems and structural defects in advance of surface improvements and promotes proactive maintenance practices.

Planned or Considered FY17 Activities

- Clean catch basin/curb inlets and connecting pipes of accumulated sediment, debris, and other pollutants on a systematic basis.
- Record quantities of debris removed and identify structures requiring more frequent cleaning cycles.
- Seasonally inspect key inlets and outfalls to prevent flooding; remove any blocking vegetation or other obstructions.
- Evaluate system performance.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP M5.

3.2.4 M8 – Winter Road Sanding and De-icing Program

Responsible Department/Division:	**BMP Contact:**
Public Works / Maintenance	Maintenance Division Director

BMP Description
Apply and clean up winter traction sand on publicly maintained roads and parking areas in conjunction with the application of a pre-wetting agent designed to reduce the need for repeat sanding. Conduct research efforts to identify and evaluate new technology and strategies for application of environmentally friendly chemical anti-icing and de-icing agents. Conduct research into new methods, practices, and efficiencies which may further limit the runoff of sanding related pollutants to the storm system. Conduct preseason staff training on the proper application methods of sand and chemical agents.

Tasks
1. Apply sand to roadways in accordance with the Public Works Snow and Ice Plan.
2. Apply chemical agents in accordance to Guidelines for Anti-icing/Deicing included in the Public Works Snow and Ice Plan.
3. Respond to priority routes as outlined in Public Works Snow and Ice Plan.
4. Collect data such as streets plowed and sanded, material used, and other data related to snow/ice events.

Measurable Goals	Status of Measurable Goals – FY16
• Minimize the use of abrasive materials for snow and ice control through adaptive management practices.	• Goal was met.
• Begin cleanup of abrasive materials when streets become free of ice and snow, and the forecast does not call for more ice and snow within the next 24 hours.	• Goal was met.

Tracking Measures	Tracking Data – FY16
• Document the quantities of sanding materials applied and collected during each storm event.	• 80 cubic yards of sand was applied during the reporting period.
• Document the volume used for deicing/anti-icing operations.	• 8,329 gallons of deicing/anti-icing agents were applied during the reporting period.

FY16 Activities and Accomplishments

- Performed annual snow and ice equipment inspection and training
- Made minor adjustments to snow routes to increase efficiency.

Planned or Considered FY17 Activities

- Conduct annual snow and ice equipment inspection and training
- Continue to subscribe to Weather Net, and participate in Base Camp in order to make informed decisions regarding sanding, plowing, and /or de-icing activities.
- Continue to research alternative technologies which may be viable for snow and ice control.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP M8.

3.2.5 P3 – Tree Planting and Information Programs

Responsible Department/Division:	**BMP Contact:**
Public Works / Parks & Open Space	Parks and Open Space Division Director

BMP Description
Manage and support both governmental and community tree planting programs. Provide information to the public about the multiple benefits that trees provide for protecting and enhancing stormwater quality.

Tasks
1. Manage and support the City's community focused Eugene Park Stewards (formerly Neighborwoods) volunteer tree planting program.
2. Manage and support the City's internally focused tree planting programs that regulate new development so they are fully planted with street trees and that ensure City-engineered street improvement projects include street trees in appropriate plantable areas.
3. Seek opportunities to provide and/or present information to the community regarding stormwater related benefits of trees.

Measurable Goals	Status of Measurable Goals – FY16
• On average, conduct 12 Neighborwoods volunteer program tree planting projects per year.	• Goal was met.
• Include the planting of street trees with all new private developments and with all new public street improvement projects as opportunities arise.	• Goal was met.
• Plant 600 trees per year through the Neighborwoods program and the City's regulatory tree planting program.	• Goal was met. A total of 941 trees were planted in FY16.
• Provide information about the stormwater benefits of trees at major publicly attended events at least 4 times per year.	• Goal was met.

Tracking Measures	Tracking Data – FY16
• Track the number of Eugene Park Stewards volunteer program planting projects and the resulting number of trees planted.	• The total number of projects in FY16 was 12 resulting in the planting of 603 trees. More specifically, the Eugene Outdoors (formerly called the Eugene Parks Stewards) volunteer program held 9 tree planting projects and

		planted 98 trees. In addition, the Friends of Trees (FOT), who is contracted by the City to assist with tree planting, held 12 volunteer projects and planted 380 trees. Finally, City staff planted 12 trees in developed parks.
• Track the number of trees planted through new development tree planting requirements and through City-engineered street improvements.		• In total, 338 trees were planted to meet this goal: 237 street trees were planted in new development projects and City-engineered street improvement projects resulted in 101 new trees.
• Track the number and type of publicly attended events where stormwater related tree information was provided or where a presentation was made.		• City staff participated in 9 public presentations where the stormwater benefits of trees were emphasized. In addition, our non-profit partner, Friends of Trees Lane County, attended more than 10 public events where they highlighted the stormwater benefits of trees.

FY16 Activities and Accomplishments

- Urban Forestry, the Eugene Outdoors volunteer program (formally called the Eugene Parks Stewards), and the Friends of Trees Eugene (FOT) have continued their partnership to plant, prune and care for public trees.
- As part of the Annual Arbor Day event at Filbert Meadows on March 1, 2016 the Eugene Outdoors volunteer program and Urban Forestry staff oversaw the planting of 54 trees by 61 volunteers who donated 120 hours.
- Eugene Outdoors partnered with a local scout troop for an Eagle Scout project to plant 30 trees in Oakmont Park on January 9, 2016 with 50 volunteers.
- During this reporting period the Friends of Hendricks Park Rhododendron Garden Volunteers partnered with Eugene Outdoors for 7 projects planting an additional 14 trees in the floral garden in Eugene's first park.
- Urban Forestry staff oversaw the contractual planting of 178 street trees in new developments and oversaw projects by FOT to plant 497 (377 planted by volunteers and 120 by homeowners) replacement trees in the public right-of-way.
- Two additional Annual Arbor Day tree stewardship events took place on April 9 and 10, 2016 along the West Bank Path adjacent to the Willamette River. During these events 65 volunteers gave 199 hours to weed, prune and mulch 360 trees.
- FOT pruned 207 newly-established street trees during 7 pruning events, continuing the partnership between the City's volunteer program and the Friends of Trees (FOT).
- Over the last fiscal year Eugene Outdoors hosted 35 volunteer events that involved maintenance of existing trees with almost 350 volunteers donating over 800 hours of service.
- Friends of Trees Lane County has also been working to increase use of volunteers to provide care to established trees.

- Urban Forestry had an intern for 10 weeks who made important progress in updating the City's tree inventory. State-of-the-art cloud-based ArcGIS software, developed in-house by Parks Planning staff to use ESRI's Collector mobile application, was used to update existing street tree and park tree information. More than 800 trees were inventoried in several neighborhood(s).
- In June 2016 UF staff joined a regional advisory panel for a research project funded by the Northwest Climate Science Center. This project is entitled: Managing urban tree canopy to mitigate ecological drought and urban thermal pollution above salmonid streams from concurrent climate change and urbanization (please see page 4 of PDF). When the results of this study are published, our staff will use them to guide management decisions and practices.

Planned or Considered FY17 Activities

- Urban Forestry staff will continue to refine their electronic tree inventory and work management systems which allow staff, contractors, and community partners to quickly reference and add information while out in the field using mobile technology.
- The City is also planning to improve educational/outreach efforts through web pages and social media.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP P3.

3.2.6 P4 – Public Stormwater System Maintenance – Developed Parks and Rights-of-Way

Responsible Department/Division:
Public Works / Parks & Open Space

BMP Contact:
Parks and Open Space Division Director

BMP Description
Evaluate and, as necessary, adapt or revise turf, landscape and natural area vegetation management programs for public lands under the City's jurisdiction. Such areas include developed parkland and public right-of-way.

The focus of this BMP is to minimize and further limit the discharge of pollutant laden runoff from these areas.

Tasks
1. Update and refine the Integrated Pest Management (IPM) policy document and operations manual as new techniques are researched and the results of implementation of these techniques are uncovered.
2. Research, evaluate and implement park and landscaped area design practices and new vegetation management techniques to minimize impervious surfaces; reduce pesticide and fertilizer use; and maximize the use of native vegetation, where appropriate.
3. Complete stormwater inspections utilizing inspection checklist for all publicly-maintained vegetated stormwater facilities within the right-of-way and developed parks. Update the new stormwater facility tracking system database with information gathered in field.
4. Evaluate the Pesticide Free Parks Program. Revise, adapt, and expand program as appropriate.
5. Utilize the IPM policy document to continue adding Pesticide Free Zones within Eugene's seven stormwater basins.

Measurable Goals	Status of Measurable Goals – FY16
• Review IPM manual at least once during the permit term, and update and refine the IPM policy document and operations manual in accordance with integrated pest management principles.	• Complete
• Conduct periodic inspection of each publicly maintained vegetated stormwater management facility within the right-of-way and developed parks. Populate the stormwater facility tracking system database with current information for each facility that is inspected.	• Complete
• Continue to provide services to existing Pesticide Free Parks.	• Complete

• All newly developed playgrounds, pools, sprayplay features, recreational areas and other park areas will be evaluated during design or within one year of initial public use for addition into the Pesticide Free Zone program.	• Complete

Tracking Measures	Tracking Data – FY16
• Document updates of IPM policy document and operations manual.	• IPM Manual was reviewed and an update is in progress. Publication is anticipated by12/01/16.
• Document new techniques and practices that are incorporated into park and landscape design.	• No new techniques or practices in landscape design were incorporated during the reporting period.
• Document the number of publicly maintained vegetated stormwater facilities inspected and information entered into the stormwater facility tracking system database annually.	• 41 publicly maintained vegetated stormwater facilities were inspected and the information was entered into the stormwater database.
• Track the condition of existing parks that are currently maintained using the Pesticide Free Parks protocol.	• Maintenance was performed at 9 pesticide free parks during the reporting period. Tasks included litter and garbage collection, weekly mowing during the first part of the growing season then a reduction in frequency to every two weeks, and weed and plant management throughout the year using alternative methods of weed control such as flame-weeding, hand weeding, and mulching.
• Calculate the total acreage that has been placed in the Pesticide Free Zone Program per year. • Utilize Chem Track program to track how much chemical (pound per acre) were used each year and determine total reduction of chemicals used annually.	• A total of 201.25 acres of pesticide free zones exist in the park system. • 24.01lbs. of pesticide were applied in FY16. This is a decrease of 6.6 lbs over the previous year.

FY16 Activities and Accomplishments

- A new work team was created within the POS division to take over all maintenance operations for public vegetated stormwater facilities. Site assessments and resource management plans (RMPs) were created for all 41 sites and used to establish maintenance priorities, condition ranking and work schedules.
- A new ArcGIS database was created to track all maintenance activities and costs.

Planned or Considered FY17 Activities

- Research the development of a "Green Streets" adoption program for private citizens to assist with maintenance activities of public facilities and revised IPM standards for stormwater facilities.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP P4.

3.2.7 P5 – Public Stormwater System Maintenance – Open Waterways

Responsible Department/Division:
Public Works / Parks & Open Space

BMP Contact:
Parks and Open Space Division Director

BMP Description
Maintain and manage open waterways consistent with adopted Open Waterway Maintenance Plans. These plans are intended to protect and enhance stormwater quality and natural resources values while continuing to maintain sufficient conveyance capacity in the waterways.

Tasks
1. Follow written procedures for on-going maintenance of open waterways: Open Waterway Maintenance Plans (for all open waterways) and U.S. Army Corps of Engineers Levee Owner's Manual (for portions of Amazon Creek).
2. Establish native trees and shrubs along portions of open waterways that are lacking shade.
3. Repair channel banks as erosion or slumping issues occur.
4. Revise Open Waterways Maintenance Plans to incorporate new information and techniques to further advance the goal of maximizing water quality and habitat benefits while also maintaining sufficient conveyance.
5. Implement storm event monitoring at potential choke points in the open waterway system.
6. Complete stormwater inspections utilizing inspection checklist for all publicly-maintained vegetated stormwater facilities (e.g., detention ponds, wetlands, bioswales). Update the stormwater facility tracking system database with information gathered during inspection.

Measurable Goals	Status of Measurable Goals – FY16
• Implement "green piping" (i.e., pruning woody vegetation within active channel zone) on 5 miles of open waterway annually to maintain conveyance.	• Completed
• Establish native trees and shrubs on 5000 lineal feet of waterway annually to help shade streams, lower water temperatures, and increase slope stability.	• Completed
• Revise all Open Waterway Maintenance Plans by December, 2012.	• Completed
• Periodic inspections for publicly-maintained vegetated stormwater facilities (e.g., detention ponds, wetlands, bioswales). Populate the stormwater facility tracking system database with current information for each facility.	• Completed

Tracking Measures	Tracking Data – FY16
• Miles of open waterways that are green-piped each year.	• 10.75 miles of open waterway were green-piped.
• Track the number of riparian vegetation planting projects, including the number of lineal feet planted, and the number and general type of native species planted (i.e. trees, shrubs, grasses, etc.).	• 450 native trees were planted along the Willamette River, in East Alton Baker Park, and another 11 native trees were planted in East Delta Ponds. These trees were planted in a non-linear fashion. • A segment of the Roosevelt Channel approximately 4500 linear feet in length was planted with native willow cuttings. • A segment of Royal Creek (at the Throne Detention Ponds) approximately 750 linear feet in length was planted with native willow cuttings.
• Number of channel bank repair projects (e.g., to reduce erosion or slumping) completed each year.	• No channel banks failures occurred during this reporting period, therefore no bank repairs were required.
• Number of times each year that the storm event monitoring program for open waterways is activated.	• Staff conducted a storm event monitoring event one time during the reporting period, on December 13, 2015.
• Number of publicly maintained vegetated stormwater facilities inspected and information entered into the stormwater facility tracking system database annually.	• Staff conducted annual inspections of 41 facilities and entered the information into the ArcGIS tracking system.

FY16 Activities and Accomplishments

- See above.

Planned or Considered FY17 Activities

- We will implement multiple projects (e.g. tree planting, green piping) that will address the measurable goals above.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP P5.

3.3 Status of Illicit Discharge Control BMPs

M1 Management of Illicit Discharges to the Municipal Stormwater System
M2 Spill Response
M7 Systematic Stormwater Field Screening and Investigation
P7 Litter and Illegal Dumping Control

3.3 Status of Illicit Discharge Control BMPs

3.3.1 M1 – Management of Illicit Discharges to the Municipal Stormwater System

Responsible Department/Division:
Public Works / Maintenance

BMP Contact:
Maintenance Division Director

BMP Description
Discourage and reduce improper discharges into the stormwater system through operation of a stormwater discharge compliance enforcement program. The primary goals of this program are to protect the quality of the receiving waters of the City's stormwater system and to ensure that discharges to the City's stormwater system are in compliance with local, state, and federal regulations to the maximum extent practicable. The City will conduct periodic review of enforcement program practices and procedures and make revisions as deemed necessary.

Tasks
1. Use CCTV inspection, dye testing, smoke testing and field investigation to identify illegal connections, cross connections with the wastewater system and failures in the pipe system.
2. Inspect stormwater outfalls to identify illicit discharges, as well as track outfalls added or removed from the stormwater system.
3. Implement the City's Stormwater System Administrative Rule, 58-02-01-F, with the intent to prohibit improper connections and illegal discharges to the City's stormwater system utilizing an effective enforcement program.

Measurable Goals	Status of Measurable Goals – FY16
• Work to reduce the number of improper discharges into the municipal stormwater system through public outreach and a reasonable enforcement of regulations.	• Goal was met.

Tracking Measures	Tracking Data – FY16
• Track the number of stormwater pollution complaints received by the City.	• 49 work orders for possible illicit discharges were created, and 34 were determined to be illicit discharges and eliminated.
• Track the number of outfalls inspected annually.	• 151 outfalls were inspected during the FY16 reporting period.
• Track the number of requests-for-service (RFS) related to illicit discharges to the municipal stormwater system which required enforcement.	• 11 written enforcement notices were issued during the FY16 reporting period.

FY16 Activities and Accomplishments

- The fourth year of the Dry Weather Field Screening program took place in FY16, with 6 major outfalls being selected, with 3 outfalls having flow. Samples were collected from the 3 outfalls and analyzed by an outside laboratory. Results of the sampling showed no evidence of illicit discharge.
- The Polk Street Stormwater Vault was cleaned 3 times during FY16 and over 21 tons of debris was removed.
- The City's Maintenance Management System (MMS) is the primary mechanism for database management and tracking of spills and illicit discharges.
- Public Works Maintenance – Spill Response Program – Technical Specialist continues to work closely with staff of Public Works Engineering-Erosion Control Team and Public Works-Wastewater Industrial Source Control as the Public Works Stormwater Enforcement Team. The Enforcement Team meets regularly to discuss discharges, educational outreach, compliance/penalty cases and joint field investigation.
- Eleventh successful year administering the "Fish Friendly" Car Wash Kits program for local Non-Profit Fundraising.
- Eight Fish Friendly Car Wash Kits were loaned to volunteer organizations during the reporting year.

Planned or Considered FY17 Activities

- Continue the Dry Weather Field Screening program to monitor for illicit discharge activities. Look to add sites to current program.
- Continue outfall inspections to look for illicit discharges, inspect conditions of infrastructure, and prevent flooding.
- Continue to manage the "Fish Friendly Car Wash Kit Program".
- Continue to partner with the Local Emergency Planning Commission on Hazardous Materials training.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP M1.

3.3.2 M2 – Spill Response

Responsible Department/Division:
Public Works / Maintenance

BMP Contact:
Maintenance Division Director

BMP Description
Maintain an on-call team trained in spill response procedures involving environmentally hazardous materials and a vehicle equipped for such spill mitigation. Coordinate efforts with other local response teams such as the City of Eugene Fire and Police Departments, Lane County, and state agencies.

Tasks
1. Maintain an on-call list of personnel trained in spill response procedures.
2. Maintain an inventory of equipment and supplies necessary to mitigate improper discharges to the municipal stormwater system.
3. Coordinate in conjunction with Fire Department / Hazmat Team on mitigation efforts including hazardous material clean-up and disposal.
4. Update the City of Eugene's Public Works Maintenance Spill Response and Illicit Discharge Operations Plan.

Measurable Goals	Status of Measurable Goals – FY16
• Maintain a list of HAZWOPER trained personnel that are available for 24-hour emergency response.	• Goal was met. • Public Works currently has 8 employees with 40hr. HAZWOPR training and 1 employee with 24hr. HAZWOPR training. • Conducted annual refresher for 8hr, 24.hr, and 40hr. HAZWOPR trained staff.
• Maintain and update, as necessary, the City's On-Call Emergency Roster for Environmental Spills.	• Goal was met.

Tracking Measures	Tracking Data – FY16
• Up-to-date list of employees trained for spill response.	• Public Works maintains a staff of 70 employees with 8hr. HAZWOPR First Responder training. • Public Works maintains a staff of 1 employee with 24hr. HAZWOPR technician training. • Public Works maintains a staff of 8 employees with 40hr. HAZWOPR technician training.

• Track number of spills and follow-up details.		• 49 work orders for possible illicit discharges were created, and 34 were determined to be illicit discharges and eliminated.

FY16 Activities and Accomplishments

- Spill Response staff continue to work closely with Stormwater and Wastewater Vacuum Truck Operators, Systematic Field Inspection staff, Street Sweeper Operators, the Stormwater Supervisor, Parks and Open Space Staff, Wastewater Industrial Source Control Technicians, Stream Team Coordinator and volunteers, Engineering Division Construction Erosion Control Technicians to identify, investigate and abate Illicit Discharges and spills through combined efforts.
- Continued response to spills and illicit discharges with City of Eugene Public Works Maintenance staff, Fire and Police Emergency Services personnel, and the use of Hazmat contractors for consultation, cleanup, and material disposal needs.
- Continued the cooperative relationship with IDDE staff from City of Springfield, working together on illicit discharge issues such as pressure washing and landscaping activities.
- The City's Maintenance Management System (MMS) is the primary mechanism for database management and tracking of spills and illicit discharges. Updates during FY16 include improved mapping and reporting functions.

Planned or Considered FY17 Activities

- Continue to manage the "Fish Friendly" Car Wash Kit program
- Continue to monitor on-street homeless camping activities with a goal of reducing levels of pollutants entering the MS4.
- Continue to partner with the Local Emergency Planning Commission on Hazardous Material trainings.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP M2.

3.3.3 M7 – Systematic Stormwater Field Screening and Investigation

Responsible Department/Division:	**BMP Contact:**
Public Works / Maintenance	Maintenance Division Director

BMP Description
The Stormwater Field Screening and Investigation program inspects the public stormwater system for condition assessment and the private stormwater system to assess water quality impacts to the municipal stormwater system. Where illicit discharges are found, attempt to identify the source and eliminate the discharge.

Tasks
1. Work with the Sub Surface Maintenance Crew to assess, inspect and map the details of the public and private stormwater system.
2. Conduct annual dry-weather field screening inspections per the City of Eugene Field Screening manual.
3. Work with the inspection and enforcement staff to continue to educate and regulate the users on the proper use of the stormwater system.

Measurable Goals	Status of Measurable Goals – FY16
• Improve accuracy of the Stormwater System layer in our Geographic Information Systems (GIS) through map update requests.	• Goal was met.
• Identify and remove illicit discharges to the municipal stormwater system through the dry-weather field screening process.	• Goal was met.
• Utilize interaction with the public as an educational opportunity to increase stormwater user awareness.	• Goal was met.
• Develop "map update" requests based on field inspections and forward this information to the GIS manager for inclusion into the citywide GIS system.	• Goal was met.

Tracking Measures	Tracking Data – FY16
• Track the number of map update requests forwarded to the GIS team.	• 65 map update requests were forwarded to the GIS team.
• Track and create work orders for the system repairs discovered through the inspection process.	• 21 work orders were created for stormwater system repairs.

• Track the number of dry-weather field screening inspections and follow-up details.	• Dry Weather Field Screening took place in 2016 at 6 major stormwater outfalls and a 3rd party testing laboratory was used to collect and analyze the samples. 3 outfalls had flow, and results of sampling did not exceed the pollutant parameter action levels.

FY16 Activities and Accomplishments

- Scheduled and oversaw the cleaning of the Polk Street Stormwater Vault. The vault was cleaned 3 times during FY16 and over 21 tons of debris was removed.
- Continued to inspect and investigate conveyance issues and system mapping irregularities in both the public and private stormwater systems.
- Continued to work in conjunction with Public Works Engineering staff on Pavement Preservation Projects to identify conveyance problems prior to new road surfacing.
- Continued investigating conveyance problems such as utility breaches, grout build-up, off-set joints, and structural deficiencies in the public stormwater system with CCTV inspections.

Planned or Considered FY17 Activities

- Will continue to partner with Public Works Engineering staff on Pavement Preservation Projects to identify defects to the stormwater system and prioritize and make recommendations for repairs prior to road surfacing.
- Work with spill response/illicit discharge staff to improve the mapping accuracy of the existing stormwater system.
- Continue to map both the public and private stormwater systems to increase information available through the GIS system.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP M7.

3.3.4 P7 – Litter and Illegal Dumping Control

Responsible Department/Division:	**BMP Contact:**
Public Works / Parks & Open Space	Parks and Open Space Division Director

BMP Description
Manage and support efforts to reduce impacts to stormwater runoff and local receiving waters by controlling litter and debris in public spaces and by removing illegally dumped refuse and debris as well as garbage and trash from illegal camp sites.

There are two primary focal points of this BMP. The first is to provide opportunities for proper disposal of litter and trash at strategic publicly owned sites to prevent it from being washed into the public stormwater system. The second is to clean-up illegal dump sites and illegal camp sites prior to pollutants from the trash and debris being washed into the public storm system or the local receiving waters.

Tasks
1. Place trash receptacles in parks, public areas and at venues for public events which are likely to generate garbage, litter and other throw-away items. Provide frequent collection service to prevent over filling.
2. Require up-front clean-up deposits for large events in City parks, for rental of City park shelters, and for rental of other City owned and operated recreation or outdoor cultural facilities.
3. Conduct routine debris inspections of significant waterways under the City's jurisdiction and remove illegally dumped or discarded debris and other items as appropriate.
4. Conduct routine inspections along riverbanks and in other undeveloped lands under the City's jurisdiction to locate, dismantle, and clean-up illegal camp sites and their associated trash, garbage, debris and bio-hazardous materials.
5. Identify and monitor known historic dump sites in remote areas of the public right-of-way (such as undeveloped cul-de-sacs, dead-end streets, etc.), attempt to identify a responsible party for significant piles of dumped debris, and remove the dumped material as soon as possible to discourage additional dumping by others.

Measurable Goals	Status of Measurable Goals – FY16
• Ensure all parks, all public space areas managed by the City and all venues for outdoor public events on City lands have adequate trash receptacles. Empty trash receptacles frequently enough to prevent spillage due to being over filled.	• Adequate trash receptacles provided in all public spaces for use by the public. Receptacles emptied regularly • Staff continues to monitor for strategic locations to place litter receptacles due to high litter and debris activity.
• Ensure at least 75% of all rentals of parks, park shelters, and other City operated outdoor facilities will result in no loose litter and debris left behind.	• All park rentals during the reporting period were managed for litter removal. One event had their cleaning deposit held to pay for litter clean up that they had not completed.

• Inspect all major waterways and riverbanks weekly for dumped or discarded debris and illegal campsites. When found, remove dumped materials within two working days. When found, dismantle illegal campsites and clean-up as soon as is physically and legally possible.	• Priority waterways including the Willamette River, Amazon Creek and Delta Ponds were checked weekly and illegal campsites were posted and removed.
• Monitor all identified historic dumping sites in the public right-of-way and clean-up as necessary at least twice per month.	• Patrolled reoccurring dump sites and camp sites throughout the reporting period.

Tracking Measures	**Tracking Data – FY16**
• Track the collection frequency for trash receptacles in City parks and other public space areas managed by the City.	• Monitored 651 outdoor public events and provided trash and litter collection. • All regional and high use neighborhood parks –trash collected daily, year round. • Low use Neighborhood parks –trash collected 2-3 times per week during winter months, daily during summer. • Dog waste cans at four dog off-leash areas checked daily and dumped as needed.
• Document the number or percentage of rentals of parks, park shelters, and other outdoor venues held on City managed land that forfeit all or part of their clean-up deposit due to excessive litter left behind.	• Of the 651 park rentals this year, one cleaning deposit was forfeited for excessive litter left behind in FY 16. Cleaning deposit amount of $150 is collected to maintain compliance with event cleanup requirements.
• Track the number of illegal campsites cleaned-up along riverbanks, waterways, or other public space areas managed by the City.	• There were 4 illegal campsites cleaned up in developed park areas in FY 2016. • A total of 1,007 illegal campsites were cleaned up along riverbanks, waterways, and undeveloped parklands in FY 2016.

• Track the frequency of collection and the amount of debris collected from waterways and from the public right-of-way.	• Litter was collected from waterways weekly by staff and sheriff's work crew. • Litter collected from developed parks daily (1,748 cubic yards). • Litter collected from public rights of way as found or reported. • Total amount collected in FY 2016 = 2,835 cubic yards.

FY16 Activities and Accomplishments

- Continued satellite trash drop boxes in the North and South Park Operations service regions to increase efficiency of litter removal and disposal. In FY16, approximately 330 Cubic Yards of trash and litter was disposed of in these satellite trash drop boxes.
- Continued tracking the dumping of Roosevelt Yard drop box to capture total trash removed from park areas (excluding trash taken to Regional Satellite drop boxes), river banks and waterways (includes litter and debris picked up by staff and Sheriff's Work Crew), and public rights of way =2,835 Cubic Yards.
- The City sponsored and provided logistical support for the 7th Annual Great Willamette River Cleanup on October 3, 2015. The day was quite rainy, so the number of volunteers was down, but the quantities of trash and needles collected was higher than last year's event –indicative of an increase in illicit activities along the waterway. This event was a partnership with Willamette Riverkeepers. Volunteers donated a collective 260 hours of stewardship in the land based efforts starting at Maurie Jacobs and Alton Baker Parks to remove 27 yards of trash and 140 needles. 87 volunteers participated in this event.

Planned or Considered FY17 Activities

- Willamette River Cleanup volunteer events in FY17.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP P7.

3.4 Status of Waste Management BMPs

B1 Household Hazardous Waste Disposal
B2 Solid Waste Management

3.4 Status of Waste Management BMPs

3.4.1 B1 – Household Hazardous Waste Disposal

Responsible Department/Division:	**BMP Contact:**
Planning and Development / Building and Permit Services	Building and Permit Services Division Director

BMP Description
Support existing efforts and programs within the Eugene metro area to inform citizens of local opportunities for the proper discard and disposal of their household hazardous waste materials. Support and promote facilities and programs that provide such opportunities.

The improper disposal of household hazardous waste poses a serious threat to local stormwater quality. Old paint, solvents and thinners, pesticides, bleach, drain cleaners, antifreeze, gasoline, used motor oil and other motor vehicle fluids can easily be flushed into the stormwater system if disposed of in yards, left uncovered in the rain, or poured down driveways or into the street. Supporting efforts to inform homeowners and tenants about where they can properly dispose of these products as well as supporting local household hazardous waste management facilities and efforts is an effective way to reduce the amount of these products that inadvertently make their way into the stormwater system and local receiving waters.

Tasks
1. Collaborate with Lane County Waste Management Division staff on educational outreach via the development and distribution of brochures, fact sheets, and community outreach events.
2. Require solid waste haulers to notify their customers of the Special Wastes Program offered through the Lane County Waste Management Division.
3. Develop information on a City website page that provides education on household hazardous waste and explains how to set up an appointment with Lane County Solid Waste to dispose of materials properly.
4. Collaborate with local metro area partners to public information in local phone books regarding waste prevention, recycling, composting, and disposal of household hazardous waste.

Measurable Goals	Status of Measurable Goals – FY16
• Work with Lane County and City of Springfield to annually update "Brown Pages" in the US Dex directory to include new electronics requirements.	• Completed
• Update the City's web site periodically to direct residents to the latest information about recycling and waste prevention news, resources, and local events.	• Completed

Tracking Measures	Tracking Data – FY16
• Document completion of "Brown Pages" update.	• Brown pages published in the US Dex Directory.
• Document materials disbursed about household hazardous materials.	• Lane County materials.

FY16 Activities and Accomplishments

- The City of Eugene's Waste Prevention and Recycling Program is primarily a regulation program focused on collection and rate regulation. Most of the Waste Prevention BMP activities are handled by our partners at Lane County Waste Management. We have links on our web site referring the public to their information.

Planned or Considered FY17 Activities

- The cities of Eugene and Springfield, in partnership with Lane County, continue to work on a 20-year Solid Waste Management and Resource Recovery Plan that is expected for 2018, and will include elements related to improved household hazardous waste management.
- Track Lane County's consideration of alternatives to annually publishing "Brown Pages" in the US Dex directory given other, more effective means of providing the information to the public.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP B1.

3.4.2 B2 – Solid Waste Management

Responsible Department/Division:	**BMP Contact:**
Planning and Development / Building and Permit Services	Building and Permit Services Division Director

BMP Description
Evaluate and revise, as necessary, existing solid waste and recycling collection rules to address stormwater quality.

Improper and/or unregulated collection and recycling of solid waste has a serious potential for creating negative impacts to stormwater quality. High collection fees, infrequent or spotty collection service may lead to illegal dumping activity. Unregulated waste containers may be prone to leaking or spilling allowing pollutants to wash into the storm system. By continuing to monitor and evaluate local solid waste management collection efforts, the City will be better able to improve local regulations so that stormwater quality is taken into account.

Tasks
1. Regulate solid waste and recycling collection activities within the city limits to curb possible impacts to the stormwater systems from leachate of garbage, yard debris, and recycling materials.
2. Support a minimum of biweekly collection service for organic materials and provide backyard composting classes for residents with or without collection service.
3. Implement the nuisance abatement enforcement program that provides rapid response to illegal dumping of garbage, yard debris, or other solid waste materials.

Measurable Goals	Status of Measurable Goals – FY16
• Review Administrative Rule to ensure regulations are up to date and include requirements to support appropriate waste management and prevention.	• Administrative Rule reviewed with no changes.
• Contract with Oregon DEQ for a waste composition study.	• Drafted Scope of Work for a 2016 Multifamily Waste Generation Study

Tracking Measures	Tracking Data – FY16
• Document total tons of yard debris collected through the curbside program.	• 12,802 tons of yard debris collected in CY2015.
• Document the number of compost demonstration workshops and participants.	• 12 demonstrations to 88 residents. • 2 workshops to 33 residents.

• Document number of enforcement cases (i.e., received complaints) related to inappropriate garbage handling.		• 498 cases of nuisance complaints received related to garbage
• Compare waste composition study with prior one.		• Most recent study completed was in 2011.

FY16 Activities and Accomplishments

- Launched the Residential Food Waste Collection Pilot

Planned or Considered FY17 Activities

- The Cities of Eugene and Springfield, in partnership with Lane County, continue work on a 20-year Solid Waste Management and resource Recovery Plan that is expected for 2018.
- Finalize Scope of Work for a 2016 Multifamily Waste Generation Study. Compare results to the 2011 Study, as applicable.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP B2.

3.5 Status of Construction and New Development BMPs

E2 Erosion Prevention and Construction Site Management Program
E4 Stormwater Development Standards
P6 Compliance Program for Maintenance of Privately owned Vegetated Stormwater Facilities
M6 Regulation of Inspection, Maintenance and Reporting of Private Underground Stormwater Structures

3.5 Status of Construction and New Development BMPs

3.5.1 E2 – Erosion Prevention and Construction Site Management Program

Responsible Department/Division:	**BMP Contact:**
Public Works / Engineering	City Engineer

BMP Description
Administer and monitor an Erosion Prevention and Construction Site Management Program in compliance with Eugene Code 6.625-6.645, preventing and mitigating pollutant and sediment discharges into the city's stormwater system due to construction activities and land disturbance.

Tasks
1. Screen all development permits for sensitive area status, conduct plan reviews, issue erosion permits, conduct erosion inspections, and provide compliance enforcement as appropriate.
2. Issue Erosion Permits for activities which disturb an area one acre or greater in size or disturb an area 500 square feet or greater within a sensitive area (i.e. adjacent to a water feature or its buffer, ground slopes greater than 10%, having highly erodible soils).
3. Conduct education and outreach related to new erosion techniques/practices.
4. Act as 1200-C Agent for DEQ.

Measurable Goals	Status of Measurable Goals – FY16
• Conduct one inspection prior to the commencement of work for all erosion permitted sites.	• Measurable Goal was met. An initial inspection continues to be required prior to any ground disturbance and prior to issuance of building permits for erosion prevention permitted sites.
• Inspect non-erosion-permitted sites at least twice during the life of the building/construction permit or as necessary to assure compliance with the program.	• Measurable Goal was met. Non-erosion-permitted sites receive inspections as necessary to assure compliance with the BMP requirements.
• Inspect permitted sites monthly or as necessary to assure compliance with the program.	• Measurable Goal was met. All erosion permitted sites are inspected monthly and/or as necessary to assure compliance.
• Conduct one annual erosion prevention training event.	• Measurable Goal was met. Eight erosion prevention training events were conducted in FY16.

Tracking Measures	Tracking Data – FY16
• Number of compliance orders issued.	• 9 Administrative Compliance Orders were issued in FY16.

• Number of erosion permits issued.	• 110 Erosion Prevention permits were issued in FY16 (37 Commercial, 64 Residential, 4 Annual and 5 1200-C).
• Number of inspections.	• 922 inspections at permitted sites were conducted and documented in FY16. Additional support inspections were conducted regularly at capital projects, non-permitted sites, stormwater emergencies (e.g. water-line breaks) and in response to complaints.
• Number of training/outreach events.	• Nine erosion prevention training/outreach events were conducted in FY16.

FY16 Activities and Accomplishments

- Finished outreach and drafted City code updates for erosion control ordinance.
- All BMP inspection staff maintained Certified Erosion and Sediment Control Lead (CESCL) training.
- Program continued in its role as Agent for Department of Environmental Quality (DEQ) to administer NPDES 1200 C permits within Eugene's jurisdictional boundary.
- Program continued to implement an intergovernmental agreement with Lane County to issue and administer Erosion Prevention permitting to properties outside City limits but within the urban growth boundary.
- Staff responded to 24 erosion prevention/stormwater complaints.
- Continued use of smart-phone technology to improve data/photo communications.
- Mailed over 200 postcards to Erosion Prevention permit holders reminding them about the City's wet-weather season and associated required measures.
- Worked with local vendors to improve availability of current BMP measures.
- Continued to provide full-time assistance (on-call basis) to help customers and counter personnel answer questions about and issue Erosion Prevention permits.
- Constructed an interactive Erosion Prevention display and participated in an all-day educational event for the public.
- Amended outreach/training presentations and as necessary to be relevant for each specific and diverse audience.
- Updated Standard Specifications and drawings to improve efficiency and effectiveness of program.
- Provided companywide training to the largest contractor in Lane County (Wildish Construction Company).

Planned or Considered FY17 Activities

- Finish and adopt update to erosion ordinances and administrative rules.
- Create erosion design guideline for consultants.
- Create erosion construction guideline for contractors.
- Update fact sheet and create additional sheets.

- Create standard drawings available for private use.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP E2.

3.5.2 E4 – Stormwater Development Standards

Responsible Department/Division:	**BMP Contact:**
Public Works / Engineering	City Engineer

BMP Description
Administer and monitor a program that implements the city's Stormwater Development Standards, Eugene Code 9.6790-9.6796, Eugene Code 7.143 (3), and associated Stormwater Management Manual. The Stormwater Development Standards regulate the location, design, construction and maintenance of private and public stormwater facilities for flood control, water quality, and natural resource protection.

Tasks
1. Screen development permits for post-construction stormwater management, conduct plan reviews, approve stormwater facilities, conduct inspections, and provide compliance enforcement as appropriate.
2. Maintain an up-to-date Stormwater Management Manual for new development.
3. Track, evaluate, and develop new technologies and practices for post-construction stormwater management.
4. Provide training and technical assistance on water quality facilities to city staff and the public.
5. Conduct a review of policies, practices and regulations to identify potential barriers to implementing low impact development techniques.

Measurable Goals	Status of Measurable Goals – FY16
• Review stormwater management proposals at the land use and/or development permit stage (i.e. earliest level of review).	• Measurable goal was met. Public Works staff reviewed all land use and permit applications for compliance with Stormwater Development Standards. Reviews occurred during first review and plan check stages.
• Review and approve construction plans for stormwater management facilities for all development sites which create 1,000 square feet or more impervious surface.	• Measurable goal was met. Public Works staff reviewed all construction plans that included 1,000 square feet of impervious surface. Staff ensured that BMP goals were met through the application of the Stormwater Development Standards.
• Update Eugene's Stormwater Management Manual every two years or as needed to provide new information or practices for post-construction stormwater management.	• Measureable goal was met. City Staff updated the Stormwater Management Manual in March of 2014.

Tracking Measures	Tracking Data – FY16
• Number of private water quality facilities permitted with building permits.	• 17 Green (vegetated) Facilities • 17 Mechanical Facilities
• Number of land use applications reviewed.	• 73 Land use applications reviewed
• Number and type of public water quality facilities constructed.	• 2 Mechanical • 26 Green
• Number of training/outreach events held.	• None

FY16 Activities and Accomplishments

- First full year of implementing LID stormwater quality hierarchy. Increase in constructing green facilities to meet permit requirements and program goals.

Planned or Considered FY17 Activities

- Collecting public and stakeholder input for the next Stormwater Management Manual update.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP E4.

3.5.3 P6 – Compliance Program for Maintenance of Privately Owned Vegetated Stormwater Facilities

Responsible Department/Division:
Public Works / Parks & Open Space

BMP Contact:
Parks and Open Space Division Director

BMP Description
Develop, implement and manage a program to ensure that privately owned and operated vegetated stormwater treatment facilities are maintained so that they function as designed and constructed. The program will employ a combination of rules, protocols and procedures to require: that each private vegetated facility is routinely inspected; that routine and corrective maintenance actions are performed in a timely manner; and that completion of both such activities are regularly reported to City staff. Based on Eugene Municipal Code requirements, penalties and/or other legal remedies will be employed to enforce compliance with these requirements when necessary.

Tasks
1. Continue to document pertinent information for new privately owned and operated vegetated stormwater facilities. This includes photo documentation of newly constructed facilities and populating the stormwater facility tracking system database with all new facility information.
2. Develop an administrative rule that details the policy guidelines, practices, procedures, specific authorities, permitted actions, and penalties to be used by City staff in managing the program.
3. Establish criteria for when maintenance audits, corrective actions, and/or enforcement actions are warranted.
4. Maintain mechanisms, processes and procedures to track BMP ownership, maintenance inspections, required reports, corrective maintenance activity and enforcement actions.
5. Develop templates for written correspondence to BMP owners, such as inspection notification, reporting reminder, notice of non-compliance, notice of violation, and enforcement documents.
6. Review required inspection and maintenance logs submitted by BMP owners.

Measurable Goals	Status of Measurable Goals – FY16
• Inspect all new vegetated private stormwater facilities at the time of construction and log pertinent information into the stormwater facility tracking database system. Adopt and implement an administrative rule to enforce the maintenance of private stormwater facilities by February 2011.	• All new vegetated private stormwater facilities were inspected at the time of construction. All information was recorded in the stormwater tracking system. • Administrative Rule has been implemented.

• Ensure the inspection of each vegetated private stormwater facility is conducted at least once per year by the owner/operator and an inspection and maintenance log documenting the necessary corrective actions is submitted to City staff annually.	• Inspection logs were received for 92 out of the 180 facilities for which letters were sent out this reporting period. • 88 formal inspections were conducted on the facilities for which logs were not received in the reporting period, with an emphasis on informing/educating owners rather than enforcement.
• Review annual reports for privately-owned vegetated stormwater facilities.	• All inspection logs submitted were reviewed by the stormwater inspector. Logs received were entered into the stormwater BMP tracking database.

Tracking Measures	Tracking Data – FY16
• Number of private vegetated stormwater facility inspections completed at time of construction.	• 36 privately maintained vegetated stormwater facilities were inspected at the time of construction and approved during the reporting period.
• Number of owner/operator inspection and maintenance logs received and reviewed annually.	• 92 inspection and maintenance logs were received and reviewed during the reporting period.
• Number of notices of non-compliance and subsequent enforcement.	• None

FY16 Activities and Accomplishments

- A new ArcGIS mapping and database system was created that allows data collection in the field using iPads. The new system provides greater reporting abilities and access to site information in the field when conducting site assessments.

Planned or Considered FY17 Activities

- Developing new outreach and education materials for private facility owners that will be available on the City web site.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP P6.

3.5.4 M6 – Regulation of Inspection, Maintenance and Reporting of Private Underground Stormwater Structures

Responsible Department/Division:
Public Works / Maintenance

BMP Contact:
Maintenance Division Director

BMP Description
Develop, implement and manage a program to ensure that privately owned and operated underground stormwater treatment structures are properly maintained.

The program will employ the guidance provided by the required individual Operations and Maintenance (O&M) plan for each structure.

Tasks
1. Develop templates for written correspondence to the private operator, such as inspection notifications, reporting reminders, notices of non-compliance, notices of violation, and enforcement documents.
2. Establish criteria for when maintenance audits, corrective actions, and/or enforcement actions are warranted.
3. Develop and maintain mechanisms, processes and procedures to track structure type, ownership, maintenance inspections, required reports, corrective maintenance activity and enforcement actions.
4. Collect and file the required annual reports as provided by the private operator.

Measurable Goals	Status of Measurable Goals – FY16
• Inspect all new private underground stormwater structures at the time of construction and log pertinent information into a database.	• All new private underground stormwater structures were inspected at the time of construction and pertinent information was logged into APTwin.
• Establish a correspondence file for each structure/operator.	• Goal was met.
• Ensure that each private underground stormwater structure is inspected, maintained and reported on as required by the O&M plan for the specific device.	• Goal was met.
• Review annual reports for privately-owned underground stormwater facilities.	• Goal was met. All inspection logs submitted were reviewed and documented in the Stormwater BMP database.

Tracking Measures	Tracking Data – FY16
• Track the number of O&M plans obtained.	• 84 Operations and Maintenance plans for mechanical facilities were received during the reporting period.
• Track the number of private inspection, maintenance and reporting activities conducted.	• 18 private facilities were visually inspected during the last reporting period.
• Track any enforcement activities related to the individual structures.	• No enforcement activities took place during the reporting period.

FY16 Activities and Accomplishments

- Continued to inform and educate private stormwater facility owners on the proper operations and maintenance of the facility.
- Continued to track the number of private mechanical stormwater facilities installed, and document facility type, location, and all other pertinent information in the Stormwater BMP database.
- Sewer inspection staff continued to inspect stormwater treatment facilities at the time of construction, and map locations and connection points to the public stormwater system using a Private Stormwater Facility form.
- Continued to work with Public Works Engineering to ensure that all private mechanical stormwater facilities are accurately mapped and included in stormwater layer of GIS as well as field maps.

Planned or Considered FY17 Activities

- Continue to work with private mechanical stormwater facility owners and maintenance contacts to provide information and education on operations and maintenance of facilities.
- Continue to work with proprietary stormwater facility manufacturers to stay current on emerging technologies and improvements in maintenance operations.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP M6.

3.6 Status of Planning, Capital Improvements, and Data Management BMPs

E1 Stormwater Capital Improvement Projects
E3 Stormwater System Mapping and Data Management
P2 Bacteria Pilot Study

3.6 Status of Planning, Capital Improvements, and Data Management BMPs

3.6.1 E1 – Stormwater Capital Improvement Projects

Responsible Department/Division:	**BMP Contact:**
Public Works / Engineering	City Engineer

BMP Description
Implement the Stormwater capital improvement program (CIP), including projects identified in the City's Stormwater Basin Master Plans (Basin Plans) for Amazon, Willow Creek, Bethel-Danebo, Willakenzie, Laurel Hill, Willamette River and the River Road – Santa Clara basins.

The Basin Plans describe a multiple-objective strategy for managing stormwater that addresses water quality protection and improvement, conveyance and flood control, and waterway protection and restoration. The basin strategies reflect the unique characteristics, problems and opportunities in each basin. Volume I contains a prioritized city-wide capital projects list including: water quality facilities in high pollutant source areas, streambank stabilization, stream restoration, and capacity enhancement projects.

The Basin Plan capital projects are one of the main sources of capital projects that comprise the City's CIP. In addition to the Basin Plans, CIP projects also originate from a list of maintenance and rehabilitation needs, from focused planning studies such as the Metro Waterways Restoration Study, and other partnership opportunities. The prioritized Basin Plan capital projects are combined with projects from these other sources, re-ranked, and incorporated into the CIP in a timeframe in-line with available budget.

Tasks
1. Incorporate projects from the Basin Plans into the City's bi-annual Capital Improvement Program and annual budget processes.
2. Include water quality criteria in ranking of capital projects from multiple sources for the CIP.
3. Maintain a GIS coverage of capital improvement projects including such attributes as location, project or facility type, drainage area and cost.
4. Maintain up-to-date Basin Plans web site, make hard copies available to the public in key locations (Library, Public Works offices).

Measurable Goals	Status of Measurable Goals – FY16
• Incorporate into the CIP projects list the projects identified in the recently completed 2010 River Road-Santa Clara Basin Plan, by September 2010.	• This task is completed. Projects from the River Road-Santa Clara Basin Plan have been incorporated into the CIP projects list including underground injection control decommissioning projects.

• Implement Stormwater CIP projects including at least one "water quality facilities in high source areas" project over the five-year permit term, and other retrofits as opportunities arise.	• This task is completed with the implementation of the I-105/Jefferson water quality project reported in FY12. The City continues to implement water quality projects as funding is available.
Tracking Measures	**Tracking Data – FY16**
• Document completion of River Road-Santa Clara Basin Plan.	• Completed and adopted in 2012.
• Track the number, type, watershed location and total drainage area of capital improvement projects constructed for water quality.	• The City tracks information of all capital projects. The city is incorporating water quality facilities into the GIS system.

FY16 Activities and Accomplishments

- FY16 the City constructed five vegetated planter type water quality rain gardens on Harris Street between 18th Avenue and 28th Avenue, and two on Fairfield Avenue between Royal and HWY 99. Both of these public projects provide water quality benefits and were constructed and funded as off-site low impact development (LID) mitigation for certain private developments unable to achieve on-site LID.
- In FY16 the City constructed a pollution reduction manhole on a 60-inch outfall at the beginning of the East Santa Clara Waterway in the River Road Santa Clara Basin.

Planned or Considered FY17 Activities

- Continue to evaluate the best locations for and scope future public water quality capital improvements.
- Seek additional resources including grant funding for construction of future projects.
- Annual review of the CIP project list by staff from the Engineering, Maintenance, and Parks and Open Space divisions of Public Works to update project needs, prioritization criteria, and implementation priorities for the CIP program.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP E1.

3.6.2 E3 – Stormwater System Mapping and Data Management

Responsible Department/Division:	**BMP Contact:**
Public Works / Engineering	City Engineer

BMP Description
Keep up-to-date inventories and maps of the public and private, natural and constructed, stormwater system. Include mapping of public and private water quality and flow control facilities such as grassy swales and detention basins. Develop and integrate asset inventory data and geographic information system (GIS) systems which describe the conveyance system, water quality attributes and related natural resource information. Integrate information generated through BMPs such as E1 (Capital Improvement Projects) and E4 (Development Standards) which create or modify system components and/or change the attributes of the stormwater system.

Tasks
1. Update stormwater system inventory and GIS on a weekly and monthly basis.
2. Develop, upgrade and maintain software applications which make system information available to staff.
3. Update stormwater infrastructure paper map sets annually.
4. Along with adoption of Stormwater Development Standards (E4), help to ensure that data management needs are identified and protocols established for documenting appropriate information to ensure that operations and maintenance, inspection and enforcement, and BMP effectiveness objectives are met.
5. In implementing the capital improvement projects outlined in the 2002 Stormwater Basin Master Plans, help to ensure documentation of location, type and other attributes of stormwater capital projects for purposes of evaluating their effectiveness and reporting progress under our permit.

Measurable Goals		Status of Measurable Goals – FY16
• Enter 95% of all newly constructed stormwater system features into inventory databases and GIS within six months of final construction approval.		• The stormwater system database and GIS is updated every 2 months.
• Ensure that 90% of GIS and data application users surveyed rate the GIS/data systems as satisfactory or better.		• During bi-annual survey key City staff were interviewed to identify GIS data and application concerns. The 2 primary areas of concern related to mapping accuracy and application performance. When the stormwater system was originally mapped about 20 years ago the accuracy was not a critical concern. Features were digitized quickly in their approximate location. In recent years, the PWE GIS staff has been gradually fixing accuracy problems in areas

		adjacent to new development, but there are still many areas that need work. In most cases, the reason for poor applications performance was due to old PCs with insufficient memory, CPU and I/O processing capabilities. Many of the PCs were replaced with state-of-the-art machines, which resolved the problems.
Tracking Measures		**Tracking Data – FY16**
• Report on map and database update activities annually.		• See FY16 Activities and Accomplishments section below for list of update activities.
• Survey map and data system users bi-annually.		• The survey was completed during FY16.

FY16 Activities and Accomplishments

- Continued to refine GIS mapping accuracy of stormwater features that were originally mapped about 20 years ago.
- Refined and updated Private Stormwater Facility (SWF) maintenance procedures and map and database content.
- The new and previously unmapped SWF drainage areas are being mapped.
- The Maintenance Management System (MMS) application was released and expanded to enable PWM staff to identify and report stormwater database and GIS mapping errors for repair by PWE GIS staff.
- Started pilot project to convert City desktop GIS query and mapping application (GeoDART) as a web application (GeoDART Online), thus allowing access in the field.
- The Illicit Discharge web applications is currently under development. It will help identify potential sources of stormwater system contamination.
- The impervious features (sidewalks, driveways, parking lots and buildings) were mapped for industrial, commercial and City properties.

Planned or Considered FY17 Activities

- Continue refining accuracy of stormwater features
- Refine and update Public Stormwater Facility (SWF) map layer
- Complete the web-based GIS query and mapping application (GeoDART Online)
- Finish the Illicit Discharge web application and distribute for use by City staff.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP E3.

3.6.3 P2 – Bacteria Pilot Study

Responsible Department/Division:	**BMP Contact:**
Public Works / Parks & Open Space	Parks and Open Space Division Director

BMP Description
Amazon Creek is water quality limited for bacteria and load reductions of 84% are necessary as specified in the 2006 Willamette Basin Bacteria TMDL.

The Bacteria Pilot Study includes three phases: Phase I focuses on efforts to identify source(s) of bacteria, followed by Phase II which focuses on the application of Bacteria Pilot Study BMPs ("BMPs") aimed at reducing bacteria, and followed by Phase III which focuses on evaluating the effectiveness of BMPs that are implemented.

Based on monitoring and site assessment work initiated with the 2005 Stormwater Management Plan the overall strategy for continuation of the Bacteria Pilot Study will be a more targeted approach that will narrow down the number of probable sources for investigation of the root of bacterial pollution within a selected study area. This more targeted approach will lead the City towards implementing Phase II and Phase III of the study.

Tasks
1. Conduct storm sampling and data analysis efforts aimed at specific monitoring locations within the study area that are suspected high source areas.
2. Continue to assess field conditions to confirm or rule out potential bacteria sources.
3. Develop and implement appropriate strategies that will help further identify or rule out potential sources of bacteria to MS4 system. Such strategies may include, but are not limited to: strategies for reducing the use of local waterways by waterfowl and rodents, evaluating historical maintenance activities including street sweeping and catch basin cleaning at commercial properties and the public system, expanding the current study area to incorporate discrete sites outside of the sub-basin which may assist in meeting study objectives.
4. Evaluate alternative investigative methods, techniques or methodologies including microbial source tracking and sediment analysis.
5. Improve internal communication by creating an electronic case history file that contains all documents generated as a result of field condition assessments and data collection and analysis.
6. When enough information is acquired to logically conclude that a particular condition or activity is a significant contributing source of bacteria, develop and implement BMPs as appropriate to target the specific source. Such BMPs, in the context of this Bacteria Pilot Study, may include, but are not limited to: door-to-door contact with residents and business owners; direct informational mailings; modifications to catch basin cleaning priorities and frequencies in specific areas; modifications to parks rules associated with wildlife feeding; and habitat management and tolerance policies for targeted wildlife species.
7. Conduct follow up stormwater sampling and data analysis to evaluate effectiveness of selected BMPs.

Measurable Goals	Status of Measurable Goals – FY16
• Collect and analyze stormwater samples within the study area during at least three (3) significant wet weather storm events per year for the duration of the permit cycle.	• Done. Stormwater samples were collected during 3 storm events, and samples were analyzed.
• Report on all field condition assessments completed during the permit year. Show how collected field data is used to confirm or eliminate bacteria sources.	• Done. Six field condition assessment events were conducted during the reporting period. Results are reported in Section 4 of this report.
• Initiate at least two (2) new BMPs by December 2011 that will either identify or rule out specific sources of bacterial contributions to the MS4 within the study area.	• Done, as previously reported.
• Starting in July 2012, initiate at least one new BMP per year that will address identified specific sources of bacteria within the study area.	• Done. One new BMP was initiated in FY16: Installation of pet waste bag distribution and disposal centers at the Washington/Jefferson Skate Park.
• Develop an electronic case history file by February 2011 that contains documentation of findings and results that can be utilized by staff to evaluate overall success of study.	• Electronic files are being kept up to date and organized.
• Report on results of stormwater sampling and analysis in association with implemented BMPs with emphasis on showing the effectiveness of the BMP selected.	• Done, as detailed in Section 4 of this report.
Tracking Measures	**Tracking Data – FY16**
• Track the number of sampling events, samples collected, and resulting bacteria analysis results.	• Samples were collected during three storm events (12/17/15, 12/21/15, and 1/28/16) at 4 locations (upstream/downstream at EWEB, and upstream/downstream at the Rose Garden structural BMP), for a total of 12 samples. • See Section 4 of this report for monitoring results and analysis.

• Track results of field condition assessments conducted and the corresponding outcome of the assessment. Attempt to correlate noted conditions with results of sampling analysis.		• A total of 6 field condition assessments were completed during the reporting period. Field evidence suggests that at the same locations avian populations contribute significant amounts of bacteria.
• Document additional strategies that will identify or rule out potential sources of bacteria. Report on any conclusions derived as a result of implementing these strategies.		• Following up on the City's 2015 project, in 2016 staff continued to monitor the impact of tree planting along the Roosevelt Channel. As the plants continue to mature, it is assumed that they will continue to be an effective deterrent for geese.
• Document the use of alternative investigative approaches such as microbial source tracking and sediment sampling.		• No additional alternative investigative approaches were considered in 2016 beyond those reported in past years' reports including an evaluation of microbial source tracking studies and sediment sampling previously conducted.
• Document all follow up sampling and analysis and conclusions derived regarding BMP effectiveness.		• All sampling results have been documented, stored electronically, and summarized in Section 4 of this report and previous year's annual reports. Results of bacteria pilot study sampling conducted in FY16 are included in Section 4.

FY16 Activities and Accomplishments

The bacteria pilot study was first incorporated into the City's SWMP in 2005. By fall 2015, the City had completed an analysis of potential sources of bacteria, applicability of each potential source to the bacteria pilot study area, inferences to bacteria sources City-wide, existing strategies to address sources, and potential additional strategies. The analysis concluded that the bacteria pilot study has served its purpose and achieved its goals to the extent that it identified potential sources of bacteria, validated the importance of current program elements that address bacteria, and led to some program refinements including incorporating four public water quality retrofit projects in to the City's Capital Improvement Program, continuation of bacteria sampling of stormwater and receiving water, and refinements to programs outside of the MS4 SWMP that will be reflected in the city's annual TMDL Implementation reports. In light of the analysis and its findings, the City's MS4 Permit Renewal package (submitted December 2015) reflects the City's proposal to discontinue this pilot study BMP.

Planned or Considered FY17 Activities

- Staff will continue to monitor the Washington/Jefferson Skate Park to evaluate the impact of installing the pet waste bag distribution and disposal centers.
- In light of the importance of the City's existing stormwater outreach and education program in address potential sources of bacteria, staff is considering developing a television commercial to urge residents to pick up their pet's waste.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP P2.

3.7 Status of Industrial Controls BMP

W1 Industrial Stormwater Management Program

3.7 Status of Industrial Controls

3.7.1 W1 – Industrial Stormwater Management Program

Responsible Department/Division:	**BMP Contact:**
Public Works / Wastewater	Wastewater Division Director

BMP Description
Provide oversight of stormwater discharges and washing activities from industrial facilities, screening new businesses for those that may require NPDES Permits, conducting inspections and providing technical assistance to industries with NPDES Permits, and responding to spills at facilities with permits.

Tasks
1. Manage 1200Z and 1700A NPDES permit files.
2. Evaluate new and existing facilities for requiring NPDES permits.
3. Determine permit compliance with existing NPDES permitted facilities.
4. Issue Request for Corrective Action letters for permit noncompliance.
5. Conduct periodic monitoring for compliance determination.
6. Provide technical assistance to permitted facilities.
7. Retain copies of Stormwater Pollution Control Plans for each permitted industry.
8. Retain copies of facility inspections.

Measurable Goals	Status of Measurable Goals – FY16
• Conduct site inspections on 20% of permitted facilities annually.	• Completed.

Tracking Measures	Tracking Data – FY16
• Percentage of permitted facilities inspected.	• 23%
• Number of corrective action letters sent and follow up responses.	• 18 corrective action letters were sent and all required responses were received.
• Number of Action Plans prepared by permit registrants.	• 97 Action Plans prepared by permit registrants were reviewed and accepted.

FY16 Activities and Accomplishments
- Currently there are seventy-three active 1200Z NPDES general industrial stormwater discharge permits and four active 1700A NPDES wash water discharge permits.
- During this reporting period, one new 1200Z was issued and four 1200Z permits were terminated.
- Six sites were evaluated and it was suggested that No Exposure Certification status be granted at five of those sites. Currently twenty-eight approved No Exposure Certifications are on file.

- One existing site was evaluated for the need of a 1200-Z Permit or No Exposure Certification and it was determined that the businesses did not qualify for coverage.
- One new Stormwater Pollution Control Plan was submitted.
- Twenty-two existing Stormwater Pollution Control Plans were modified and approved.
- Four permittees were referred for formal enforcement for failure to conduct required monitoring. These businesses are as follows; BJB Milling & Lumber, Ninkasi Brewing Company, Pacific Recycling, and Rexius Forest By-Products.

Planned or Considered FY17 Activities

- Formal inspections and informal site visits will continue be conducted at 1200-Z and 1700-A permitted facilities to assist with and assess permit compliance.
- Stormwater sampling will be conducted at industrial and commercial facilities if there is a particular concern that the stormwater discharge from a site is significantly increasing the pollutant load to the MS4 or if there is a need to verify the accuracy of self-monitoring data.
- New and existing businesses will continue to be evaluated to determine the need for NPDES permitting and compliance with stormwater pollution related local ordinances.

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP W1.

3.8 Status of Permit Management

E5 Permit Management & Reporting

3.8 Status of Permit Management

3.8.1 E5 – Permit Management & Reporting

Responsible Department/Division:	**BMP Contact:**
Public Works / Engineering	City Engineer

BMP Description
Administration of the overall NPDES permit compliance effort, including permit renewals, annual reports, program evaluations and documentation of the City's adaptive management processes, and updates to the City's TMDL benchmark assessment.

Tasks
1. Coordinate with all City divisions and groups that administer BMPs described within the SWMP to review program commitments, gather tracking data, and where appropriate, assist with program evaluation and additional goal setting or BMP enhancements.
2. Evaluate programs and BMPs as described in the SWMP to ensure that the overall NPDES permit objectives are being met, including reduction of pollutants on the DEQ 2004/2006 303(d) list and established TMDLs as compared to the pollutant load reduction benchmarks.
3. Conduct appropriate public involvement efforts related to various NPDES permit elements such as SWMP/Monitoring plan updates or proposed adaptive management. May include presentations to advisory groups, elected officials, and public notices.

Measurable Goals	Status of Measurable Goals – FY16
• Submit Annual Reports to DEQ, that summarize implementation of the requirements as described in the City's MS4 permit, Schedule B.	• Year 2015 Stormwater Annual Report submitted to DEQ on December 1, 2015.
• Evaluate progress towards meeting TMDL pollution reduction benchmarks for each five year renewal submittal.	• TMDL Pollutant Load Reduction Evaluation (including evaluation of progress toward meeting TMDL benchmarks) and TMDL Wasteload Allocation Attainment Assessment were submitted to DEQ November 26, 2014 (Supplement to Stormwater Annual Report). • Updated TMDL Benchmarks submitted to DEQ December 28, 2015 (Municipal Stormwater Permit Renewal).

• Conduct public involvement within an appropriate time to meet legal requirements for the five year renewal submittals, and for on-going adaptive management as appropriate.	• Published notice in the Register Guard of the opportunity to review draft Municipal Stormwater Permit Renewal document (specifically the updated SWMP and updated TMDL pollutant reduction benchmarks). Posted draft document on the City's web site and made printed copy available at PWE offices. • Published notice in the Register Guard of the opportunity to review draft 2015 Stormwater Annual Report. Posted draft report on the City's web site and made printed copy available at PWE offices. • Kept MS4 web page up to date and included staff contact information for additional information, comments or questions.

Tracking Measures	Tracking Data – FY16
• Track public involvement events and number of people reached.	• No public comments were received on the draft 2015 Stormwater Annual Report. • No public comments were received on the draft Municipal Stormwater Permit Renewal document.
• Post Annual Reports on City's web site.	• Final 2015 Stormwater Annual Report and the Municipal Stormwater Permit Renewal are posted on the City's web site.

FY16 Activities and Accomplishments

- Municipal Stormwater Permit renewal was submitted to DEQ December 28, 2015 and included: a maximum extent practicable (MEP) evaluation; Proposed Stormwater Management Plan (SWMP) changes and updated SWMP; estimate of total annual stormwater pollutant loads and projected service area expansion; updated TMDL benchmarks, stormwater program fiscal evaluation; proposed monitoring program revisions; and Draft Monitoring Plan.
- Kept Stormwater Policy team and Stormwater Management team apprised of and engaged in discussions with DEQ.
- Collaborated on regulatory and non-regulatory topics with partner agencies including in the Eugene-Springfield area, other members of the Oregon Association of Clean Water Agencies (ACWA), and with the recently-formed National Association of Clean Water Agencies Stormwater Advocacy Network (NSAN).
- Provided opportunities for public input on permit renewal deliverables.

Planned or Considered FY17 Activities

- Finalize and submit 2016 Stormwater Annual Report by December 1, 2016.
- Continue to work with other city stormwater managers to ensure that permit due dates continue to be met, and for multi-year efforts, that we stay on track to meet permit due dates.
- Coordinate with City stormwater managers and staff to continue implementing the adaptive management process of "develop – implement – collect data & information – evaluate – assess needs – modify."

Proposed Revisions to BMP, Measurable Goals or Tracking Measures

- See City of Eugene's Municipal Stormwater Permit Renewal application package (December 2015) for proposed changes to the City's SWMP including BMP E5.

4 MONITORING PROGRAM

4.1 Monitoring Results Summary

For nearly twenty years, water samples have been collected from streams receiving stormwater runoff within the Eugene, Oregon urban growth area and tested for pollutants. Statistical tests indicate long-term water quality changes have been occurring to streams for multiple pollutants, which are summarized in Figures 4-1a and 4-1b. The figures illustrate the locations of water quality monitoring sites and their respective drainage basin areas, and list those pollutants having either an increasing or decreasing concentration trend. Green may be presumed to be a "good" indicator, while red a "poor" indicator, with the exception of dissolved oxygen, which in this instance an increasing trends is desirable and indicative of improving water quality. Decreasing pollutant concentration trends are observed at both Amazon and Willamette basin monitoring sites, and include metals (dissolved (D) fraction and total (T) sample), nitrogen and phosphorus nutrients, water hardness, bacteria, temperature, suspended solids, and turbidity. Increasing concentration trends for zinc occur at multiple sites in the Amazon basin. These pollutants are among a suite of forty-one water quality tests; those not shown in the figures means no statistically significant trend is observed. We attribute the decreasing pollutant trends to the sum of stormwater program BMPs applied within the Eugene urban growth boundary to control stormwater pollutants caused by human activities.

Intra-basin water quality comparisons, whereby results observed at a downstream monitoring site are compared to an upstream site, indicate statistically significant change occurs to water quality as the stream flows through the urbanized area. These comparisons are summarized in Figures 4-1c and 4-1d and are color coded and ordered such that the upstream site is listed first in the comparison; analytes with the highest value have the same color as the monitoring site name. One exception to this ordering is the Willow Creek-Amazon Creek at 29th pair which compares a reference site in a relatively undeveloped area (Willow Creek) to a site located in a developed residential area (Amazon/29th). With a few exceptions, concentrations of metals and solids are typically higher at the downstream monitoring site in the paired comparisons; examples include Amazon Creek at 29th Avenue (upstream) compared to Amazon Creek at the Railroad Crossing (downstream), and the Willamette River Upstream of the Urban Growth Boundary (upstream) compared to the Willamette River Downstream of Beltline Bridge (downstream). In the first comparison nutrient concentrations are sometimes deplenished downstream, water hardness and *E. coli* decrease downstream, while fecal coliform counts increase downstream. In the latter comparison nutrient concentrations and bacteria counts are higher downstream at the Beltline Bridge site.

For the 2015/2016 monitoring period, pollutant concentrations exceeding Oregon's water quality criteria are summarized in Figures 4-1e and 4-1f. These include arsenic, copper, lead, mercury, zinc, bacteria, dissolved oxygen, turbidity, and temperature. Note the analytes are color coded for those with a statistically significant increasing or decreasing trend. A key of the analytes shown in Figures 4-1a through 4-1f is presented in Table 4-1 after the figures.

Subsequent sections of this report describe the methodologies used to characterize the water quality data that are generalized in the figures below, as well as other stormwater program monitoring elements.

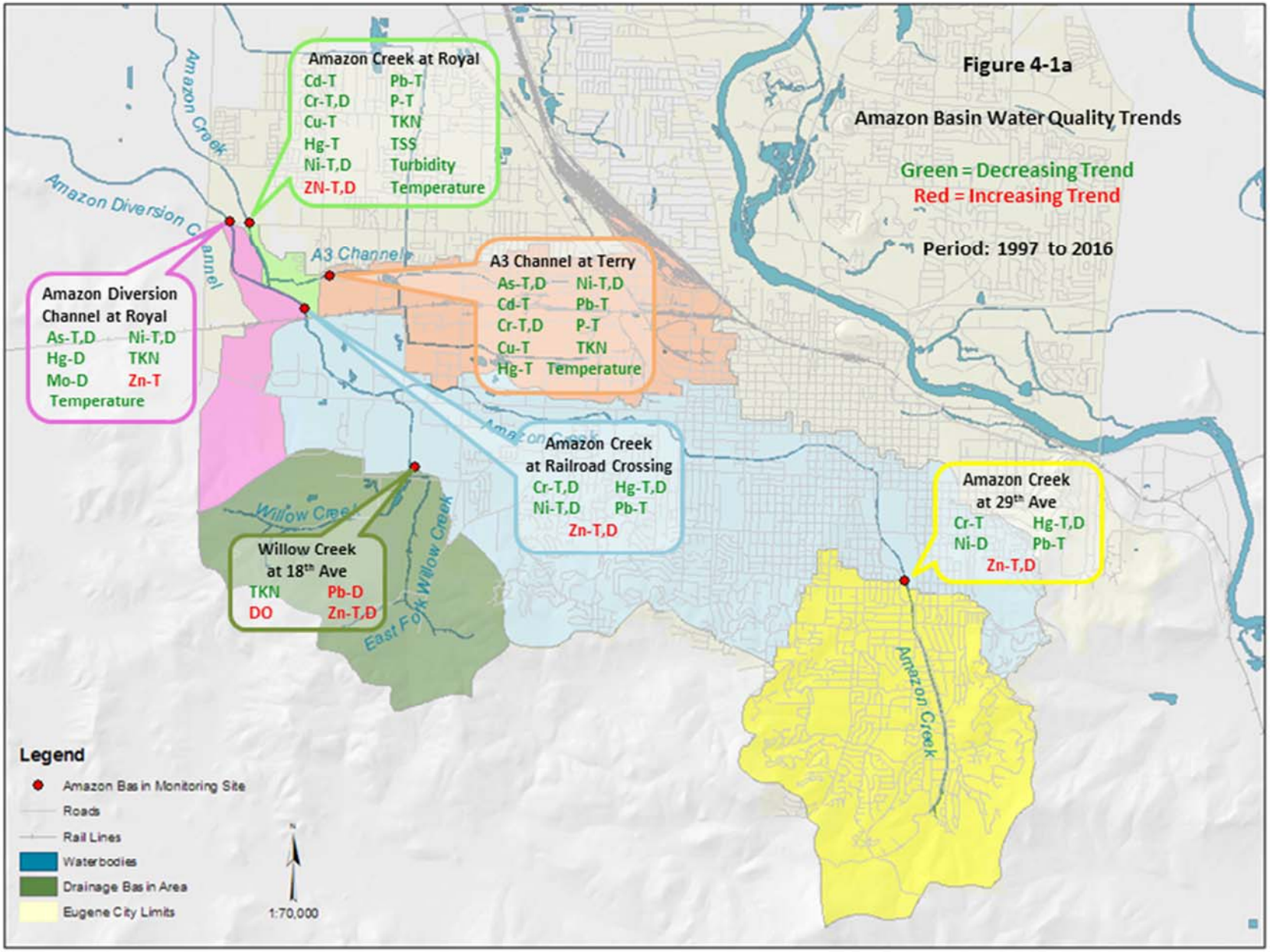
Figure 4-1a
Amazon Basin Water Quality Trends
Green = Decreasing Trend
Red = Increasing Trend
Period: 1997 to 2016
Amazon Creek at Royal
Cd-T Pb-T
Cr-T,D P-T
Cu-T TKN
Hg-T TSS
Ni-T,D Turbidity
ZN-T,D Temperature
Amazon Diversion Channel at Royal
As-T,D Ni-T,D
Hg-D TKN
Mo-D Zn-T
Temperature
A3 Channel at Terry
As-T,D Ni-T,D
Cd-T Pb-T
Cr-T,D P-T
Cu-T TKN
Hg-T Temperature
Amazon Creek at Railroad Crossing
Cr-T,D Hg-T,D
Ni-T,D Pb-T
Zn-T,D
Amazon Creek at 29th Ave
Cr-T Hg-T,D
Ni-D Pb-T
Zn-T,D
Willow Creek at 18th Ave
TKN Pb-D
DO Zn-T,D
Amazon Creek
Amazon Diversion Channel
A3 Channel
Willow Creek
East Fork Willow Creek
Legend
Amazon Basin Monitoring Site
Roads
Rail Lines
Waterbodies
Drainage Basin Area
Eugene City Limits
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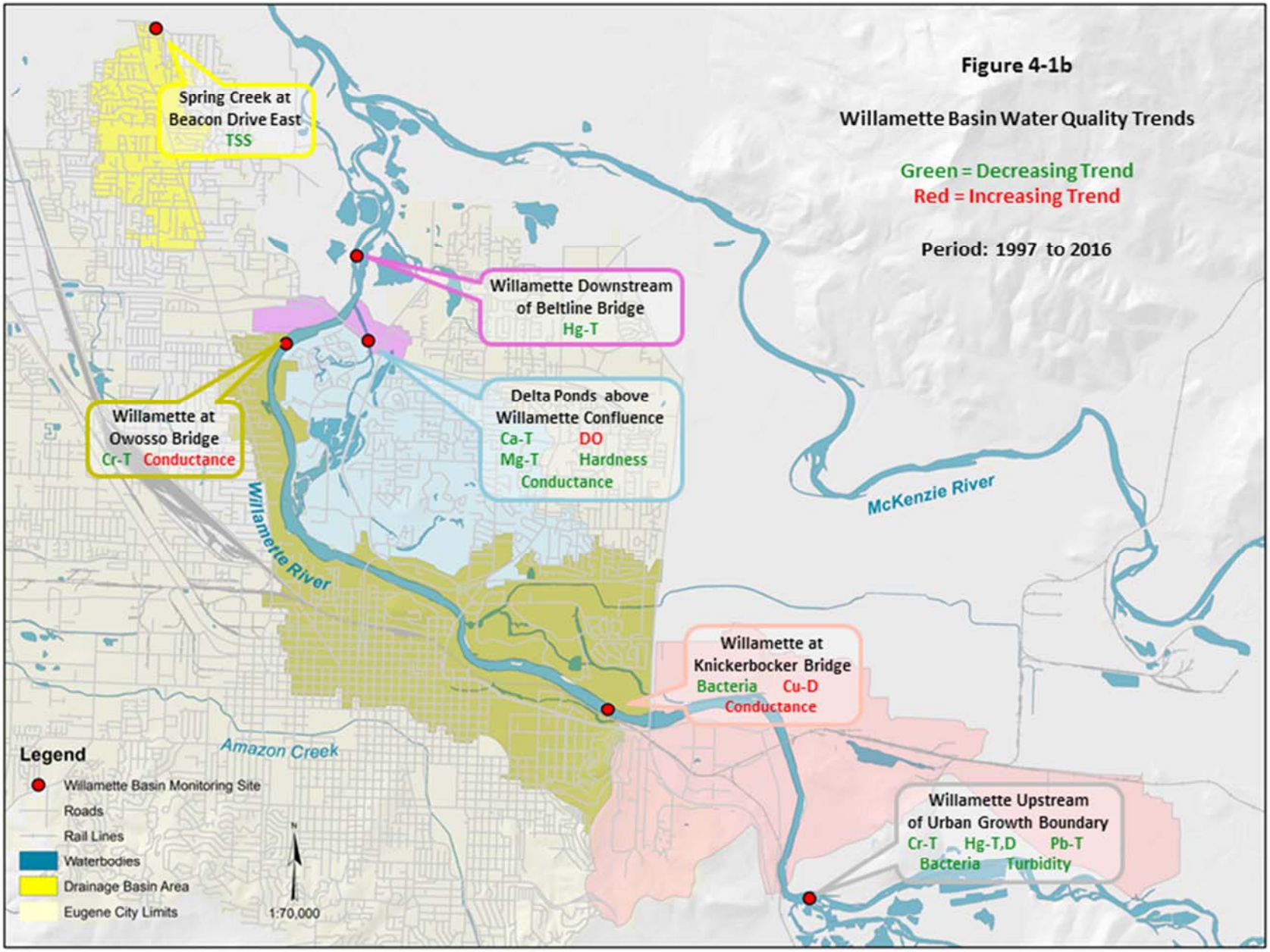
Figure 4-1b
Willamette Basin Water Quality Trends
Green = Decreasing Trend
Red = Increasing Trend
Period: 1997 to 2016
Spring Creek at
Beacon Drive East
TSS
Willamette Downstream
of Beltline Bridge
Hg-T
Willamette at
Owosso Bridge
Cr-T Conductance
Delta Ponds above
Willamette Confluence
Ca-T DO
Mg-T Hardness
Conductance
Willamette River
McKenzie River
Willamette at
Knickerbocker Bridge
Bacteria Cu-D
Conductance
Amazon Creek
Willamette Upstream
of Urban Growth Boundary
Cr-T Hg-T,D Pb-T
Bacteria Turbidity
Legend
Willamette Basin Monitoring Site
Roads
Rail Lines
Waterbodies
Drainage Basin Area
Eugene City Limits
N
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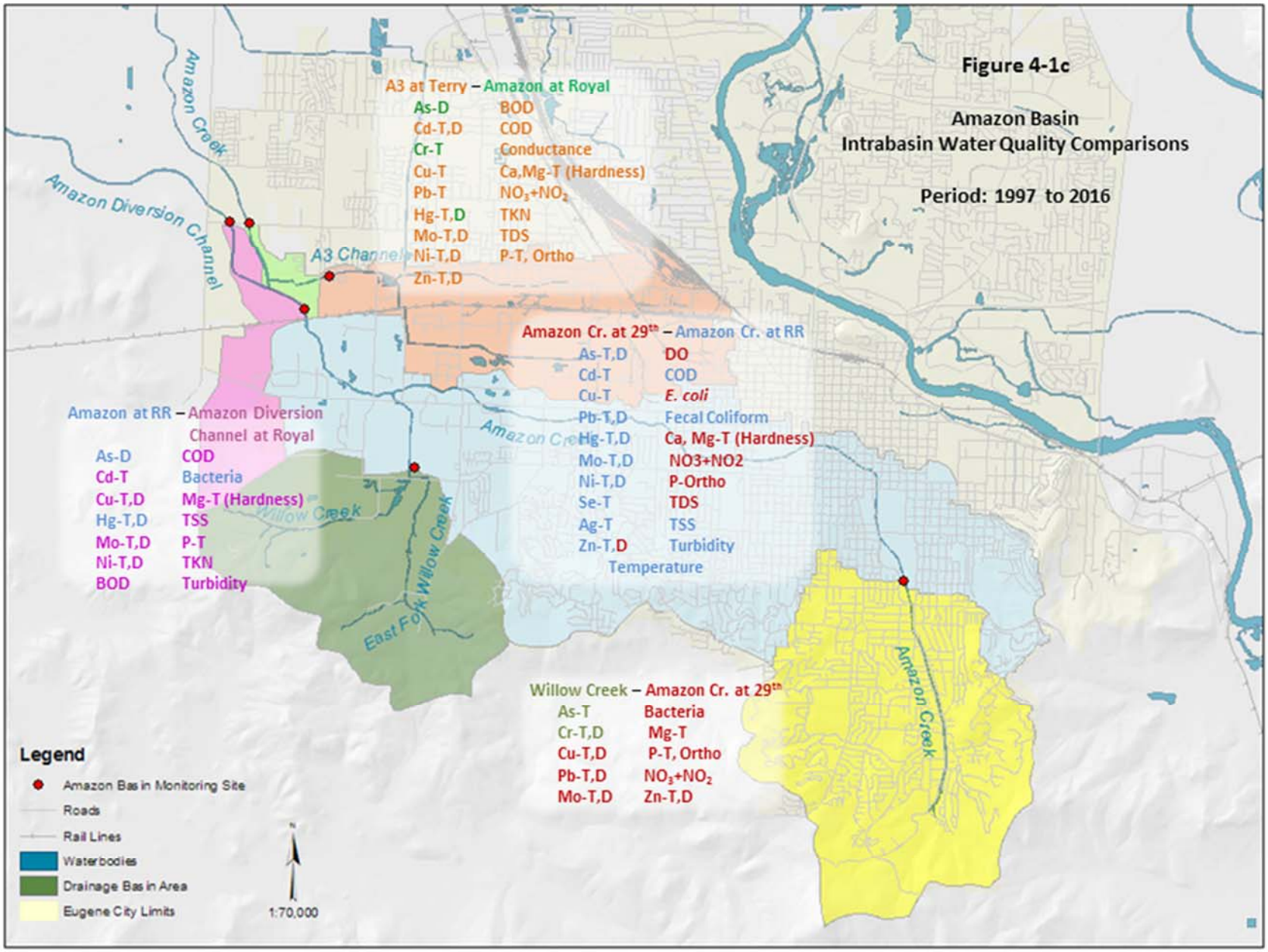
Figure 4-1c
Amazon Basin
Intrabasin Water Quality Comparisons
Period: 1997 to 2016
A3 at Terry – Amazon at Royal
As-D
Cd-T,D
Cr-T
Cu-T
Pb-T
Hg-T,D
Mo-T,D
Ni-T,D
Zn-T,D
BOD
COD
Conductance
Ca,Mg-T (Hardness)
NO_3+NO_2
TKN
TDS
P-T, Ortho
Amazon Cr. at 29th – Amazon Cr. at RR
As-T,D
Cd-T
Cu-T
Pb-T,D
Hg-T,D
Mo-T,D
Ni-T,D
Se-T
Ag-T
Zn-T,D
DO
COD
E. coli
Fecal Coliform
Ca, Mg-T (Hardness)
NO3+NO2
P-Ortho
TDS
TSS
Turbidity
Temperature
Amazon at RR – Amazon Diversion Channel at Royal
As-D
Cd-T
Cu-T,D
Hg-T,D
Mo-T,D
Ni-T,D
BOD
COD
Bacteria
Mg-T (Hardness)
TSS
P-T
TKN
Turbidity
Willow Creek – Amazon Cr. at 29th
As-T
Cr-T,D
Cu-T,D
Pb-T,D
Mo-T,D
Bacteria
Mg-T
P-T, Ortho
NO_3+NO_2
Zn-T,D
Amazon Creek
Amazon Diversion Channel
A3 Channel
Willow Creek
East Fork Willow Creek
Legend
Amazon Basin Monitoring Site
Roads
Rail Lines
Waterbodies
Drainage Basin Area
Eugene City Limits
1:70,000

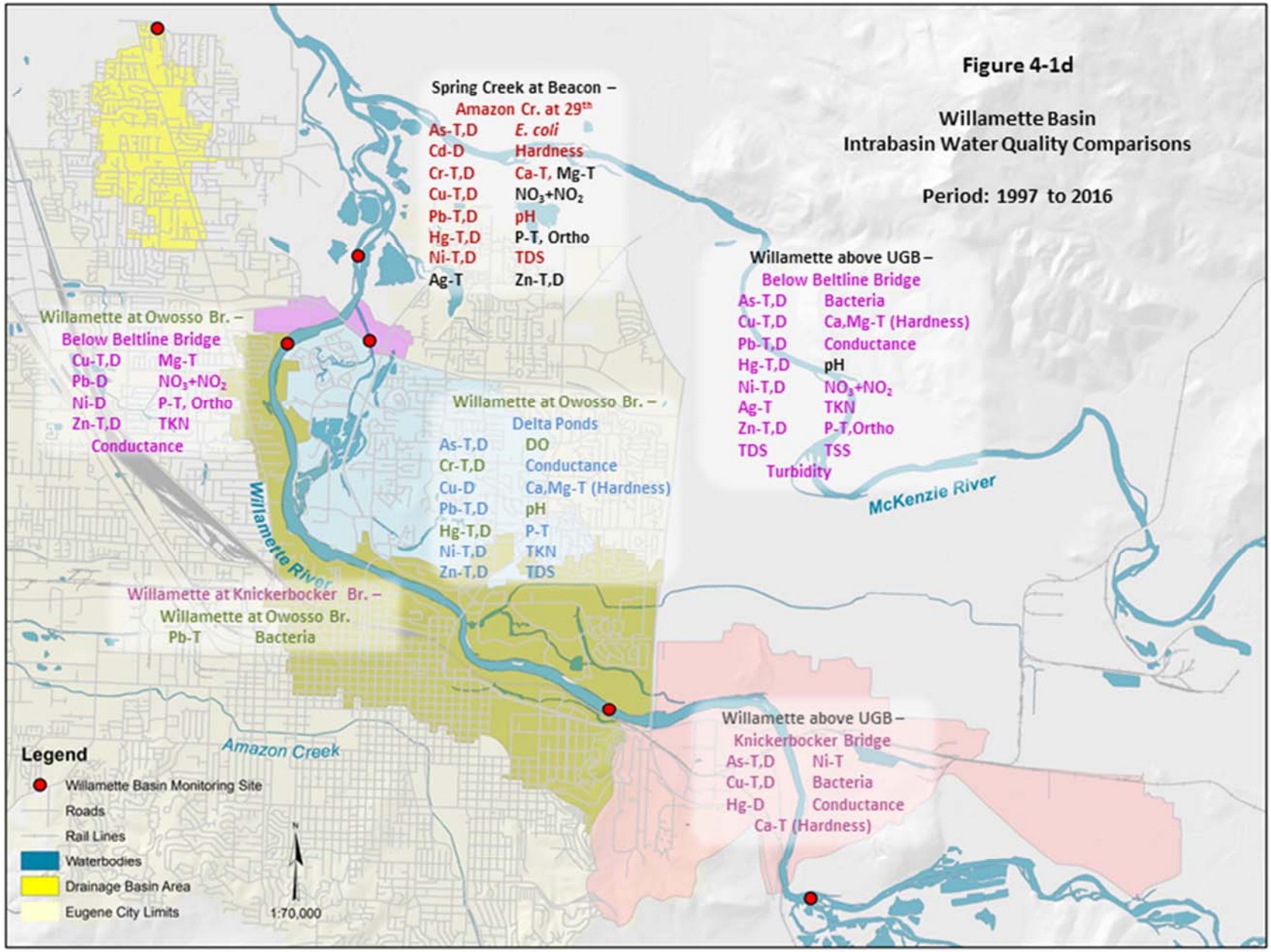
Figure 4-1d
Willamette Basin
Intrabasin Water Quality Comparisons
Period: 1997 to 2016
Spring Creek at Beacon –
Amazon Cr. at 29th
As-T,D E. coli
Cd-D Hardness
Cr-T,D Ca-T, Mg-T
Cu-T,D NO3+NO2
Pb-T,D pH
Hg-T,D P-T, Ortho
Ni-T,D TDS
Ag-T Zn-T,D
Willamette above UGB –
Below Beltline Bridge
As-T,D Bacteria
Cu-T,D Ca,Mg-T (Hardness)
Pb-T,D Conductance
Hg-T,D pH
Ni-T,D NO3+NO2
Ag-T TKN
Zn-T,D P-T,Ortho
TDS TSS
Turbidity
Willamette at Owosso Br. –
Below Beltline Bridge
Cu-T,D Mg-T
Pb-D NO3+NO2
Ni-D P-T, Ortho
Zn-T,D TKN
Conductance
Willamette at Owosso Br. –
Delta Ponds
As-T,D DO
Cr-T,D Conductance
Cu-D Ca,Mg-T (Hardness)
Pb-T,D pH
Hg-T,D P-T
Ni-T,D TKN
Zn-T,D TDS
Willamette River
McKenzie River
Willamette at Knickerbocker Br. –
Willamette at Owosso Br.
Pb-T Bacteria
Amazon Creek
Willamette above UGB –
Knickerbocker Bridge
As-T,D Ni-T
Cu-T,D Bacteria
Hg-D Conductance
Ca-T (Hardness)
Legend
Willamette Basin Monitoring Site
Roads
Rail Lines
Waterbodies
Drainage Basin Area
Eugene City Limits
N
1:70,000

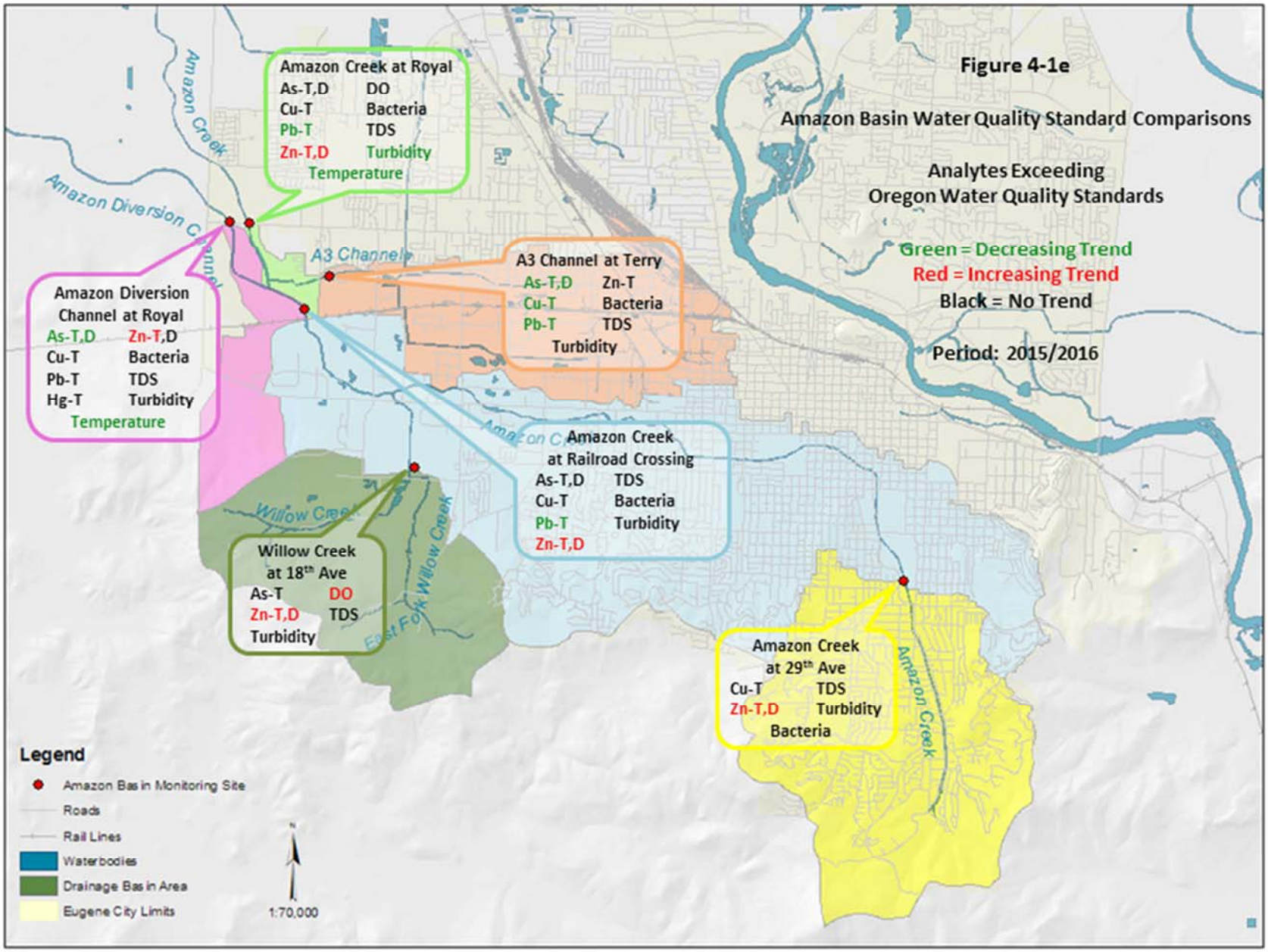
Figure 4-1e
Amazon Basin Water Quality Standard Comparisons
Analytes Exceeding
Oregon Water Quality Standards
Green = Decreasing Trend
Red = Increasing Trend
Black = No Trend
Period: 2015/2016
Amazon Creek at Royal
As-T,D DO
Cu-T Bacteria
Pb-T TDS
Zn-T,D Turbidity
Temperature
Amazon Diversion Channel at Royal
As-T,D Zn-T,D
Cu-T Bacteria
Pb-T TDS
Hg-T Turbidity
Temperature
A3 Channel at Terry
As-T,D Zn-T
Cu-T Bacteria
Pb-T TDS
Turbidity
Amazon Creek at Railroad Crossing
As-T,D TDS
Cu-T Bacteria
Pb-T Turbidity
Zn-T,D
Willow Creek at 18th Ave
As-T DO
Zn-T,D TDS
Turbidity
Amazon Creek at 29th Ave
Cu-T TDS
Zn-T,D Turbidity
Bacteria
Amazon Creek
Amazon Diversion Channel
A3 Channel
Willow Creek
East Fork Willow Creek
Legend
Amazon Basin Monitoring Site
Roads
Rail Lines
Waterbodies
Drainage Basin Area
Eugene City Limits
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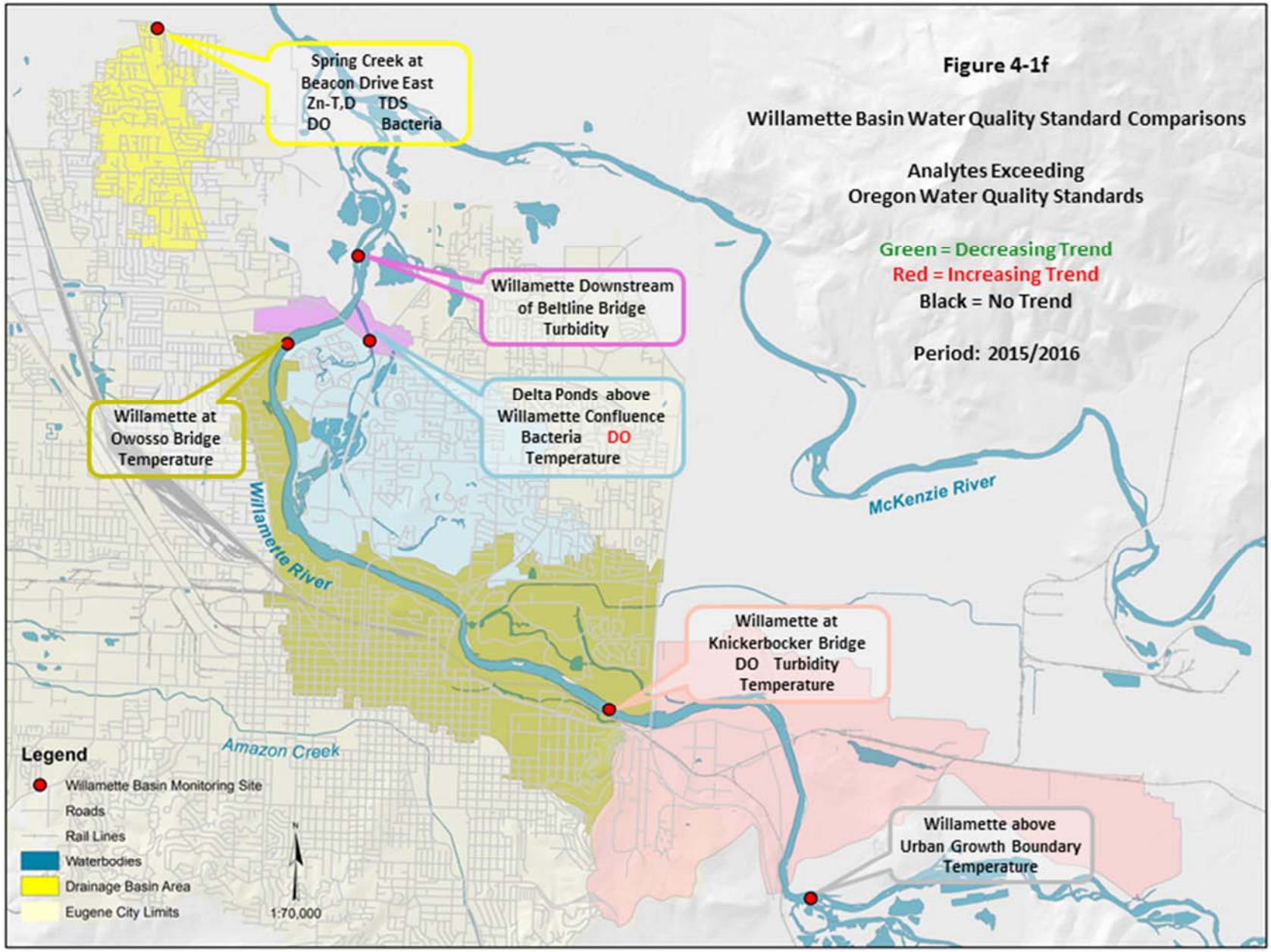


Figure 4-1f
Willamette Basin Water Quality Standard Comparisons
Analytes Exceeding
Oregon Water Quality Standards
Green = Decreasing Trend
Red = Increasing Trend
Black = No Trend
Period: 2015/2016
Spring Creek at
Beacon Drive East
Zn-T,D TDS
DO Bacteria
Willamette Downstream
of Beltline Bridge
Turbidity
Delta Ponds above
Willamette Confluence
Bacteria DO
Temperature
Willamette at
Owosso Bridge
Temperature
Willamette River
McKenzie River
Willamette at
Knickerbocker Bridge
DO Turbidity
Temperature
Amazon Creek
Willamette above
Urban Growth Boundary
Temperature
Legend
Willamette Basin Monitoring Site
Roads
Rail Lines
Waterbodies
Drainage Basin Area
Eugene City Limits
N
1:70,000

Table 4-1 Analyte Key for Figures 4-1a through 4-1f	
Metals:	
As	Arsenic
Cd	Cadmium
Cr	Chromium
Cu	Copper
Pb	Lead
Hg	Mercury
Mo	Molybdenum
Ni	Nickel
Se	Selenium
Ag	Silver
Zn	Zinc
Non-Metals:	
TKN	Total Kjeldahl Nitrogen
NH_3	Ammonia – as Nitrogen
NO_3+NO_2	Nitrate+Nitrite – as Nitrogen
P-O	Ortho Phosphorus
P-T	Total Phosphorus
Ca-T	Total Calcium
Mg-T	Total Magnesium
Hardness	Water Hardness
Conductance	Specific Conductance
TDS	Total Dissolved Solids
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
E. coli	Escherichia coli bacteria
Fecal Coliform	Fecal Coliform bacteria
TSS	Total Suspended Solids
Turbidity	Water turbidity
pH	Water Field pH
Temperature	Water Temperature
D = Dissolved fraction T = Total sample	

4.2 Objectives of the Monitoring Program

Permits issued under the MS4 Phase I permit program require ongoing water-quality monitoring to assess the chemical, biological, and physical effects of stormwater on receiving water bodies. The monitoring described in this report was conducted under the City's NPDES permit (December 30, 2010) and the City's Stormwater Monitoring Plan (November 2011 Rev. 1.0). For purposes of the Monitoring Plan, the term "monitoring" includes water quality monitoring (sample collection), monitoring activities (such as construction) in a watershed, monitoring changes in a watershed, or monitoring the success of BMPs. This section describes the overall program effectiveness by means of analysis of water quality data and assessment of water quality trends for representative major surface water bodies receiving stormwater discharges from the City's stormwater system.

The objectives of the Stormwater Monitoring Plan include:

- Meet the regulatory requirements of the City's MS4 permit;
- Identify pollutants of concern and their source;
- Identify the degree to which stormwater discharges may be contributing to water quality criteria exceedances in receiving waters;
- Identify, to the best practical extent, the impact of stormwater discharges to the aquatic environment of receiving waters;
- Identify the most effective best management practices (control measures);
- Refine estimates of annual and seasonal pollutant loads;
- Determine the frequency of monitoring required to reveal water quality trends and assess the effectiveness of control measures; and
- Maintain efficient and effective tools for storage, retrieval, and analysis of data collected, and assure data quality.

The monitoring plan was designed to provide technical information to assist in meeting the stated objectives to the maximum extent practical given available resources.

4.3 Organization of the Water Quality Monitoring Program

Water quality monitoring for the annual period covered by this report includes three program elements:

- Storm event water quality monitoring;
- Ambient water quality monitoring of waterbodies receiving MS4 discharges;
- Data management, analysis, and reporting.

Every third year biological assessments through macroinvertebrate surveys of the MS4 receiving waterbodies, as well as physical field condition assessments are performed and results summarized; these program elements were reported in the previous annual report.

The following sections will focus on analysis of monitoring activities to assess overall stormwater program effectiveness by reviewing historical water quality trends for those water bodies receiving stormwater. Sampling sites are located in or near the permit boundary for the City of Eugene. Maps of the sampling locations to assess ambient and stormwater quality are

referenced in the following paragraphs and included at the end of Section 4. All sampling follows the protocol established in the Monitoring Plan, including appropriate sampling, handling, and analysis methods described by the EPA and in the guidelines of 40CFR136 establishing test procedures for the analysis of pollutants. Quality assurance and controls were applied to all elements of the monitoring program, including sample collection, handling, laboratory analysis, and reporting. The Eugene/Springfield Environmental Laboratory performed analytical services under a DEQ-approved Quality Assurance Plan. Documentation and data management activities follow environmental management systems described in ISO 14001:2004(E); the Eugene/Springfield Wastewater Management Facility is registered as conforming to the ISO 14001 standard.

4.4 Program Activities

Program activities for the permit period primarily consisted of storm event monitoring, ambient water quality monitoring, and bacteria field assessments. Figures 4-7a, 4-8 and 4-9 are small-scale maps showing the locations of all ambient surface water and storm event sampling sites, and their respective drainage basin areas. More detailed maps are provided and referenced in report discussions below.

4.4.1 Storm Event Water Quality Monitoring

Storm event monitoring was conducted at five sites to assess stormwater quality; Table 4-2 below summarizes the sampling locations and types of samples collected for the analytes indicated (see Figures 4-7a through 4-7e for monitoring locations and drainage basin areas at the end of Section 4). Table 4-2 also indicates the respective receiving waterbody, located either within the Amazon drainage basin or the Willamette River. Other storm event sampling locations include a Contech water quality structural facility located in the Owen Rose Garden adjacent the Willamette River, Spring Creek in north Eugene for pesticides screening, and the Roosevelt Channel to assess a Bacteria Pilot Study (BMP P2) BMP installation to control bacteria. Typically, storm event samples would have been collected from Willow Creek for comparison purposes; the Willow Creek drainage basin is relatively undeveloped and serves as a good baseline for water quality comparisons, however, there was no streamflow during storm event monitoring.

Water quality is characterized through a variety of analytical tests, including field measures of dissolved oxygen, pH, and temperature, and a suite of conventional water quality tests including bacteria, hardness, solids, oxygen demand, nitrogen and phosphorus nutrients, and metals. The sample type – either grab or flow proportional – is also shown in the table above for each sampling location. In addition, a few surface water and piped-system MS4 sites were tested for dioxin, chlorinated hydrocarbons, and methyl mercury.

Table 4-2 2015/2016 Storm Event Water Quality Monitoring Sites			
Location	**MS4 System Type**	**Sample Type**	**Analyte Type**
Amazon Basin Sampling Sites:			
Chambers at 18th Avenue, NE; MH 55404	Piped System	Grab & Flow Proportional	Field, Metals, MeHg, Conventional, Nutrients, and Chlorinated Organics
Roosevelt Channel Upstream; MH 79222 Downstream; MH 79206	Open Channel	Grab	Field, Bacteria
West 5th at Seneca; MH 63693	Piped System	Grab & Flow Proportional	Field, Metals, MeHg, Conventional, Nutrients, Chlorinated Organics
Willamette River Basin Sampling Sites:			
Copping; MH 77793	Piped System	Grab & Flow Proportional	Metals, Conventional, Nutrients, Dioxin
Contech WQ Structural Facility Downstream Structure 85867 Upstream Structure 85866	Piped System	Grab	Field, Bacteria

Flow-proportional stormwater samples collected from the 5th Avenue/Seneca monitoring site, which receives runoff from a combination of wholesale (12%), general services (15%), retail (15%), and industrial (15%) properties; other significant uses include roads (17%) and vacant lots (12). Samples from the Chambers at 18th Avenue monitoring site are primarily from parks (65%, retail (27%), and roads (8%); the Copping site is a combination of single family residential (64%), roads (17%, parks (12%), and vacant (6%) properties. Within the Willow Creek drainage basin, primarily parks (25%), timber (17%), single family residential (6%), roads (4%), general services (5%), and vacant lands (44%) comprise the land use categories.

Laboratory data for stormwater samples collected from these five locations are presented in Appendix A, Tables A.1 through A.7 and color coded to indicate percent change of geomeans of the 2015/2016 samples compared to historical data. Boxplots of all data, the 2015/2016 combined with the historical data set, are shown in Appendix B, Figures B.1 through B.21. The boxplots compare the data to Oregon's water quality standard when available. While the water quality standard is not directly applicable to stormwater data, these comparisons are helpful in assessing whether stormwater pollutants contribute toward exceedance of a water quality standard for an impaired waterbody, or has potential to cause acute or chronic aquatic toxicity. Boxplots consist of a horizontal line in the middle of the box, which marks the median of the sample set; the median splits the ordered sample set in half. The box represents the central 50 percent of data values; the outer edge of each box mark the 25th and 75th percentiles. Whiskers extending from the box mark the range of values that fall within 1.5 box-lengths from the 25th or 75th percentile. Outliers and extreme values are also depicted in the figures, values that are more

than 1.5 box-lengths from the 25th or 75th percentiles are identified as outliers and are denoted by an open circle; extreme values are more than 3 box-lengths and are denoted by an asterisk.

In general, water quality comparisons of storm-event data shown in the tables are for a small number of sampling events for the 2015/2016 sampling period; the historical data set for the Chambers at 18th and W. 5th at Seneca sites consists of 22 and 21 events respectively for the full suite of water quality parameters. Thus, the observed water quality changes may appear to exhibit large changes over short time periods; however, when these data are compared to historical data, the storm-event data tend to be within the observed range of historical water quality. Exceptions will be described in the sections below. Historical data from storm event monitoring will be used to assess implementation of the City's SWMP BMPs and will inform adaptive management measures to reduce pollutant contributions from the MS4 to downstream waterbodies. Further discussion of storm event monitoring is presented in the sections below.

Storm event monitoring for the Contech structural facility located in the Owen Rose Garden included three pairs of grab samples during storm events, both upstream and downstream of the structure. At this time there are insufficient data to draw any conclusions as to the effectiveness of the Contech device. Data are presented in Tables A.4 and A.5.

4.4.1.1 Chambers & West 18th Avenue, NE Lot: MH 55404 – MS4 Piped System

This drainage basin includes commercial properties, portions of Westmoreland Park, and Jefferson Middle and Magnet Arts schools (see Figure 4-7b). Impervious surfaces, including rooftops and paved parking areas at these properties, as well as a section of West 18th Avenue, a minor arterial roadway, are sources of stormwater runoff influencing water quality characteristics at this MS4 piped system monitoring location (MH 55404). Three flow-proportional storm events were sampled for the full suite of water quality analytes, 81% of which had geomean concentrations modestly lower than or equal to historical values. Geomeans for metals arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver and zinc, were lower for the 2015/2016 sampling events than historical values. About 19% of the analyte values, including *E. coli*, fecal coliform, nitrogen and phosphorus nutrients, were higher than historical data values. Analysis of chlorinated hydrocarbons indicated tetrachloroethene was present in at least two samples. Table A.1 in Appendix A summarizes these stormwater quality results.

Comparison of stormwater quality values for this piped system location to state water quality standards indicate concentrations of arsenic, cadmium, copper, lead, mercury, zinc, and dissolved solids, bacteria, pH and turbidity (see Section 4.4.3.5 for a discussion of stream-flow derived turbidity standards) in stormwater are greater than the lowest listed acute, chronic or human health criterion, or other water quality standard (see Figures B.1 through B.21). Amazon Creek, which is the receiving waterbody for stormwater from this location, frequently exceeds applicable state water quality standards for the same pollutants both upstream and downstream of the outfall to which this stormwater monitoring site discharges. In addition, statistically significant concentration increases occur for most of these pollutants in the reach of Amazon Creek 2.5 miles upstream of the 29th Avenue monitoring site and 4.5 miles downstream to the Railroad Track Crossing monitoring site with respect to the location of this MS4 outfall. Later

sections of this report discuss significant water quality trends for stormwater receiving waterbodies in the ambient monitoring program.

Two storm events were sampled at this location for dissolved and total methyl mercury; the maximum observed dissolved methyl mercury concentration was reported at 0.0364 ng/L with a reporting limit of 0.0250 ng/L (one-half the PQL of 0.050 ng/L). The maximum total methyl mercury was reported at 0.0918 ng/L, also with a reporting limit of 0.0250 ng/L.

Chlorinated hydrocarbons were also analyzed for the three storm events at this piped system location, including 1,1-dichloroethene, trans-1,2-dichloroethene, trichloroethene (TCE), and tetrachloroethene (PCE); dichloroethene is a degradate of TCE. Amazon Creek is impaired for these pollutants (2004 303(d) listed). Two values for PCE were J-flagged, that is, analysis indicated the possible presence of these compounds; the detected concentration was less than the reporting limit of 5 µg/L. While J-flagged values are higher than the criteria, the waterbody is not presently used for fish nor water consumption by humans; however, the presence of these pollutants in stormwater may contribute to degradation of Amazon Creek. The J-flagged values were 0.38 µg/L and 0.64 µg/L; the human health criterion is 0.24 µg/L. One value for trichloroethene was J-flagged at 0.16 µg/L; the human health criterion is 1.4 µg/L. Note that the human health criterion for both pollutants is for fish and water consumption; these pollutants have no toxics criteria for fish.

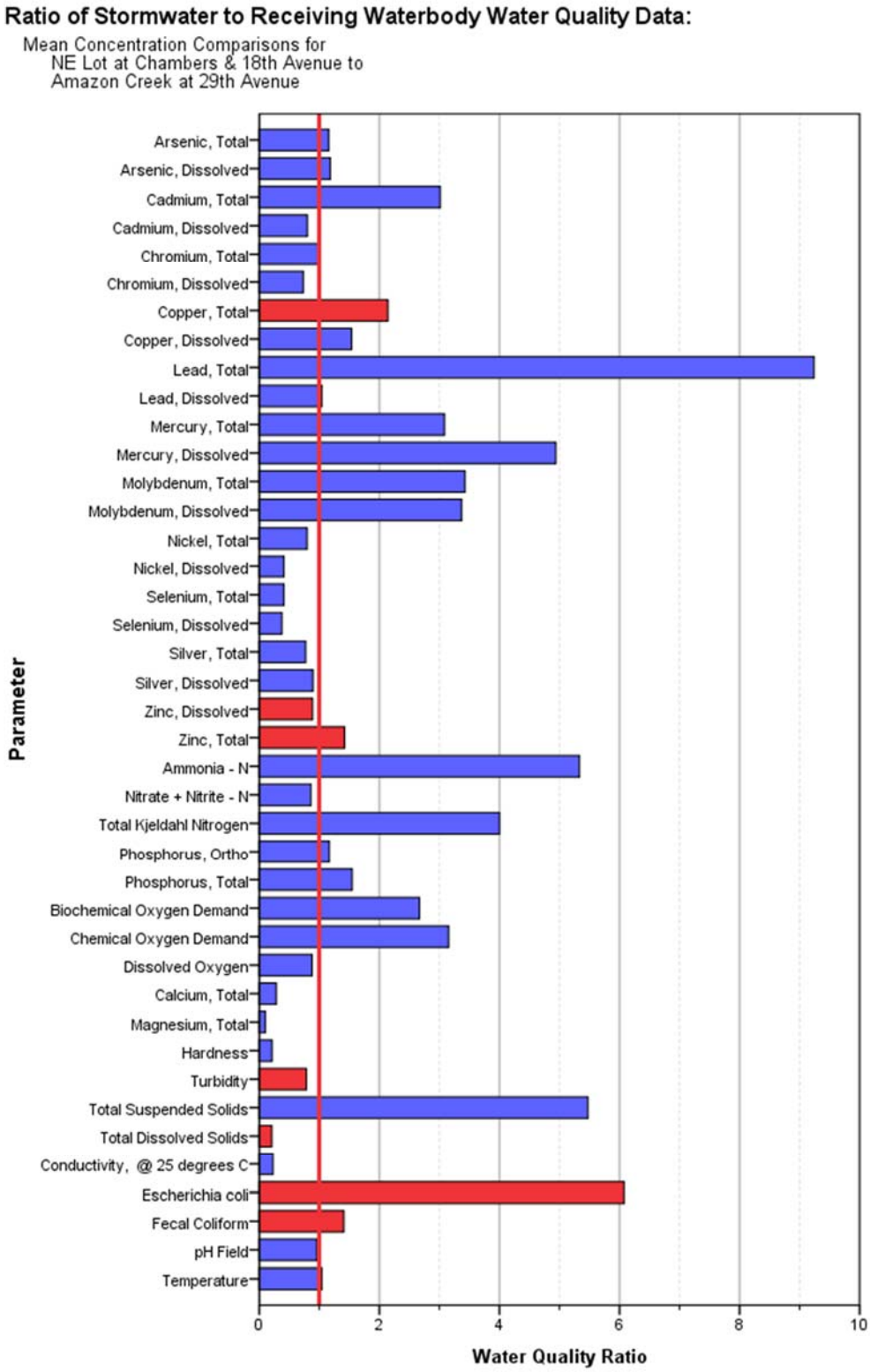
No land use activities typically associated with these types of pollutants are located within the drainage basin area. However, consumer products such as cleaners and solvents containing small amounts of these chlorinated hydrocarbons may be available to the public from commercial businesses within the basin. Businesses within the basin also may utilize these consumer products for operations/maintenance purposes.

Comparison of MS4 stormwater quality to ambient receiving waterbody quality is useful in assessing relative concentrations of pollutants. Figure 4-2 compares mean stormwater quality data for the site to the historical means at the nearest upstream ambient monitoring site, in this case Amazon Creek at 29th Avenue. Multiple analytes exceed an equivalence ratio of one, that is, the concentration of the stormwater analyte value is greater than that of the receiving water body value.

Red bars represent analytes measured in the respective receiving waterbody that exceed applicable Oregon water quality standards for ambient samples collected during the monitoring period. Given the magnitude of the concentration ratios, it can be presumed a ratio greater than one indicates stormwater pollutant loads contribute toward exceedance of water quality standards. The equivalent ratio is useful in terms of assessing which pollutants are of potential concern in stormwater runoff when compared to receiving waterbody quality. Water quality ratios obviously depend on the relative analyte concentrations in the waterbodies being compared.

Analyte concentrations were used to estimate pollutant loads for three drainage basin areas as defined by the stormwater sampling locations within the MS4 (see Figures 4-7b through 7d).

Figure 4-2


Ratio of Stormwater to Receiving Waterbody Water Quality Data:
Mean Concentration Comparisons for
NE Lot at Chambers & 18th Avenue to
Amazon Creek at 29th Avenue
Parameter
Arsenic, Total
Arsenic, Dissolved
Cadmium, Total
Cadmium, Dissolved
Chromium, Total
Chromium, Dissolved
Copper, Total
Copper, Dissolved
Lead, Total
Lead, Dissolved
Mercury, Total
Mercury, Dissolved
Molybdenum, Total
Molybdenum, Dissolved
Nickel, Total
Nickel, Dissolved
Selenium, Total
Selenium, Dissolved
Silver, Total
Silver, Dissolved
Zinc, Dissolved
Zinc, Total
Ammonia - N
Nitrate + Nitrite - N
Total Kjeldahl Nitrogen
Phosphorus, Ortho
Phosphorus, Total
Biochemical Oxygen Demand
Chemical Oxygen Demand
Dissolved Oxygen
Calcium, Total
Magnesium, Total
Hardness
Turbidity
Total Suspended Solids
Total Dissolved Solids
Conductivity, @ 25 degrees C
Escherichia coli
Fecal Coliform
pH Field
Temperature
0
2
4
6
8
10
Water Quality Ratio
Red Analytes = Water quality criterion exceeded in receiving waterbody during 2015/2016 monitoring period.

Pollutant load estimates for the drainage basin areas were calculated based upon results of flow-proportional storm event water quality sampling. Charts in Figures B.22 through B.31 present boxplots for estimated pollutant loads for the NE lot at Chambers & 18th sampling location, in units per acre, for all storm event sampling performed since 2010. Bacteria and turbidity pollutant load contributions to Amazon Creek appear to be significant given the stream is water-quality impaired for these two parameters; the median bacteria loading is about one-billion per acre for *E. coli*, and turbidity loading is about 120,000 NTU per acre. Pollutant loads for the remaining analytes at this site are below estimates described in the City's December 2015, Permit Renewal Report. Additional sampling events conducted over the course of the permit term will be evaluated to refine pollutant mass loading estimates and BMP strategies that target activities and/or sources for these and other pollutants of concern.

Three storm event hydrographs for the MS4 piped system were collected for flow proportional sampling at this site and is shown in Figures B.213 through B.215. All three storm events were sampled from September through November of 2015.

4.4.1.2 Copping Street – MS4 Piped System

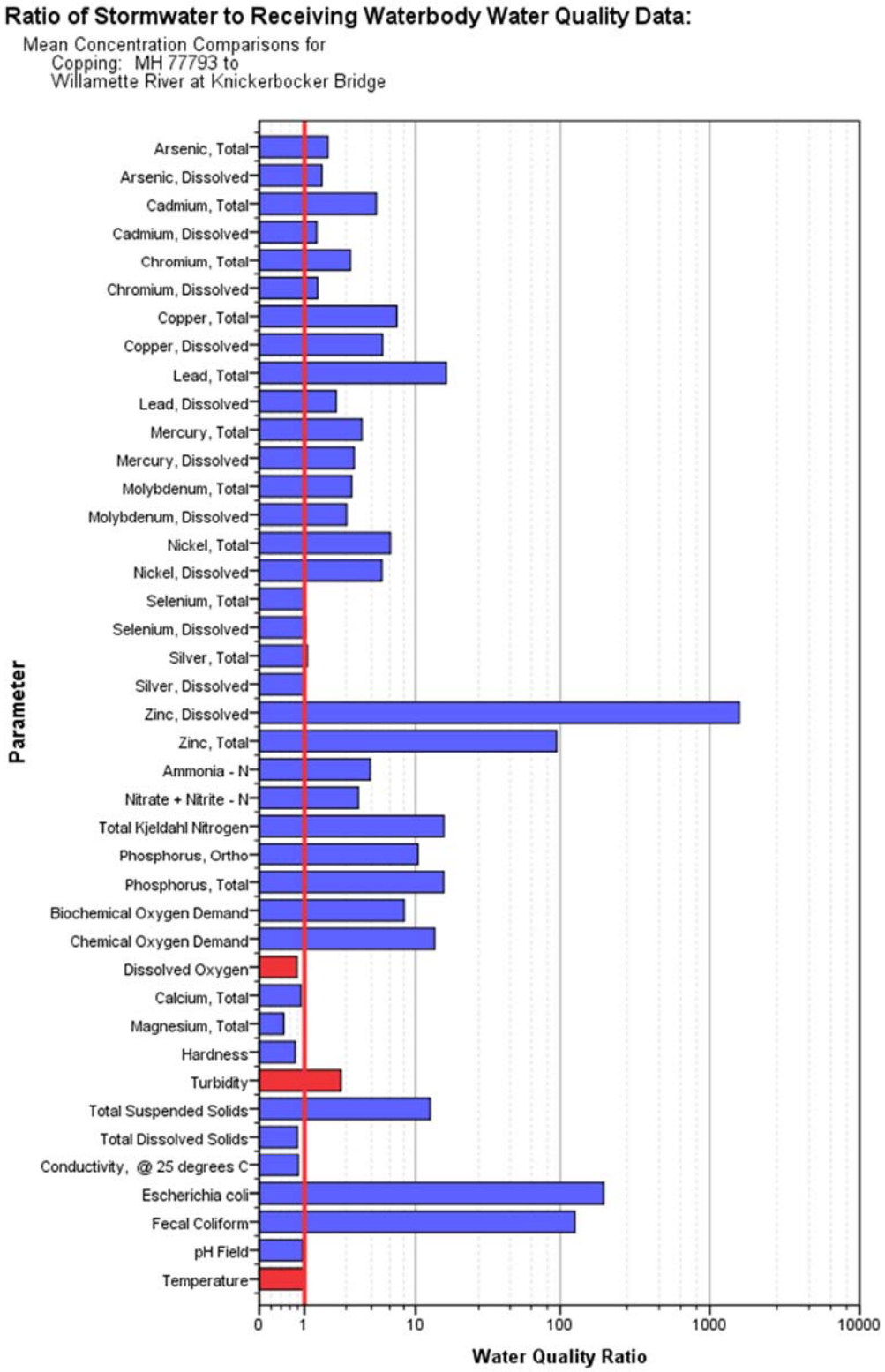
Two storm events were sampled at this residential MS4 site during the 2015/2016 monitoring season (see Figure 4-7c for the location and areal extent of this drainage basin). Modest analyte concentration decreases were observed for 30% of analytes; geomean concentrations increased for 70%.

Total and dissolved arsenic, copper, and nickel, total cadmium, chromium, and selenium, and dissolved mercury, molybdenum, silver, and zinc were among the metals with higher concentrations for the storm events sampled. *E. coli*, nitrogen and phosphorus nutrients, and oxygen demand were also significantly higher than the historical geomean. Only a handful of analytes had concentrations lower than the historical geomen, including dissolved cadmium, chromium, lead and selenium, as well as total lead, mercury, molybdenum, silver and zinc. A slight concentration decrease was also observed for oil and grease (SGT-HEM), and turbidity (see Section 4.4.3.5 for a discussion of stream-flow derived turbidity standards). Table A.2 summarizes stormwater quality data for this sampling site.

While state water quality standards are not directly applicable to stormwater data, comparisons here are helpful in assessing whether stormwater pollutants contribute toward exceedance of a water quality standard for an impaired waterbody (see Figures B.1 through B.21). The Willamette River was listed in the 2004/2006 303(d) as impaired for dioxin, and currently as water quality limited for mercury, bacteria, and temperature. Pollutant load calculations for the sampling event suggest that the Copping drainage basin area is not a significant source of listed pollutants, nor a source of significant pollutant loads to the Willamette River, as estimated in Figures B.22 through B.31.

Figure 4-3 compares mean stormwater quality data for the Copping site to the historical means at the nearest upstream ambient monitoring site, the Willamette River at Knickerbocker Bridge. Multiple analytes exceed an equivalence ratio of one, that is, the concentration of the stormwater analyte value is greater than that of the receiving water body value; *E. coli* and fecal coliform

Figure 4-3



Red Analytes = Water quality criterion exceeded in receiving waterbody during 2015/2016 monitoring period.

counts in the stormwater are over 100 times greater the Willamette River, the total zinc concentration is over 1,000 times higher than the Willamette River. The concentration of multiple analytes in stormwater runoff from the Copping site are at least ten times greater than the Willamette River. Statistical tests described later in this report indicate an increase in lead and bacteria concentrations in the Willamette River between the Knickerbocker Bridge and the next downstream ambient monitoring location at the Owosso Bridge. Tire weights fallen from vehicle tires and subsequently pulverized on roadways are a primary source of particulate lead in stormwater (EPA); lead-acid batteries are also a significant source of lead is MS4 runoff, although this residential MS4 drainage basin likely contributes only a fraction of the total lead concentration leading to the observed increase between the two Willamette River monitoring sites.

The storm event hydrographs for this MS4 piped system sample is shown in Figures B.216 and B.217, which was sampled in September and November 2015.

4.4.1.3 W 5th Avenue at Seneca: MH 63693 – MS4 Piped System

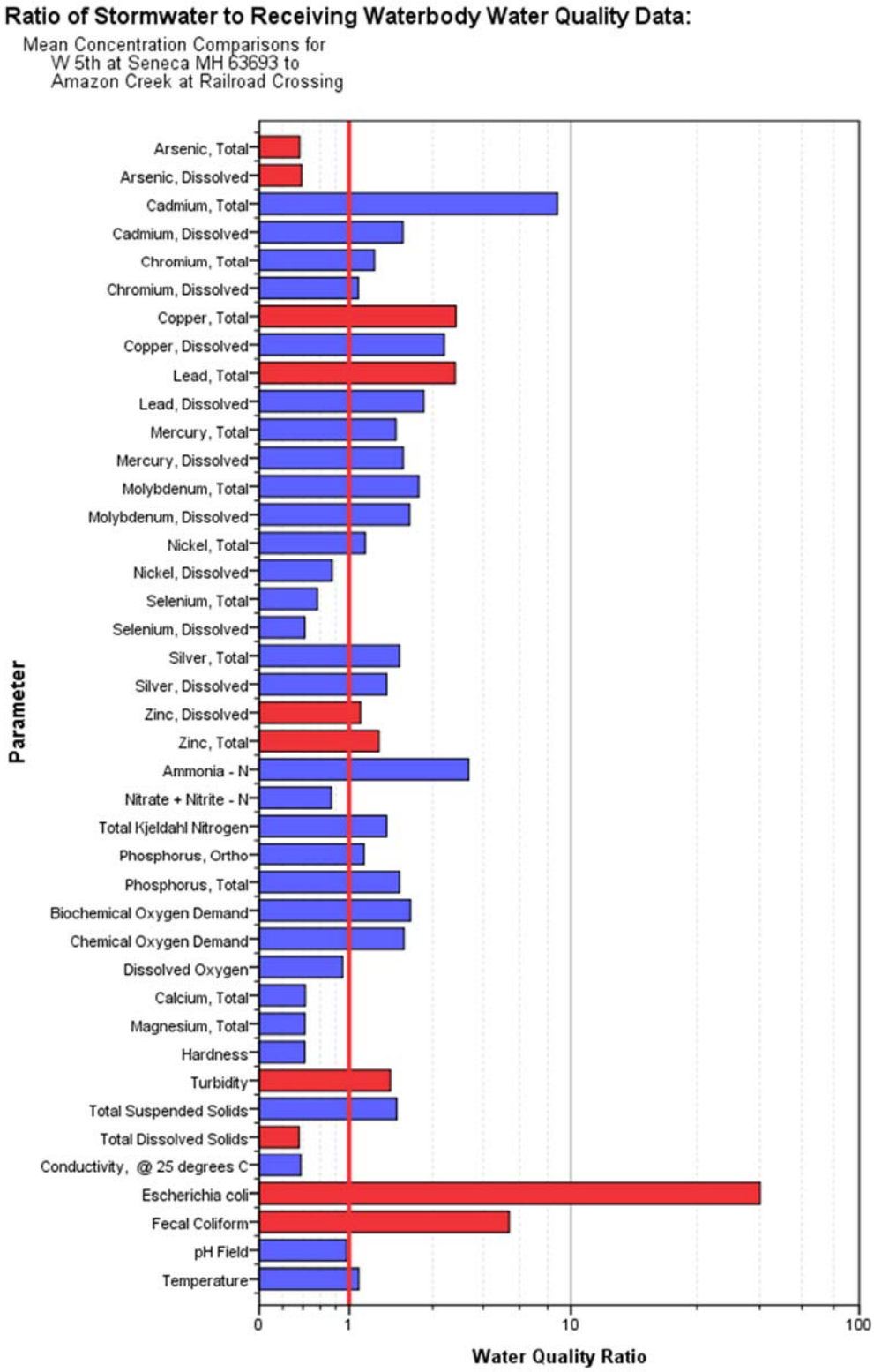
Two storm events were sampled at this monitoring location for the full suite of metals, field measurements, conventional analytes, chlorinated hydrocarbons; and dissolved and total methyl mercury (see Table A.3 for a summary of stormwater quality results). The W 5th Avenue at Seneca site (see Figure 4-7d) was selected to assess pollutant sources of 1,1-dichloroethene (DCE), trans-1,2-dichloroethene and tetrachloroethene (PCE) to the A3 Channel because it is on Oregon's 303(d) list of impaired waterbodies for these pollutants. Dichloroethene is a degradate of trichloroethene. One value for DCE was J-flagged, that is, analysis indicated the possible presence of these compounds; the concentration was 0.07 µg/L, less than the reporting limit of 2.5 µg/L (one-half the PQL). The human health criterion for DCE is 230 µg/L for fish and water consumption; the estimated concentration of DCE in stormwater is over three orders of magnitude less than the criterion. While the waterbody is not presently used for fish and water consumption by humans, the presence of these types of pollutants in stormwater may contribute to degradation of the A3 Channel, as well as Amazon Creek immediately downstream.

Potential sources of chlorinated hydrocarbons within this industrial and commercial drainage basin area include multiple businesses. Recent revisions to General 1200 Z stormwater discharge permits require permittees to monitor for chlorinated hydrocarbons and institute compliance benchmarks. The combination of industrial, stormwater, and ambient monitoring efforts will greatly assist in minimizing release of these pollutants to Oregon's waterbodies.

Of the analytes tested on the two sets of stormwater samples, 70 percent of results had geomean concentrations that were equal to or lower than historical data for this site; overall, changes were mostly modest.

Two storm events were sampled at this site for dissolved and total methyl mercury; the maximum observed concentration for dissolved methyl mercury was 0.0313 ng/L with a reporting limit of 0.0250 ng/L (one-half the PQL of 0.050 ng/L). The maximum observed concentration for total methyl mercury was 0.0542 ng/L, also with a reporting limit of 0.0250 ng/L.

Figure 4-4



Red Analytes = Water quality criterion exceeded in receiving waterbody during 2015/2016 monitoring period.

Comparison of stormwater runoff from this MS4 site to state water quality standards indicates concentrations of arsenic, cadmium, copper, lead, mercury, silver, zinc, turbidity (see Section 4.4.3.5 for a discussion of stream-flow derived turbidity standards), dissolved solids, and bacteria in stormwater are greater than state water quality criteria (see Figures B.1 through B.21).

The nearest ambient monitoring location on the A3 Channel at Terry Street is downstream of the W 5th and Seneca MS4 monitoring site so a comparison would include the pollutant contributions from this MS4 site. Instead, a comparison of stormwater quality from this site is made to ambient water quality measured on Amazon Creek at the Railroad Crossing, which is upstream of the confluence with the A3 Channel. Figure 4-4 indicates that the mean stormwater concentration of multiple metals contribute toward exceedance of water quality standards in Amazon Creek. Additionally, bacteria counts are up to 40 times higher in the MS4 samples. Stormwater hydrographs for this site are shown in Figures B.217 through B.218.

Analyte concentrations were used to estimate pollutant loads for the drainage basin areas as defined by the sampling location within the MS4 (see Figure 4-7d). Figures B.22 through B.31 present boxplots for estimated pollutant loads at the W 5th and Seneca sampling location, in units per acre, for all storm events sampled since 2010. Bacteria and turbidity pollutant load contributions to the A3 Channel appear to be significant given Amazon Creek, to which the A3 Channel discharges, is water-quality impaired for these two parameters. Median fecal Coliform and *E. coli* loading is about 50 billion per acre, greater than the city-wide mean bacteria load estimate of 23 billion per acre in the City's December 2015, Permit Renewal Report; the median turbidity load is about 500,000 NTU per acre. Pollutant loads for the remaining analytes at this site are below estimates documented in the City's Permit Renewal Report.

4.4.1.4 Pesticides in Storm Event Samples

The City's MS4 permit requires three stormwater sampling events be performed at a minimum of two sites for pesticides during the permit period, which began upon permit issuance in December 2010. Sampling has been completed and the data compiled in this report. Pesticide sampling was done at four sites, shown in Figure 4-7f to assess upstream and downstream water quality changes in two waterbodies, the A3 Channel at Seneca (upstream) and Bertelsen (downstream), and in Spring Creek at Naismith (upstream) and Beacon Drive East (downstream). Table 4-3 is a summary of those pesticide values for which concentrations were detected above the reporting limit (in this instance one-half the practical quantitation limit, PQL), for the three sampling events collected over the permit period. Pesticide data are re-summarized here and compared to water quality standards, where available (a more thorough review was done since the last reporting period), including the U.S. EPA human health drinking water quality standards, the U.S. EPA aquatic life benchmarks for fish and invertebrates, and Oregon's human health criteria in Table 40, and aquatic life criteria in Tables 30 and 31, which are shown in the rightmost column of Table 4-3. Note that human health criteria are only available for a few of the pesticides detected; the remainder are benchmarks established by the U.S. EPA and consist of the lowest concentrations listed for the protection of aquatic life. The entire data set, which includes laboratory results for about 190 different pesticides, is included in Tables A.8 through A.11.

One pesticide, fipronil, was found to exceed EPA's benchmark for invertebrate chronic toxicity and is shaded in the table. These data will be examined when evaluating BMPs and potential

adaptive management to address pesticides in Eugene's waterways. The following entries briefly describe the pesticide detected and their common uses:

- **2,4-D:** 2,4-Dichlorophenoxyacetic acid is a common systemic herbicide used in the control of broadleaf weeds. It is a synthetic auxin and one of the most widely used herbicides in the world. 2,4-D is toxic to fish and other aquatic life. Oregon's water quality standard for the consumption of fish and water is 100 µg/L; the federal drinking water criterion, maximum contaminant level (MCL) for 2,4-D is 70 µg/L.

- **Dicamba:** Dicamba (3,6-dichloro-2-methoxybenzoic acid) is an herbicide used for broadleaf control before and after they sprout. In combination with a phenoxy herbicide or with other herbicides, dicamba is used in also used along fencerows and roadways to control weeds. Dicamba functions by increasing plant growth rate to outgrow its nutrient supply and die.

- **Dichlobenil:** Dichlobenil is a nonselective preemergence herbicide used primarily as a weed and grass killer. It is a solid soluble in organic solvents and works by interfering with cellulose synthesis, and is commonly used to control weeds within roadway right of way.

- **Diuron:** Diuron is a substituted urea herbicide used to control a wide variety of annual and perennial broadleaf and grassy weeds, as well as mosses. It is used on non-crop areas and many agricultural crops. Diuron works by inhibiting photosynthesis.

- **Fipronil:** Fipronil is a broadly used insecticide that disrupts the insect central nervous system resulting in CNS toxicity. Fipronil is highly toxic to fish and aquatic invertebrates, although its tendency to bind to sediments and its low water solubility may reduce the potential hazard to aquatic wildlife.

- **MCPP:** Mecoprop, or methylchlorophenoxypropionic acid, is a common general use herbicide found in many household weed killers and "weed-and-feed" type lawn fertilizers. It is primarily used to control broadleaf weeds and is often used in combination with other chemically related herbicides such as 2,4-D, dicamba, and MCPA.

- **Propiconazole:** Propiconazole is a triazole fungicide, also known as a DMI, or demethylation inhibiting. Propiconazole is used agriculturally as a systemic fungicide on turf grasses. It is also used in combination with permethrin in formulations for wood preservation.

- **Pyrimethanil:** Pyrimethanil is a broad-spectrum fungicide used to control gray mold and blight, often used on fruits and vegetables (tomato, cucumber, strawberry, chives, etc.), and to inhibit black spot on fruit tree leaves.

- **Quinclorac:** Quinclorac is a selective herbicide used primarily to control weeds in agricultural crops, and is also found in some household herbicides for lawn use. Most

lawn maintenance companies use the product for the control of annual grass weeds like crabgrass.

- **Simazine:** Simazine is an herbicide used to control broad-leaved weeds and annual grasses. The federal drinking water standard, MCL, for simazine is 4 µg/L.

- **Triclopyr:** Triclopyr is a systemic foliar herbicide used to control broadleaf weeds while leaving grasses and conifers unaffected. Triclopyr is effective on woody plants and is used for brush control in rights of way and defoliation of wooded areas.

Table 4-3
Summary of Pesticides Detected in Storm-Event Samples

Parameter	Maximum (µg/L)	Geometric Mean (µg/L)	RL (µg/L)	WQ Standard Or Benchmark (µg/L or µg/kg/day – see notes)
A3 Channel at Seneca (Upstream				
2,4-D	1.80	0.27	0.08	70 [a] 100 [d]
Dicamba	0.16	< 0.08	0.08	61 [e]
Dichlobenil	0.45	0.16	0.12	10 [b] 30 [f] 45 [c]
Diuron	0.56	0.23	0.12	2.4 [e] 15 [f] 26.4 [h]
MCPP	0.29	< 0.08	0.08	40 [b]
Propiconazole	3.20	0.87	0.30	21 [e] 95 [h] 100 [b]
Triclopyr	0.25	0.11	0.08	50 [c]
A3 Channel at Bertelsen (Downstream)				
2,4-D	0.38	0.17	0.08	70 [a] 100 [d]
Dichlobenil	0.14	< 0.12	0.12	10 [b] 30 [f] 45 [c]
Diuron	0.76	0.18	0.12	2.4 [e] 15 [f] 26.4 [h]
Propiconazole	4.10	1.37	0.30	21 [e] 95 [h] 100 [b]
Triclopyr	0.20	< 0.08	0.08	50 [c]

See continued table for annotation comments.

Table 4-3 Continued Summary of Pesticides Detected in Storm-Event Samples				
Parameter	**Maximum (µg/L)**	**Geometric Mean (µg/L)**	**RL (µg/L)**	**WQ Standard Or Benchmark (µg/L or µg/kg/day – see notes)**
Spring Creek at Naismith (Upstream)				
2,4-D	1.80	0.18	0.08	70 [a] 100 [d]
Dicamba	0.65	0.10	0.08	61 [e]
Fipronil	0.24	0.18	0.12	0.11 [k] 0.011 [m]
MCPA	0.10	< 0.08	0.08	170 [f] 300 [e]
MCPP	2.00	0.15	0.08	40 [b]
Pyrimethanil	0.15	< 0.12	0.12	20 [h]
Quinclorac	0.27	< 0.08	0.08	380 [b]
Simazine	0.44	0.28	0.06	2.24 [e] 4 [a]
Triclopyr	0.13	< 0.08	0.08	50 [c]
Spring Creek at Beacon Drive East (Downstream)				
2,4-D	0.46	0.12	0.08	70 [a] 100 [d]
Dichlobenil	0.14	< 0.12	0.12	10 [b] 30 [f] 45 [c]
MCPP	0.18	< 0.08	0.08	40 [b]

[a] EPA Drinking Water Maximum Contaminant Level (MCL)
[b] EPA Human Health Benchmark Chronic RfD: µg/kg/day
[c] EPA Human Health Benchmark Acute RfD: µg/kg/day
[d] Oregon Human Health Water Quality Criterion for Toxic Pollutants, Table 40
[e] EPA Aquatic Life Benchmark, Nonvascular Plants Acute
[f] EPA Aquatic Life Benchmark, Vascular Plants Acute
[g] EPA Aquatic Life Benchmark, Fish Acute
[n] EPA Aquatic Life Benchmark, Fish Chronic
[k] EPA Aquatic Life Benchmark, Invertebrate Acute
[m] EPA Aquatic Life Benchmark, Invertebrate Chronic
Shaded cells indicate exceedance of WQ Benchmark.

4.4.2 Bacteria Study – Westmoreland Park, Polk Sub-Basin

The A3 Channel, Amazon Diversion Channel, and Amazon Creek are water quality limited for bacteria and in 2006 the State of Oregon issued the Willamette Basin TMDL for Bacteria. It specifies bacteria load reductions for these waterbodies which range from 33% in the A3 Channel to 84% in Amazon Creek. In addition, a 65% reduction in bacteria applies to the remaining Eugene MS4 permit area within the Willamette River basin. Stormwater monitoring data analysis suggests bacteria concentrations in Eugene's stormwater contribute toward exceedance of the state water quality criterion; hence the City has implemented a number of measures focused on identifying bacteria sources and reducing bacteria loads.

Under ideal conditions a multitude of variables would be measured to enable assessment of bacteria source contributions adequately, including stream flow, stormwater runoff flow from various land use types, storm event magnitude and duration, MS4 basin characteristics, focused land use sampling, and, among others, an ability to predict precisely storm event properties to enable collection of representative stormwater samples. Recognizing resource constraints and the complexity of collecting this information, the City of Eugene has focused on specific drainage basin areas with known characteristic from which information can be acquired while minimizing project complexity.

The City's bacteria pilot study was first outlined in the December 2005 Second Annual Report. Goals of the study include: 1) to better understand bacteria source contribution areas through observation and monitoring; 2) design and implement pilot study BMPs to reduce bacteria loads to stormwater; and 3) assess through additional monitoring BMP effectiveness in reducing bacteria loads to stormwater and, ultimately, to Amazon Creek. Lessons learned from the study would be considered for applicability and effectiveness in reducing bacteria from other areas within the Amazon basin and in Eugene city-wide. During the 2015/2016 permit year the City's investigations continued with sampling and analysis of bacteria limited to a select group of MS4 sites from piped and open channel systems, specifically, Roosevelt Blvd. upstream and downstream of new riparian planting, and upstream and downstream of a Contech water quality structure. Field surveys were also performed to characterize field conditions that might provide insights of potential bacteria sources; a summary of these data are presented here.

Figures 4-7a and 4-7e show the bacteria sampling sites, the first site is within the Roosevelt Channel, which parallels Roosevelt Blvd., and due east of Beltline Road. As stated previously, the Contech structure, located near the Owen Rose Garden adjacent the Willamette River.

Escherichia coli and/or fecal Coliform data, as well as field water quality measurements for the 2015/2016 monitoring period, are summarized in Tables A.4 through A.7, and boxplots for the data sets shown in Figures B.32 and B.33. At this time modestly lower bacteria counts are observed compared to the three historical sampling events; however, bacteria counts have thus far exceeded the bacteria human health water quality criterion of 406 colonies per 100 mL.

Six field condition assessment surveys for bacteria were done during the 2015/2016 monitoring period. Field condition assessment surveys were started in February 2007, to document basin conditions such as amount, type, and location of wildlife and domestic pets; human behaviors; location and number of wildlife and domestic animal waste; conditions within commercial

loading areas, recycling areas, and garbage dumpster areas, etc. Bacteria field surveys have been focused within a portion of the Polk Street sub-basin and the Morse Ranch dog park. Figure 4-5 presents a semi-quantitative summary of all the field survey observations. Populations of animals and waste present are summarized as percentages of the total animal and waste data sets. Survey results suggest a strong avian prevalence among the information collected in the surveys. From this we postulate bacteria in stormwater runoff is principally avian, consistent with recent studies conducted by other municipalities who have performed costly genomic ribotyping of aquatic samples.

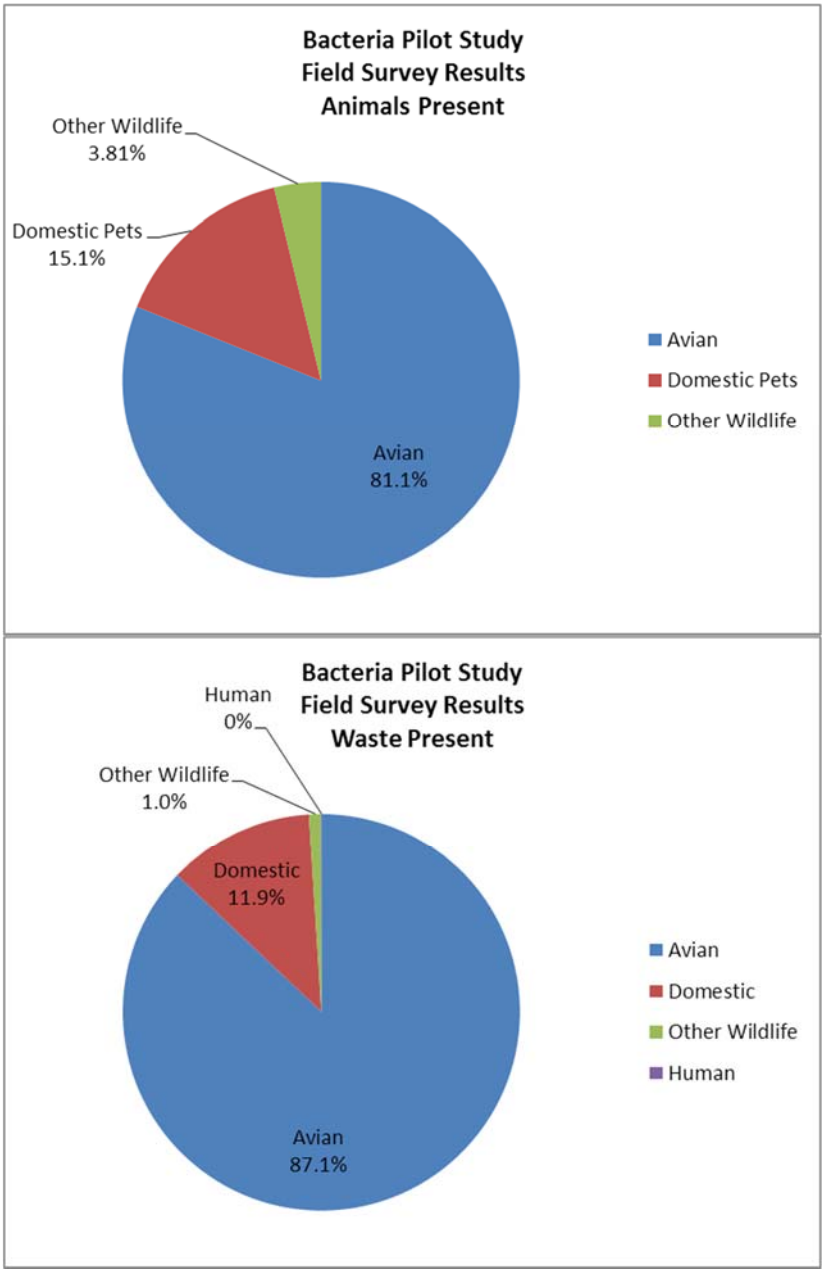
Restoration of riparian habitat along sections of Amazon Creek and grassy parklands adjacent to the waterbody has temporarily attracted populations of nesting ducks and geese. Field surveys suggest areas along Amazon Creek receive significant amounts of avian waste which directly contributes to bacteria loads in the waterbody. However, as restorations mature development of canopy cover should sufficiently reduce field of sight for migrating avian species to make these restored areas less attractive to large populations for prolonged habitation. This approach is being used for the riparian restoration project along Roosevelt Channel; field condition assessment surveys suggest geese are less inclined to occupy the northern channel bank due to the recent plantings, which are protected by wire cages that may also act as a deterrent to avian habitation. Table A.6 and A.7 summarize bacteria and field data collected over the monitoring period. Field assessment and sampling will continue at this site to monitor avian activity and bacteria counts. Insufficient data preclude any meaningful assessment of the effectiveness of the riparian plantings; however, upon maturity the plantings should prove an effective deterrent as demonstrated in other riparian buffer areas.

Other sources of avian waste bacteria noted during field surveys include populations of swallows, starlings, gulls, crows, and sparrows, and large numbers of their waste deposits observed on sidewalks and parking lots, as well as rooftops. These impervious surfaces within the bacteria study area are easily flushed by seasonal rains and directly transported via the MS4 to Amazon Creek. Over time, outreach to commercial businesses should help improve waste handling and disposal to reduce the vectors contributing to bacteria loads. Other wildlife have been observed during the field surveys, however these are believed to contribute only a small portion of the total bacteria load within the urban area.

Domestic animal waste accounts for the second largest percentages of waste present within the study area, and is perhaps one that is more easily controllable. Educational outreach is done on nearly a continuous basis to bring awareness to pet owners the importance of picking up after their animals; transcending the 'ick' factor is challenging, one that many communities difficult to achieve. While some have implemented innovative methods to incentivize pet owner participation these are often punitive involving fines. The City continues to explore other methods to gain pet owner participation to address this source of bacteria to Eugene's waterbodies.

Figure 4-5

Semi-Quantitative Summary of Bacteria Field Survey Results



The significance of illegal camping on bacteria loads in urban streams is difficult to estimate and is perhaps not negligible, although within the study area human waste was rarely found. Like other communities in the northwest along the I-5 corridor, Eugene has expended considerable resources to address illegal camping, some of which was observed during field surveys in areas with dense woods and shrubs along Amazon Creek.

In summary, field surveys suggest sources of bacteria to Amazon Creek within the study area are predominantly avian, followed by domestic animals, other wildlife, and potentially some human contributions. Field surveys, in combination with ambient and stormwater monitoring, will prove helpful in assessing and adaptively managing Eugene's existing BMPs to improve their effectiveness in reducing bacteria. One such program is the city's Canines for Clean Water outreach program implemented citywide several years ago. A description of this educational outreach BMP can be found in Section 3.1 of this report.

4.4.3 Ambient Water Quality Monitoring

Ambient water quality monitoring has continued at twelve monitoring locations, including six within the Willamette River basin – four sites on the Willamette River, one near the Delta Ponds outlet, one on Spring Creek; and six in the Amazon Creek basin, three on Amazon Creek, and one each on Willow Creek, the A3 Channel, and the Amazon Diversion Channel. Surface flows through the Delta Ponds, which consists of sloughs and former aggregate excavation sites, are to the Willamette River. Extensive riparian restoration was made several years ago by the U.S. ACOE and the City of Eugene to create and enhance riparian habitat for fish spawning and rearing. The Delta Ponds also receives stormwater discharges from surrounding commercial and residential development; thus assessment of water quality from this area is important in evaluating the effects of stormwater runoff to Delta Ponds and creation of riparian habitat that is conducive to fish spawning and rearing objectives. The ambient sampling sites are listed in Table 4-4 below and locations shown in Figures 4-8 and 4-9. Sampling is generally conducted at each site every other month such that sampling events are representative of both the rainy season (October through April), and drier months (May through September). All ambient sampling is conducted utilizing clean sampling techniques; both total and dissolved metals are analyzed as well as conventional water quality parameters.

Analytical results and statistical analyses characterizing water quality at the monitored sites are described here. For the most part grab samples collected every other month represent snapshots of ambient water quality – analytical results may not necessarily represent average water quality, or the full range of water quality variability; however, the City has monitored water quality at most of these sites since 1997 and median water quality values have shown little variability. Six additional sampling events were done since the last annual reporting period, although a few locations could not be sampled because they lacked streamflow. Data generated for these latest sampling events have been added to the historical data set that begins in January 1997. For the current permit year sampling events occurred between July 2015, and June 2016.

Table 4-4 Ambient Water Quality Monitoring Sites	
Amazon Creek Basin Sampling Sites: • Amazon Creek at 29th Avenue • Willow Creek 450 feet north of 18th Avenue • Amazon Creek at Railroad Track Crossing • Amazon Diversion Channel at Royal Avenue • A3 Channel at Terry Street • Amazon Creek at Royal Avenue	**Willamette River Basin Sampling Sites:** • Upstream of Urban Growth Boundary (River Mile 186.9) • At Knickerbocker Bridge (RM 183.9) • At Owosso Bridge (RM 178.6) • Delta Ponds North of Beltline Bridge & Upstream of Willamette River Confluence • Downstream of Beltline Bridge (RM 176.8) • Spring Creek at Beacon Drive East

4.4.3.1 Results

Ambient water quality data were screened for outliers before applying statistics tests. In general, outliers are anomalous measurements that do not appear to be within the bounds of an historical data set. Outliers may result from any number of factors, including sample collection and handling procedures, analytical methodologies, transcription error, etc. Inclusion of anomalous measurements in statistical tests used to assess water quality characteristics can skew results and lead to erroneous conclusions. However, distinguishing anomalous measurements from an actual elevated pollutant concentration due to some site disturbance can be difficult if methodical evaluation of all probable factors is not performed. The methods commonly used to test for outliers include skewness, kurtosis, and Shapiro-Wilk assume normal distribution of water quality measurements; it was found, however, that most of the analytes did not follow a normal distribution. Identification of an outlier using these methods does not preclude investigation into the anomaly and its possible cause. Outliers were investigated and corrected if possible, including traceable error such as transcription, dilution error and the like.

For data sets whose distributions are not normal, best professional judgment was applied when selecting outliers to exclude from further statistical analysis. Best professional judgment may include reanalysis of the sample provided the holding time has not been exceeded.

Multiple outliers were identified in the 2015/2016 ambient dataset and were excluded from statistical analysis. In some instances it appears sample containers may have been mislabeled, sample handling and preparation compromised results, or instrumentation issues were identified which may have biased results. Results are reported for the identified outliers and denoted “EV” in report tables. Outliers were also identified in the historical data set, and while these are ultimately excluded from final statistical analysis results, the outliers are only temporarily excluded; they are added to the data pool at the beginning of each annual data analysis for distribution tests as applicable. Analytical data for the most recent monitoring period are presented in Tables A.12 and A.13. Note there are no data for one or two sampling dates at the A3 Channel at Royal, A3 Channel at Terry Street, Willow Creek, Delta Ponds, and Spring Creek because these sites were dry or had insufficient flow at the time of sample collection.

Censored data, those values reported as less than the reporting limit, are included in the summaries utilizing the restricted maximum likelihood estimation technique for miscellaneous parameters, and the delta distribution estimator for the metals data. These estimators reduce the problems associated with censored data when calculating mean and standard deviation, and are

superior to substitution of censored data with one-half the reporting limit. Means and standard deviations for the ambient historical data set are summarized in Tables A.14 through A.16.

4.4.3.2 Seasonal Trends

The Seasonal Kendall statistic, Z, is used here to describe long-term analyte trend with consideration given to seasonal variation. This trend estimator is free of distributional assumptions. Developed by the U.S. Geological Survey[1], the Seasonal Kendall statistic is the most frequently used test to assess trend in environmental data. In assessing analyte trends, we presume in-stream flow is the result of multiple water pathways in the hydrologic cycle, including overland flow, ground-water discharge, and precipitation; precipitation directly and indirectly influences the concentration of analytes as measured in samples collected from the Amazon and Willamette basins, and may also contribute trace amounts of pollutants through atmospheric deposition, such as mercury. The temporal distribution of the precipitation events, including intensity and duration, influences analyte concentration; however, data for these factors are not available, are not easily obtained, and their effects on seasonal pollutant concentration difficult to assess.

Our simplified approach assumes these factors are intrinsic to the period during which the sampling event occurs. Average monthly precipitation for Eugene was divided into four "seasons," or periods, based on average monthly precipitation and trend increase or decrease. The periods should help to identify seasonal variations in analyte concentration. The wet season (Period 1: November, December, January) is followed by a drying trend extending into July. The drying trend is subdivided into Period 2 (February, March, April) and Period 3 (May, June, July), the latter being the driest period. Months leading to the wet season comprise Period 4 (August, September, and October) and are progressively wetter. Precipitation data is from the Eugene, Oregon airport weather station (#352709) with a period of coverage from 1939 to 2011. Each sampling event for the entire data set (historical and current year data) is assigned to a period based on the sampling date.

The USGS has developed a DOS-executable program to run the Seasonal Kendall test statistic. In this application, rejection of the null hypothesis of no trend is calculated at $2\rho = 1\%$, that is, a 2ρ value of 0.01 indicates there is a 1% probability of the observed trend due to random sample variability. Program output includes slope estimator, *m*, to describe the overall analyte trend.

Results of trend analysis using the Seasonal Kendall test statistic indicate significant trends occur at all 12 monitoring locations listed in Table 4-4. Water quality trends for the waterbodies tend to be subtle, hence, those noted in previous reports but not observed here and vice versa are commonly influenced by the most recent water quality data such that statistical significance of the trend changes upon addition of new analyte results.

Figures B.34 through B.107 (Appendix B) show the historical data sets plotted against time with trend lines, which are averages of the four differentiated seasons based on precipitation; a summary of the program output is presented in Table A.17 in Appendix A. All significant long-term concentration trends are summarized in Table 4-5 below. A number of pollutants listed are

[1] Dennis R. Helsel, Mueller, David K., and Slack, James R., Computer Program for the Kendall Family of Trend Tests: U.S. Geological Survey SIR 2005-5275.

on Oregon's 2004 303(d) list and several have approved TMDLs. Results of the Seasonal Kendall test statistic indicate significant progress is being made to reduce pollutants in the listed impaired waterbodies.

We noted long-term decreasing concentration trends for at least some analytes at all twelve ambient monitoring sites; these sites are located upstream, downstream or within the urban environment and are likely influenced by human activities occurring within respective drainage basin areas. We attribute the decreasing pollutant trend to the sum of stormwater program BMPs applied within these drainage basins to control stormwater pollutants caused by human activities within the urban environment. Decreasing concentration trends in the Amazon and Willamette basins are primarily observed for metals, including arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, and nickel. Nutrients (nitrogen and phosphorus), suspended solids, turbidity, hardness (calcium and magnesium), and temperature also have decreasing concentration trends at a few ambient monitoring sites.

Arsenic is naturally occurring in Willamette valley soils due to their volcanic origin, and is commonly mobilized through soil disturbance and other anthropogenic activities. Decreasing concentration trends in Amazon Diversion Channel at Royal Avenue, which encompasses the entire Amazon basin upstream of this site, and the A3 Channel site, whose drainage basin primarily consists of industrial and commercial properties, is positive progress; however, observed concentrations (see Table A.12) tend to exceed the human health water quality criterion of 2.1 µg/L. The decreasing arsenic trends observed at these two sites is perhaps indicative of the effectiveness of the West Eugene Wetlands in trapping suspended particulate; dissolved arsenic concentrations, however, also tend to exceed the water quality criterion and emphasize the need for continued progress applying sediment control BMPs.

Mercury also occurs naturally in Willamette valley soils and accounts for about 48% of the mercury load to Willamette basin waterbodies. The next largest source of mercury in the Willamette valley is atmospheric deposition to land at 42%, a significant portion of this load originates in China but also originates locally from the combustion of fossil fuels, forest fires, and anthropogenic activities. Mobilization of land-deposited atmospheric mercury occurs readily during precipitation events. About 5.9% of atmospheric mercury is deposited directly into waterbodies. Sources of mercury are described and assessed in the 2006 Willamette Basin TMDL for Mercury. As with arsenic, effectual sediment control BMPs are perhaps the best tools to achieve mercury reduction in Eugene's urban waterways.

Table 4-5 Summary of Seasonal Kendall Water Quality Analyte Trend Analysis [1]		
Monitoring Location	**Trend of Water Quality Analyte**	
	Decreasing Concentration Trends	**Increasing Concentration Trend**
Amazon Creek Basin Sites:		
Willow Creek	Total Kjeldahl Nitrogen	Lead, Dissolved Zinc, Dissolved & Total Dissolved Oxygen
Amazon Creek at 29th Avenue	Chromium, Total Mercury, Dissolved & Total Nickel, Dissolved [2] Lead, Total	Zinc, Dissolved & Total
Amazon Creek at Railroad Tracks	Chromium, Dissolved & Total Mercury, Dissolved & Total Nickel, Dissolved & Total [2] Lead, Total	Zinc, Dissolved & Total
Amazon Diversion Channel at Royal Avenue	[2] Arsenic, Dissolved & Total [2] Mercury, Dissolved Molybdenum, Dissolved Nickel, Dissolved & Total Temperature Total Kjeldahl Nitrogen	Zinc, Total
A3 Channel at Terry Street	[2] Arsenic, Dissolved & Total Cadmium, Total Chromium, Dissolved & Total Copper, Total [2] Mercury, Total Nickel, Dissolved & Total [2] Lead, Total Phosphorus, Total Temperature Total Kjeldahl Nitrogen	None
Amazon Creek at Royal Avenue	Cadmium, Total Chromium, Dissolved & Total Mercury, Total Nickel, Total [2] Lead, Total Temperature Total Suspended Solids Turbidity	Zinc, Dissolved & Total

[1] Significant at 2ρ = 0.01
[2] On Oregon 2004/2006 303(d) list.

Table 4-5 Continued Summary of Seasonal Kendall Water Quality Analyte Trend Analysis [1]		
Monitoring Location	**Trend of Water Quality Analyte**	
	Decreasing Concentration Trends	**Increasing Concentration Trend**
Willamette River Basin Sites:		
Upstream of Urban Growth Boundary	Chromium, Total [2] Mercury, Dissolved & Total [2] Lead, Total [2] *Escherichia coli* Turbidity	
Knickerbocker Bridge	[2] Fecal Coliform	Copper, Dissolved Specific Conductance
Owosso Bridge	Chromium, Total	Specific Conductance
Downstream of Beltline Bridge	[2] Mercury, Total	None
Delta Ponds	Calcium, Total Magnesium, Total Hardness Specific Conductance	[2] Dissolved Oxygen
Spring Creek at Beacon Drive East	Total Suspended Solids	None

[1] Significant at 2ρ = 0.01
[2] On Oregon 2004/2006 303(d) list.

Other trace metals with significant decreasing concentration trends in Eugene's waterways such as cadmium, chromium, copper, lead, molybdenum, and nickel, are commonly associated with automobiles, as well as some industrial and commercial activities. Concentrations of copper and lead have been found to exceed the chronic toxicity criterion for samples collected from nearly all Amazon Basin ambient monitoring sites. Samples collected for total lead analysis during the 2015/2016 monitoring period from all Amazon basin sites with the exception of Willow Creek and Amazon Creek at 29th Avenue, exceeded the chronic toxicity for lead (see Table A.12); however, Willow Creek has an increasing trend for dissolved lead, the cause of which is unknown at this time. Fewer historical water quality exceedances and no current data were observed to exceed the chronic criterion for the more toxic dissolved lead fraction. Current BMPs minimizing road grit from entering the MS4, MS4 maintenance BMPs, and industrial source control establishing pollutant benchmarks and permit-required monitoring, have proven effective mechanisms in reducing these metals in waterbodies receiving stormwater flow.

An increasing trend is observed for zinc at multiple locations, including Willow Creek, Amazon Creek at 29th Avenue, the Railroad Crossing, and Royal Avenue, and the Amazon Diversion Channel at Royal Avenue. During the 2015/2016 monitoring period, zinc concentrations at all Amazon Basin monitoring sites as well as Spring Creek, have exceeded the acute or chronic water quality criterion (see Table A.12). Powdered zinc sulfate and zinc metal strips are widely

used for moss control in the Pacific Northwest and increasing concentration trends for this metal in local waterbodies is being actively addressed through educational BMPs that provide property owners with information on alternative products for moss control.

A slight increasing trend for dissolved copper is observed in the Willamette River at the Knickerbocker Bridge. While copper is naturally occurring in soils, copper is also used prevalently in automobile brake pads, electrical equipment, roof cladding and rain gutters, in some pesticides, and other manufactured products. A slight increasing trend is also observed for conductance in the Willamette River at the Knickerbocker and Owosso Bridges could be related to a combination of factors, such as weathering and dissolution processes of soils; trace dissolved metals such as copper from anthropogenic sources also contribute toward increased conductance but this would be a minute fraction of the overall conductance value. An increasing trend is also noted for dissolved oxygen in Delta Ponds and is likely due to regulated Willamette River diversions of flow through the ponds; decreasing trends for hardness (calcium and magnesium) as well as specific conductance can be attributed to the regulated flow diversions.

In the Willamette River, decreasing trends are also observed for chromium, mercury, lead, *E. coli* and turbidity upstream of the urban growth boundary. A decreasing concentration trend is also observed for chromium at the Owosso Bridge, and downstream of Beltline Bridge, a slight decreasing trend occurs for total mercury. We also noted a decreasing trend for fecal Coliform at the Knickerbocker Bridge site, and for suspended solids in Spring Creek at Beacon Drive East.

Water quality trends are often associated with anthropogenic activities; however, in some instances measurement technique and/or instrumentation can influence trends. For example, instrument sensitivity for the testing of trace metals and other analytes has increased significantly over the years since monitoring was begun in 1997. This instrument sensitivity evolution may in part explain a discernible change in data variability, which is noticeably more pronounced in early sampling events when compared with those taken later. Some recent data for analytes such as cadmium and silver suggests current analytical instrumentation has reach a lower sensitivity limit whereby most of the reported values are censored, or less than the reporting limit. Trying to establish a meaningful trend beyond these data becomes problematic.

There is a small probability that some decreasing or increasing metals trends may not have been identified by the Seasonal Kendall test because of changes in laboratory testing facilities and analytical instrumentation. While laboratories may utilize the same analytical methodology, specifically, EPA 200.8, the reporting limits will vary. Ongoing review of analytical procedures will help ensure optimum results are obtained to generate historical trends that are accurate and meaningful.

4.4.3.3 Water Quality Changes: 2015/2016 Permit Year vs. Historical Data Set

The Mann-Whitney test statistic is used here to assess whether any water quality changes have occurred over the most recent monitoring period compared to the historical data compiled for each sampling location. Mann-Whitney is a nonparametric calculation based on the sums of ranks for independent samples and is suitable for censored data sets. Table A.18 in Appendix A summarizes significant water quality changes, which consists of comparing sampling events for the 2015/2016 period to historical data. For comparison purposes, averages are reported for the

recent monitoring data and the historical data set; data comparisons are statistically significant at $\alpha = 0.05$. The full program output for the statistic is shown in Tables A.19 and A.20.

Note that some analytes in Table A.18 are annotated, indicating that the data set includes some censored values which have been set at one-half the reporting limit (either the PQL or MDL depending on the analyte and method). In general, mean corrected averages cannot be reasonably estimated on small data sets with a large number of censored values. For example, with few exceptions cadmium and selenium values for Amazon Basin and Willamette River sites consist of censored values, hence the statistical significance of annotated means if the population of censored values is greater than 50 percent is somewhat questionable and therefore generally excluded from tables summarizing statistically significant comparisons. Consult Tables A.14 and A.15 for analytes reported as INS, that is, insufficient uncensored data available to compute the statistic.

Examination of water-quality changes that have occurred during the most recent monitoring period are helpful in identifying those drainage basin areas where land use activities have had, either directly or indirectly, a significant influence on water quality – either resulting in water quality improvements or degradation. A third outcome of this examination is that no water quality change occurs, which is also a significant finding in that this enables assessment of the effectiveness of applied best management practices (BMPs) within specific drainage basin areas.

The city's ambient monitoring program includes 41 regular analytes plus a few special organics at select sites. An ideal outcome of the statistical tests would be that, for all those analytes present above natural or background conditions, an improvement occurs for the recent monitoring year when compared to the historical water quality data – a somewhat unrealistic scenario given urbanized areas and activities within them often influence water quality characteristics. In general, water quality improvement of urban streams is achieved gradually over an extended period of time as is shown by the trends described in the previous section. The following sections assess ambient water quality data and identify basin areas for review consideration of BMPs.

Amazon Basin Sites

Four samples were collected from the A3 Channel at Terry Street, Amazon Diversion Channel at Royal Avenue, and Amazon Creek at the Railroad Crossing; five samples each from Amazon Creek at Royal Avenue, Amazon Creek at 29th Avenue, and Willow Creek. On occasion, lack of stream flow precludes sample collection. An extended dry period has been observed in the Willamette valley during typically wetter months; similarly dry conditions have occurred on multiple occasions since ambient monitoring began in 1997.

Willow Creek originates just south of a preserve held by The Nature Conservancy and has similar geomorphologic characteristics to the upper reaches of Amazon Creek; its headwaters flow through some rural residential properties and the creek receives some stormwater from the former Hynix facility (a silicon chip manufacturer whose operations ceased during the 2007/2008 period although maintenance of stormwater facilities and monitoring continue). The water quality characteristics of Willow Creek, which is for the most part a local, minimally-urbanized stream, has served as a reasonably good baseline for comparing the water quality

characteristics observed for Amazon Creek; however, recent water quality trends indicate some degradation, specifically bacteria, dissolved lead, and total and dissolved zinc.

Referring to Table A.18 in Appendix A, all six Amazon basin monitoring sites, including Willow Creek have recent analyte averages that differ from historical means. Overall, concentrations for 33 of 45 analytes, or about 73%, had statistically significant decreases compared to historical means. In addition, all six sites had statistically significant analyte values that were higher in 2015/2016 than observed historical means (12 of 45 analytes). Total and/or dissolved zinc concentrations are higher at all sites except Willow Creek. Zinc concentration differences are the most pronounced in this comparison. The statistically significant two to three-fold increase in zinc concentrations in Amazon Creek, in addition to recent increasing concentration trends, indicates greater use and mobilization of zinc compounds within the urban area.

Modest concentration decreases occur for other metals and conventional water quality parameters at Amazon basin sites. Turbidity values decreased at all six ambient monitoring sites compared to historical averages.

Willamette River Sites

Analyte comparisons summarized in Table A.18 show that all four sites on the Willamette River, Delta Ponds, and Spring Creek had recent analyte averages differing significantly from historical means. Overall, 28 of 43 analyte values (65%) show statistically significant decreases during the 2015/2016 monitoring period compared to historical averages.

Total suspended solids and turbidity showed modest decreases at the three upstream Willamette River sites and Spring Creek; turbidity values were higher in the Willamette River downstream of Beltline Bridge and in Delta Ponds in 2015/2016 compared to the historical average. Other analytes whose average concentrations were lower include lead, nickel, selenium, Kjeldahl nitrogen and total phosphorus; those with higher average concentrations Mercury, calcium, ortho phosphorus and chemical oxygen demand.

At the Delta Ponds site, in addition to turbidity, chromium and nickel average concentrations were higher than historical averages; nickel, selenium, calcium, chemical oxygen demand, and conductance values were lower. At Spring Creek, in addition to turbidity, statistically significant concentration decreases were observed for nickel, selenium, calcium, magnesium, chemical oxygen demand dissolved.

The improving water quality trends described above for the Amazon and Willamette basin sites, and to some extent the improvements of recent water quality data when compared to historical data, are positive indicators that BMPs applied within the permit area are effective, resulting in measurable pollutant decreases in receiving waterbodies that have approved TMDLs or that are on the state's 303(d) list. Full program output for the 2015/2016 to Historical data set comparison is shown in Tables A.19 and A.20.

4.4.3.4 Intra-Basin Water Quality Differences

In addition to temporal changes in water quality, intra-basin differences are of interest because water quality comparisons are made between an upstream and downstream monitoring site, which provides a means of assessing whether urban activities affect a waterbody as it flows through the urban area. The Mann-Whitney test statistic is used here to assess water quality differences between any two sites within the same stream basin or between drainage basin areas. Mann-Whitney is a nonparametric calculation based on the sums of ranks for independent samples and is suitable for censored data sets. Comparisons described utilize the all data for each monitoring location, including the data recently acquired in 2015/2016. Table A.21 and A.22 in Appendix A summarize significant average analyte values; comparisons are significant at $\alpha = 0.05$. The full program output for the statistic is shown in Tables A.23 and A.34.

Amazon Basin Monitoring Locations

Intra-basin comparisons include the analysis of the 29th Avenue site on Amazon Creek compared to the site on Willow Creek (see Figure 4-8 for sampling locations and basin extent), streams that originate in the same low hills south of Eugene but drain different sub-basins. In addition, the 29th Avenue site, comprised predominately of residential land use, is compared to Spring Creek at Beacon Drive East, also comprised of mostly residential land use but originating within the urbanized Santa Clara – River Road stormwater basin.

The concentration of metals, nutrients and bacteria are higher in Amazon Creek at the 29th Avenue site in comparison to Willow Creek. Of the 41 water quality analytes monitored, the concentrations of 16 analytes were found to be statistically higher in Amazon Creek at the 29th Avenue site, including dissolved and total chromium, copper, lead, molybdenum, and zinc, as well as *E. coli*, fecal Coliform, nitrate+nitrite as nitrogen (NO_3+NO_2-N), ortho and total phosphorus, and total magnesium. Only total arsenic is higher at the Willow Creek site.

Relative percent concentration differences (the absolute difference divided by the mean of the two values) range from 31% for dissolved lead, to 85% for total zinc; for non-metal parameters the relative percent difference ranges from 2.1% for total magnesium to 143% for *E. coli*.

Comparing metals across the two basins; dissolved and total copper is 37% and 38% higher in Amazon Creek at 29th Avenue, dissolved and total chromium are 43% and 54% higher, dissolved and total lead are 31 and 77% higher, dissolved and total molybdenum 67% higher, and dissolved and total zinc 72 and 85% higher, respectively, at the Amazon Creek at 29th Avenue site. Total arsenic is higher in Willow creek by 27%.

Comparing non-metals across the two basins; fecal Coliform and *Escherichia coli* averages are 124% and 143% higher, respectively, at the Amazon Creek at 29th Avenue site compared to bacteria counts observed at Willow Creek. These bacteria ratios have decreased from previous reporting periods; as mentioned above, bacteria counts in Willow Creek have been noticeably higher over the last few years. Ortho and total phosphorus, NO_3+NO_2-N, and pH are also higher at the Amazon Creek site. The higher metal, nutrient and bacteria concentrations observed in Amazon Creek are pollutants commonly associated with urbanized environments.

Intra-basin comparisons are also shown for the 29th Avenue (upstream) site, and Amazon Creek at Royal Avenue and Amazon Diversion Channel at Royal Avenue (downstream) – these are upstream-downstream comparisons and summarized in the Table 4.6 below. Only those parameters with statistically significant differences as determined by the Mann-Whitney statistic are shown. Metals concentrations are higher at the downstream locations except total zinc, which is correlated with lower values for suspended solids and turbidity downstream – total zinc is basically settling out of the water column with the particulate load. For the other conventional pollutants the higher pollutant concentration does not always occur downstream; bacteria counts vary slightly within the Amazon basin, as does hardness (calcium and magnesium). Dissolved oxygen, NO_3+NO_2-N, and ortho phosphorus become depleted downstream. Dissolved solids, temperature, and pH increased downstream.

Table 4-6
Intra-Basin Water Quality Comparison of Willow, Amazon, and Spring Creeks [1] Using Mann-Whitney Statistic [2]

Analyte	Units	Amazon Creek at 29th Avenue (Upstream)	Amazon Creek at Royal Avenue (Downstream)	Amazon Diversion Channel at Royal Avenue (Downstream)
Arsenic – Total	(*µg/L*)	1.08	3.43	3.87
Arsenic – Dissolved		0.883	2.27	2.28
Cadmium – Total		0.00564	0.0147	0.0242
Chromium – Total		1.55		1.81
Copper – Total		3.39	4.07	5.91
Copper – Dissolved		1.79		2.31
Lead – Total		0.568	1.69	2.13
Lead – Dissolved		0.0428	0.100	0.102
Mercury – Total		0.00249	0.00666	0.00711
Mercury – Dissolved		0.00099	0.00170	0.00134
Molybdenum – Total		0.292	0.624	0.981
Molybdenum – Dissolved		0.278	0.614	0.896
Nickel – Total		2.03	2.46	3.05
Nickel – Dissolved		1.42	1.71	2.02
Selenium - Total		0.140	0.207	0.226
Silver – Total		0.00466	0.0157	0.0130
Zinc – Total		23.5	25.0	28.1
Zinc – Dissolved		13.8	11.9	13.1

[1] Comparisons made: Amazon Creek at 29th Avenue to Amazon Creek at Royal Avenue and to Amazon Diversion Channel at Royal Avenue
[2] Mann-Whitney test statistic comparisons significant at $\alpha = 0.05$.
Shaded cells indicate the higher analyte concentration in the comparison.

Table 4-6 Continued Intra-Basin Water Quality Comparison of Willow, Amazon, and Spring Creeks [1] Using Mann-Whitney Statistic [2]				
Analyte	**Units**	**Amazon Creek at 29th Avenue (Upstream)**	**Amazon Creek at Royal Avenue (Downstream)**	**Amazon Diversion Channel at Royal Avenue (Downstream)**
Biochemical Oxygen Demand	mg/L	< 2		2.1
Chemical Oxygen Demand		< 5	18	22
Dissolved Oxygen		8.0		7.8
Escherichia coli	(*Col./100 mL*)	661	456	373
Fecal Coliform		310	727	268
Calcium - Total	(*mg/L*)	22	20	
Magnesium - Total		7.7	7.2	10
Hardness	mg eq $CaCO_3$/L	87	78	95
Ammonia – as Nitrogen	(*mg/L*)	0.9		< 0.01
Nitrate+Nitrite – as Nitrogen		0.31	0.19	0.22
Total Kjeldahl Nitrogen		0.2	0.5	0.8
Phosphorus – Ortho		0.05	0.04	0.04
Phosphorus – Total		0.10		0.16
Field pH	(*Units*)	7.1	7.5	7.3
Temperature	°C	11.1	14.3	13.8
Total Dissolved Solids	mg/L	140	135	
Total Suspended Solids		7.6	21	19
Turbidity	NTU	14	26	35

[1] Comparisons made: Amazon Creek at 29th Avenue to Amazon Creek at Royal Avenue and to Amazon Diversion Channel at Royal Avenue
[2] Mann-Whitney test statistic comparisons significant at α = 0.05.
Shaded cells indicate the higher analyte concentration in the comparison.

Comparing Amazon Creek at 29th with Spring Creek at Beacon Drive East, statistically significant differences were found for 25 of 41 analytes, including metals, nutrients, hardness (calcium and magnesium), specific conductance, *E. coli* and pH. For the metals, 16 of 22 fractions had statistically significant differences, all values except zinc and silver are higher in Amazon Creek at 29th Avenue, including dissolved and total arsenic, chromium, copper, lead, mercury, and nickel. Relative percent differences range from 52% for dissolved lead to 145% for total chromium. The average dissolved zinc concentration in Spring Creek is over twice that of Amazon Creek at 29th, the total fraction is 69% higher. Amazon Creek has a slightly higher pH, higher concentrations of hardness (calcium), and nearly twice the *E. coli* count than Spring Creek. Spring Creek has higher nutrient concentrations than Amazon Creek at 29th, including NO_3+NO_2-N (143%), ortho phosphorus (57%), and total phosphorus (34%).

Comparing water quality data for at Amazon basin monitoring sites we generally find that as stream flow passes through the urban environment the concentrations of metals, oxygen demand, suspended solids, turbidity, fecal Coliform, and temperature <u>increase</u> at respective downstream monitoring sites; dissolved oxygen, *E. coli*, hardness (calcium and magnesium), NO_3+NO_2-N,

ortho phosphorus, dissolved solids, pH, and dissolved zinc concentrations tend to decrease at respective downstream monitoring sites. The 29th Avenue site is the uppermost monitoring location on Amazon Creek, followed by Amazon Creek at the Railroad Crossing; the Amazon Diversion Channel at Royal Avenue and Amazon Creek at Royal Avenue are farthest downstream monitoring sites. The A3 Channel at Terry Street drains into the lower Amazon Creek (see Figure 4-8).

There are a few notable exceptions to the intra-basin water quality comparison characteristics described above:

- A3 Channel at Terry Street (upstream) compared to Amazon Creek at Royal Avenue (downstream)
    - 22 of 25 analytes having statistically significant differences have historical averages that are greatest upstream at the Terry Street site, including BOD, COD, hardness (calcium and magnesium), specific conductance, TDS, and nutrients (NO_3+NO_2-N, Kjeldahl nitrogen, and ortho and total phosphorus); metals include total and dissolved cadmium, molybdenum, nickel and zinc, and total copper, lead and mercury.
    - Dissolved arsenic and mercury, and total chromium averages are greater downstream at the Amazon Creek at Royal Avenue site.
- Amazon Creek at 29th Avenue (upstream) compared to Amazon Creek at Railroad Track Crossing (downstream)
    - 9 of 29 analytes having statistically significant difference have historical averages that are greatest upstream at the Amazon Creek at 29th Avenue. Dissolved zinc is greatest upstream, as are DO, hardness (calcium and magnesium), dissolved solids, nutrients (NO_3+NO_2-N and ortho phosphorus), and *E. coli*.
    - Fecal Coliform, temperature, TSS, and turbidity, as well as total and dissolved arsenic, lead, mercury, molybdenum, and nickel, as well as total cadmium, copper, selenium, silver, and zinc average concentrations are greatest downstream at the Railroad Track Crossing monitoring site.
- Amazon Creek at 29th Avenue (upstream) compared to Amazon Diversion Channel at Royal Avenue (downstream)
    - 7 of 33 analytes having statistically significant differences have historical averages that are greatest upstream at the Amazon Creek at 29th Avenue site. Dissolved zinc is greatest upstream, as are dissolved oxygen, bacteria (*E. coli* and fecal Coliform), and nutrients (NH3-N, NO_3+NO_2-N and ortho phosphorus).
    - Total and dissolved arsenic, copper, lead, mercury, molybdenum, nickel, and total chromium, selenium, silver, and zinc have higher average concentrations at the downstream monitoring location. Oxygen demand (BOD and COD), hardness

(magnesium), nutrients (total phosphorus and Kjeldahl nitrogen), TSS, and turbidity are also greater downstream.

- Amazon Creek at Railroad Track Crossing (upstream) compared to Amazon Diversion Channel at Royal Avenue (downstream)

  - 5 of 20 analytes having statistically significant difference have historical averages that are greatest upstream at the Amazon Creek at Railroad Track Crossing, including total and dissolved mercury, total arsenic, and bacteria (*E. coli* and fecal Coliform).

  - Total and dissolved copper, molybdenum, nickel, and total cadmium, as well as BOD, COD, hardness (magnesium), total phosphorus, Kjeldahl nitrogen, TSS, and turbidity are greater downstream.

Tables A.21 and A.22 in Appendix A includes a summary of all Amazon Basin monitoring sites whose analytes have statistically significant differences using the Mann-Whitney test statistic; Tables A.23 and A.24 present the full program output.

Willamette River Monitoring Locations

Results of the Mann-Whitney test statistic applied to historical data for the Willamette River monitoring locations indicate that analytes statistically significant at $\alpha = 0.05$, had concentrations that were greater at downstream sites than at corresponding upstream sites. Most of these water quality differences occur when comparing Willamette River locations upstream of the Urban Growth Boundary and downstream of Beltline Bridge (see Figure 4-9). Of the 41 analytes compared between these two sites, 27 are statistically different, 26 of which have higher average concentrations downstream of Beltline Bridge. Table 4-7 below summarizes those pollutants whose concentrations increase as the Willamette River flows through the urban growth area. Increases include total and dissolved arsenic, copper, lead, mercury, nickel, and zinc, as well as total silver. Bacteria counts (*E. coli* and fecal Coliform), hardness (calcium and magnesium), dissolved solids, specific conductance, nutrients (NO_3+NO_2-N, Kjeldahl nitrogen, and ortho and total phosphorus), and turbidity values also increase as the Willamette River courses through the urban area. pH decreases slightly.

Table 4-7 Comparison of Willamette River Average Analyte Concentrations Upstream and Downstream of the Urban Growth Boundary Using Mann-Whitney Statistic [1]			
Analyte	**Units**	**Upstream of Urban Growth Boundary (RM 186.9)**	**Downstream of Beltline Bridge (RM 176.8)**
Arsenic – Total	(*µg/L*)	0.268	0.332
Arsenic – Dissolved		0.203	0.257
Copper – Total		0.558	0.796
Copper – Dissolved		0.295	0.443
Lead – Total		0.0763	0.105
Lead – Dissolved		0.00787	0.0176
Mercury – Total		0.00156	0.00187
Mercury - Dissolved		0.00072	0.00082
Nickel – Total		0.305	0.350
Nickel - Dissolved		0.184	0.227
Silver – Total		0.00192	0.00481
Zinc – Total		1.30	1.87
Zinc – Dissolved		0.391	0.937
Escherichia coli	(*col./100 mL*)	19	43
Fecal Coliform		14	37
Nitrate+Nitrite – as Nitrogen	(*mg/L*)	< 0.05	0.11
Total Kjeldahl Nitrogen		< 0.2	0.2
Phosphorus – Ortho		0.03	0.05
Phosphorus – Total		0.04	0.07
Total Dissolved Solids		41	45
Total Suspended Solids		4.2	5.0
Turbidity	NTU	6.6	7.2
Calcium - Total	(*mg/L*)	4.7	5.1
Magnesium – Total		1.6	1.7
Hardness	(*mg eq $CaCO_3$/L*)	18	20
Specific Conductance	(*µmhos/cm*)	47	55
pH	Standard Units	7.3	7.0

[1] Mann-Whitney test statistic comparisons significant at α = 0.05.
Shaded cells indicate analyte value at downstream monitoring site greater than upstream site.

An examination of water quality changes over shorter stream reaches indicates fewer statistically significant differences in analyte concentrations. These are summarized as follows:

- Willamette River Upstream of Urban Growth Boundary (upstream) compared to Willamette River at the Knickerbocker Bridge (downstream)

- No analytes had statistically significant differences of historical averages greatest upstream of the Urban Growth Boundary.
- 11 of 11 analytes, including total and dissolved arsenic and copper, and dissolved mercury and lead have higher average concentrations at the downstream monitoring location. *E. coli*, fecal Coliform, hardness (calcium), and specific conductance are also greater downstream.

- Willamette River at the Knickerbocker Bridge (upstream) compared to Willamette River at the Owosso Bridge (downstream)
  - No analytes had statistically significant differences of historical averages greatest upstream of the Urban Growth Boundary.
  - 3 analytes, including total lead, *E. coli* and fecal Coliform are greater downstream.
- Willamette River at the Owosso Bridge (upstream) compared to Willamette River Downstream of the Beltline Bridge (downstream)
  - No analytes had statistically significant differences of historical averages greatest upstream at the Owosso Bridge.
  - 12 of 12 analytes, including total and dissolved copper and zinc, and dissolved lead and nickel, as well as magnesium, specific conductance, and nutrients (NO_3+NO_2-N, Kjeldahl nitrogen, ortho and total phosphorus), are greater downstream.
- Willamette River at the Owosso Bridge (upstream) compared to Delta Ponds (downstream)
  - 6 of 21 analytes had statistically significant differences of historical averages greatest upstream at the Owosso Bridge, including total and dissolved chromium and mercury, dissolved oxygen and pH.
  - 15 of 21 analytes, including total and dissolved arsenic, lead, nickel, zinc, and dissolved copper, as well as hardness (calcium and magnesium), specific conductance, dissolved solids, and total phosphorus are greater downstream (Delta Ponds).

As mentioned in a previous section, flow management of the Delta Ponds along with extensive restoration of riparian habitat has been conducted by the City of Eugene and the U.S. Army Corps of Engineers. The effect of these activities has been to alter the water quality characteristics of Delta Ponds, particularly during periods when flow management through Delta Ponds provides for higher flows to simulate more closely seasonal changes.

Tables A.21 and A.22 in Appendix A includes a summary of all Willamette River monitoring sites whose analytes have statistically significant differences using the Mann-Whitney test statistic; Tables A.23 and A.24 present the full program output.

The Willamette River was 303(d) listed in 2004 for dioxin (2,3,7,8-TCDD) and ambient samples were collected upstream of the urban growth boundary and downstream of Beltline Bridge during the 2015/2016 monitoring period; all results were reported as not detected (see Table A.13) with reporting limits ranging from 2.4 to 2.8 pg/L.

4.4.3.5 Comparison of Ambient Water Quality Data to Oregon Standards

Water quality standards and beneficial uses for surface waters are defined in Chapter 340, Division 41 of the Oregon Administrative Rules (OAR). Analytical results for surface water samples collected from Amazon Basin and Willamette River sites are assessed in this section for overall conformance to Oregon water quality standards.

Boxplot charts are shown in Appendix B, Figures B.108 through B.211, of water quality data from the Amazon Basin and Willamette River ambient monitoring sites and compared to Oregon standards. The horizontal line in the middle of the box for each analyte marks the median of the sample set; the median splits the ordered sample set in half. The box represents the central 50 percent of data values; the outer edge of each box mark the 25th and 75th percentiles. Whiskers extending from the box mark the range of values that fall within 1.5 box-lengths from the 25th or 75th percentile. Outliers and extreme values are also depicted in the figures and are defined using different criteria than those used to identify anomalous measurements. Values that are more than 1.5 box-lengths from the 25th or 75th percentiles are identified as outliers and are denoted by an open circle; extreme values are more than 3 box-lengths and are denoted by an asterisk.

All six monitoring stations in the Amazon Basin are grouped together to obtain a visual synopsis of the analytical data, as are the data for the Willamette River, Spring Creek, and Delta Ponds. Note that all total and dissolved metals values are grouped together for each analyte (Figures B.108 through B.124). The boxplots provide a means of quickly characterizing the data sets graphically in terms of the types of analytes and percentile of sampling events exceeding the applicable water quality standard. Appendix B also presents boxplots for each water quality parameter by individual monitoring location (Figures B.125 through B.211). Boxplots also depict applicable Oregon water quality standard for each analyte when available. The water quality standard is defined by a vertical line through the concentration axis with the applicable criterion listed at the top of the chart. Metals toxicity criteria are adjusted for hardness using the equations of Table 30 in OAR 340-041. In all instances the lowest criterion is indicated.

In the case of arsenic (Figure B.108), for Amazon Basin monitoring locations, about 25 percent of the values exceed the human health criterion, which is 2.1 µg/L; the highest observed concentrations from Amazon basin sites is about seven times greater than the standard, while data for Willamette basin sites exceeded the standard in one instance, an extreme value from Delta Ponds where the concentration was about 2.46 µg/L. Willamette valley soils are volcanic in origin and contain relatively high concentrations of naturally occurring arsenic; in some locations total arsenic concentrations in soil can be as high as 20 mg/kg.

Cadmium concentrations exceeded the chronic toxicity criterion in both Amazon and Willamette basin monitoring sites, all of which are identified as extreme values. Most of the Amazon basin exceedances are associated with total values from the A3 Channel at Terry Street, while a handful of values scattered at the Knickerbocker and Owosso Bridge sites on the Willamette River within the urban area accounted for exceedances in the Willamette basin. Extreme values in the cadmium data set for Amazon basin sites are nearly three times greater than the chronic criterion; the majority of exceedances are less than two times the chronic criterion. Unlike previous reports where cadmium data were evaluated against a higher toxicity standard effective at that time, no water quality exceedances were observed. The cadmium toxicity criterion was recently updated by the Oregon DEQ, which has resulted in multiple exceedances (see Figure B.109).

Copper concentrations measured at monitoring sites from the Willamette Basin (Figure B.111) are for the most part less than the acute and chronic criteria with the exception of a few extreme values. In the Amazon Basin about 50% of values in the data set exceed the chronic criteria by up to seven times the 3.5 µg/L chronic criterion; values within 1.5 times the 75th percentile as defined by the extent of the whisker (about 7.0 µg/L) exceed both the chronic and acute toxicity criteria.

Nearly 70% of the stream samples collected from the Amazon Basin exceed the chronic criterion for lead at 0.54 µg/L (Figure B.112); none exceed the acute criterion. For the Willamette Basin monitoring sites the values for a few extreme values slightly exceed the chronic criterion.

Multiple extreme values and outliers at Amazon Basin sites exceed the mercury criterion of 0.012 µg/L (see Figure B.113); the extent of the whisker at 1.5 times the 75th percentile is near the mercury criterion. At the Willamette Basin sites a couple of extreme values slightly exceed the chronic criterion for mercury.

The chronic criterion for silver is 0.085 µg/L and is exceeded by a few extreme values in the Amazon Basin; one value exceeded the acute criterion. One value at the Willamette River Owosso Bridge site exceeded the water quality standard (Figure B.117).

Amazon Basin samples occasionally exceed both the acute and chronic criteria for zinc (Figure B.118), which are 36.2 µg/L and 37.0 µg/L, respectively (collectively shown as 36 µg/L on the chart). The extent of the whisker exceeds both criteria. About a dozen samples collected from the Willamette Basin sites exceed both water quality criteria for zinc.

Exceedances of non-metal water quality standards are also observed for samples collected from the Amazon and Willamette Basins. These included DO, bacteria, pH, temperature, and turbidity. Minimum DO criteria are not met at either the Amazon or Willamette Basin sites for at least some periods of the year. For the Amazon Basin samples this would typically occur during summer months when water temperatures are warmer and stream flows are lower. Boxplots in Figure B.119 indicate that over a quarter of samples from the Amazon Basin may not meet the 6.5 mg/L minimum DO criterion. Sampling protocol does not strictly meet the 30-day mean definition of the criterion given a sampling frequency of six times per year; however, the values are strong evidence that depleted oxygen conditions may persist in the waterbody.

The DO criterion for the Willamette River is for the period extending from October 15 to May 15 (the spawning period for salmonids); about 60% of the samples measured at Willamette Basin sites did not meet the 11.0 mg/L minimum DO criterion, though this is somewhat skewed by inclusion of the Delta Ponds and Spring Creek samples which, on average, have 6.1 and 7.7 mg/L DO, respectively. Boxplots in Figure B.194 indicate that only about 60% of the samples collected from Willamette Basin sites met the 11.0 mg/L DO criterion during the spawning period. Note that over half of the samples did not meet the DO criterion at the site upstream of the urban growth boundary, thus the Willamette River was found to be oxygen depleted even before passing through Eugene urban area. Median DO concentrations are lowest near the Owosso Bridge monitoring site but improve somewhat downstream of Beltline Bridge. Pollutants transported by stormwater likely contribute to oxygen depletion of the river through biological and chemical processes.

Escherichia coli counts exceed the criterion of 406 organisms per 100 mL in about 30 percent of samples collected from the Amazon Basin sites (Figure B.120); a few outliers exceeded the criterion from Willamette Basin sites, primarily from the Spring Creek and Delta Ponds sites (see Figure B.201). The magnitude of exceedance for outliers and extreme values at the Amazon Basin sites is nearly two orders of magnitude greater than the criterion. Unlike the Amazon Basin sites where *E. coli* counts tend to decrease downstream, *E. coli* counts in samples from the Willamette River increase slightly as the river flows through the urban growth area (see Table 4-7 above); however, values for monitoring sites on the main-stem Willamette River did not exceed the water quality criterion for bacteria. Fecal Coliform values exceed the criterion less frequently as shown in Figure B.121; the few outliers for the Willamette Basin are associated with the Spring Creek site (see Figure B.201), samples from the Willamette River did not exceed the bacteria criterion.

Field pH measurements from Amazon Basin sites sometimes exceed both the minimum and maximum pH criteria of 6.5 and 8.5 pH units respectively; some samples from the Willamette River sites exceed the minimum pH criterion (Figure B.122). Most of these exceedances are associated with field measurements performed during the early years of the monitoring program where greater pH variability was observed; however, recent measurements indicate exceedances do occur as has occurred for Delta Ponds and Spring Creek at Beacon Drive East.

Nearly 60% of the samples collected from the Amazon Basin exceed the salmon and trout rearing and migration temperature criterion of 18 ˚C (Figure B.124), effective from May 16th through October 14th; a few samples from the Willamette Basin also exceed this criterion. The salmon and steelhead spawning temperature criterion of 13 ˚C (Figure B.123) is applicable to the Willamette River and is effective from October 15th through May 15th; samples collected from the four main-stem monitoring sites occasionally exceed this criterion.

Figures B.207 through B.212 in Appendix B are boxplots of turbidity measurements compared to the applicable flow-based turbidity target defined in Chapter 10 on page 212 of the Willamette Basin TMDL; boxplots in Figure B.207 summarize the data by criterion. DEQ derived the Amazon Creek turbidity targets using Long Tom River flows near Noti as a reference river discharge. Collection dates for historical turbidity values measured under the ambient monitoring program were correlated to river flows on the Long Tom recorded by the USGS. The

applicable turbidity target was then derived for each turbidity value; boxplots of the data sets are grouped by the applicable turbidity target, as defined on each chart. Most of the turbidity values with lower targets exceed the applicable criterion, though it is instructive to note that the median of turbidity values for Willow Creek tends to center on the target at higher turbidity values. Turbidity values for Amazon Creek at 29th Avenue are comparable to – and often times less turbid than – Willow Creek, suggesting the upper reach of Amazon Creek may already exhibit turbidity levels representative of baseline conditions, which we have designated Willow Creek, a relatively undisturbed stream originating within this basin. Additional efforts will be needed at downstream sites to improve water quality such that it meets the turbidity targets required by DEQ; at present, only Amazon Creek at Royal Avenue has a long-term decreasing trend for turbidity.

OAR 340-041-0036 describes the turbidity criterion applicable to the Willamette River, which states that no more than a ten percent cumulative increase in natural stream turbidities may be allowed as measured relative to a control point immediately upstream. A statistically significant difference was observed for turbidity between the uppermost monitoring site on the Willamette River upstream of the urban growth boundary, and the lowermost site downstream of the Beltline Bridge (see Tables 4-7 above). Figure B.206 presents turbidity boxplots for the Willamette River sites.

Figures 4-1a and 4-1b in Section 4.1 summarize the Seasonal Kendal trends; green text analytes indicate decreasing trends while analytes in red text indicate an increasing trend. Green may be presumed to be a "good" indicator, while red a "poor" indicator, with the exception of dissolved oxygen; in this instance increasing trends desired and are indicative of improving water quality.

Figures 4-1c and 4-1d compare statistically significant water quality changes across the Amazon and Willamette drainage basins. Each analyte is color coded to its respective drainage basin area; for example, in the comparison of Amazon Creek at 29th Avenue to Amazon Creek at the Railroad Crossing, analytes in red text indicate concentrations are greater at the 29th Avenue site, while those analytes in blue text indicate concentrations are greater at the Railroad Crossing site. Comparisons are for the entire water quality data set.

Finally, Figures 4-1e and 4-1f compares water quality data for the most recent monitoring period (2015/2016) to Oregon water quality standard; all analytes listed indicate an exceedance of a water quality standard, green text analytes indicate the analyte has a decreasing concentration trend for the entire data set, red text indicates an increasing trend, and black text indicates no trend in the data set.

4.4.3.6 Water Quality Correlations

Factor analysis of the ambient water quality data was done to study the interrelated water quality analytes at each monitoring location. This concept is important because it may provide important characteristics of the water body and the types of pollutants detected both during dry and wet seasons. For example, suspended solid and turbidity increases in a waterbody may be associated with increases of other pollutants, hence application of specific BMPs to control solids and turbidity would prove beneficial in controlling other pollutants that are problematic in the same waterbody.

Our analysis consisted of reviewing the entire water quality data set using commercially available software to perform factor analysis. In addition to the 41 water quality analytes, three additional variables were added to the analysis; precipitation, river flow, and seasonality. River flow for sites other than the Willamette River utilizes flow measurements in the Long Tom River near Noti, and seasonality is as defined in the Seasonal Trends section above. While derivation of a model summarizing the many analytes into a few factors is possible, our interest at this initial stage of review was generation of a correlation matrix of all analytes and their interrelationships. Correlations, or r values, measure the strength of linear associations between each analyte. Upon obtaining the correlations, all analyte pairs exceeding an r value of 0.3 and whose comparison was significant at $\alpha = 0.05$, were selected as "significant" analytes. A simple correlation index was developed whereby the sum of significant analyte pairs is divided by the total number of possible significant pairs. The index was calculated for four analyte groupings including; all analytes, metals, nonmetals, and metal-nonmetal correlations. If all analytes are linearly correlated within their respective group, an index of 1 (one) would be observed.

Figure 4-6 summarizes the correlation indexes for each ambient monitoring location. In general, the lowest correlation indexes are located at Willow Creek and Willamette River sites; by comparison, Amazon Creek, the A3 and Diversion Channels, Spring Creek, and Delta Ponds had significantly higher indexes. Overall, the highest correlation index observed for all analytes was 0.49 for Spring Creek at Beacon Drive East followed by Amazon Creek at the Railroad Crossing with a 0.44 correlation index.

Spring Creek had the highest metals and non-metals correction index at 0.54 and 0.50 respectively, followed by Amazon Creek at the Railroad Crossing at 0.44 and 0.44. At Spring Creek, molybdenum, copper, mercury, lead, arsenic, and zinc had the greatest number of metal-metal correlations. For the non-metals, NO_3+NO_2-N, fecal Coliform, COD, total phosphorus, specific conductance, hardness (calcium and magnesium), TDS and turbidity had the greatest number of correlations.

The Willamette River Upstream of the Urban Growth Boundary had the highest correlation index at 0.33 for the metal group. The correlation matrix for this group indicates copper, nickel, and mercury had the highest number of significant correlations. For the non-metals, the Willamette River Downstream of Beltline Bridge had the highest correlation at 0.21, temperature, specific conductance, magnesium, total phosphorus, and turbidity had the greatest number of correlations.

A final comparison was made to evaluate the metal-nonmetal relationships. Once again, the Spring Creek at Beacon Drive East had the highest correlation index at 0.47, followed by Amazon Creek at the Railroad Crossing 0.43. Analyte pair combinations for the Spring Creek site with the highest number of correlations include dissolved lead, total phosphorus, fecal Coliform, total mercury, hardness, and total chromium. For the Amazon Creek at the Railroad Crossing site, the highest number of correlations include hardness (magnesium), specific conductance, temperature, suspended solids, dissolved oxygen, total phosphorus, and NO_3+NO_2-N.

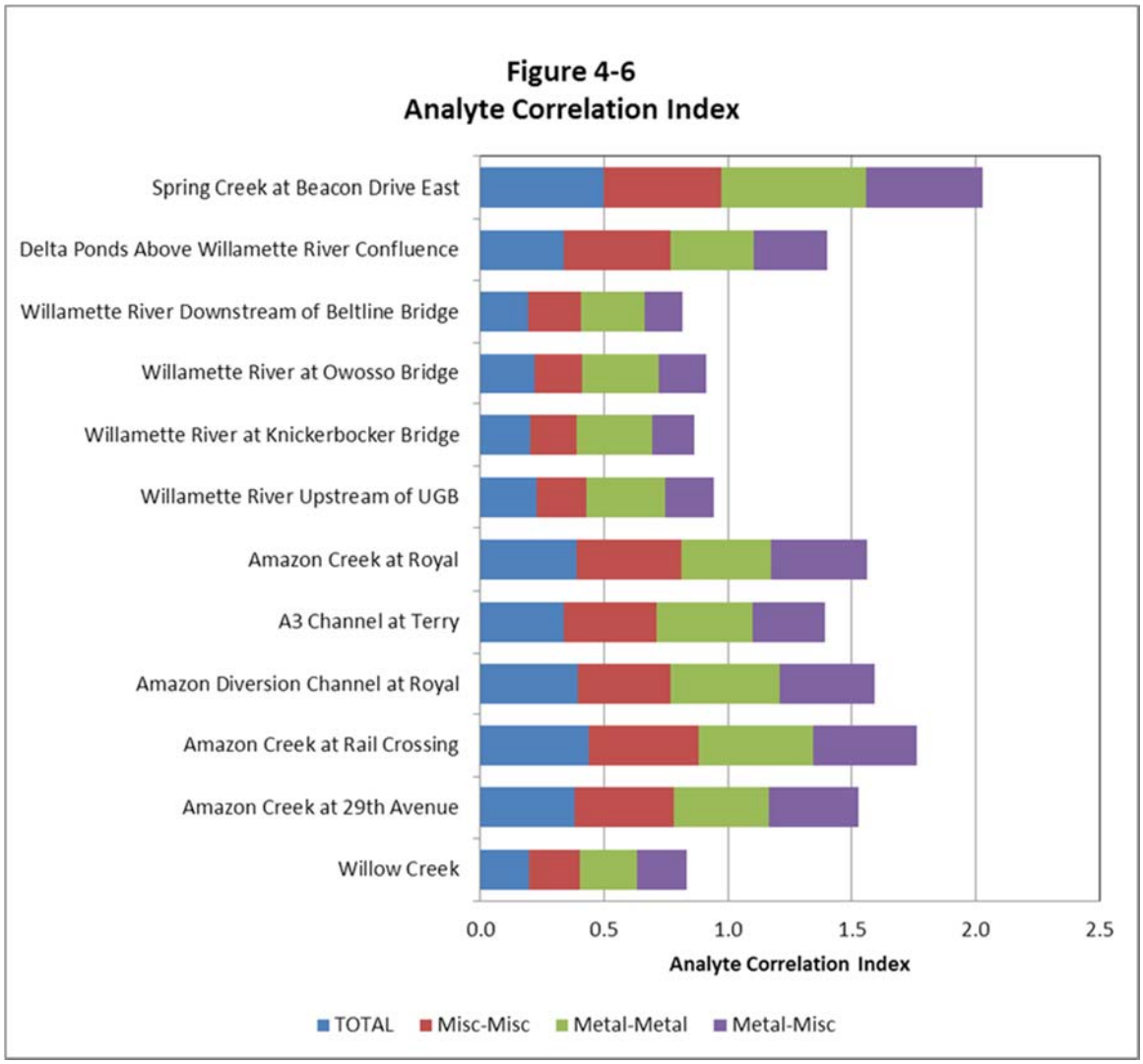


Table 4-8 below lists analyte correlations with turbidity and suspended solids for the Amazon and Willamette River basins. These data suggest BMPs that control total suspended solids and turbidity may also be effective in reducing multiple other pollutants in waterbodies receiving stormwater flow.

Table 4-8 Analyte Correlation with TSS and Turbidity			
Amazon Basin Monitoring Sites		**Willamette Basin Monitoring Sites**	
Non-Metals	**Metals**	**Non-Metals**	**Metals**
Fecal Coliform COD DO Specific Conductance TDS TSS Turbidity Total Phosphorus Kjeldahl Nitrogen Temperature	Arsenic – T Cadmium – T Chromium – T Copper – D & T Lead – T Mercury – D & T Molybdenum – D Nickel – T Silver – T Zinc – T	Seasonality River Flow COD Hardness (Mg) TDS TSS Turbidity *E. coli* Total Phosphorus Kjeldahl Nitrogen Temperature	Arsenic – T Chromium – T Copper – D & T Lead – T Mercury – D & T Nickel – T Zinc – T
D – Dissolved T - Total			

4.4.4 Data Management, Documentation and Record-Keeping

Laboratory analysis performed at the Eugene/Springfield Water Pollution Control Facility (E/S WPCF) is performed under an Environmental Management System (EMS) for which the facility has earned certification under the International Organization for Standardization (ISO). Organizations that earn ISO certification under the 14001:2004(E) standard commit to develop an environmental policy, establish objectives and processes to achieve policy commitments, take action as needed to improve its performance and demonstrate the conformity of the system to the requirements of the ISO standard. ISO 14001 elements include establishing, implementing and maintaining procedures applicable to legal requirements, documentation and records determined to be necessary to ensure effective planning, operation and control of processes, control of records and documents, evaluation of legal compliance, defining roles, responsibilities and authority of staff, competence and training requirements, and management review. In addition, the E/S WPCF's EMS is audited by internal and external auditors on a frequent basis to ensure conformance and compliance to the policies and objectives established by and applicable to the E/S WPCF.

As such, all sampling and analysis of stormwater, stream, and MS4 samples performed by staff at the E/S WPCF falls under the umbrella of the EMS program. Documents and records associated with stormwater monitoring elements are readily available through the E/S WPCF electronic document control system, including the facility's QAP and all SOPs associated with sample collection, handling, analysis, and reporting. All laboratory and field measurements collected to meet the stormwater NPDES monitoring requirements is controlled through the E/S WPCF's Laboratory Information Management System, which has strict controlled data entry requirements and access restrictions.

The City's Stormwater Monitoring Plan (November 2011, Rev. 1.0) documents the sampling and analysis protocols followed which meet the requirements specified in Schedule B of the City's NPDES permit. The Monitoring Plan is available to the public at any time via the City's Stormwater Program internet web site. While no changes to the current Monitoring Plan are being proposed at this time, a revised draft Monitoring Plan was submitted with the City's MS4 Permit Renewal Package (December 2015).

All water quality data collected during this monitoring period as well as historical data, are also posted to the City's Stormwater Program internet web site at http://www.eugene-or.gov/index.aspx?nid=476 .

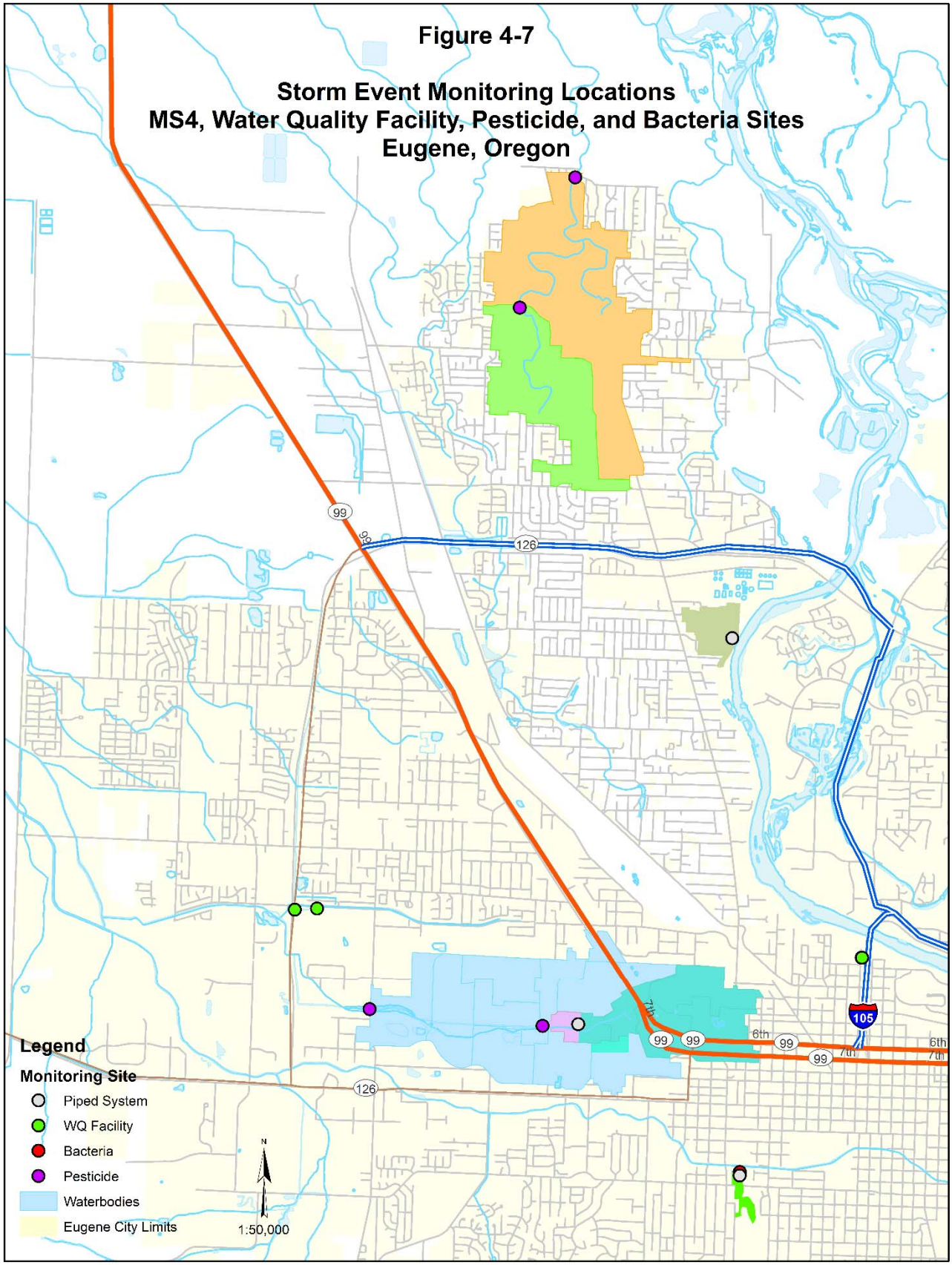


Figure 4-7
Storm Event Monitoring Locations
MS4, Water Quality Facility, Pesticide, and Bacteria Sites
Eugene, Oregon
99
126
105
6th
7th
Legend
Monitoring Site
Piped System
WQ Facility
Bacteria
Pesticide
Waterbodies
Eugene City Limits
N
1:50,000

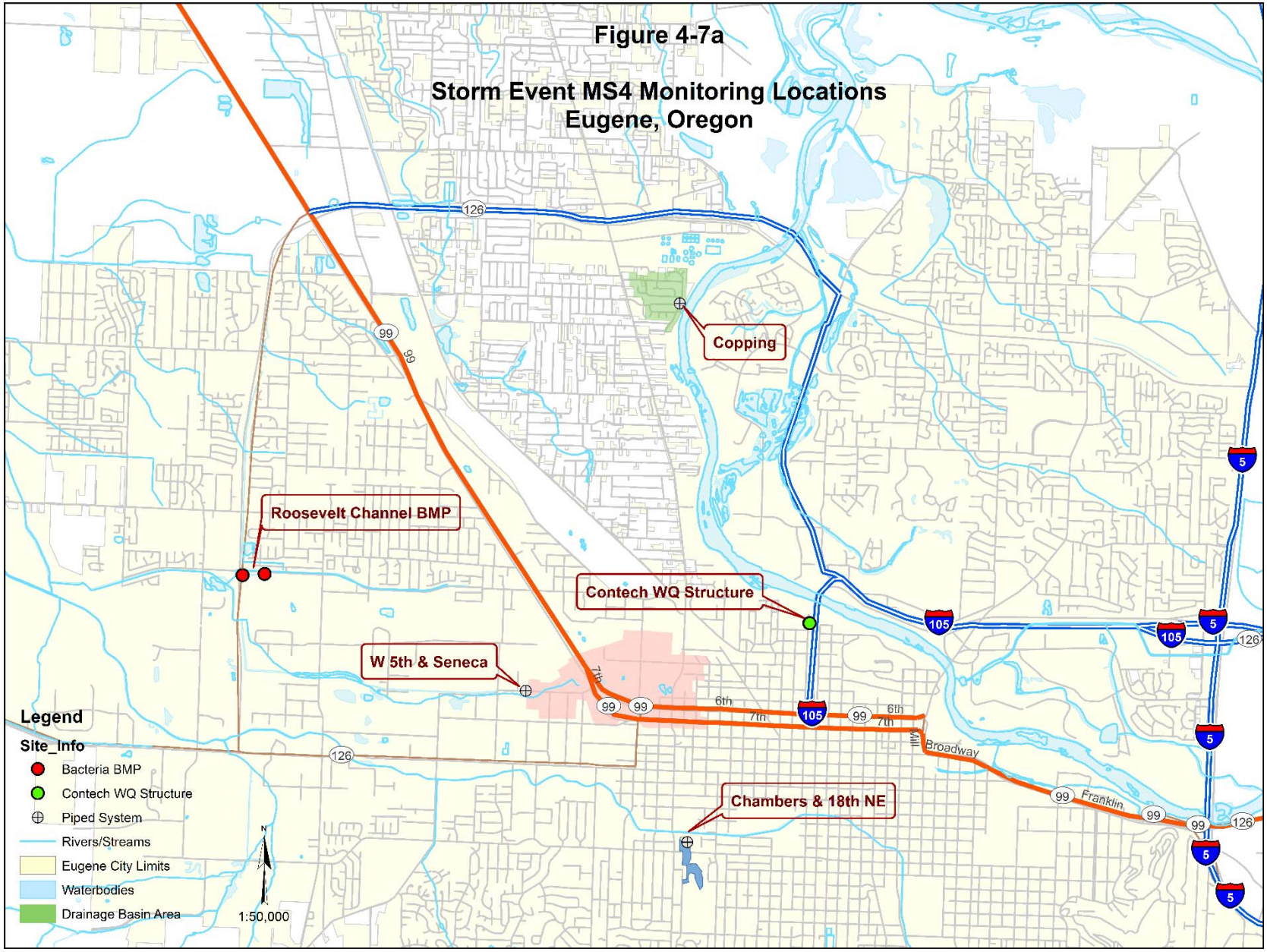


Figure 4-7a
Storm Event MS4 Monitoring Locations
Eugene, Oregon
Copping
Roosevelt Channel BMP
Contech WQ Structure
W 5th & Seneca
Chambers & 18th NE
Legend
Site_Info
Bacteria BMP
Contech WQ Structure
Piped System
Rivers/Streams
Eugene City Limits
Waterbodies
Drainage Basin Area
1:50,000
126
99
105
5
6th
7th
Broadway
Franklin

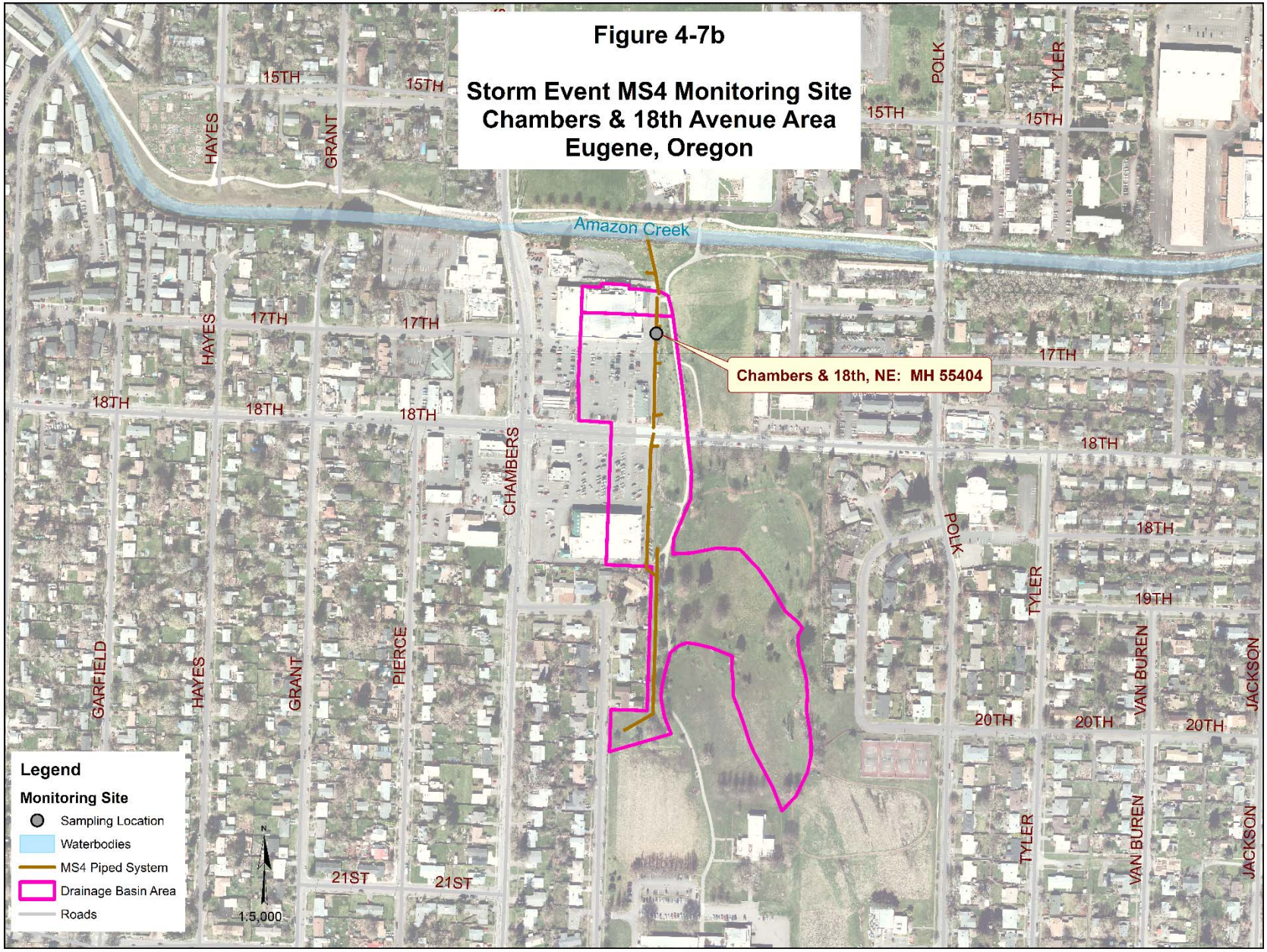


Figure 4-7b
Storm Event MS4 Monitoring Site
Chambers & 18th Avenue Area
Eugene, Oregon
Amazon Creek
Chambers & 18th, NE: MH 55404
15TH
17TH
18TH
19TH
20TH
21ST
HAYES
GRANT
CHAMBERS
POLK
TYLER
VAN BUREN
JACKSON
GARFIELD
PIERCE
Legend
Monitoring Site
Sampling Location
Waterbodies
MS4 Piped System
Drainage Basin Area
Roads
1:5,000

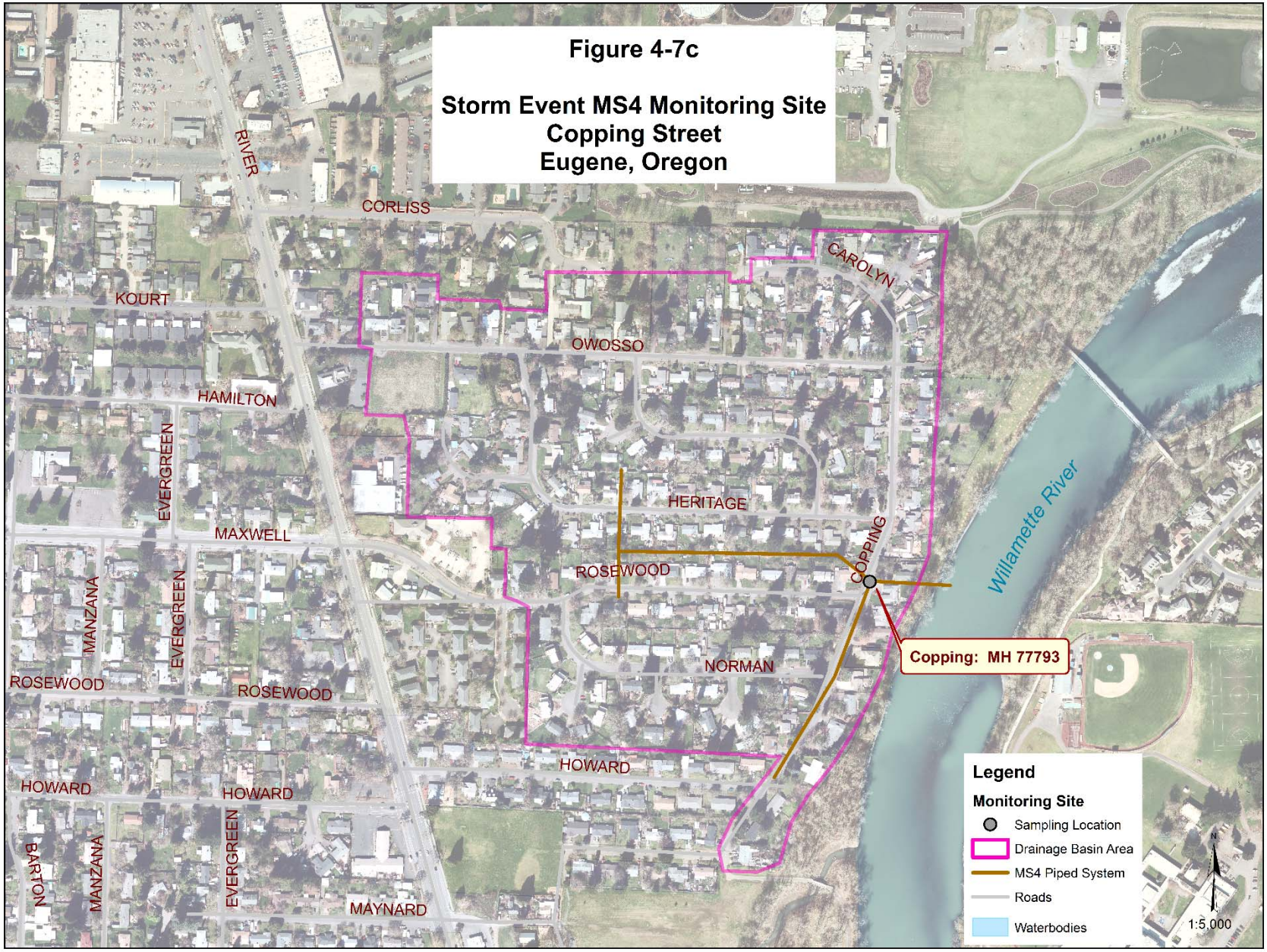


Figure 4-7c
Storm Event MS4 Monitoring Site
Copping Street
Eugene, Oregon
RIVER
CORLISS
KOURT
CAROLYN
OWOSSO
HAMILTON
EVERGREEN
HERITAGE
MAXWELL
COPPING
ROSEWOOD
MANZANA
EVERGREEN
Willamette River
Copping: MH 77793
NORMAN
ROSEWOOD
ROSEWOOD
HOWARD
HOWARD
HOWARD
BARTON
MANZANA
EVERGREEN
MAYNARD
Legend
Monitoring Site
Sampling Location
Drainage Basin Area
MS4 Piped System
Roads
Waterbodies
N
1:5,000

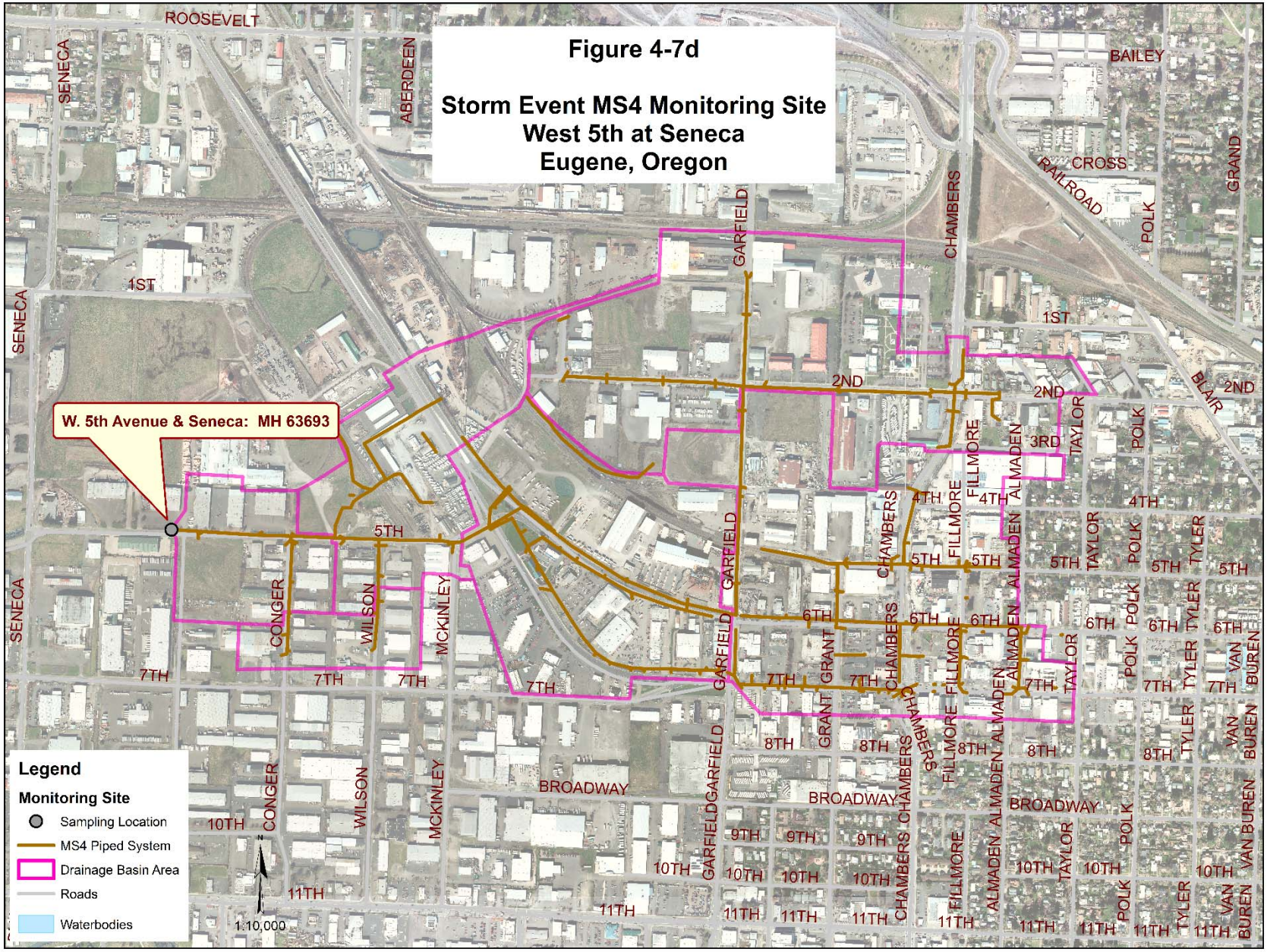


Figure 4-7d
Storm Event MS4 Monitoring Site
West 5th at Seneca
Eugene, Oregon
W. 5th Avenue & Seneca: MH 63693
Legend
Monitoring Site
Sampling Location
MS4 Piped System
Drainage Basin Area
Roads
Waterbodies
1:10,000
ROOSEVELT
SENECA
ABERDEEN
BAILEY
CROSS
RAILROAD
GRAND
POLK
CHAMBERS
GARFIELD
BLAIR
1ST
2ND
3RD
4TH
5TH
6TH
7TH
8TH
9TH
10TH
11TH
TAYLOR
FILLMORE
ALMADEN
TYLER
VAN BUREN
GRANT
CONGER
WILSON
MCKINLEY
BROADWAY

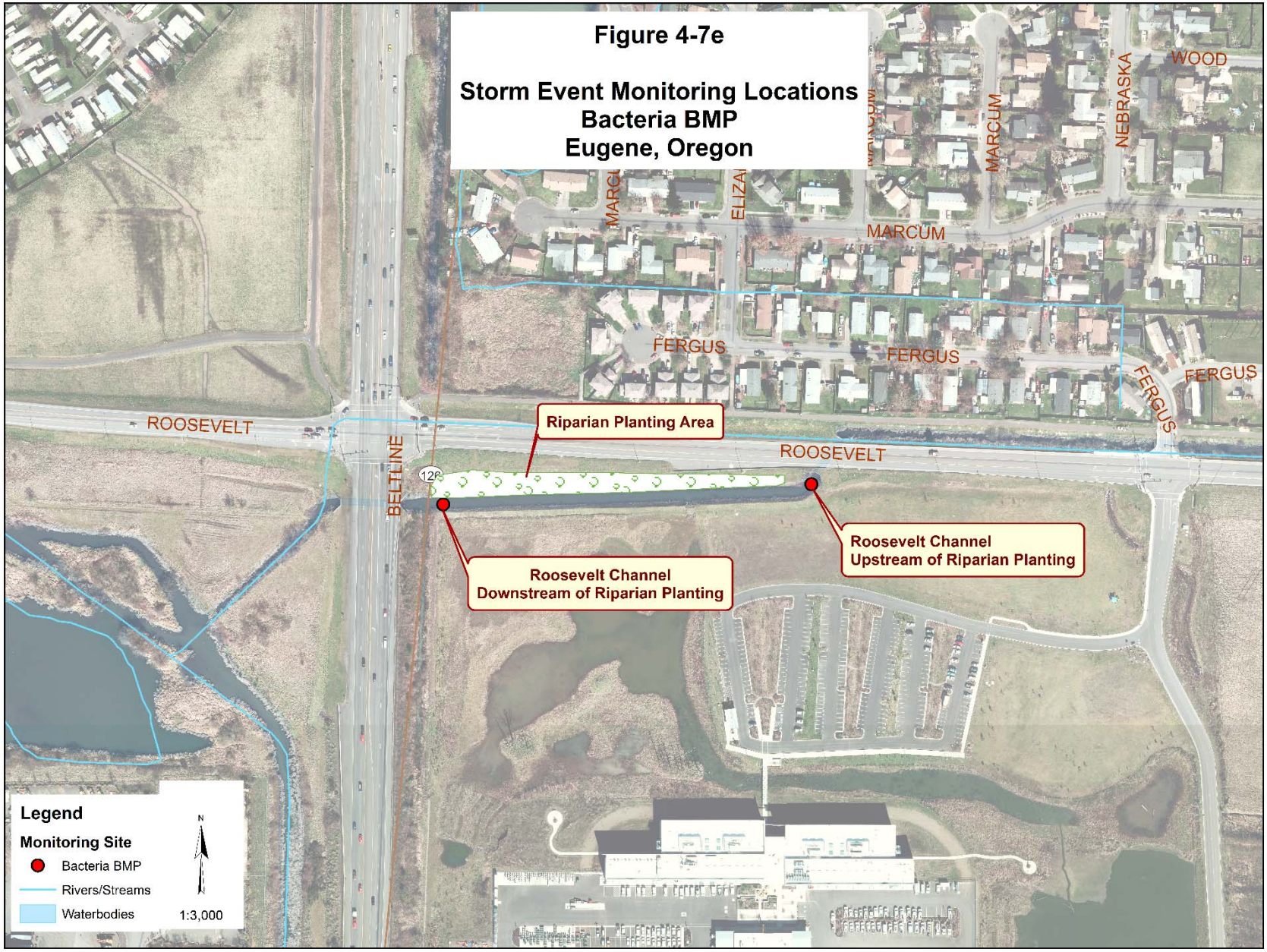


Figure 4-7e
Storm Event Monitoring Locations
Bacteria BMP
Eugene, Oregon
WOOD
NEBRASKA
MARCUM
MARCUM
ELIZA
MARCUM
FERGUS
FERGUS
FERGUS
FERGUS
ROOSEVELT
ROOSEVELT
BELTLINE
Riparian Planting Area
Roosevelt Channel
Upstream of Riparian Planting
Roosevelt Channel
Downstream of Riparian Planting
Legend
Monitoring Site
Bacteria BMP
Rivers/Streams
Waterbodies
N
1:3,000

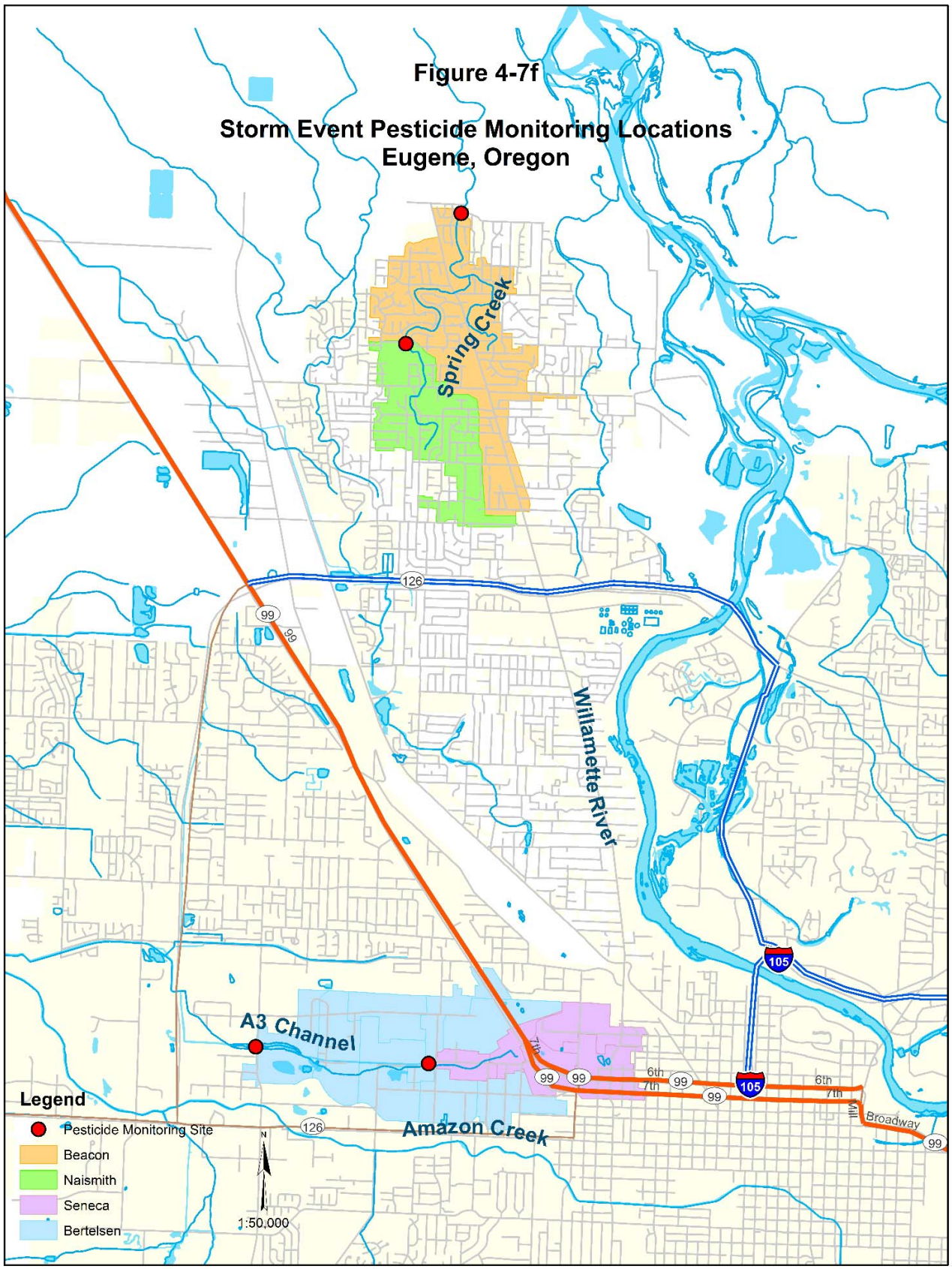


Figure 4-7f
Storm Event Pesticide Monitoring Locations
Eugene, Oregon
Spring Creek
Willamette River
A3 Channel
Amazon Creek
126
99
105
6th
7th
Broadway
Legend
Pesticide Monitoring Site
Beacon
Naismith
Seneca
Bertelsen
N
1:50,000

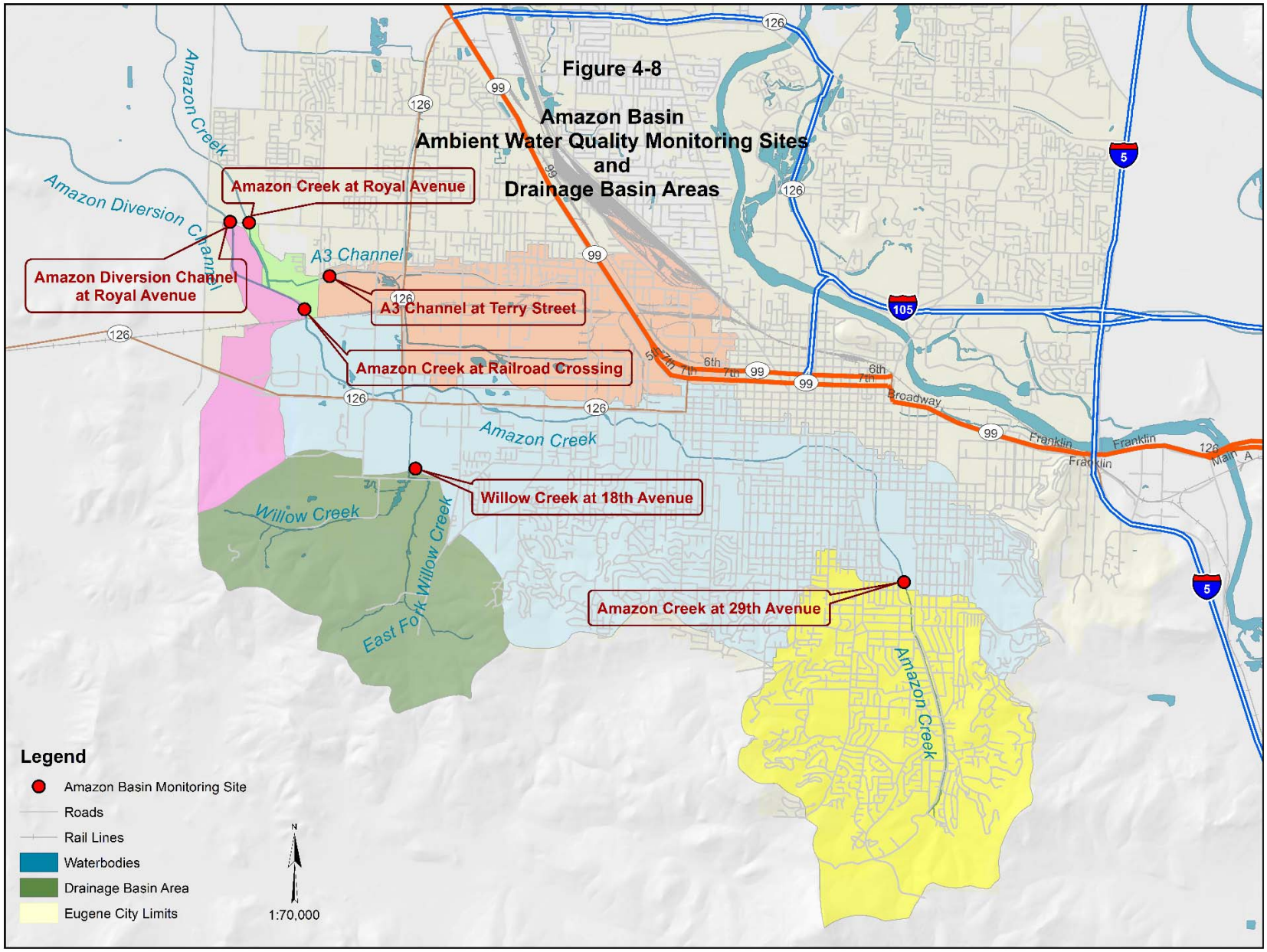


Figure 4-8
Amazon Basin
Ambient Water Quality Monitoring Sites
and
Drainage Basin Areas
Amazon Creek at Royal Avenue
Amazon Diversion Channel at Royal Avenue
A3 Channel at Terry Street
Amazon Creek at Railroad Crossing
Willow Creek at 18th Avenue
Amazon Creek at 29th Avenue
Amazon Creek
Amazon Diversion Channel
A3 Channel
Willow Creek
East Fork Willow Creek
Broadway
Franklin
Legend
Amazon Basin Monitoring Site
Roads
Rail Lines
Waterbodies
Drainage Basin Area
Eugene City Limits
N
1:70,000

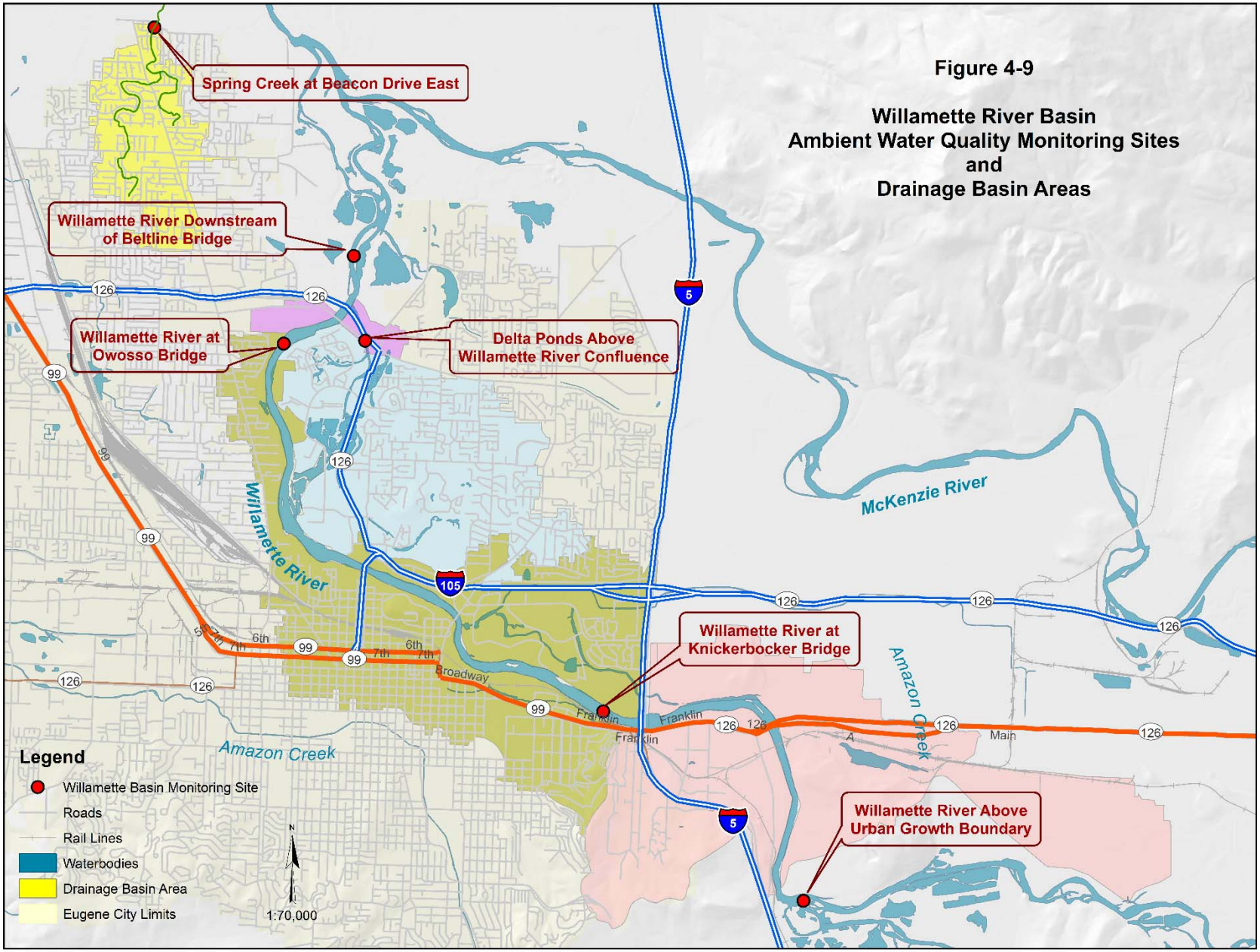


Figure 4-9
Willamette River Basin
Ambient Water Quality Monitoring Sites
and
Drainage Basin Areas
Spring Creek at Beacon Drive East
Willamette River Downstream of Beltline Bridge
Willamette River at Owosso Bridge
Delta Ponds Above Willamette River Confluence
Willamette River at Knickerbocker Bridge
Willamette River Above Urban Growth Boundary
Willamette River
McKenzie River
Amazon Creek
Legend
Willamette Basin Monitoring Site
Roads
Rail Lines
Waterbodies
Drainage Basin Area
Eugene City Limits
1:70,000

APPENDIX A

Tabulated Water Quality Data and Summaries

Storm Event Monitoring Data
Descriptive Statistics

Table A.1

Receiving Waterbody: Amazon Creek
System Type: Piped
System Location: (MH 55404)

Location	Parameter	N	GeoMean	Mean Std. Deviation	Median	Minimum	Maximum	RL	Units	% Change from Historical
Chambers & W 18th Ave, NE: MH 55404	1,1-Dichloroethene	3	2.5	0.0	2.5	2.5	2.5	5.0	µg/L	-28
	Ammonia - N	3	0.23	0.15	0.30	0.10	0.40	0.10	mg/L	107
	Arsenic, Dissolved	3	0.853	0.100	0.816	0.784	0.971	0.0500	µg/L	-6
	Arsenic, Total	3	1.04	0.169	1.07	0.865	1.20	0.0500	µg/L	-24
	Biochemical Oxygen Demand	3	4	5	3	2	11	1	mg/L	-11
	Cadmium, Dissolved	3	0.0164	0.0071	0.0160	0.0110	0.0250	0.0500	µg/L	-56
	Cadmium, Total	3	0.0399	0.0280	0.0360	0.0230	0.077	0.0500	µg/L	-58
	Calcium, Total	3	5.1	1.3	4.8	4.2	6.7	1.0	mg/L	-19
	Chemical Oxygen Demand	3	21	24	17	10	55	5.0	mg/L	-44
	Chromium, Dissolved	3	0.419	0.110	0.401	0.334	0.549	0.100	µg/L	-50
	Chromium, Total	3	1.32	0.629	1.24	0.876	2.10	0.100	µg/L	-50
	Conductivity, @ 25 degrees C	3	43	10	42	34	54	NA	µmhos/cm	-13
	Copper, Dissolved	3	3.11	1.35	2.58	2.42	4.84	0.0500	µg/L	-28
	Copper, Total	3	5.84	4.24	4.24	4.09	11.50	0.0500	µg/L	-37
	Dissolved Oxygen	4	9.5	0.8	9.4	8.6	10.6	NA	mg/L	5
	Escherichia coli	3	3532	1952	4000	1900	5800	1	per 100 mL	178
	Fecal Coliform	3	891	440	970	520	1400	1	per 100 mL	4
	Hardness	3	15	4	14	13	20	2.5	mg eq CaCO3/L	-21
	Lead, Dissolved	3	0.0711	0.0401	0.0670	0.0440	0.122	0.0500	µg/L	-48
	Lead, Total	3	1.79	2.16	1.38	0.854	4.83	0.0500	µg/L	-57
	Magnesium, Total	3	0.646	0.208	0.600	0.500	0.900	0.500	mg/L	-48
	Mercury, Dissolved	5	0.00298	0.00255	0.00271	0.00150	0.00795	0.00050	µg/L	23
	Mercury, Total	5	0.00410	0.00288	0.00354	0.00253	0.00963	0.00050	µg/L	-29
	Methyl Mercury, Dissolved	2	0.0302	0.00806	0.0307	0.0250	0.0364	0.0500	ng/L	-52
	Methyl Mercury, Total	2	0.0604	0.0368	0.0658	0.0398	0.0918	0.0500	ng/L	-53
	Molybdenum, Dissolved	3	0.817	0.213	0.712	0.710	1.08	0.100	µg/L	-37
	Molybdenum, Total	3	0.876	0.291	0.737	0.736	1.24	0.100	µg/L	-34
	Nickel, Dissolved	3	0.412	0.222	0.328	0.305	0.700	0.0500	µg/L	-57
	Nickel, Total	3	1.06	0.788	0.820	0.682	2.11	0.0500	µg/L	-53
	Nitrate + Nitrite - N	3	0.41	0.03	0.41	0.38	0.44	0.05	mg/L	123
	pH Field	4	7.2	0.6	7.4	6.4	7.9	NA	pH Units	2
	Phosphorus, Ortho	3	0.065	0.035	0.050	0.050	0.110	0.010	mg/L	80
	Phosphorus, Total	3	0.047	0.114	0.090	0.005	0.230	0.010	mg/L	-68
	Selenium, Dissolved	3	0.0317	0.0286	0.0250	0.0180	0.0706	0.100	µg/L	-49
	Selenium, Total	3	0.0554	0.0151	0.0500	0.0460	0.0740	0.100	µg/L	-29
	Silica Gel Treated Hexane Ext. Material	3	2.5	0.0	2.5	2.5	2.6	5.1	mg/L	-42
	Silver, Dissolved	3	0.0171	0.0098	0.0250	0.0080	0.0250	0.0500	µg/L	-27
	Silver, Total	3	0.0104	0.0106	0.0090	0.0050	0.0250	0.0500	µg/L	-67
	Temperature	4	10.9	3.1	11.2	8.6	14.0	NA	˚C	0
	Tetrachloroethene	3	0.85	1.2	0.64	0.38	2.5	5.0	µg/L	-3
	Total Dissolved Solids	3	27	5	25	23	33	10	mg/L	-25
	Total Kjeldahl Nitrogen	3	0.7	0.5	0.6	0.4	1.4	0.2	mg/L	24
	Total Suspended Solids	3	14	18	9.2	7.2	40	1.0	mg/L	-51
	trans-1,2-Dichloroethene	3	2.5	0.0	2.5	2.5	2.5	5.0	µg/L	-18
	Trichloroethene	3	1.0	1.4	2.5	0.16	2.5	5.0	µg/L	-28
	Turbidity	3	8.8	5.5	7.0	6.0	16	0.5	NTU	-66
	Zinc, Dissolved	3	18.4	5.16	18.5	13.9	24.2	0.200	µg/L	-7
	Zinc, Total	3	38.7	22.4	31.0	27.5	67.9	0.500	µg/L	-23

Storm Event Monitoring Data
Descriptive Statistics

Table A.2

Receiving Waterbody:
Willamette River

System Type: Piped

System Location: (MH 77793)

Location	Parameter	N	GeoMean	Mean Std. Deviation	Median	Minimum	Maximum	RL	Units	% Change from Historical
Copping St: MH 77793	2,3,7,8-TCDD	2	2.4E-06	2.1E-08	2.4E-06	2.4E-06	2.4E-06	4.9E-06	µg/L	-58
	Ammonia - N	2	0.14	0.25	0.23	0.05	0.40	0.10	mg/L	62
	Arsenic, Dissolved	2	0.434	0.0643	0.437	0.391	0.482	0.0500	µg/L	20
	Arsenic, Total	2	0.669	0.299	0.702	0.490	0.913	0.0500	µg/L	13
	Biochemical Oxygen Demand	2	16	2	17	15	18	1	mg/L	165
	Cadmium, Dissolved	2	0.0353	0.00495	0.0355	0.0320	0.0390	0.0500	µg/L	-27
	Cadmium, Total	2	0.0806	0.0403	0.0855	0.0570	0.114	0.0500	µg/L	5
	Calcium, Total	2	4.6	0.7	4.6	4.1	5.1	1.0	mg/L	59
	Chemical Oxygen Demand	2	64	32	68	45	90	5.0	mg/L	129
	Chromium, Dissolved	2	0.251	0.178	0.281	0.155	0.407	0.100	µg/L	-4
	Chromium, Total	2	0.777	0.916	1.01	0.364	1.66	0.100	µg/L	2
	Conductivity, @ 25 degrees C	2	43	16	44	33	55	NA	µmhos/cm	25
	Copper, Dissolved	2	3.06	1.72	3.30	2.08	4.51	0.0500	µg/L	49
	Copper, Total	2	5.51	4.91	6.51	3.04	9.98	0.0500	µg/L	28
	Dissolved Oxygen	3	8.4	1.9	8.8	6.5	10.3	NA	mg/L	1
	Escherichia coli	3	3756	4007	4800	1200	9200	1	per 100 mL	629
	Fecal Coliform	3	1100	1263	1700	280	2800	1	per 100 mL	61
	Hardness	2	14	2	15	13	16	2.5	mg eq $CaCO_3$/L	110
	Lead, Dissolved	2	0.0776	0.0214	0.0791	0.0640	0.0942	0.0500	µg/L	-20
	Lead, Total	2	1.20	1.77	1.73	0.483	2.98	0.0500	µg/L	-22
	Magnesium, Total	2	0.7	0.1	0.8	0.7	0.8	0.5	mg/L	54
	Mercury, Dissolved	2	0.00259	0.00139	0.00278	0.00179	0.00376	0.00050	µg/L	20
	Mercury, Total	2	0.00426	0.00442	0.00529	0.00216	0.00841	0.00050	µg/L	-32
	Molybdenum, Dissolved	2	0.138	0.0502	0.143	0.107	0.178	0.100	µg/L	35
	Molybdenum, Total	2	0.121	0.155	0.164	0.054	0.273	0.100	µg/L	-34
	Nickel, Dissolved	2	0.961	0.350	0.993	0.745	1.24	0.0500	µg/L	65
	Nickel, Total	2	1.93	0.438	1.95	1.64	2.26	0.0500	µg/L	35
	Nitrate + Nitrite - N	2	0.26	0.28	0.33	0.13	0.53	0.05	mg/L	222
	pH Field	3	7.0	0.3	7.1	6.7	7.2	NA	pH Units	6
	Phosphorus, Ortho	2	0.330	0.014	0.330	0.320	0.340	0.010	mg/L	209
	Phosphorus, Total	2	0.503	0.064	0.505	0.460	0.550	0.010	mg/L	119
	Selenium, Dissolved	2	0.0362	0.0353	0.0440	0.0190	0.0689	0.100	µg/L	-28
	Selenium, Total	2	0.0739	0.0168	0.0749	0.0630	0.0867	0.100	µg/L	6
	Silica Gel Treated Hexane Ext. Material	2	2.6	0.2	2.7	2.5	2.8	5.6	mg/L	-42
	Silver, Dissolved	2	0.0250	0.0000	0.0250	0.0250	0.0250	0.0500	µg/L	3
	Silver, Total	2	0.0128	0.0151	0.0167	0.0060	0.0273	0.0500	µg/L	-64
	Temperature	3	11.2	3.0	12.6	8.1	13.7	NA	˚C	-10
	Total Dissolved Solids	2	31	8	32	26	38	10	mg/L	34
	Total Kjeldahl Nitrogen	2	1.3	1.3	1.6	0.7	2.5	0.2	mg/L	129
	Total Suspended Solids	2	36	46	49	16	81	1.0	mg/L	36
	Turbidity	2	16	9	18	11	24	0.5	NTU	-2
	Zinc, Dissolved	2	612	1519	1236	162	2310	0.200	µg/L	360
	Zinc, Total	2	24.8	173	125	2.50	247	0.200	µg/L	-84

Storm Event Monitoring Data
Descriptive Statistics

Table A.3

Receiving Waterbody: A3 Channel
System Type: Piped
System Location: (MH 63693)

Location	Parameter	N	GeoMean	Mean Std. Deviation	Median	Minimum	Maximum	RL	Units	% Change from Historical
W5th at Seneca:	1,1-Dichloroethene	3	2.5	0.0	2.5	2.50	2.5	5.0	µg/L	2
MH 63693	Ammonia - N	2	0.17	0.14	0.20	0.10	0.30	0.10	mg/L	49
	Arsenic, Dissolved	2	0.647	0.0764	0.649	0.595	0.703	0.0300	µg/L	-6
	Arsenic, Total	2	0.860	0.0983	0.863	0.793	0.932	0.0500	µg/L	-46
	Biochemical Oxygen Demand	2	5	1	6	5	6	1	mg/L	-13
	Cadmium, Dissolved	2	0.0405	0.0007	0.0405	0.0400	0.0410	0.0500	µg/L	-41
	Cadmium, Total	2	0.0883	0.0156	0.0890	0.0780	0.100	0.0500	µg/L	-60
	Calcium, Total	2	5.8	1.4	5.9	4.9	6.9	1.0	mg/L	-39
	Chemical Oxygen Demand	2	22	4.2	22	19	25	5.0	mg/L	-48
	Chromium, Dissolved	2	0.347	0.0099	0.347	0.340	0.354	0.0500	µg/L	-42
	Chromium, Total	2	1.53	0.396	1.56	1.28	1.84	0.0500	µg/L	-48
	Conductivity, @ 25 degrees C	2	56	15	57	46	67	NA	µmhos/cm	-30
	Copper, Dissolved	2	6.44	1.16	6.49	5.67	7.31	0.0500	µg/L	3
	Copper, Total	2	12.5	1.56	12.5	11.4	13.6	0.0500	µg/L	-35
	Dissolved Oxygen	4	8.9	1.2	8.8	7.6	10.6	NA	mg/L	11
	Escherichia coli	3	1977	819	2300	1200	2800	1	per 100 mL	61
	Fecal Coliform	3	1347	2287	1000	520	4700	1	per 100 mL	37
	Hardness	2	22	7.1	23	18	28	2.5	mg eq CaCO3/L	-43
	Lead, Dissolved	2	0.271	0.0460	0.273	0.240	0.305	0.0500	µg/L	-29
	Lead, Total	2	2.46	0.205	2.47	2.32	2.61	0.0500	µg/L	-73
	Magnesium, Total	2	2.0	0.8	2.1	1.5	2.6	0.5	mg/L	-49
	Mercury, Dissolved	4	0.00282	0.00078	0.00287	0.00197	0.00389	0.00050	µg/L	30
	Mercury, Total	4	0.00637	0.00337	0.00671	0.00321	0.0114	0.00050	µg/L	-57
	Methyl Mercury, Dissolved	2	0.0280	0.00445	0.0282	0.0250	0.0313	0.0500	ng/L	-56
	Methyl Mercury, Total	2	0.0531	0.00156	0.0531	0.0520	0.0542	0.0500	ng/L	-64
	Molybdenum, Dissolved	2	0.685	0.0396	0.686	0.658	0.714	0.0500	µg/L	11
	Molybdenum, Total	2	0.748	0.0375	0.749	0.722	0.775	0.0500	µg/L	-21
	Nickel, Dissolved	2	0.732	0.0141	0.732	0.722	0.742	0.0500	µg/L	-35
	Nickel, Total	2	1.88	0.0919	1.89	1.82	1.95	0.0500	µg/L	-46
	Nitrate + Nitrite - N	2	0.31	0.01	0.31	0.30	0.32	0.05	mg/L	10
	pH Field	4	7.0	0.4	7.0	6.6	7.6	NA	pH Units	1
	Phosphorus, Ortho	2	0.065	0.007	0.065	0.060	0.070	0.010	mg/L	60
	Phosphorus, Total	2	0.17	0.021	0.18	0.16	0.19	0.010	mg/L	-38
	Selenium, Dissolved	2	0.0269	0.00283	0.0270	0.0250	0.0290	0.0500	µg/L	-66
	Selenium, Total	2	0.0869	0.0233	0.0885	0.0720	0.105	0.0500	µg/L	-16
	Silica Gel Treated Hexane Ext. Material	3	2.6	0.2	2.5	2.5	2.8	5.6	mg/L	-46
	Silver, Dissolved	2	0.0250	0.0000	0.0250	0.0250	0.0250	0.0500	µg/L	-3
	Silver, Total	2	0.0132	0.0163	0.0175	0.0060	0.0290	0.0500	µg/L	-71
	Temperature	4	11.7	2.5	11.7	9.5	14.5	NA	˚C	2
	Tetrachloroethene	3	2.5	0.0	2.5	2.5	2.5	5.0	µg/L	-28
	Total Dissolved Solids	2	39	6	39	35	43	10	mg/L	-28
	Total Kjeldahl Nitrogen	2	0.5	0.1	0.5	0.4	0.6	0.2	mg/L	-18
	Total Suspended Solids	2	16	4.2	16	13	19	1.0	mg/L	-69
	trans-1,2-Dichloroethene	3	2.5	0.0	2.5	2.5	2.5	5.0	µg/L	-24
	Turbidity	2	27	0.7	28	27	28	0.5	NTU	-49
	Zinc, Dissolved	2	53.7	7.85	54.0	48.4	59.5	0.200	µg/L	13
	Zinc, Total	2	88.8	2.33	88.9	87.2	90.5	0.500	µg/L	14

Storm Event Monitoring Data
Descriptive Statistics

Table A.4

Receiving Waterbody: Willamette River
System Type: Structural BMP
System Location: (85866)

Location	Parameter	N	GeoMean	Mean Std. Deviation	Median	Minimum	Maximum	RL	Units	% Change from Historical
Contech WQ Structure Facility Upstream: 85866	Dissolved Oxygen	3	10.9	1.2	11.3	9.6	12.0	NA	mg/L	21
	Escherichia coli	3	956	1292	710	440	2800	1	per 100 mL	-48
	Fecal Coliform	3	625	287	630	400	970	1	per 100 mL	-69
	pH Field	3	7.3	1.4	7.0	6.3	9.0	NA	pH Units	5
	Temperature	3	9.8	1.6	9.2	8.8	11.8	NA	˚C	-39

Table A.5

Receiving Waterbody: Willamette River
System Type: Structural BMP
System Location: (85867)

Location	Parameter	N	GeoMean	Mean Std. Deviation	Median	Minimum	Maximum	RL	Units	% Change from Historical
Contech WQ Structure Facility Downstream: 85867	Dissolved Oxygen	3	10.6	1.0	10.7	9.5	11.6	NA	mg/L	12
	Escherichia coli	3	1550	5419	690	540	10000	1	per 100 mL	-32
	Fecal Coliform	3	651	382	930	300	990	1	per 100 mL	-73
	pH Field	3	7.0	0.6	7.0	6.4	7.6	NA	pH Units	2
	Temperature	3	9.1	2.0	8.5	7.7	11.5	NA	˚C	-43

Table A.6

Waterbody: Roosevelt Channel
System Type: Surface Water
System Location: (MH79222)

Location	Parameter	N	GeoMean	Mean Std. Deviation	Median	Minimum	Maximum	RL	Units	% Change from Historical
Roosevelt Channel Upstream: MH 79222	Dissolved Oxygen	3	9.8	0.2	9.7	9.7	10.0	NA	mg/L	29
	Escherichia coli	3	376	121	410	260	500	1	per 100 mL	-90
	Fecal Coliform	3	320	161	400	170	480	1	per 100 mL	-88
	pH Field	3	7.0	0.4	7.0	6.6	7.3	NA	pH Units	-1
	Temperature	3	8.8	2.4	8.0	7.2	11.7	NA	˚C	-25

Table A.7

Waterbody: Roosevelt Channel
System Type: Surface Water
System Location: (MH79206)

Location	Parameter	N	GeoMean	Mean Std. Deviation	Median	Minimum	Maximum	RL	Units	% Change from Historical
Roosevelt Channel Downstream: MH 79206	Dissolved Oxygen	3	9.0	0.7	9.1	8.3	9.7	NA	mg/L	19
	Escherichia coli	3	431	602	440	140	1300	1	per 100 mL	-89
	Fecal Coliform	3	241	78	290	160	300	1	per 100 mL	-91
	pH Field	3	7.0	0.4	7.0	6.7	7.4	NA	pH Units	0
	Temperature	3	9.0	2.2	8.1	7.7	11.7	NA	˚C	-23

Table A.8 **Waterbody: A3 Channel**

Location:
A3 Channel at Seneca (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
2,4-D	3	**0.27**	0.70	0.96	0.26	<0.08	**1.80**	0.08
2,4-DB	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,4-TP	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,5-T	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,5-TP	2	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
3-Hydroxycarbofuran	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
a-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Acetochlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Acifluorfen	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Alachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Aldicarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldicarb sulfone	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldicarb sulfoxide	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ametryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Amitraz	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Aspon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Atrazine	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Azinphos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Azoxystrobin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
b-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Bendiocarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Benfluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Bensulfide	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bentazon	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Bifenthrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Boscalid	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bromacil	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bromopropylate	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Captafol	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Captan	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Carbaryl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Carbofenothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Carbofuran	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Carfentrazone-ethyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Chlordane	3	<0.60	0.30	0.00	0.30	<0.60	<0.60	0.60
Chlorfenvinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chlorobenzilate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chloroneb	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chlorothalonil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Chlorpyrifos	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Chlorpyrifos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Clopyralid	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08

Table A.8 Continued **Waterbody: A3 Channel**

Location:
A3 Channel at Seneca (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Clothianidin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Coumaphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Cyanazine	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Cyfluthrin	3	<0.60	0.25	0.09	0.30	<0.60	<0.60	0.60
Cyhalothrin	3	<0.60	0.25	0.09	0.30	<0.60	<0.60	0.60
Cypermethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
d-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dacthal	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
DCPMU	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Deltamethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
Demeton	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Diazinon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dicamba	3	<0.08	0.08	0.07	0.04	<0.08	**0.16**	0.08
Dichlobenil	3	**0.16**	0.22	0.20	0.15	<0.12	**0.45**	0.12
Dichlorofenthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dichlorprop	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Dichlorvos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Diclofop-methyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Dicloran	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dicofol	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dicrotophos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dieldrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dimethenamid	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Dimethoate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dinoseb	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Diphenylamine	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Disulfoton	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dithiopyr	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Diuron	3	**0.23**	0.30	0.24	0.23	<0.12	**0.56**	0.12
Endosulfan I	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endosulfan II	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endosulfan sulfate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin aldehyde	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin ketone	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
EPN	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Esfenvalerate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ethalfluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ethion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Ethofumesate	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Ethoprop	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Etridiazole	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Famphur	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30

Table A.8 Continued **Waterbody: A3 Channel**

Location:
A3 Channel at Seneca (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Fenamiphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenarimol	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Fenbuconazole	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fenitrothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenobucarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fenoxaprop-ethyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fensulfothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fenvalerate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Fipronil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fluazifop-p-butyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fludioxonil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Flumioxazin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fluometuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fluroxypyr-meptyl	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Flutolanil	3	<1.20	0.60	0.00	0.60	<1.20	<1.20	1.20
Folpet	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
g-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Heptachlor	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Heptachlor epoxide	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Hexachlorobenzene	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Hexazinone	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Imidacloprid	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Iprodione	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Isoxaben	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Linuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Malathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
MCPA	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
MCPP	3	<0.08	0.12	0.14	0.04	<0.08	**0.29**	0.08
Mefenoxam	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Merphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Metalaxyl	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Methidathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Methiocarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Methomyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Methoxychlor	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Metolachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Metribuzin	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Mevinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Mirex	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Monocrotophos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Monuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12

Table A.8 Continued **Waterbody: A3 Channel**

Location:
A3 Channel at Seneca (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Myclobutanil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Napropamide	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Neburon	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Norflurazon	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ovex	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Oxadiazon	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Oxamyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Oxyfluorfen	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDD	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDE	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDT	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Parathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Parathion methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
PCNB	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Pendimethalin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Permethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
Phorate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Phosmet	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Phosphamidon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Picloram	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Pirimicarb	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Pirimiphos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Prodiamine	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Prometon	3	<0.60	0.21	0.16	0.30	<0.60	<0.60	0.60
Prometryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Pronamide	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Propachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Propanil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Propargite	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Propazine	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Propiconazole	3	**0.87**	1.37	1.59	0.52	**0.39**	**3.20**	0.30
Propoxur	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Pyraclostrobin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Pyridaben	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Pyrimethanil	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Quinclorac	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Ronnel	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Sethoxydim	3	<6.0	2.20	1.39	3.00	<6.0	<6.0	6.00
Siduron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Simazine	3	<0.60	0.21	0.16	0.30	<0.60	<0.60	0.60
Simetryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Sulfentrazone	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Sulprofos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30

Table A.8 Continued **Waterbody: A3 Channel**

Location:
A3 Channel at Seneca (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Tebuconazole	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Tebuthiuron	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Terbacil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Terbufos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Tetrachlorvinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Thiabendazole	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Thiobencarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Tokuthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Toxaphene	3	<6.0	2.10	1.56	3.00	<6.0	<6.0	6.00
Triadimefon	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Trichloronate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Triclopyr	3	**0.11**	0.14	0.11	0.14	<0.08	**0.25**	0.08
Trifloxystrobin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Triflumizole	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Trifluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Vinclozalin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12

Table A.9 **Waterbody: A3 Channel**

Location:
A3 Channel at Bertelsen Downstream

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
2,4-D	3	**0.17**	0.25	0.18	0.33	<0.08	**0.38**	0.08
2,4-DB	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,5-T	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,5-TP	2	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
3-Hydroxycarbofuran	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
a-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Acetochlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Acifluorfen	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Alachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Aldicarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldicarb sulfone	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldicarb sulfoxide	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ametryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Amitraz	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Aspon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Atrazine	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Azinphos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Azoxystrobin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
b-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Bendiocarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Benfluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Bensulfide	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bentazon	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Bifenthrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Boscalid	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bromacil	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bromopropylate	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Captafol	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Captan	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Carbaryl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Carbofenothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Carbofuran	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Carfentrazone-ethyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Chlordane	3	<0.60	0.30	0.00	0.30	<0.60	<0.60	0.60
Chlorfenvinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chlorobenzilate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chloroneb	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chlorothalonil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Chlorpyrifos	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Chlorpyrifos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Clopyralid	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Clothianidin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12

Table A.9 Continued **Waterbody: A3 Channel**

Location:
A3 Channel at Bertelsen Downstream

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Coumaphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Cyanazine	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Cyfluthrin	3	<0.60	0.25	0.09	0.30	<0.60	<0.60	0.60
Cyhalothrin	3	<0.60	0.25	0.09	0.30	<0.60	<0.60	0.60
Cypermethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
d-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dacthal	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
DCPMU	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Deltamethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
Demeton	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Diazinon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dicamba	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Dichlobenil	3	<0.12	0.09	0.05	0.06	<0.12	**0.14**	0.12
Dichlorofenthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dichlorprop	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Dichlorvos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Diclofop-methyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Dicloran	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dicofol	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dicrotophos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dieldrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dimethenamid	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Dimethoate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dinoseb	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Diphenylamine	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Disulfoton	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dithiopyr	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Diuron	3	**0.18**	0.35	0.37	0.26	<0.12	**0.76**	0.12
Endosulfan I	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endosulfan II	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endosulfan sulfate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin aldehyde	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin ketone	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
EPN	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Esfenvalerate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ethalfluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ethion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Ethofumesate	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Ethoprop	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Etridiazole	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Famphur	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenamiphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30

Table A.9 Continued **Waterbody: A3 Channel**

Location:
A3 Channel at Bertelsen Downstream

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Fenarimol	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Fenbuconazole	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fenitrothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenobucarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fenoxaprop-ethyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fensulfothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fenvalerate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Fipronil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fluazifop-p-butyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fludioxonil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Flumioxazin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fluometuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fluroxypyr-meptyl	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Flutolanil	3	<1.20	0.60	0.00	0.60	<1.20	<1.20	1.20
Folpet	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
g-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Heptachlor	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Heptachlor epoxide	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Hexachlorobenzene	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Hexazinone	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Imidacloprid	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Iprodione	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Isoxaben	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Linuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Malathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
MCPA	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
MCPP	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Mefenoxam	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Merphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Metalaxyl	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Methidathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Methiocarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Methomyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Methoxychlor	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Metolachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Metribuzin	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Mevinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Mirex	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Monocrotophos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Monuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Myclobutanil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60

Table A.9 Continued **Waterbody: A3 Channel**

Location:
A3 Channel at Bertelsen Downstream

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Napropamide	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Neburon	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Norflurazon	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ovex	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Oxadiazon	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Oxamyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Oxyfluorfen	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDD	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDE	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDT	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Parathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Parathion methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
PCNB	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Pendimethalin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Permethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
Phorate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Phosmet	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Phosphamidon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Picloram	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Pirimicarb	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Pirimiphos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Prodiamine	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Prometon	3	<0.60	0.21	0.16	0.30	<0.60	<0.60	0.60
Prometryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Pronamide	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Propachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Propanil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Propargite	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Propazine	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Propiconazole	3	**1.37**	1.90	1.91	0.91	**0.69**	**4.10**	0.30
Propoxur	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Pyraclostrobin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Pyridaben	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Pyrimethanil	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Quinclorac	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Ronnel	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Sethoxydim	3	<6.0	2.20	1.39	3.00	<6.0	<6.0	6.00
Siduron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Simazine	3	<0.60	0.21	0.16	0.30	<0.60	<0.60	0.60
Simetryn	3	<0.30	0.08	0.06	0.06	<0.30	<0.30	0.30
Sulfentrazone	3	<0.60	0.13	0.15	0.06	<0.60	<0.60	0.60
Sulprofos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Tebuconazole	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60

Table A.9 Continued **Waterbody: A3 Channel**

Location:
A3 Channel at Bertelsen Downstream

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Tebuthiuron	3	<0.60	0.14	0.14	0.06	<0.60	<0.60	0.60
Terbacil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Terbufos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Tetrachlorvinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Thiabendazole	3	<0.60	0.13	0.15	0.06	<0.60	<0.60	0.60
Thiobencarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Tokuthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Toxaphene	3	<6.0	3.00	0.00	3.00	<6.0	<6.0	6.00
Triadimefon	3	<0.60	0.14	0.14	0.06	<0.60	<0.60	0.60
Trichloronate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Triclopyr	3	<0.08	0.09	0.09	0.04	<0.08	**0.20**	0.08
Trifloxystrobin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Triflumizole	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Trifluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Vinclozalin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12

Table A.10 **Waterbody: Spring Creek**

Spring Creek at Naismith (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
2,4-D	3	**0.18**	0.64	1.00	0.09	<0.08	**1.80**	0.08
2,4-DB	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,5-T	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,5-TP	2	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
3-Hydroxycarbofuran	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
a-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Acetochlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Acifluorfen	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Alachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Aldicarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldicarb sulfone	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldicarb sulfoxide	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ametryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Amitraz	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Aspon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Atrazine	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Azinphos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Azoxystrobin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
b-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Bendiocarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Benfluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Bensulfide	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bentazon	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Bifenthrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Boscalid	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bromacil	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bromopropylate	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Captafol	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Captan	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Carbaryl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Carbofenothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Carbofuran	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Carfentrazone-ethyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Chlordane	3	<0.60	0.30	0.00	0.30	<0.60	<0.60	0.60
Chlorfenvinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chlorobenzilate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chloroneb	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chlorothalonil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Chlorpyrifos	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Chlorpyrifos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Clopyralid	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Clothianidin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Coumaphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30

Table A.10 Continued **Waterbody: Spring Creek**

Spring Creek at Naismith (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Cyanazine	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Cyfluthrin	3	<0.60	0.25	0.09	0.30	<0.60	<0.60	0.60
Cyhalothrin	3	<0.60	0.25	0.09	0.30	<0.60	<0.60	0.60
Cypermethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
d-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dacthal	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
DCPMU	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Deltamethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
Demeton	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Diazinon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dicamba	3	**0.10**	0.24	0.35	0.04	<0.08	**0.65**	0.08
Dichlobenil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dichlorofenthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dichlorprop	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Dichlorvos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Diclofop-methyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Dicloran	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dicofol	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dicrotophos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dieldrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dimethenamid	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Dimethoate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dinoseb	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Diphenylamine	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Disulfoton	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dithiopyr	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Diuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Endosulfan I	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endosulfan II	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endosulfan sulfate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin aldehyde	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin ketone	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
EPN	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Esfenvalerate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ethalfluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ethion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Ethofumesate	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Ethoprop	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Etridiazole	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Famphur	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenamiphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenarimol	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Fenbuconazole	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60

Table A.10 Continued **Waterbody: Spring Creek**

Spring Creek at Naismith (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Fenitrothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenobucarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fenoxaprop-ethyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fensulfothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fenvalerate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Fipronil	3	<0.60	0.28	0.03	0.30	<0.60	<0.60	0.60
Fluazifop-p-butyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fludioxonil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Flumioxazin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fluometuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fluroxypyr-meptyl	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Flutolanil	3	<1.20	0.60	0.00	0.60	<1.20	<1.20	1.20
Folpet	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
g-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Heptachlor	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Heptachlor epoxide	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Hexachlorobenzene	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Hexazinone	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Imidacloprid	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Iprodione	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Isoxaben	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Linuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Malathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
MCPA	3	<0.08	0.06	0.03	0.04	<0.08	**0.10**	0.08
MCPP	3	**0.15**	0.69	1.13	0.04	<0.08	**2.00**	0.08
Mefenoxam	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Merphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Metalaxyl	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Methidathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Methiocarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Methomyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Methoxychlor	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Metolachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Metribuzin	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Mevinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Mirex	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Monocrotophos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Monuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Myclobutanil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Napropamide	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Neburon	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Norflurazon	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12

Table A.10 Continued **Waterbody: Spring Creek**

Spring Creek at Naismith (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Ovex	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Oxadiazon	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Oxamyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Oxyfluorfen	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDD	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDE	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDT	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Parathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Parathion methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
PCNB	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Pendimethalin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Permethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
Phorate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Phosmet	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Phosphamidon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Picloram	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Pirimicarb	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Pirimiphos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Prodiamine	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Prometon	3	<0.60	0.21	0.16	0.30	<0.60	<0.60	0.60
Prometryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Pronamide	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Propachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Propanil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Propargite	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Propazine	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Propiconazole	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Propoxur	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Pyraclostrobin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Pyridaben	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Pyrimethanil	3	<0.12	0.09	0.05	0.06	<0.12	**0.15**	0.12
Quinclorac	3	<0.08	0.12	0.13	0.04	<0.08	**0.27**	0.08
Ronnel	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Sethoxydim	3	<6.0	2.20	1.39	3.00	<6.0	<6.0	6.00
Siduron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Simazine	3	<0.60	0.35	0.08	0.30	<0.60	<0.60	0.60
Simetryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Sulfentrazone	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Sulprofos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Tebuconazole	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Tebuthiuron	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Terbacil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Terbufos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Tetrachlorvinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30

Table A.10 Continued **Waterbody: Spring Creek**

Spring Creek at Naismith (Upstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Thiabendazole	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Thiobencarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Tokuthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Toxaphene	3	<6.0	3.00	0.00	3.00	<6.0	<6.0	6.00
Triadimefon	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Trichloronate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Triclopyr	3	<0.08	0.07	0.05	0.04	<0.08	**0.13**	0.08
Trifloxystrobin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Triflumizole	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Trifluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Vinclozalin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12

Table A.11 **Waterbody: Spring Creek**

Spring Creek at Beacon Drive East (Downstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
2,4-D	3	**0.12**	0.20	0.23	0.09	<0.08	**0.46**	0.08
2,4-DB	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,4-TP	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,5-T	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
2,4,5-TP	2	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
3-Hydroxycarbofuran	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
a-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Acetochlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Acifluorfen	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Alachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Aldicarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldicarb sulfone	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldicarb sulfoxide	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Aldrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ametryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Amitraz	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Aspon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Atrazine	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Azinphos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Azoxystrobin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
b-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Bendiocarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Benfluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Bensulfide	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bentazon	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Bifenthrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Boscalid	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bromacil	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Bromopropylate	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Captafol	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Captan	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Carbaryl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Carbofenothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Carbofuran	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Carfentrazone-ethyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Chlordane	3	<0.60	0.30	0.00	0.30	<0.60	<0.60	0.60
Chlorfenvinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chlorobenzilate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chloroneb	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Chlorothalonil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Chlorpyrifos	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Chlorpyrifos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Clopyralid	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Clothianidin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Coumaphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30

Table A.11 Continued **Waterbody: Spring Creek**

Spring Creek at Beacon Drive East (Downstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Cyanazine	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Cyfluthrin	3	<0.60	0.25	0.09	0.30	<0.60	<0.60	0.60
Cyhalothrin	3	<0.60	0.25	0.09	0.30	<0.60	<0.60	0.60
Cypermethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
d-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dacthal	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
DCPMU	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Deltamethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
Demeton	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Diazinon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dicamba	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Dichlobenil	3	<0.12	0.09	0.05	0.06	<0.12	**0.14**	0.12
Dichlofenthion	1	<0.30	0.15		0.15	<0.30	<0.30	0.30
Dichlorofenthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dichlorprop	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Dichlorvos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Diclofop-methyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Dicloran	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dicofol	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dicrotophos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dieldrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Dimethenamid	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Dimethoate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dinoseb	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Diphenylamine	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Disulfoton	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Dithiopyr	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Diuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Endosulfan I	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endosulfan II	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endosulfan sulfate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin aldehyde	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Endrin ketone	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
EPN	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Esfenvalerate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ethalfluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ethion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Ethofumesate	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Ethoprop	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Etridiazole	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Famphur	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenamiphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenarimol	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Fenbuconazole	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60

Table A.11 Continued **Waterbody: Spring Creek**

Spring Creek at Beacon Drive East (Downstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Fenitrothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenobucarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fenoxaprop-ethyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fensulfothion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Fenuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fenvalerate	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Fipronil	3	**0.18**	0.22	0.14	0.12	<0.12	**0.18**	0.12
Fluazifop-p-butyl	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Fludioxonil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Flumioxazin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fluometuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Fluroxypyr-meptyl	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Flutolanil	3	<1.20	0.60	0.00	0.60	<1.20	<1.20	1.20
Folpet	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
g-BHC	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Heptachlor	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Heptachlor epoxide	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Hexachlorobenzene	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Hexazinone	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Imidacloprid	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Iprodione	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Isoxaben	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Linuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Malathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
MCPA	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
MCPP	3	<0.08	0.09	0.08	0.04	<0.08	**0.18**	0.08
Mefenoxam	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Merphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Metalaxyl	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Methidathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Methiocarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Methomyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Methoxychlor	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Metolachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Metribuzin	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Mevinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Mirex	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Monocrotophos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Monuron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Myclobutanil	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Napropamide	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Neburon	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Norflurazon	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Ovex	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12

Table A.11 Continued **Waterbody: Spring Creek**

Spring Creek at Beacon Drive East (Downstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Oxadiazon	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Oxamyl	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Oxyfluorfen	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDD	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDE	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
p,p'-DDT	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Parathion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Parathion methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
PCNB	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Pendimethalin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Permethrin	3	<1.20	0.35	0.23	0.30	<1.20	<1.20	1.20
Phorate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Phosmet	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Phosphamidon	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Picloram	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Pirimicarb	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Pirimiphos-methyl	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Prodiamine	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Prometon	3	<0.60	0.21	0.16	0.30	<0.60	<0.60	0.60
Prometryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Pronamide	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Propachlor	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Propanil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Propargite	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Propazine	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Propiconazole	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Propoxur	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Pyraclostrobin	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Pyridaben	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Pyrimethanil	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Quinclorac	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Ronnel	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Sethoxydim	3	<6.0	2.20	1.39	3.00	<6.0	<6.0	6.00
Siduron	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Simazine	3	<0.60	0.21	0.16	0.30	<0.60	<0.60	0.60
Simetryn	3	<0.30	0.11	0.07	0.15	<0.30	<0.30	0.30
Sulfentrazone	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Sulprofos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Tebuconazole	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Tebuthiuron	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Terbacil	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Terbufos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Tetrachlorvinphos	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Thiabendazole	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12
Thiobencarb	3	<0.12	0.05	0.02	0.06	<0.12	<0.12	0.12

Table A.11 Continued **Waterbody: Spring Creek**

Spring Creek at Beacon Drive East (Downstream)

Parameter	N	Geometric Mean	Mean	Mean Std. Dev.	Median	Minimum	Maximum	RL
Tokuthion	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Toxaphene	3	<6.0	3.00	0.00	3.00	<6.0	<6.0	6.00
Triadimefon	3	<0.60	0.22	0.14	0.30	<0.60	<0.60	0.60
Trichloronate	3	<0.30	0.15	0.00	0.15	<0.30	<0.30	0.30
Triclopyr	3	<0.08	0.04	0.00	0.04	<0.08	<0.08	0.08
Trifloxystrobin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Triflumizole	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Trifluralin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12
Vinclozalin	3	<0.12	0.06	0.00	0.06	<0.12	<0.12	0.12

Table A.12
2015/2016 QA/QC Qualified Ambient Water Quality Data
Amazon Basin and Willamette River Monitoring Sites
Metals (µg/L)

Date / Site	As (D)	As (T)	Cd (D)	Cd (T)	Cr (D)	Cr (T)	Cu (D)	Cu (T)	Pb (D)	Pb (T)	Hg (D)	Hg (T)	Mo (D)	Mo (T)	Ni (D)	Ni (T)	Se (D)	Se (T)	Ag (D)	Ag (T)	Zn (D)	Zn (T)
Amazon Creek at 29th Avenue																						
7/28/2015*																						
9/9/2015	1.25	1.37	< 0.025	< 0.025	0.103	0.201	1.15	1.45	0.0193	0.107	< 0.0005	0.00057	0.525	0.538	1.44	1.48	0.236	0.183	< 0.025	< 0.025	5.04	7.47
12/2/2015	0.761	0.858	0.0050	0.0060	0.644	1.21	2.50	3.75	0.0950	0.466	0.00133	0.00232	0.470	0.425	1.01	1.44	0.057	0.082	< 0.025	0.006	51.6	72.3
2/1/2016	0.492	0.747	< 0.025	0.005 EV	0.820	2.16	2.67	4.06	0.0990	0.282	0.00062	0.00234	0.078	0.120	1.09	1.77	0.089	0.152	< 0.025	0.019	21.8	32.1
2/1 Dup	0.432	0.741	< 0.025	0.005 EV	0.934	2.05	2.43	3.98	0.0930	0.277	< 0.0005	0.00272	0.164 EV	0.124	1.04	1.72	0.086	0.192	0.005	0.016	25.4	31.8
3/17/2016	0.500	0.756	< 0.025	0.0040	0.865	2.22	2.79	3.96	0.114	0.295	0.00173 EV	0.00078	0.053	0.092	1.09	1.72	0.101	0.215	0.005	0.007	16.1	20.5
5/10/2016	0.857	0.953	< 0.025	< 0.025	0.261	0.317	1.02	1.24	0.0210	0.097	< 0.0005	0.00066	0.282	0.288	0.779	0.889	0.033	0.042	< 0.025	< 0.025	11.1	13.6
Willow Creek near 18th Avenue																						
7/28/2015*																						
9/9/2015	1.70	2.33	< 0.025	< 0.025	0.067	0.631	0.58	1.69	0.0191	0.368	< 0.0005	0.00123	0.579	0.571	1.62	2.12	0.061	0.103	< 0.025	< 0.025	5.42	10.4
9/9 Dup	1.65	2.30	< 0.025	< 0.025	0.073	0.753	0.56	1.74	0.0164	0.352	< 0.0005	0.00124	0.561	0.589	1.66	2.17	0.050	0.131	< 0.025	< 0.025	8.94	15.2
12/2/2015	0.434	0.510	0.0080	0.0090	0.267	0.219	0.83	1.01	0.0340	0.104	0.00060	0.00062	0.172	0.201	1.19	1.29	0.023	0.048	< 0.025	0.002	150	176
2/1/2016	0.423	0.958	< 0.025	0.0030	0.323	1.14	1.40	2.91	0.0690	0.198	0.00168	0.00319	0.047	0.052	0.545	1.12	0.079	0.161	< 0.025	0.016	2.16	4.54
3/17/2016	0.656	1.08	< 0.025	0.0030	0.347	1.08	1.81	3.02	0.0850	0.271	< 0.0005	0.00357	0.042	0.055	0.764	1.18	0.094	0.223	< 0.025	0.007	2.52	4.44
5/10/2016	1.76	3.15	< 0.025	0.006 EV	0.210	0.404	1.10	1.68	0.0400	0.217	0.00079	0.00157	0.192	0.180	1.84	2.18	0.069	0.131	< 0.025	< 0.025	5.68	7.95
5/10 Dup	1.70	3.11	< 0.025	0.005 EV	0.131	0.372	1.02	1.62	0.0370	0.209	0.00077	0.00152	0.186	0.180	1.84	2.10	0.055	0.197	< 0.025	< 0.025	24.9 EV	32.5 EV
Amazon Creek at Railroad Crossing																						
7/28/2015*																						
9/9/2015*																						
12/2/2015	1.53	1.83	0.0050	0.0130	0.269	1.05	2.63	4.22	0.156	0.912	0.00188	0.00298	0.324	0.338	0.923	1.47	0.038	0.103	< 0.025	0.008	81.0	90.6
2/1/2016	0.862	1.44	< 0.025	0.0080	0.382	1.17	1.85	3.44	0.0750	0.407	0.00186	0.00406	0.139	0.143	0.772	1.42	0.051	0.152	< 0.025	0.016	47.1	61.8
3/17/2016	1.31	1.73	< 0.025	0.0060	0.447	1.30	2.44	3.54	0.103	0.374	0.00062	0.00338	0.107	0.127	1.10	1.54	0.120	0.190	0.005	0.010	26.5	28.8
5/10/2016	3.02	4.43	< 0.025	0.0130	0.114	0.847	1.33	2.90	0.0940	1.11	0.00136	0.00462	0.688	0.634	1.09	1.55	0.047	0.182	0.005	0.002	27.7	53.4
Amazon Diversion Channel at Royal Avenue																						
7/28/2015*																						
9/9/2015*																						
12/2/2015	1.50	2.28	< 0.025	0.0180	0.198	0.991	1.99	4.34	0.0920	1.03	0.00089	0.00414	0.517	0.708	0.886	1.54	0.026	0.096	< 0.025	0.008	77.3	94.7
2/1/2016	0.945	1.37	< 0.025	0.0100	0.411	1.29	2.28	3.68	0.102	0.464	0.00237	0.00538	0.165	0.189	0.897	1.41	0.067	0.123	< 0.025	0.019	36.2	49.3
3/17/2016	1.19	1.64	0.0070	0.0130	0.402	0.943	2.70	3.74	0.120	0.557	0.00148	0.00267	0.537	0.543	1.40	1.66	0.063	0.127	< 0.025	0.008	26.3	29.6
5/10/2016	2.18	4.50	< 0.025	0.0360	0.083	2.42	0.83	5.61	0.0310	3.05	< 0.0005	0.00446	1.24	0.979	1.41	3.01	0.036	0.435	0.006	0.014	2.53	43.5
A3 Channel at Terry Street																						
7/28/2015*																						
9/9/2015*																						
12/2/2015	0.728	1.06	0.0120	0.0340	0.371	1.04	2.80	6.00	0.175	1.65	0.00238	0.00751	0.561	0.754	0.708	1.52	0.019	0.068	< 0.025	0.015	30.1	44.2
12/2 Dup	0.922	1.06	0.0150	0.0300	0.369	1.03	3.40	6.03	0.232	1.66	0.00368	0.00763	0.669	0.685	0.852	1.50	0.036	0.073	< 0.025	0.014	29.8	43.6
2/1/2016	0.789	1.31	0.0240	0.0270	0.183	0.562	2.29	4.03	0.102	0.681	0.00166	0.00409	0.796	0.799	1.57	1.65	0.025	0.059	< 0.025	0.020	35.7	46.8
3/17/2016	1.12	1.72	0.0180	0.0280	0.233	0.622	2.68	3.72	0.129	0.909	0.00075	0.00237	1.07	0.972	1.77	1.98	0.042	0.074	0.005	0.009	35.6	39.6
3/17 Dup	1.11	1.74	0.0170	0.0280	0.246	0.615	2.42	3.74	0.111	0.914	0.00174	0.00272	1.04	0.978	1.74	1.97	0.036	0.089	0.008	0.009	35.8	39.8
5/10/2016	3.08	4.41	< 0.025	0.0130	0.132	0.406	1.02	1.81	0.0190	0.940	0.00054	0.00284	1.64	1.73	1.85	2.16	0.045	0.105	< 0.025	0.002	35.1	50.0
Amazon Creek at Royal Avenue																						
7/28/2015																						
9/9/2015	4.53	6.13	< 0.025	< 0.025	0.238	1.37	1.61	3.50	0.0520	1.36	< 0.0005	0.00262	1.32	1.25	4.48	5.28	0.196	0.276	< 0.025	< 0.025	3.07	28.8
12/2/2015	1.28	2.17	< 0.025	0.0160	0.216	1.16	1.81	4.24	0.118	1.15	0.00122	0.00315	0.181	0.257	0.664	1.54	0.018	0.104	< 0.025	0.007	71.4	93.6
2/1/2016	0.773	1.52	0.0120	0.0220	0.244	0.898	2.04	4.17	0.0760	0.608	0.00190	0.00418	0.478	0.573	1.05	1.68	0.040	0.105	< 0.025	0.015	35.6	45.6
3/17/2016	1.28	1.64	< 0.025	0.0080	0.464	1.38	2.54	3.66	0.0950	0.402	0.00290	0.00392	0.094	0.122	1.10	1.54	0.090	0.191	0.005	0.009	18.2	22.2
5/10/2016	1.90	3.49	< 0.025	0.0060	0.098	0.668	1.34	2.33	0.107	0.951	0.00087	0.00296	0.794	0.755	1.39	1.79	0.045	0.194	< 0.025	0.006	14.2	25.0

* No flow; no sample collected.

Table A.12
2015/2016 QA/QC Qualified Ambient Water Quality Data
Amazon Basin and Willamette River Monitoring Sites
Metals (µg/L)

Date / Site	As (D)	As (T)	Cd (D)	Cd (T)	Cr (D)	Cr (T)	Cu (D)	Cu (T)	Pb (D)	Pb (T)	Hg (D)	Hg (T)	Mo (D)	Mo (T)	Ni (D)	Ni (T)	Se (D)	Se (T)	Ag (D)	Ag (T)	Zn (D)	Zn (T)
Willamette River Upstream of Urban Growth Boundary (RM 186.9)																						
7/29/2015	0.250	0.282	< 0.025	< 0.025	0.150	< 0.050	0.304	0.329	< 0.025	0.025	< 0.0005	0.00062	0.072	0.072	0.182	0.211	< 0.05	< 0.05	< 0.025	< 0.025	0.715	0.712
9/8/2015	0.248	0.300	< 0.025	< 0.025	0.069	0.076	0.265	0.332	< 0.025	< 0.025	< 0.0005	0.00050	0.074	0.083	0.187	0.251	0.046	< 0.05	< 0.025	< 0.025	0.214	0.756
9/8 Dup	0.260	0.304	< 0.025	< 0.025	0.121 EV	0.090	0.286	0.324	< 0.025	0.023	< 0.0005	0.00052	0.077	0.077	0.192	0.233	< 0.05	< 0.05	< 0.025	< 0.025	0.308	0.298 EV
12/1/2015	0.265	0.296	< 0.025	< 0.025	0.096	0.154	0.324	0.417	0.0060	0.046	< 0.0005	0.00070	< 0.025	< 0.025	0.091	0.161	0.011	0.030	< 0.025	0.002	0.359	0.846
2/2/2016	0.187	0.282	< 0.025	< 0.025	0.203	0.345	0.350	0.573	0.0410	0.097	0.00085	0.00126	0.051 EV	0.048	0.141	0.299	0.014	0.072	< 0.025	0.007	0.295	0.762
2/2 Dup	0.185	0.355	< 0.025	< 0.025	0.193	0.409	0.396	0.794	0.0280	0.090	0.00116	0.00201	0.028	0.045	0.128	0.291	0.032	0.073	< 0.025	0.007	0.492	1.14
3/15/2016	0.172	0.289	< 0.025	< 0.025	0.202	0.448	0.569	0.935	0.0550	0.149	0.00054	0.00149	0.028	0.029	0.130	0.279	0.058	0.124	< 0.025	0.002	0.985	2.04
5/11/2016	0.165	0.186	< 0.025	< 0.025	0.165	0.167	0.489 EV	0.257	0.0280	0.042	< 0.0005	0.00074	0.040	0.043	0.074	0.127	0.011	0.041	< 0.025	< 0.025	0.693	0.835
Willamette River at Knickerbocker Bridge (RM 183.9)																						
7/29/2015	0.302	0.377	< 0.025	< 0.025	0.098	< 0.050	0.317	0.378	< 0.025	0.030	< 0.0005	0.00140	0.071	0.066	0.178	0.238	< 0.05	0.064	< 0.025	< 0.025	0.474	0.446
9/8/2015	0.348	0.428	< 0.025	< 0.025	0.157 EV	0.113	0.349	0.394	0.0073	0.028	< 0.0005	0.00053	0.080	0.079	0.204	0.248	< 0.05	< 0.05	< 0.025	< 0.025	0.443	1.02
12/1/2015	0.246	0.321	< 0.025	0.004 EV	0.110	0.183	1.20 EV	1.22 EV	0.596 EV	0.975 EV	0.00063	0.00098	0.020	< 0.025	0.102	0.178	0.014	0.035	< 0.025	0.004	1.25	1.74
12/1 Dup	0.291	0.318	< 0.025	< 0.025	0.121	0.176	0.403	0.469	0.0090	0.047	0.00065	0.00097	< 0.025	< 0.025	0.103	0.161	0.023	0.026	< 0.025	0.002	0.218 EV	0.485 EV
2/2/2016	0.265	0.344	< 0.025	0.0030	0.300	0.438	0.637	0.933	0.0410	0.093	0.00124	0.00235	0.059	0.052	0.228	0.343	0.037	0.079	< 0.025	0.008	0.426	1.06
3/15/2016	0.262	0.552	< 0.025	0.0070	0.305	1.02	1.22	2.46	0.0840	0.333	0.00154	0.00214	0.034	0.042	0.273	0.658	0.070	0.175	< 0.025	0.005	1.32	3.13
5/11/2016	0.199	0.233	< 0.025	< 0.025	0.153	0.184	0.402	0.320	0.0180	0.037	0.00066	0.00087	0.039	0.049	0.085	0.140	0.033	0.045	< 0.025	< 0.025	0.524 EV	0.504
5/11 Dup	0.205	0.228	< 0.025	< 0.025	0.134	0.161	0.475	0.303	0.0150	0.033	0.00059	0.00085	0.038	0.043	0.080	0.123	0.023	0.038	< 0.025	< 0.025	0.352	0.432
Willamette River at Owosso Bridge (RM 178.6)																						
7/29/2015	0.315	0.361	< 0.025	< 0.025	0.144 EV	0.080	0.353	0.399	0.0059	0.048	< 0.0005	0.00054	0.070	0.070	0.201	0.248	< 0.05	< 0.05	< 0.025	< 0.025	0.479	0.532
7/29 Dup	0.302	0.370	< 0.025	< 0.025	0.170 EV	< 0.050	0.339	0.397	0.0057	0.043	< 0.0005	0.00053	0.066	0.083	0.199	0.267	< 0.05	< 0.05	< 0.025	< 0.025	0.284	0.399
9/8/2015	0.366	0.439	< 0.025	< 0.025	0.119	0.101	0.326	0.415	0.0101	0.042	< 0.0005	0.00057	0.082	0.089	0.224	0.256	< 0.05	< 0.05	< 0.025	< 0.025	0.243	0.593
12/1/2015	0.300	0.270	< 0.010	< 0.010	0.130	0.160	0.380	0.480	0.0180	0.047	0.00068	0.00091	0.150	0.148	0.170	0.220	< 0.05	< 0.05	0.007	0.004	1.00	1.27
2/2/2016	0.184	0.349	< 0.025	0.0060	0.227	0.485	0.688	1.23	0.405 EV	0.907 EV	0.00133	0.00226	0.124 EV	0.071	0.186	0.373	0.033	0.082	< 0.025	0.010	0.708	1.53
3/15/2016	0.263	0.580	< 0.025	0.0050	0.276	1.05	1.09	2.44	0.0390	0.241	0.00214	0.00305	0.044	0.045	0.263	0.669	0.064	0.213	< 0.025	0.005	1.22	3.03
5/11/2016	0.194	0.219	< 0.025	< 0.025	0.160	0.170	0.247	0.320	0.0140	0.052	0.00059	0.00082	0.043	0.046	0.074	0.143	0.018	0.035	< 0.025	< 0.025	0.144	0.472
Willamette River Downstream of Beltline Bridge (RM 176.8)																						
7/29/2015	0.346	0.400	< 0.025	< 0.025	0.135	0.124	0.427	0.485	0.0154	0.053	< 0.0005	0.00165	0.114	0.105	0.239	0.302	< 0.05	< 0.05	< 0.025	< 0.025	0.988	1.09
9/8/2015	0.368	0.438	< 0.025	< 0.025	0.112	0.111	0.342	0.415	0.0108	0.046	< 0.0005	0.00060	0.088	0.093	0.239	0.283	< 0.05	< 0.05	< 0.025	< 0.025	0.938	1.24
12/1/2015	0.300	0.330	< 0.010	< 0.010	0.150	0.170	0.430	0.530	0.0220	0.054	0.00057	0.00102	0.100	0.094	0.200	0.250	< 0.05	< 0.05	< 0.010	< 0.010	1.60	1.89
2/2/2016	0.279	0.353	< 0.025	0.0040	0.335	0.450	0.854	1.16	0.247 EV	0.484 EV	0.00149	0.00207	0.039	0.059	0.247	0.362	0.038	0.067	< 0.025	0.009	0.970	1.81
3/15/2016	0.280	0.580	< 0.025	0.007 EV	0.219	1.01	1.00	2.46	0.0300	0.255	0.00218	0.00302	0.090 EV	0.068	0.248	0.674	0.078	0.219	< 0.025	0.005	2.46	5.12
3/15 Dup	0.278	0.578	< 0.025	0.005 EV	0.278	1.04	1.12	2.45	0.0440	0.249	0.00163	0.00329	0.044	0.066	0.282	0.688	0.080	0.206	< 0.025	0.006	1.79	3.74
5/11/2016	0.203	0.229	< 0.025	< 0.025	0.170	0.234	0.317	0.411	0.0610	0.129	0.00057	0.00087	0.060	0.057	0.088	0.158	0.015	0.037	< 0.025	< 0.025	0.463	0.741
Delta Ponds Above Willamette River Confluence																						
7/29/2015*																						
9/8/2015*																						
12/1/2015*																						
2/2/2016	0.256	0.353	< 0.025	0.0040	0.238	0.384	0.538	0.773	0.0340	0.119	0.00136	0.00240	0.044	0.053	0.204	0.339	0.040	0.071	< 0.025	0.008	1.32	3.44
3/15/2016	0.310	0.518	< 0.025	0.0060	0.250	0.778	1.05	1.98	0.0380	0.247	0.00201	0.00337	0.086	0.074	0.286	0.594	0.065	0.181	0.008	0.005	2.73	5.75
5/11/2016	0.585	0.624	< 0.025	< 0.025	0.217 EV	0.097	0.473	0.400	0.0430	0.098	0.00057	< 0.0005	0.103	0.102	0.170	0.201	0.018	0.036	< 0.025	< 0.025	8.91	9.03
Spring Creek at Beacon Drive East																						
7/28/2015*																						
9/9/2015*																						
12/2/2015	0.353	0.401	0.0170	0.0200	0.279	0.240	2.01	2.59	0.0450	0.145	0.00121	0.00117	0.282 EV	0.211	0.615	0.771	0.035	0.040	< 0.025	0.002	246	256
2/1/2016	0.287	0.345	0.0050	0.0090	0.174	0.221	0.485	0.646	0.0070	0.037	< 0.0005	< 0.0005	0.090	0.107	0.415	0.511	0.081	0.104	< 0.025	0.003	31.9	48.0
3/17/2016	0.305	0.301	< 0.025	0.0050	0.219	0.211	0.535	0.527	0.0070	0.027	< 0.0005	< 0.0005	0.097	0.097	0.475	0.474	0.103	0.085	< 0.025	0.002	37.1	34.4
5/10/2016	0.315	0.335	< 0.025	0.0030	0.148	0.152	0.366	0.403	0.0070	0.027	< 0.0005	< 0.0005	0.090	0.097	0.437	0.468	0.078	0.082	< 0.025	< 0.025	30.7	29.6

* No flow; no sample collected.

Table A.13
2015/2016 QA/QC Qualified Ambient Water Quality Data
Amazon Basin and Willamette River Monitoring Sites
Miscellaneous Parameters

Date / Site	TKN (mg/L)	NH_3 (mg/L)	NO_3+NO_2 (mg/L)	P (Ortho) (mg/L)	P (T) (mg/L)	Ca (T) (mg/L)	Mg (T) (mg/L)	Hardness (mg eq/L)	Cond (µmho/cm)	TDS (mg/L)	BOD (mg/L)	COD (mg/L)	DO (mg/L)	E. coli (MPN)	Fecal Coliform (col./100 mL)	TSS (mg/L)	Turbidity (NTU)	pH (Units)	Temp (°C)	2,3,7,8-TCDD (pg/L)
Amazon Creek at 29th Avenue																				
7/28/2015*																				
9/9/2015	<0.1	< 0.05	0.06	0.07	0.08	25	9	99	260	160	< 2	13	7.3	2100	2900	3.4	4	7.5	17.2	
12/2/2015	0.3	< 0.05	0.92	0.07	0.09	17	6	66	170	110	< 2	14	10	< 1	300	3.6	14	7.4	9.3	
2/1/2016	0.3	< 0.05	0.54	0.06	0.06	14	5	56	140	110	< 2	< 2.5	13	550	310	3.0	16	7.6	7.9	
2/1 Dup	0.3	< 0.05	0.53	0.06	0.06	14	5	56	140	110	< 2	< 2.5	12	690	340	3.0	16	7.6	7.9	
3/17/2016	<0.1	< 0.05	0.57	0.05	0.07	15	6	60	150	120	< 2	15	12	130	140	5.8	20	7.6	9.6	
5/10/2016	<0.1	< 0.05	0.23	0.05	0.06	27	10	110	280	170	< 2	5	10	520	140	1.8	4	7.7	13.0	
Willow Creek near 18th Avenue																				
7/28/2015*																				
9/9/2015	<0.1	< 0.05	< 0.025	0.04	0.07	24	7	89	250	150	< 2	19	6.2	190	60	19	22	7.4	17.0	
9/9 Dup	0.3	< 0.05	< 0.025	0.03	0.06	24	7	89	250	180 EV	< 2	14	6.2	220	160	16	20	7.4	16.5	
12/2/2015	<0.1	< 0.05	0.08	0.01	0.02	35	10	130	350	240	< 2	6	11	180	52	1.6	4	7.0	6.3	
2/1/2016	0.3	< 0.05	0.09	0.03	0.05	8.3	3	32	100	96	< 2	< 2.5	12	26	< 10	2.4	18	7.4	6.0	
3/17/2016	<0.1	< 0.05	0.06	0.02	0.05	9.9	3	38	110	100	< 2	14	12	17	18	5.4	20	7.5	9.0	
5/10/2016	<0.1	< 0.05	< 0.025	0.02	0.06	27	8	100	290	190	< 2	14	8.5	20	1	5.0	12	7.4	13.9	
5/10 Dup	<0.1	< 0.05	< 0.025	0.02	0.06	27	8	100	290	190	< 2	5 EV	8.6	15	10	6.2	13	7.3	14.0	
Amazon Creek at Railroad Crossing																				
7/28/2015*																				
9/9/2015*																				
12/2/2015	0.3	< 0.05	0.53	0.10	0.15	8.9	3	34	95	100	4	13	9.6	< 1	1300	9.2	17	7.1	7.3	
2/1/2016	0.3	< 0.05	0.38	0.04	0.06	9.5	3	38	100	74	< 2	6	11	120	70	4.8	14	7.2	6.7	
3/17/2016	0.3	< 0.05	0.62	0.04	0.06	14	5	55	140	110	< 2	13	11	55	40	6.0	16	7.4	9.6	
5/10/2016	0.3	< 0.05	0.14	0.03	0.09	23	8	92	260	150	< 2	11	8.0	6	< 10	14	16	7.7	17.5	
Amazon Diversion Channel at Royal Avenue																				
7/28/2015*																				
9/9/2015*																				
12/2/2015	0.4	0.2	0.47	0.06	0.12	15	7	64	200	130	3	17	10	1600	470	15	22	7.2	4.5	
2/1/2016	0.3	< 0.05	0.41	0.04	0.06	10	4	40	110	82	< 2	10	11	250	110	7.2	16	7.1	7.9	
3/17/2016	<0.1	< 0.05	0.78	0.04	0.08	18	8	77	190	130	< 2	16	8.4	58	70	6.8	13	7.1	10.5	
5/10/2016	0.7	< 0.05	< 0.025	0.02	0.20	28	12	120	310	180	4	25	6.6	21	20	67	59	7.2	18.7	
A3 Channel at Terry Street																				
7/28/2015*																				
9/9/2015*																				
12/2/2015	<0.1	< 0.05	0.32	0.09	0.15	7.2	4	32	87	57	3	17	9.8	< 1	880	9.6	22	7.3	6.2	
12/2 Dup	0.3	< 0.05	0.32	0.09	0.14	7.2	4	32	87	78	3	12	9.7	2400	750	9.2	19	7.2	6.2	
2/1/2016	0.4	0.1	1.0	0.06	0.10	22	10	96	220	130	< 2	5	8.6	64	30	5.6	10	7.0	7.9	
3/17/2016	0.4	0.1	1.2	0.05	0.13	27	13	120	280	180	< 2	21	8.4	43	30	12	14	7.0	10.7	
3/17 Dup	0.4	0.1	1.1	0.06	0.13	26	12	110	280	170	< 2	18	8.4	39	20	5.2	16	7.0	10.7	
5/10/2016	0.4	< 0.05	< 0.025	0.04	0.14	35	19	170	370	230	4	15	10	45	70	10	14	7.6	15.8	
Amazon Creek at Royal Avenue																				
7/28/2015*																				
9/9/2015	1.3	< 0.05	< 0.025	0.02	0.14	27	10	110	290	200	5	64	5.2	140	130	37	33	7.6	18.3	
12/2/2015	0.3	< 0.05	0.42	0.09	0.15	8.7	3	34	100	66	5	19	10	1600	920	17	19	7.4	6.9	
2/1/2016	0.4	0.1	0.91	0.06	0.09	19	9	82	200	93	< 2	7	11	140	90	6.0	13	7.3	6.6	
3/17/2016	<0.1	< 0.05	0.57	0.04	0.06	13	5	51	140	98	< 2	15	9.9	110	60	6.0	17	7.3	9.5	
5/10/2016	0.3	< 0.05	0.09	0.02	0.09	23	8	91	260	160	< 2	23	2.6	26	40	15	15	7.0	17.7	

* No flow: no sample collected.

Table A.13
2015/2016 QA/QC Qualified Ambient Water Quality Data
Amazon Basin and Willamette River Monitoring Sites
Miscellaneous Parameters

Date / Site	TKN (mg/L)	NH_3 (mg/L)	NO_3+NO_2 (mg/L)	P (Ortho) (mg/L)	P (T) (mg/L)	Ca (T) (mg/L)	Mg (T) (mg/L)	Hardness (mg eq/L)	Cond (µmho/cm)	TDS (mg/L)	BOD (mg/L)	COD (mg/L)	DO (mg/L)	E. coli (MPN)	Fecal Coliform (col./100 mL)	TSS (mg/L)	Turbidity (NTU)	pH (Units)	Temp (°C)	2,3,7,8-TCDD (pg/L)
Willamette River Upstream of Urban Growth Boundary (RM 186.9)																				
7/29/2015	<0.1	< 0.05	< 0.025	0.02	0.02	5.1	2	20	55	51	< 2	< 2.5	10	3	3	2.2	2	7.8	20.4	< 2.66
9/8/2015	<0.1	< 0.05	< 0.025	0.03	0.02	5.5	2	22	57	42	< 2	7	10	1	3	1.6	2	8.1	18.4	< 2.74
9/8 Dup	<0.1	< 0.05	< 0.025	0.03	0.02	5.5	2	22	57	18 EV	< 2	9	8.2	3	4	2.6	2	8.2	18.1	< 2.63
12/1/2015	<0.1	< 0.05	0.08	0.03	0.03	5.5	2	21	59	48	< 2	< 2.5	13	6	5	2.8	4	7.7	7.5	< 2.63
2/2/2016	<0.1	< 0.05	0.06	0.05	0.04	4.4	2	18	46	39	< 2	< 2.5	13	1	3	3.4	7	7.4	6.6	< 2.80
2/2 Dup	<0.1	< 0.05	0.14 EV	0.04	0.03	4.5	2	17	47	40	< 2	< 2.5	13	9	3	4.0	8	7.4	6.6	< 2.41
3/15/2016	<0.1	< 0.05	0.14	0.03	0.04	4.3	1	16	44	48	< 2	< 2.5	12	45	30	7.6	12	7.1	8.1	< 2.41
5/11/2016	<0.1	< 0.05	< 0.025	0.04	0.02	4.1	1	16	44	33	< 2	< 2.5	13	5	4	2.0	2	7.0	12.7	< 2.58
Willamette River at Knickerbocker Bridge (RM 183.9)																				
7/29/2015	<0.1	< 0.05	< 0.025	0.02	0.04	5.4	2	21	57	42	< 2	5	9.3	8	5	2.4	2	7.5	19.4	
9/8/2015	<0.1	< 0.05	< 0.025	0.03	0.02	5.7	2	22	58	31	< 2	10	5.8	7	8	2.2	2	7.7	17.4	
12/1/2015	<0.1	< 0.05	0.14	0.03	0.02	5.6	2	21	61	47	< 2	< 2.5	13	7	1	1.2	4	7.6	6.6	
12/1 Dup	<0.1	< 0.05	0.14	0.03	0.03	5.7	2	22	61	55	< 2	< 2.5	13	6	3	2.6	4	7.6	6.6	
2/2/2016	<0.1	< 0.05	0.14	0.04	0.03	4.6	2	18	48	40	< 2	< 2.5	13	13	7	3.0	8	7.3	6.6	
3/15/2016	<0.1	< 0.05	0.20	0.03	0.06	5.0	2	19	50	52	< 2	7	12	110	48	12	23	7.3	8.1	
5/11/2016	<0.1	< 0.05	< 0.025	0.04	0.02	4.4	1	17	46	29	< 2	< 2.5	12	10	7	2.0	3	7.2	11.6	
5/11 Dup	<0.1	< 0.05	< 0.025	0.04	0.02	4.4	1	17	47	34	< 2	< 2.5	12	12	1	2.0	3	7.1	11.5	
Willamette River at Owosso Bridge (RM 178.6)																				
7/29/2015	<0.1	< 0.05	< 0.025	0.02	0.02	5.6	2	21	58	49	< 2	< 2.5	9.0	22	14	2.0	2	7.5	20.0	
7/29 Dup	<0.1	< 0.05	< 0.025	0.02	0.02	5.7	2	22	58	49	< 2	< 2.5	9.1	16	18	2.6	2	7.5	19.7	
9/8/2015	0.3	< 0.05	< 0.025	0.03	0.02	5.9	2	23	60	45	< 2	12	9.3	18	17	2.2	2	7.6	17.1	
12/1/2015	<0.1	< 0.05	0.14	0.03	0.02	5.7	2	22	62	57	< 2	< 2.5	13	7	10	3.4	4	7.4	6.2	
2/2/2016	<0.1	< 0.05	0.12	0.04	0.04	4.6	2	18	48	37	< 2	< 2.5	13	14	8	3.6	8	7.3	6.5	
3/15/2016	0.4	< 0.05	0.21	0.03	0.06	5.1	2	19	50	58	< 2	< 2.5	13	110	40	13	23	7.3	8.2	
5/11/2016	<0.1	< 0.05	< 0.025	0.04	0.02	4.2	1	16	46	35	< 2	< 2.5	13	20	13	1.8	3	6.9	11.4	
Willamette River Downstream of Beltline Bridge (RM 176.8)																				
7/29/2015	0.3	0.2	< 0.025	0.04	0.04	5.7	2	22	64	48	< 2	6	8.8	28	22	1.8	2	7.5	20.2	< 2.44
9/8/2015	0.3	< 0.05	< 0.025	0.04	0.03	5.9	2	23	62	41	< 2	12	9.1	36	39	2.2	2	7.4	17.1	< 2.43
12/1/2015	0.4	0.3	0.15	0.03	0.04	5.8	2	22	69	54	< 2	< 2.5	13	11	5	2.6	4	7.4	6.4	< 2.65
2/2/2016	<0.1	< 0.05	0.17	0.06	0.05	4.7	2	18	51	48	< 2	< 2.5	14 EV	14	8	4.8	8	7.2	6.6	< 2.67
3/15/2016	<0.1	< 0.05	0.28	0.05	0.08	5.4	2	20	54	56	< 2	9	12	100	54	12	25	7.5	8.5	< 2.58
3/15 Dup	<0.1	< 0.05	0.28	0.04	0.08	5.4	2	20	54	52	< 2	< 2.5	12	150	< 2	12	24	7.3	8.3	< 2.71
5/11/2016	<0.1	< 0.05	< 0.025	0.05	0.04	4.4	1	17	48	40	< 2	< 2.5	12	24	7	2.6	3	6.6	11.0	< 2.71
Delta Ponds Above Willamette River Confluence																				
7/29/2015*																				
9/8/2015*																				
12/1/2015*																				
2/2/2016	<0.1	< 0.05	0.15	0.04	0.04	5.2	2	20	55	37	< 2	< 2.5	14 EV	19	12	4.0	8	7.0	7.1	
3/15/2016	<0.1	< 0.05	0.21	0.02	0.06	5.8	2	23	58	56	< 2	8	11	100	96	10	20	7.2	8.9	
5/11/2016	<0.1	< 0.05	< 0.025	0.04	0.03	6.5	3	27	69	47	< 2	< 2.5	7.9	130	71	< 0.5	2	7.1	19.0	
Spring Creek at Beacon Drive East																				
7/28/2015*																				
9/9/2015*																				
12/2/2015	0.4	< 0.05	0.68	0.37	0.31	5.9	3	25	82	89	4	13	9.1	980	370	2.0	5	7.1	6.0	
2/1/2016	<0.1	< 0.05	3.7	0.11	0.07	18	10	85	210	140	< 2	< 2.5	9.7	86	20	< 0.5	1	6.7	10.1	
3/17/2016	<0.1	< 0.05	3.4	0.08	0.05	19	10	89	220	150	< 2	8	10	120	58	1.4	< 1	6.8	11.3	
5/10/2016	<0.1	< 0.05	2.8	0.08	0.07	18	10	86	220	160	< 2	< 2.5	6.3	550	50	< 0.5	1	7.0	11.8	

* No flow: no sample collected.

Table A.14
Summary Statistics for QA/QC Qualified Ambient Water Quality Data
Metals

Surface Water Sample Location:		Amazon Creek at 29th Avenue	Willow Creek near 18th Avenue	Amazon Creek at Railroad Crossing	Amazon Diversion Channel at Royal Avenue	A3 Channel at Terry Street	Amazon Creek at Royal Avenue	Willamette River Upstream of Urban Growth Boundary (RM 186.9)	Willamette River at Knickerbocker Bridge (RM 183.9)	Willamette River at Owosso Bridge (RM 178.6)	Delta Ponds Above Willamette River Confluence	Willamette River Downstream of Beltline Bridge (RM 176.8)	Spring Creek at Beacon Drive East
Metals (*µg/L*)	**Statistic**												
As (D)	$\hat{\mu}$	0.883	0.912	2.47	2.28	2.14	2.27	0.203	0.240	0.247	0.404	0.257	0.339
	$\hat{\sigma}$	0.332	0.440	1.03	1.18	1.19	1.05	0.0557	0.0614	0.0654	0.170	0.0704	0.0904
As (T)	$\hat{\mu}$	1.08	1.41	3.92	3.87	3.54	3.43	0.268	0.320	0.331	0.540	0.332	0.389
	$\hat{\sigma}$	0.328	0.648	1.76	2.02	2.91	1.73	0.0967	0.0998	0.106	0.340	0.105	0.0897
Cd (D)	$\hat{\mu}$	0.00083	0.00124	0.00252	0.00489	0.0117	0.00255	0.00054	0.00234	0.00107	INS	0.00124	0.00092
	$\hat{\sigma}$	0.00168	0.00188	0.00362	0.00831	0.0118	0.00449	0.00256	0.00813	0.00403	INS	0.00426	0.00326
Cd (T)	$\hat{\mu}$	0.00564	0.00251	0.0156	0.0242	0.0447	0.0147	0.00143	0.00301	0.00167	0.00086	0.00188	0.00233
	$\hat{\sigma}$	0.00742	0.00329	0.0142	0.0177	0.0261	0.0149	0.00394	0.00612	0.00373	0.00255	0.00489	0.00442
Cr (D)	$\hat{\mu}$	0.552	0.342	0.544	0.567	0.617	0.558	0.134	0.150	0.143	0.0646	0.166	0.119
	$\hat{\sigma}$	0.380	0.233	0.356	0.383	0.412	0.357	0.105	0.109	0.102	0.0725	0.115	0.0807
Cr (T)	$\hat{\mu}$	1.55	0.876	1.63	1.81	1.45	1.62	0.330	0.375	0.373	0.175	0.368	0.234
	$\hat{\sigma}$	0.910	0.568	0.952	0.921	1.12	0.909	0.224	0.246	0.248	0.138	0.235	0.136
Cu (D)	$\hat{\mu}$	1.79	1.23	1.79	2.31	2.32	1.90	0.295	0.379	0.383	0.511	0.443	0.687
	$\hat{\sigma}$	0.714	0.399	0.602	0.984	1.31	0.626	0.110	0.141	0.131	0.222	0.150	0.382
Cu (T)	$\hat{\mu}$	3.39	2.31	3.98	5.91	6.07	4.07	0.558	0.686	0.704	0.814	0.796	1.09
	$\hat{\sigma}$	1.48	0.908	1.45	3.78	4.04	1.45	0.268	0.341	0.326	0.762	0.351	0.910
Pb (D)	$\hat{\mu}$	0.0428	0.0294	0.0998	0.102	0.140	0.100	0.00787	0.0131	0.0114	0.0266	0.0176	0.0220
	$\hat{\sigma}$	0.0277	0.0215	0.0521	0.0542	0.0910	0.0463	0.00907	0.0137	0.00900	0.0145	0.0105	0.0170
Pb (T)	$\hat{\mu}$	0.568	0.269	1.92	2.13	2.19	1.69	0.0763	0.0844	0.0974	0.170	0.105	0.228
	$\hat{\sigma}$	0.330	0.159	1.16	1.24	1.49	0.948	0.0432	0.0450	0.0462	0.103	0.0487	0.158
Hg (D)	$\hat{\mu}$	0.00099	0.00103	0.00199	0.00134	0.00130	0.00170	0.00072	0.00083	0.00086	0.00020	0.00082	0.00020
	$\hat{\sigma}$	0.00052	0.00052	0.00094	0.00082	0.00063	0.00085	0.00036	0.00037	0.00036	0.00028	0.00037	0.00028
Hg (T)	$\hat{\mu}$	0.00249	0.00262	0.00800	0.00711	0.00967	0.00666	0.00156	0.00171	0.00178	0.00089	0.00187	0.00081
	$\hat{\sigma}$	0.00134	0.00140	0.00374	0.00376	0.00625	0.00330	0.00083	0.00082	0.00089	0.00062	0.00093	0.00064
Mo (D)	$\hat{\mu}$	0.278	0.116	0.496	0.896	1.22	0.614	INS	INS	INS	INS	INS	INS
	$\hat{\sigma}$	0.159	0.0988	0.284	0.452	0.534	INS	INS	INS	INS	INS	INS	INS
Mo (T)	$\hat{\mu}$	0.292	0.124	0.510	0.981	1.27	0.624	INS	INS	INS	INS	INS	INS
	$\hat{\sigma}$	0.151	0.0996	0.273	0.531	0.548	0.354	INS	INS	INS	INS	INS	INS
Ni (D)	$\hat{\mu}$	1.42	1.78	1.66	2.02	2.13	1.71	0.184	0.205	0.204	0.620	0.227	0.699
	$\hat{\sigma}$	0.368	1.23	0.426	0.666	0.650	0.526	0.0644	0.0696	0.0671	0.228	0.0778	0.190
Ni (T)	$\hat{\mu}$	2.03	2.18	2.37	3.05	2.89	2.46	0.305	0.337	0.327	0.730	0.350	0.790
	$\hat{\sigma}$	0.689	1.26	0.680	1.09	0.979	0.778	0.124	0.147	0.130	0.316	0.133	0.150
Se (D)	$\hat{\mu}$	INS	INS	INS	INS	INS	INS	INS	INS	INS	INS	INS	INS
	$\hat{\sigma}$	INS	INS	INS	INS	INS	INS	INS	INS	INS	INS	INS	INS
Se (T)	$\hat{\mu}$	0.140	0.165	0.252	0.226	0.199	0.207	INS	INS	INS	INS	INS	INS
	$\hat{\sigma}$	0.080	0.108	0.140	0.146	0.119	0.121	INS	INS	INS	INS	INS	INS
Ag (D)	$\hat{\mu}$	0.00097	0.00175	0.00242	0.00157	0.00060	0.00186	0.00058	0.00159	0.00150	0.00035	0.00105	0.00207
	$\hat{\sigma}$	0.00191	0.00445	0.00465	0.00412	0.00205	0.00416	0.00282	0.00606	0.00522	0.00008	0.00248	0.00338
Ag (T)	$\hat{\mu}$	0.00466	0.00240	0.0156	0.0130	0.0104	0.0157	0.00192	0.00187	0.00292	0.00143	0.00481	0.00029
	$\hat{\sigma}$	0.00759	0.00441	0.0158	0.00879	0.00988	0.0154	0.00433	0.00399	0.00591	0.00613	0.00640	0.00027
Zn (D)	$\hat{\mu}$	13.8	5.24	12.7	13.1	21.3	11.9	0.391	0.504	0.494	5.02	0.937	45.8
	$\hat{\sigma}$	8.25	3.32	15.4	7.36	16.4	7.20	0.278	0.360	0.299	11.0	0.541	50.6
Zn (T)	$\hat{\mu}$	23.5	8.11	28.4	28.1	39.5	25.0	1.30	1.36	1.46	7.20	1.87	48.3
	$\hat{\sigma}$	19.7	4.49	19.2	19.4	21.9	23.1	0.809	0.823	0.842	12.3	0.973	51.6

μ_μ : Mean corrected for censored data
σ_σ : Standard deviation corrected for censored data
INS = Insufficient uncensored data to compute statistic.

Table A.15
Summary Statistics for QA/QC Qualified Ambient Water Quality Data
Miscellaneous Parameters

Surface Water Sample Location:		Amazon Creek at 29th Avenue	Willow Creek near 18th Avenue	Amazon Creek at Railroad Crossing	Amazon Diversion Channel at Royal Avenue	A3 Channel at Terry Street	Amazon Creek at Royal Avenue	Willamette River Upstream of Urban Growth Boundary (RM 186.9)	Willamette River at Knickerbocker Bridge (RM 183.9)	Willamette River at Owosso Bridge (RM 178.6)	Delta Ponds Above Willamette River Confluence	Willamette River Downstream of Beltline Bridge (RM 176.8)	Spring Creek at Beacon Drive East
Miscellaneous Parameters	**Statistic**												
NH_3 – as N (*mg/L*)	μ_μ	0.9	INS	0.2	< 0.1	< 0.1	< 0.1	INS	INS	INS	INS	< 0.1	1.3
	σ_σ	2.4	INS	1.5	0.7	0.5	1.0	INS	INS	INS	INS	0.3	2.7
$NO_3 + NO_2$ – as N (*mg/L*)	μ_μ	0.31	< 0.05	0.24	0.22	0.35	0.19	< 0.05	< 0.05	< 0.05	0.04	0.11	2.1
	σ_σ	0.34	0.18	0.30	0.39	0.39	0.33	0.10	0.15	0.09	0.19	0.09	0.91
TKN – as N (*mg/L*)	μ_μ	0.2	0.2	0.4	0.8	0.7	0.5	< 0.2	< 0.2	< 0.2	< 0.2	0.2	0.2
	σ_σ	0.4	0.5	0.4	0.7	0.8	0.5	0.5	0.5	0.5	0.6	0.3	0.5
P – Ortho (*mg/L*)	μ_μ	0.05	0.02	0.04	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.05	0.10
	σ_σ	0.03	0.03	0.05	0.06	0.04	0.05	0.02	0.01	0.01	0.01	0.03	0.07
P – Total (*mg/L*)	μ_μ	0.10	0.06	0.11	0.16	0.20	0.11	0.04	0.04	0.04	0.06	0.07	0.15
	σ_σ	0.08	0.03	0.06	0.10	0.10	0.10	0.03	0.03	0.03	0.06	0.05	0.09
BOD (*mg/L*)	μ_μ	< 2	< 2	< 2	2.1	2.3	< 2	INS	INS	INS	< 2	INS	2.4
	σ_σ	11	9.6	2.9	2.8	2.8	2.7	INS	INS	INS	4.6	INS	12
COD (*mg/L*)	μ_μ	< 5	7	15	22	23	16	INS	INS	INS	< 5	INS	< 5
	σ_σ	16	14	12	14	13	13	19	INS	INS	10	INS	17
Dissolved Oxygen (*mg/L*)	μ_μ	8.0	8.9	7.8	7.8	7.4	8.0	10	10	9.7	6.4	9.8	7.9
	σ_σ	3.8	2.6	2.7	2.7	2.9	2.8	3.2	2.9	3.3	3.1	3.1	2.9
Calcium - Total (*mg/L*)	μ_μ	22	33	20	22	25	20	4.7	4.9	5.0	14	5.1	17
	σ_σ	9.2	69	6.7	8.1	9.2	6.9	0.6	0.6	0.6	4.6	0.7	5.1
Magnesium - Total (*mg/L*)	μ_μ	7.7	8.1	6.9	10	13	7.2	1.6	1.6	1.6	6.0	1.7	8.9
	σ_σ	3.1	7.4	2.4	4.2	5.3	2.8	0.2	0.2	0.2	2.3	0.2	3.0
Hardness (*mg eq* $CaCO_3$*/L*)	μ_μ	87	115	80	95	115	78	18	19	19	59	20	78
	σ_σ	36	201	27	36	46	29	2.2	2.2	2.3	21	2.3	25
Turbidity (*NU*)	μ_μ	14	17	23	35	23	26	6.6	7.0	7.1	5.5	7.2	4.3
	σ_σ	15	13	13	29	21	19	8.3	8.1	8.6	5.9	8.4	3.9
TSS (*mg/L*)	μ_μ	7.6	8.0	19	31	21	21	4.2	4.7	4.8	4.0	5.0	6.4
	σ_σ	13	10	17	31	16	20	12	10	11	12	10	7.2
TDS (*mg/L*)	μ_μ	140	218	139	151	170	135	41	43	43	79	45	122
	σ_σ	58	371	45	59	59	46	16	14	15	28	14	50
Specific Conductance (*µmos/cm*)	μ_μ	212	312	218	237	275	210	47	49	50	139	55	191
	σ_σ	90	538	75	87	95	75	5	5	7	46	7	57
Escherichia coli (*Col./100 mL*)	μ_μ	661	141	481	373	525	456	19	28	39	82	43	292
	σ_σ	2427	290	1683	1504	1100	1030	32	25	36	125	36	389
Fecal coliform (*Col./100 mL*)	μ_μ	310	104	480	268	315	727	14	21	32	55	37	890
	σ_σ	901	212	2724	1993	698	5239	19	19	31	79	31	3335
pH (*Units*)	μ_μ	7.1	7.1	7.1	7.3	7.1	7.5	7.3	7.3	7.3	7.0	7.0	6.8
	σ_σ	1.9	0.8	1.2	0.9	1.3	0.6	0.8	0.4	0.4	0.3	1.2	0.2
Temperature (°*C*)	μ_μ	11.1	11.3	13.8	14.8	14.4	14.3	11.4	11.4	11.2	11.2	11.5	12.1
	σ_σ	4.9	4.6	5.8	6.3	6.1	6.1	3.7	3.8	4.3	4.0	3.9	2.9
2,3,7,8-TCDD (Dioxin; *pg/L*)	μ_μ							INS				INS	
	σ_σ							INS				INS	

μ_μ : Mean corrected for censored data
σ_σ : Standard deviation corrected for censored data
INS = Insufficient uncensored data to compute statistic.

Table A.16
2015/2016 QA/QC Qualified Ambient Water Qnality Data
Amazon Basin Monitoring Sites
Chlorinated Hydrocarbons

Date / Site	1,1-Dichloroethene (µg/L)	cis 1,2-Dichloroethene (µg/L)	trans 1,2-Dichloroethene (µg/L)	Trichloroethene (µg/L)	Tetrachloroethene (µg/L)
Amazon Creek at Royal Avenue[1]					
7/28/2015**					
9/9/2015	5		< 5	< 5	< 5
12/2/2015	0.5		< 0.5	< 0.5	< 0.5
2/1/2016	0.5	0.080 *	< 0.5	0.13 *	0.32
4/1/2016	0.5	< 0.5	< 0.5	0.14 *	< 0.2
5/10/2016	0.5	< 0.5	< 0.5	0.16 *	< 0.2
Amazon Creek at Railroad Crossing[1]					
7/28/2015**					
9/9/2015**					
12/2/2015	0.5		< 0.5	0.080 *	< 0.5
2/1/2016	0.5	< 0.5	< 0.5	< 0.5	< 0.5
4/1/2016	0.5	< 0.5	< 0.5	0.18 *	< 0.2
5/10/2016	0.5	< 0.5	< 0.5	0.16 *	< 0.2
Amazon Creek at 29th Avenue[1]					
4/1/2016	0.5	< 0.5	< 0.5	< 0.5	0.10 *
5/10/2016	0.5	< 0.5	< 0.5	< 0.5	< 0.2

[1] 303(d) listed for Dichloroethene, Trichloroethene, and Tetrachloroethene.
* Analyte detected but concentration is less than the reporting limit.
** No flow or insufficient flow in creek.

Table A.17
Analytes Showing Significant Seasonal Trend
Utilizing Seasonal Kendall Statistic[1]
Analysis of Water Quality Data Set

Monitoring Location	Analyte	Parameter				
		Tau	*S*	*Z*	*2ρ*	*m*
Willow Creek	[2] Lead, Dissolved	0.350	207	3.941	0.000	0.001428
	[2] Zinc, Dissolved	0.425	244	4.754	0.000	0.2484
	Zinc, Total	0.340	201	3.827	0.000	0.2138
	Dissolved Oxygen	0.261	141	2.863	0.008	0.07817
	[2] Total Kjeldahl Nitrogen	-0.345	-204	-4.025	0.000	-0.0155
Amazon Creek at 29th Avenue	[2] Chromium, Total	-0.259	-159	-2.986	0.006	-0.044
	[2] Mercury, Dissolved	-0.234	-165	-2.814	0.010	-2.5E-05
	[2] Mercury, Total	-0.261	-184	-3.133	0.003	-6.8E-05
	Nickel, Total	-0.284	-179	-3.301	0.002	-0.02949
	Lead, Total	-0.452	-326	-5.467	0.000	-0.02425
	Zinc, Dissolved	0.440	318	5.332	0.000	0.5994
	Zinc, Total	0.313	226	3.787	0.000	0.589
Amazon Creek at Railroad Track Crossing	[2] Chromium, Dissolved	-0.344	-171	-3.727	0.000	-0.02636
	Chromium, Total	-0.268	-133	-2.894	0.008	-0.04339
	[2] Mercury, Dissolved	-0.380	-189	-4.124	0.000	-8.1E-05
	Mercury, Total	-0.535	-266	-5.811	0.000	-0.00038
	Nickel, Dissolved	-0.266	-132	-2.873	0.008	-0.02357
	Nickel, Total	-0.260	-129	-2.808	0.010	-0.03125
	Lead, Total	-0.380	-189	-4.122	0.000	-0.0535
	Zinc, Dissolved	0.360	179	3.904	0.000	0.5717
	Zinc, Total	0.348	173	3.771	0.000	1.15
Amazon Diversion Channel at Royal Avenue	[2] Arsenic, Dissolved	-0.266	-163	-3.061	0.004	-0.04537
	[2] Arsenic, Total	-0.330	-202	-3.799	0.000	-0.095
	[2] Mercury, Dissolved	-0.293	-201	-3.496	0.001	-4.1E-05
	[2] Molybdenum, Dissolved	-0.393	-57	-2.894	0.008	-0.0469
	Nickel, Dissolved	-0.372	-228	-4.290	0.000	-0.0625
	Nickel, Total	-0.378	-232	-4.366	0.000	-0.07
	Zinc, Total	0.349	246	4.194	0.000	1.125
	Temperature	-0.240	-169	-2.877	0.008	-0.1422
	[2] Total Kjeldahl Nitrogen	-0.259	-182	-3.128	0.004	-0.025

[1] Significant at 2ρ = 0.01
[2] Assumes censored values in data set are one-half the reporting limit.

Table A.17 Continued
Analytes Showing Significant Seasonal Trend
Utilizing Seasonal Kendall Statistic[1]
Analysis of Water Quality Data Set

Monitoring Location	Analyte	Parameter				
		Tau	*S*	*Z*	*2ρ*	*m*
A3 Channel at Terry Street	[2] Arsenic, Dissolved	-0.389	-178	-4.079	0.000	-0.0463
	Arsenic, Total	-0.489	-224	-5.137	0.000	-0.1337
	[2] Cadmium, Total	-0.515	-236	-5.413	0.000	-0.00358
	[2] Chromium, Dissolved	-0.407	-180	-4.232	0.000	-0.04603
	Chromium, Total	-0.509	-233	-5.345	0.000	-0.1159
	Copper, Total	-0.279	-128	-2.925	0.007	-0.1966
	[2] Mercury, Dissolved	-0.376	-172	-3.944	0.000	-5.6E-05
	Mercury, Total	-0.520	-238	-5.459	0.000	-0.00065
	Nickel, Dissolved	-0.408	-187	-4.286	0.000	-0.05675
	Nickel, Total	-0.526	-241	-5.530	0.000	-0.1021
	Lead, Total	-0.367	-168	-3.847	0.000	-0.1067
	Total Phosphorus	-0.325	-149	-3.414	0.001	-0.0075
	Temperature	-0.338	-155	-3.550	0.001	-0.2268
	[2] Total Kjeldahl Nitrogen	-0.312	-143	-3.299	0.002	-0.03333
Amazon Creek at Royal Avenue	[2] Cadmium, Total	-0.270	-195	-3.288	0.002	-0.00062
	[2] Chromium, Dissolved	-0.295	-186	-3.431	0.001	-0.02529
	Chromium, Total	-0.302	-190	-3.507	0.001	-0.04904
	[2] Mercury, Total	-0.406	-286	-4.878	0.000	-0.00021
	Nickel, Total	-0.289	-182	-3.358	0.002	-0.04
	[2] Lead, Total	-0.499	-360	-6.039	0.000	-0.0925
	[2] Zinc, Dissolved	0.510	368	6.174	0.000	0.7062
	Zinc, Total	0.422	305	5.114	0.000	1.049
	Temperature	-0.288	-208	-3.486	0.001	-0.15
	[2] Total Suspended Solids	-0.322	-227	-3.874	0.000	-0.8155
	Turbidity	-0.298	-215	-3.609	0.001	-0.7735

[1] Significant at 2ρ = 0.01
[2] Assumes censored values in data set are one-half the reporting limit.

Table A.17 Continued
Analytes Showing Significant Seasonal Trend
Utilizing Seasonal Kendall Statistic[1]
Analysis of Water Quality Data Set

Monitoring Location	Analyte	Parameter				
		Tau	*S*	*Z*	*2ρ*	*m*
Willamette River Upstream of Urban Growth Boundary	[2] Chromium, Total	-0.324	-204	-3.766	0.000	-0.01187
	[2] Mercury, Dissolved	-0.370	-241	-4.340	0.000	-2.5E-05
	[2] Mercury, Total	-0.399	-281	-4.793	0.000	-5.6E-05
	[2] Lead, Total	-0.259	-187	-3.129	0.004	-0.00181
	[2] *Escherichia coli*	-0.273	-197	-3.305	0.002	-0.6875
	Turbidity	-0.234	-169	-2.914	0.007	-0.08333
Willamette River at Knickerbocker Bridge	[2] Copper, Dissolved	0.288	208	3.482	0.001	0.00625
	[2] Mercury, Total	-0.239	-168	-2.858	0.009	-3.1E-05
	Specific Conductance	0.312	225	3.786	0.000	0.375
	[2] Fecal Coliform	-0.372	-179	-3.998	0.000	-1.5
Willamette River at Owosso Bridge	[2] Chromium, Total	-0.281	-177	-3.265	0.002	-0.01089
	Specific Conductance	0.259	187	3.140	0.003	0.3333
Willamette River Downstream of Beltline Bridge	[2] Mercury, Total	-0.270	-190	-3.236	0.002	-3.3E-05
Delta Ponds above Willamette River Confluence	Calcium, Total	-0.434	-56	-2.992	0.006	-0.7583
	Specific Conductance	-0.434	-56	-3.000	0.005	-6.667
	Dissolved Oxygen	0.574	74	3.932	0.000	0.45
	Hardness	-0.434	-56	-2.974	0.006	-3.75
	Magnesium, Total	-0.434	-56	-2.963	0.006	-0.4
Spring Creek at Beacon Drive East	[2] Total Suspended Solids	-0.806	-25	-3.361	0.002	-3.033

[1] Significant at 2ρ = 0.01
[2] Assumes censored values in data set are one-half the reporting limit.

Table A.18
Comparison of 2015/2016 Data to Historical Data
Analytes Showing Significant Change
Utilizing Mann-Whitney Statistic[1]
Amazon Basin Monitoring Sites

Monitoring Location	Analyte	Units	Average Analyte Value Monitoring Period	
			Historical	2015/2016
Willow Creek	[2] Lead, Total	µg/L	0.264	0.232
	Nickel, Dissolved	µg/L	1.82	1.19
	Nickel, Total	µg/L	2.21	1.58
	[2] Selenium, Dissolved	µg/L	0.204	0.0653
	Calcium, Total	mg/L	33.4	20.8
	[2] Escherichia coli	MPN/100 mL	148	87
	Turbidity	NTU	17	15
Amazon Creek at 29th Avenue	Zinc, Dissolved	µg/L	13.6	21.2
	Zinc, Total	µg/L	23.1	29.7
	Calcium, Total	mg/L	23.8	18.7
	[2] Chemical Oxygen Demand	mg/L	10	8.7
	Turbidity	NTU	15.6	12.3
Amazon Creek at Railroad Track Crossing	[2] Arsenic, Total	µg/L	4.04	2.36
	Mercury, Total	µg/L	0.00819	0.00376
	Nickel, Dissolved	µg/L	1.69	0.971
	Nickel, Total	µg/L	2.40	1.50
	[2] Selenium, Dissolved	µg/L	0.231	0.640
	Zinc, Dissolved	µg/L	11.2	45.6
	Zinc, Total	µg/L	27.0	58.6
	Calcium, Total	mg/L	20.7	13.8
	Turbidity	NTU	23.0	15.8
Amazon Diversion Channel at Royal Avenue	[2] Nickel, Dissolved	µg/L	2.05	1.15
	Nickel, Total	µg/L	3.10	1.91
	[2] Selenium, Dissolved	µg/L	0.224	0.0480
	[2] Zinc, Dissolved	µg/L	11.0	35.6
	Zinc, Total	µg/L	27.1	54.3
	Calcium, Total	mg/L	22.1	17.8
	Turbidity	NTU	35.5	27.5

[1] Significant at α = 0.05
[2] Assumes censored values in data set are one-half the reporting limit.
Shaded cells indicate the higher average.

Table A.18 Continued
Comparison of 2015/2016 Data to Historical Data
Analytes Showing Significant Change
Utilizing Mann-Whitney Statistic[1]
Amazon Basin Monitoring Sites

Monitoring Location	Analyte	Units	Average Analyte Value Monitoring Period	
			Historical	2015/2016
A3 Channel at Terry Street	[2] Lead, Total	µg/L	0.142	0.106
	Mercury, Total	µg/L	0.00992	0.00420
	Nickel, Dissolved	µg/L	2.16	1.47
	Nickel, Total	µg/L	2.94	1.83
	[2] Selenium, Dissolved	µg/L	0.204	0.0328
	[2] Selenium, Total	µg/L	0.229	0.0765
	Zinc, Dissolved	µg/L	20.7	34.1
	Zinc, Total	µg/L	39.3	45.2
	Calcium, Total	mg/L	25.5	22.8
	Turbidity	NTU	24.2	15.0
Amazon Creek at Royal Avenue	[2] Mercury, Total	µg/L	0.00690	0.00337
	[2] Selenium, Dissolved	µg/L	0.242	0.0778
	Zinc, Dissolved	µg/L	10.8	28.5
	Zinc, Total	µg/L	24.1	43.0
	Calcium, Total	mg/L	19.7	18.1
	[2] Chemical Oxygen Demand	mg/L	16.9	25.6
	Turbidity	NTU	26.7	19.4

[1] Significant at $\alpha = 0.05$
[2] Assumes censored values in data set are one-half the reporting limit.
Shaded cells indicate the higher average.

Table A.18 Continued
Comparison of 2015/2016 Data to Historical Data
Analytes Showing Significant Change
Utilizing Mann-Whitney Statistic[1]
Willamette River Monitoring Sites

Monitoring Location	Analyte	Units	Average Analyte Value Monitoring Period	
			Historical	2015/2016
Willamette River Upstream of Urban Growth Boundary	[2] Lead, Dissolved	µg/L	0.0136	0.0316
	[2] Lead, Total	µg/L	0.0862	0.0687
	[2] Mercury, Dissolved	µg/L	0.00082	0.00094
	[2] Nickel, Dissolved	µg/L	0.195	0.135
	[2] Selenium, Dissolved	µg/L	0.144	0.0292
	Calcium, Total	mg/L	4.6	4.8
	Hardness	mg eq $CaCO_3$/L	17.9	18.7
	[2] Ortho Phosphorus	mg/L	0.026	0.036
	[2] Phosphorus, Total	mg/L	0.038	0.030
	[2] Total Suspended Solids	mg/L	4.8	3.3
	Turbidity	NTU	6.7	5.1
Willamette River at Knickerbocker Bridge	[2] Selenium, Dissolved	µg/L	0.141	0.0423
	Calcium, Total	mg/L	4.9	5.1
	[2] Chemical Oxygen Demand	mg/L	5.2	4.9
	[2] Ortho Phosphorus	mg/L	0.023	0.032
	[2] Total Suspended Solids	mg/L	4.9	3.8
Willamette River at Owosso Bridge	[2] Lead, Total	µg/L	0.0167	0.0174
	Calcium, Total	mg/L	5.0	5.2
	[2] Ortho Phosphorus	mg/L	0.022	0.032
	[2] Total Suspended Solids	mg/L	5.2	4.3
	Turbidity	NTU	7.1	7.0
Willamette River Downstream of Beltline Bridge	Calcium, Total	mg/L	5.1	5.3
	[2] Chemical Oxygen Demand	mg/L	5.1	5.8
	[2] Total Kjeldahl Nitrogen	mg/L	0.31	0.22
	[2] Total Suspended Solids	µmhos/cm	5.2	4.3
	Turbidity	NTU	7.2	7.3

[1] Significant at $\alpha = 0.05$
[2] Assumes censored values in data set are one-half the reporting limit.
Shaded cells indicate the higher average.

Table A.18 Continued
Comparison of 2015/2016 Data to Historical Data
Analytes Showing Significant Change
Utilizing Mann-Whitney Statistic[1]
Willamette River Monitoring Sites

Monitoring Location	Analyte	Units	Average Analyte Value Monitoring Period	
			Historical	2015/2016
Delta Ponds above Willamette River Confluence near Beltline Bridge	[2] Chromium, Dissolved	µg/L	0.0911	0.244
	[2] Mercury, Dissolved	µg/L	0.00034	0.00131
	Nickel, Dissolved	µg/L	0.648	0.220
	Nickel, Total	µg/L	0.755	0.378
	[2] Selenium, Dissolved	µg/L	0.161	0.0410
	Calcium, Total	mg/L	14.4	5.8
	[2] Chemical Oxygen Demand	mg/L	7.5	4.3
	Specific Conductance	µmhos/cm	145	61
	Turbidity	NTU	5.2	10
Spring Creek at Beacon Drive East	Nickel, Dissolved	µg/L	0.742	0.486
	Nickel, Total	µg/L	0.837	0.556
	[2] Selenium, Dissolved	µg/L	0.160	0.0742
	[2] Selenium, Total	µg/L	0.143	0.0778
	Calcium, Total	mg/L	16.9	15.2
	[2] Chemical Oxygen Demand	mg/L	7.1	6.5
	Magnesium, Total	mg/L	9.1	8.1
	Turbidity	NTU	5.0	1.9

[1] Significant at $\alpha = 0.05$
[2] Assumes censored values in data set are one-half the reporting limit.
Shaded cells indicate the higher average.

Table A.19
Comparison of Metals Water Quality Data for 2015/2016 to Historical Data Set
Mann-Whitney Statistic

Monitoring Location	As (D)	As (T)	Cd (D)	Cd (T)	Cr (D)	Cr (T)	Cu (D)	Cu (T)	Pb (D)	Pb (T)	Hg (D)	Hg (T)	Mo (D)	Mo (T)	Ni (D)	Ni (T)	Se (D)	Se (T)	Ag (D)	Ag (T)	Zn (D)	Zn (T)
Amazon Creek at 29th Avenue																						
Mann-Whitney U	210.5	190	128	198.5	233	299	245.5	324	181	142	147	200	121	122	112	129.5	51	118	100	177	204	260
Z	-1.28	-1.53	-2.53	-0.31	-0.67	-0.05	-1.03	-0.07	-1.84	-2.31	-1.72	-1.57	-0.83	-0.81	-2.60	-2.37	-2.90	-0.92	-2.85	-1.90	-1.55	-0.87
Asymp. Sig. (2-tailed)	0.200	0.126	0.011	0.760	0.500	0.957	0.305	0.940	0.066	0.021	0.086	0.116	0.405	0.420	0.009	0.018	0.004	0.355	0.004	0.057	0.122	0.383
Exact Sig. [2*(1-tailed Sig.)]													0.422	0.437			0.009	0.379				
Willow Creek																						
Mann-Whitney U	212	206	82.5	143.5	160.5	190	196	205	120.5	222.5	130.5	182.5	86	91.5	138.5	127	3	68	17.5	161	174.5	187
Z	-0.14	-0.24	-2.42	-0.80	-0.85	-0.51	-0.59	-0.51	-1.83	-0.16	-1.60	-0.84	-0.16	-0.04	-1.39	-1.58	-3.82	-0.96	-3.50	-1.22	-0.91	-0.83
Asymp. Sig. (2-tailed)	0.892	0.812	0.015	0.421	0.397	0.609	0.556	0.607	0.067	0.872	0.110	0.402	0.871	0.968	0.165	0.113	0.000	0.337	0.000	0.224	0.365	0.407
Exact Sig. [2*(1-tailed Sig.)]				0.439									0.893	0.970			0.000	0.362				
Amazon Creek at Railroad Track Crossing																						
Mann-Whitney U	100	65.5	97.5	80	104	115.5	123	160.5	138.5	81	111	26	56	57.5	6	7	1	59	148	109	18	41
Z	-1.52	-2.14	-1.57	-1.90	-1.31	-1.23	-1.07	-0.40	-0.72	-1.85	-1.29	-2.89	-1.41	-1.44	-3.26	-3.24	-3.55	-1.40	-0.61	-1.36	-3.04	-2.61
Asymp. Sig. (2-tailed)	0.129	0.032	0.116	0.057	0.191	0.218	0.286	0.690	0.473	0.064	0.196	0.004	0.157	0.149	0.001	0.001	0.000	0.163	0.543	0.174	0.002	0.009
Exact Sig. [2*(1-tailed Sig.)]	0.135	0.028	0.125	0.058	0.203	0.227	0.303	0.701	0.487	0.064	0.208	0.001	0.169	0.154	0.000	0.000	0.000	0.175	0.569	0.186	0.000	0.005
Amazon Diversion Channel at Royal Avenue																						
Mann-Whitney U	138	127	124	163	119.5	156	185.5	173	197.5	129.5	211.5	125	48	47.5	32	64.5	0	96	68.5	155.5	90	74
Z	-1.09	-1.26	-1.42	-0.85	-1.28	-0.77	-0.51	-0.72	-0.32	-1.38	-0.07	-1.43	-1.61	-1.77	-2.85	-2.31	-3.61	-0.20	-2.33	-0.97	-1.98	-2.25
Asymp. Sig. (2-tailed)	0.274	0.209	0.156	0.393	0.202	0.441	0.614	0.469	0.750	0.169	0.944	0.154	0.107	0.077	0.004	0.021	0.000	0.845	0.020	0.331	0.048	0.025
Exact Sig. [2*(1-tailed Sig.)]					0.211								0.113	0.077			0.000	0.864				
A3 Channel at Terry Street																						
Mann-Whitney U	109.5	89	110.5	105	68	82.5	155	106	161	65.5	163	56	69.5	64	68.5	31.5	0	12	74	130	71	101.5
Z	-1.20	-1.60	-1.17	-1.26	-1.93	-1.73	-0.30	-1.27	-0.18	-2.07	-0.14	-2.26	-0.80	-1.00	-2.01	-2.74	-3.72	-2.86	-1.92	-0.80	-1.96	-1.36
Asymp. Sig. (2-tailed)	0.231	0.109	0.244	0.207	0.053	0.083	0.766	0.205	0.859	0.038	0.890	0.024	0.421	0.317	0.044	0.006	0.000	0.004	0.055	0.426	0.050	0.175
Exact Sig. [2*(1-tailed Sig.)]	0.241	0.113	0.261	0.220	0.052	0.083	0.782	0.218	0.871	0.035	0.901	0.020	0.436	0.339	0.041	0.002	0.000	0.001	0.059	0.449	0.049	0.182
Amazon Creek at Royal Avenue																						
Mann-Whitney U	188	190	71	204.5	132	153.5	268	240	269	157	221.5	79	113	119	139	126	31	112	109	233	130	114
Z	-0.96	-0.93	-2.80	-0.92	-1.73	-1.48	-0.06	-0.45	-0.01	-1.58	-0.65	-2.66	-0.35	-0.18	-1.69	-1.89	-2.79	-0.38	-2.26	-0.52	-1.97	-2.19
Asymp. Sig. (2-tailed)	0.336	0.352	0.005	0.357	0.083	0.140	0.950	0.653	0.989	0.115	0.517	0.008	0.725	0.861	0.091	0.059	0.005	0.702	0.024	0.604	0.049	0.028
Exact Sig. [2*(1-tailed Sig.)]													0.744	0.876			0.009	0.723				

b. Not corrected for ties.

Shaded cells significant at $\alpha = 0.05$

Table A.19
Comparison of Metals Water Quality Data for 2015/2016 to Historical Data Set
Mann-Whitney Statistic

Monitoring Location	As (D)	As (T)	Cd (D)	Cd (T)	Cr (D)	Cr (T)	Cu (D)	Cu (T)	Pb (D)	Pb (T)	Hg (D)	Hg (T)	Mo (D)	Mo (T)	Ni (D)	Ni (T)	Se (D)	Se (T)	Ag (D)	Ag (T)	Zn (D)	Zn (T)
Willamette River Upstream of Urban Growth Boundary																						
Mann-Whitney U	307	253.5	38.5	80.5	236	295.5	183	361	124.5	347	187	217	110	116	146	255	33	104	45.5	311.5	250	352.5
Z	-0.54	-1.25	-4.00	-3.52	-1.17	-0.69	-1.67	-0.20	-2.93	-0.32	-2.13	-1.86	-0.57	-1.67	-2.51	-1.23	-3.90	-1.92	-3.92	-0.79	-1.13	-0.26
Asymp. Sig. (2-tailed)	0.588	0.212	0.000	0.000	0.240	0.492	0.094	0.842	0.003	0.745	0.033	0.063	0.568	0.095	0.012	0.219	0.000	0.055	0.000	0.432	0.260	0.795
Exact Sig. [2*(1-tailed Sig.)]													.635b	.141b			.000b	.077b				
Willamette River at Knickerbocker Bridge																						
Mann-Whitney U	185	200	45	215.5	180	255	164.5	253	146.5	204	255	258	144	122	241.5	232.5	48	106	45	235.5	143	315.5
Z	-1.55	-1.39	-3.57	-0.77	-0.91	-0.62	-1.41	-0.24	-1.72	-0.92	-0.72	-0.81	-0.26	-0.91	-0.77	-0.92	-3.09	-1.34	-3.58	-1.11	-1.57	-0.11
Asymp. Sig. (2-tailed)	0.122	0.163	0.000	0.442	0.363	0.538	0.160	0.812	0.086	0.357	0.473	0.420	0.792	0.364	0.444	0.356	0.002	0.181	0.000	0.268	0.118	0.914
Exact Sig. [2*(1-tailed Sig.)]													.829b	.437b			.004b	.233b				
Willamette River at Owosso Bridge																						
Mann-Whitney U	251.5	241	60	253	152.5	248.5	255.5	298	259.5	127	259.5	208	101	97	247	258	98	140	69.5	234	242	278
Z	-0.66	-0.84	-3.37	-0.94	-1.37	-0.67	-0.78	-0.33	-0.04	-2.00	-0.72	-1.45	-0.84	-1.62	-0.66	-0.57	-1.61	-0.37	-3.26	-1.15	-0.83	-0.55
Asymp. Sig. (2-tailed)	0.507	0.401	0.001	0.347	0.171	0.503	0.438	0.741	0.966	0.046	0.469	0.148	0.399	0.105	0.512	0.566	0.106	0.714	0.001	0.248	0.409	0.582
Exact Sig. [2*(1-tailed Sig.)]													.467b	.152b			.160b	.751b				
Willamette River Downstream of Beltline Bridge																						
Mann-Whitney U	186	216.5	64.5	162	225	282	270	277.5	222.5	205	242	261.5	87	124	284.5	252	99	134	56	214.5	213	322
Z	-1.53	-1.14	-3.30	-1.52	-0.90	-0.28	-0.52	-0.59	-0.58	-0.88	-0.83	-0.76	-1.19	-0.82	-0.17	-0.62	-1.59	-0.53	-3.41	-1.40	-1.19	-0.03
Asymp. Sig. (2-tailed)	0.125	0.254	0.001	0.128	0.370	0.776	0.604	0.555	0.565	0.379	0.408	0.446	0.232	0.415	0.863	0.534	0.113	0.598	0.001	0.160	0.234	0.980
Exact Sig. [2*(1-tailed Sig.)]													.282b	.468b			.168b	.639b				
Delta Ponds above Willamette River Confluence near Beltline Bridge																						
Mann-Whitney U	56	59	9	40	2	31	33.5	52	27	53	5	42	21	25.5	5	8	5	40	15	58	61	45
Z	-0.32	-0.18	-2.65	-1.14	-2.17	-1.46	-1.34	-0.50	-1.62	-0.40	-3.63	-0.96	-1.77	-1.62	-2.64	-2.50	-3.08	-0.98	-2.38	-0.25	-0.09	-0.82
Asymp. Sig. (2-tailed)	0.750	0.856	0.008	0.254	0.030	0.145	0.179	0.617	0.106	0.692	0.000	0.336	0.076	0.106	0.008	0.012	0.002	0.329	0.017	0.806	0.927	0.413
Exact Sig. [2*(1-tailed Sig.)]	.780b	.881b	.007b	.322b	.018b	.160b	.190b	.651b	.119b	.725b	.002b	.368b	.082b	.111b	.002b	.006b	.004b	.397b	.025b	.847b	.949b	.445b
Spring Creek at Beacon Drive East																						
Mann-Whitney U	39	26	36	19	16	35.5	34	33	18	17	37	25	26	23	8	3	6	10	12	16	22	23
Z	-0.08	-1.08	-0.33	-1.67	-1.40	-0.35	-0.32	-0.54	-1.71	-1.78	-0.33	-1.19	-0.37	-1.32	-2.48	-2.87	-2.55	-2.33	-2.27	-1.94	-1.39	-1.32
Asymp. Sig. (2-tailed)	0.938	0.278	0.744	0.094	0.161	0.727	0.746	0.588	0.088	0.075	0.744	0.233	0.714	0.186	0.013	0.004	0.011	0.020	0.023	0.052	0.163	0.188
Exact Sig. [2*(1-tailed Sig.)]	.970b	.309b	.794b	.115b	.185b	.737b	.785b	.627b	.097b	.081b	.852b	.273b	.763b	.210b	.010b	.001b	.009b	.018b	.029b	.068b	.183b	.210b

b. Not corrected for ties.
Shaded cells significant at $\alpha = 0.05$

Table A.20
Comparison of Miscellaneous Water Quality Data for 2015/2016 to Historical Data Set
Mann-Whitney Statistic

Monitoring Location	NH_3	BOD	Ca (T)	COD	Cond	DO	E. coli	Fecal Coliform	Hardness	Mg (T)	NO_3+NO_2	Field pH	Ortho P	Total P	Temp	TDS	TKN	TSS	Turbidity
Amazon Creek at 29th Avenue																			
Mann-Whitney U	246.5	238.5	21	84.5	252.5	236.5	256	306	242.5	175.5	236	267	112	95	193	271.5	100	135	9
Z	-0.55	-0.67	-3.87	-3.01	-0.26	-0.73	-0.74	-0.08	-0.85	-1.77	-0.94	-0.52	-0.67	-1.17	-1.35	-0.23	-1.20	0.00	-4.03
Asymp. Sig. (2-tailed)	0.580	0.504	0.000	0.003	0.791	0.464	0.461	0.937	0.394	0.076	0.348	0.601	0.501	0.242	0.177	0.814	0.231	1.000	0.000
Exact Sig. [2*(1-tailed Sig.)]													0.520	0.255			0.322	1.000	
Willow Creek																			
Mann-Whitney U	117	121.5	7.5	19.5	94	111	23	70	67	121	48.5	101.5	36.5	42.5	125	108	33	41	16
Z	-0.21	-0.10	-2.79	-2.53	-0.63	-0.38	-2.44	-1.46	-1.50	-0.30	-1.87	-0.75	-0.83	-0.49	-0.06	-0.45	-1.10	-0.56	-2.60
Asymp. Sig. (2-tailed)	0.834	0.917	0.005	0.011	0.526	0.704	0.015	0.143	0.135	0.761	0.062	0.452	0.407	0.624	0.954	0.654	0.272	0.573	0.009
Exact Sig. [2*(1-tailed Sig.)]	0.852	0.922	0.001	0.005	0.553	0.728	0.008	0.154	0.145	0.782	0.060	0.471	0.439	0.654	0.966	0.679	0.377	0.616	0.003
Amazon Creek at Railroad Track Crossing																			
Mann-Whitney U	198	226.5	15	164	189.5	234.5	196.5	236	212	177	214	153	133	129	152	224	115.5	106	66
Z	-0.87	-0.41	-3.91	-1.47	-0.90	-0.33	-0.90	-0.30	-0.56	-1.21	-0.61	-1.63	-0.06	-0.18	-1.65	-0.50	-0.54	-0.85	-3.04
Asymp. Sig. (2-tailed)	0.382	0.680	0.000	0.142	0.370	0.743	0.369	0.761	0.574	0.225	0.539	0.103	0.953	0.861	0.099	0.620	0.587	0.396	0.002
Exact Sig. [2*(1-tailed Sig.)]													0.966	0.875			0.631	0.414	
Amazon Diversion Channel at Royal Avenue																			
Mann-Whitney U	259	281.5	51	233	224	234	241.5	290	200	255	265.5	300	110.5	123	276	236	115	128	15
Z	-0.33	-0.05	-3.43	-1.01	-0.81	-0.73	-0.90	-0.29	-1.39	-0.72	-0.51	-0.08	-0.64	-0.35	-0.13	-0.74	-0.57	-0.21	-3.94
Asymp. Sig. (2-tailed)	0.738	0.960	0.001	0.312	0.420	0.464	0.370	0.772	0.163	0.473	0.611	0.936	0.521	0.726	0.897	0.460	0.572	0.836	0.000
Exact Sig. [2*(1-tailed Sig.)]													0.530	0.743			0.631	0.853	
A3 Channel at Terry Street																			
Mann-Whitney U	181	194	79	135.5	139	115	148	172	153	109.5	162	94	98.5	101.5	145	175.5	94	98	12.5
Z	-0.31	-0.11	-2.27	-1.17	-1.00	-1.59	-0.97	-0.52	-0.88	-1.69	-0.71	-1.96	-0.14	-0.04	-1.03	-0.46	-0.35	-0.16	-3.58
Asymp. Sig. (2-tailed)	0.755	0.911	0.023	0.241	0.317	0.112	0.331	0.601	0.380	0.091	0.478	0.050	0.888	0.972	0.304	0.647	0.729	0.873	0.000
Exact Sig. [2*(1-tailed Sig.)]	0.769	0.921	0.022	0.25	0.332	0.117	0.347	0.618	0.396	0.092	0.495	0.049	0.891	0.973	0.319	0.657	0.784	0.891	0
Amazon Creek at Royal Avenue																			
Mann-Whitney U	233	259.5	39	140	220.5	260.5	225	303	255	177	281	225	123	122	201.5	278	112	121	41.5
Z	-0.71	-0.33	-3.62	-2.25	-0.82	-0.35	-1.12	-0.08	-0.65	-1.73	-0.30	-1.03	-0.27	-0.30	-1.20	-0.10	-0.64	-0.33	-3.58
Asymp. Sig. (2-tailed)	0.477	0.744	0.000	0.025	0.411	0.725	0.264	0.936	0.516	0.084	0.766	0.305	0.788	0.765	0.230	0.920	0.520	0.741	0.000
Exact Sig. [2*(1-tailed Sig.)]													0.805	0.782			0.57	0.76	

b. Not corrected for ties.

Shaded cells significant at $\alpha = 0.05$

Table A.20
Comparison of Miscellaneous Water Quality Data for 2015/2016 to Historical Data Set
Mann-Whitney Statistic

Monitoring Location	NH_3	BOD	Ca (T)	COD	Cond	DO	E. coli	Fecal Coliform	Hardness	Mg (T)	NO_3+NO_2	Field pH	Ortho P	Total P	Temp	TDS	TKN	TSS	Turbidity
Willamette River Upstream of Urban Growth Boundary																			
Mann-Whitney U	277	269	15	51	215	161	208.5	269	82.5	197.5	276.5	274	40	77.5	221	243	48	27	15
Z	-0.03	-0.19	-3.94	-3.46	-0.90	-1.78	-1.16	-0.50	-2.99	-1.46	-0.24	-0.39	-3.31	-2.00	-0.82	-0.49	-3.04	-3.54	-3.94
Asymp. Sig. (2-tailed)	0.977	0.850	0.000	0.001	0.366	0.075	0.245	0.620	0.003	0.146	0.807	0.695	0.001	0.045	0.415	0.625	0.002	0.000	0.000
Exact Sig. [2*(1-tailed Sig.)]													0.004	0.093			0.009	0.001	
Willamette River at Knickerbocker Bridge																			
Mann-Whitney U	181	194.5	27	57	208	225.5	230	297	266.5	241.5	234.5	296	44	103	214.5	283	53.5	48	15
Z	-1.38	-1.27	-3.78	-3.38	-0.97	-0.85	-0.92	-0.12	-0.46	-0.87	-0.86	-0.09	-3.17	-1.12	-0.95	-0.03	-2.85	-2.90	-3.94
Asymp. Sig. (2-tailed)	0.168	0.204	0.000	0.001	0.330	0.393	0.355	0.904	0.644	0.387	0.388	0.924	0.002	0.265	0.344	0.977	0.004	0.004	0.000
Exact Sig. [2*(1-tailed Sig.)]													0.006	0.366			0.014	0.009	
Willamette River at Owosso Bridge																			
Mann-Whitney U	184.5	211	15	39	219	217.5	235	300.5	245	264.5	167	298.5	71	108	206	268	60	43	15
Z	-1.39	-1.03	-3.94	-3.63	-0.84	-0.94	-0.86	-0.07	-0.79	-0.49	-1.80	-0.06	-2.16	-0.92	-1.10	-0.20	-2.62	-3.02	-3.95
Asymp. Sig. (2-tailed)	0.166	0.303	0.000	0.000	0.398	0.349	0.392	0.941	0.430	0.627	0.073	0.951	0.031	0.355	0.270	0.839	0.009	0.003	0.000
Exact Sig. [2*(1-tailed Sig.)]													0.062	0.448			0.027	0.005	
Willamette River Downstream of Beltline Bridge																			
Mann-Whitney U	153.5	195	21	51	237	234.5	273	269.5	215.5	252.5	243.5	297	120	116.5	208.5	238	51	66	21
Z	-1.79	-1.26	-3.86	-3.46	-0.58	-0.73	-0.29	-0.52	-1.16	-0.68	-0.74	-0.08	-0.48	-0.52	-1.07	-0.68	-2.94	-2.21	-3.86
Asymp. Sig. (2-tailed)	0.073	0.207	0.000	0.001	0.563	0.468	0.770	0.600	0.247	0.494	0.460	0.935	0.631	0.606	0.286	0.500	0.003	0.027	0.000
Exact Sig. [2*(1-tailed Sig.)]													0.679	0.652			0.012	0.043	
Delta Ponds above Willamette River Confluence near Beltline Bridge																			
Mann-Whitney U	47.5	39	4.5	13.5	14	34	20	38	36	37.5	45	50	48.5	45	47	48	14.5	49	4.5
Z	-0.54	-0.95	-2.89	-2.44	-2.09	-1.20	-1.88	-1.00	-1.11	-0.92	-1.02	-0.42	-0.22	-0.48	-0.56	-0.51	-2.48	-0.29	-2.93
Asymp. Sig. (2-tailed)	0.591	0.341	0.004	0.015	0.037	0.231	0.060	0.317	0.269	0.355	0.310	0.676	0.828	0.634	0.574	0.608	0.013	0.771	0.003
Exact Sig. [2*(1-tailed Sig.)]	0.61	0.371	0.002	0.021	0.035	0.255	0.062	0.345	0.298	0.373	0.545	0.712	0.839	0.672	0.61	0.644	0.032	0.823	0.002
Spring Creek at Beacon Drive East																			
Mann-Whitney U	35	34	7.5	7.5	29	18.5	25	35	36	15	36	35.5	28	21	16.5	31	16	28	9
Z	-0.22	-0.31	-2.78	-2.76	-0.74	-1.66	-1.09	-0.22	-0.13	-1.96	-0.19	-0.18	-0.84	-1.45	-1.83	-0.57	-1.92	-0.65	-2.49
Asymp. Sig. (2-tailed)	0.827	0.760	0.005	0.006	0.458	0.097	0.275	0.827	0.896	0.049	0.851	0.860	0.403	0.147	0.067	0.570	0.055	0.515	0.013
Exact Sig. [2*(1-tailed Sig.)]	0.866	0.8	0.005	0.005	0.497	0.098	0.306	0.866	0.933	0.053	0.933	0.866	0.445	0.168	0.066	0.612	0.066	0.559	0.014

b. Not corrected for ties.
Shaded cells significant at α = 0.05

Table A.21
Intra-Basin Comparison of Water Quality Data
Using Mann-Whitney Statistic[1]
Metals (*µg/L*)

Monitoring Locations	As (D)	As (T)	Cd (D)	Cd (T)	Cr (D)	Cr (T)	Cu (D)	Cu (T)	Pb (D)	Pb (T)	Hg (D)	Hg (T)	Mo (D)	Mo (T)	Ni (D)	Ni (T)	Se (D)	Se (T)	Ag (D)	Ag (T)	Zn (D)	Zn (T)
Amazon Basin Comparisons																						
Amazon Creek at 29th Avenue		1.08			0.552	1.55	1.79	3.39	0.0428	0.568			0.278	0.292							13.8	23.5
Willow Creek		1.41			0.342	0.876	1.23	2.31	0.0294	0.269			0.116	0.124							5.24	8.11
Amazon Creek at 29th Avenue	0.883	1.08		0.00564				3.39	0.0428	0.568	0.00099	0.00249	0.278	0.292	1.42	2.03		0.140		0.00466	13.8	23.5
Amazon Creek at Railroad Crossing	2.47	3.92		0.0156				3.98	0.0998	1.92	0.00199	0.00800	0.496	0.510	1.66	2.37		0.252		0.0156	12.7	28.4
Amazon Creek at 29th Avenue	0.883	1.08		0.00564		1.55	1.79	3.39	0.0428	0.568	0.00099	0.00249	0.278	0.292	1.42	2.03		0.140		0.00466	13.8	23.5
Amazon Diversion Channel at Royal	2.28	3.87		0.0242		1.81	2.31	5.91	0.102	2.13	0.00134	0.00711	0.896	0.981	2.02	3.05		0.226		0.0130	13.1	28.1
Amazon Creek at Railroad Crossing	2.47			0.0156			1.79	3.98			0.00199	0.00800	0.496	0.510	1.66	2.37						
Amazon Diversion Channel at Royal	2.28			0.0242			2.31	5.91			0.00134	0.00711	0.896	0.981	2.02	3.05						
A3 Channel at Terry Street	2.14		0.0117	0.0447		1.45		6.07		2.19	0.00130	0.00967	1.22	1.27	2.13	2.89					21.3	39.5
Amazon Creek at Royal Avenue	2.27		0.00255	0.0147		1.62		4.07		1.69	0.00170	0.00666	0.614	0.624	1.71	2.46					11.9	25.0
Amazon Creek at 29th Avenue	0.883	1.08		0.00564				3.39	0.0428	0.568	0.00099	0.00249	0.278	0.292	1.42	2.03		0.140		0.00466	13.8	
Amazon Creek at Royal Avenue	2.27	1.05		0.0147				4.07	0.100	1.69	0.00170	0.00666	0.614	0.624	1.71	2.46		0.207		0.0157	11.9	
Willamette Basin Comparisons																						
Upstream of Urban Growth Boundary	0.203	0.268					0.295	0.558			0.00072				0.184							
Knickerbocker Bridge	0.240	0.320					0.379	0.686			0.00083				0.205							
Knickerbocker Bridge										0.0844												
Owosso Bridge										0.0974												
Owosso Bridge							0.383	0.704	0.0114						0.204						0.494	1.46
Downstream of Belt Line Bridge							0.443	0.796	0.0176						0.227						0.937	1.87
Upstream of Urban Growth Boundary	0.203	0.268					0.295	0.558	0.00787	0.0763	0.00072	0.00156			0.184	0.305				0.00192	0.391	1.30
Downstream of Beltline Bridge	0.257	0.332					0.443	0.796	0.0176	0.105	0.00082	0.00187			0.227	0.350				0.00481	0.937	1.87
Owosso Bridge	0.247	0.331			0.143	0.373	0.383		0.0114	0.0974	0.00086	0.00178			0.204	0.327					0.494	1.46
Delta Ponds	0.404	0.540			0.0646	0.368	0.511		0.0266	0.170	0.00020	0.00089			0.620	0.730					5.02	7.20
Amazon Creek at 29th Avenue	0.883	1.08	0.00083		0.552	1.55	1.79	3.39	0.0428	0.568	0.00099	0.00249			1.42	2.03				0.00097	13.8	23.5
Spring Creek at Beacon Drive East	0.339	0.389	0.00092		0.119	0.234	0.687	1.09	0.0220	0.228	0.00020	0.00081			0.699	0.790				0.00207	45.8	48.3

[1]Significant at α = 0.05 for reported means.
Shaded cells indicate downstream analyte value greater than upstream site. Amazon Creek M2 at 29th Avenue comparisons to Spring Creek and Willow Creek sub-basins are exceptions; greatest values are shaded.

Table A.22
Intra-Basin Comparison of Water Quality Data
Using Mann-Whitney Statistic[1]
Miscellaneous Parameters

Monitoring Location	NH_3 (*mg/L*)	BOD (*mg/L*)	Ca (T) (*mg/L*)	COD (*mg/L*)	Cond (µmhos/cm)	DO (*mg/L*)	*E. coli* (MPN/*100 mL*)	Fecal Coliform (MPN/*100 mL*)	Hardness (*mg eq/L*)	Mg (T) (*mg/L*)	NO_3+NO_2 (*mg/L*)	pH (*Units*)	P (Ortho) (*mg/L*)	P (T) (*mg/L*)	Temp (°C)	TDS (*mg/L*)	TKN (*mg/L*)	TSS (*mg/L*)	Turbidity (*NU*)
Amazon Basin Comparisons																			
Amazon Creek at 29th Avenue							661	310		7.7	0.31		0.05	0.10					
Willow Creek							141	104		8.1	<0.05		0.02	0.06					
Amazon Creek at 29th Avenue			22	<5		8.0	661	310	87	7.7	0.31		0.05		11.1	140		7.6	14
Amazon Creek at Railroad Track Crossing			20	15		7.8	481	480	80	6.9	0.24		0.04		13.8	139		19	23
Amazon Creek at 29th Avenue	0.9	<2		<5		8.0	661	310		7.7	0.31	7.1	0.05	0.10	11.1		0.2	7.6	14
Amazon Diversion Channel at Royal Ave.	<0.1	2.1		22		7.8	373	268		10	0.22	7.3	0.04	0.16	14.8		0.8	31	35
Amazon Creek at Railroad Track Crossing		<2		15			481	480	80	6.9				0.11			0.4	19	23
Amazon Diversion Channel at Royal Ave.		2.1		22			373	268	95	10				0.16			0.8	31	35
A3 Channel at Terry Street		2.3	25	23	275				115	13	0.35		0.05	0.20		170	0.7		
Amazon Creek at Royal Avenue		<2	20	16	210				78	7.2	0.19		0.04	0.11		135	0.5		
Amazon Creek at 29th Avenue			22	<5			661	310	87	7.7	0.31	7.1	0.05		11.1	140	0.2	7.6	14
Amazon Creek at Royal Avenue			20	16			456	727	78	7.2	0.19	7.5	0.04		14.3	135	0.5	21	26
Willamette River Comparisons																			
Upstream of Urban Growth Boundary			4.7		47		19	14	18										
Knickerbocker Bridge			4.9		49		28	21	19										
Knickerbocker Bridge							28	21											
Owosso Bridge							39	32											
Owosso Bridge					50					1.6	<0.05		0.02	0.04			<0.2		
Downstream of Belt Line Bridge					55					1.7	0.11		0.05	0.07			0.2		
Upstream of Urban Growth Boundary			4.7		47		19	14	18	1.6	<0.05	7.3	0.03	0.04		41	<0.2	4.2	6.6
Downstream of Belt Line Bridge			5.1		55		43	37	20	1.7	0.11	7.0	0.05	0.07		45	0.2	5.0	7.2
Owosso Bridge			5.0		50	9.7			19	1.6		7.3		0.04		43			
Delta Ponds			14		139	6.4			59	6.0		7.0		0.06		79			
Amazon Creek at 29th Avenue			22		212		661		87	7.7	0.31	7.1	0.05	0.10					
Spring Creek at Beacon Drive East			17		191		292		78	8.9	2.2	6.8	0.10	0.15					

[1]Significant at α = 0.05 for reported means.
Shaded cells indicate downstream analyte value greater than upstream site. Amazon Creek M2 at 29th Avenue comparisons to Spring Creek and Willow Creek sub-basins are exceptions; greatest values are shaded.

Table A.23
Mann-Whitney Statistic Output for
Intra-Basin Comparison of Water Quality Data

Monitoring Location	As (D)	As (T)	Cd (D)	Cd (T)	Cr (D)	Cr (T)	Cu (D)	Cu (T)	Pb (D)	Pb (T)	Hg (D)	Hg (T)	Mo (D)	Mo (T)	Ni (D)	Ni (T)	Se (D)	Se (T)	Ag (D)	Ag (T)	Zn (D)	Zn (T)
Amazon Creek at 29th Avenue : Willow Creek																						
Mann-Whitney U	4785	3811	5520.5	4738.5	3156	3170	3187.5	3467	4287.5	2648	4871.5	5277	547	505.5	4545	5016	1080	1113	5492.5	5155.5	2093.5	1333.5
Z	-0.58	-2.85	-0.13	-1.82	-3.25	-4.42	-5.46	-5.09	-3.11	-6.60	-1.27	-0.82	-4.49	-4.92	-1.16	-0.01	-0.06	-0.60	-0.24	-1.32	-7.83	-9.81
Asymp. Sig. (2-tailed)	0.564	0.004	0.897	0.069	0.001	0.000	0.000	0.000	0.002	0.000	0.204	0.415	0.000	0.000	0.246	0.988	0.955	0.547	0.808	0.188	0.000	0.000
Amazon Creek at 29th Avenue : Amazon Creek at Railroad Track Crossing																						
Mann-Whitney U	631.5	101.5	4789.5	3695.5	4381	4422	5140.5	3784.5	1785	1621	2277.5	659.5	826	904.5	3352	3491.5	1151	1010.5	5119	3720	4368	4183.5
Z	-10.77	-11.98	-1.43	-3.90	-0.07	-1.59	-0.61	-3.91	-8.18	-8.65	-7.07	-10.92	-4.10	-3.86	-4.26	-3.92	-1.62	-3.26	-0.34	-4.00	-2.50	-3.01
Asymp. Sig. (2-tailed)	0.000	0.000	0.152	0.000	0.948	0.111	0.543	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.105	0.001	0.731	0.000	0.013	0.003
Amazon Creek at 29th Avenue : Amazon Diversion Channel at Royal Avenue																						
Mann-Whitney U	1525.5	477	5472	3009	4864	4516.5	4578.5	2972	2394	1471	5333	1609	148.5	132.5	2417.5	2157	1225.5	1181.5	6104.5	3991	4711	5501
Z	-9.271	-11.51	-1.765	-6.886	-0.212	-2.466	-3.854	-7.215	-8.24	-10.05	-2.041	-9.716	-8.031	-8.352	-7.301	-7.876	-1.265	-2.273	-0.234	-5.05	-3.495	-2.202
Asymp. Sig. (2-tailed)	0.000	0.000	0.078	0.000	0.832	0.014	0.000	0.000	0.000	0.000	0.041	0.000	0.000	0.000	0.000	0.000	0.206	0.023	0.815	0.000	0.000	0.028
Amazon Creek at 29th Avenue : Amazon Creek at Royal Avenue																						
Mann-Whitney U	1095.5	337.5	5730.5	4652.5	4961.5	4900	5611.5	4541.5	2075	1794.5	3492	1499	821.5	785	3691.5	3415	981	1222.5	6030	4381	4882	6278.5
Z	-10.22	-11.86	-1.45	-3.55	-0.33	-1.71	-1.88	-4.10	-8.88	-9.39	-5.81	-9.94	-4.34	-4.55	-4.49	-5.10	-1.88	-2.03	-0.50	-4.28	-3.34	-0.66
Asymp. Sig. (2-tailed)	0.000	0.000	0.147	0.000	0.742	0.086	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.043	0.614	0.000	0.001	0.509
Amazon Creek at Railroad Track Crossing : Amazon Diversion Channel at Royal Avenue																						
Mann-Whitney U	3968.5	4435.5	5029	4201	4352	4561.5	3854.5	3415	5086.5	4674.5	3122	4165	563.5	552.5	3387	3037.5	1332	1381.5	5183	5231	4806.5	5325.5
Z	-2.59	-1.23	-0.34	-2.70	-0.26	-1.04	-3.39	-4.59	-0.26	-1.48	-5.03	-2.69	-5.12	-5.74	-4.00	-4.85	-0.32	-0.79	-0.08	-0.32	-1.20	-0.21
Asymp. Sig. (2-tailed)	0.010	0.218	0.734	0.007	0.794	0.297	0.001	0.000	0.792	0.138	0.000	0.007	0.000	0.000	0.000	0.000	0.748	0.432	0.935	0.752	0.232	0.837
A3 Channel at Terry Street : Amazon Creek at Royal Avenue																						
Mann-Whitney U	3674.5	4034	3519	2163.5	4103	3798.5	4375	3458	4669.5	3828.5	3575	3516	450.5	407.5	2764.5	3429	985.5	1317	4531.5	4671	2975	2456.5
Z	-2.66	-1.74	-3.51	-6.88	-0.61	-2.34	-1.68	-3.89	-0.87	-2.91	-3.44	-3.58	-5.93	-6.21	-4.97	-3.28	-1.00	-0.20	-0.99	-0.87	-5.05	-6.30
Asymp. Sig. (2-tailed)	0.008	0.082	0.000	0.000	0.545	0.019	0.093	0.000	0.384	0.004	0.001	0.000	0.000	0.000	0.000	0.001	0.316	0.842	0.322	0.384	0.000	0.000

Shaded cells significant at a = 0.05

Table A.23
Mann-Whitney Statistic Output for
Intra-Basin Comparison of Water Quality Data

Monitoring Location	As (D)	As (T)	Cd (D)	Cd (T)	Cr (D)	Cr (T)	Cu (D)	Cu (T)	Pb (D)	Pb (T)	Hg (D)	Hg (T)	Mo (D)	Mo (T)	Ni (D)	Ni (T)	Se (D)	Se (T)	Ag (D)	Ag (T)	Zn (D)	Zn (T)
Willamette River Upstream of Urban Growth Boundary (RM 186.9) : Knickerbocker Bridge (RM 183.9)																						
Mann-Whitney U	3424.5	3657	6182	6410	4489	5115.5	3744	5019.5	5620.5	5669	5069.5	5564.5	1578	1547.5	4350.5	5025.5	1563	1595.5	6324.5	6393.5	4585	5857
Z	-4.91	-4.65	-0.19	-0.18	-1.13	-1.24	-4.80	-2.97	-1.25	-1.56	-1.98	-1.77	-0.12	-0.66	-2.54	-1.54	-0.21	-0.35	-0.01	-0.21	-1.68	-1.29
Asymp. Sig. (2-tailed)	0.000	0.000	0.852	0.859	0.256	0.217	0.000	0.003	0.213	0.119	0.048	0.076	0.907	0.508	0.011	0.123	0.830	0.727	0.994	0.833	0.093	0.198
Willamette River at Knickerbocker Bridge (RM 183.9) : Owosso Bridge (RM 178.6)																						
Mann-Whitney U	5401	5451.5	6234	6352.5	4846	5532	5939	6101	5749.5	4734.5	5853	6211	1317.5	1403.5	5373	5597	1601.5	1530	6350	6222.5	5239	6012.5
Z	-0.37	-0.60	-0.19	-0.29	-0.49	-0.07	-0.35	-0.69	-0.86	-3.36	-0.42	-0.35	-1.79	-1.40	-0.20	-0.05	-0.15	-0.58	-0.07	-0.45	-0.62	-0.87
Asymp. Sig. (2-tailed)	0.711	0.547	0.846	0.768	0.621	0.941	0.727	0.492	0.389	0.001	0.677	0.724	0.074	0.161	0.842	0.962	0.883	0.560	0.943	0.655	0.537	0.386
Willamette River at Owosso Bridge (RM 178.6) : Downstream of Beltline Bridge (176.8)																						
Mann-Whitney U	4820	5456.5	6215	6186.5	4679.5	5602.5	4410	5363	4489.5	5385	5900.5	6061.5	1148	1228	4575	4714.5	1617.5	1545.5	6006.5	5756.5	2756	4457
Z	-1.68	-0.48	0.00	-0.63	-1.13	-0.03	-3.47	-2.28	-3.32	-1.93	-0.08	-0.66	-2.52	-2.46	-2.02	-1.92	-0.04	-0.48	-0.44	-1.50	-6.48	-4.01
Asymp. Sig. (2-tailed)	0.093	0.633	0.998	0.528	0.260	0.973	0.001	0.023	0.001	0.053	0.935	0.511	0.012	0.014	0.043	0.055	0.964	0.630	0.661	0.132	0.000	0.000
Willamette River Upstream of Urban Growth Boundary (RM 183.9) : Downstream of Belt Line Bridge (RM 176.8)																						
Mann-Whitney U	2853	3195.5	6156	6255.5	4329	5102	2202.5	3678.5	3707	3560.5	4865	5152	899	973	3397	4074.5	1527.5	1528.5	5925	5474.5	2080	3625
Z	-6.19	-5.58	-0.01	-0.49	-1.75	-1.37	-8.03	-5.74	-5.07	-5.75	-2.21	-2.61	-4.16	-4.18	-4.72	-3.55	-0.45	-0.75	-0.50	-2.18	-7.73	-5.77
Asymp. Sig. (2-tailed)	0.000	0.000	0.992	0.623	0.081	0.169	0.000	0.000	0.000	0.000	0.027	0.009	0.000	0.000	0.000	0.000	0.656	0.455	0.619	0.029	0.000	0.000
Willamette River at Owosso Bridge (178.6) : Delta Ponds above Willamette River Confluence near Beltline Bridge																						
Mann-Whitney U	827.5	858.5	2159	2404.5	1076	1307.5	1488.5	2303	1153.5	1636.5	713.5	1036	313.5	381.5	293	383.5	986.5	847	2475.5	2531	95	302.5
Z	-6.34	-6.25	-1.43	-0.71	-2.41	-4.33	-3.95	-1.00	-5.09	-3.32	-7.07	-5.81	-6.19	-5.99	-8.46	-8.14	-1.07	-2.68	-0.26	-0.13	-9.33	-8.63
Asymp. Sig. (2-tailed)	0.000	0.000	0.152	0.478	0.016	0.000	0.000	0.316	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.283	0.007	0.792	0.894	0.000	0.000
Amazon Creek at 29th Avenue : Spring Creek at Beacon Drive East																						
Mann-Whitney U	77	0	898	1259.5	306	140	257.5	253.5	883.5	489.5	381.5	389	231	226	64	25.5	391.5	528.5	903	1228	490	796
Z	-7.19	-7.64	-2.72	-0.55	-4.65	-6.81	-6.08	-6.29	-2.77	-4.93	-5.55	-5.50	-4.52	-4.74	-7.27	-7.50	-2.16	-1.62	-2.55	-0.86	-4.96	-3.30
Asymp. Sig. (2-tailed)	0.000	0.000	0.007	0.581	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.031	0.104	0.011	0.392	0.000	0.001

Shaded cells significant at a = 0.05

Table A.24
Mann-Whitney Statistic Output for
Intra-Basin Comparison of Water Quality Data

Monitoring Location	NH_3	BOD	Ca (T)	COD	Cond	DO	E. coli	Fecal Coliform	Hardness	Mg (T)	NO_3+NO_2	Field pH	Ortho P	Total P	Temp	TDS	TKN	TSS	Turbidity
Amazon Creek at 29th Avenue : Willow Creek																			
Mann-Whitney U	3680	5757.5	5500.5	5095	5753.5	5415.5	1696.5	1665	5071	4576.5	600.5	2400	1696	2801	5258.5	5275	5174	5840.5	5840.5
Z	-1.60	-0.40	-0.78	-1.63	-0.23	-0.17	-9.02	-6.33	-1.49	-2.78	-11.46	-7.32	-8.81	-6.66	-1.18	-0.94	-1.44	-0.04	-0.04
Asymp. Sig. (2-tailed)	0.110	0.689	0.438	0.104	0.821	0.869	0.000	0.000	0.135	0.005	0.000	0.000	0.000	0.000	0.237	0.346	0.151	0.970	0.970
Amazon Creek at 29th Avenue : Amazon Creek at Railroad Track Crossing																			
Mann-Whitney U	4320	3950.5	4172.5	3157	5178.5	3763	3395	3411.5	4106	3919	4361	2803.5	2707	4914.5	4536	4383	4640	2610.5	2610.5
Z	-0.75	-4.79	-3.03	-5.48	-0.75	-3.52	-4.79	-2.49	-3.10	-3.50	-2.42	-5.83	-6.12	-1.23	-2.21	-2.15	-1.92	-6.59	-6.59
Asymp. Sig. (2-tailed)	0.455	0.000	0.002	0.000	0.452	0.000	0.000	0.013	0.002	0.000	0.015	0.000	0.000	0.217	0.027	0.032	0.055	0.000	0.000
Amazon Creek at 29th Avenue : Amazon Diversion Channel at Royal Avenue																			
Mann-Whitney U	4086.5	3008.5	5788.5	1978	6090	4543.5	3306.5	2424.5	6276	4922	4983.5	4361.5	3795	3437	4725	6266	2906	1982.5	1982.5
Z	-2.02	-8.27	-1.63	-9.13	-1.04	-3.47	-6.55	-5.26	-0.45	-3.35	-3.05	-4.30	-5.39	-6.31	-3.74	-0.24	-7.37	-9.18	-9.18
Asymp. Sig. (2-tailed)	0.044	0.000	0.102	0.000	0.300	0.001	0.000	0.000	0.656	0.001	0.002	0.000	0.000	0.000	0.000	0.810	0.000	0.000	0.000
Amazon Creek at 29th Avenue : Amazon Creek at Royal Avenue																			
Mann-Whitney U	4131.5	4626	4521.5	3342	5711.5	4880	4192.5	3225.5	4624	4894	4469.5	4966	2866.5	6135	5070	4975.5	4525	2465	2465
Z	-1.58	-5.17	-4.15	-6.55	-1.79	-2.87	-4.80	-2.89	-3.77	-3.41	-3.99	-3.18	-7.29	-0.84	-3.06	-2.87	-4.03	-8.17	-8.17
Asymp. Sig. (2-tailed)	0.114	0.000	0.000	0.000	0.074	0.004	0.000	0.004	0.000	0.001	0.000	0.001	0.000	0.401	0.002	0.004	0.000	0.000	0.000
Amazon Creek at Railroad Track Crossing : Amazon Diversion Channel at Royal Avenue																			
Mann-Whitney U	4098.5	3642.5	4858	3385	4737	5125.5	4210	3096	4018	2962.5	5195	5189.5	5052	3240	4846.5	4550.5	3038	4047.5	4047.5
Z	-1.30	-4.34	-1.28	-4.43	-1.56	-0.22	-2.77	-3.25	-3.13	-5.55	-0.51	-0.02	-0.72	-4.91	-1.31	-1.56	-5.50	-3.14	-3.14
Asymp. Sig. (2-tailed)	0.192	0.000	0.200	0.000	0.119	0.829	0.006	0.001	0.002	0.000	0.611	0.984	0.473	0.000	0.192	0.119	0.000	0.002	0.002
A3 Channel at Terry Street : Amazon Creek at Royal Avenue																			
Mann-Whitney U	3048.5	3441	3124	3266.5	2929.5	4261	4923.5	3874	2432	1770.5	3783	4190	3130	1856.5	5049.5	2891	3894	4554.5	4554.5
Z	-3.93	-4.19	-4.70	-4.28	-5.16	-1.13	-0.22	-0.25	-6.21	-7.88	-3.04	-1.76	-4.74	-7.70	-0.06	-4.92	-2.77	-1.02	-1.02
Asymp. Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.260	0.822	0.806	0.000	0.000	0.002	0.078	0.000	0.000	0.955	0.000	0.006	0.307	0.307

Shaded cells significant at a = 0.05

Table A.24
Mann-Whitney Statistic Output for
Intra-Basin Comparison of Water Quality Data

Monitoring Location	NH_3	BOD	Ca (T)	COD	Cond	DO	E. coli	Fecal Coliform	Hardness	Mg (T)	NO_3+NO_2	Field pH	Ortho P	Total P	Temp	TDS	TKN	TSS	Turbidity
Willamette River Upstream of Urban Growth Boundary (RM 186.9) : Knickerbocker Bridge (RM 183.9)																			
Mann-Whitney U	4417.5	6668.5	5013.5	6423	5377.5	5540	3903.5	2920.5	5077.5	5844	5818	6308	5812	6219	6559	5801	6433.5	5827.5	5827.5
Z	-1.01	-0.01	-3.09	-0.35	-2.55	-0.86	-5.37	-3.92	-2.71	-1.33	-1.84	-0.61	-1.49	-0.92	-0.22	-1.29	-0.64	-1.69	-1.69
Asymp. Sig. (2-tailed)	0.315	0.990	0.002	0.724	0.011	0.390	0.000	0.000	0.007	0.183	0.065	0.544	0.135	0.359	0.827	0.196	0.524	0.090	0.090
Willamette River at Knickerbocker Bridge (RM 183.9) : Owosso Bridge (RM 178.6)																			
Mann-Whitney U	4371.5	6669	5982.5	6361	5944.5	5748	5136.5	3120	5768	5688	6597.5	6231	6172.5	6412.5	6484	6387.5	6558.5	6315.5	6315.5
Z	-1.00	-0.01	-1.07	-0.52	-1.33	-0.41	-2.93	-3.38	-1.28	-1.65	-0.15	-0.87	-0.72	-0.41	-0.14	-0.11	-0.29	-0.71	-0.71
Asymp. Sig. (2-tailed)	0.319	0.993	0.283	0.602	0.185	0.680	0.003	0.001	0.199	0.099	0.878	0.385	0.474	0.684	0.887	0.914	0.773	0.478	0.478
Willamette River at Owosso Bridge (RM 178.6) : Downstream of Beltline Bridge (176.8)																			
Mann-Whitney U	3587.5	6669	5746.5	6096.5	4211.5	5777	5938.5	3832	5552	5550	3340.5	5855	2027	2810.5	6462	5814	4020.5	6644	6644
Z	-4.04	-0.01	-1.67	-1.13	-4.77	-0.12	-1.34	-1.34	-1.84	-2.03	-6.46	-1.18	-9.21	-7.60	-0.19	-1.27	-5.77	-0.05	-0.05
Asymp. Sig. (2-tailed)	0.000	0.993	0.095	0.257	0.000	0.905	0.182	0.180	0.066	0.042	0.000	0.237	0.000	0.000	0.853	0.205	0.000	0.959	0.959
Willamette River Upstream of Urban Growth Boundary (RM 183.9) : Downstream of Belt Line Bridge (RM 176.8)																			
Mann-Whitney U	3467.5	6668.5	3939	6434.5	2741	5180.5	2562	1475	3812	4260.5	2489	5132	2800	2605.5	6579	5209	3709.5	5474.5	5474.5
Z	-4.86	-0.01	-5.39	-0.18	-7.75	-1.42	-8.03	-7.76	-5.40	-4.63	-8.26	-2.55	-7.57	-8.08	-0.18	-2.49	-6.55	-2.39	-2.39
Asymp. Sig. (2-tailed)	0.000	0.990	0.000	0.860	0.000	0.156	0.000	0.000	0.000	0.000	0.000	0.011	0.000	0.000	0.858	0.013	0.000	0.017	0.017
Willamette River at Owosso Bridge (178.6) : Delta Ponds above Willamette River Confluence near Beltline Bridge																			
Mann-Whitney U	2070	2193	119.5	1906.5	112.5	651	2366	1909	101	100.5	2241	1110.5	2096.5	1464.5	2516	530.5	1846.5	2277	2277
Z	-1.20	-3.76	-9.50	-3.12	-9.40	-7.01	-0.92	-0.73	-9.54	-9.49	-1.49	-5.67	-2.06	-4.34	-0.19	-7.67	-3.47	-1.06	-1.06
Asymp. Sig. (2-tailed)	0.230	0.000	0.000	0.002	0.000	0.000	0.358	0.467	0.000	0.000	0.136	0.000	0.039	0.000	0.851	0.000	0.001	0.290	0.290
Amazon Creek at 29th Avenue : Spring Creek at Beacon Drive East																			
Mann-Whitney U	1080	1299.5	596	979	1008	1021.5	824	919	991.5	1011	72	188	535	926.5	1303	968	1203	1209.5	1209.5
Z	-1.14	-0.93	-4.41	-2.42	-2.13	-1.56	-3.14	-1.40	-2.17	-2.11	-7.28	-6.67	-4.69	-2.59	-0.49	-1.70	-1.02	-1.01	-1.01
Asymp. Sig. (2-tailed)	0.253	0.354	0.000	0.016	0.033	0.119	0.002	0.162	0.030	0.035	0.000	0.000	0.000	0.010	0.623	0.089	0.307	0.312	0.312

Shaded cells significant at a = 0.05

APPENDIX B

Boxplots for Water Quality Parameters

Figure B.1

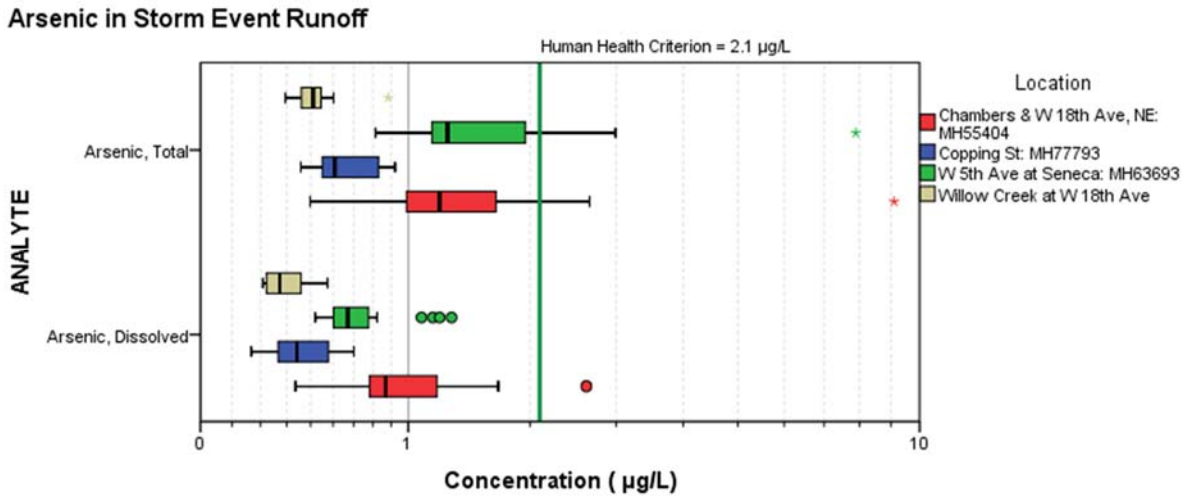


Figure B.2

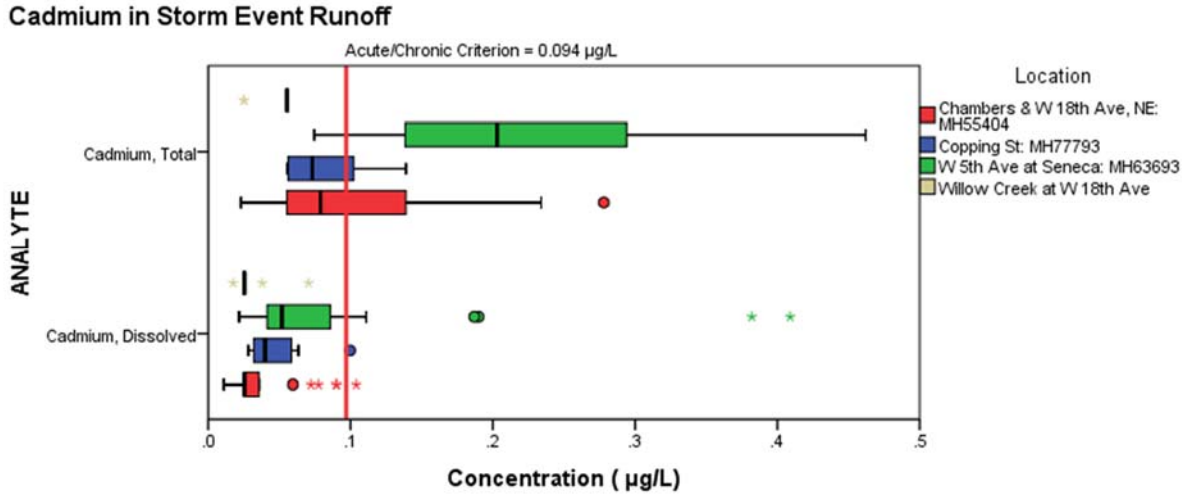


Figure B.3

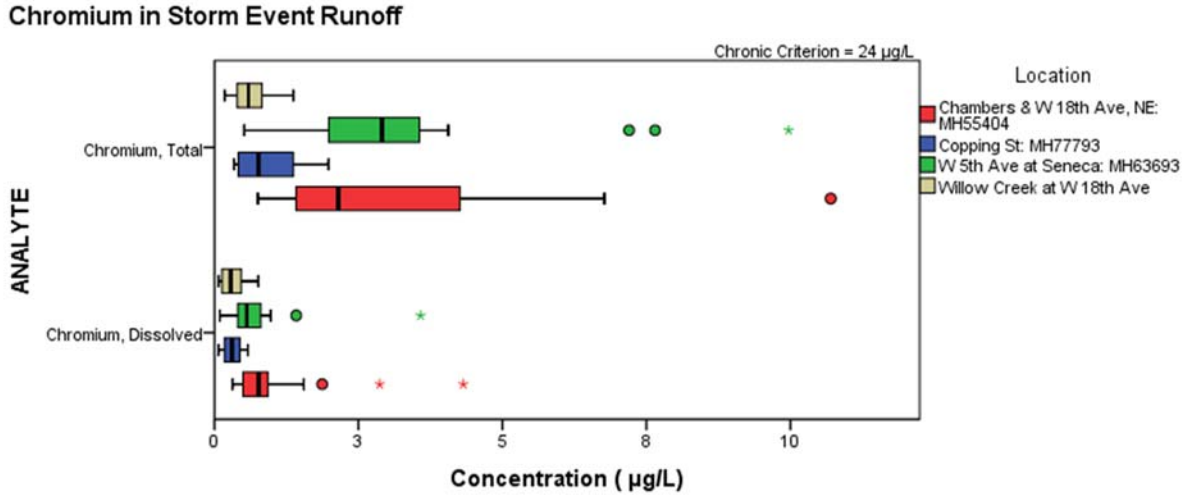


Figure B.4

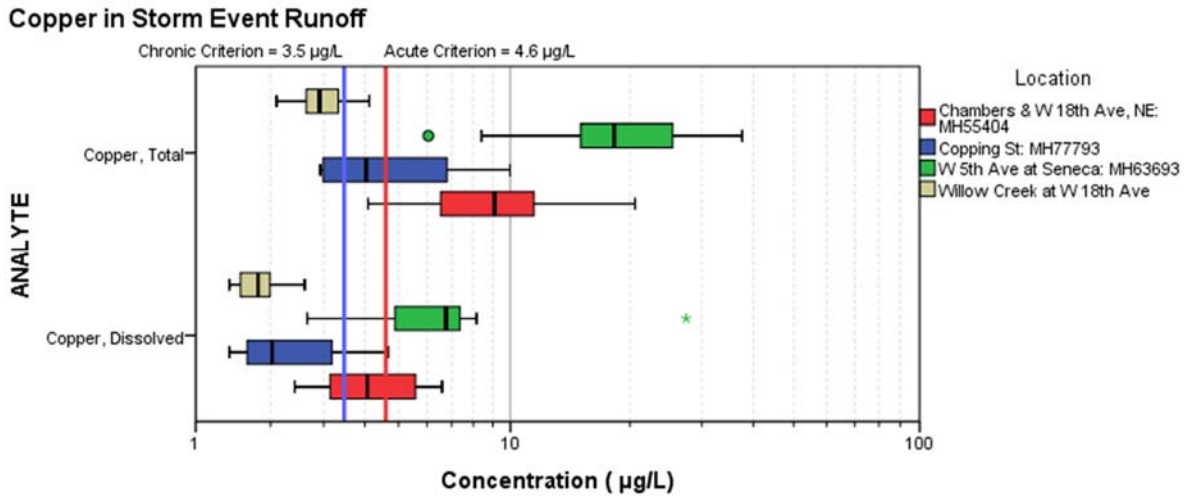


Figure B.5

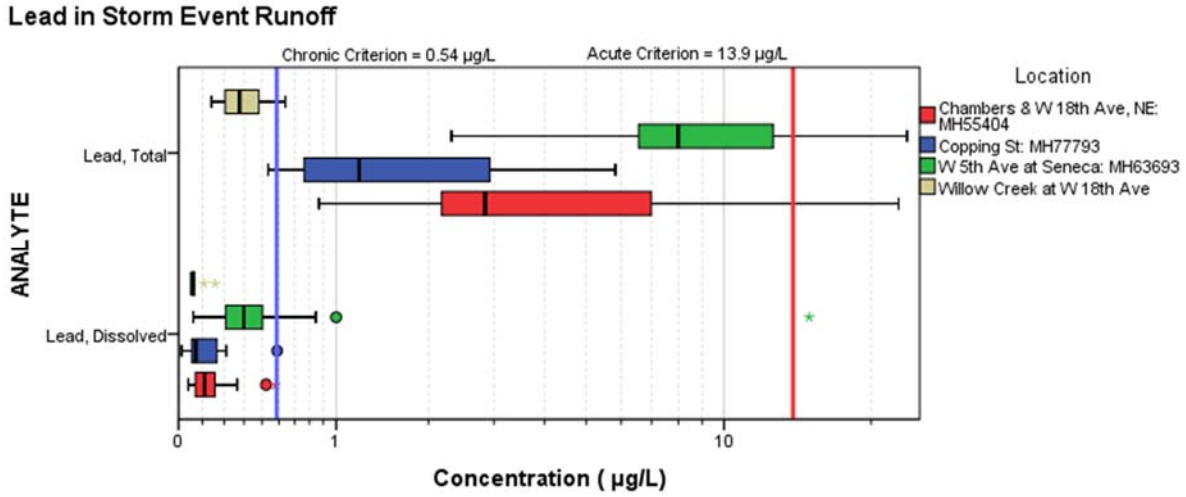


Figure B.6

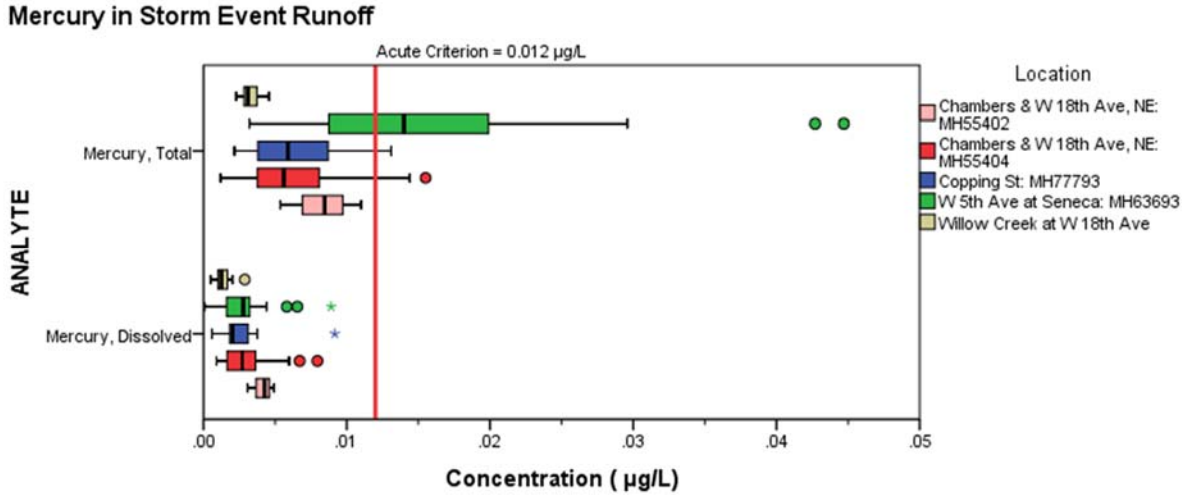


Figure B.7

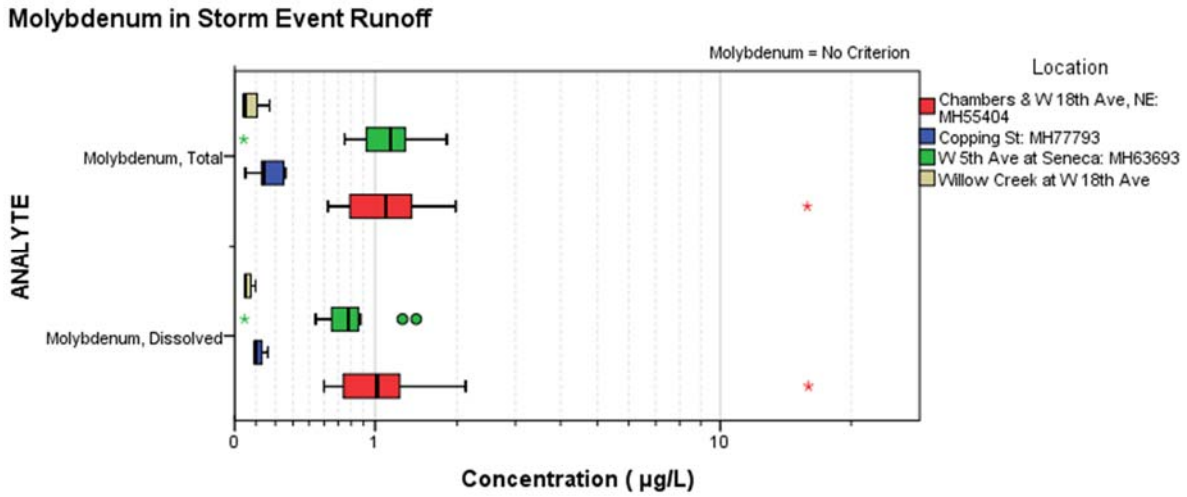


Figure B.8

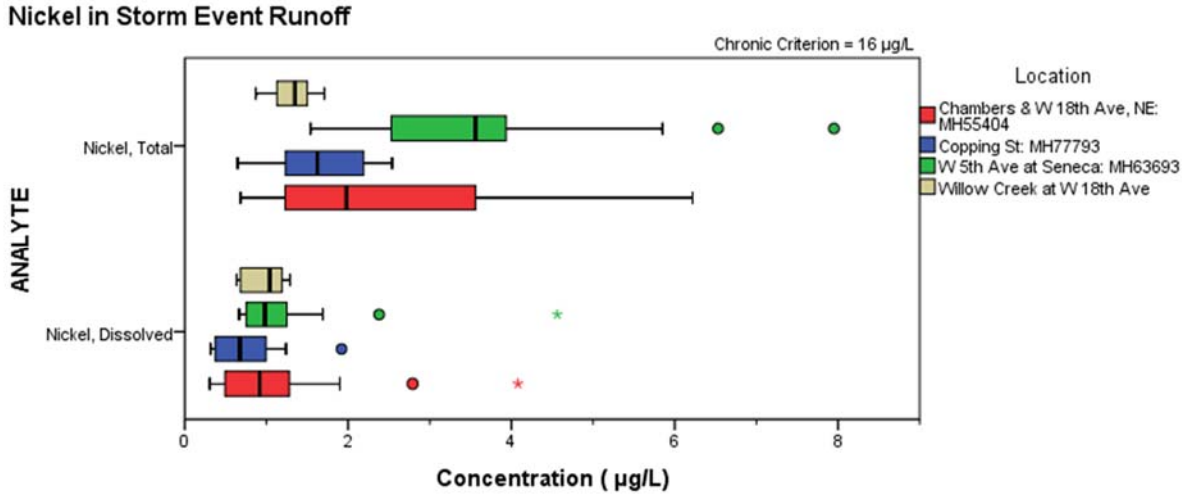


Figure B.9

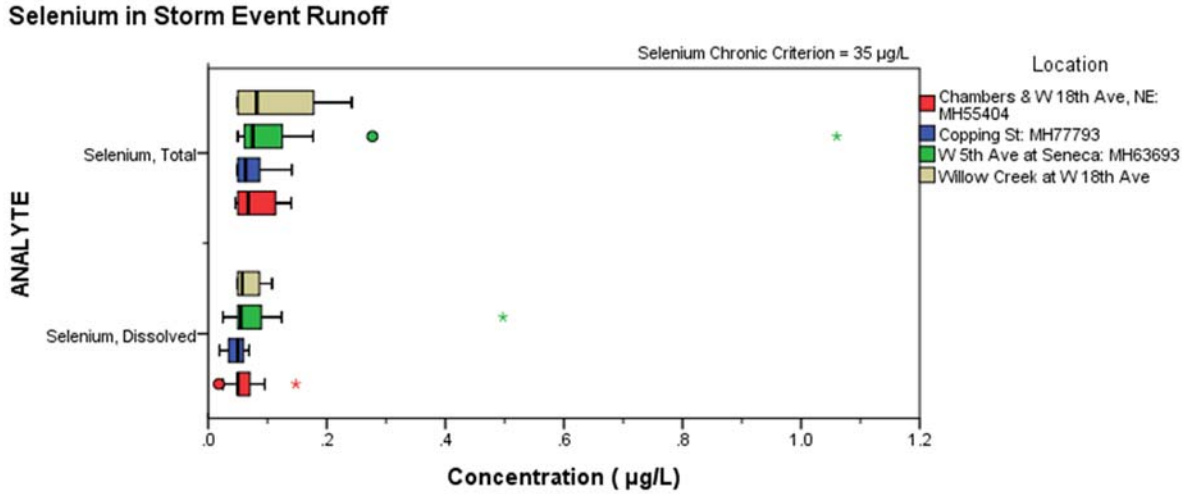


Figure B.10

Silver in Storm Event Runoff

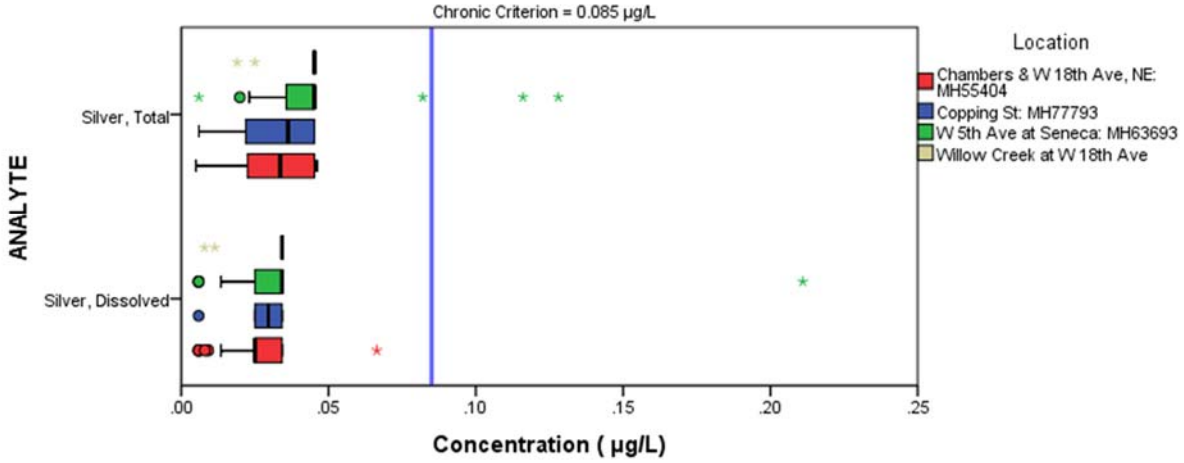


Figure B.11

Zinc in Storm Event Runoff

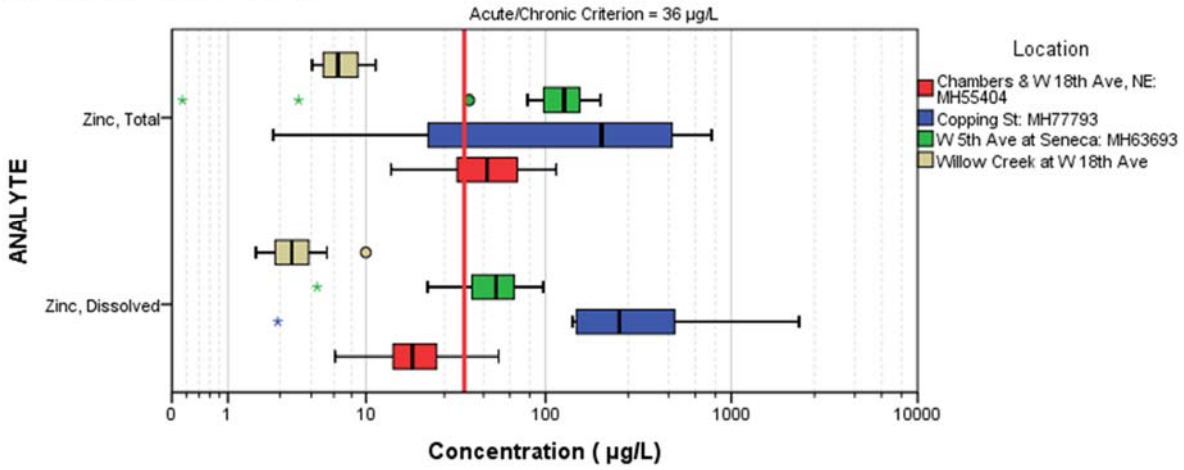


Figure B.12

Oxygen Demand in Storm Event Runoff

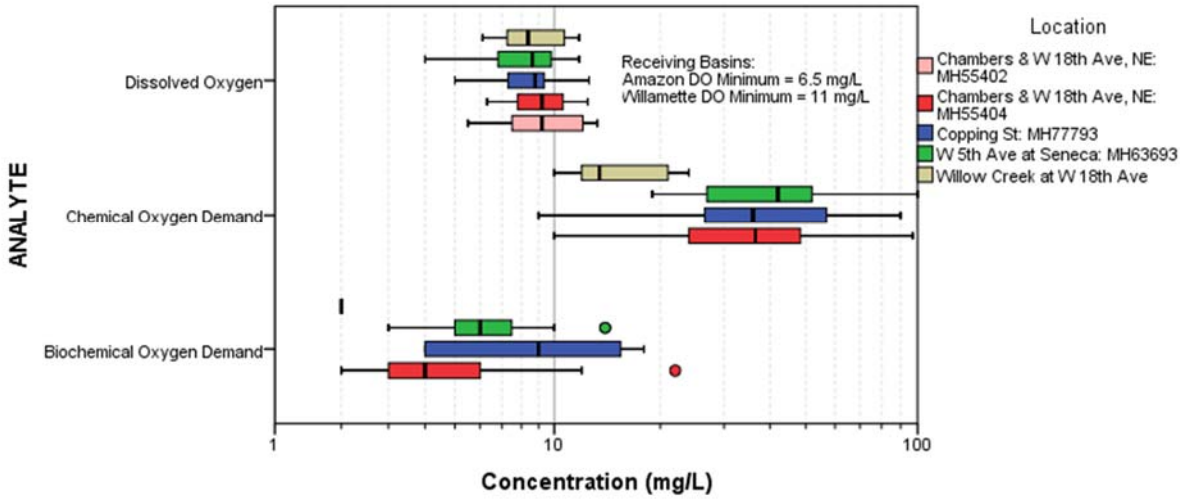


Figure B.13

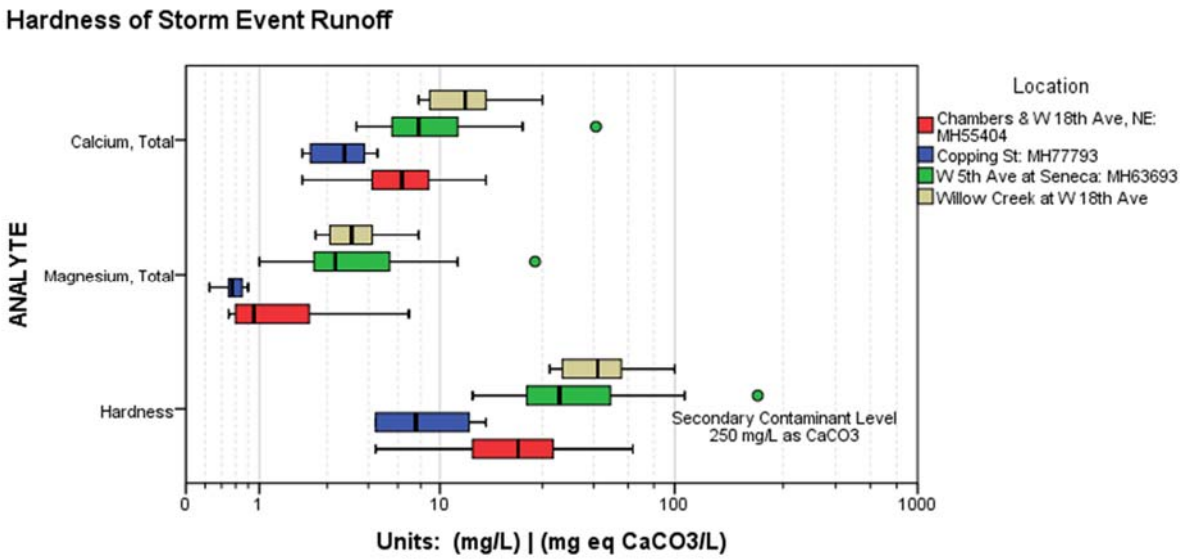


Figure B.14

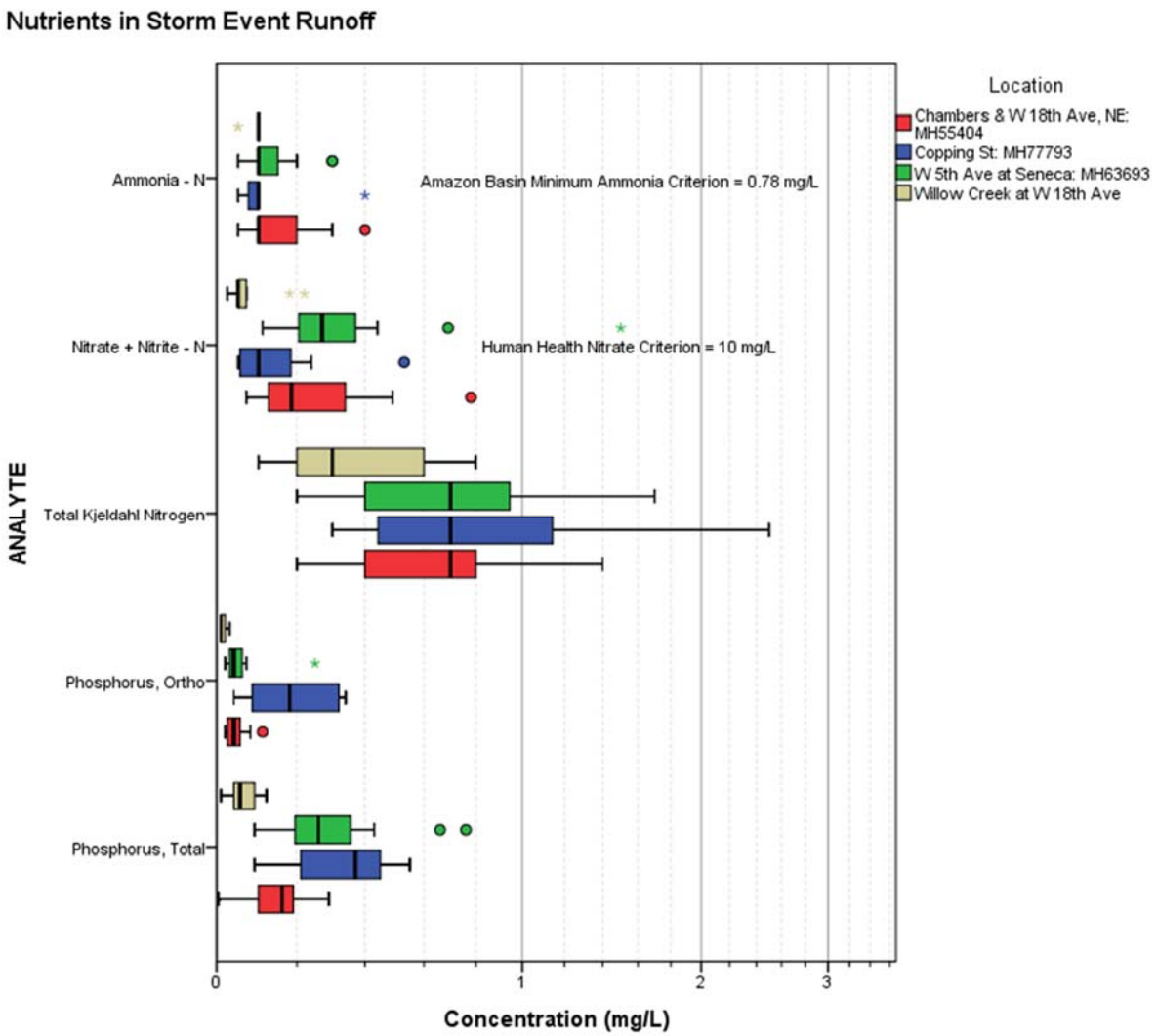


Figure B.15

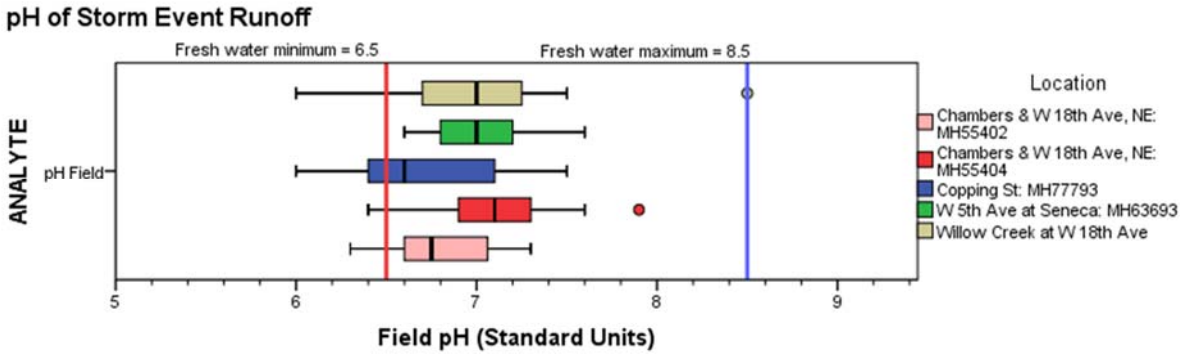


Figure B.16

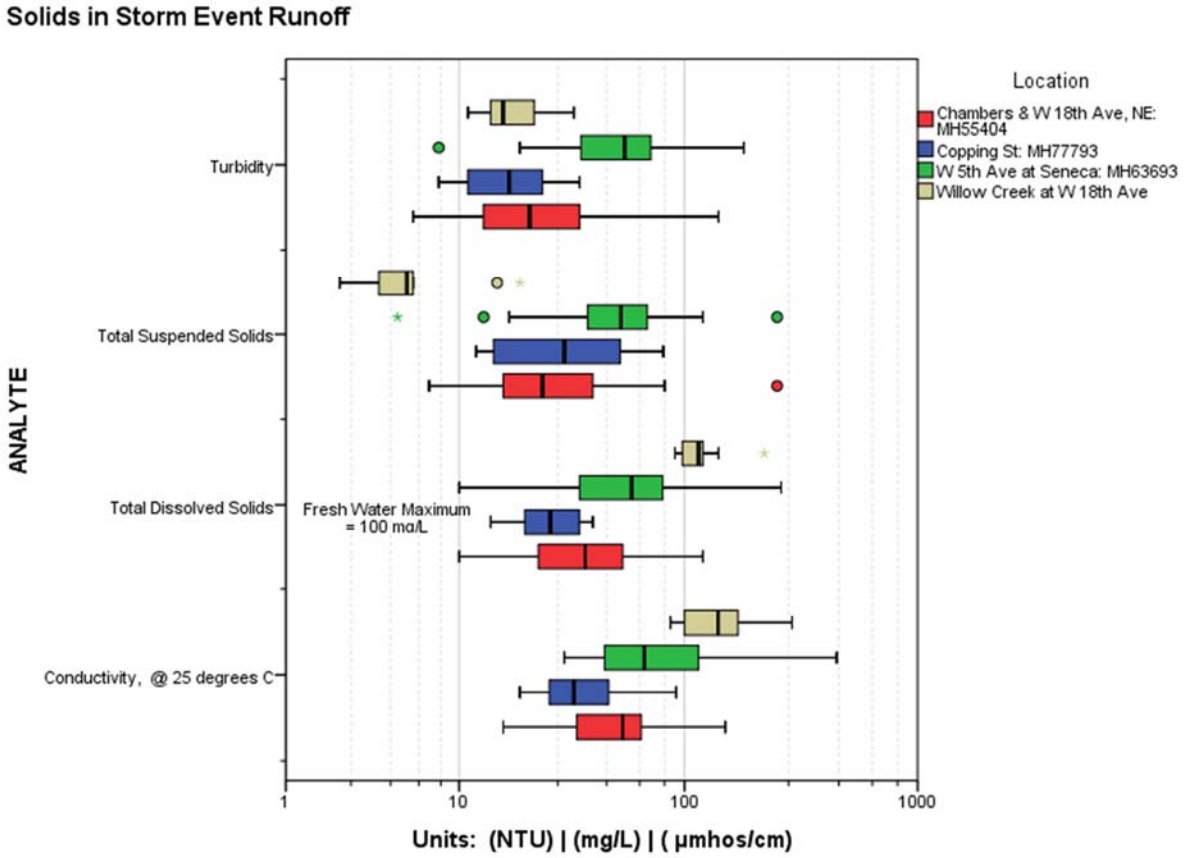


Figure B.17

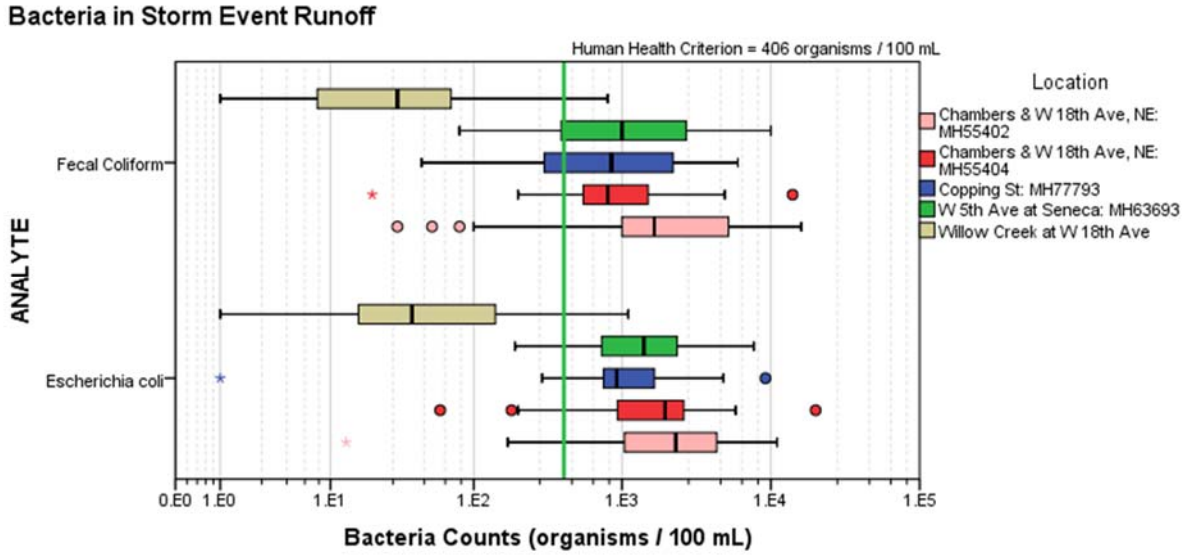


Figure B.18

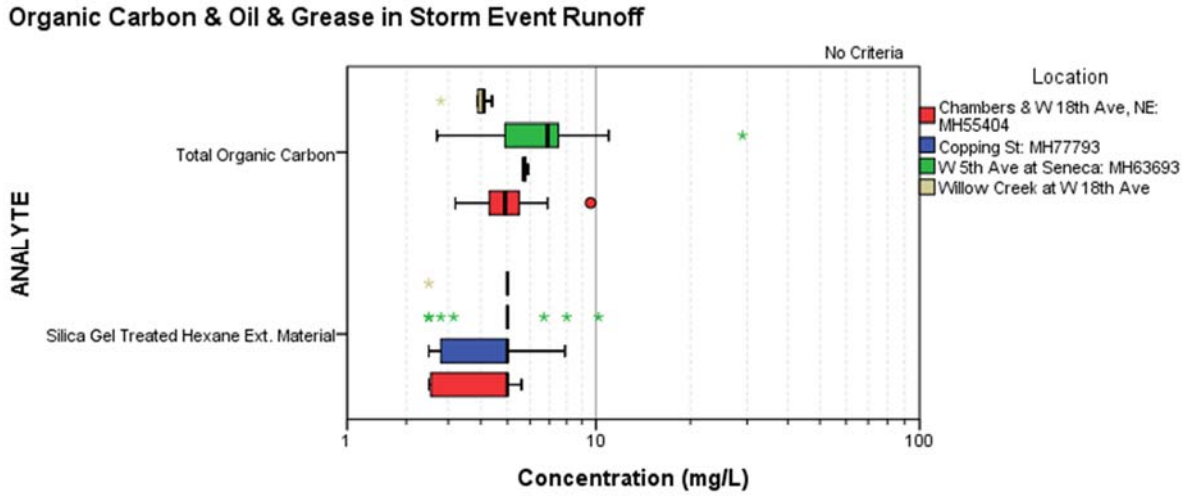


Figure B.19

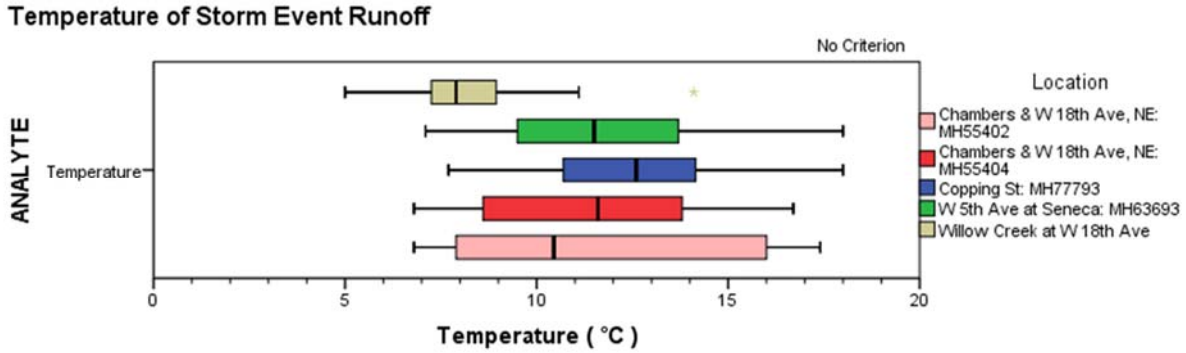


Figure B.20

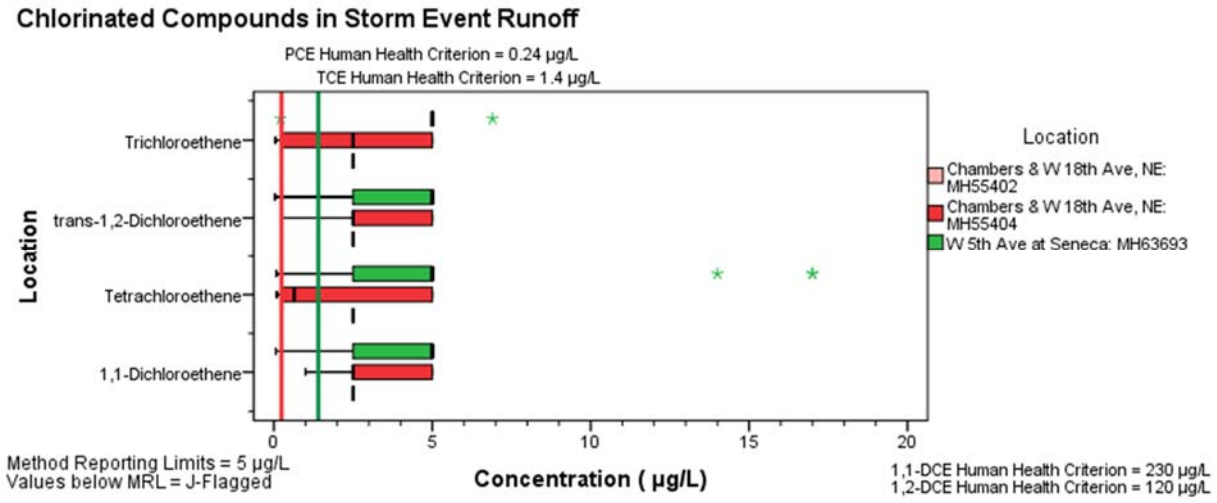


Figure B.21

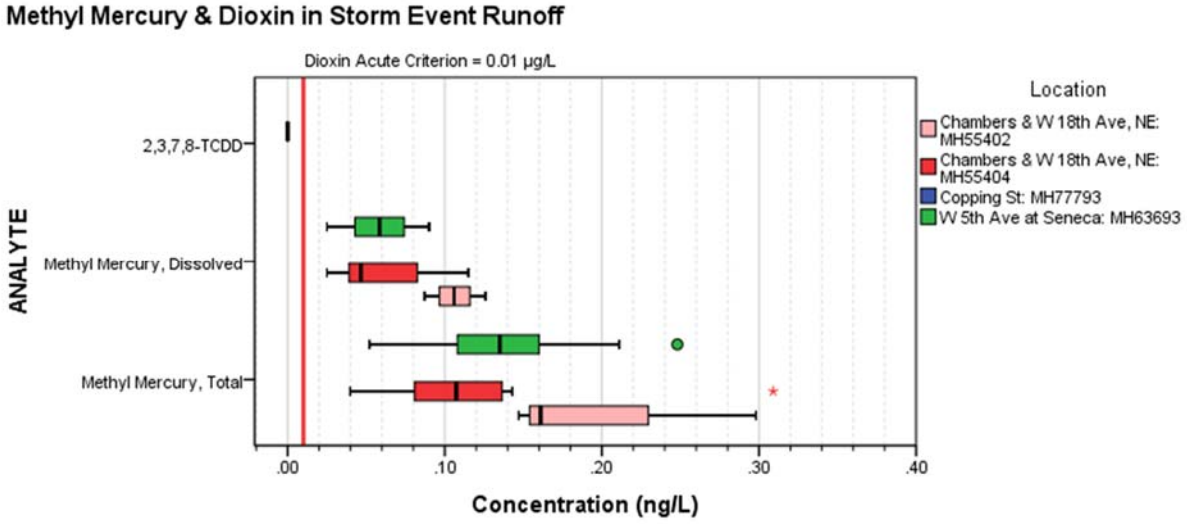


Figure B.22

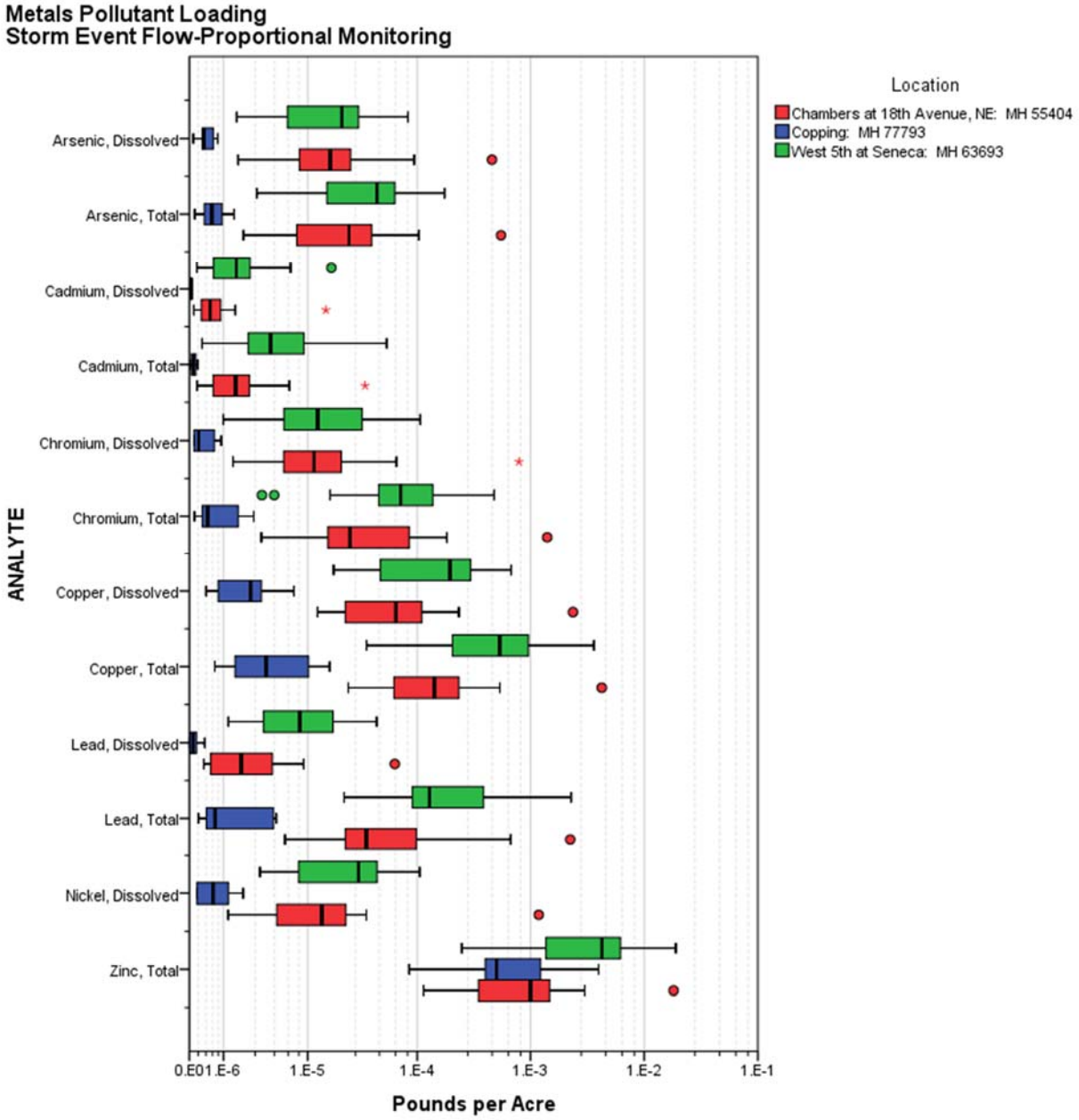

Metals Pollutant Loading
Storm Event Flow-Proportional Monitoring
Location
Chambers at 18th Avenue, NE: MH 55404
Copping: MH 77793
West 5th at Seneca: MH 63693
ANALYTE
Arsenic, Dissolved
Arsenic, Total
Cadmium, Dissolved
Cadmium, Total
Chromium, Dissolved
Chromium, Total
Copper, Dissolved
Copper, Total
Lead, Dissolved
Lead, Total
Nickel, Dissolved
Zinc, Total
0.E01.E-6
1.E-5
1.E-4
1.E-3
1.E-2
1.E-1
Pounds per Acre

Figure B.23

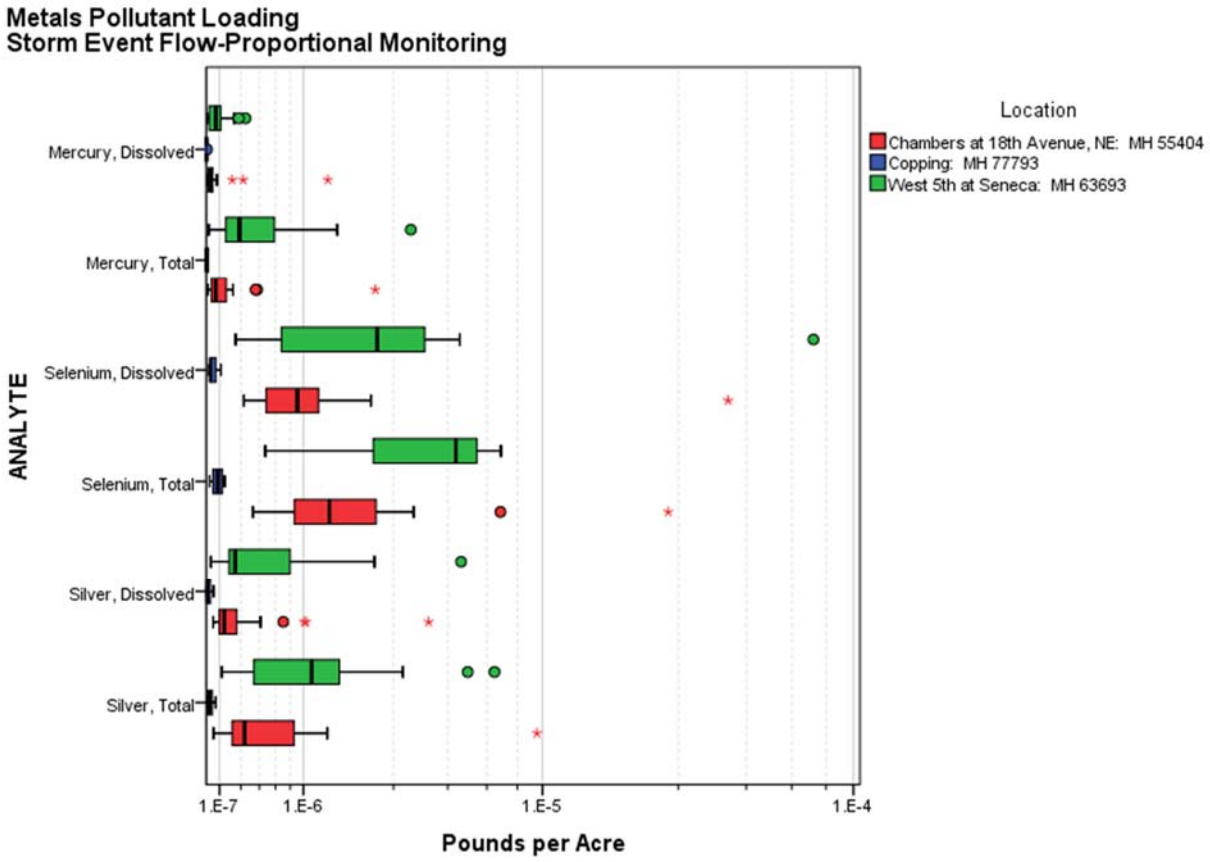


Figure B.24

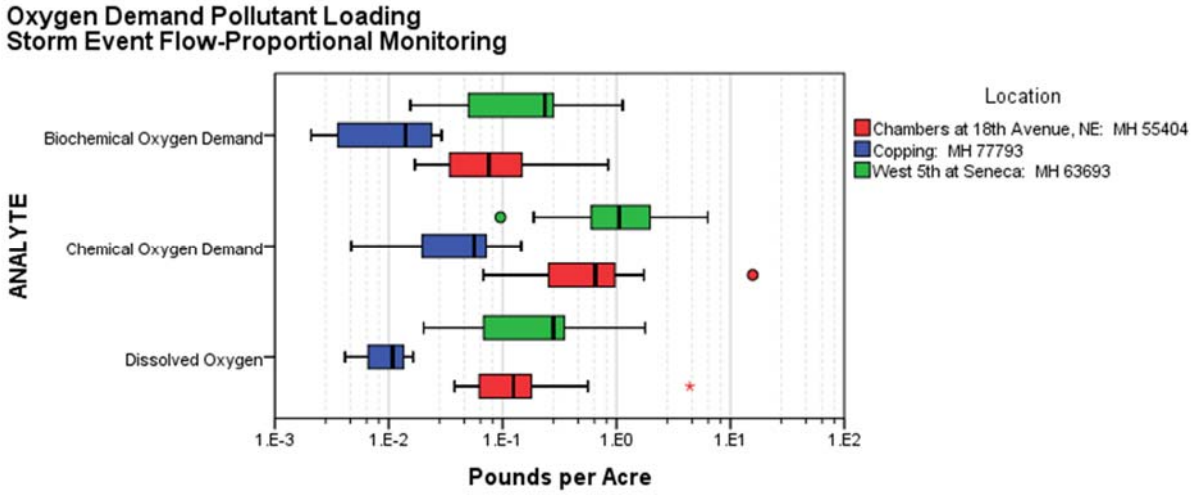


Figure B.25

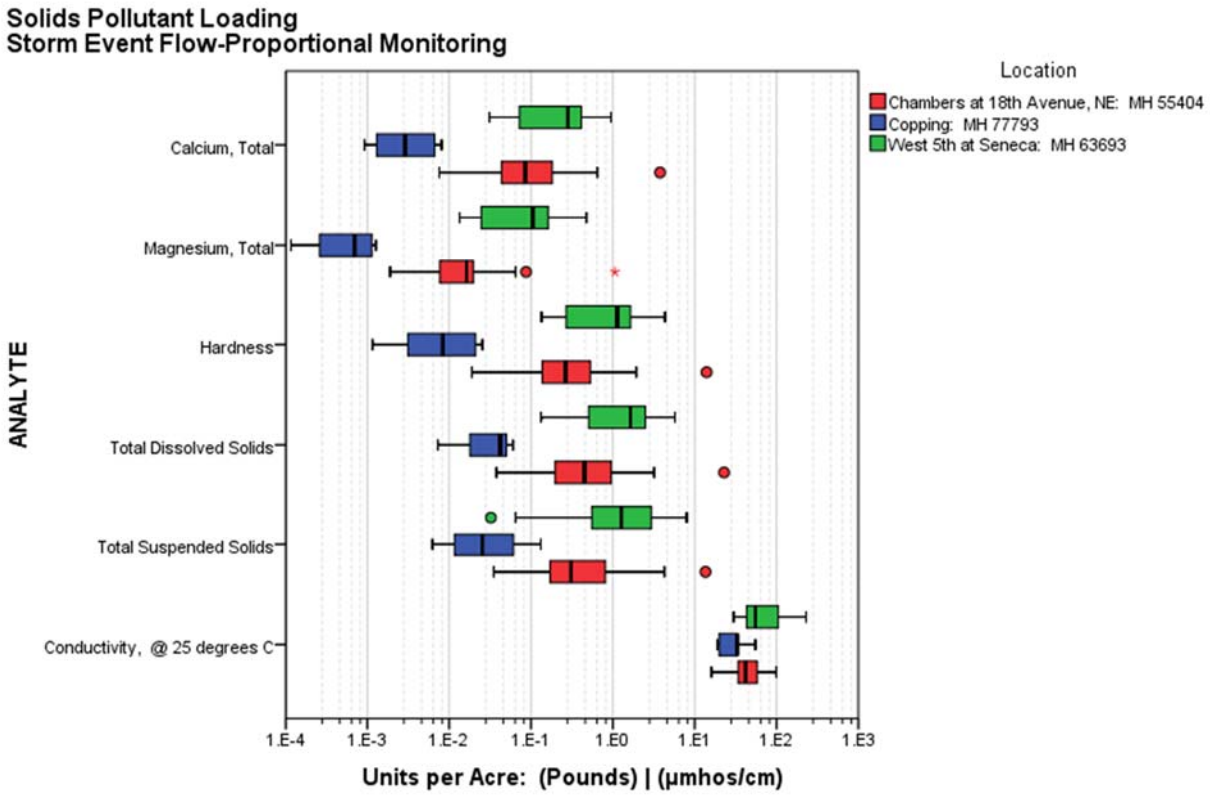


Figure B.26

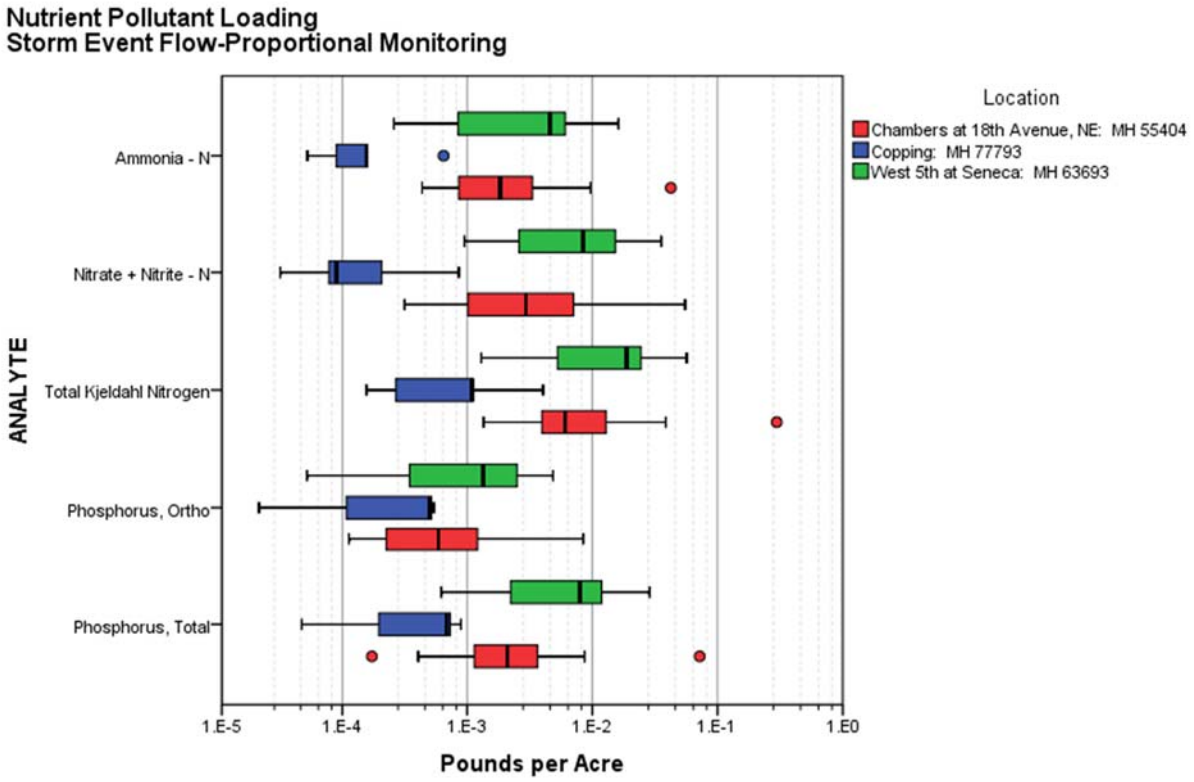


Figure B.27

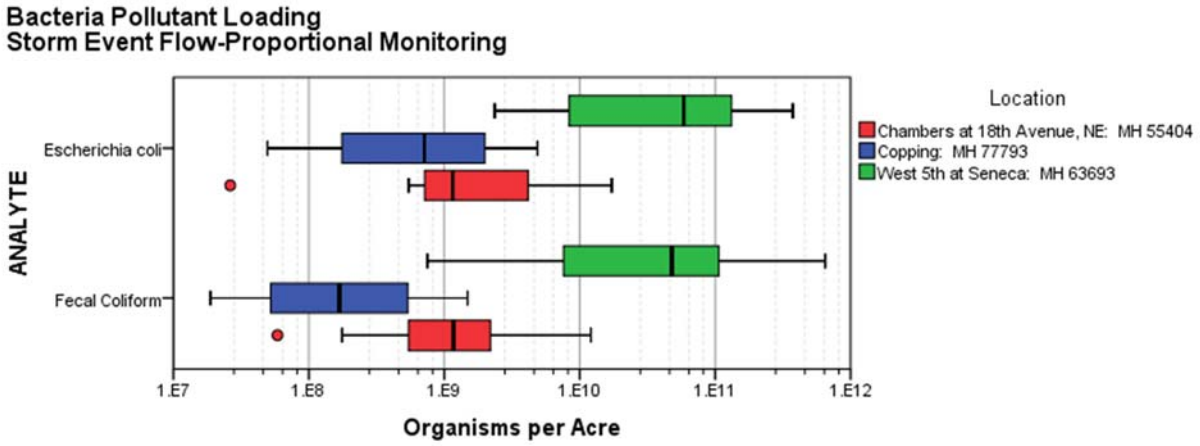


Figure B.28

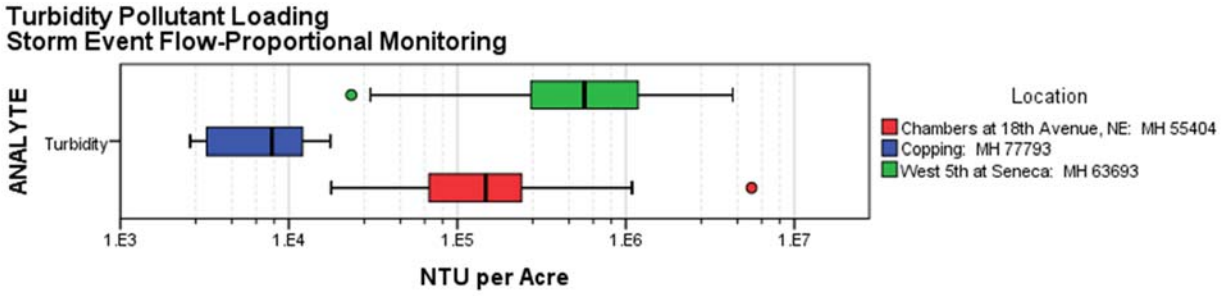


Figure B.29

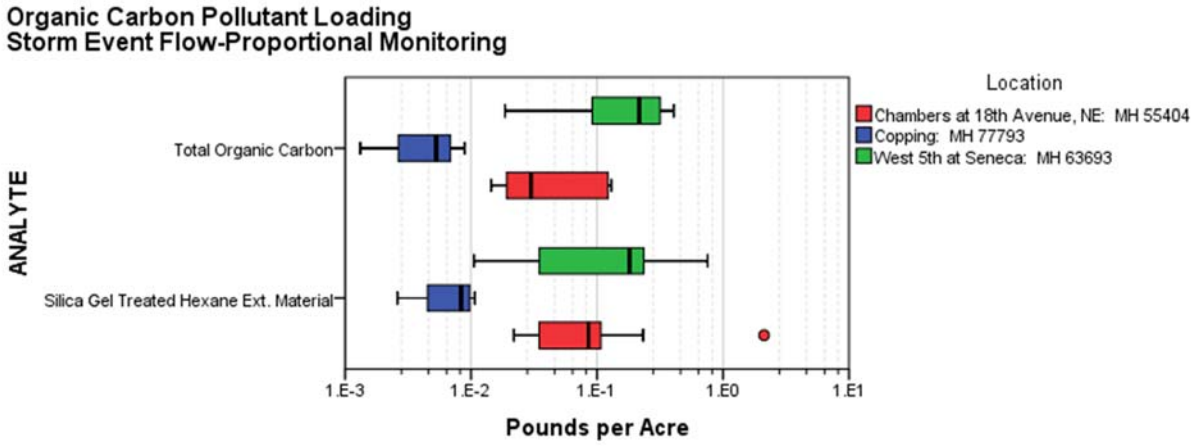


Figure B.30

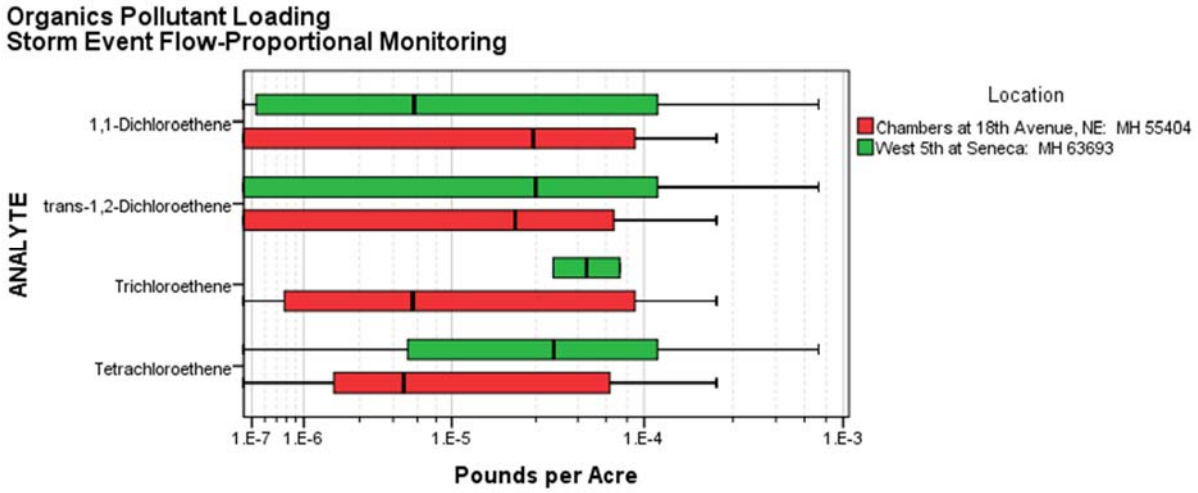


Figure B.31

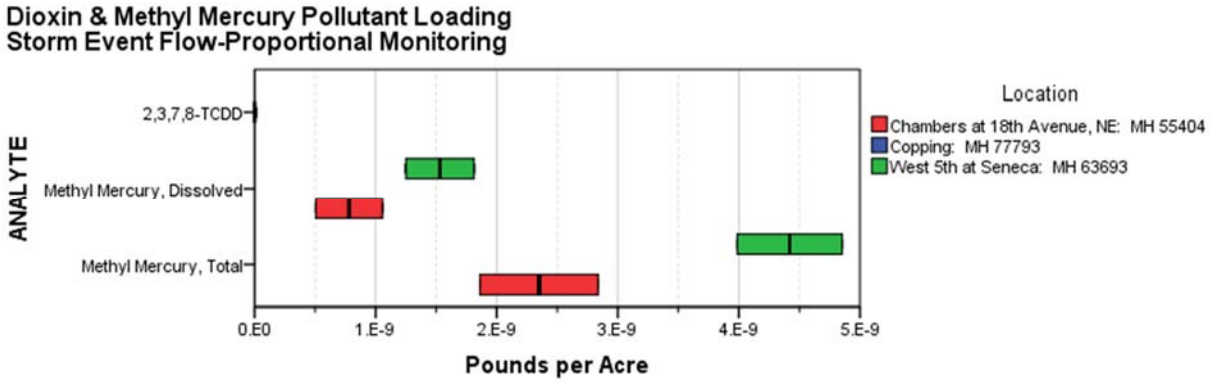


Figure B.32

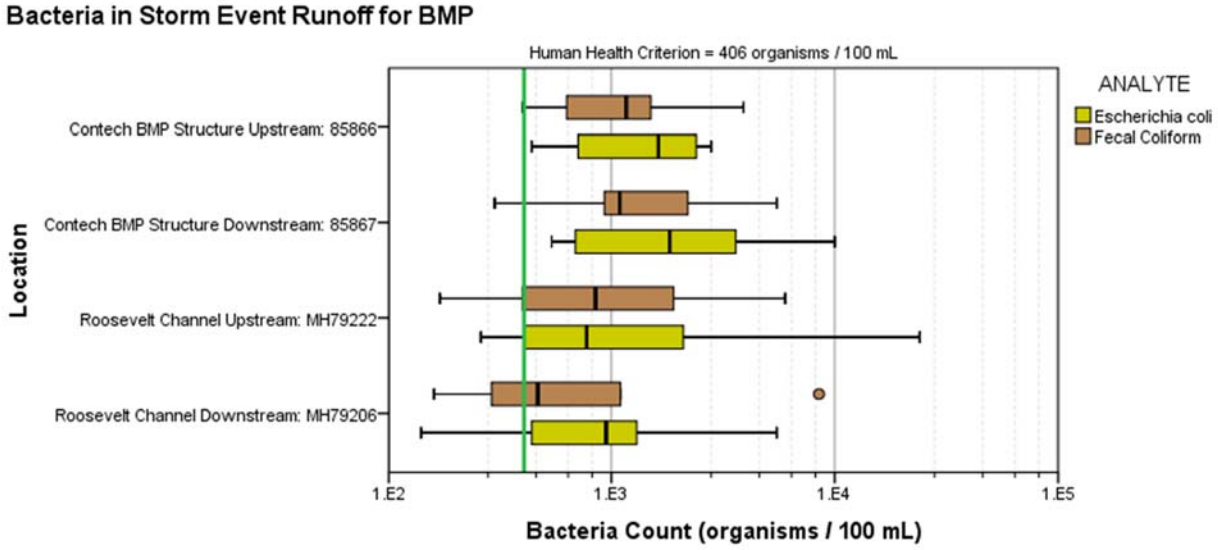


Figure B.33

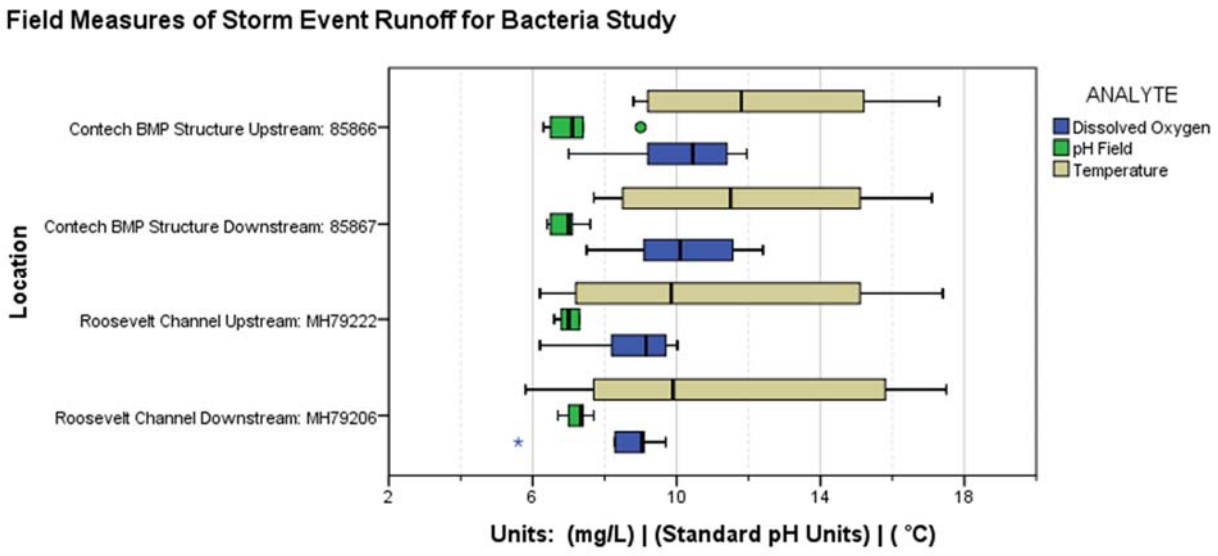

Field Measures of Storm Event Runoff for Bacteria Study
Contech BMP Structure Upstream: 85866
Contech BMP Structure Downstream: 85867
Roosevelt Channel Upstream: MH79222
Roosevelt Channel Downstream: MH79206
Location
2
6
10
14
18
Units: (mg/L) | (Standard pH Units) | (°C)
ANALYTE
Dissolved Oxygen
pH Field
Temperature

Figure B.34
Willow Creek Near 18th Avenue
Trend for Dissolved Lead

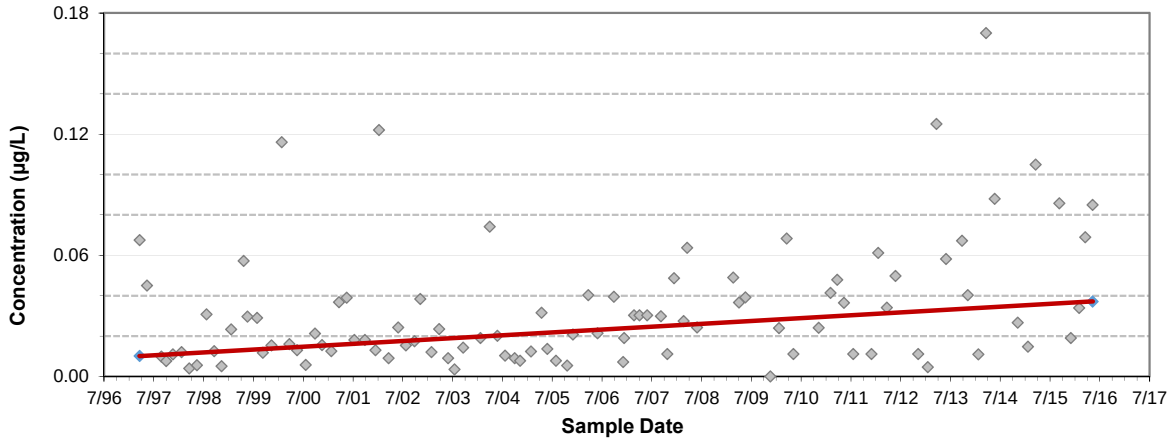


Figure B.35
Willow Creek Near 18th Avenue
Trend for Dissolved Zinc

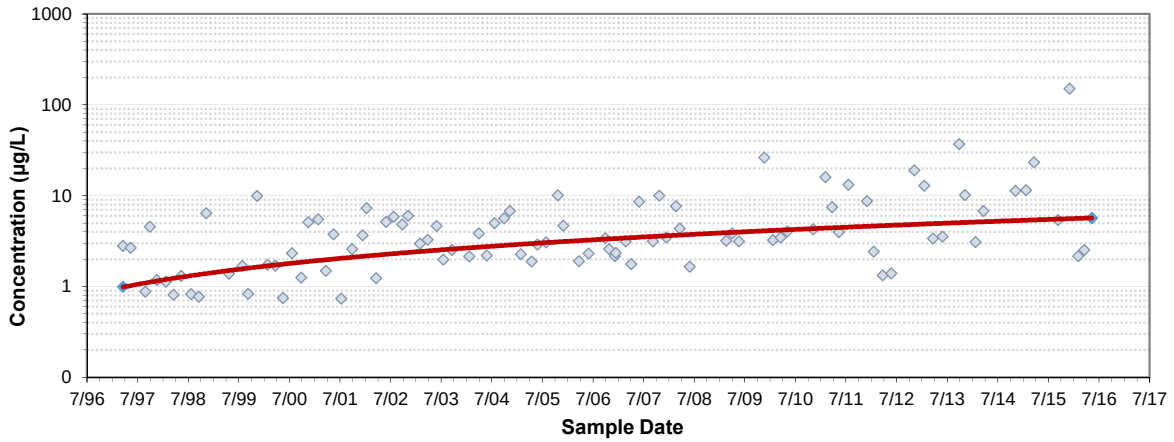


Figure B.36
Willow Creek Near 18th Avenue
Trend for Total Zinc

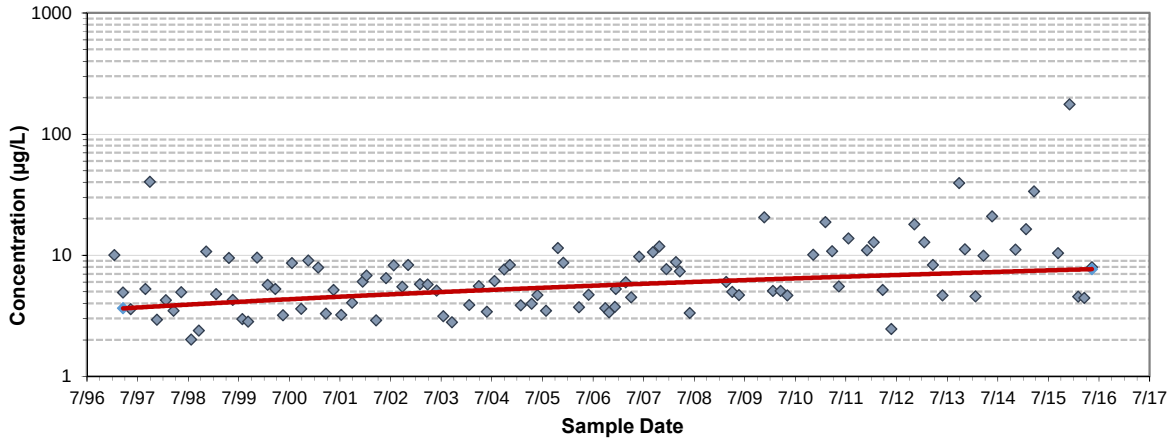


Figure B.37
Willow Creek Near 18th Avenue
Trend for Dissolved Oxygen

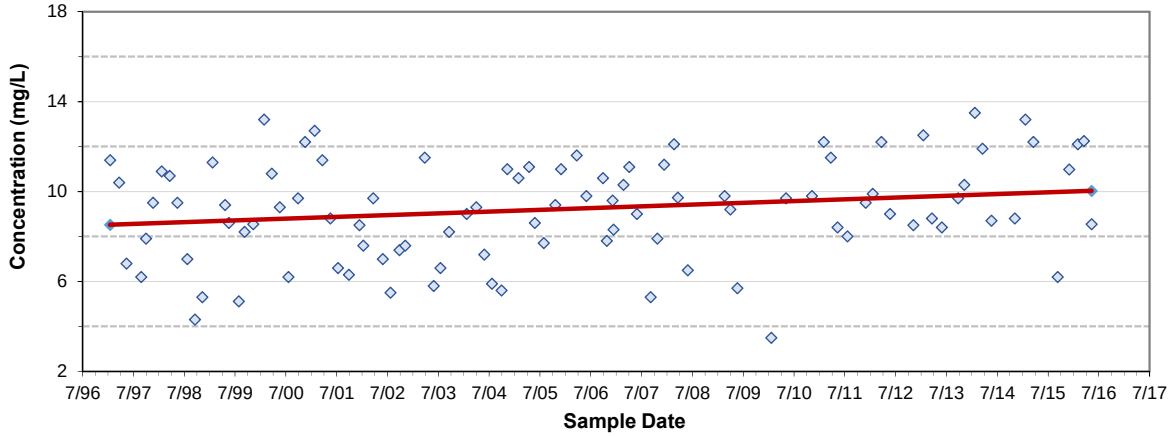


Figure B.38
Willow Creek Near 18th Avenue
Trend for Total Kjeldahl Nitrogen

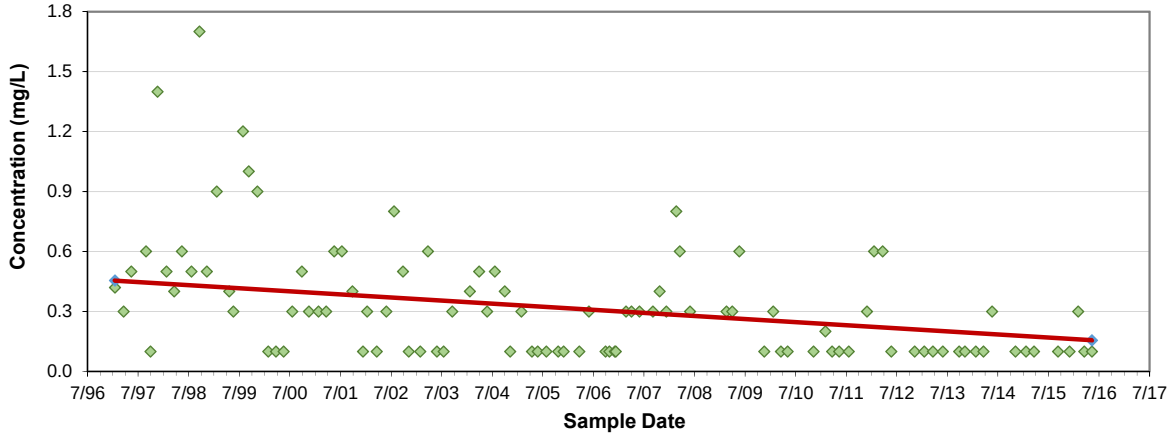


Figure B.39
Amazon Creek at 29th Avenue
Trend for Total Chromium

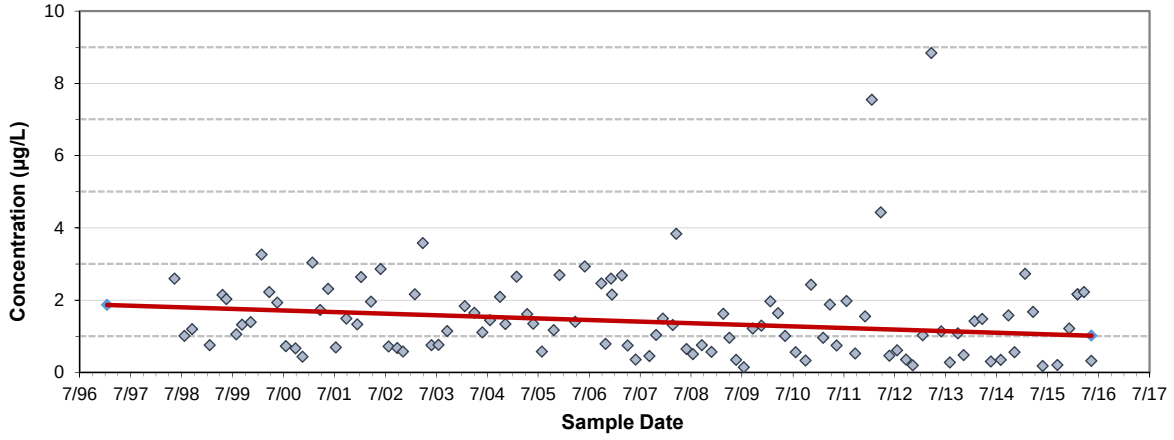


Figure B.40
Amazon Creek at 29th Avenue
Trend for Dissolved Mercury

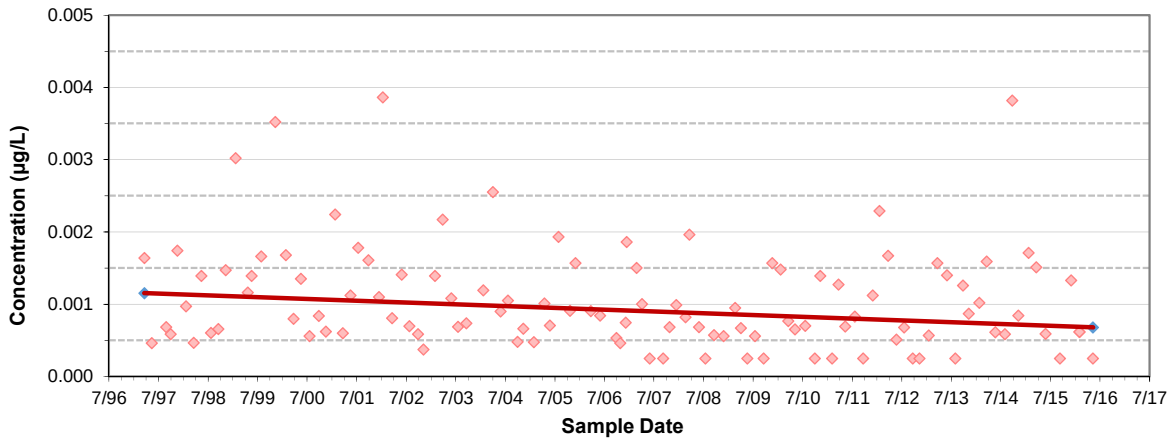


Figure B.41
Amazon Creek at 29th Avenue
Trend for Total Mercury

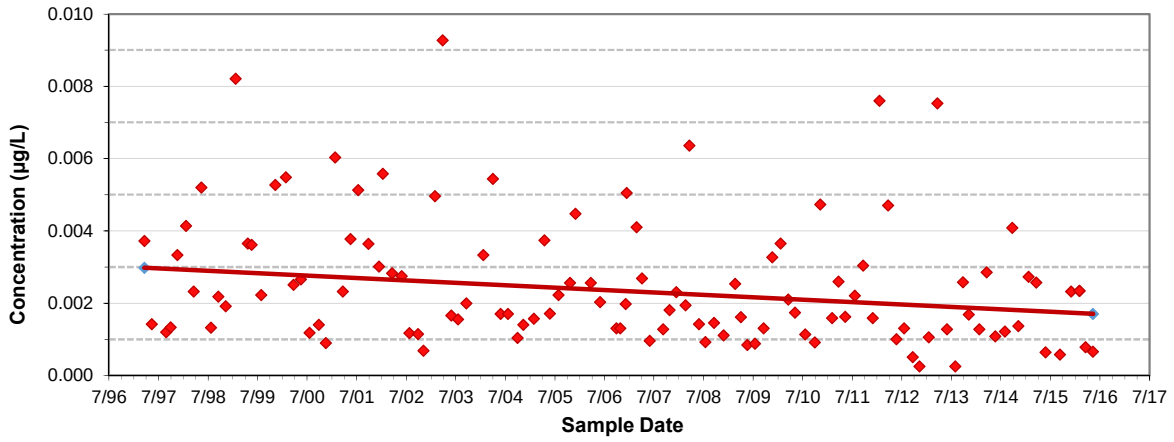


Figure B.42
Amazon Creek at 29th Avenue
Trend for Total Nickel

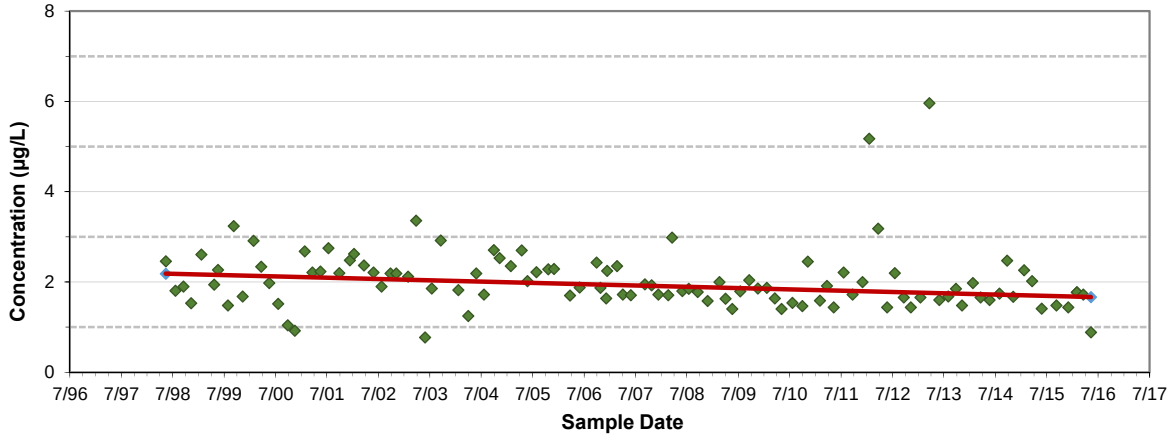


Figure B.43
Amazon Creek at 29th Avenue
Trend for Total Lead

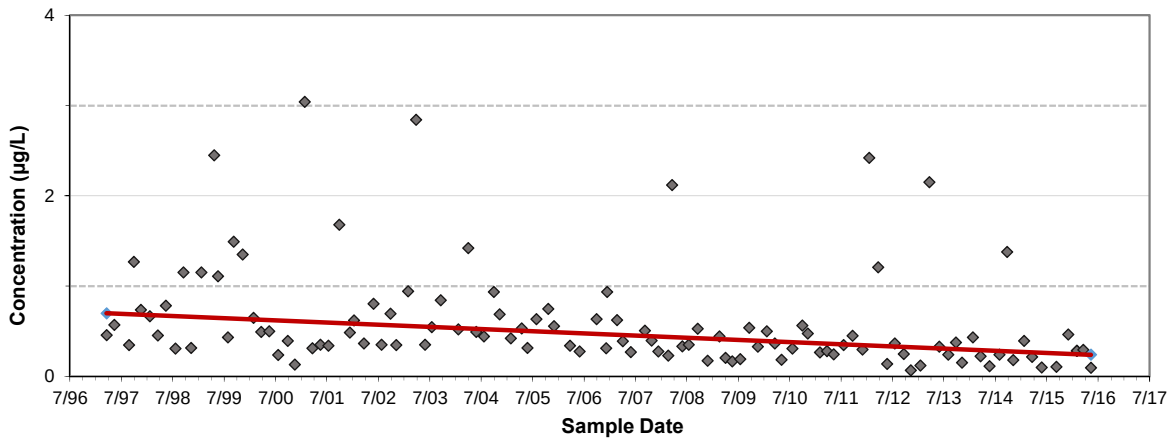


Figure B.44
Amazon Creek at 29th Avenue
Trend for Dissolved Zinc

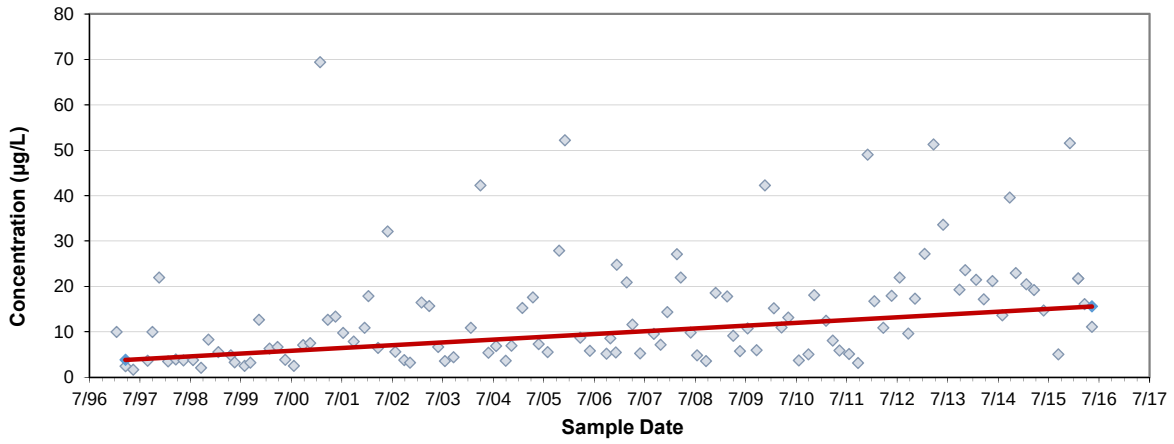


Figure B.45
Amazon Creek at 29th Avenue
Trend for Total Zinc

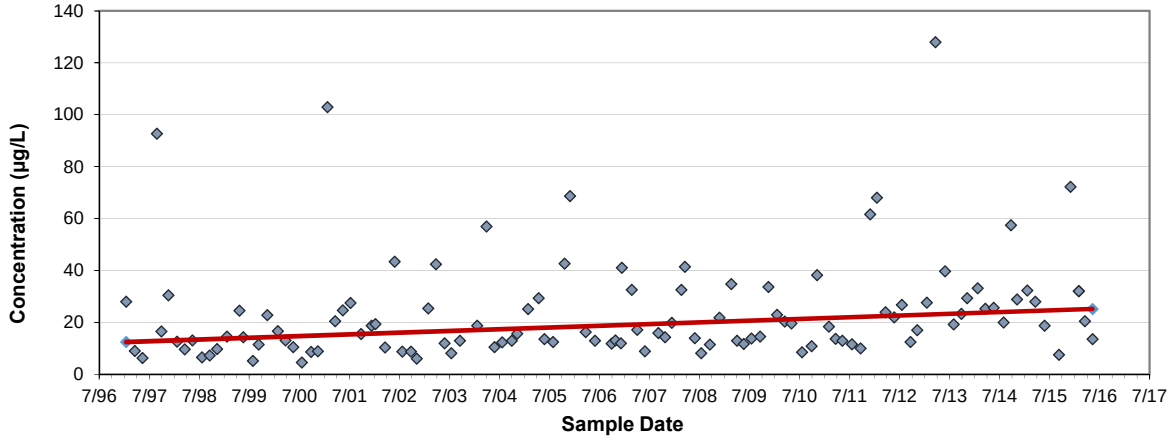


Figure B.46
Amazon Creek at Railroad Crossing
Trend for Dissolved Chromium

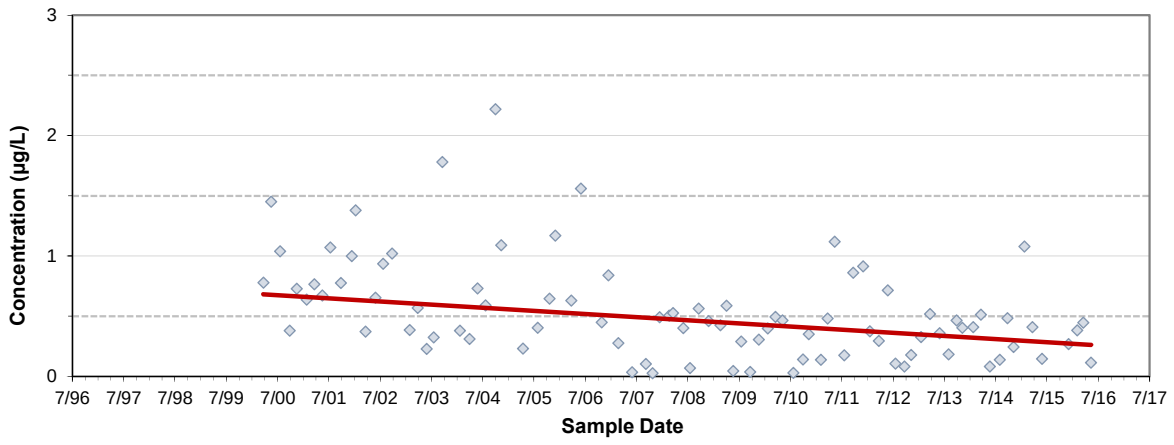


Figure B.47
Amazon Creek at Railroad Crossing
Trend for Total Chromium

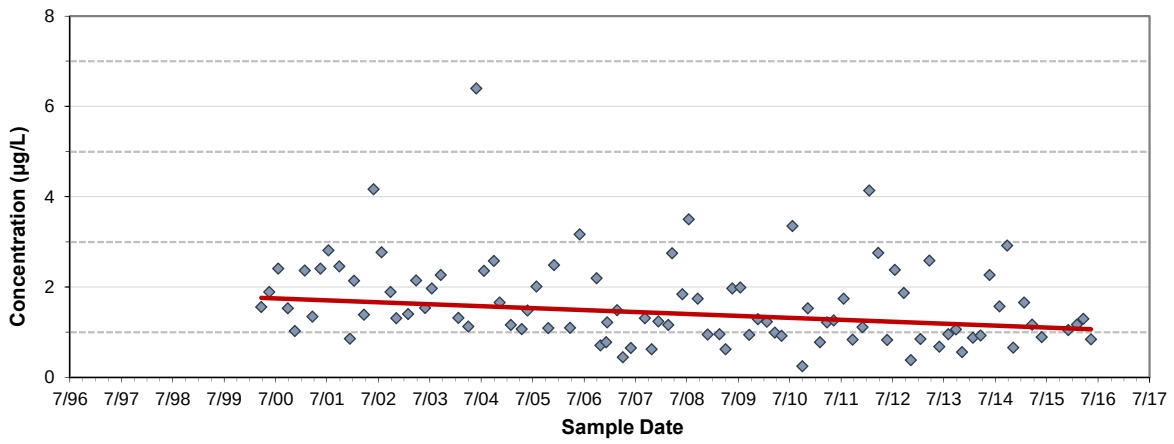


Figure B.48
Amazon Creek at Railroad Crossing
Trend for Dissolved Mercury

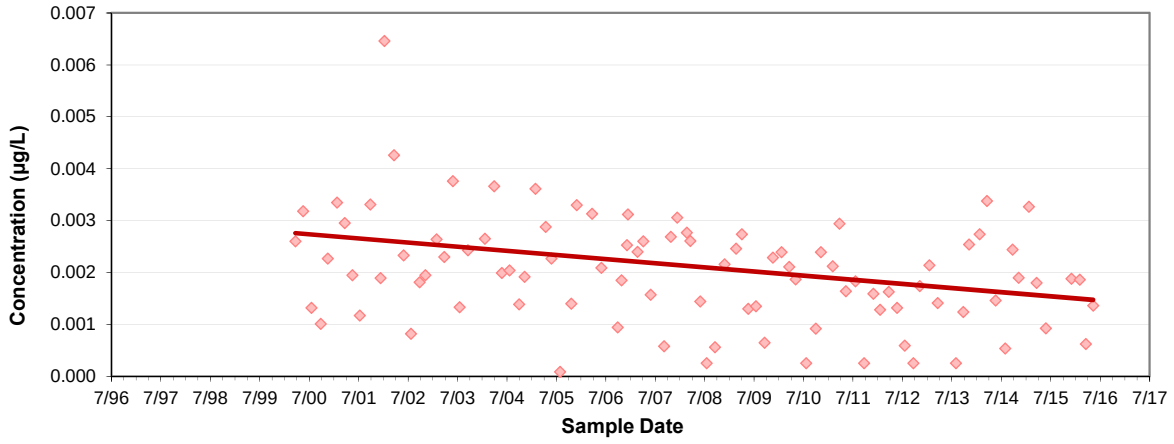


Figure B.49
Amazon Creek at Railroad Crossing
Trend for Total Mercury

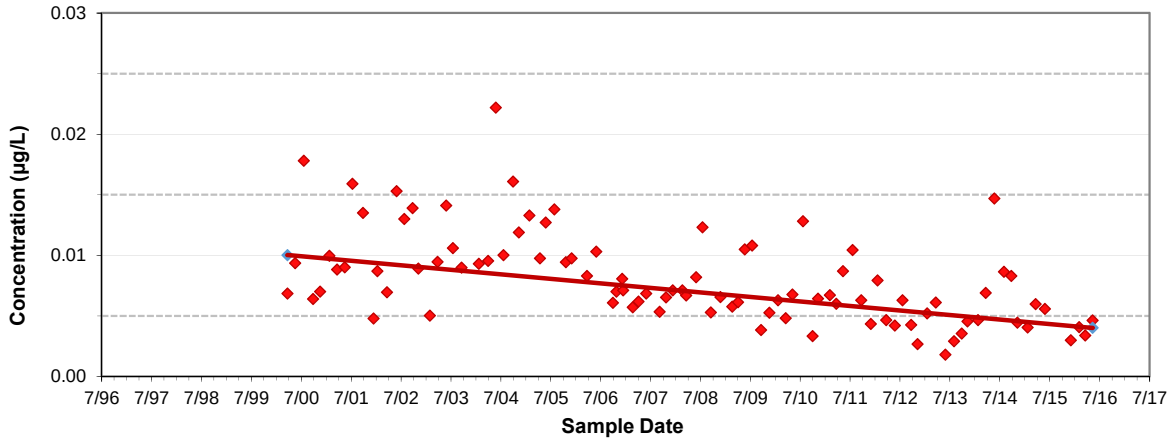


Figure B.50
Amazon Creek at Railroad Crossing
Trend for Dissolved Nickel

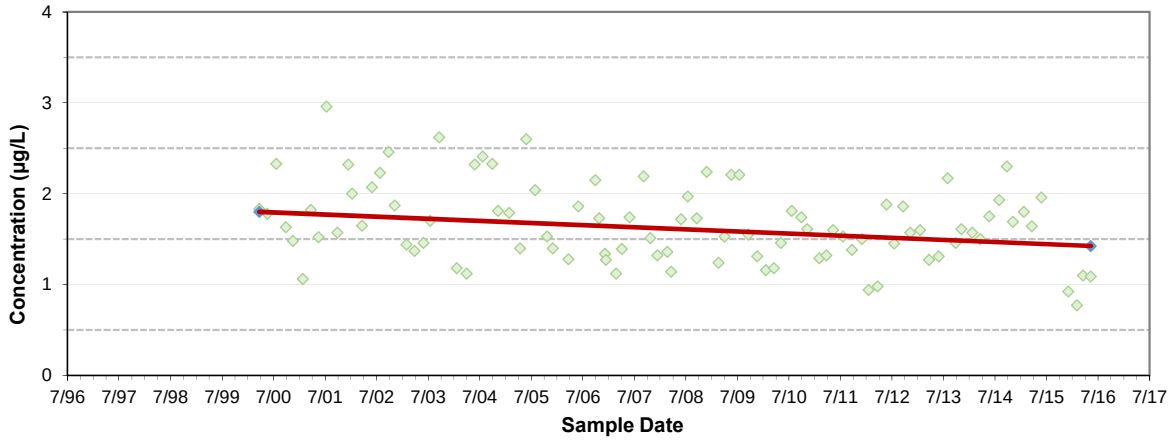


Figure B.51
Amazon Creek at Railroad Crossing
Trend for Total Nickel

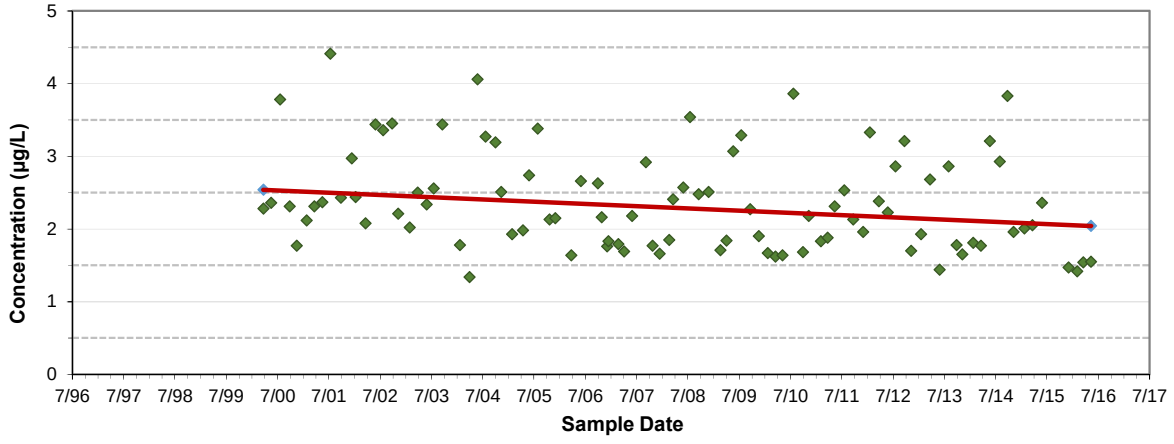


Figure B.52
Amazon Creek at Railroad Crossing
Trend for Total Lead

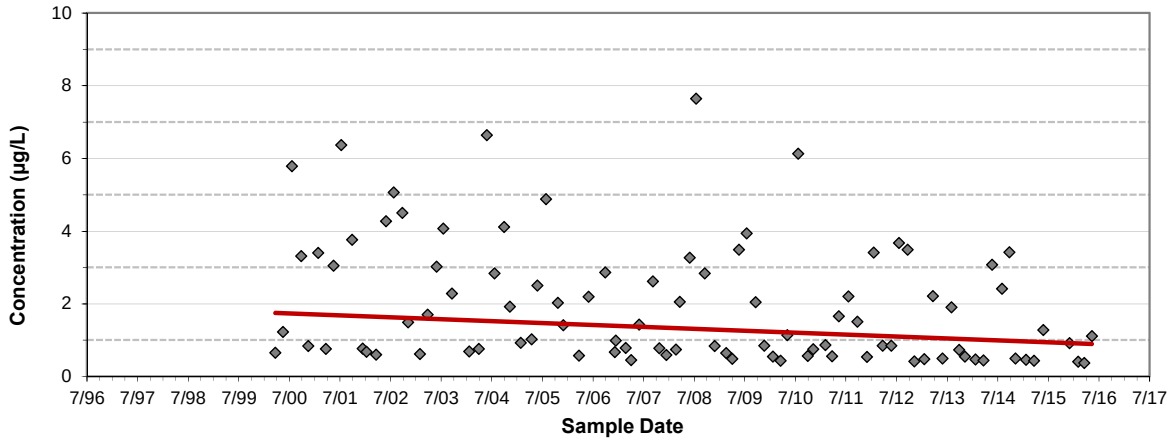


Figure B.53
Amazon Creek at Railroad Crossing
Trend for Dissolved Zinc

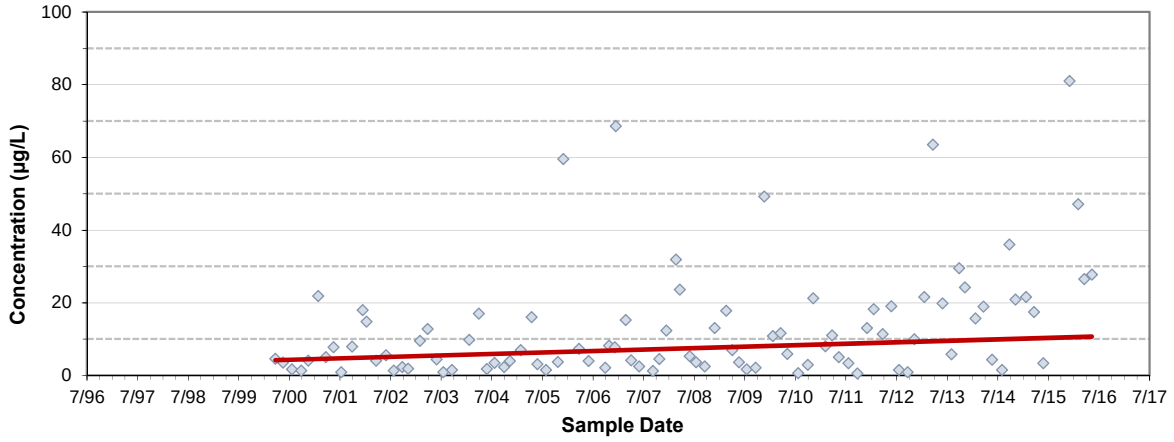


Figure B.54
Amazon Creek at Railroad Crossing
Trend for Total Zinc

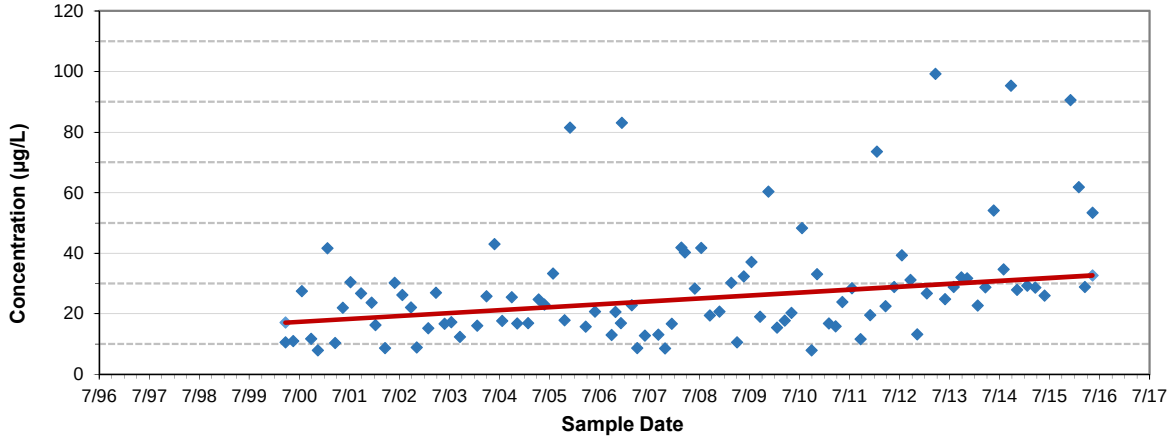


Figure B.55
Amazon Diversion Channel at Royal Avenue
Trend for Dissolved Arsenic

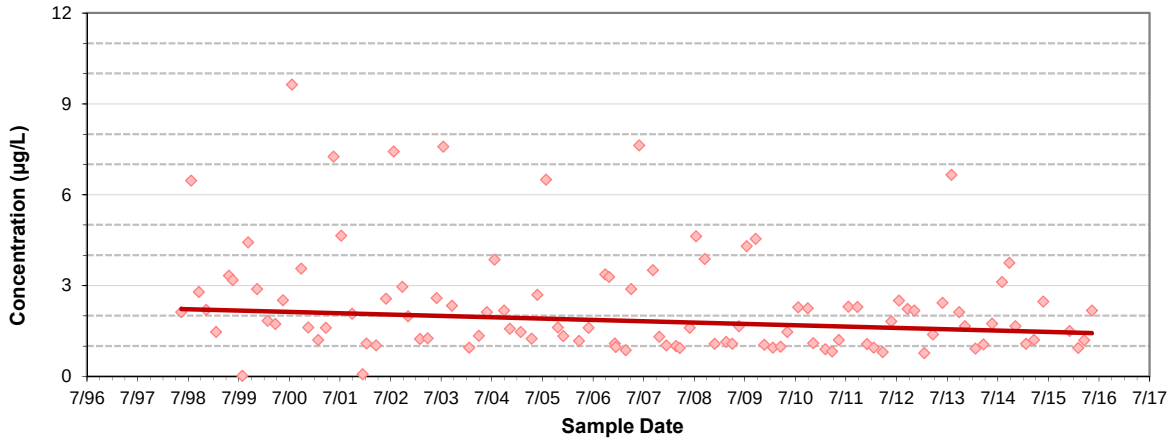


Figure B.56
Amazon Diversion Channel at Royal Avenue
Trend for Total Arsenic

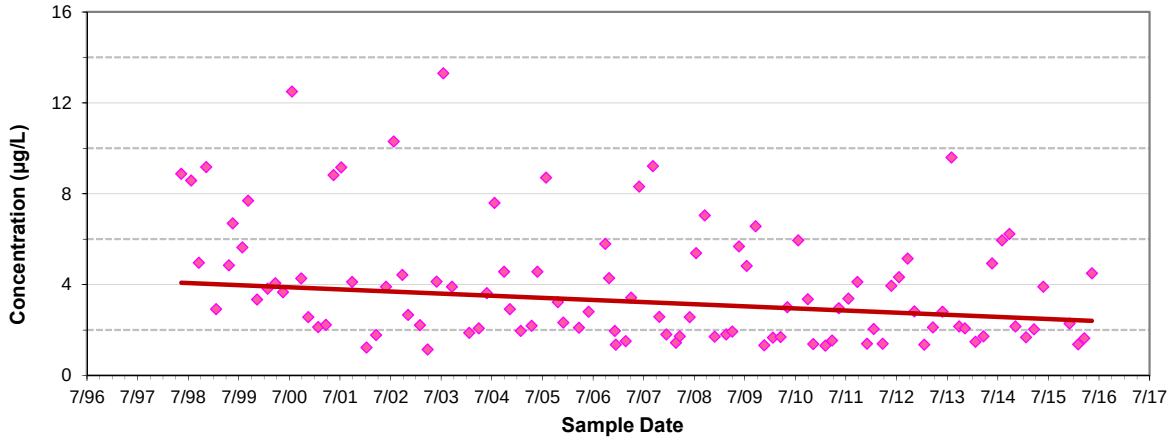


Figure B.57
Amazon Diversion Channel at Royal Avenue
Trend for Dissolved Mercury

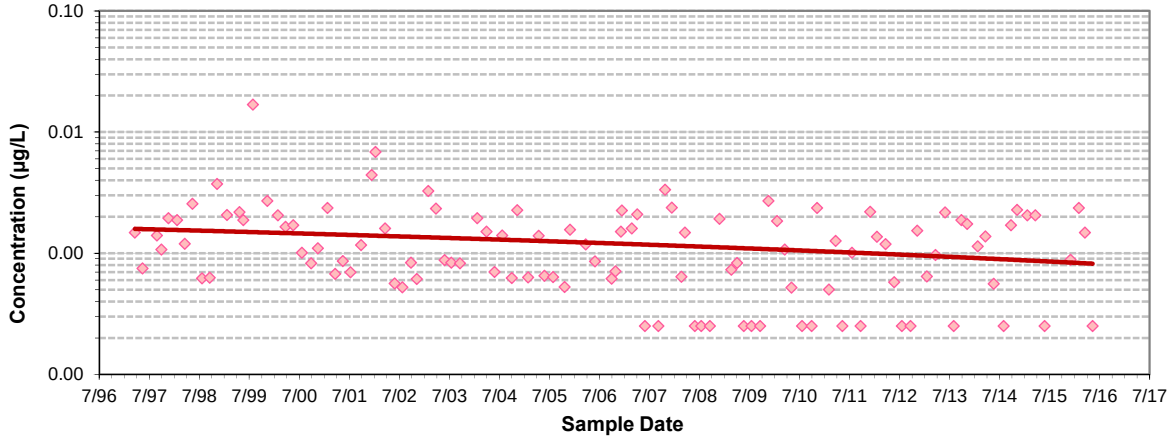


Figure B.58
Amazon Diversion Channel at Royal Avenue
Trend for Dissolved Molybdenum

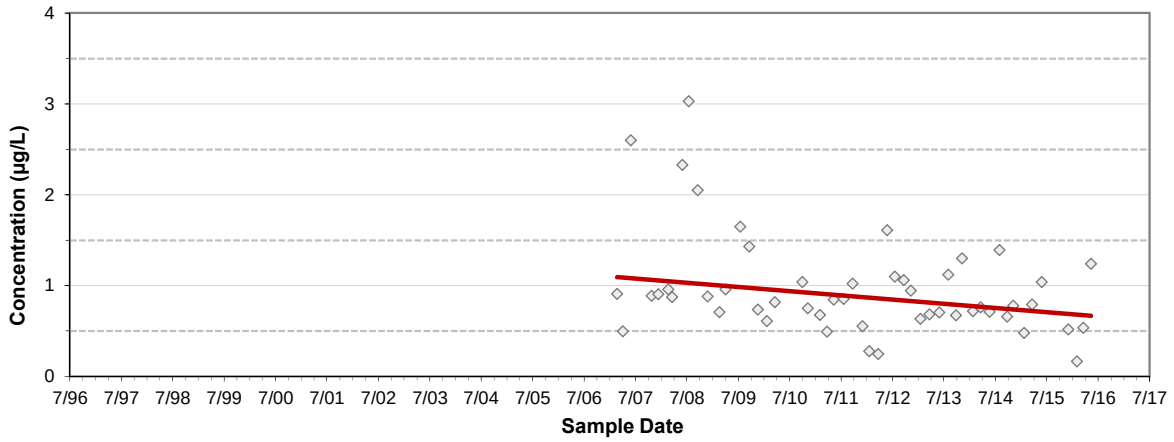


Figure B.59
Amazon Diversion Channel at Royal Avenue
Trend for Dissolved Nickel

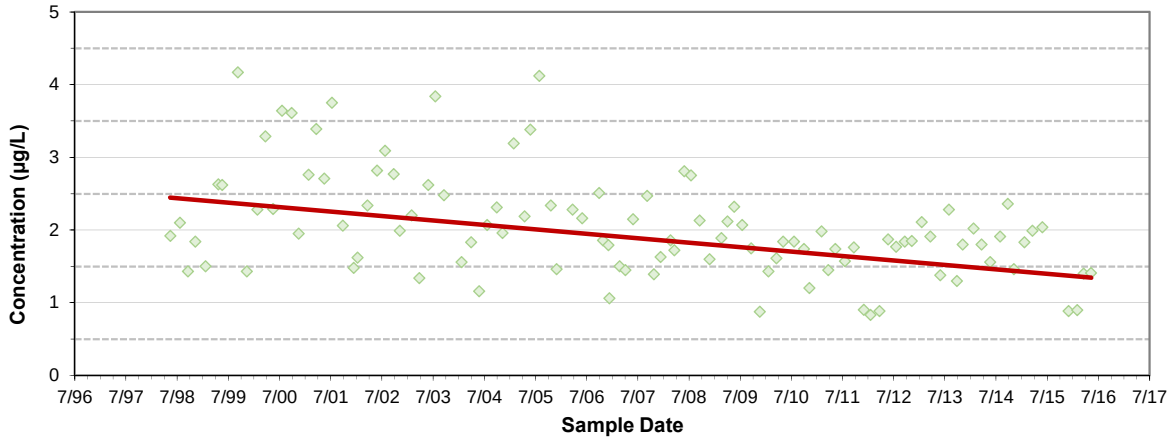


Figure B.60
Amazon Diversion Channel at Royal Avenue
Trend for Total Nickel

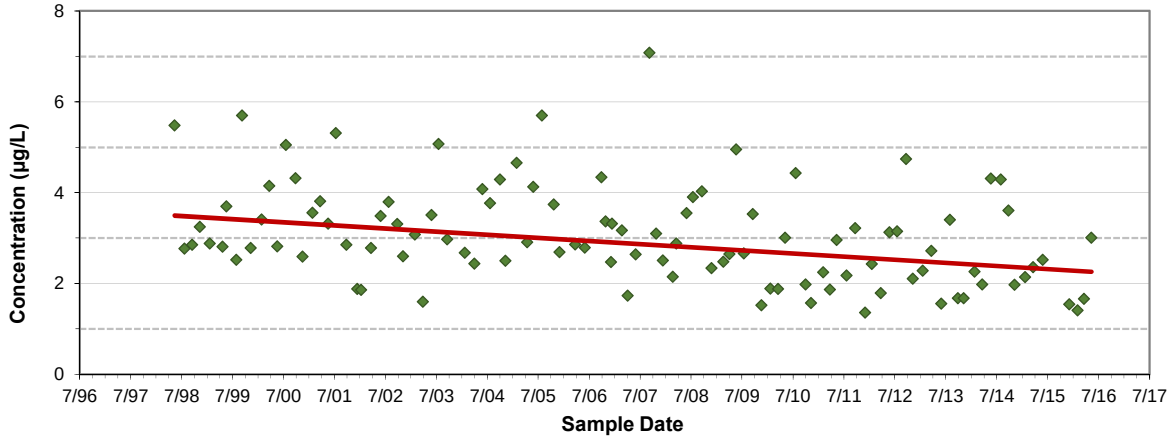


Figure B.61
Amazon Diversion Channel at Royal Avenue
Trend for Total Zinc

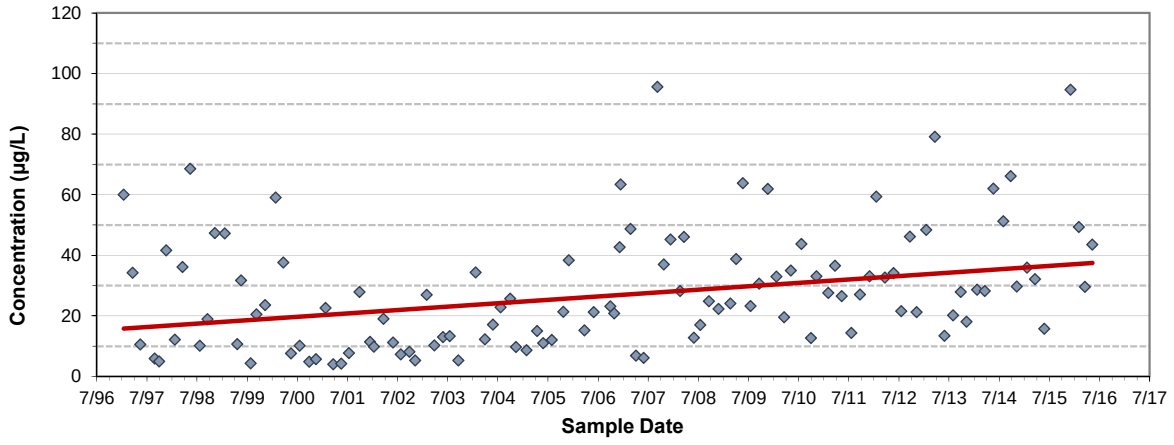


Figure B.62
Amazon Diversion Channel at Royal Avenue
Trend for Temperature

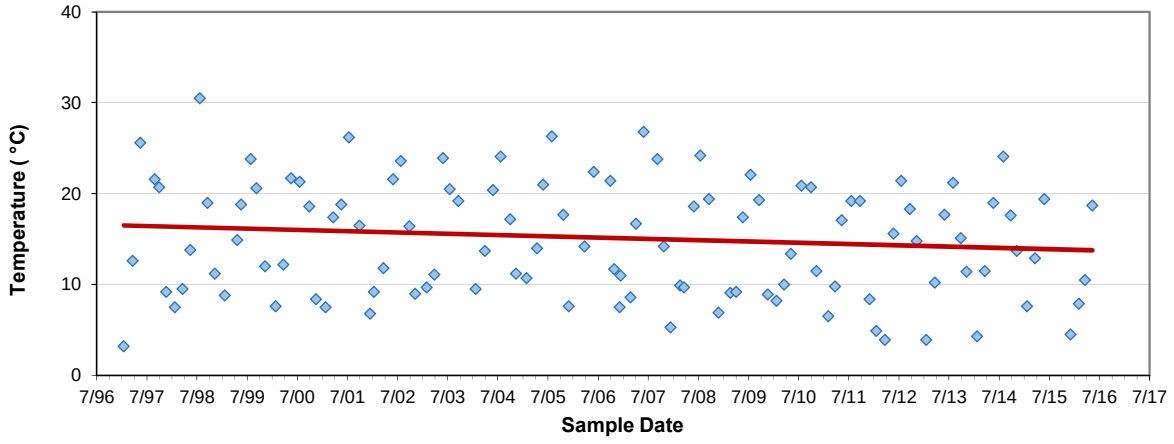


Figure B.63
Amazon Diversion Channel at Royal Avenue
Trend for Total Kjeldahl Nitrogen

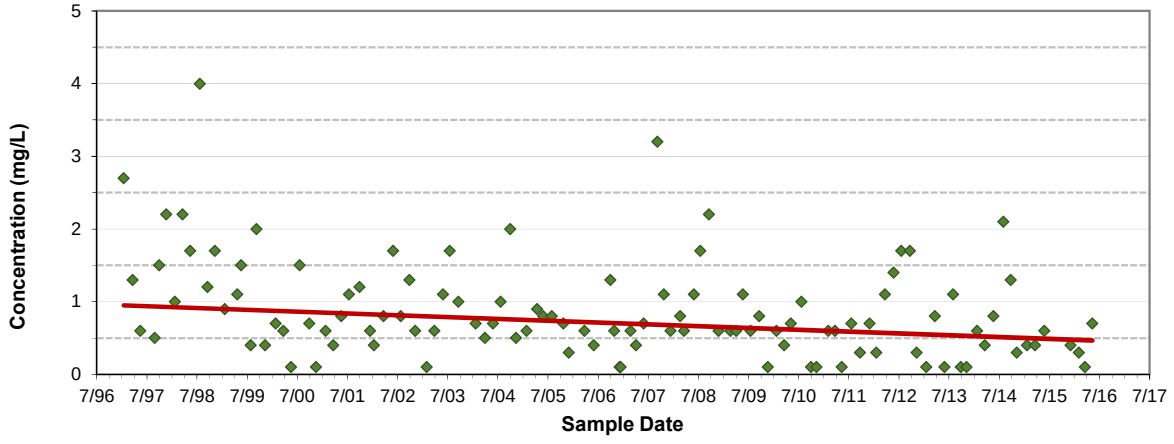


Figure B.64
A3 Channel at Terry Street
Trend for Dissolved Arsenic

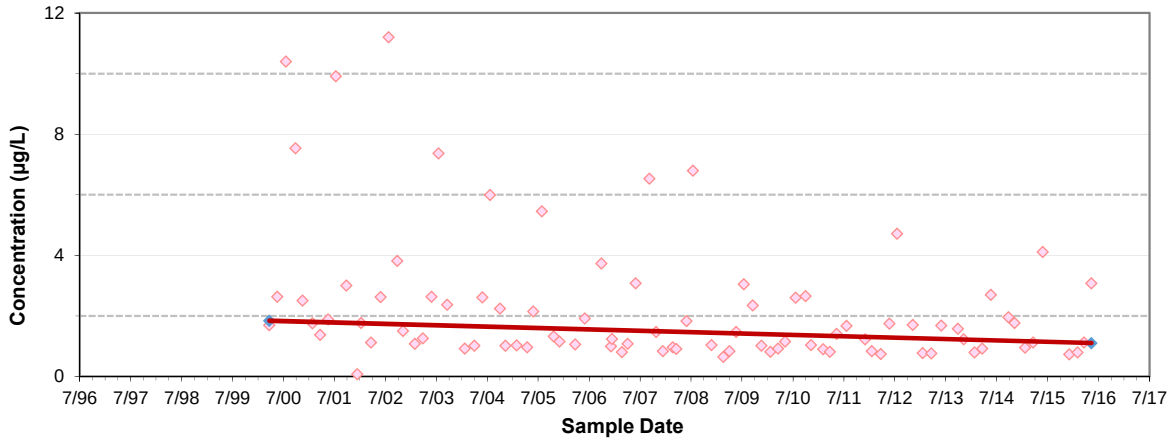


Figure B.65
A3 Channel at Terry Street
Trend for Total Arsenic

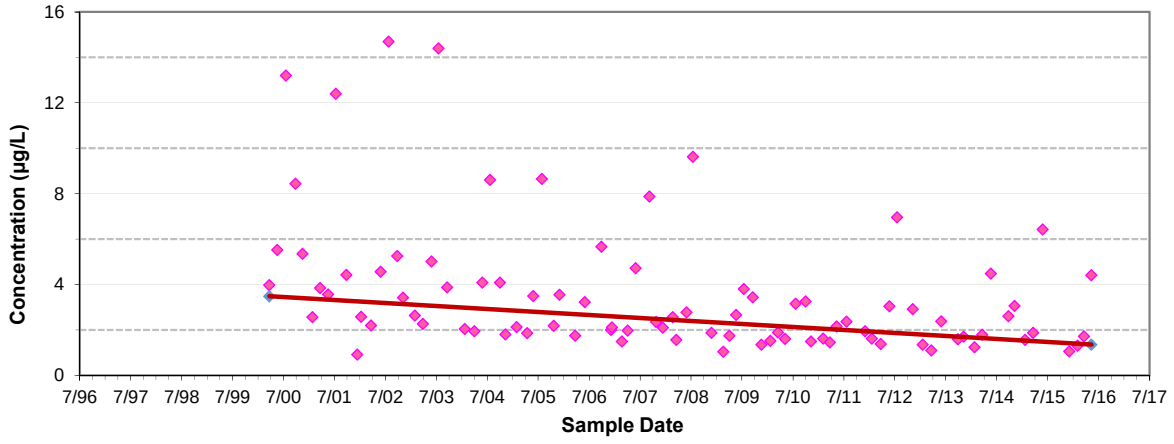


Figure B.66
A3 Channel at Terry Street
Trend for Total Cadmium

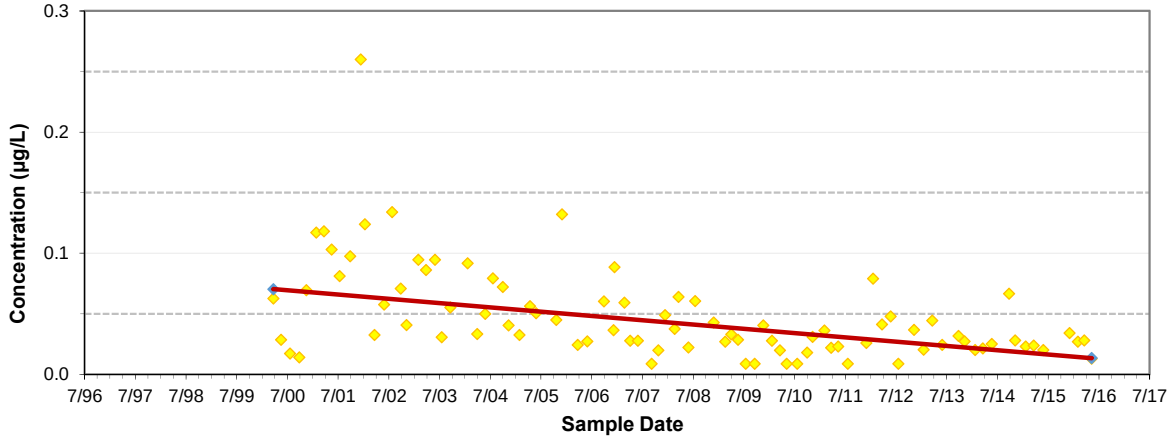


Figure B.67
A3 Channel at Terry Street
Trend for Dissolved Chromium

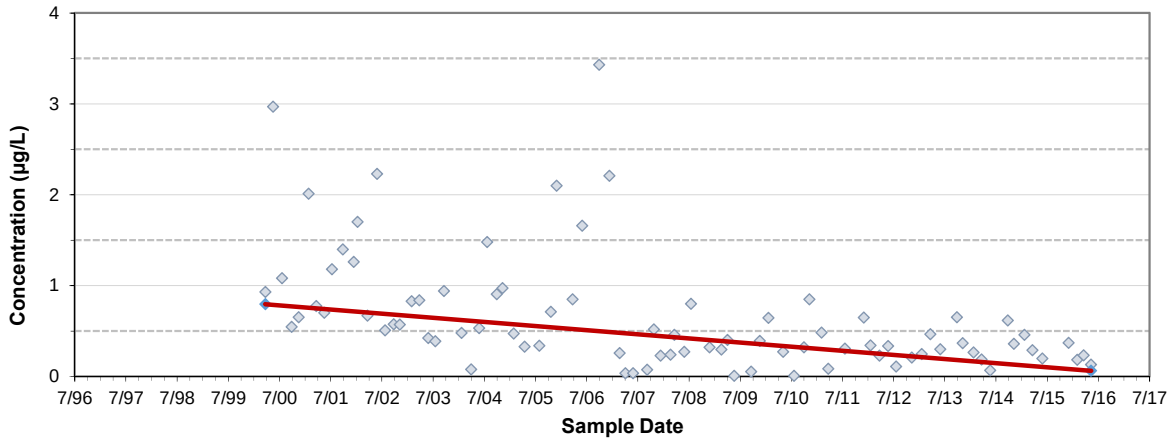


Figure B.68
A3 Channel at Terry Street
Trend for Total Chromium

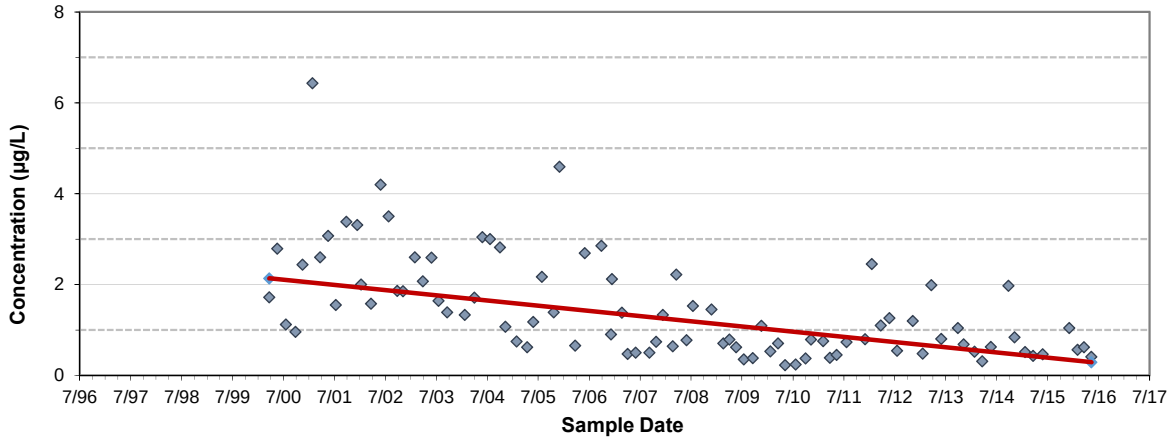


Figure B.69
A3 Channel at Terry Street
Trend for Total Copper

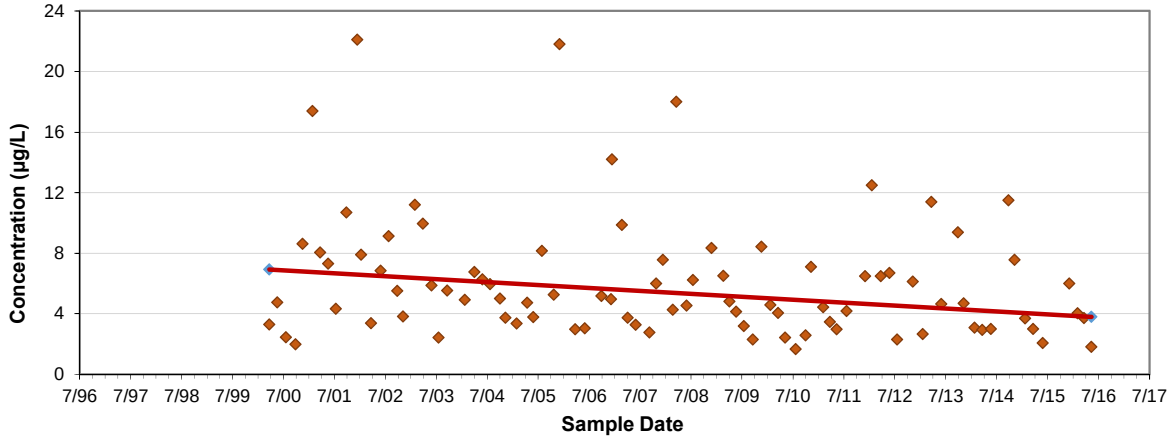


Figure B.70
A3 Channel at Terry Street
Trend for Dissolved Mercury

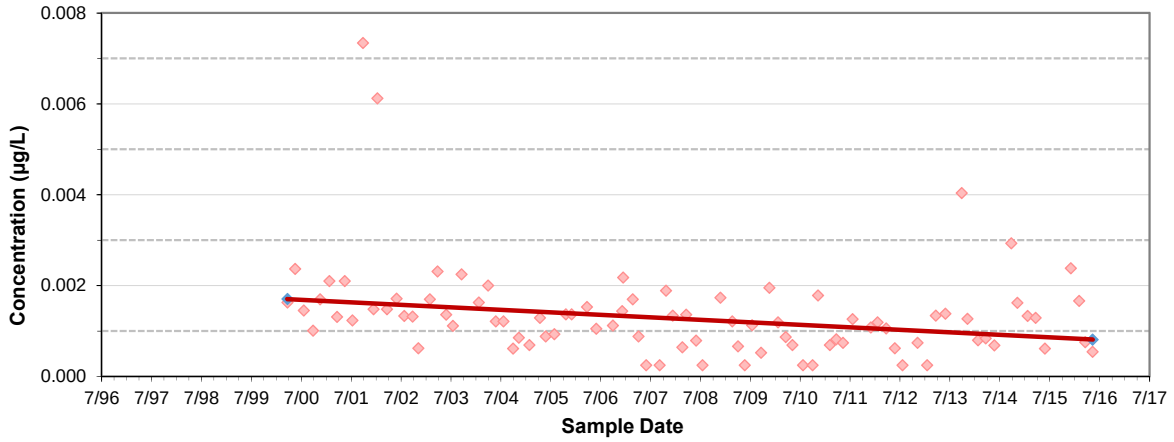


Figure B.71
A3 Channel at Terry Street
Trend for Total Mercury

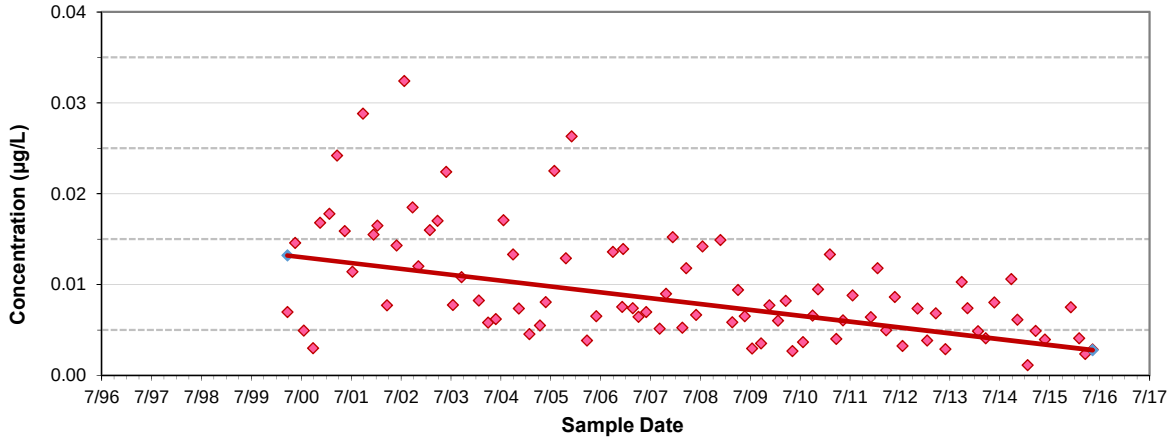


Figure B.72
A3 Channel at Terry Street
Trend for Dissolved Nickel

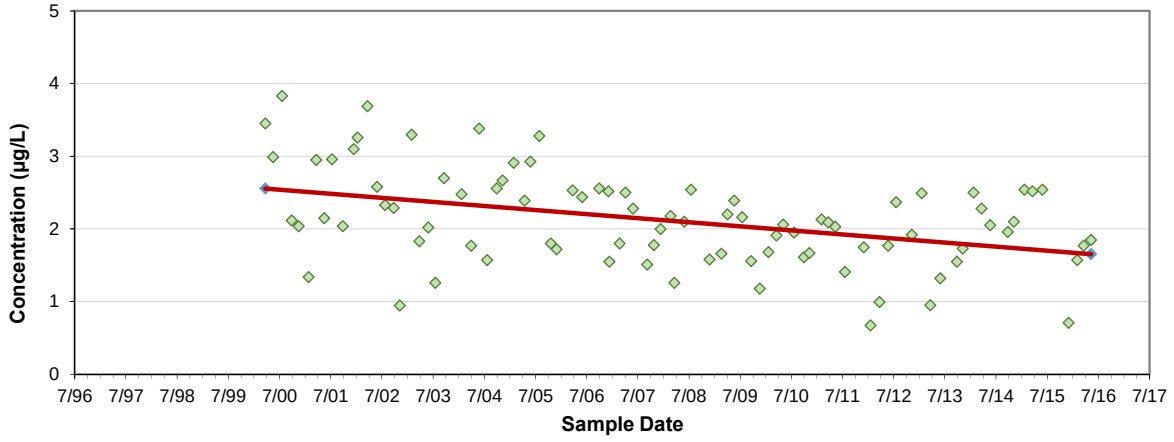


Figure B.73
A3 Channel at Terry Street
Trend for Total Nickel

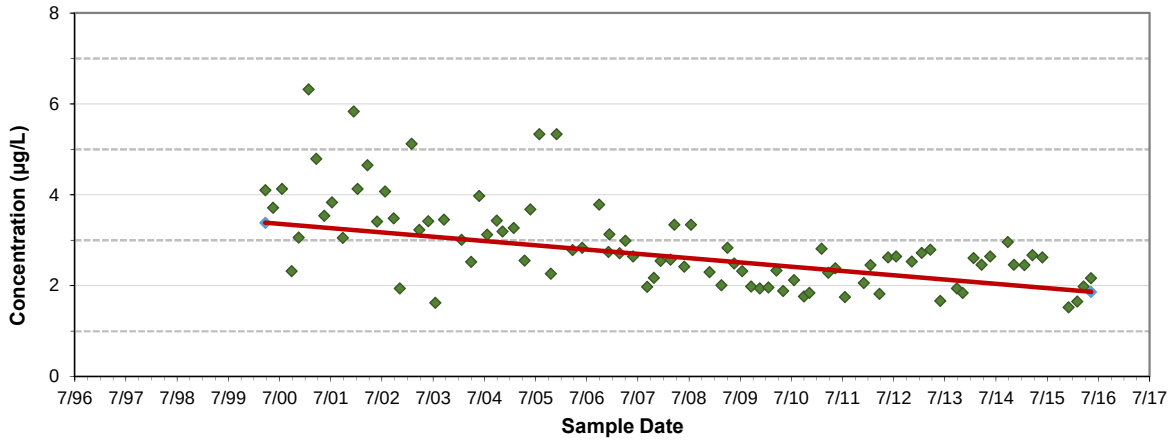


Figure B.74
A3 Channel at Terry Street
Trend for Total Lead

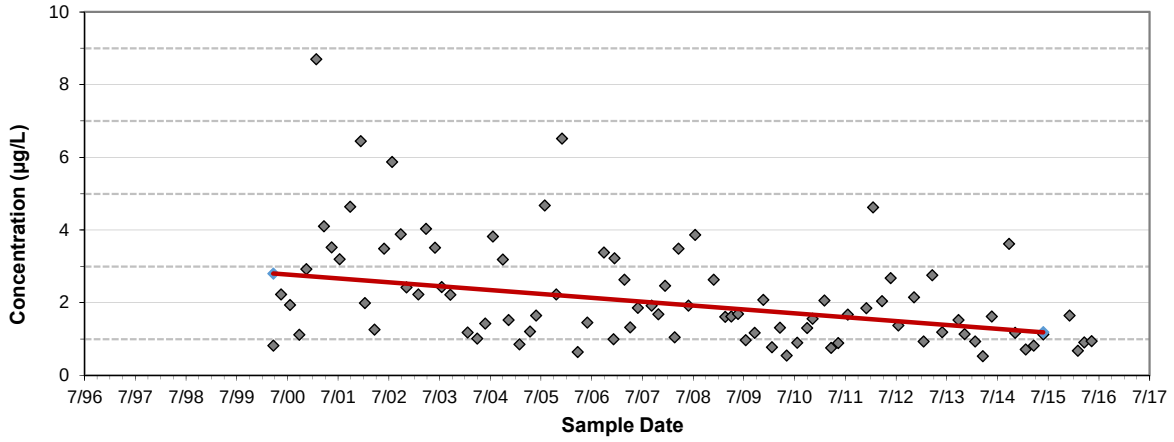


Figure B.75
A3 Channel at Terry Street
Trend for Total Phosphorus

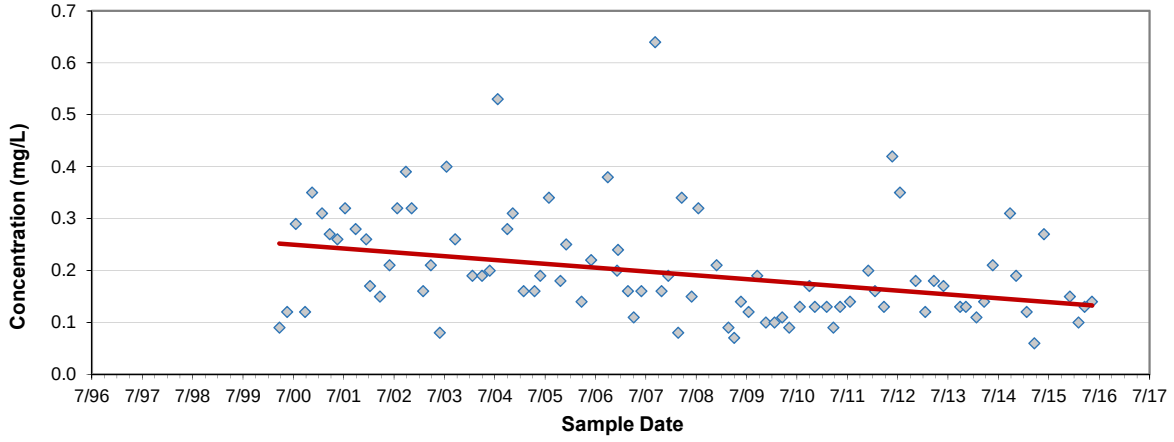


Figure B.76
A3 Channel at Terry Street
Trend for Temperature

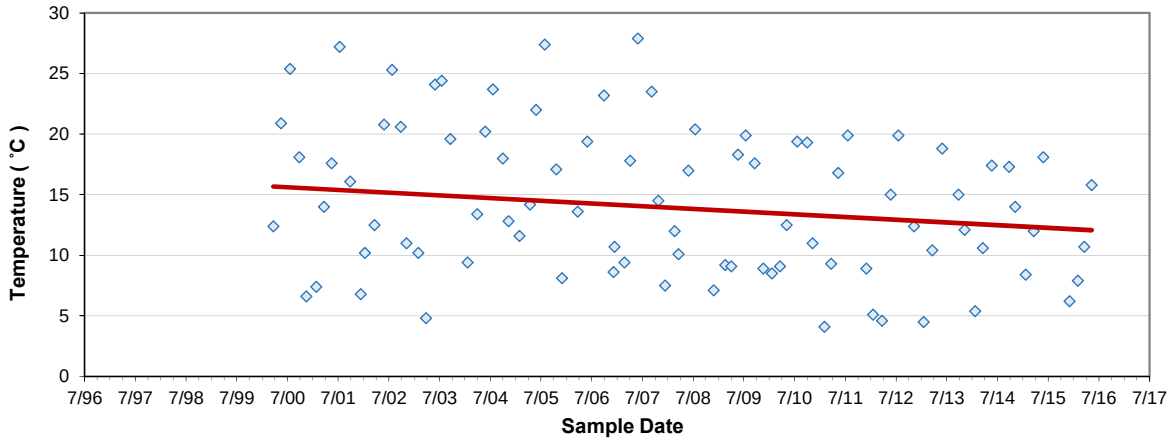


Figure B.77
A3 Channel at Terry Street
Trend for Total Kjeldahl Nitrogen

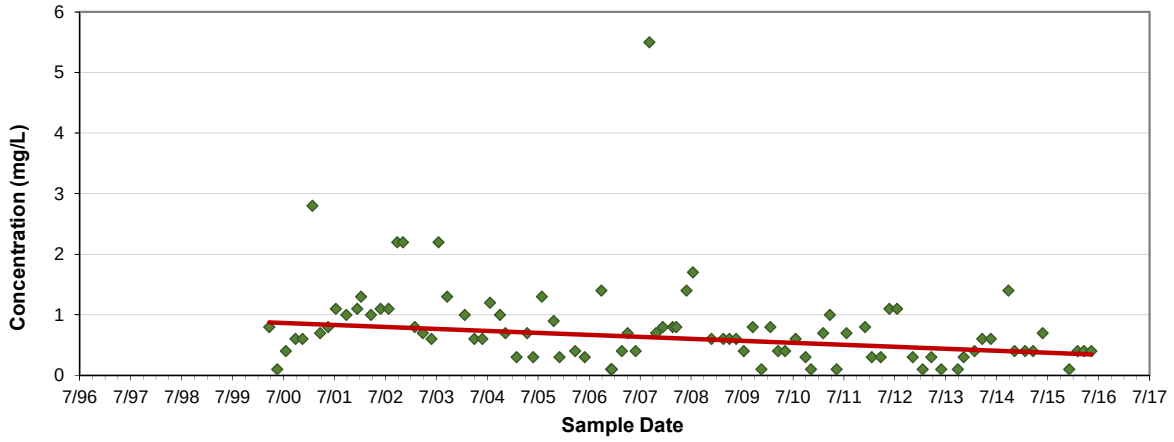


Figure B.78
Amazon Creek at Royal Avenue
Trend for Total Cadmium

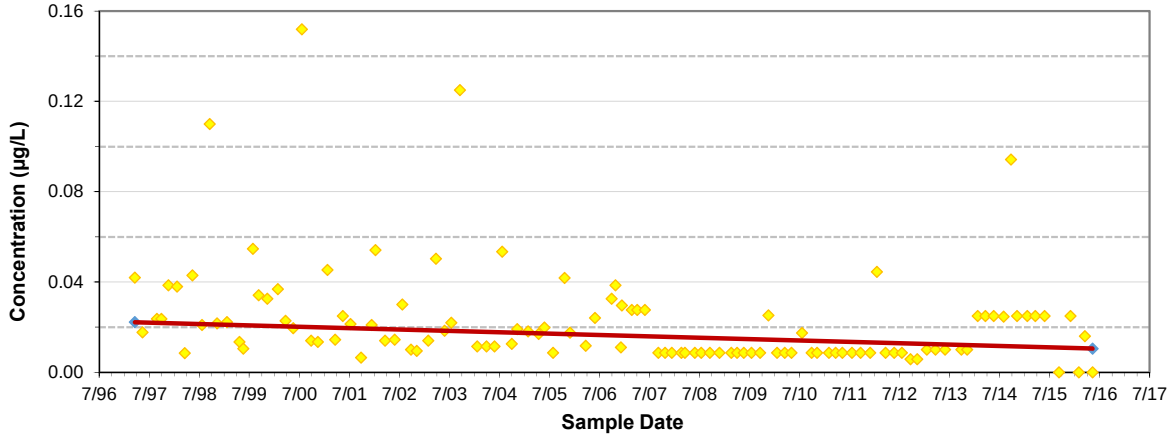


Figure B.79
Amazon Creek at Royal Avenue
Trend for Dissolved Chromium

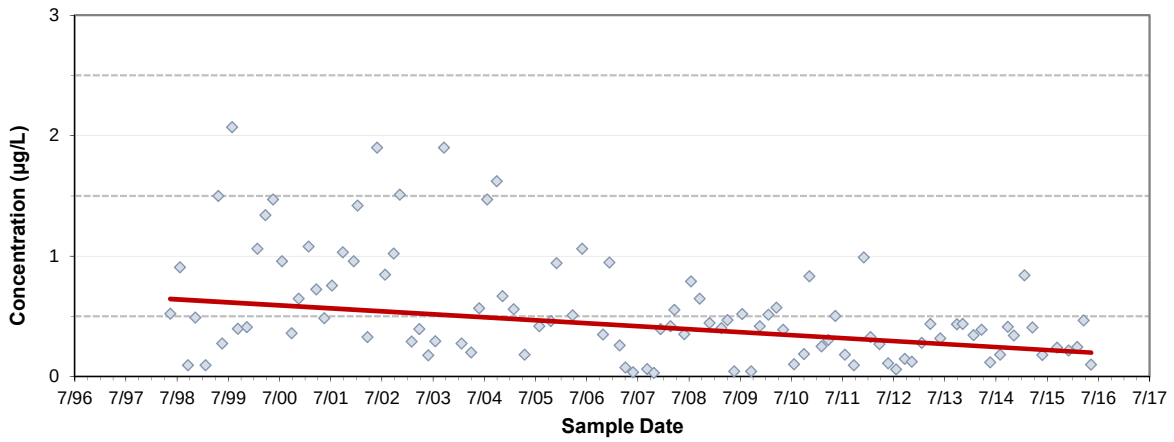


Figure B.80
Amazon Creek at Royal Avenue
Trend for Total Chromium

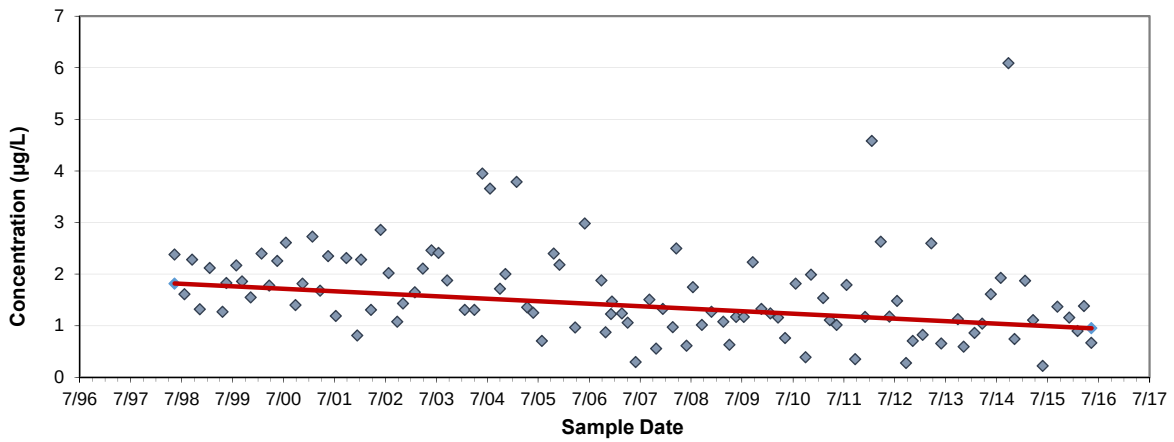


Figure B.81
Amazon Creek at Royal Avenue
Trend for Total Mercury

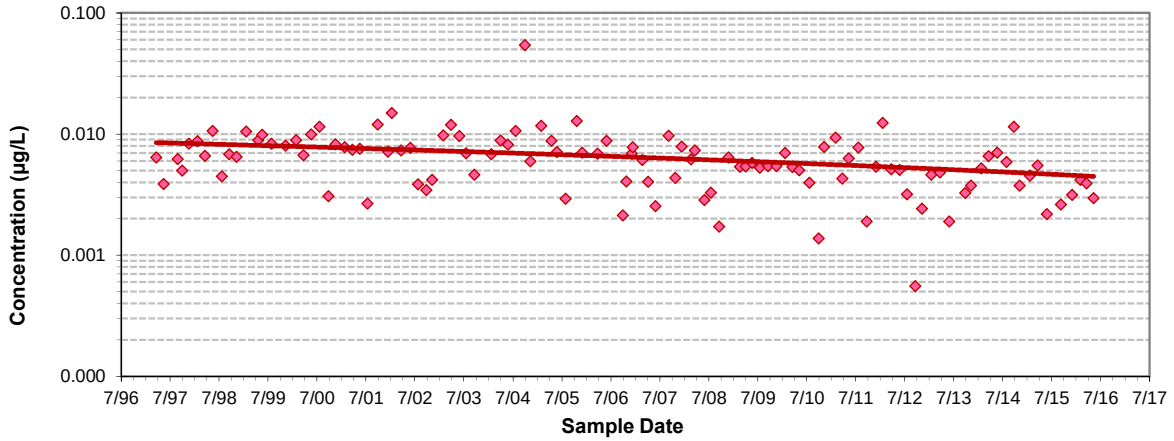


Figure B.82
Amazon Creek at Royal Avenue
Trend for Total Nickel

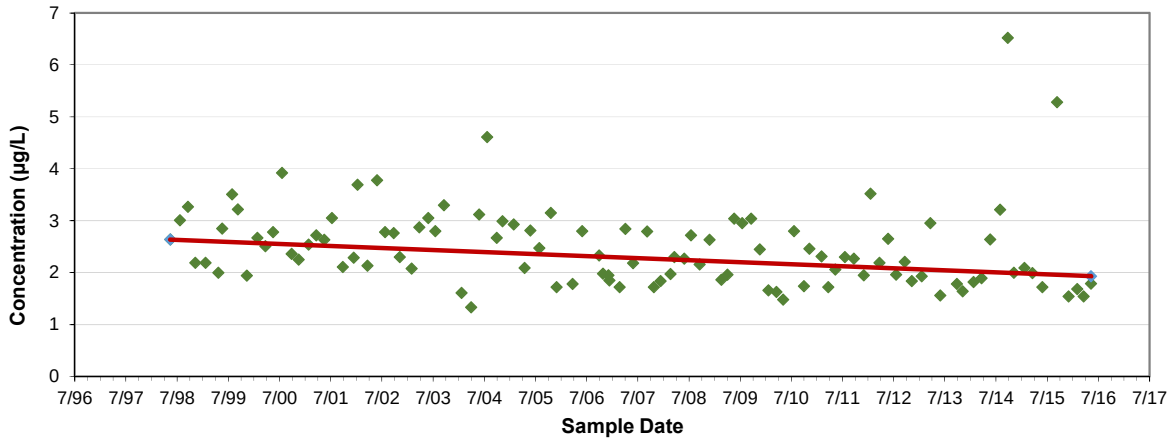


Figure B.83
Amazon Creek at Royal Avenue
Trend for Total Lead

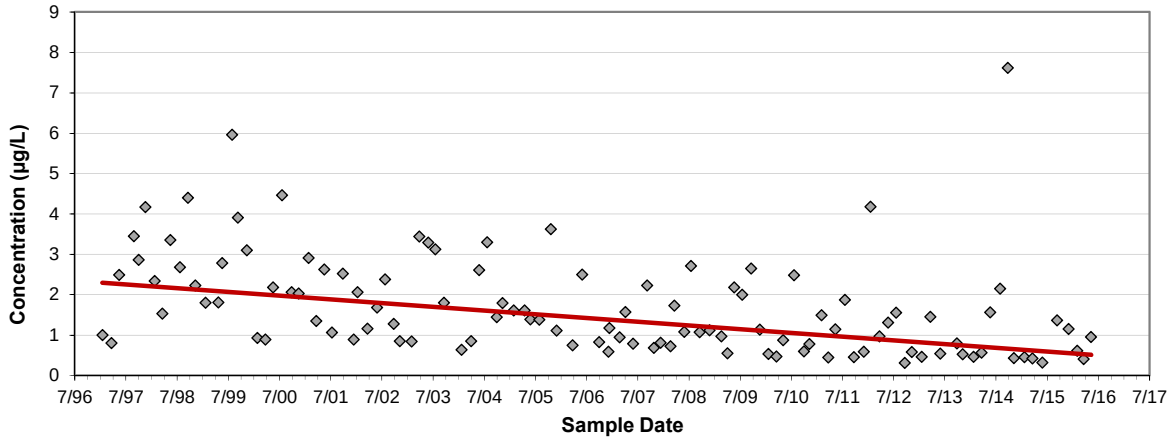


Figure B.84
Amazon Creek at Royal Avenue
Trend for Dissolved Zinc

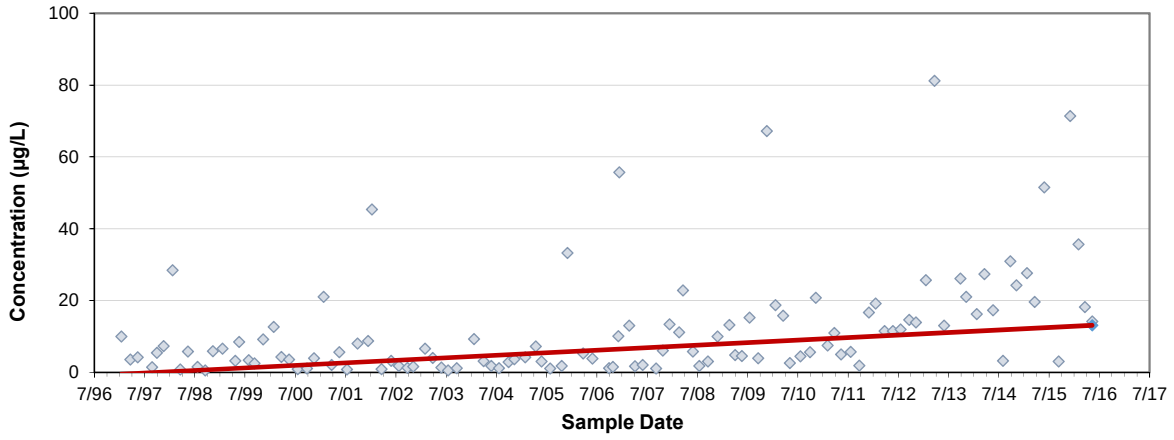


Figure B.85
Amazon Creek at Royal Avenue
Trend for Total Zinc

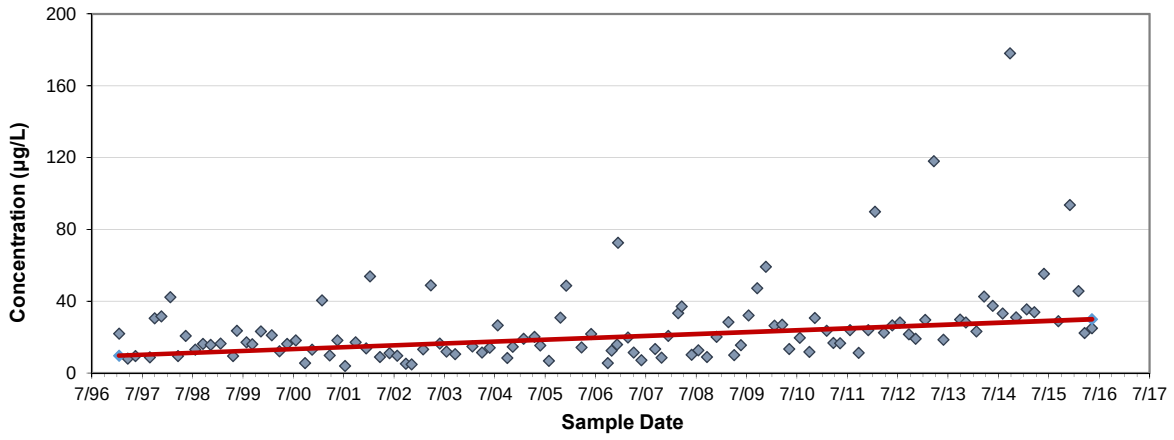


Figure B.86
Amazon Creek at Royal Avenue
Trend for Temperature

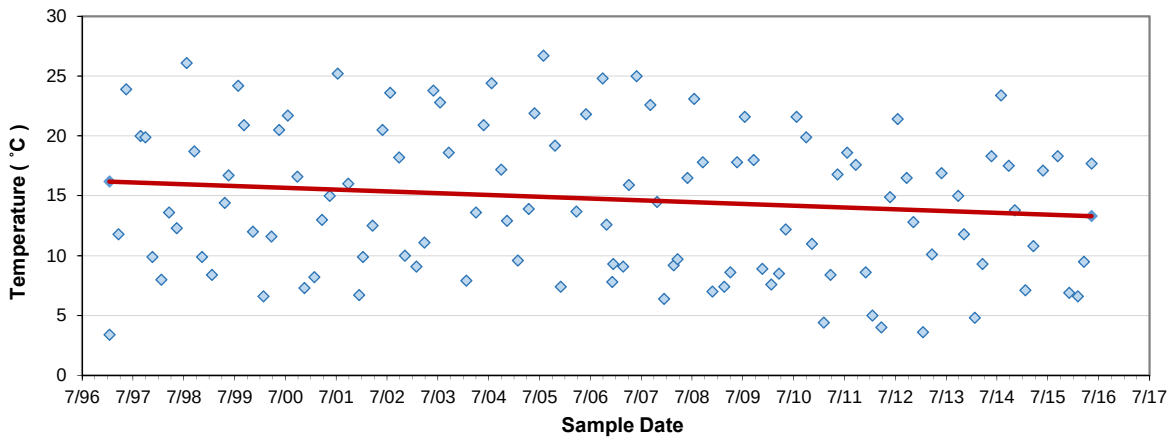


Figure B.87
Amazon Creek at Royal Avenue
Trend for Total Suspended Solids

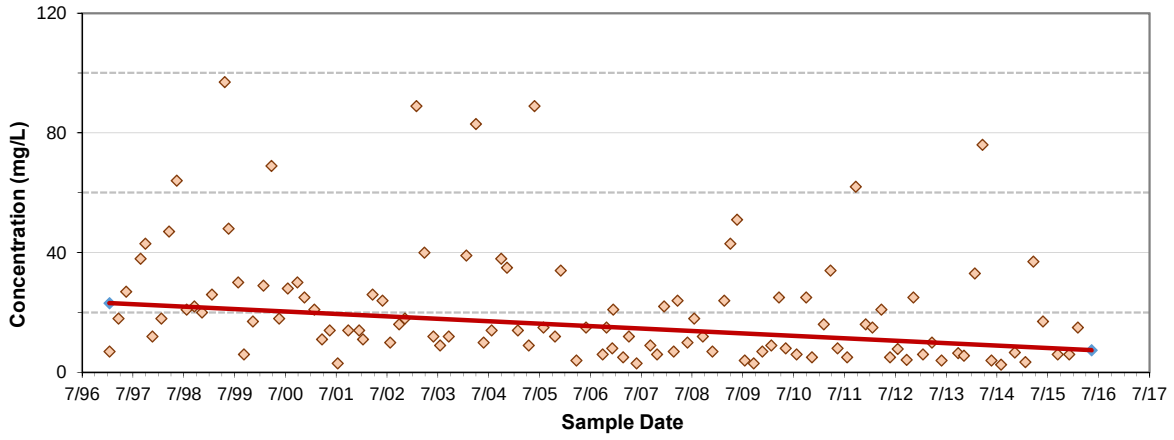


Figure B.88
Amazon Creek at Royal Avenue
Trend for Turbidity

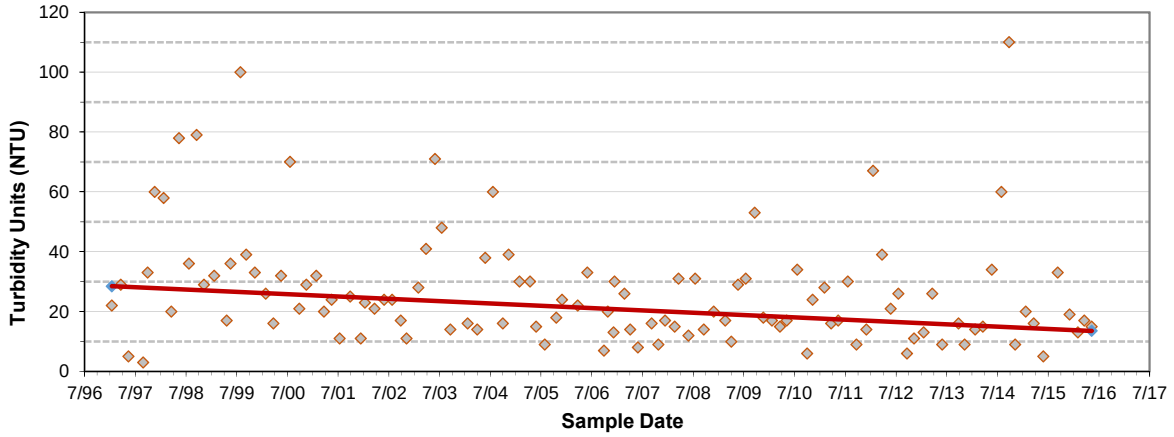


Figure B.89
Willamette River Upstream of Urban Growth Boundary
Trend for Total Chromium

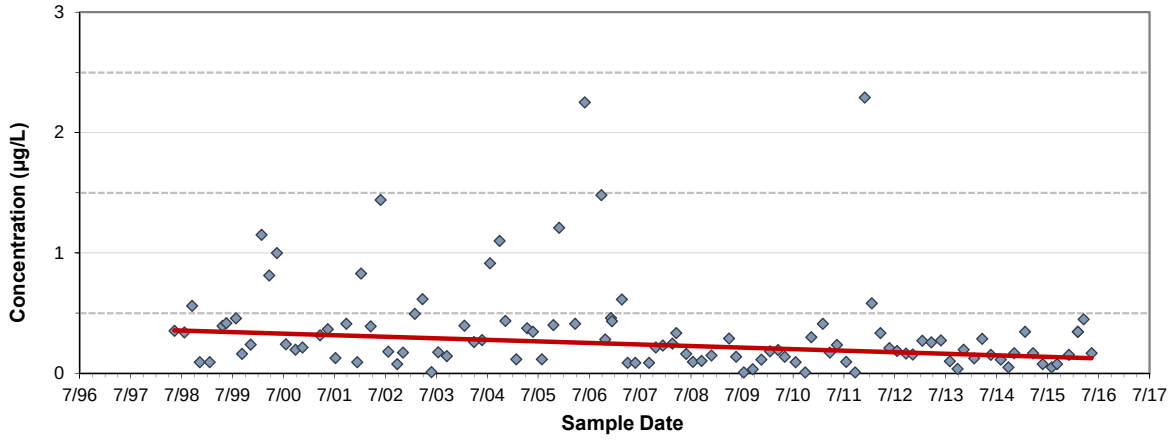


Figure B.90
Willamette River Upstream of Urban Growth Boundary
Trend for Dissolved Mercury

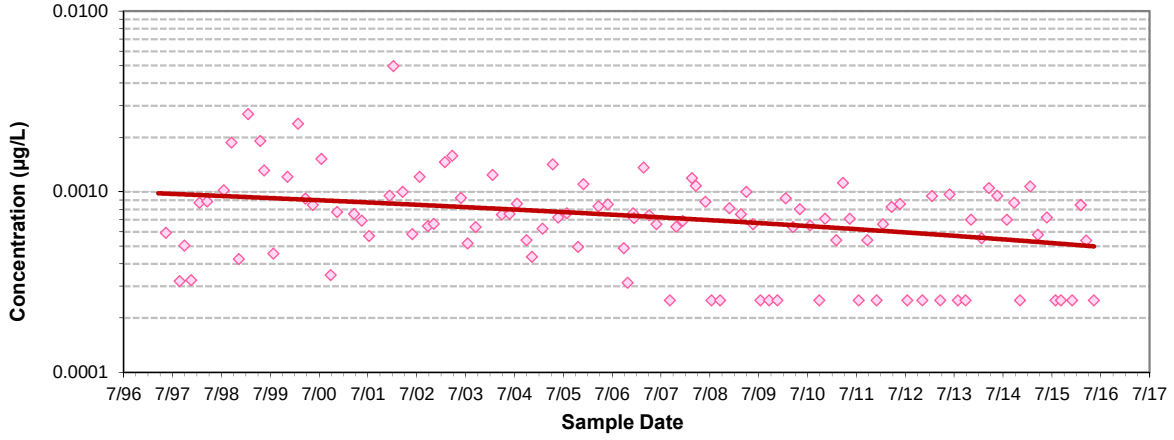


Figure B.91
Willamette River Upstream of Urban Growth Boundary
Trend for Total Mercury

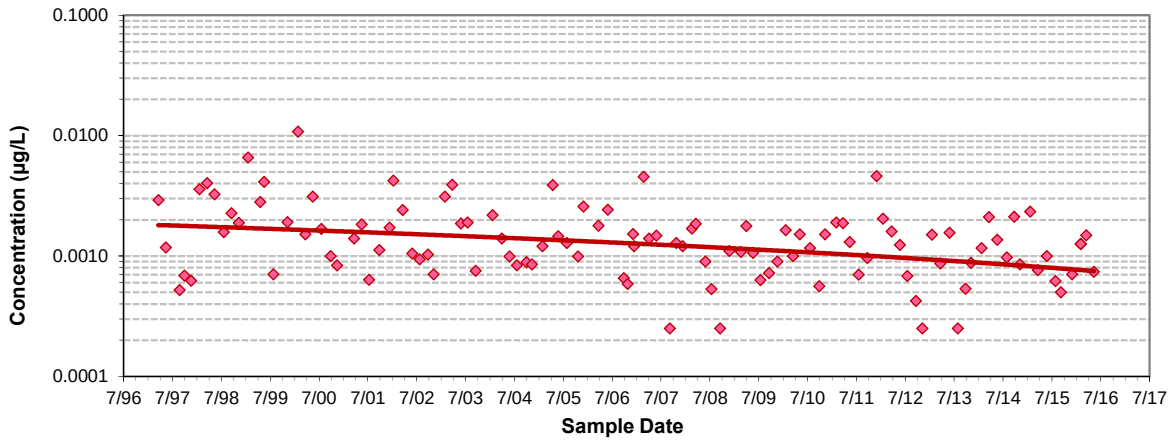


Figure B.92
Willamette River Upstream of Urban Growth Boundary
Trend for Total Lead

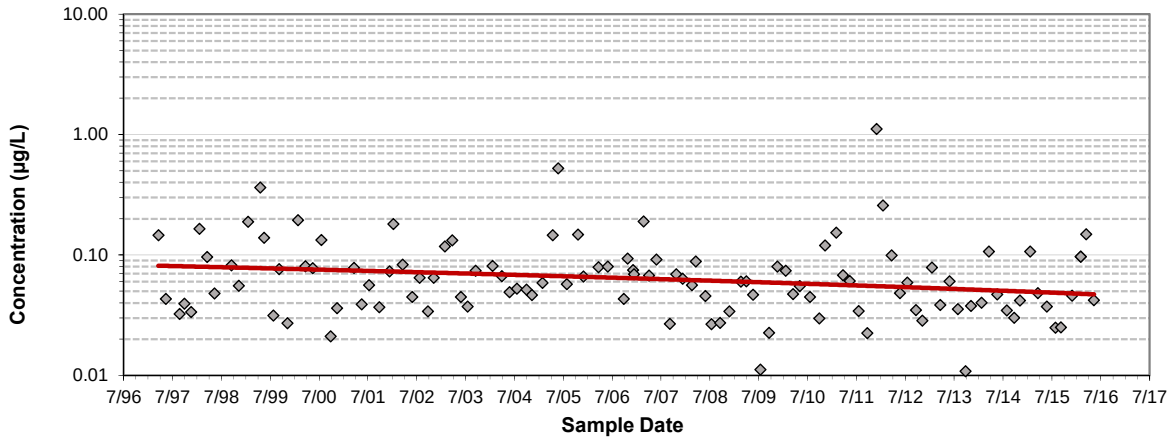


Figure B.93
Willamette River Upstream of Urban Growth Boundary
Trend for *Escherichia coli*

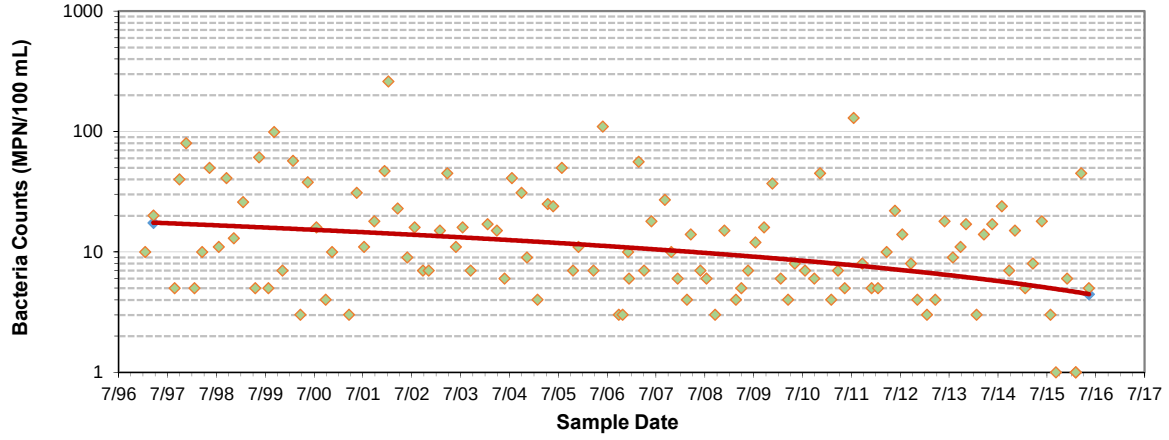


Figure B.94
Willamette River Upstream of Urban Growth Boundary
Trend for Turbidity

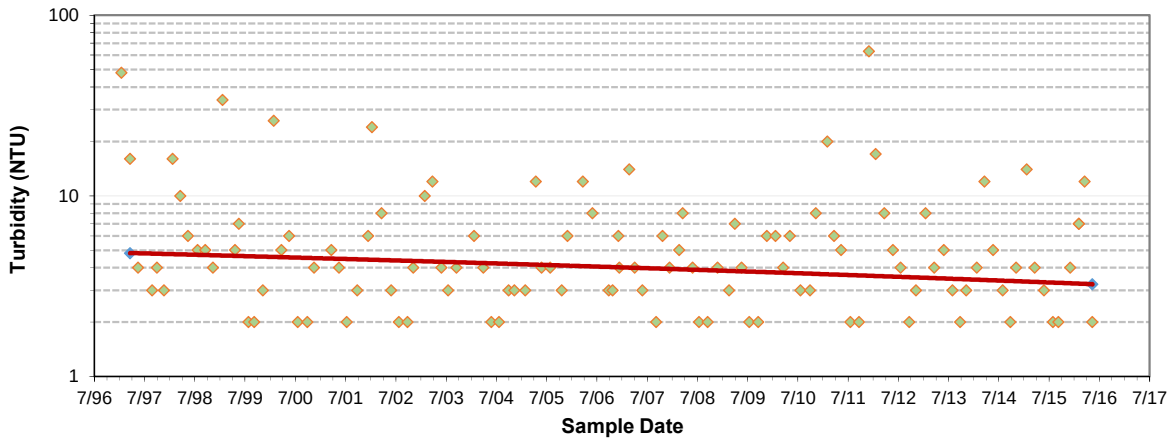


Figure B.95
Willamette River at Knickerbocker Bridge
Trend for Dissolved Copper

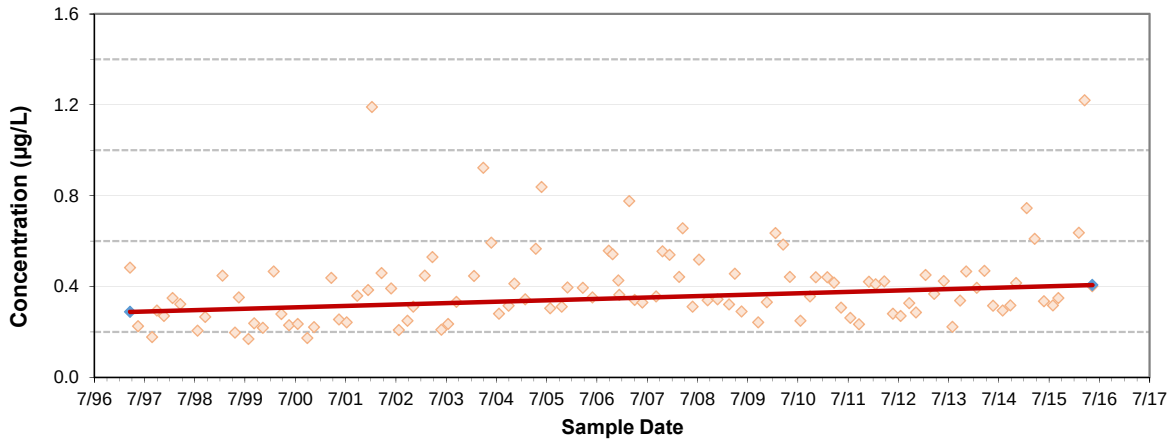


Figure B.96
Willamette River at Knickerbocker Bridge
Trend for Total Mercury

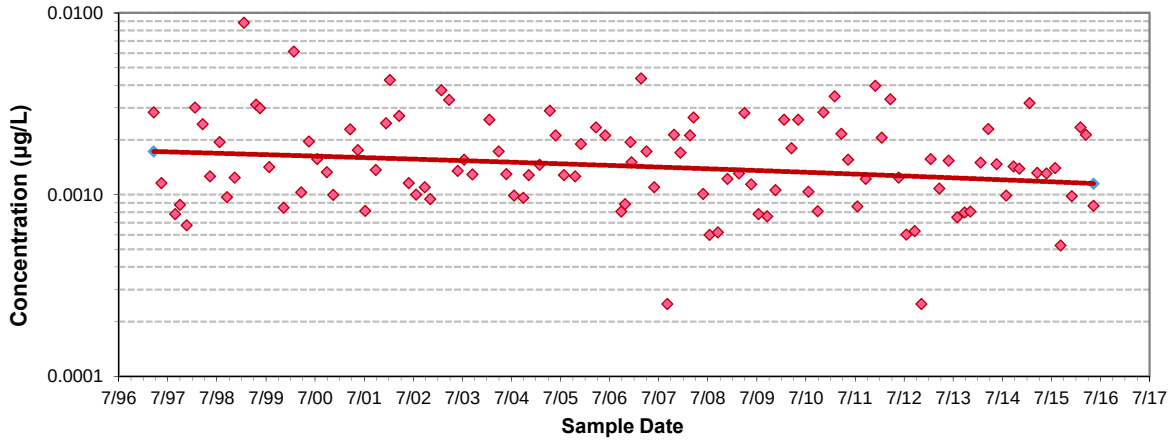


Figure B.97
Willamette River at Knickerbocker Bridge
Trend for Specific Conductance

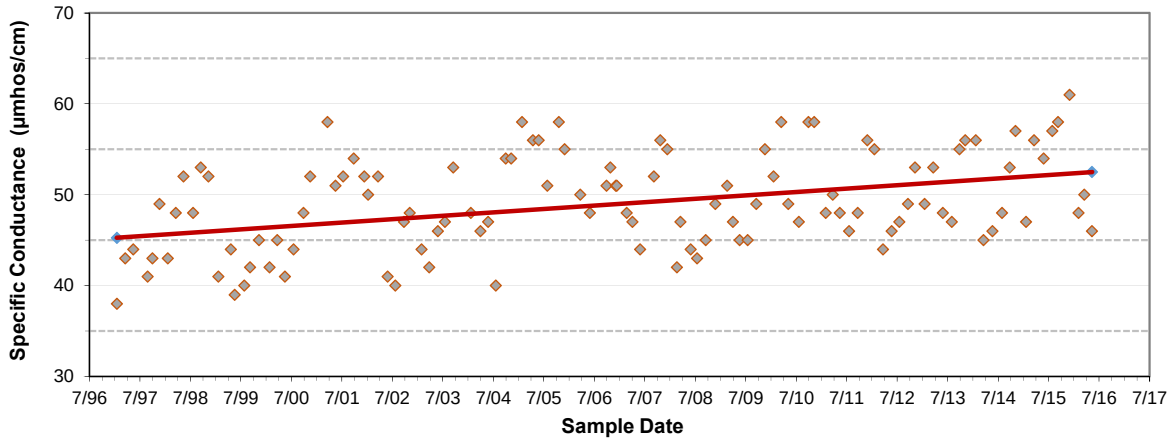


Figure B.98
Willamette River at Knickerbocker Bridge
Trend for Fecal Coliform

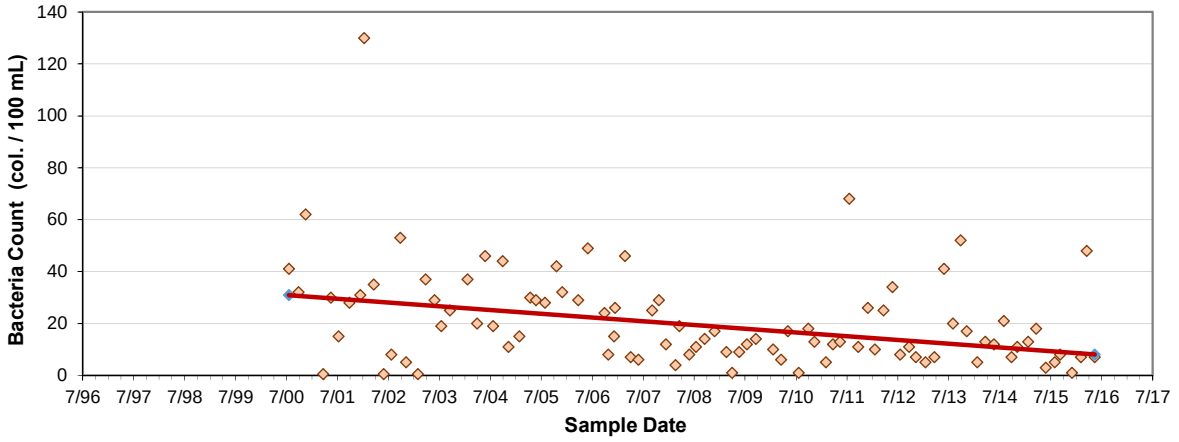


Figure B.99
Willamette River at Owosso Bridge
Trend for Total Chromium

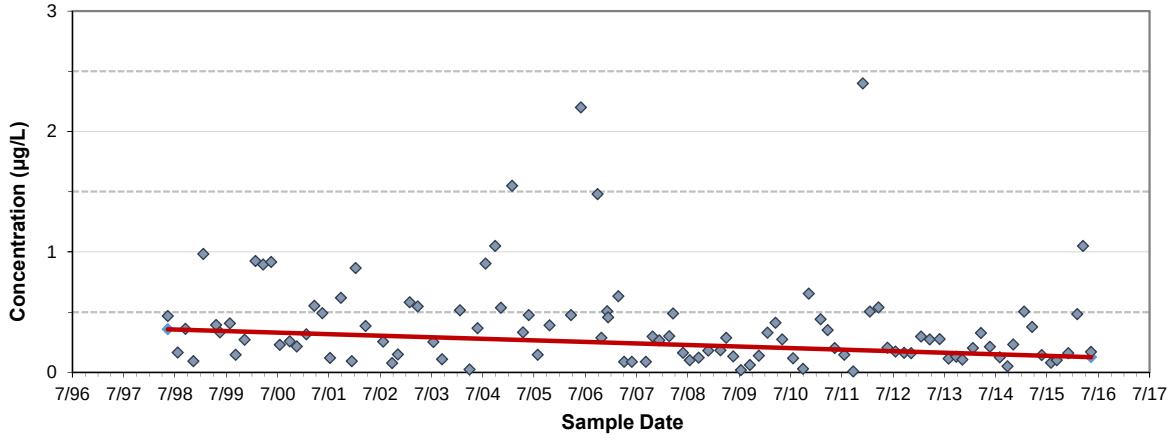


Figure B.100
Willamette River at Owosso Bridge
Trend for Specific Conductance

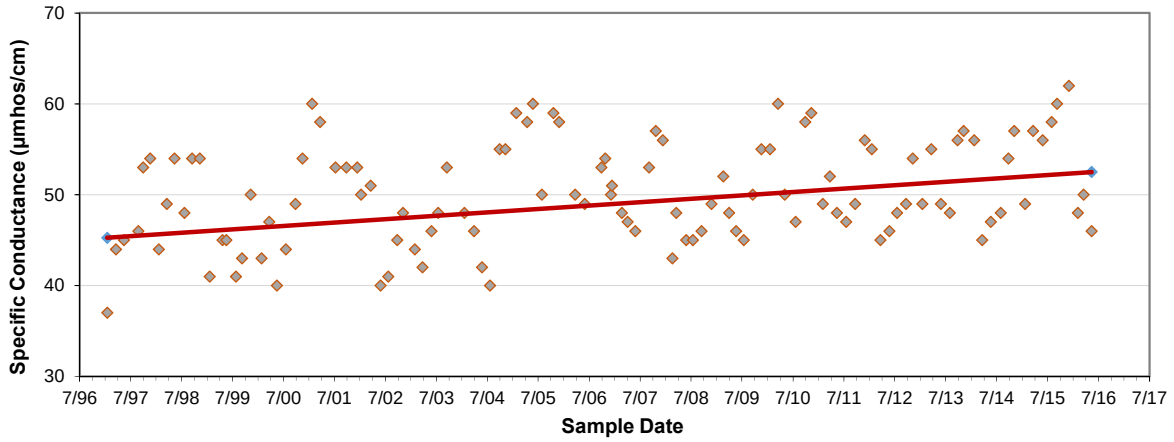


Figure B.101
Willamette River Downstream of Beltline Bridge
Trend for Total Mercury

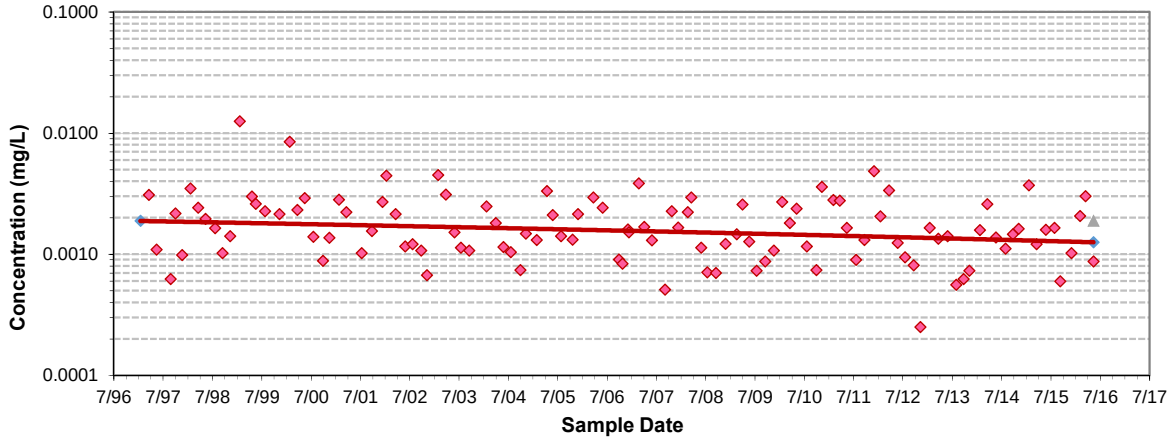


Figure B.102
Delta Ponds Above Willamette River Confluence
Trend for Total Calcium

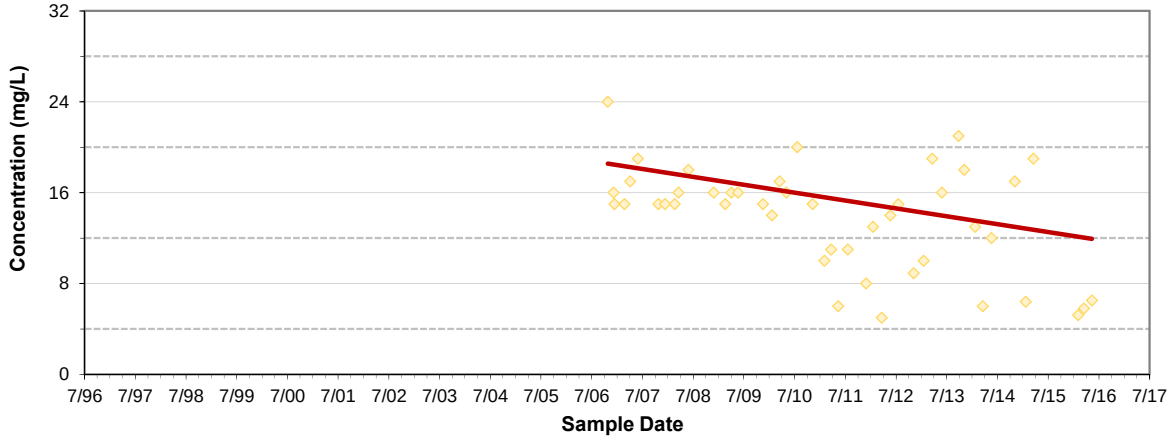


Figure B.103
Delta Ponds Above Willamette River Confluence
Trend for Total Magnesium

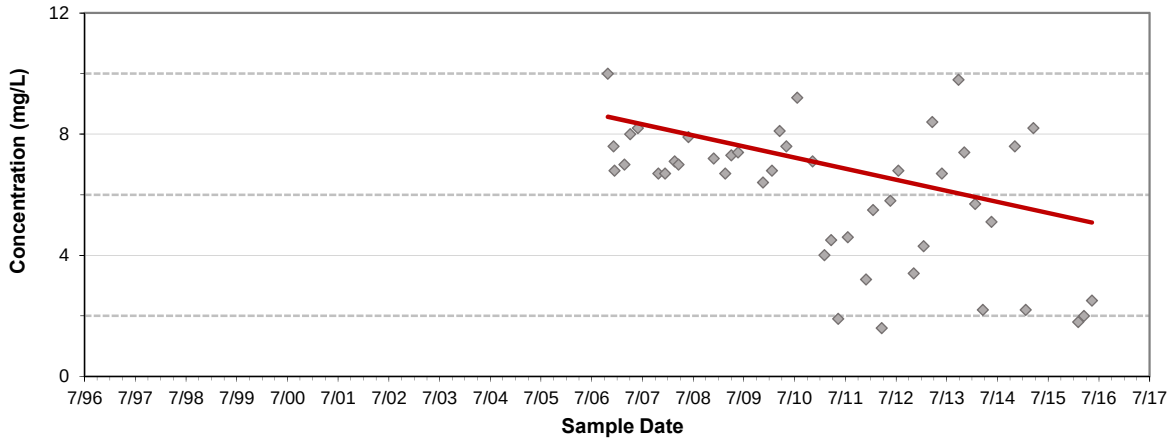


Figure B.104
Delta Ponds Above Willamette River Confluence
Trend for Hardness

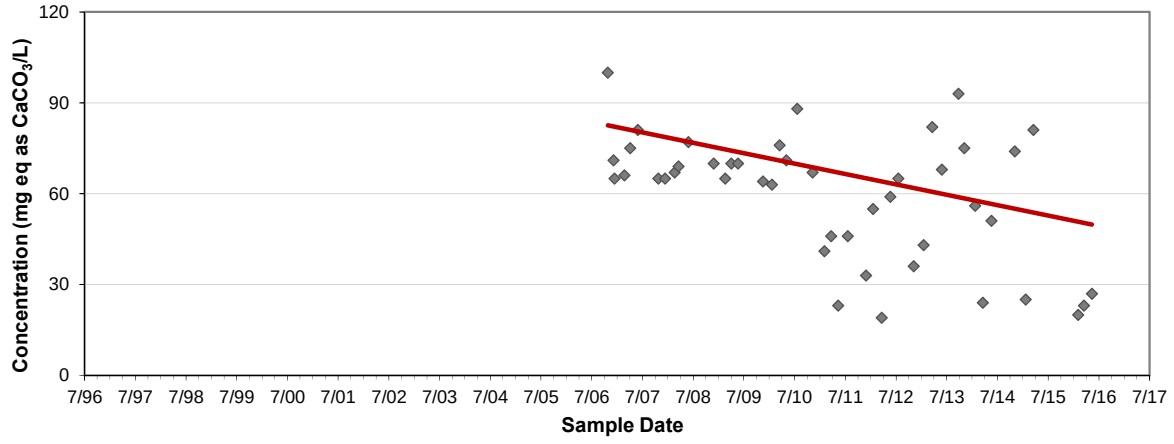
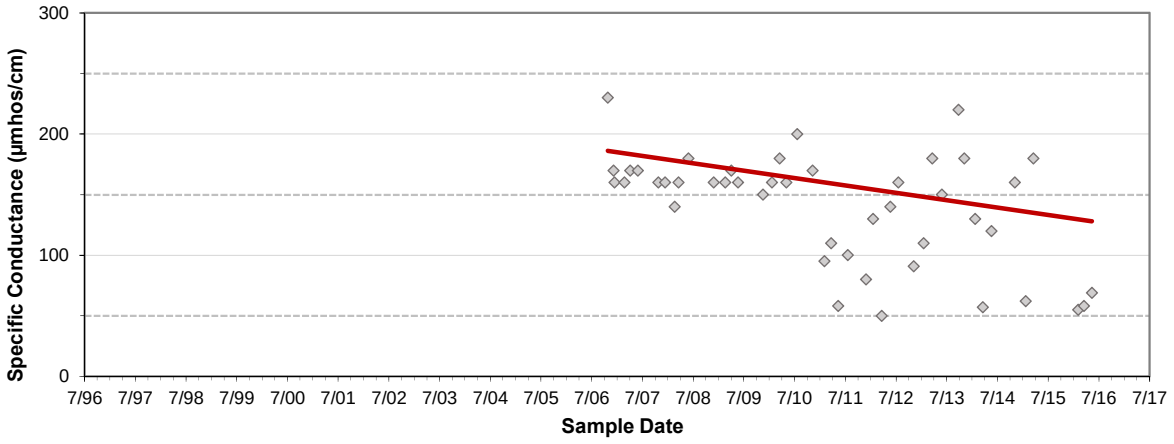


Figure B.105
Delta Ponds Above Willamette River Confluence
Trend for Specific Conductance



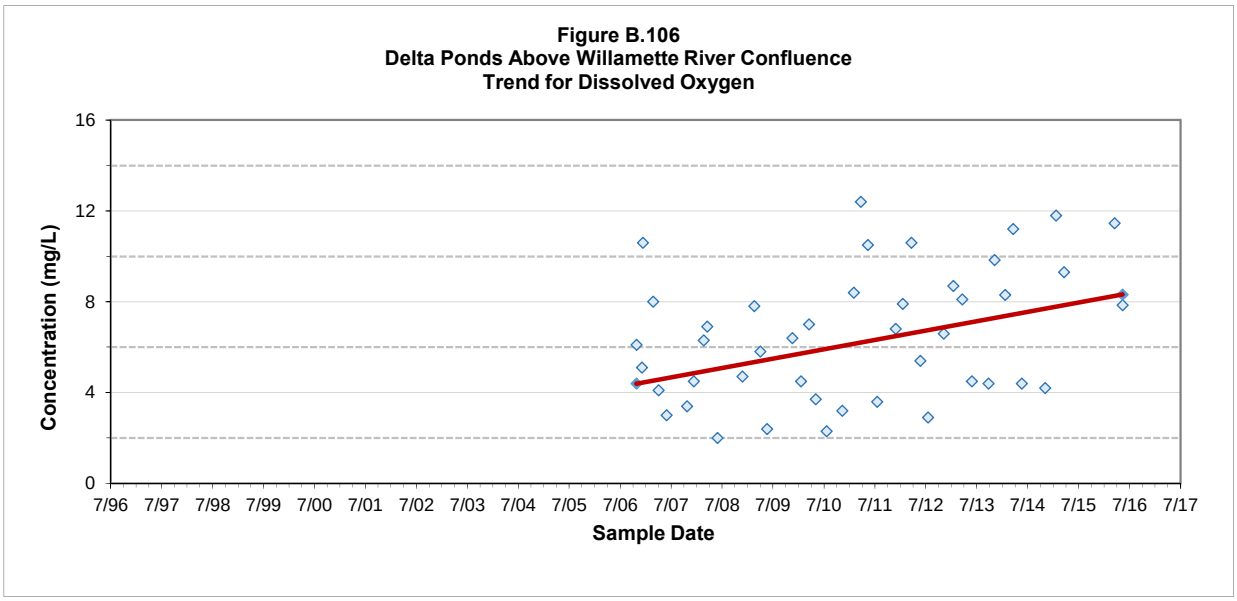


Figure B.106
Delta Ponds Above Willamette River Confluence
Trend for Dissolved Oxygen
Concentration (mg/L)
16
12
8
4
0
7/96 7/97 7/98 7/99 7/00 7/01 7/02 7/03 7/04 7/05 7/06 7/07 7/08 7/09 7/10 7/11 7/12 7/13 7/14 7/15 7/16 7/17
Sample Date

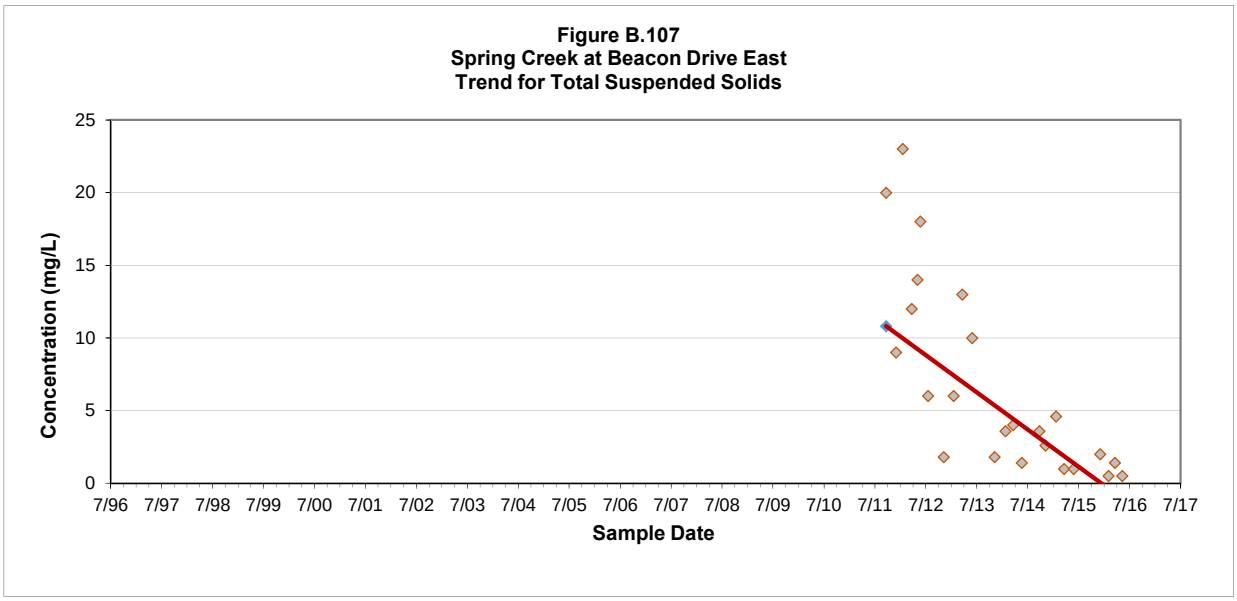


Figure B.107
Spring Creek at Beacon Drive East
Trend for Total Suspended Solids
Concentration (mg/L)
25
20
15
10
5
0
7/96 7/97 7/98 7/99 7/00 7/01 7/02 7/03 7/04 7/05 7/06 7/07 7/08 7/09 7/10 7/11 7/12 7/13 7/14 7/15 7/16 7/17
Sample Date

Figure B.108

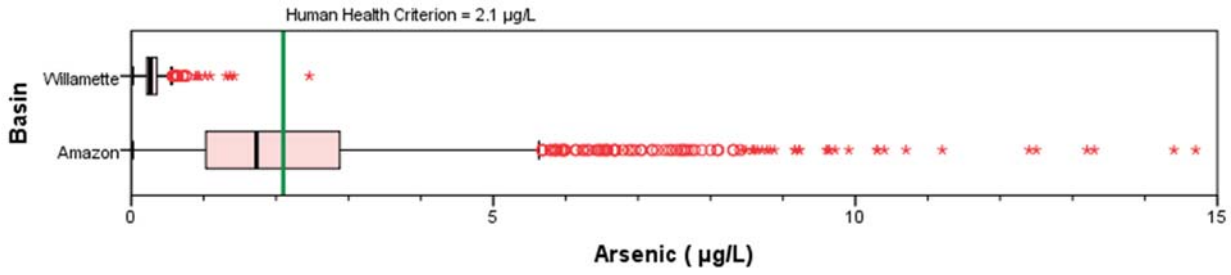


Figure B.109

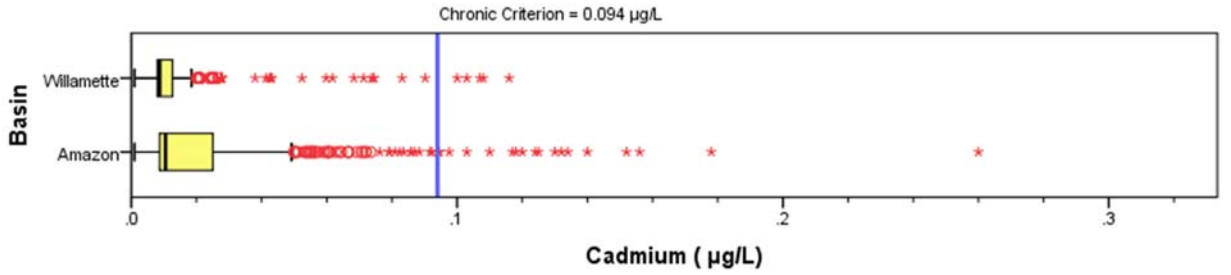


Figure B.110

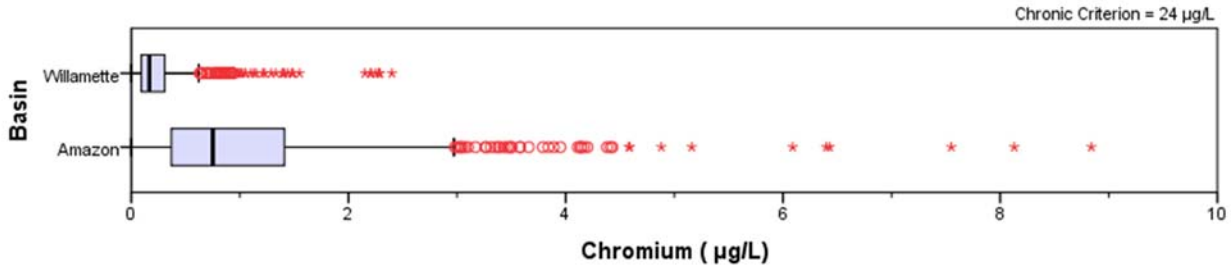


Figure B.111

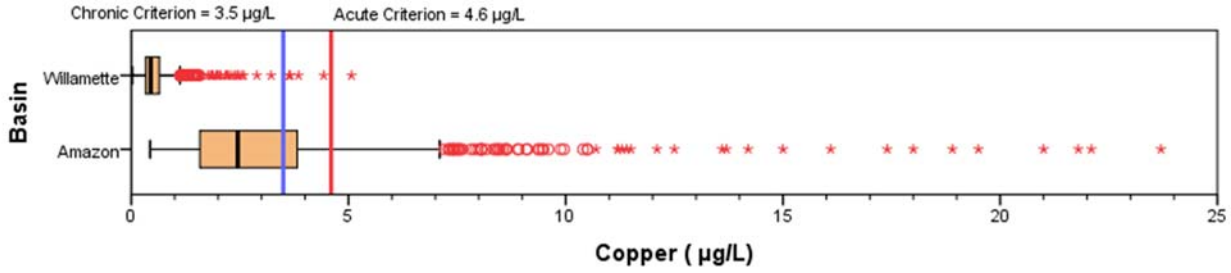


Figure B.112

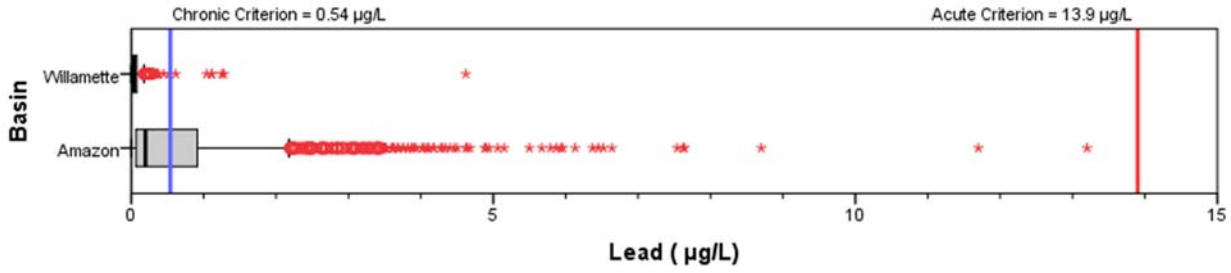


Figure B.113

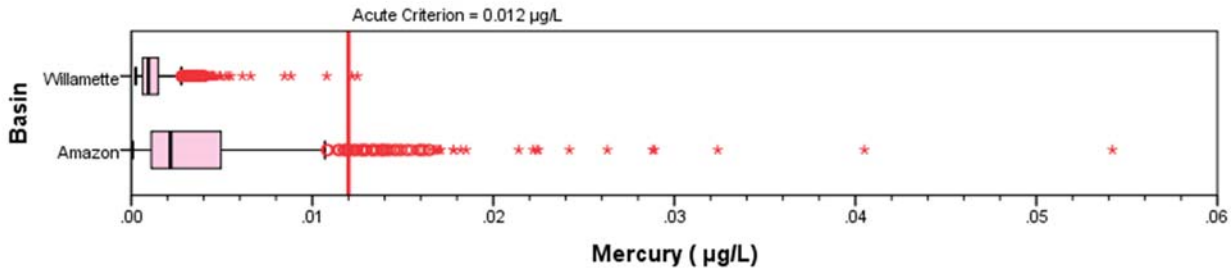


Figure B.114

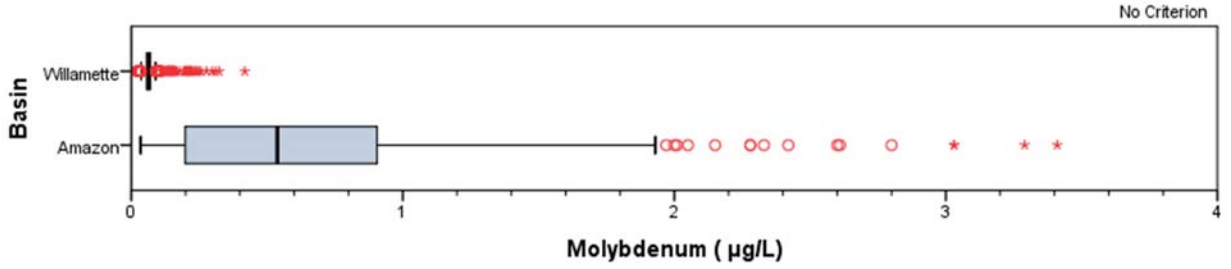


Figure B.115

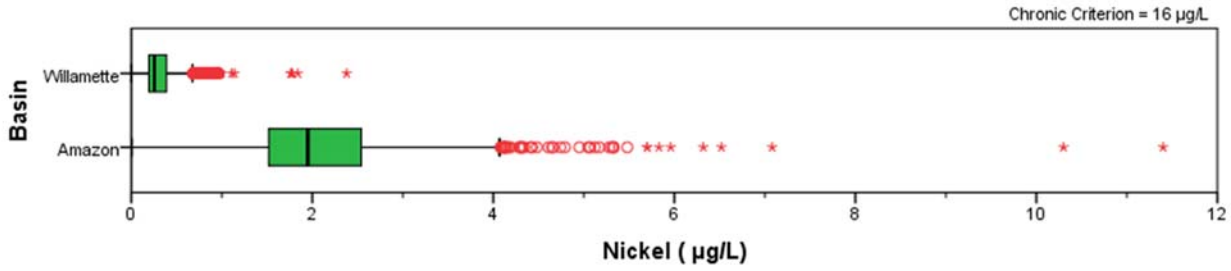


Figure B.116

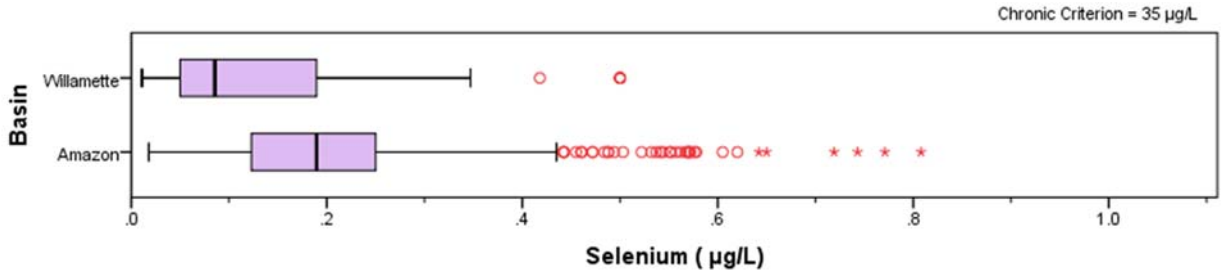


Figure B.117

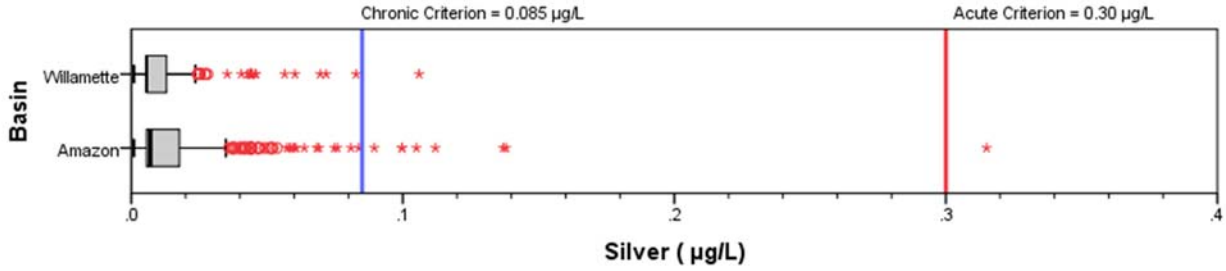


Figure B.118

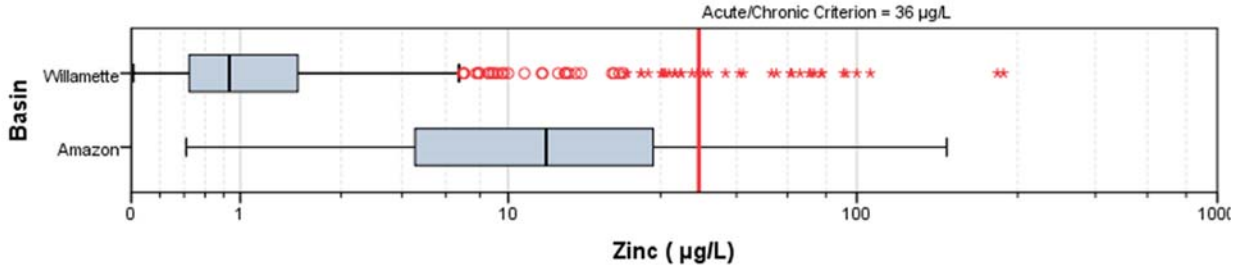


Figure B.119

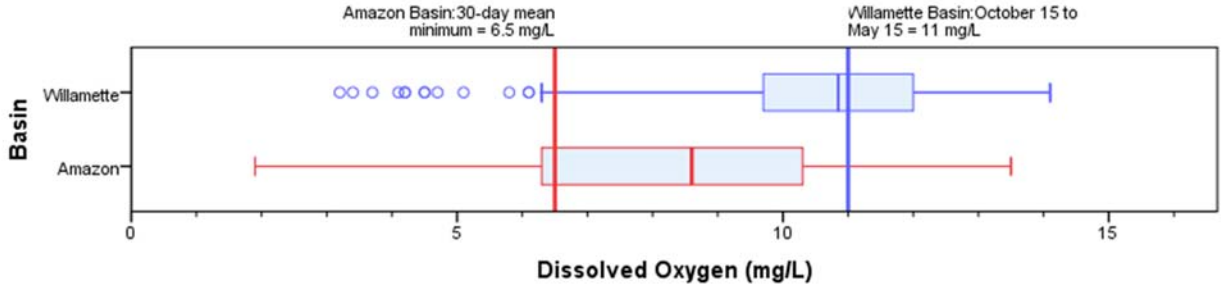


Figure B.120

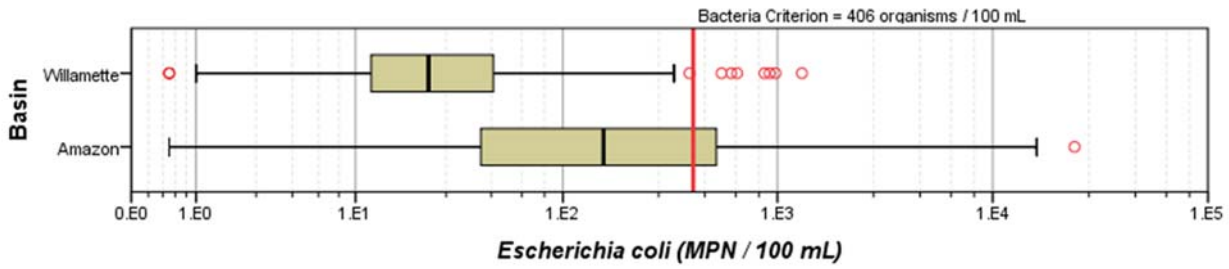


Figure B.121

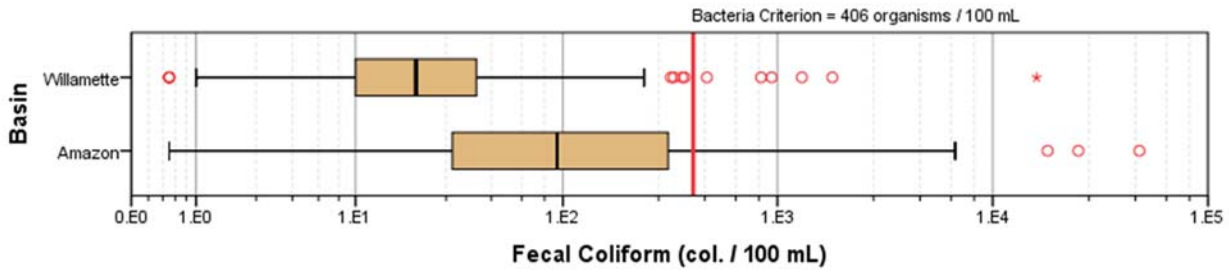


Figure B.122

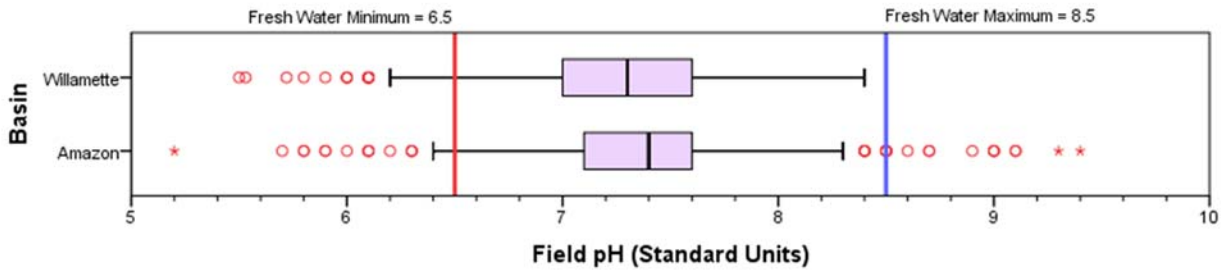


Figure B.123

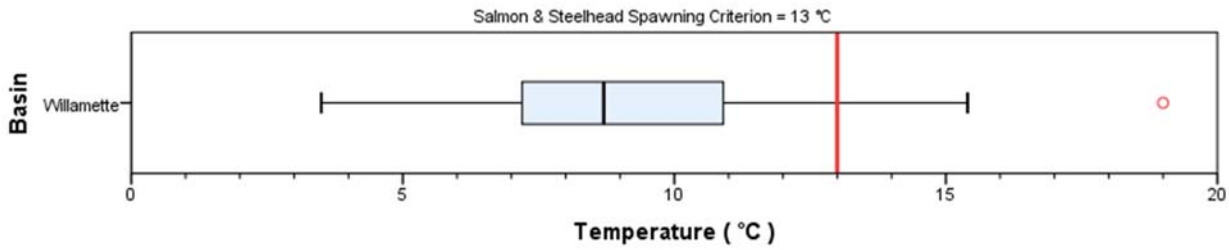


Figure B.124

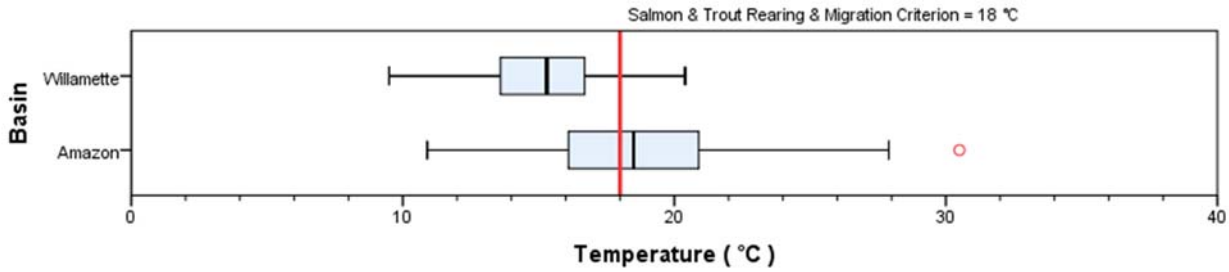


Figure B.125

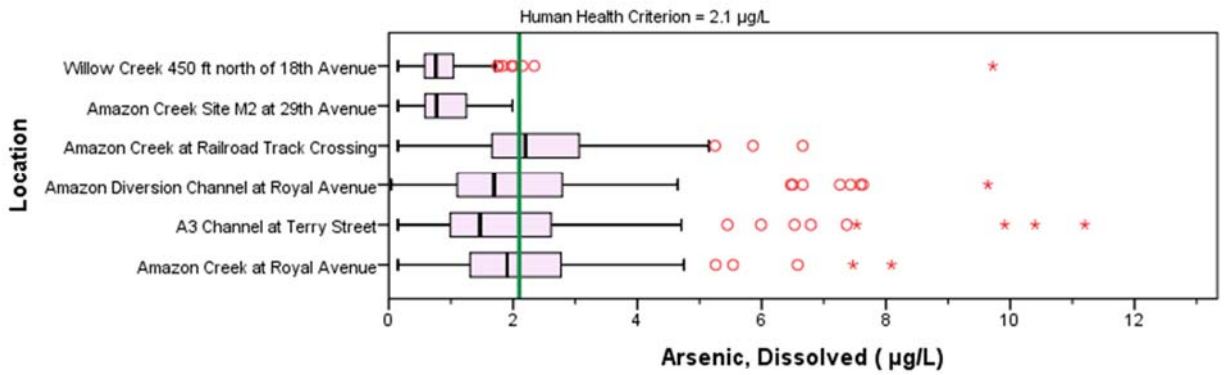


Figure B.126

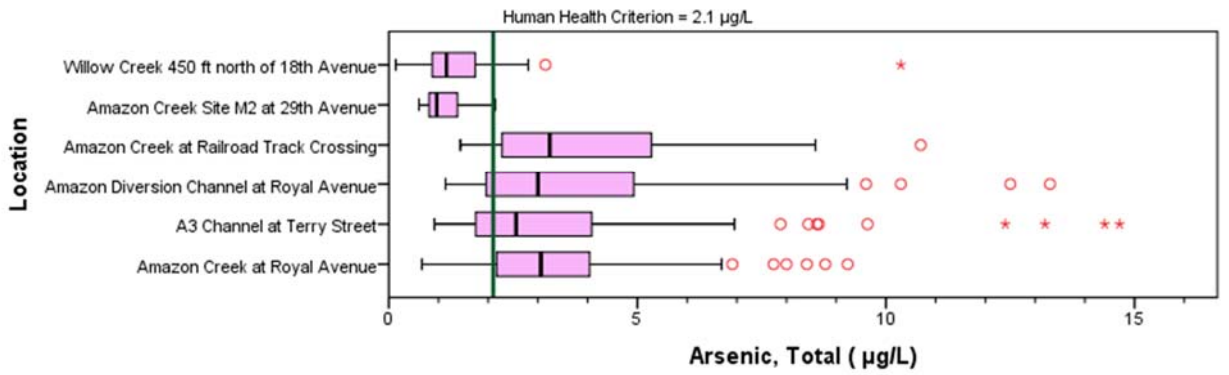


Figure B.127

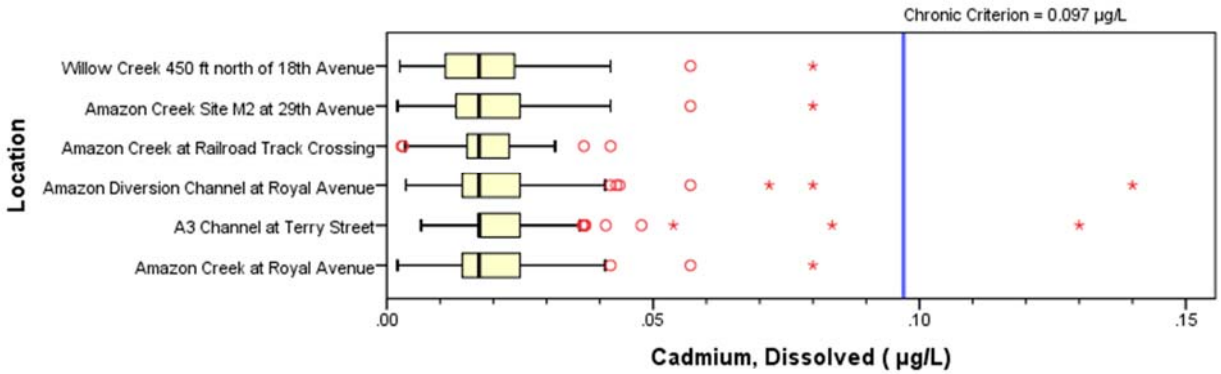
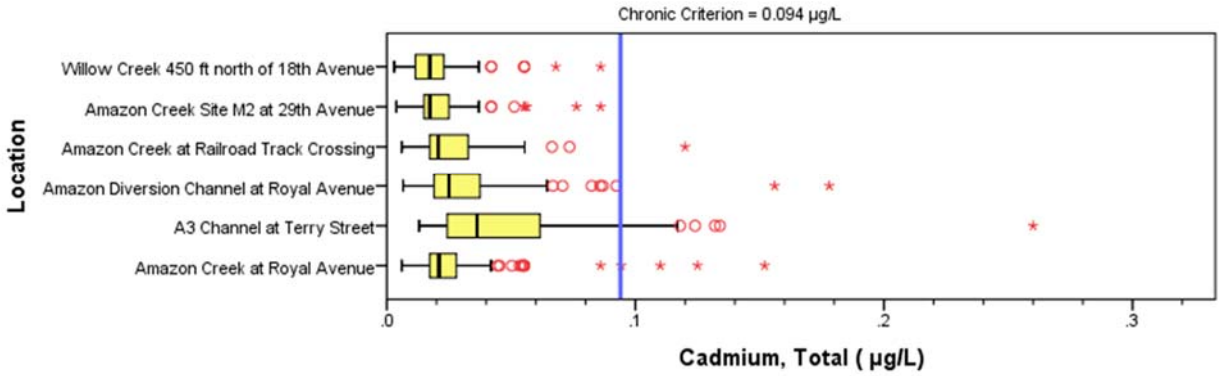


Figure B.128



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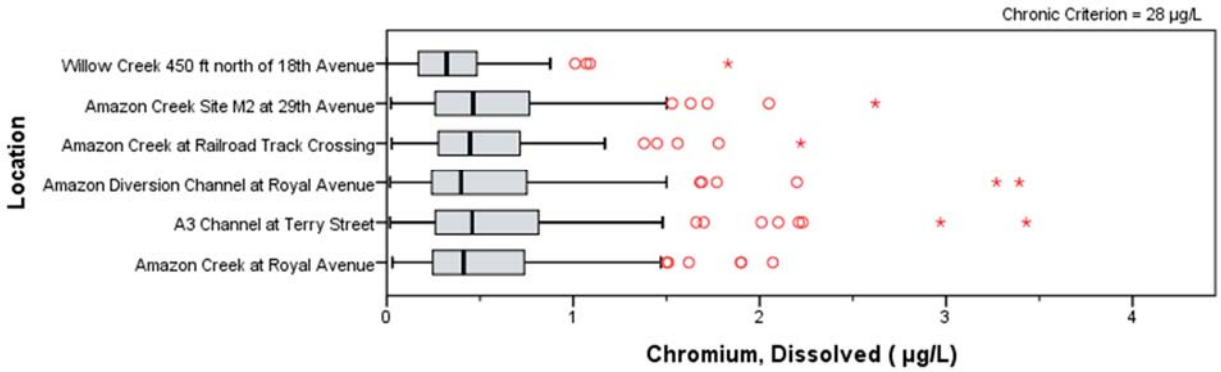

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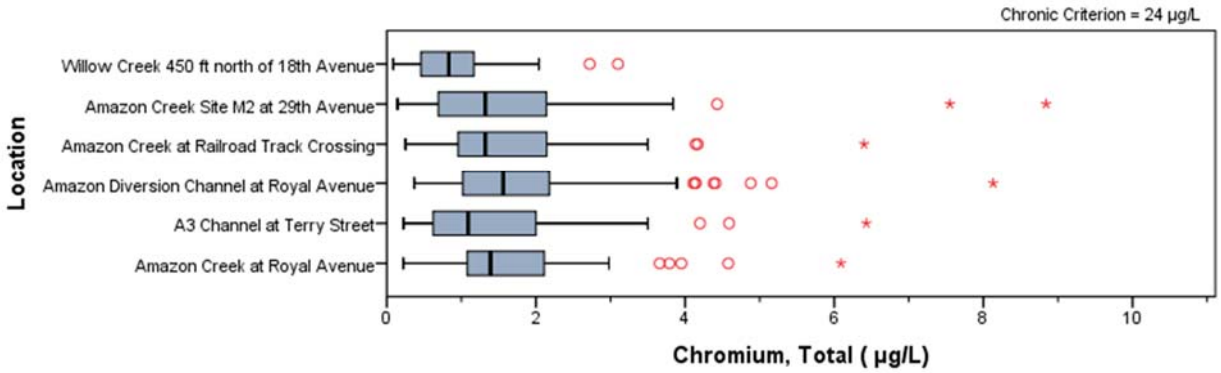

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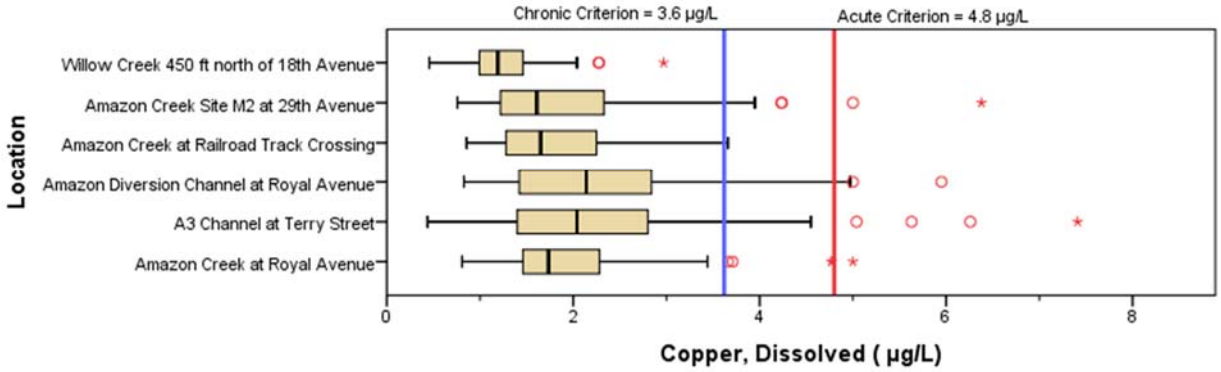

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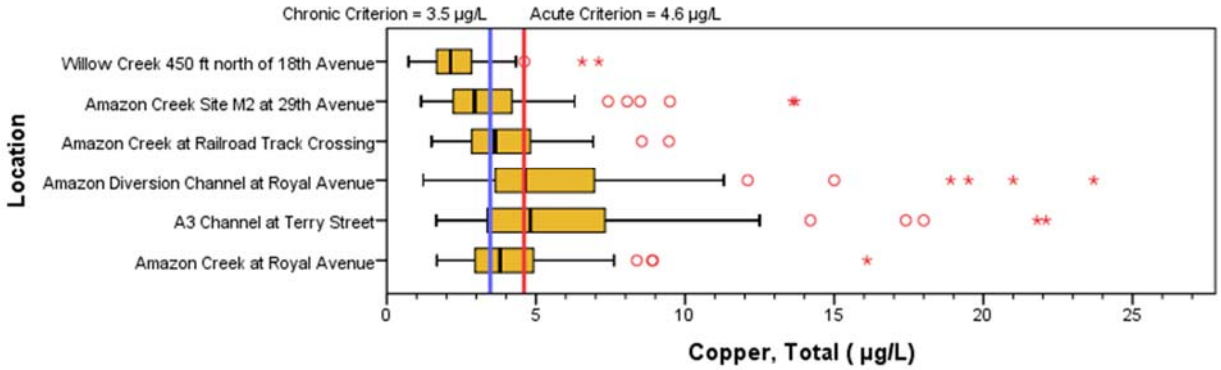

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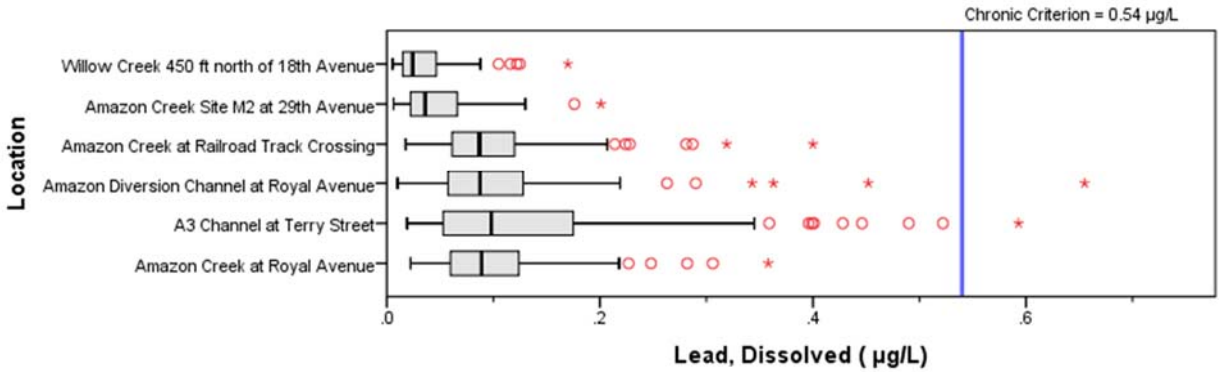

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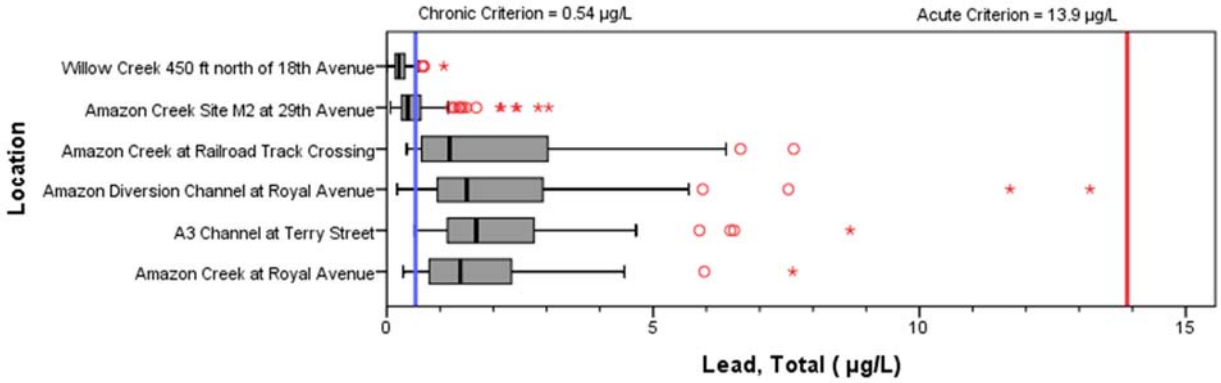

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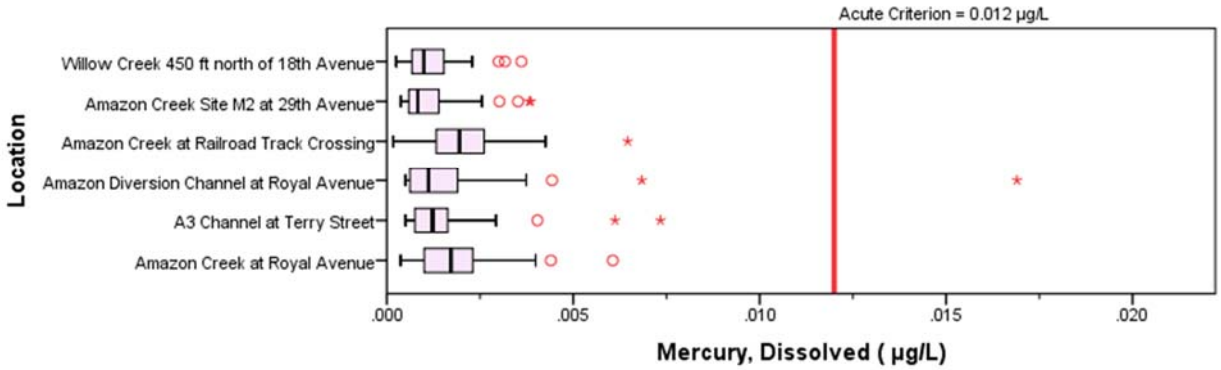

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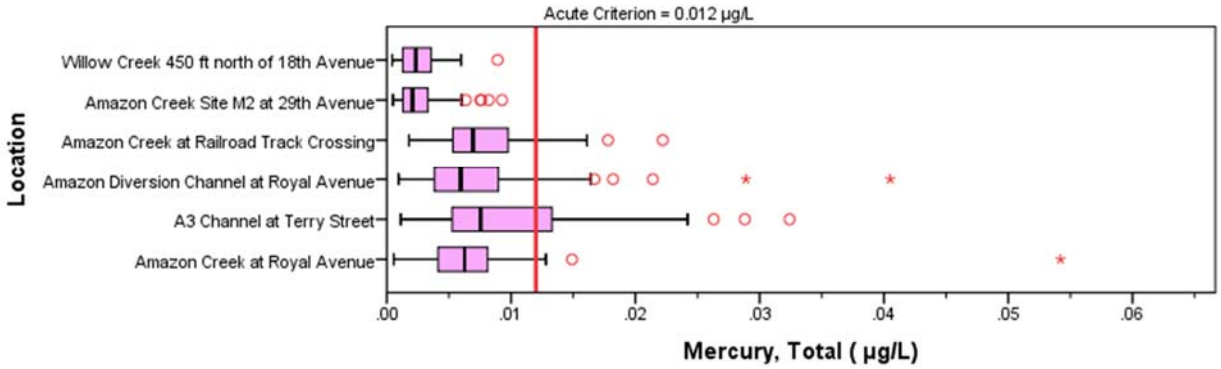

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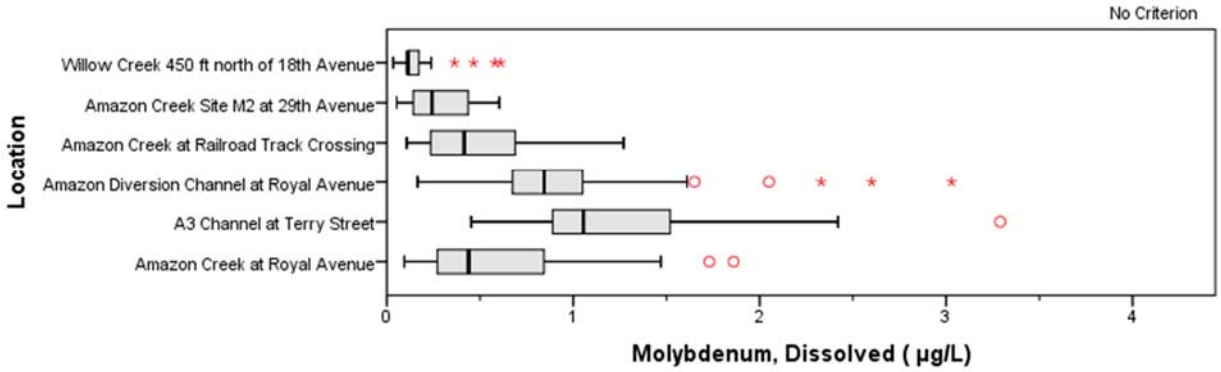

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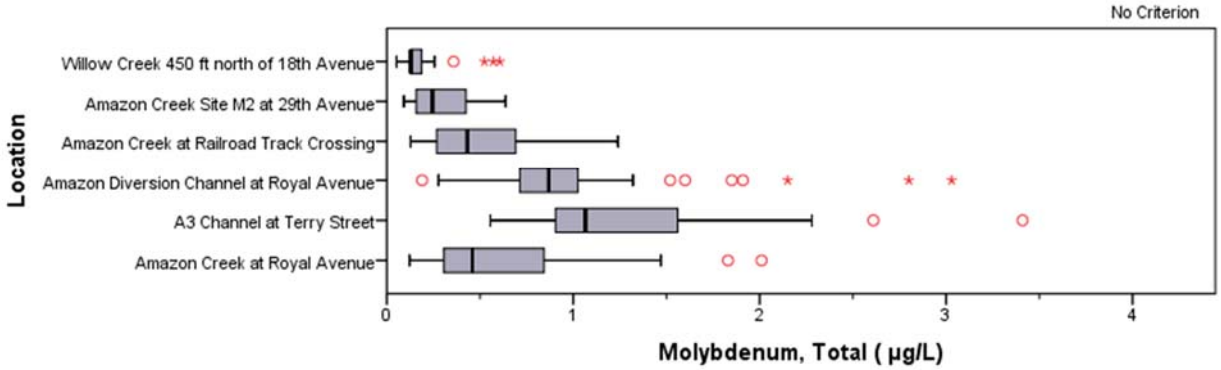

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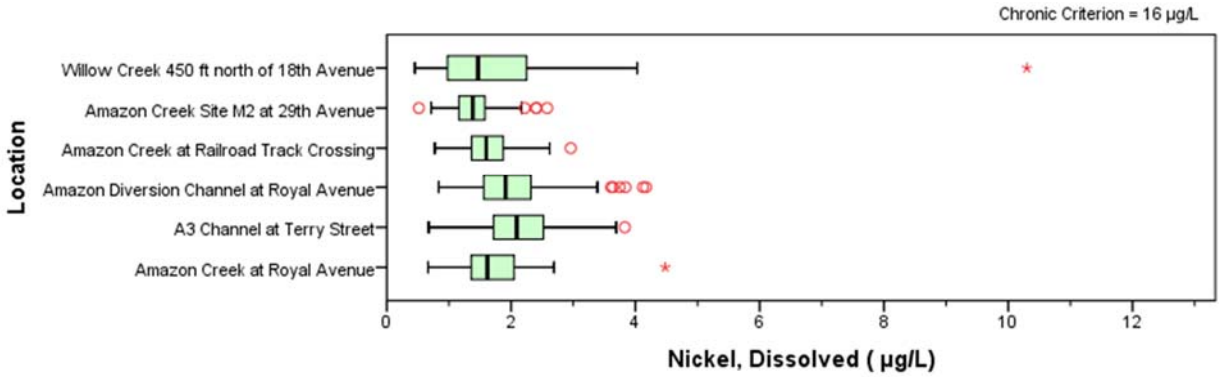

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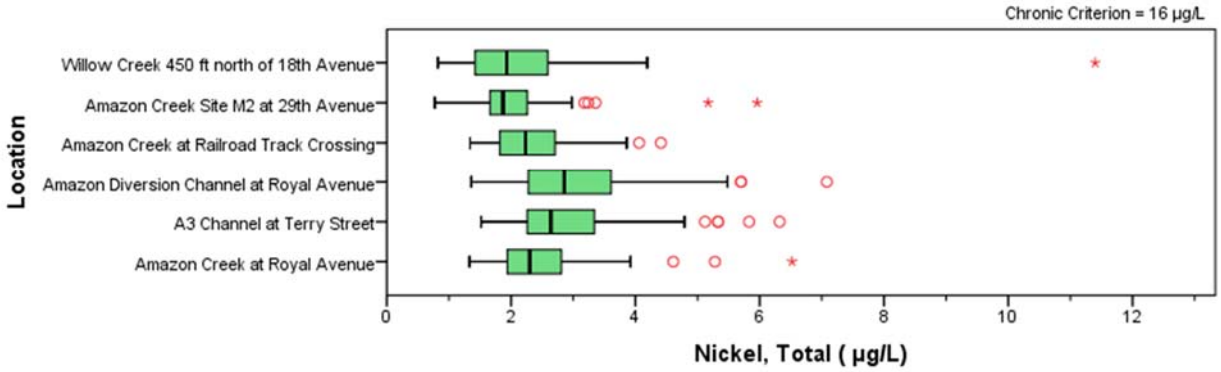

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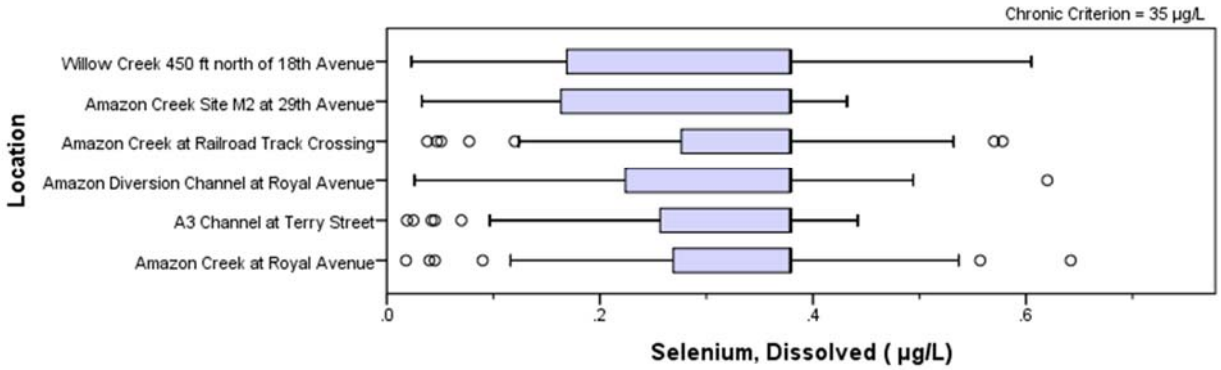

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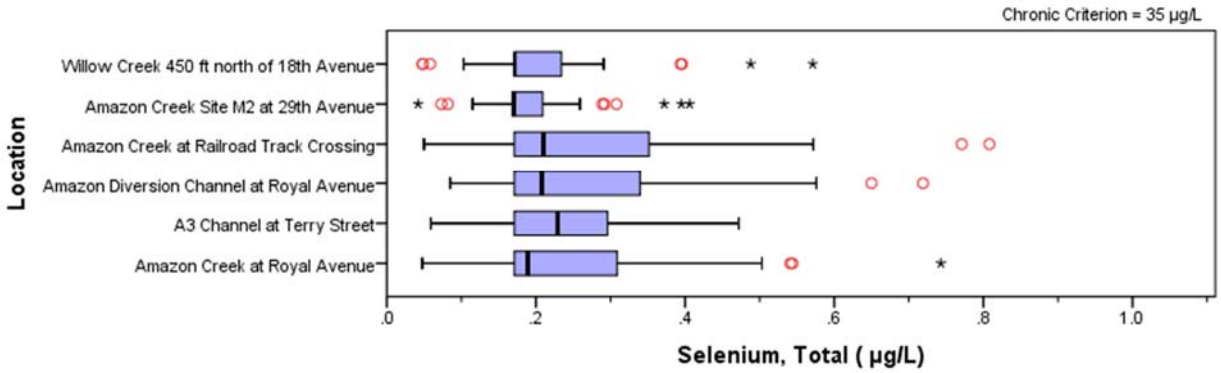

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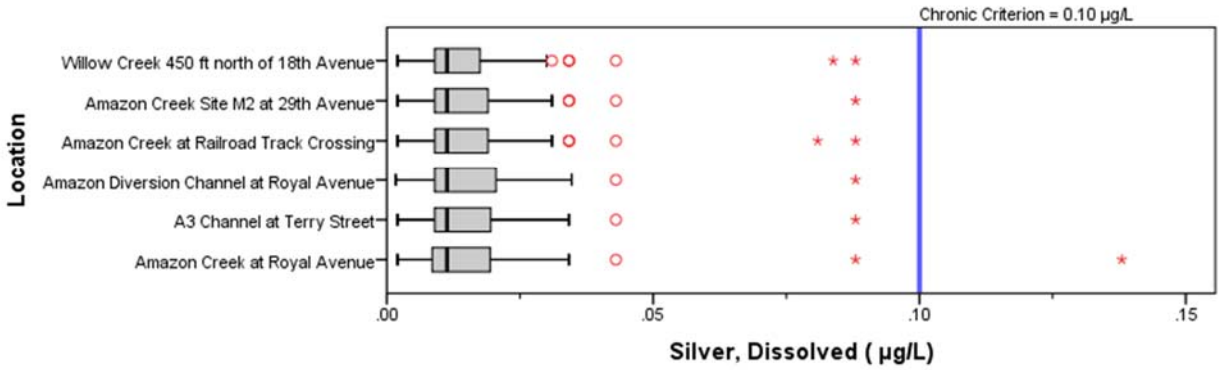


Figure B.144

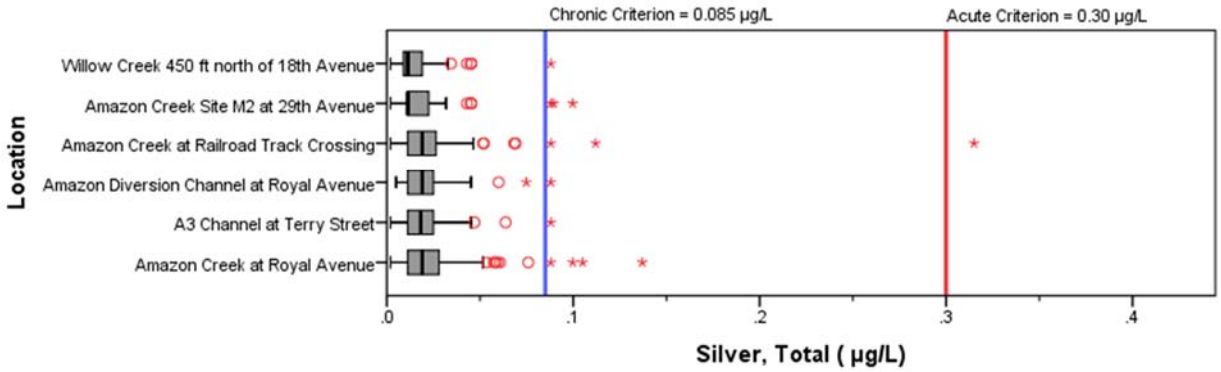


Figure B.145

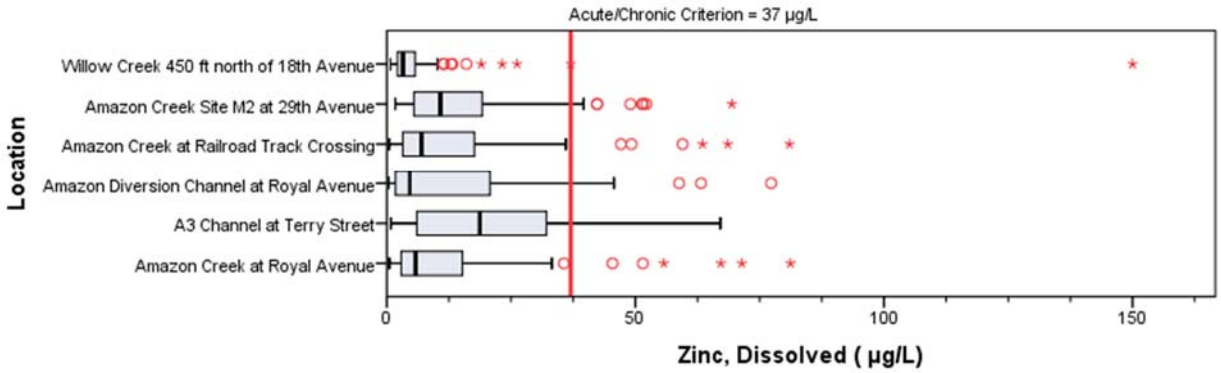


Figure B.146

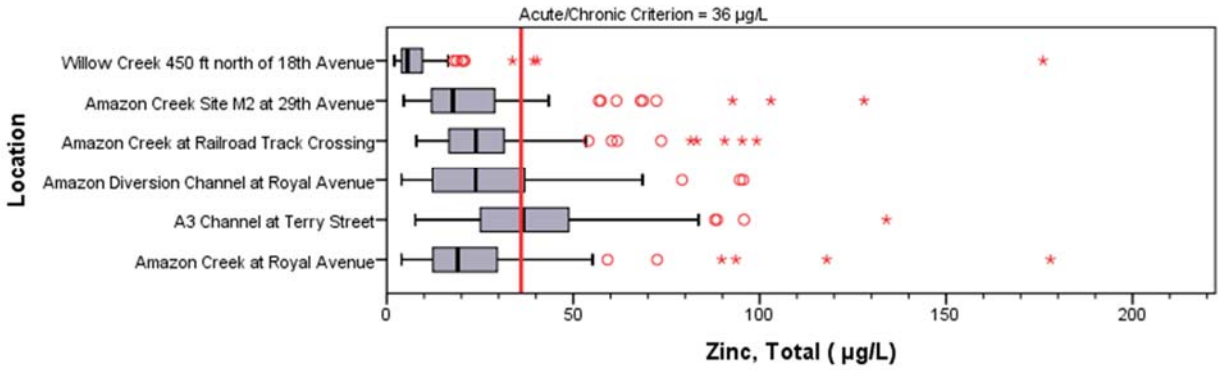
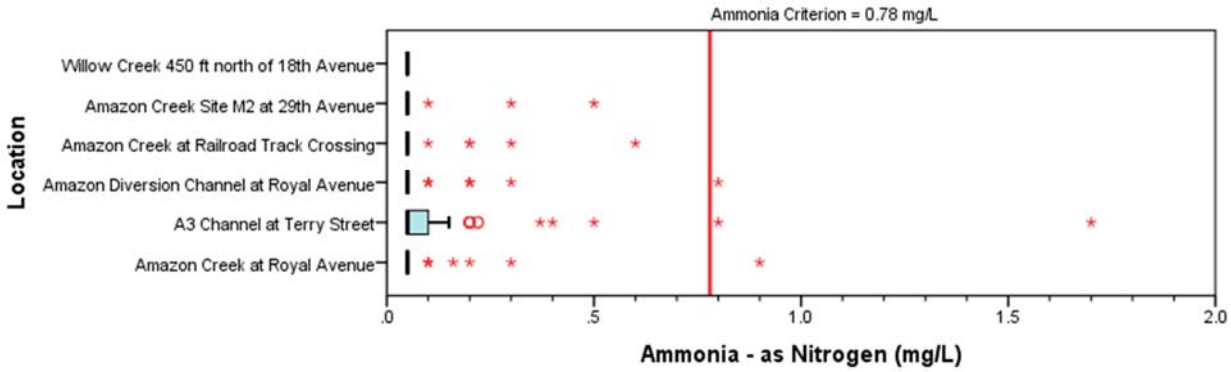


Figure B.147



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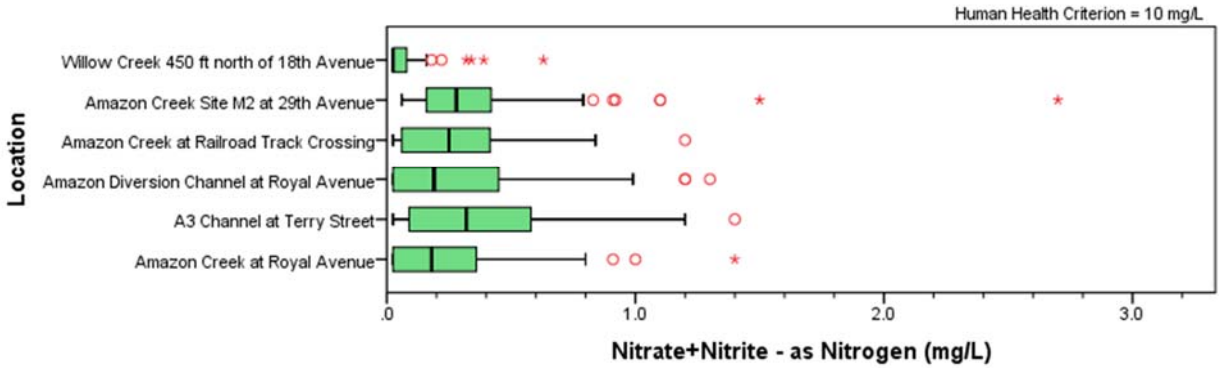

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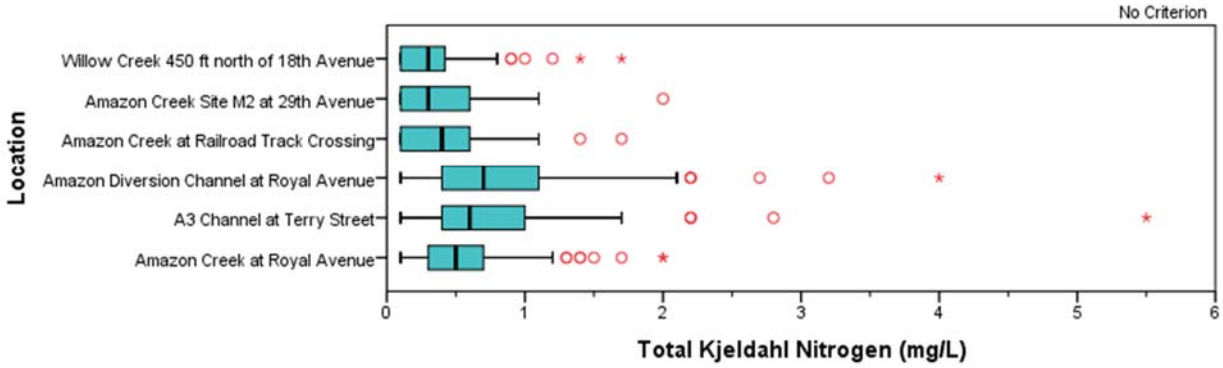

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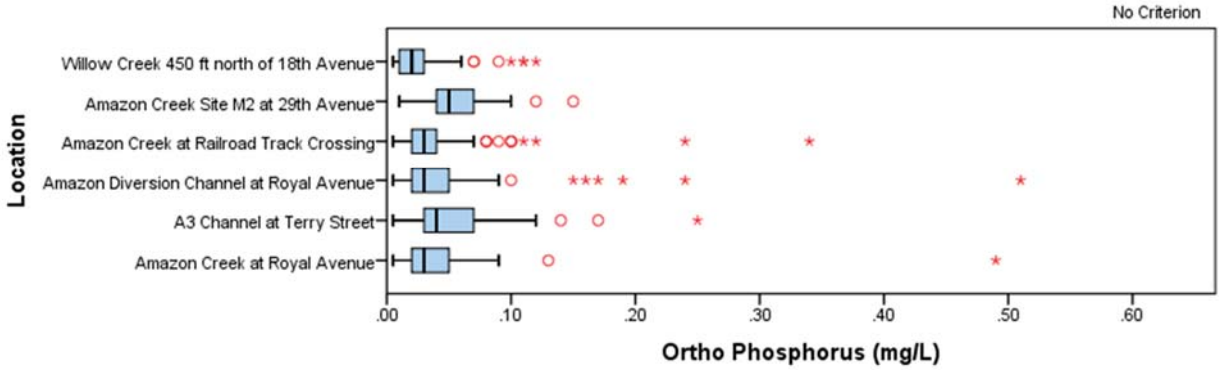
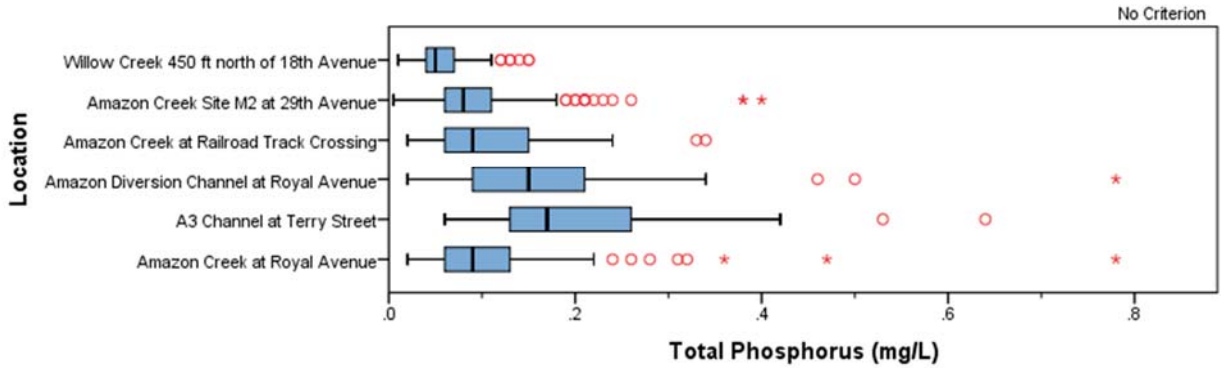


Figure B.151



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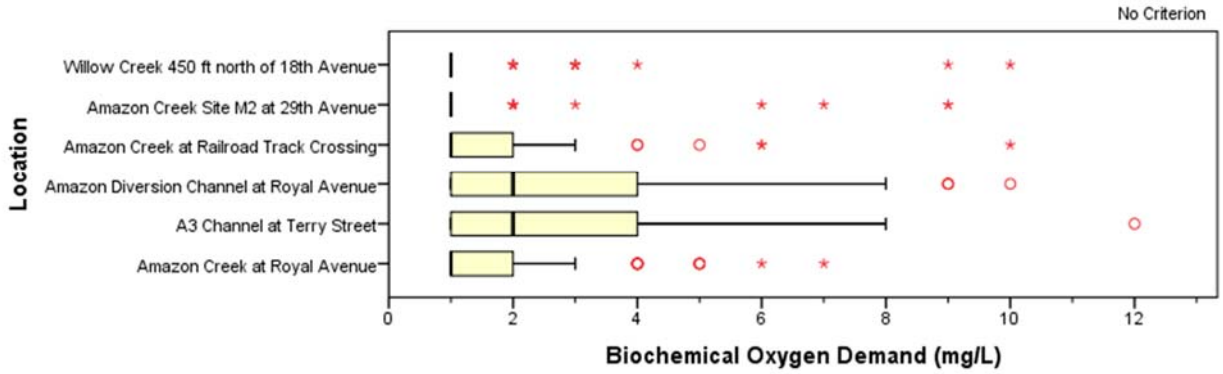

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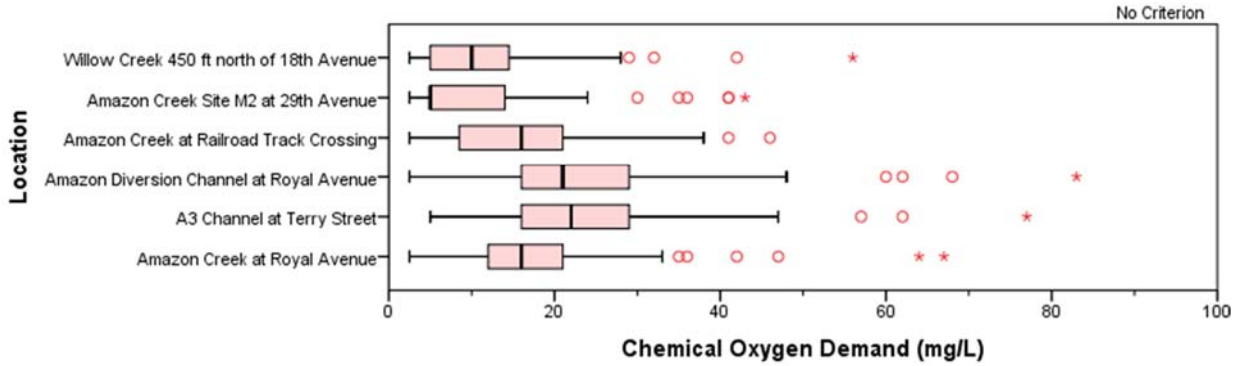

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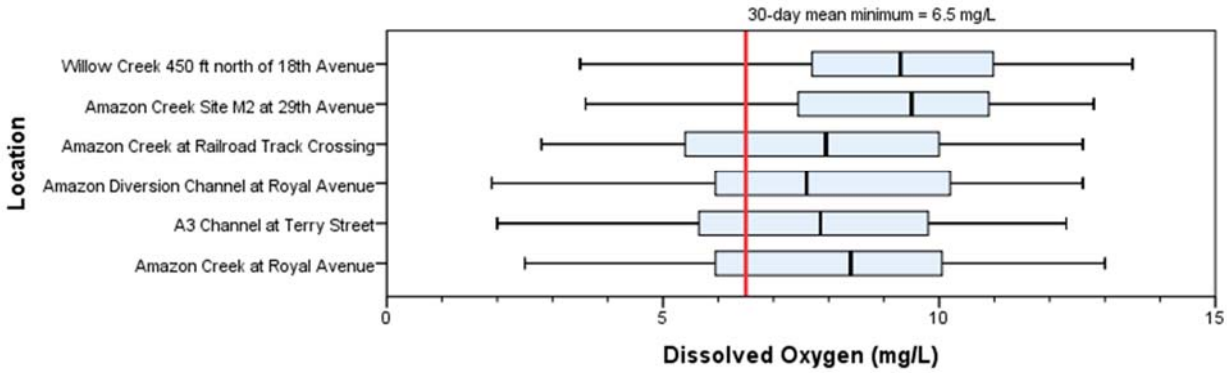

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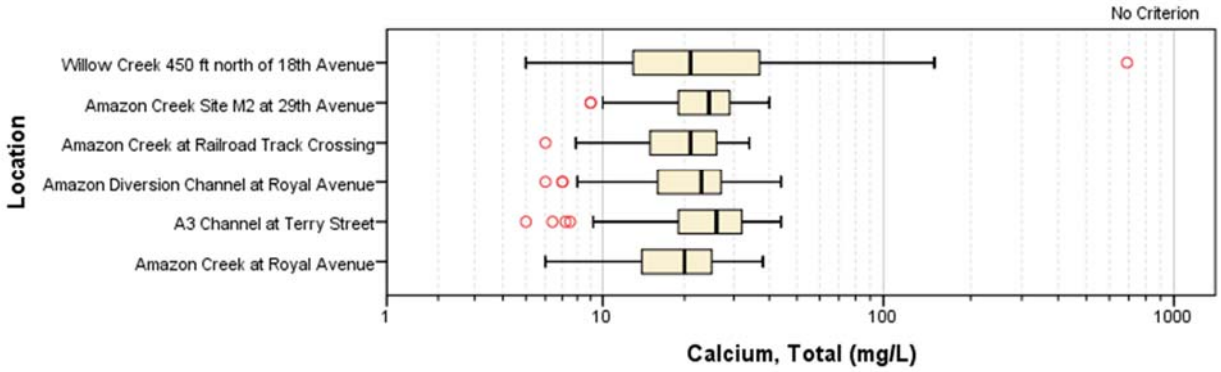

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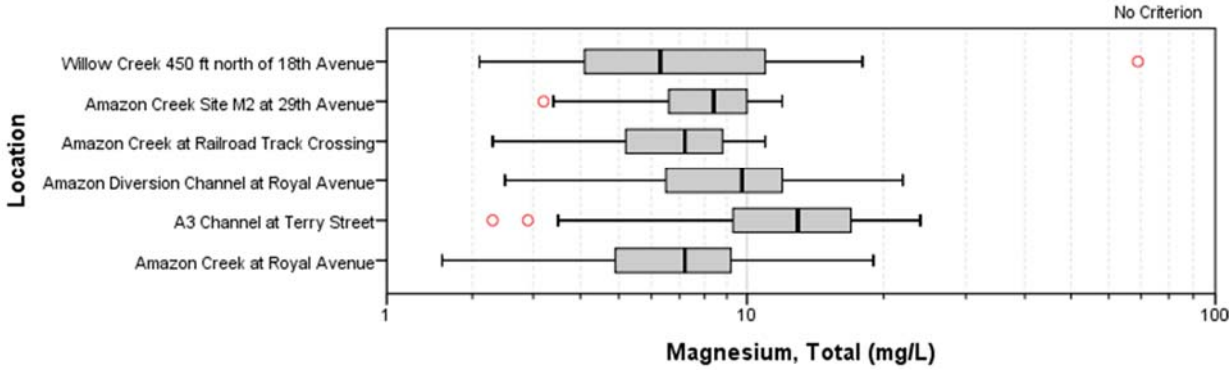

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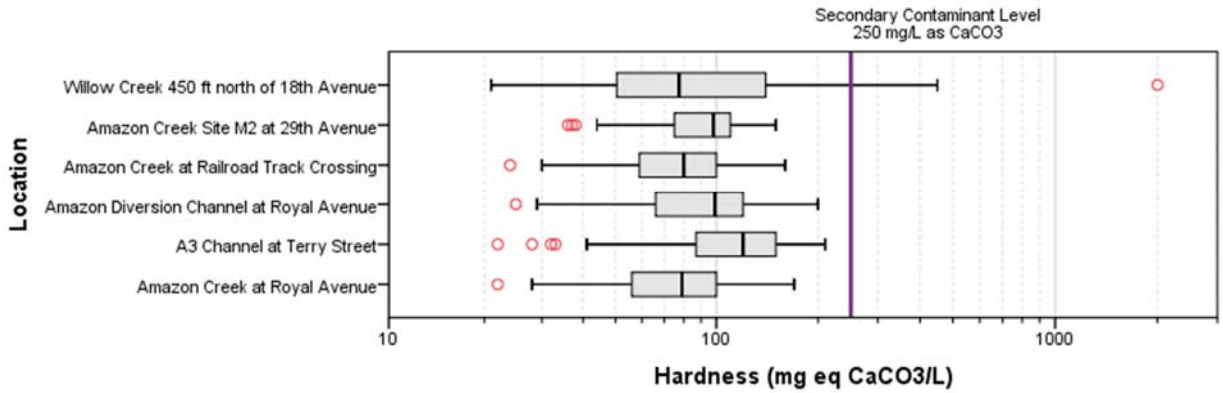

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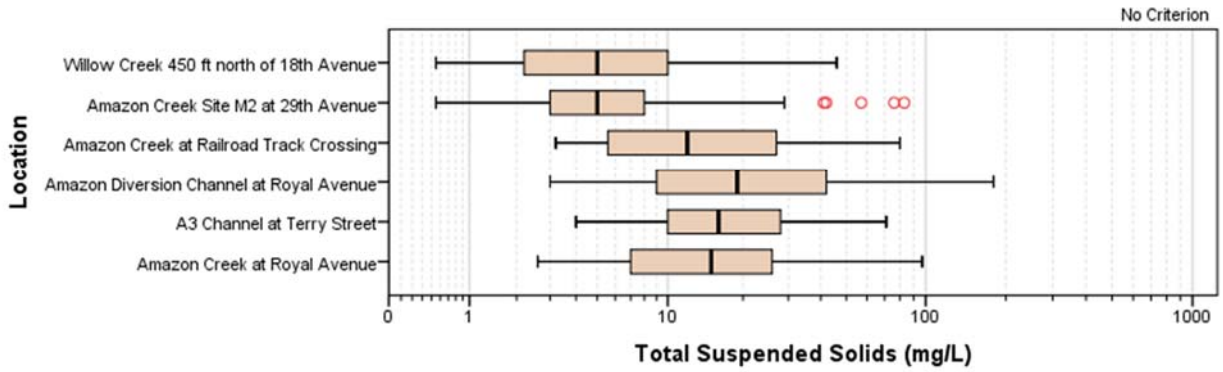

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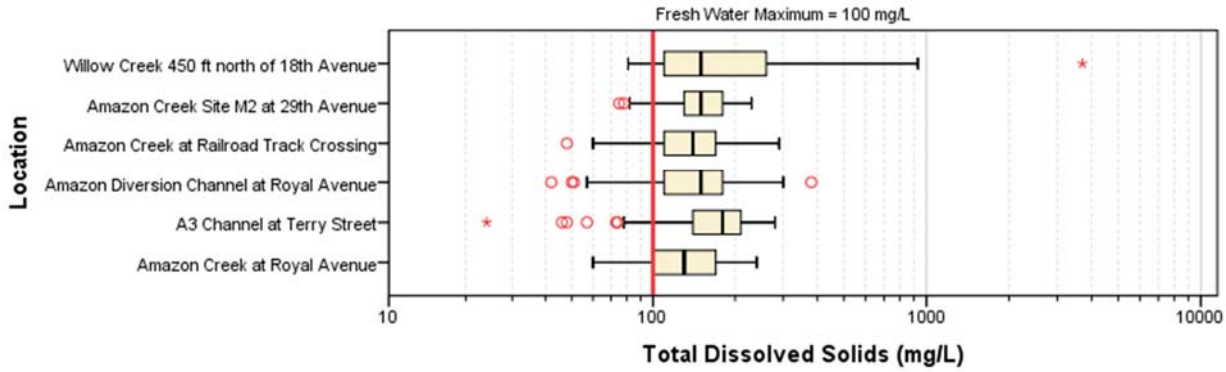

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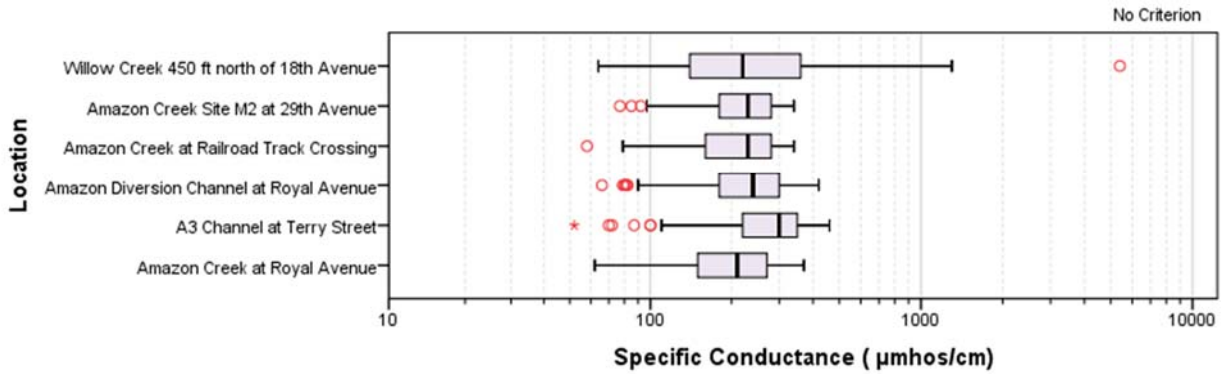

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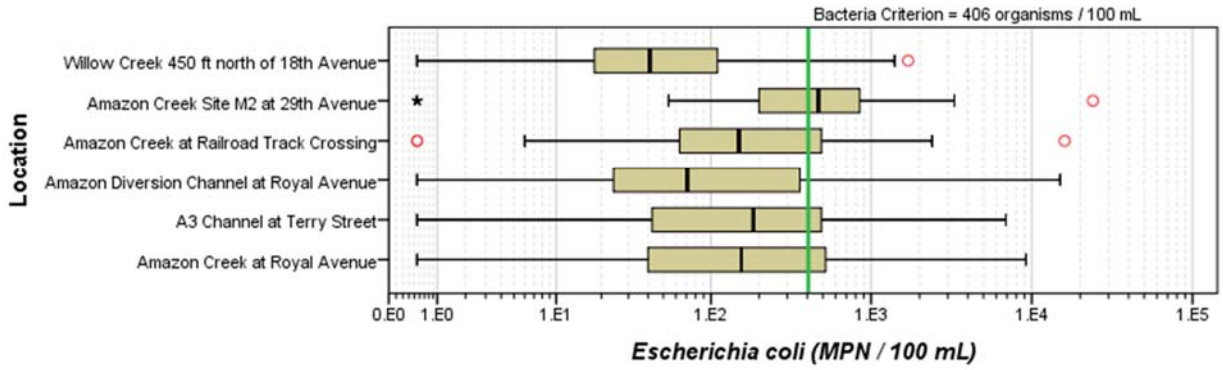

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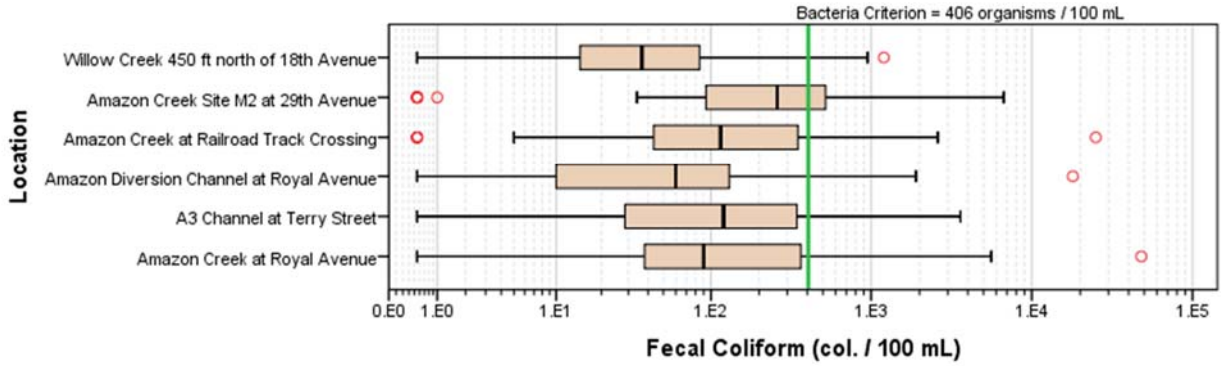

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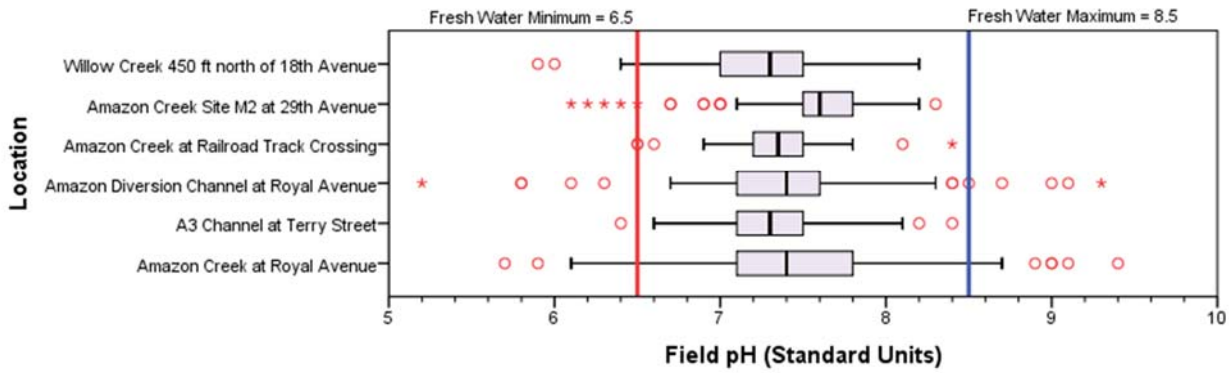

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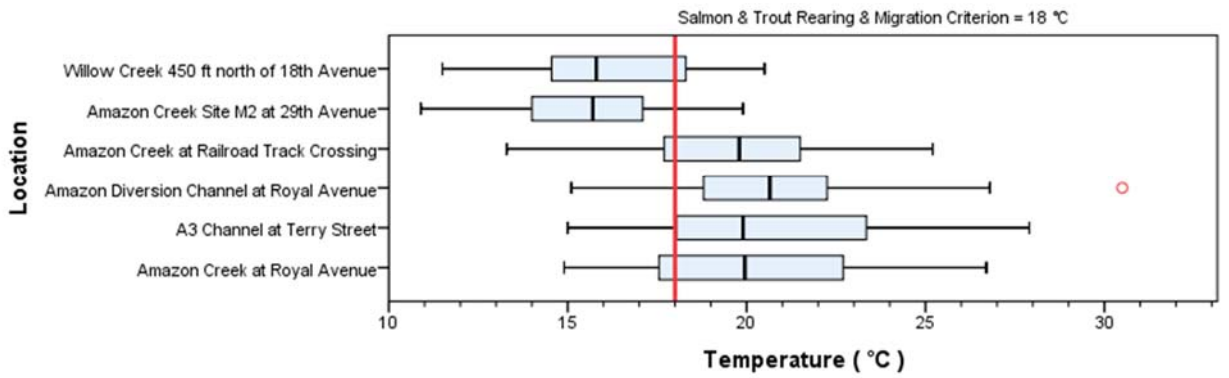

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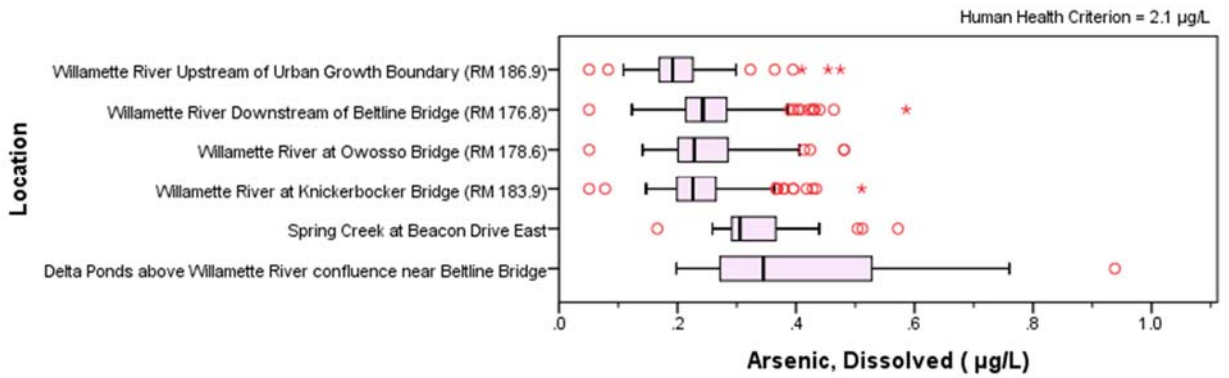

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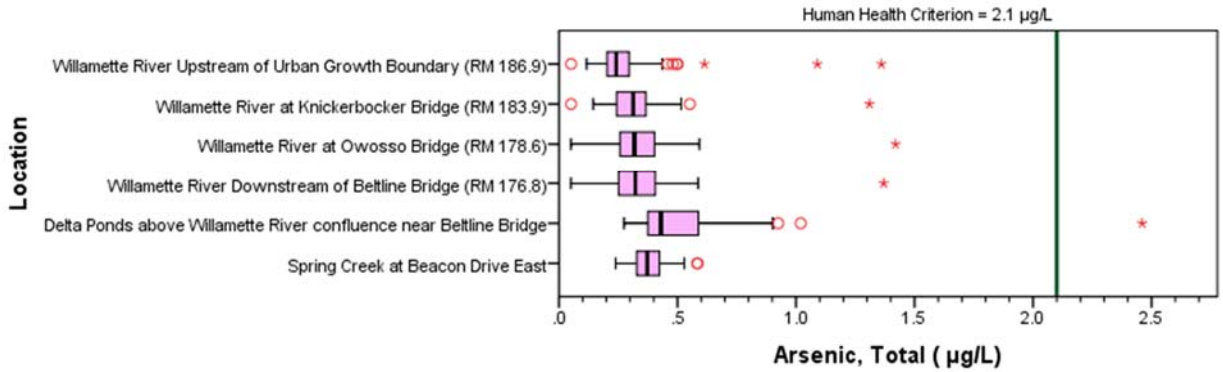

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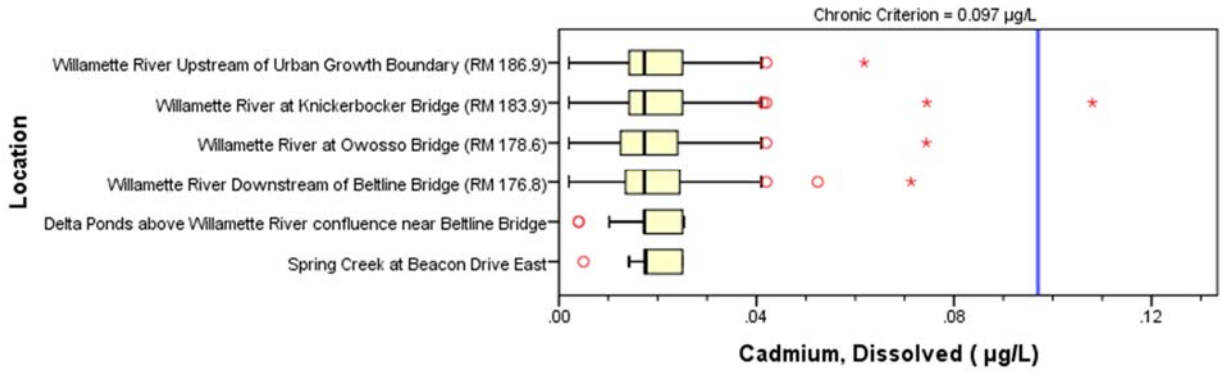

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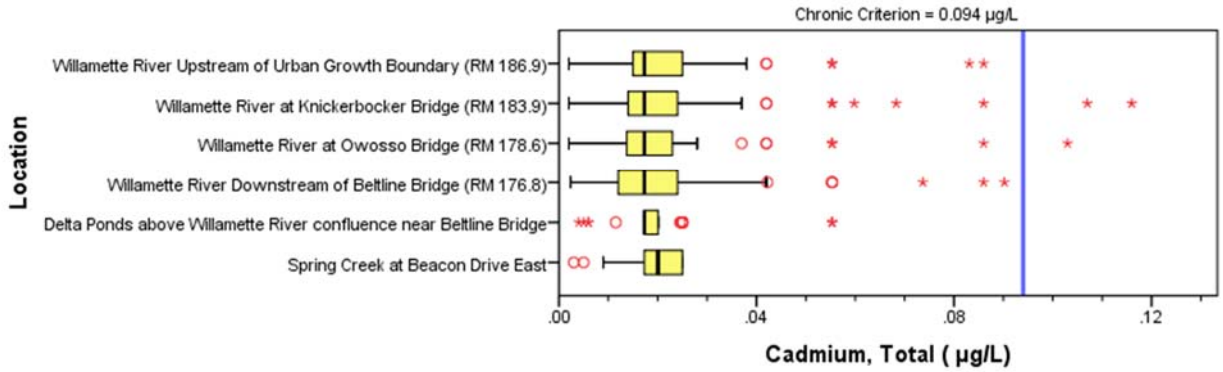

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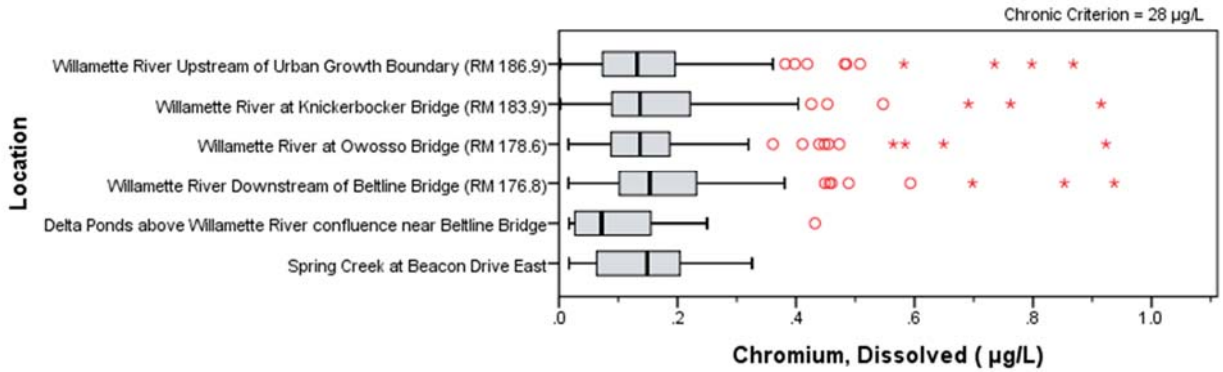

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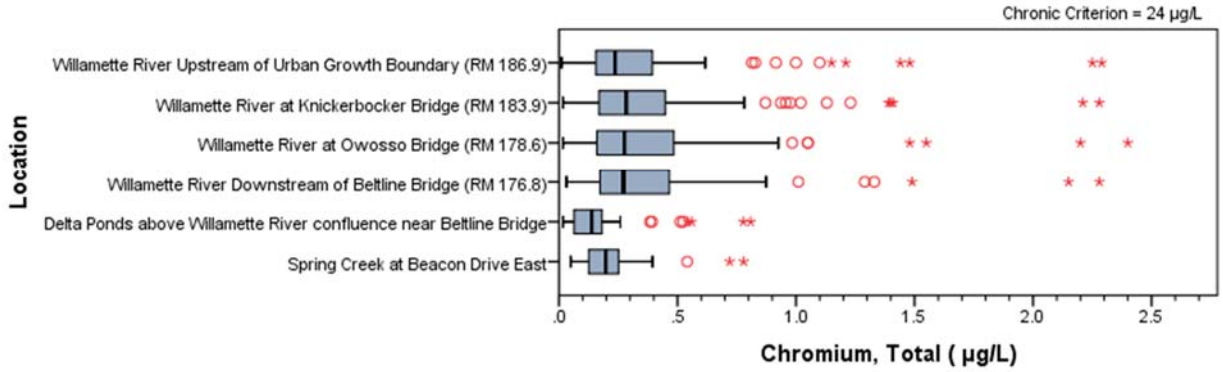

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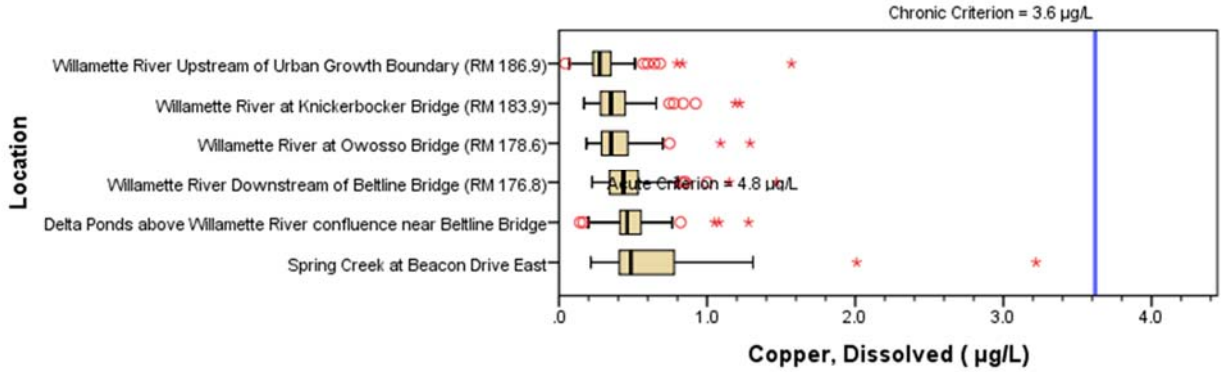

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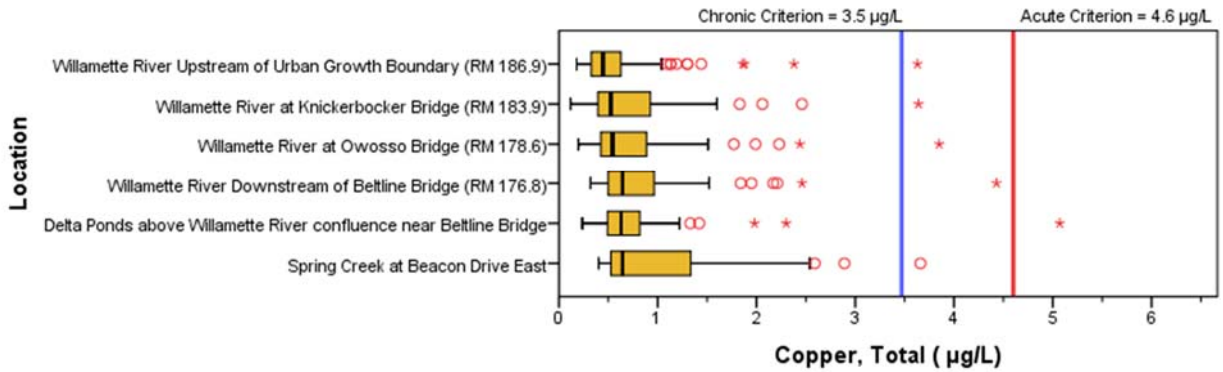

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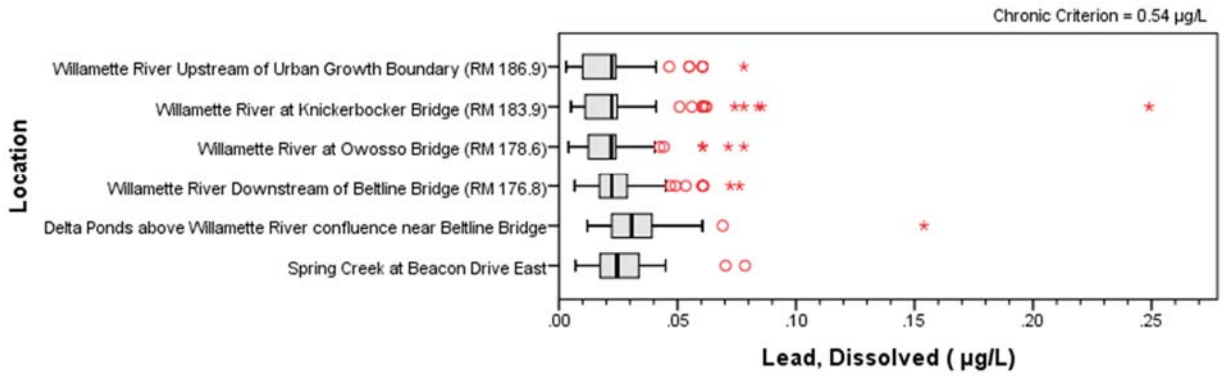

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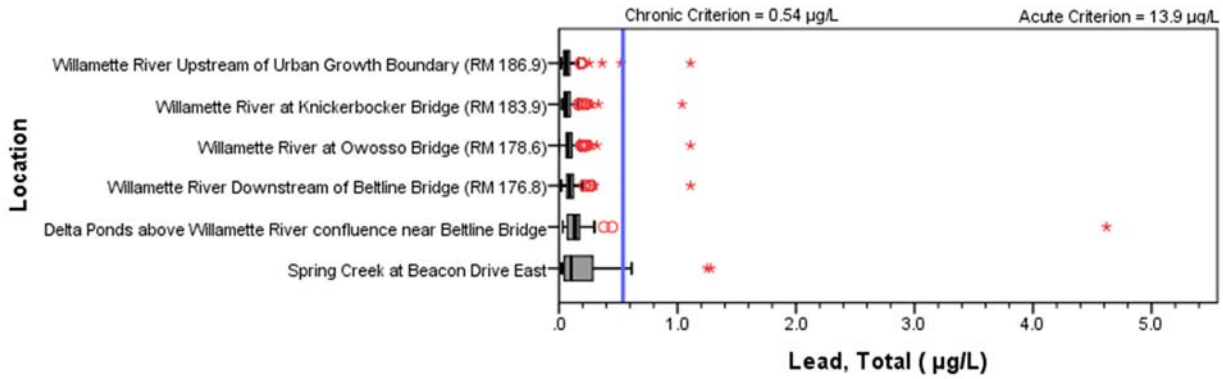

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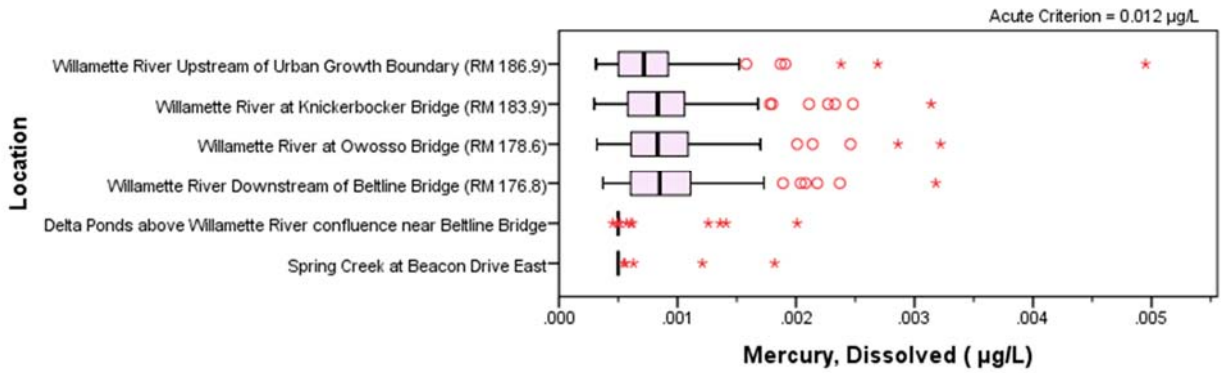

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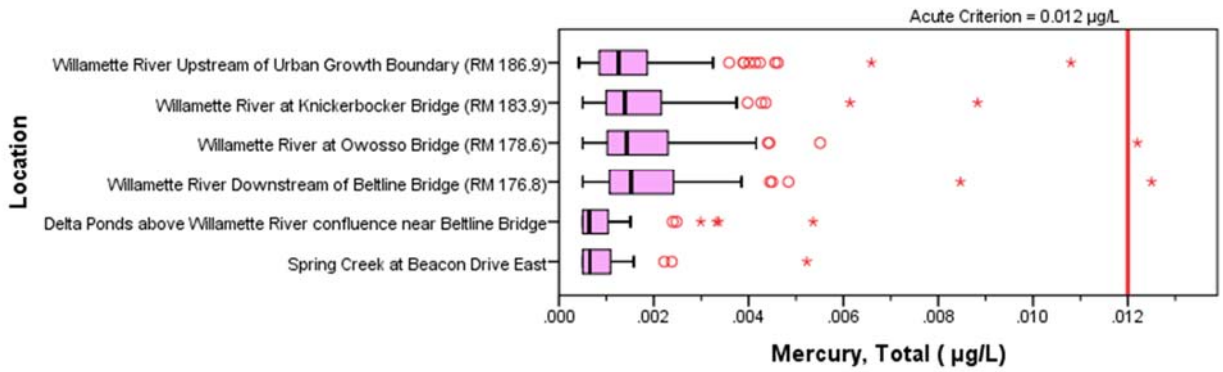

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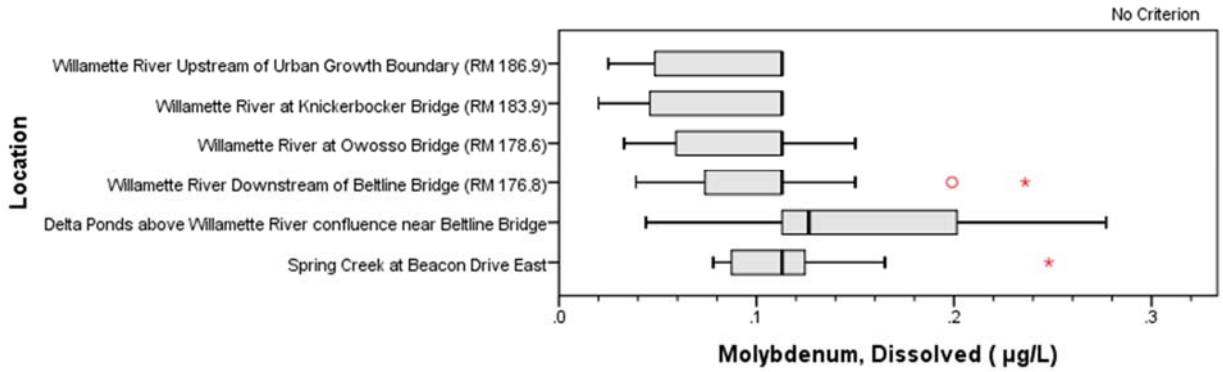

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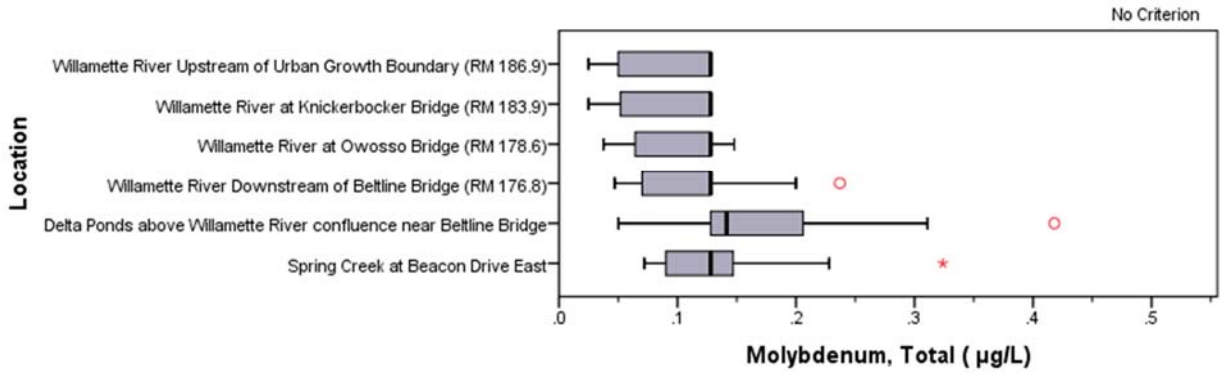

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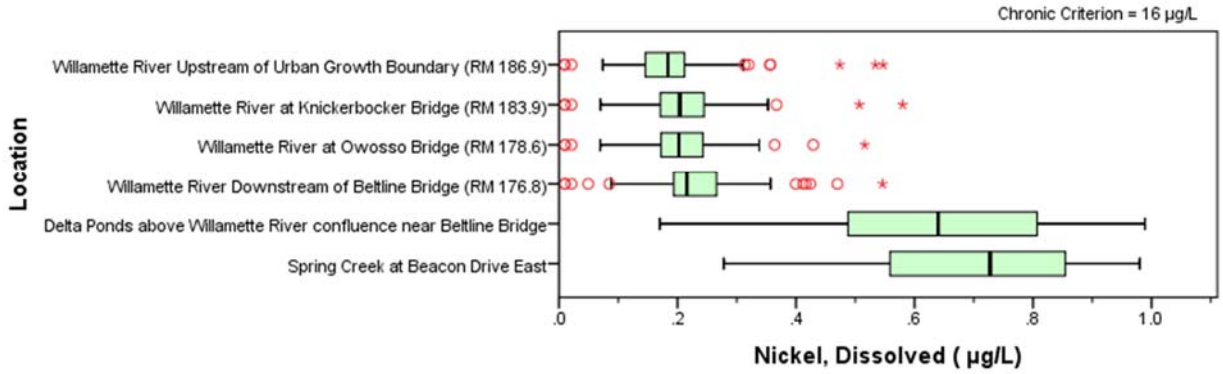

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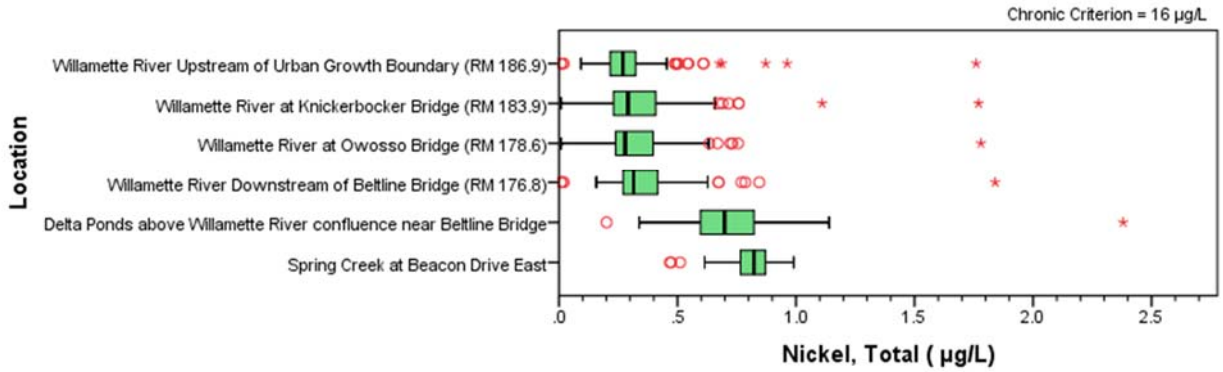

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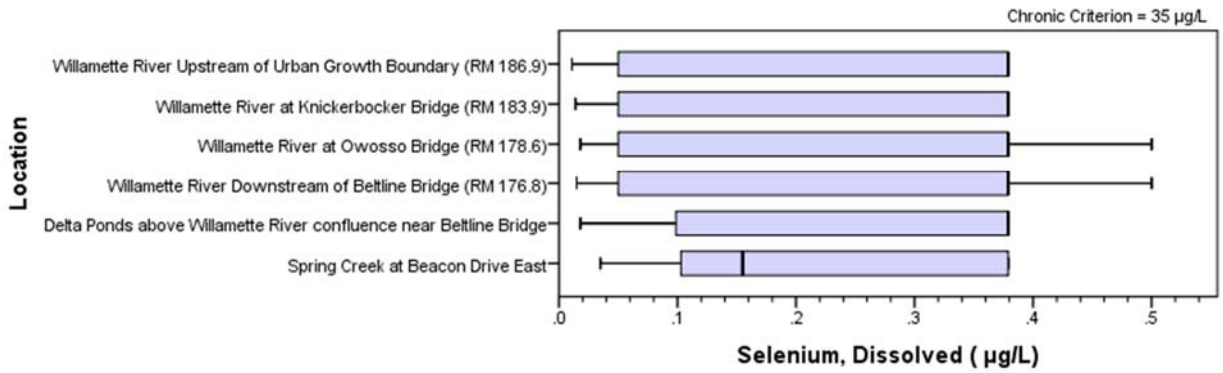

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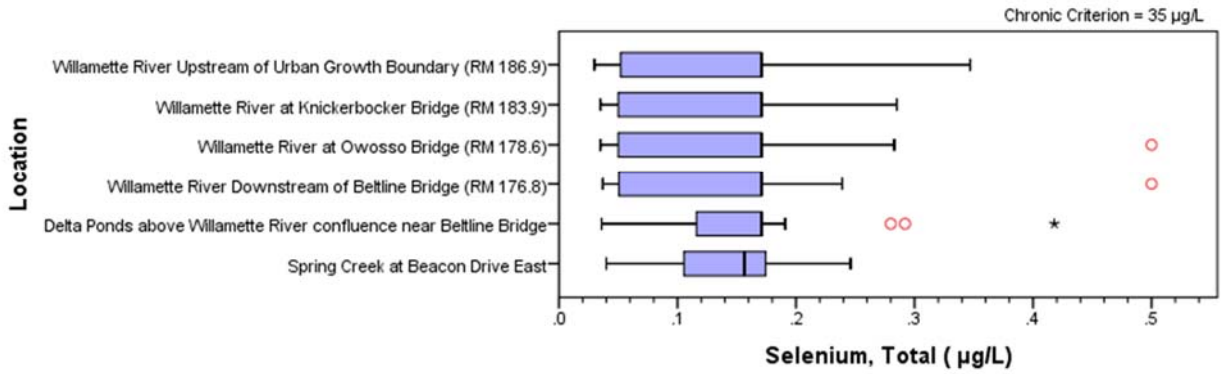

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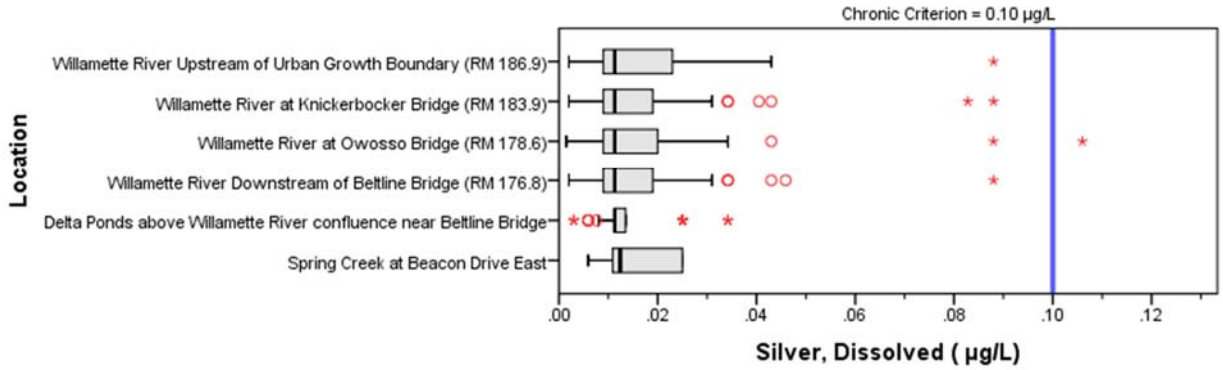

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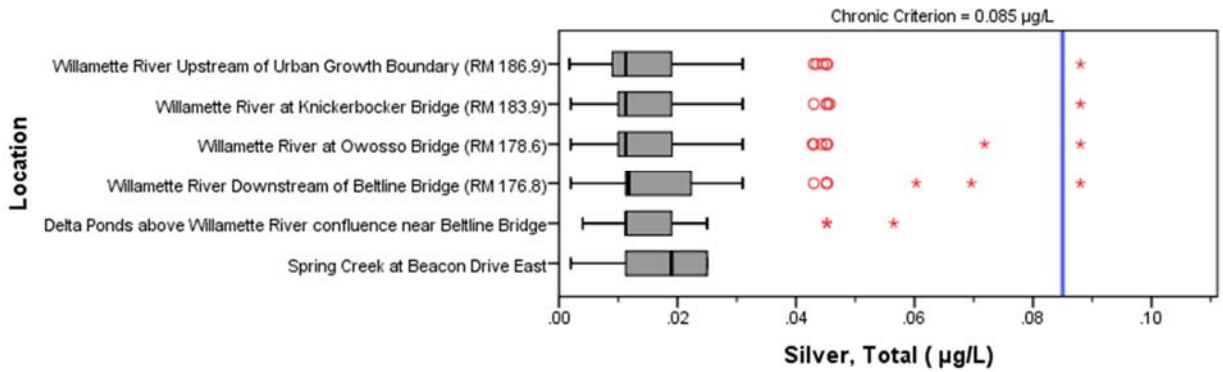

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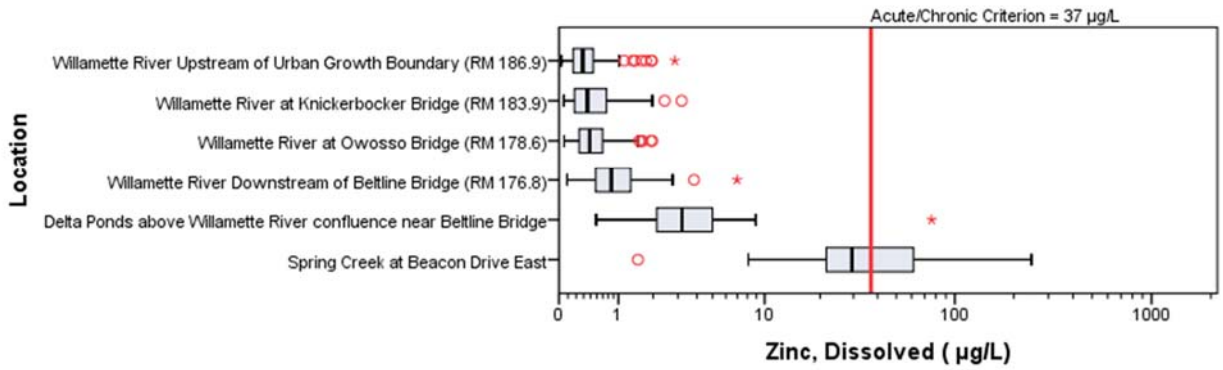

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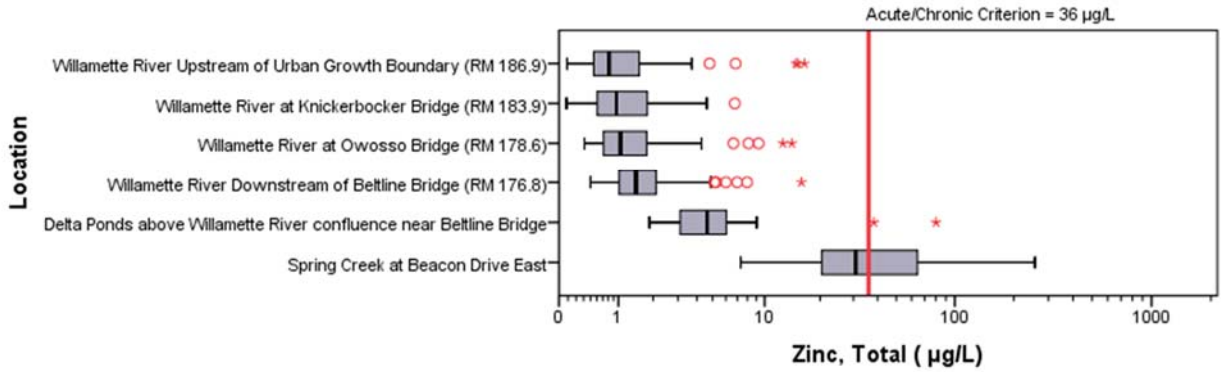

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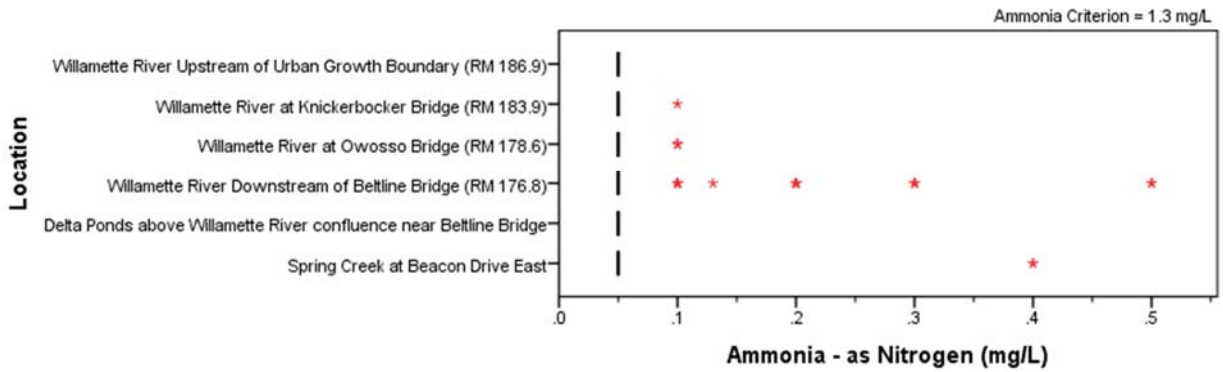

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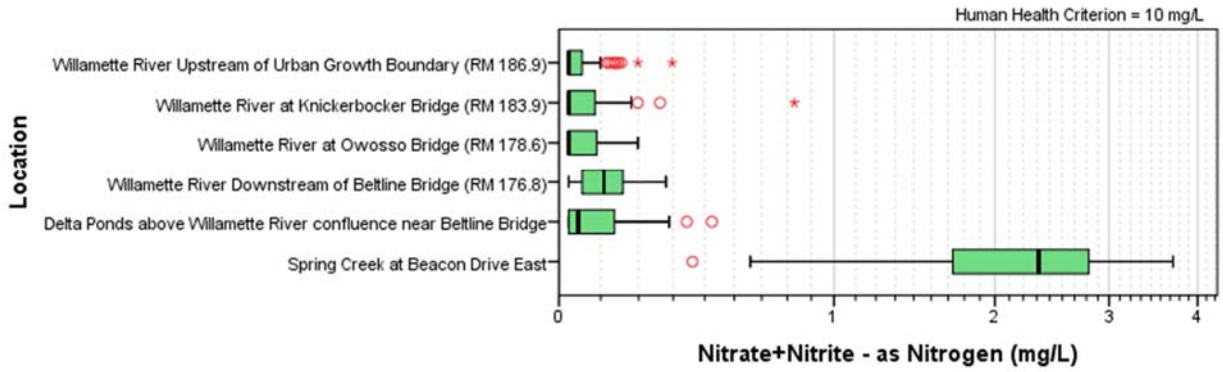

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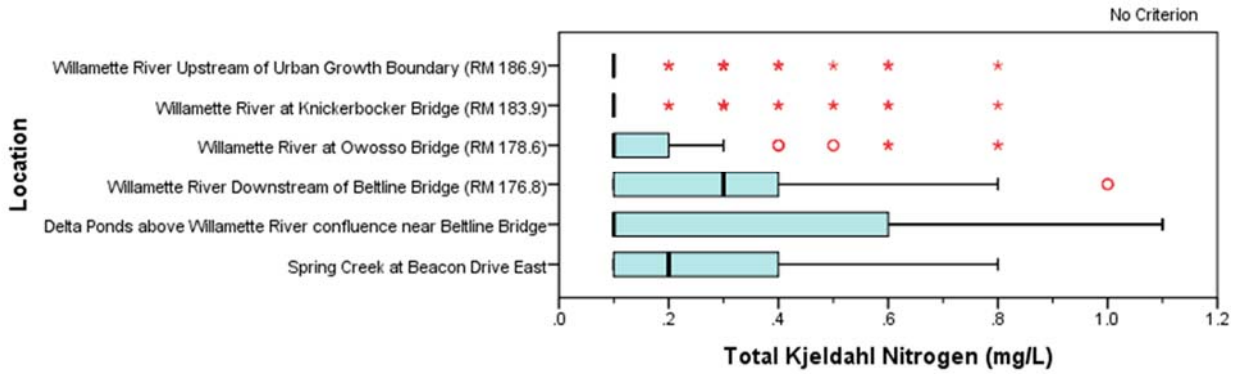

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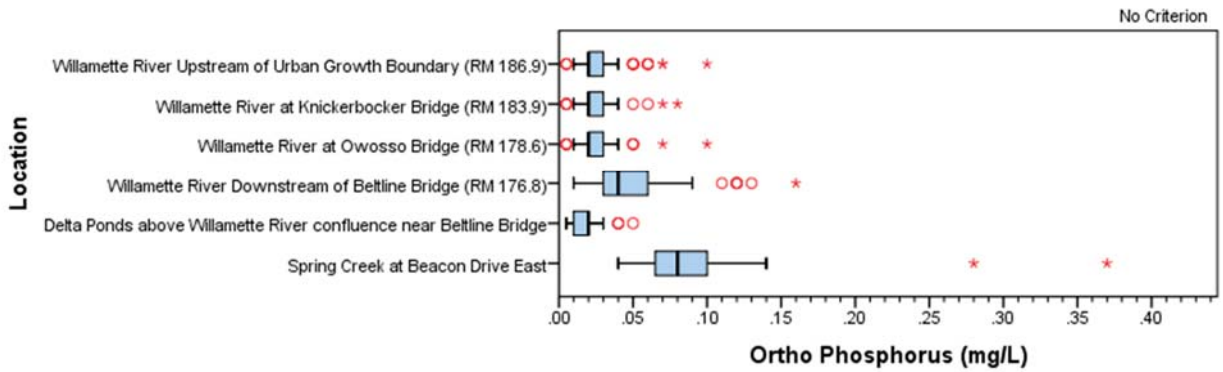

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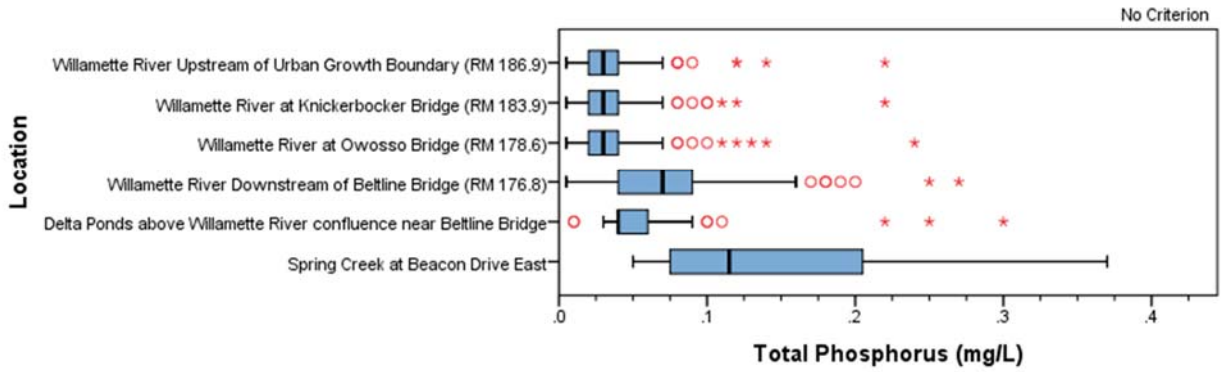

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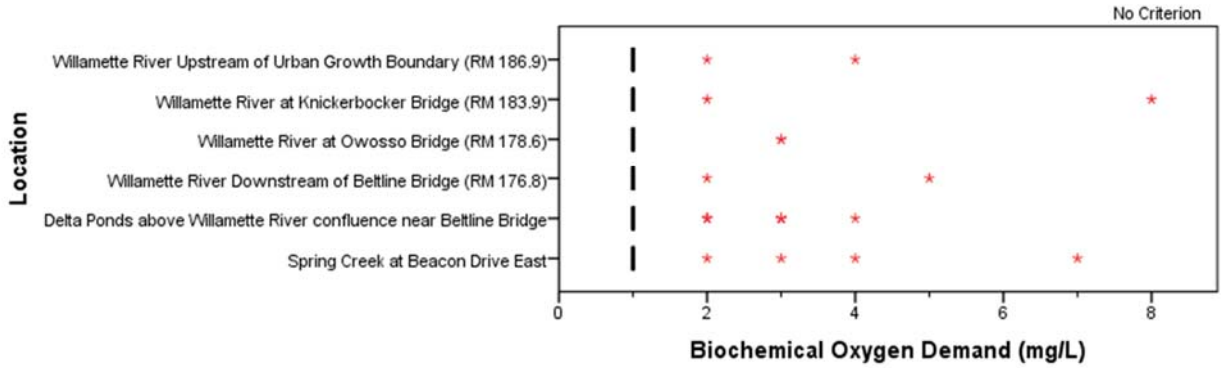

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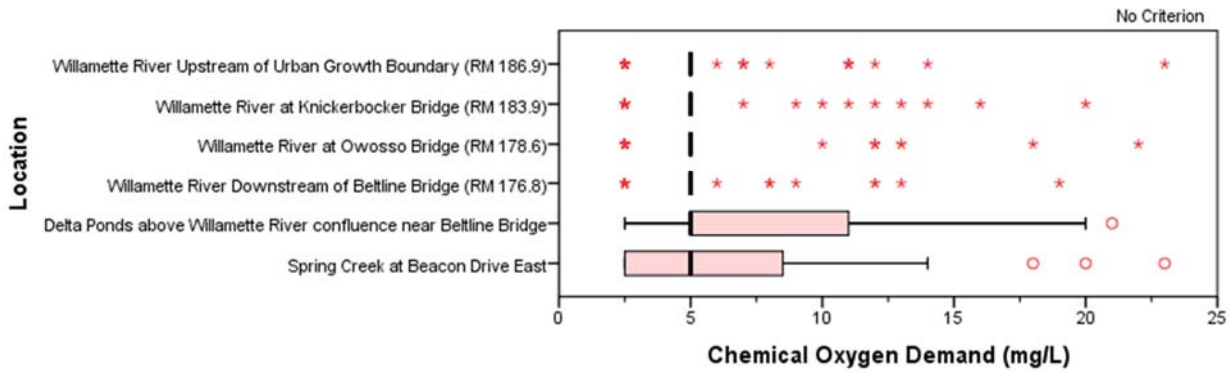

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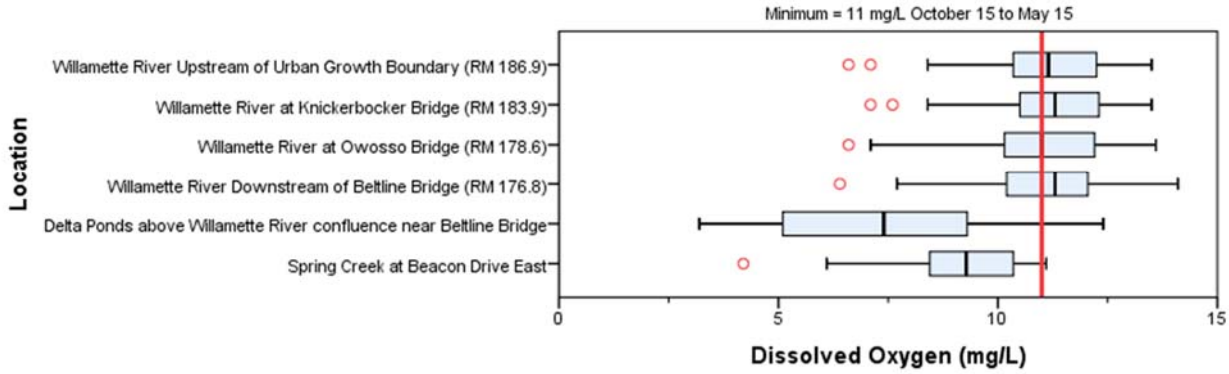

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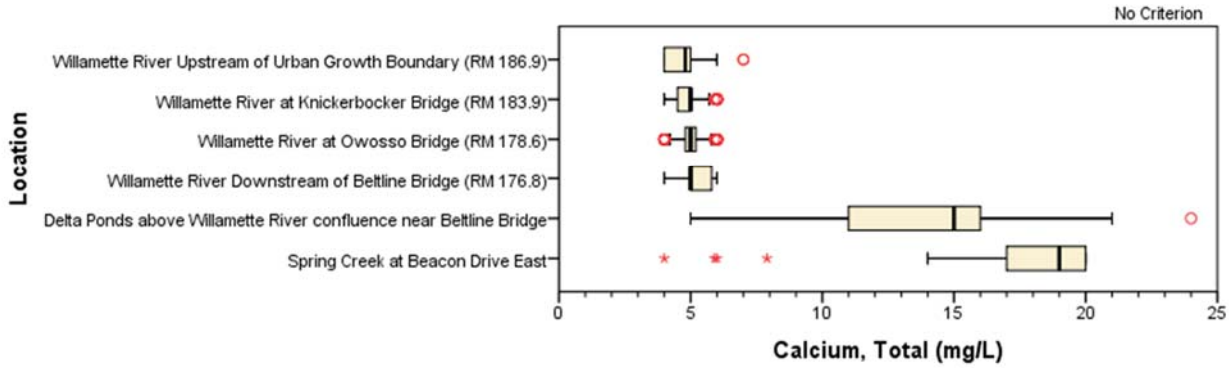

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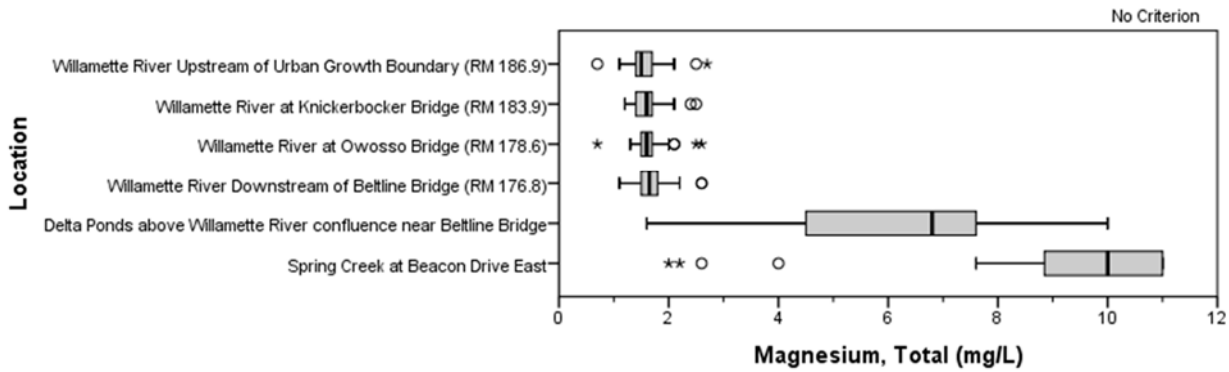

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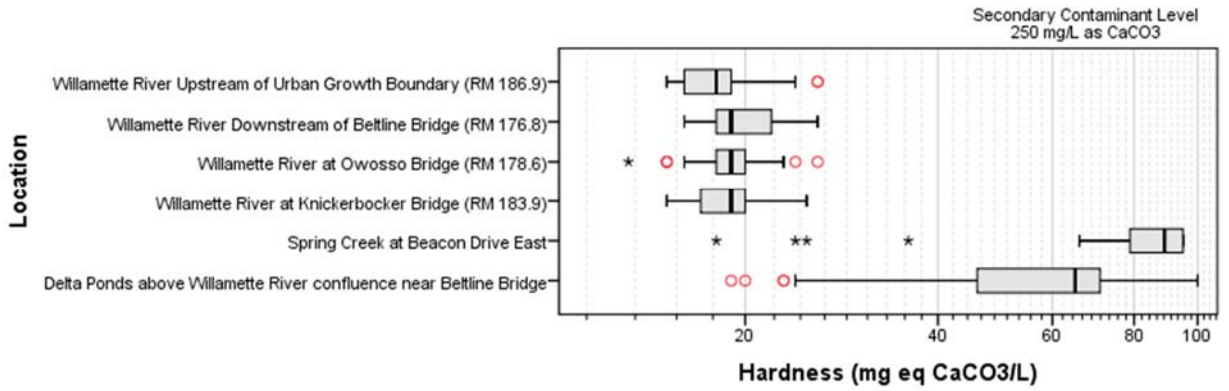

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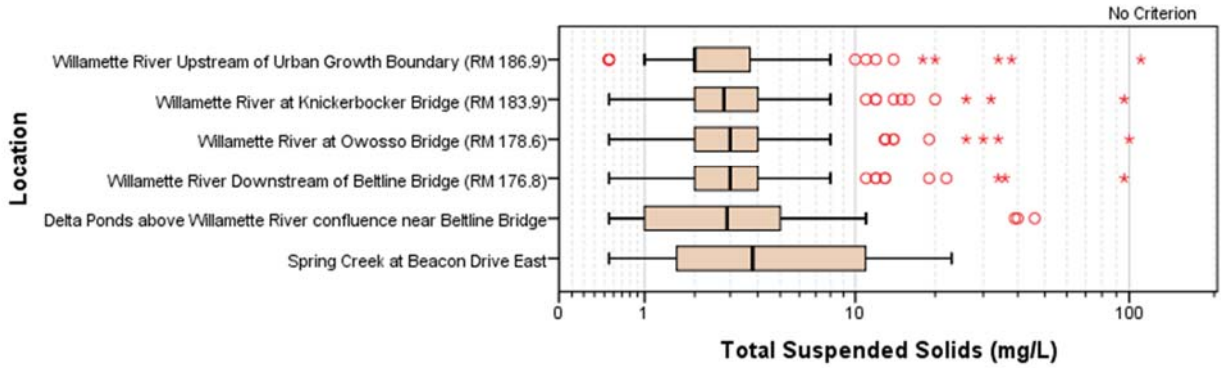

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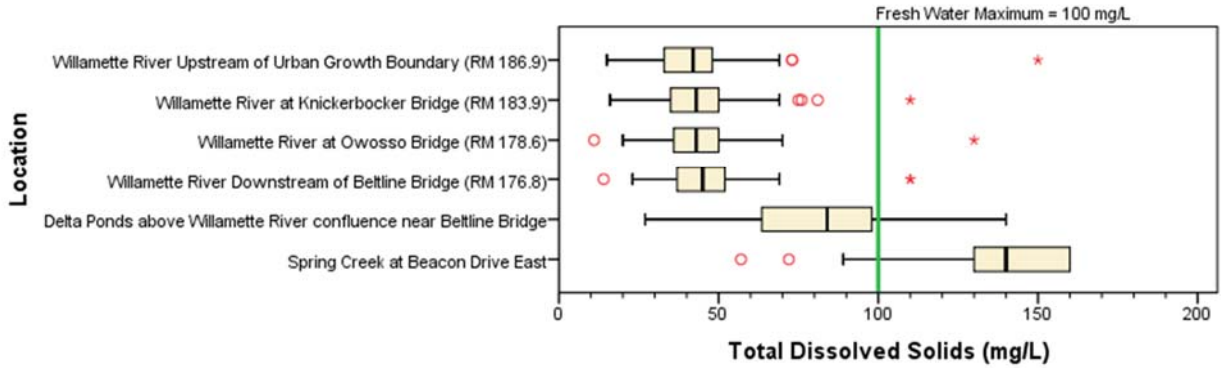

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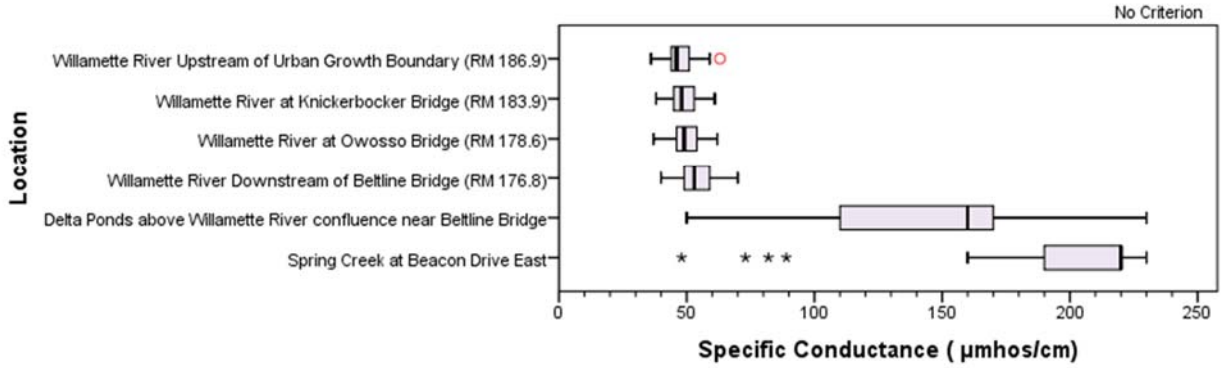

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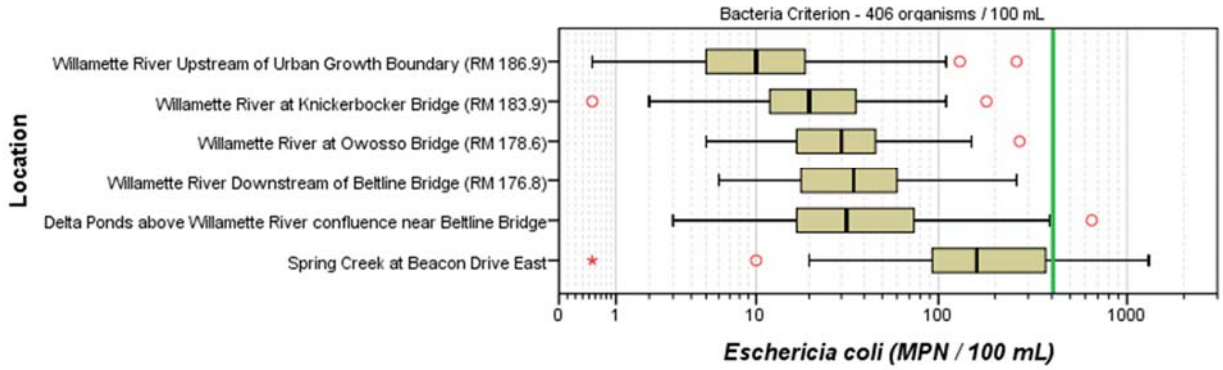

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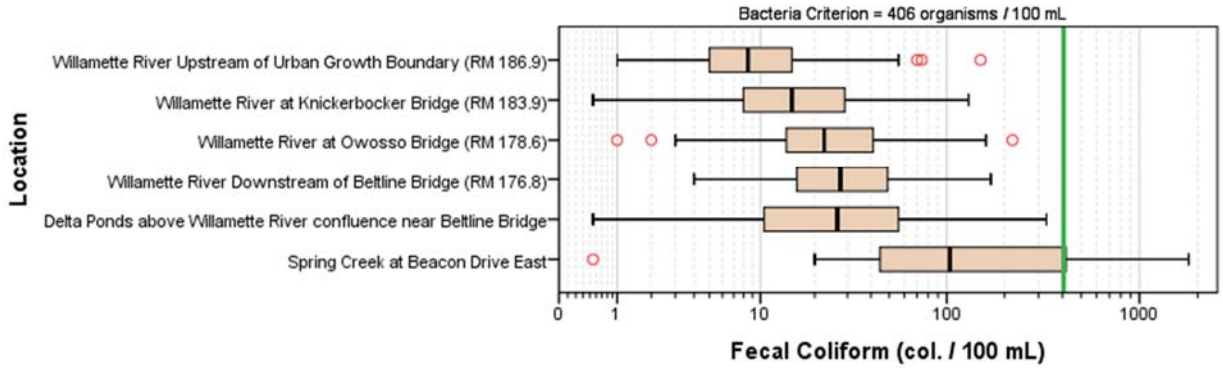

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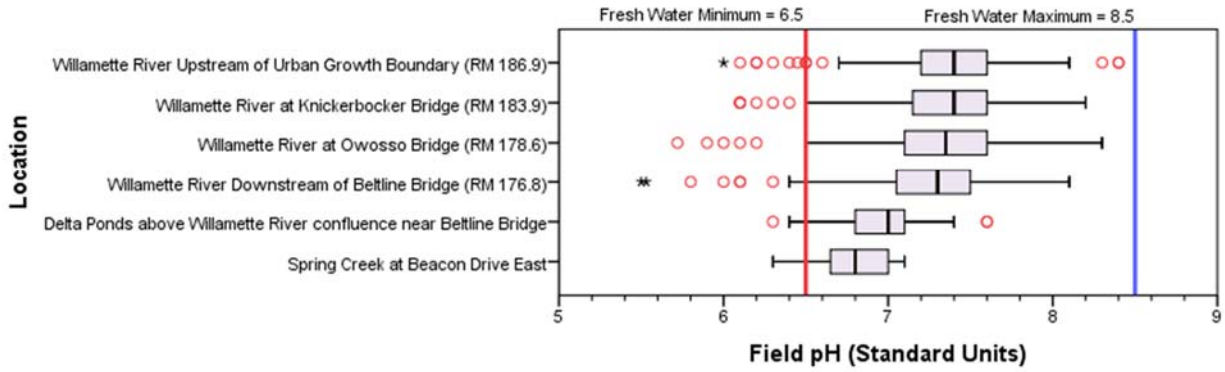

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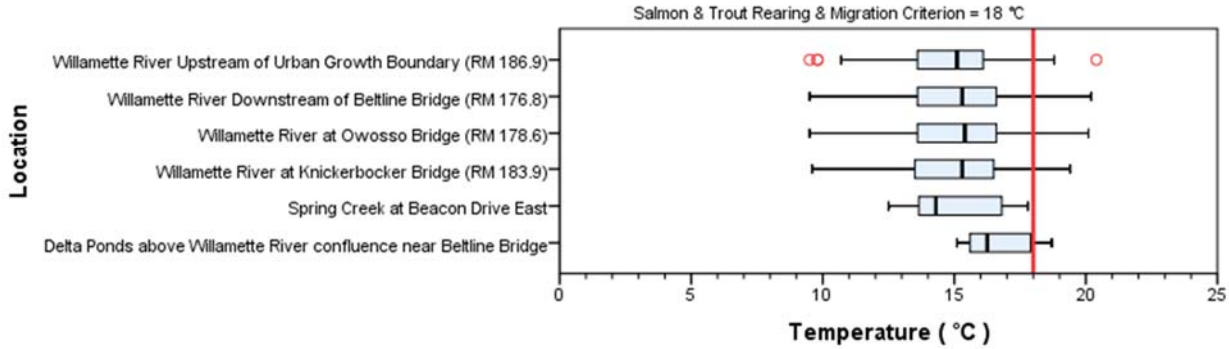

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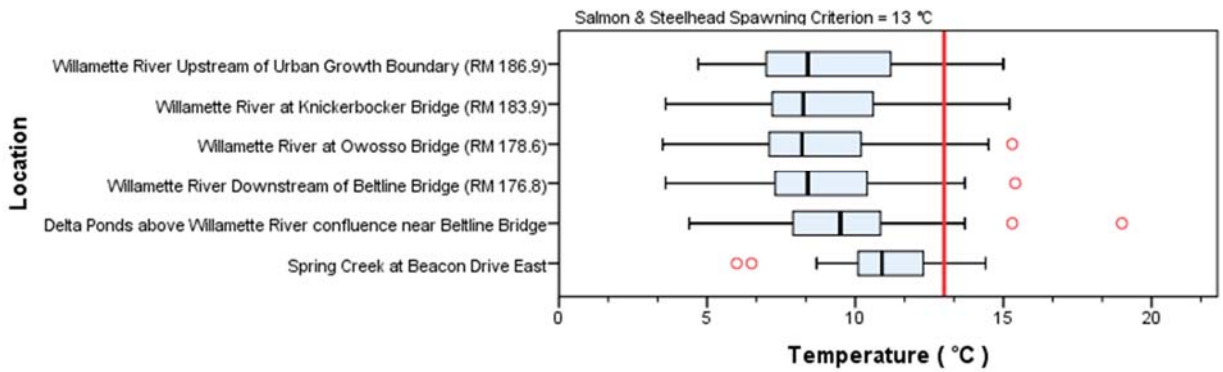

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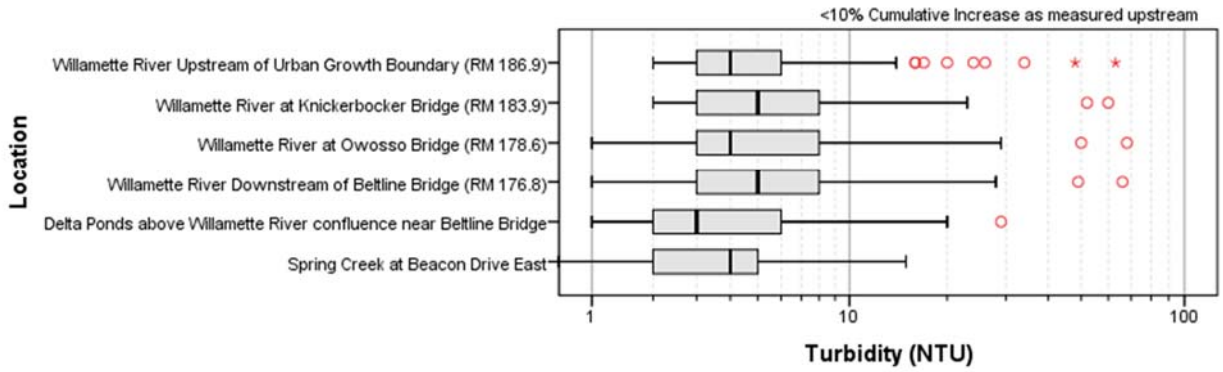

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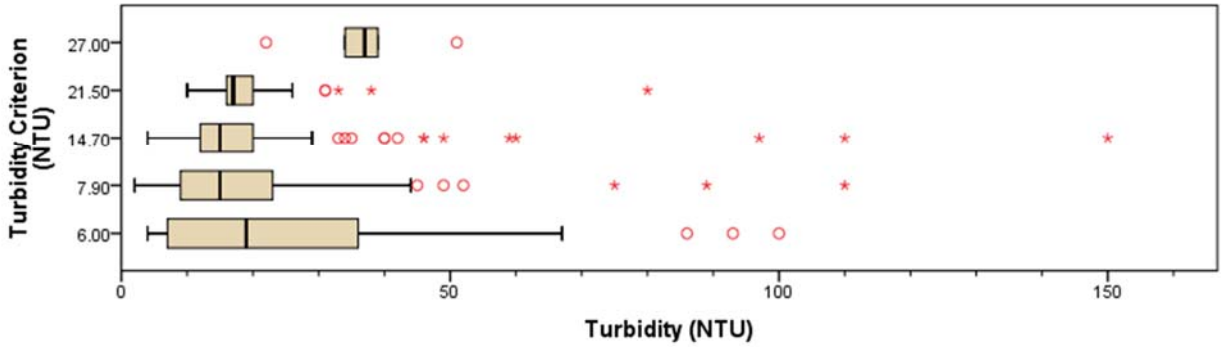

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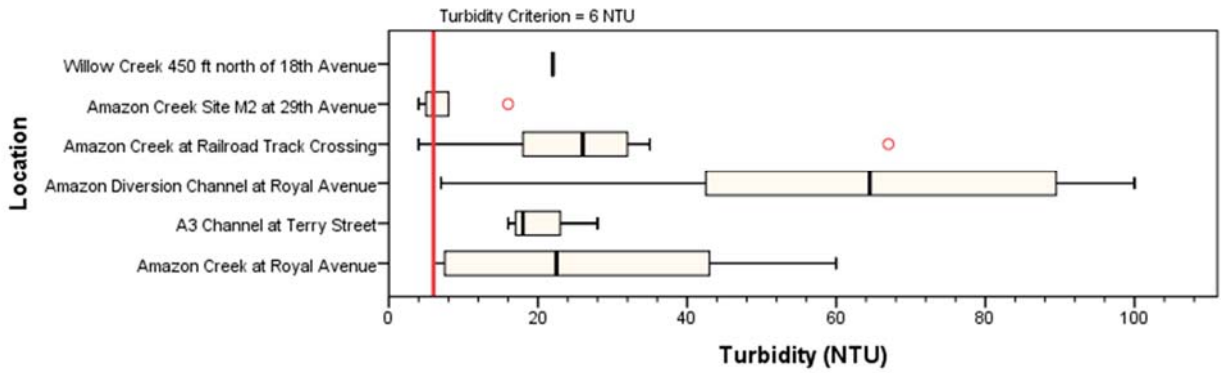

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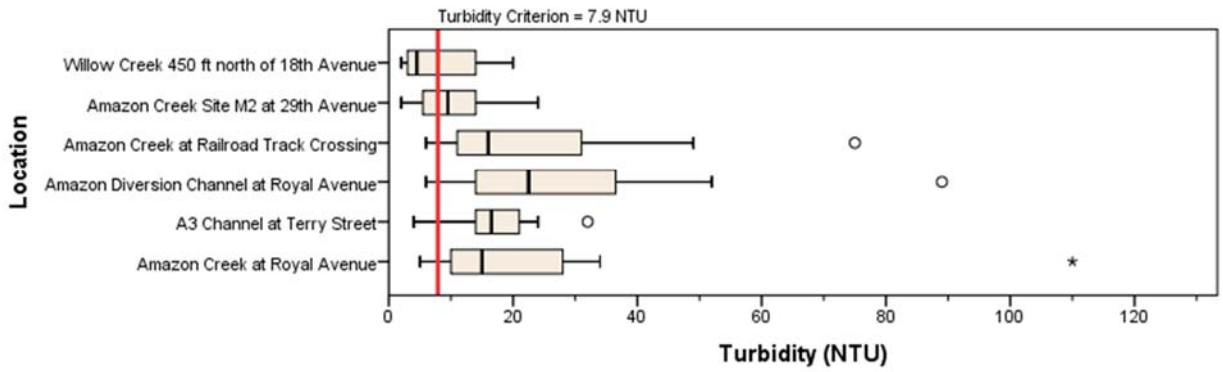
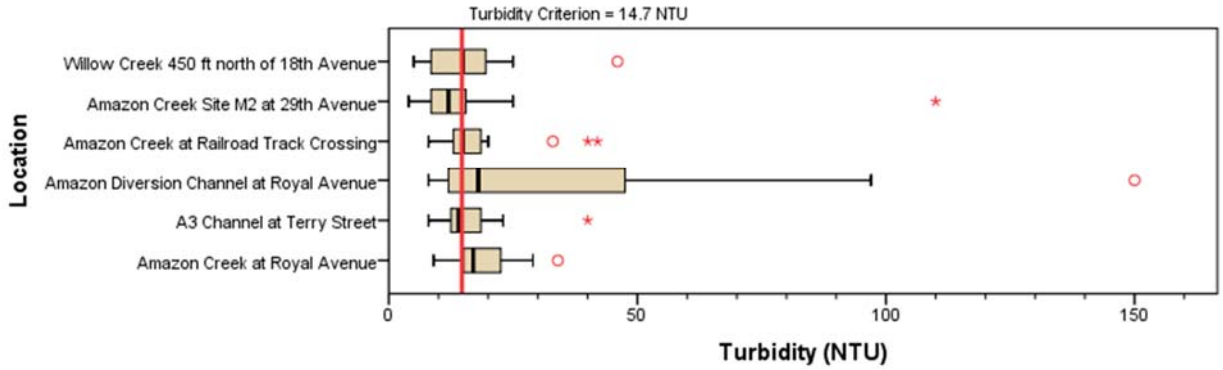


Figure B.210



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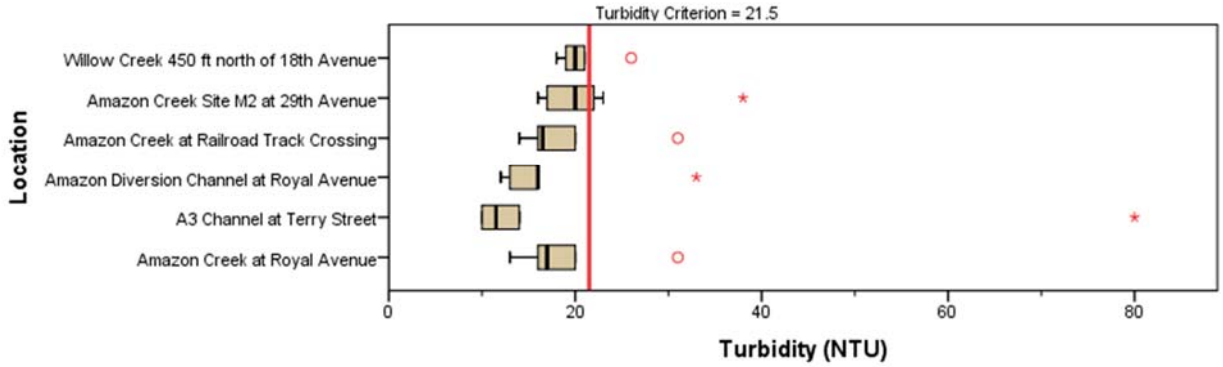

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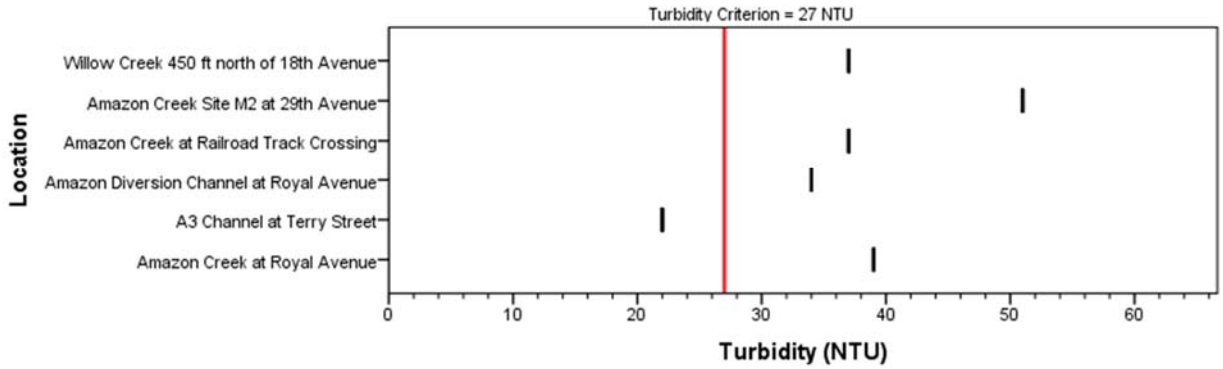


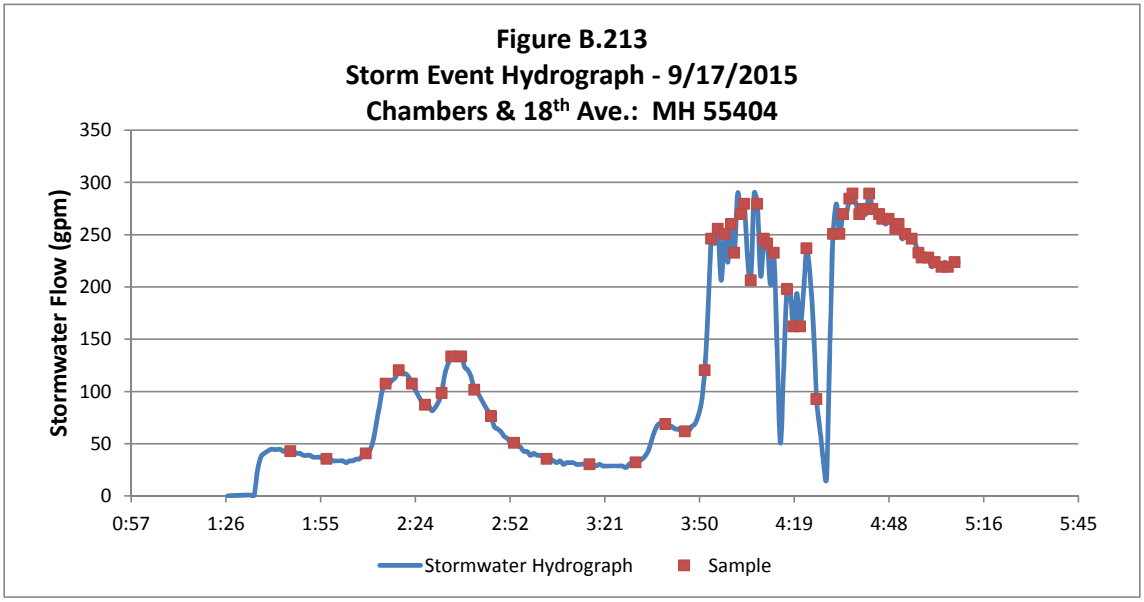


Figure B.213
Storm Event Hydrograph - 9/17/2015
Chambers & 18th Ave.: MH 55404
Stormwater Flow (gpm)
350
300
250
200
150
100
50
0
0:57
1:26
1:55
2:24
2:52
3:21
3:50
4:19
4:48
5:16
5:45
Stormwater Hydrograph
Sample

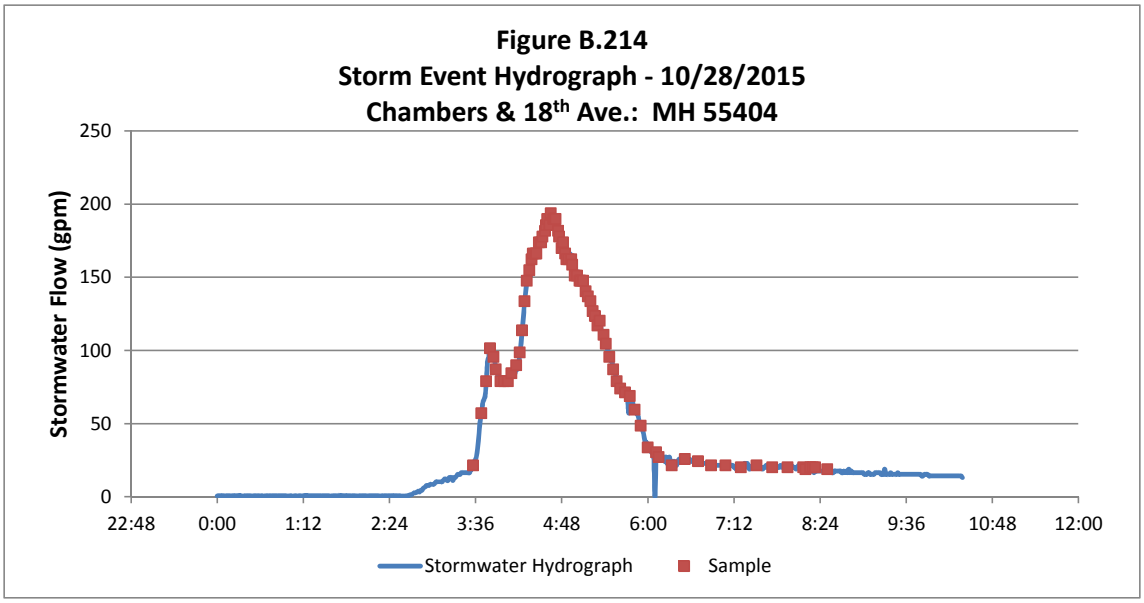


Figure B.214
Storm Event Hydrograph - 10/28/2015
Chambers & 18th Ave.: MH 55404
Stormwater Flow (gpm)
250
200
150
100
50
0
22:48
0:00
1:12
2:24
3:36
4:48
6:00
7:12
8:24
9:36
10:48
12:00
Stormwater Hydrograph
Sample

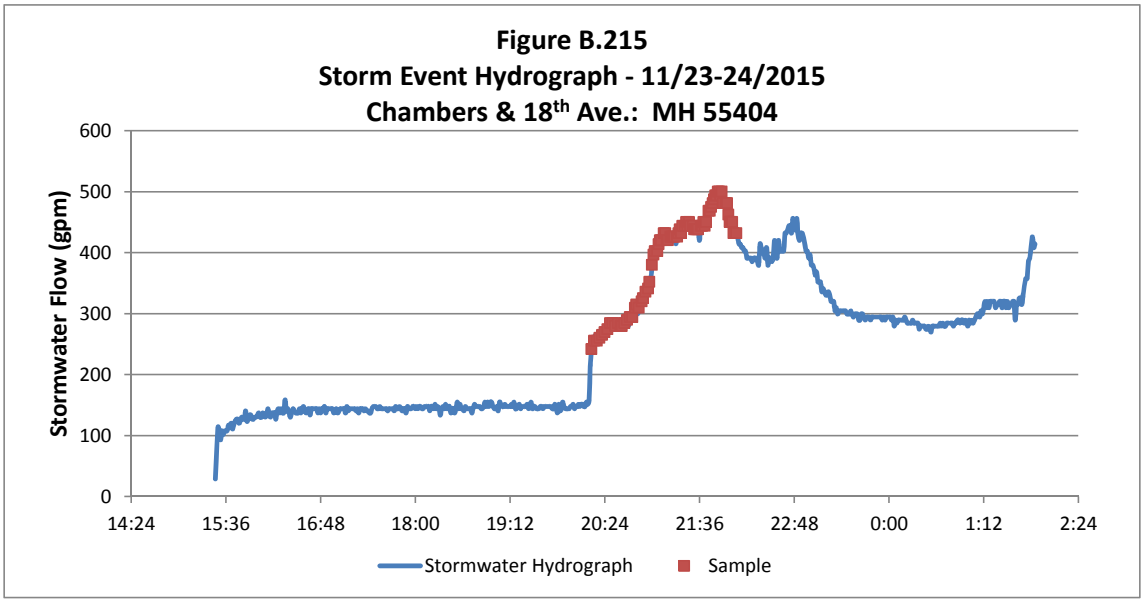


Figure B.215
Storm Event Hydrograph - 11/23-24/2015
Chambers & 18th Ave.: MH 55404
Stormwater Flow (gpm)
600
500
400
300
200
100
0
14:24
15:36
16:48
18:00
19:12
20:24
21:36
22:48
0:00
1:12
2:24
Stormwater Hydrograph
Sample

Figure B.216
Storm Event Hydrograph - 9/17/2015
Copping: MH 77793

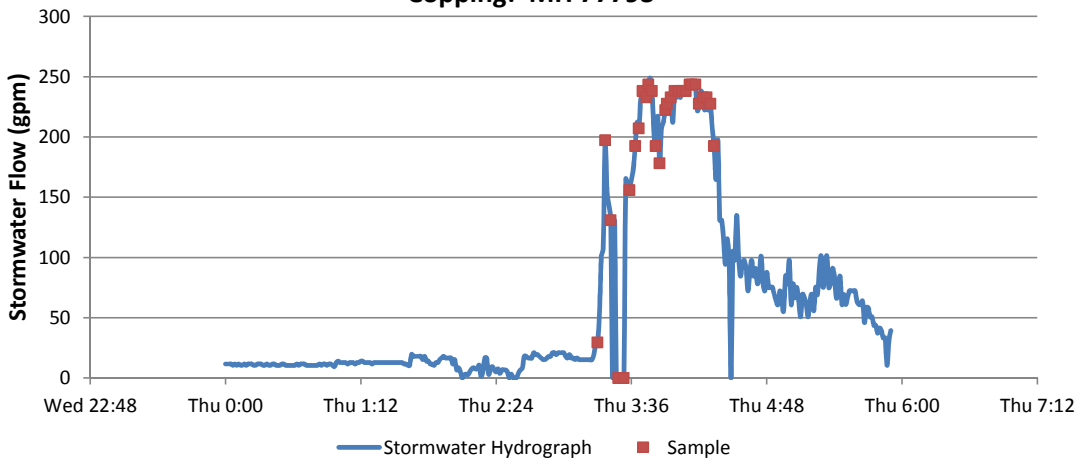


Figure B.217
Storm Event Hydrograph - 11/23/2015
Copping: MH 77793

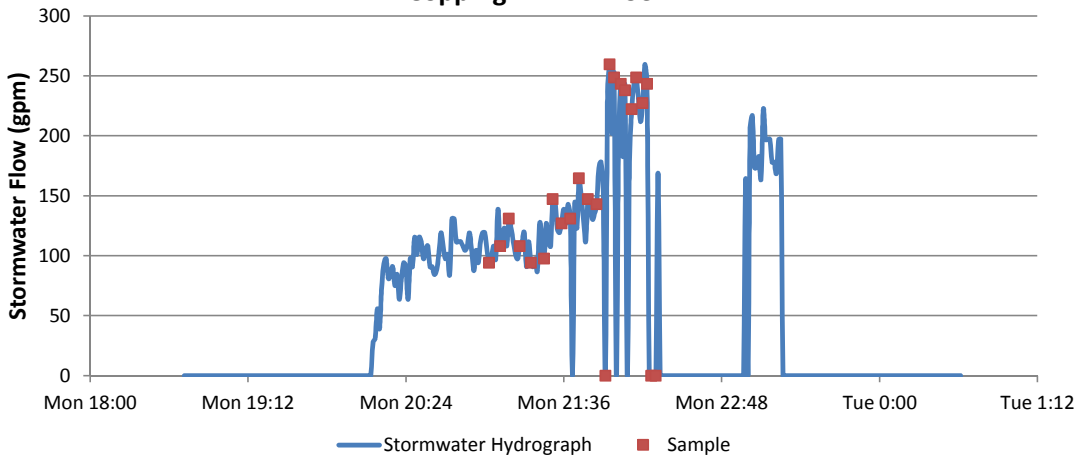
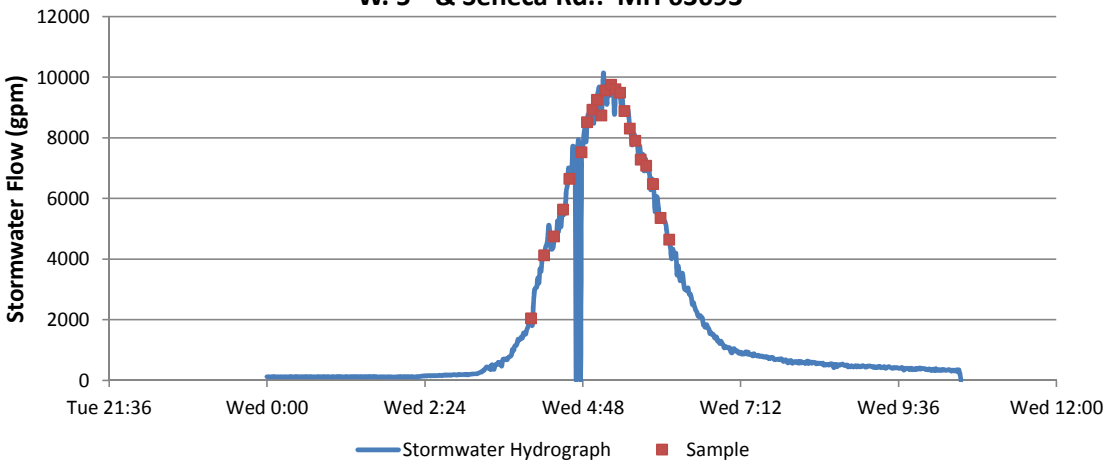


Figure B.218
Storm Event Hydrograph - 10/28/2015
W. 5th & Seneca Rd.: MH 63693



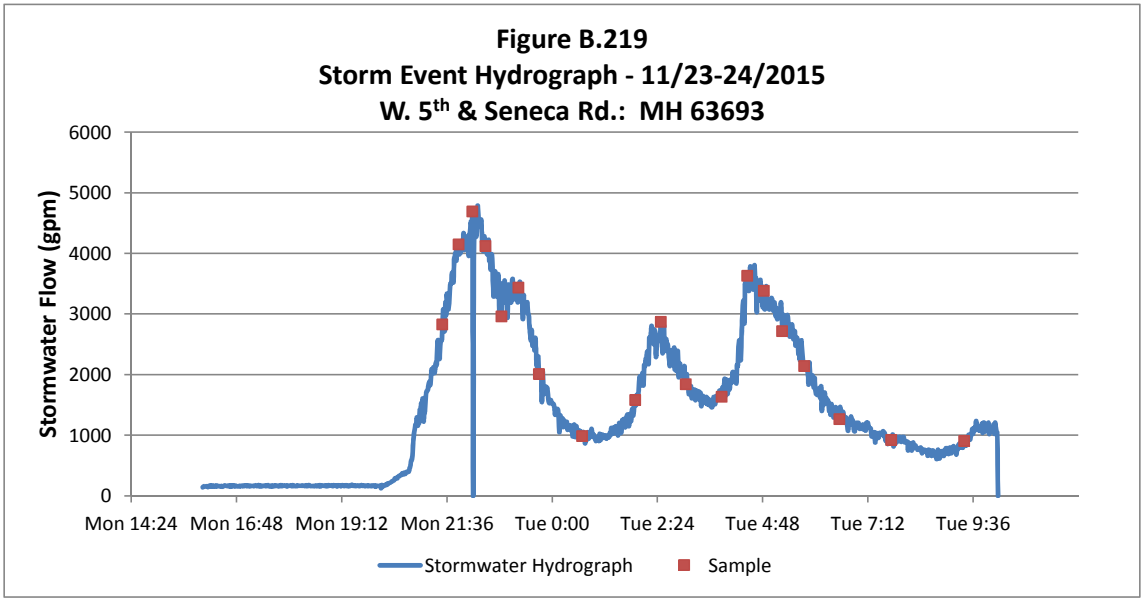


Figure B.219
Storm Event Hydrograph - 11/23-24/2015
W. 5th & Seneca Rd.: MH 63693
Stormwater Flow (gpm)
6000
5000
4000
3000
2000
1000
0
Mon 14:24
Mon 16:48
Mon 19:12
Mon 21:36
Tue 0:00
Tue 2:24
Tue 4:48
Tue 7:12
Tue 9:36
Stormwater Hydrograph
Sample

APPENDIX C

December 2010 MS4 Permit

Expiration Date: December 29, 2015
Permit Number:101244
File Number:107989

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) DISCHARGE PERMIT

Oregon Department of Environmental Quality
811 SW 6th Ave. Portland, OR 97204
Telephone: (503) 229-5185

Issued pursuant to Oregon Revised Statute 468B.050 and the Federal Clean Water Act

ISSUED TO:
City of Eugene

SOURCES COVERED BY THIS PERMIT:
This permit covers all existing and new discharges of stormwater from the Municipal Separate Storm Sewer System (MS4) within the incorporated areas of the City of Eugene.

COUNTY: Lane

RECEIVING WATERBODIES:
Basin(s): Willamette River
Subbasin(s): Upper Willamette
Waterbodies: Willamette River, McKenzie River, Amazon Creek, Amazon Diversion Channel, A-3 Channel and Fern Ridge Reservoir

WASTE LOAD ALLOCATIONS: A Total Maximum Daily Load (TMDL) that includes waste load allocations for urban stormwater has been established for the Upper Willamette Subbasin, including Willamette River and tributaries, Upper Amazon Creek, Amazon Diversion Channel, A-3 Channel and Fern Ridge Reservoir Watershed. Waste load allocations are addressed in **Schedule D** of this permit.

EPA REFERENCE NO.: ORS107989
This permit is issued in response to Application Number 972437 received on September 2, 2008.

Annette Liebe, Surface Water Management Section Manager

12/30/2010
Date

PERMITTED ACTIVITIES

Until this permit expires or is modified or revoked, the permittee is authorized to discharge municipal stormwater to waters of the state in conformance with the requirements and conditions set forth in the attached schedules. Where conflict exists between specific conditions (found in **Schedules A-D**) and general conditions (**Schedule F**), the specific conditions supersede the general conditions.

		Page
Schedule A	Controls and Limitations for Stormwater Discharges	2
Schedule B	Monitoring and Reporting Requirements	14
Schedule C	Compliance Schedules and Dates	22
Schedule D	Special Conditions	22
Schedule F	General Conditions	28

SCHEDULE A

Controls and Limitations for Stormwater Discharges from Municipal Separate Storm Sewer Systems

1. **Prohibit Non-stormwater Discharges**
   The permittee must effectively prohibit non-stormwater discharges into the MS4 unless such discharges are otherwise permitted under Subsection A.4.a.xii., another NPDES permit or other applicable state or federal permit, or are otherwise exempted or authorized by the Department.

2. **Reduce Pollutants to the Maximum Extent Practicable**
   The permittee must reduce the discharge of pollutants from the MS4 to the maximum extent practicable (MEP). Compliance with this permit and implementation of a stormwater management program, including the Department-approved Stormwater Management Plan (SWMP), establishes this MEP requirement, unless or until the Department reopens the permit as provided in Oregon Administrative Rule (OAR) 340-045-0040 and 0050 to require additional controls.

3. **Implement the Stormwater Management Plan (SWMP)**
   The permittee must continue to implement and assess the effectiveness of its Department-approved SWMP. The SWMP must guide the permittee in the implementation of its stormwater management program.

   a. The SWMPs and any Department-approved amendments thereto, are hereby incorporated into the permit by reference. The applicable SWMP is as follows:

      i. The proposed SWMP submitted with the NPDES permit re-application and amendment received by the Department on August 12, 2010, the addition of the special conditions specified in **Schedule D.6.**, and any subsequent changes made to the SWMP in accordance with the conditions of this permit.

   b. The permittee is responsible for compliance within its jurisdiction as identified in this permit, and is not responsible for compliance outside of its jurisdiction.

c. The SWMP must be electronically available through direct incorporation into the permittee's website and/or other similar method approved by the Department.

4. **Stormwater Management Plan Requirements**
The permittee must implement a SWMP that outlines the practices, techniques or provisions associated with protecting water quality and satisfying requirements of this permit and includes measurable goals for the stormwater program elements identified in subsections a-h. The measurable goals must identify actions the permittee will undertake to implement best management practices (BMPs), and include, where appropriate the frequency, timeline and/or location where the BMP actions will occur.

a. **Illicit Discharge Detection and Elimination**: The permittee must continue to implement a comprehensive program to detect, remove, and eliminate illicit discharges to the MS4. The program must:

i. Prohibit, through ordinance or other regulatory mechanism, illicit discharges into the permittee's MS4.

ii. Include documentation in an enforcement response plan or similar document by December 1, 2011, describing the enforcement response procedures the permittee implements when an illicit discharge investigation identifies a responsible party.

iii. Develop or identify pollutant parameter action levels that will be used as part of the field screening and analysis. The action levels will identify concentrations for identified pollutants that, if exceeded, will require further investigation, including laboratory sample analyses, to identify the source of the illicit discharge. The pollutant parameter action levels and rationale for using the action levels must be documented in an enforcement response plan or similar document, and reported to the Department by July 1, 2012.

iv. Conduct annual dry-weather inspection activities during the term of the permit. By July 1, 2012, the dry-weather inspection activities must include identified priority locations documented by the permittee and field screening at these locations at a minimum of once per calendar year. Priority locations must, where possible, be located at an accessible location downstream of any source of suspected illegal or illicit activity or other location as identified by the permittee. Priority locations must be based on an equitable consideration of hydrological conditions, total drainage area of the location, population density of the location, traffic density, age of the structures or building in the area, history of the area, land use types, personnel safety, accessibility, historical complaints or other appropriate factors as identified by the permittee. The dry-weather field screening activities must occur after an antecedent dry period of at least 72-hours. The dry-weather field screening activities must be documented and include:

1. General observations, including visual presence of flow, turbidity, oil sheen, trash, debris or scum, condition of conveyance system or outfall, color, odor and any other

relevant observations related to the potential presence of non-storm water or illicit discharges.

2. Field Screening - If flow is observed, and the source is unknown, a field analysis must be conducted to determine the cause of the dry-weather flow. The field analysis must include sampling for pollutant parameters that are likely to be found based upon the suspected source of discharge or by other effective investigatory approaches or means to identify the source or cause of the suspected illicit discharge. Where appropriate, field screening pollutant parameter action levels identified by the permittee must be considered. Suspected sources of discharge include, but are not limited to, sanitary cross-connections or leaks, spills, seepage from storage containers, non-stormwater discharges or other residential, commercial, industrial or transportation-related activities.

3. Laboratory Analysis – If general observations and field screening indicate the presence of a suspected illicit discharge and the source or cause of the suspected illicit discharge cannot be identified through other investigatory methods, the permittee must collect a water quality sample for laboratory analyses for ongoing discharges. The water quality sample must be analyzed for pollutant parameters or identifiers that will aid in the determination of the source of the illicit discharge. The types of pollutant parameters or identifiers may include, but are not limited to genetic markers, industry-specific toxic pollutants, or other pollutant parameters that may be specifically associated with a source type.

v. Identify response procedures to investigate portions of the MS4 that, based on the results of general observations, field screening, laboratory analysis or other relevant information, such as a complaint or referral, indicates the likely presence of an illicit discharge. The response procedures must reflect the goal to eliminate the illicit discharge in an expeditious manner, as specified in subsection vii. below.

vi. Maintain a system for documenting illicit discharge complaints or referrals, and suspected illicit discharge investigation activities.

vii. Once the source of an illicit discharge is determined, the permittee must take appropriate action to eliminate the illicit discharges, including an initial evaluation of the feasibility to eliminate the discharge, within 5 working days. If the permittee determines that the elimination of the illicit discharge will take more than 15 working days due to technical, logistical or other reasonable issues, the permittee must develop and implement an action plan to eliminate the illicit discharge in an expeditious manner. The action plan must be completed within 20 working days of determining the source of an illicit discharge. In lieu of developing and implementing an individual action plan for common types of illicit discharges, the permittee may document and implement response procedures, a response plan or similar document. The action plan, response procedures, response plan or similar document must include a timeframe for elimination of the illicit discharge as soon as practicable.

viii. Describe and implement procedures to prevent, contain, respond to and mitigate spills that may discharge into the MS4. Spills, or other similar illicit discharges, that may endanger human health or the environment must be reported in accordance with all applicable federal and state laws, including proper notification to the Oregon Emergency Response System.

ix. In the case of a known illicit discharge that originates within the permittee's MS4 regulated area and that discharges directly to a storm sewer system or property under the jurisdiction of another municipality, the permittee must notify the affected municipality as soon as practicable, and at least within one working day of becoming aware of the discharge.

x. In the case of a known illicit discharge that is identified within the permittee's MS4 regulated area, but is determined to originate from a contributing storm sewer system or property under the jurisdiction of another municipality, the permittee must notify the contributing municipality or municipality with jurisdiction as soon as practicable, and at least within one working day of identifying the illicit discharge.

xi. Maintain maps identifying known permittee-owned MS4 outfalls discharging to waters of the State. The dry-weather screening priority locations must be specifically identified on maps by July 1, 2012. If the permittee identifies the need to modify these maps, the maps must be updated in digital or hard-copy within six months of identification.

xii. Unless the following non-stormwater discharges are identified in a particular case as a significant source of pollutants to waters of the State by the permittee or the Department, they are not considered illicit discharges and are authorized by this permit: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; uncontaminated groundwater infiltration; uncontaminated pumped ground water; discharges from potable water sources; start up flushing of groundwater wells; potable groundwater monitoring wells; draining and flushing of municipal potable water storage reservoirs; foundation drains; air conditioning condensate; irrigation water; springs; water from crawl space pumps; footing drains; lawn watering; individual residential car washing; charity car washing; flows from riparian habitats and wetlands; dechlorinated swimming pool discharges; street wash waters; discharges of treated water from investigation, removal and remedial actions selected or approved by the Department pursuant to Oregon Revised Statute (ORS) Chapter 465; and, discharges or flows from emergency fire fighting activities. If any of these non-stormwater discharges under the permittee's jurisdiction is a significant source of pollutants, the permittee must develop and require implementation of appropriate BMPs to reduce the discharge of pollutants associated with the source.

b. **Industrial and Commercial Facilities**: The permittee must continue to implement a program to reduce pollutants in stormwater discharges to the MS4 from facilities the permittee previously identified as being subject to a Department-issued industrial stormwater NPDES 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, or facilities that have been identified as contributing a significant pollutant load to the MS4. The permittee must:

i. Screen existing and new industrial facilities to assess whether they have the potential to be subject to an industrial stormwater NPDES permit or have the potential to contribute a significant pollutant load to the MS4.

ii. Within 30 days after the facility is identified, notify the industrial facility and the Department that an industrial facility is potentially subject to an industrial stormwater NPDES permit.

iii. Implement an updated strategy to reduce pollutants in stormwater discharges to the MS4 from industrial and commercial facilities where site-specific information has identified a discharge as a source that contributes a significant pollutant load to the MS4. The strategy must include a description of the rationale for identifying commercial and industrial facilities as a significant contributor, and establish the priorities and procedures for inspection of and implementation of stormwater control measures. This strategy must be implemented by January 1, 2013, and applied within one calendar year from the date a new source contributing a significant pollutant load to the MS4 has been identified.

c. **Construction Site Runoff Control**: The permittee must continue to implement a program to reduce pollutants in stormwater runoff to the MS4 from construction activities. The program must:

i. Include ordinances or other enforceable regulatory mechanisms that require erosion prevention and sediment controls be designed, implemented, and maintained to prevent adverse impacts to water quality and minimize the transport of construction-related contaminants to waters of the State. The construction site runoff control program ordinances or other enforceable regulatory mechanism must apply to construction activities that result in a land disturbance of 1,000 square feet or greater.

ii. Require construction site operators to develop erosion prevention and sediment control site plans, and to implement and to maintain effective erosion prevention and sediment control best management practices.

iii. Require construction site operators to prevent or control non-stormwater waste that may cause adverse impacts to water quality such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste.

iv. Describe site plan review procedures to ensure that stormwater BMPs are appropriate and address the construction activities being proposed. At a minimum, construction site erosion prevention and sediment control plans for sites disturbing one acre or greater must be consistent with the substantive requirements of the State of Oregon's 1200-C permit site erosion prevention and sediment control plans.

v. Permittee must perform on-site inspections in accordance with documented procedures and criteria to ensure that the approved erosion prevention and sediment control plan is properly implemented. Inspections of construction sites must include disturbed areas of the site, material and waste storage areas, stockpile areas, construction site entrances and exits, sensitive areas, discharge locations to the MS4, and, if appropriate, discharge locations to receiving waters. Inspections must be documented, including photographs and monitoring results as appropriate.

vi. Describe in an enforcement response plan or similar document describing the enforcement response procedures the permittee will implement. The enforcement response procedures must ensure construction activities are in compliance with the ordinances or other regulatory mechanisms.

d. **Education and Outreach:** The permittee must implement an education and outreach program designed to achieve measurable goals based on target audiences, specific stormwater quality issues in the community, or identified pollutants of concern. The program must:

i. Continue to implement a documented public education and outreach strategy that promotes pollutant source control and a reduction of pollutants in stormwater discharges. The strategy must identify targeted pollutants of concern, the targeted audience, specific education activities, and the entity or individual responsible for implementation. The public education and outreach strategy may incorporate cooperative efforts with other MS4 regulated permittees or efforts by other groups or organizations provided a mechanism is developed and implemented to track the public education and outreach efforts within the MS4 regulated area and the results of such efforts are reported annually.

ii. Provide educational materials to the community or conduct equivalent outreach activities describing the impacts of stormwater discharges on water bodies and the steps or actions the public can take to reduce pollutants in stormwater runoff.

iii. Provide public education on the proper use and disposal of pesticides, herbicides, fertilizers and other household chemicals.

iv. Provide public education on the proper operation and appropriate maintenance of privately-owned or operated stormwater quality management facilities.

v. Provide notice to construction site operators concerning where education and training to meet erosion prevention and sediment control requirements can be obtained.

vi. Conduct or participate in an effectiveness evaluation to measure the success of public education activities during the term of this permit. The effectiveness evaluation must focus on assessing changes in targeted behaviors. The results of the effectiveness evaluation must be used in the adaptive management of the education and outreach program, and reported to the Department no later than December 1, 2014.

vii. Include training for permittee employees involved in MS4-related activities, as appropriate. The training should include stormwater pollution prevention and reduction from municipal operations, including, but not limited to, parks and open space maintenance, fleet and building maintenance, new municipal facility construction and related land disturbances, design and construction of street and storm drain systems, discharges from non-emergency fire fighting-related training activities, and stormwater system maintenance.

viii. Promote, publicize and facilitate public reporting of illicit discharges through the use of newspapers, newsletters, utility bills, door hangers, radio public service announcements, videos, televised council meetings, brochures, signs, posters or other effective methods.

e. **Public Involvement and Participation:** The permittee must implement a public participation approach that provides opportunities for the public to effectively participate in the development, implementation and modification of the permittee's stormwater management program. The approach must include provisions for receiving and considering public comments on the monitoring plan due to the Department on May 1, 2011, annual reports, SWMP revisions, and the TMDL pollutant load reduction benchmark development.

f. **Post-Construction Site Runoff:** The permittee must continue to implement their post-construction stormwater pollutant and runoff control program.

i. By January 1, 2014, the post-construction stormwater pollutant and runoff control program applicable to new development and redevelopment projects that create or replace 1000 ft^2 of impervious surface must meet the following conditions:

1) Incorporate site-specific management practices to mimic natural surface or predevelopment hydrologic functions as much as practicable practicable. The site-specific management practices should optimize on-site retention based on the site conditions;

2) Reduce site specific post-development stormwater runoff volume, duration and rates of discharges to the municipal separate storm sewer system (MS4) to minimize hydrological and water quality impacts from impervious surfaces;

3) Prioritize and include implementation of Low-Impact Development (LID), Green Infrastructure (GI) or equivalent planning, design and construction approaches; and,

4) Capture and treat 80% of the annual average runoff volume, based on a documented local or regional rainfall frequency and intensity.

ii. The permittee must identify, and where practicable, minimize or eliminate ordinance, code and development standard barriers within their legal authority that inhibit design and implementation techniques intended to minimize impervious surfaces and reduce stormwater runoff (e.g., Low Impact Development, Green Infrastructure). Such

modifications to code and development standards are only required to the extent they are permitted under federal and state laws. The permittee must review ordinance, code and development standards for modification, minimization or elimination, and appropriately modify ordinance, code and development standard barriers by January 1, 2014. If an ordinance, code or development standard barrier is identified at any time subsequent to January 1, 2014, the applicable ordinance, code or development standard must be modified within three years.

iii. To reduce pollutants and mitigate the volume, duration, time of concentration and rate of stormwater runoff, the permittee must develop or reference an enforceable post-construction stormwater quality management manual or equivalent document by January 1, 2014 that, at a minimum, includes the following:

1) Establish a threshold that is at least as small as set out in f. i. above;

2) A defined design storm or an acceptable continuous simulation method to address the capture and treatment of 80% of the annual average runoff volume;

3) Applicable LID, GI or similar stormwater runoff reduction approaches, including the practical use of these approaches;

4) Conditions where the implementation of LID, GI or equivalent approaches may be impracticable; and,

5) BMPs, including a description of the following:
   a. Site-specific design requirements;
   b. Design requirements that do not inhibit maintenance; and,
   c. Conditions where the BMP applies; and,

6) Pollutant removal efficiency performance goals that maximize the reduction in discharge of pollutants.

iv. The permittee must review, approve and verify proper implementation of post-construction site plans for new development and redevelopment projects applicable to this section.

v. Where a new development or redevelopment project site is characterized by factors limiting use of on-site stormwater management methods to achieve the post-construction site runoff performance standards, such as high water table, shallow bedrock, poorly-drained or low permeable soils, contaminated soils, steep slopes or other constraints, the Post-Construction Stormwater Management program must require equivalent pollutant reduction measures, such as off-site stormwater quality management. Off-site stormwater quality management may include off-site mitigation, such as using low impact development principles in the construction of a structural stormwater facility within the sub-watershed, a stormwater quality structural facility mitigation bank or a payment-in-lieu program.

vi. A description of the inspection and enforcement response procedures the permittee will follow when addressing project compliance issues with the enforceable post-construction stormwater management performance standards.

g. **Pollution Prevention for Municipal Operations:** The permittee must continue to implement a program to reduce the discharge of pollutants to the MS4 from properties owned or operated by the permittee for which the permittee has authority, including, but not limited to, parks and open spaces, fleet and building maintenance facilities, transportation systems and fire-fighting training facilities. The permittee must conduct, at a minimum, the following program activities:

i. Operate and maintain public streets, roads and highways over which the permittee has authority in a manner designed to minimize the discharge of stormwater pollutants to the MS4, including pollutants discharged as a result of deicing activities;

ii. Implement a management program to control and minimize the use and application of pesticides, herbicides and fertilizers on permittee-owned properties;

iii. By January 1, 2013, inventory, assess, and implement a strategy to reduce the impact of stormwater runoff from municipal facilities that treat, store or transport municipal waste, such as yard waste or other municipal waste and are not already covered under a 1200 series NPDES, a DEQ solid waste, or other permit designed to reduce the discharge of pollutants;

iv. Limit infiltration of seepage from the municipal sanitary sewer system to the MS4;

v. Implement a program to prevent or control the release of materials related to fire-fighting training activities; and,

vi. Assess permittee flood control projects to identify potential impacts on the water quality of receiving water bodies and determine the feasibility of retrofitting structural flood control devices for additional stormwater pollutant removal. The results of this assessment must be incorporated and considered along with the results of the Stormwater Retrofit Assessment required by this permit;

h. **Structural Stormwater Controls Operation and Maintenance Activities:**

i. By January 1, 2013 the permittee must inventory and map stormwater structural facilities and controls and implement a program to verify that structural facilities are inspected, operated and maintained for effective pollutant removal, infiltration and/or flow control. At a minimum, the program must include the following:

1. Legal authority to inspect and require effective operation and maintenance;

2. A program to inventory and map public and private stormwater treatment facilities as provided under **Schedule A.4.h.ii.**; and,

3. Public and private stormwater facility inspection and maintenance requirements to ensure proper operation for stormwater facilities that have been inventoried and mapped as provided under Schedule A.4.h.ii.

ii. As part of the Stormwater Structural Facilities and Controls Inspection and Maintenance program, the permittee must develop and implement a strategy that guides the long-term maintenance and management of all permittee-owned and identified privately-owned stormwater structural facilities and controls. At a minimum, the strategy must describe the following:

1. Permittee-owned or operated stormwater quality facilities
   a. Inventory and mapping process;

   b. Inspection and maintenance schedule;

   c. Inspection, operation and maintenance criteria and priorities;

   d. Description of inspector type and staff position or title; and,

   e. Inspection and maintenance tracking mechanisms.

2. Privately-owned or operated stormwater quality facilities
   a. Procedures for and types of stormwater facilities that will be inventoried and mapped, including the rationale and criteria used. At a minimum, the inventory and mapping must include the following:
      i. Private stormwater facilities for new development and redevelopment projects constructed under the permittee's post-construction management manual or equivalent document after January 1, 2011;
      ii. Private stormwater facilities identified by the permittee and used to estimate the pollutant load reduction as part of the TMDL benchmark evaluation; and,
      iii. Any major private stormwater facilities or structural controls.

   b. Inspection criteria, rationale, priorities, frequency and procedures for inspection of private stormwater facilities that have been inventoried and mapped;

   c. Required training or qualifications to inspect private stormwater facilities;

   d. Reporting requirements; and,

   e. Inspection and maintenance tracking mechanism.

5. **Hydromodification Assessment:** The permittee must conduct an initial hydromodification assessment and submit a report by December 1, 2014 that examines the hydromodification impacts related to the permittee's MS4 discharges, including erosion, sedimentation, and/or alteration to stormwater flow, volume and duration that may cause or contribute to water quality

degradation. The report shall describe existing efforts and proposed actions the permittee has identified to address the following objectives:

a. Collect and maintain information that will inform future stormwater management decisions related to hydromodification based on local conditions and needs;

b. Identify or develop strategies to address hydromodification information or data gaps related to waterbodies within the permittee's jurisdiction;

c. Identify strategies and priorities for preventing or reducing hydromodification impacts related to the permittee's MS4 discharges; and,

d. Identify or develop effective tools to reduce hydromodification.

6. **Stormwater Retrofit Strategy Development:** The permittee must develop a stormwater quality retrofit strategy identified in a plan that applies to developed areas identified by the permittee as impacting water quality and that are underserved or lacking stormwater quality controls.

   a. The stormwater retrofit strategy must be based on a permittee-defined set of stormwater quality retrofit objectives and a comprehensive evaluation of a range of stormwater quality retrofit control measures and their appropriate use. The permittee-defined objectives must prioritize progress towards meeting applicable TMDL wasteload allocations. Development of the stormwater retrofit strategy must allow for public comment and consider public input.

   b. The permittee must develop and submit a stormwater retrofit plan to the Department by December 1, 2014 that the permittee will use to guide the implementation of its stormwater retrofit strategy. The stormwater retrofit plan must describe or reference the following:

      i. Stormwater retrofit strategy statement and summary, including objectives and rationale;

      ii. Summary of current stormwater retrofit control measures being implemented, and current estimate of annual program resources directed towards stormwater retrofits;

      iii. Identification of developed areas or land uses impacting water quality that are high priority retrofit areas;

      iv. Consideration of new stormwater control measures;

      v. Preferred retrofit structural control measures, including rationale;

      vi. A retrofit control measure project or approach priority list, including rationale, identification and map of potential stormwater retrofit locations where appropriate, and an estimated timeline and cost for implementation of each project or approach.

   c. By December 1, 2013, the permittee must identify one stormwater quality facility project, at a minimum, to be constructed or implemented in a high pollutant source area. The project

must target the reduction of applicable TMDL pollutant parameters. The project must be associated with a Capital Improvement Project or other municipal retrofit project or strategy, and construction or implementation must be completed during the permit term.

7. **Implementation Schedule:** The following implementation schedule provides a summary of due dates for the new permit conditions identified in **Schedule A**.

PERMIT CONDITION	SUMMARY OF IMPLEMENTATION SCHEDULE ACTIVITIES	DUE DATE
Illicit Discharge Detection and Elimination – A.4.a.	1. Document enforcement response procedures	December 1, 2011
	2. Develop or identify pollutant parameter action levels	July 1, 2012
	3. Identify and map dry-weather screening priority locations	July 1, 2012
Industrial and Commercial Facilities – A.4.b	1. Implement updated industrial and commercial facility inspection and stormwater control program	January 1, 2013
Education and Outreach – A.4.d.	1. Conduct or participate in effectiveness evaluation	December 1, 2014
Post-Construction Site Runoff – A.4.f.	1. Implement updated post-construction site runoff program	January 1, 2014
Pollution Prevention for Municipal Operations – A.4.g.	1. Inventory and assess municipal operations	January 1, 2013
Structural Stormwater Controls Operation and Maintenance Activities – A.4.h.	1. Implement structural stormwater controls operation and maintenance program	January 1, 2013
Hydromodification Assessment – A.5.	1. Conduct hydromodification assessment and submit report	December 1, 2014
Stormwater Retrofit Strategy Development – A.6.	1. Develop stormwater retrofit strategy and submit stormwater retrofit plan	December 1, 2014
	2. Identify stormwater quality improvement project	December 1, 2013
	3. Initiate or construct stormwater quality improvement project	Permit expiration date

SCHEDULE B
Monitoring and Reporting Requirements

1. MONITORING PROGRAM - The permittee must continue to implement a monitoring program to support adaptive stormwater management and the evaluation of stormwater management program effectiveness in reducing the discharge of pollutants from the MS4.

    a. The monitoring program must incorporate the following objectives:

        i. Evaluate the source(s) of the 2004/2006 303(d) listed pollutants applicable to the permittee's permit area;

        ii. Evaluate the effectiveness of Best Management Practices (BMPs) in order to help determine BMP implementation priorities;

        iii. Characterize stormwater based on land use type, seasonality, geography or other catchment characteristics;

        iv. Evaluate status and long-term trends in receiving waters associated with MS4 stormwater discharges;

        v. Assess the chemical, biological, and physical effects of MS4 stormwater discharges on receiving waters; and,

        vi. Assess progress towards meeting TMDL pollutant load reduction benchmarks.

    b. The monitoring program must include environmental monitoring that incorporates the requirements identified in **Table B-1**. The requirements in **Table B-1** become effective with the approval of the monitoring plan in accordance with **Schedule B.2.d.**, and no later than July 1, 2011.

Table B-1 Environmental Monitoring			
Monitoring Type	**Monitoring Location(s)**	**Monitoring Frequency**	**Pollutant Parameter Analyte(s)**
Instream Monitoring	Six (6) sites in the Amazon Basin	Six (6) events/year	Field; Conventional; Nutrients; Metals
	Five (5) sites in the Willamette Basin		
	One (1) site representing a small urban stream		
Instream Monitoring - Organics	One (1) site in the Amazon Subbasin	Six (6) events/year	Organics – Amazon Subbasin
	One (1) site in the Willamette Basin		Organics – Willamette Basin
Stormwater Monitoring – Focused Basin	Two (2) sites during each storm event on a rotating basis	Three (3) storm events/year	Field; Conventional; Nutrients; Metals
Stormwater Monitoring - Pesticides	Two (2) sites during each storm event on a rotating basis	Three (3) storm events	Pesticides
Stormwater Monitoring - Organics	Two (2) sites	Three (3) storm events/year	Organics as identified by site basin location
Stormwater Monitoring – Bacteria	Two (2) sites during each storm event	Three (3) storm events/year prior to BMP implementation & Three (3) storm events/year after BMP implementation	Field; Fecal Coliform, E. coli
Stormwater Monitoring - Mercury	Two (2) sites	Two (2) storm events/year; one summer and one winter storm event	Mercury, Total Recoverable & Dissolved Methyl Mercury, Total Recoverable & Dissolved
Macro-invertebrate Monitoring	Five (5) sites in the Amazon Basin	One (1) event/permit term	N/A
	Five (5) sites in the Willamette Basin		
	One (1) site representing a small urban stream		
	One (1) reference site		
Geomorphic Condition Monitoring	Photomonitoring - Varies Citywide	Annually	N/A
	Waterway assessment - Varies Citywide	One (1) event/permit term	N/A
Structural BMP Monitoring	One (1) stormwater structural control measure	Three (3) events/permit term	Field; Conventional; Nutrients; Metals

Special Conditions:

1) The monitoring frequency reflects the number of required sample events per monitoring location.
2) If after 18 Instream Monitoring events a pollutant parameter analyte value is reported as a non-detect greater than 90% of the samples, the pollutant parameter analyte may be eliminated from routine monitoring.
3) If after 9 Stormwater Monitoring events a pollutant parameter analyte value is reported as a non-detect greater than 90% of the samples, the pollutant parameter analyte may be eliminated from routine monitoring.
4) Field pollutant parameters for Stormwater Monitoring activities include Flow Rate.
5) Conventional pollutant parameters for Stormwater Monitoring include Oil & Grease (Silica Gel Treated Hexane Extractable Material).
6) Stormwater Monitoring for bacteria includes a field condition assessment of the catchment areas where the monitoring activity is located.
7) Additional pesticide pollutant parameters that must be considered for purposes of the pesticide monitoring requirement include any pesticides currently used by the City of Eugene within its MS4 jurisdictional areas and the following: Insecticides: Bifenthrin, Cypermethrin or Permethrin, Imidacloprid, Fipronil, Malathion, Carbaryl; Herbicides: Triclopyr, 2,4-D, Glyphosate & degradate (AMPA), Trifluaralin, Pendimethalin; and, Fungicides: Chlorothalonil, Propiconazole, Myclobutanil
8) The Macroinvertebrate monitoring must follow a generally accepted macroinvertebrate monitoring methodology (e.g., DEQ Benthic Macroinvertebrate Protocol for Wadeable Rivers and Streams). The methodology must be documented in the monitoring plan.
9) Photomonitoring must photo document and record observations of the condition of the identified monitoring location.
10) Monitoring and analysis for mercury and methyl mercury must be conducted in accordance with DEQ's December 23, 2010 "Mercury Monitoring Requirements for Willamette Basin Permittees" memo. After 2 years of monitoring (minimum of 4 samples), the permittee may request in writing to the Department that the mercury and methyl mercury monitoring be eliminated. The monitoring may be eliminated only after written approval by the Department. EPA Method 1669 ultra clean sampling protocol is to be used to collect samples. Monitoring for total and dissolved mercury must be performed according to US EPA method 1631E with a quantitation limit of 0.5 ng/L. Monitoring for total and dissolved methyl mercury must be performed according to US EPA method 1630 with a quantitation limit of 0.05 ng/L.

Pollutant parameter(s) identified in each analyte category in **Table B-1** are as follows:

Field	Conventional	Nutrients	Metals (Total Recoverable & Dissolved)
Dissolved Oxygen pH Temperature	*Escherichia coli* (E. coli) Fecal Coliform Conductivity Calcium, Total Magnesium, Total Hardness (Calculated) Biochemical Oxygen Demand (BOD_5) Chemical Oxygen Demand (COD) Total Suspended Solids (TSS) Total Dissolved Solids (TDS) Turbidity	Total Kjeldahl Nitrogen (TKN) Nitrate-Nitrite (NO_3-NO_2) Ammonia Nitrogen (NH_3-N) Total Phosphorus (TP) Ortho-Phosphorus (O-PO_4)	Arsenic Cadmium Chromium Copper Lead Molybdenum Nickel Selenium Silver Zinc
Pesticides 2,4-D Chlorpyrifos Diazinon		Organics - Willamette Basin Dioxin (2,3,7,8-TCDD) Organics - Amazon Subbasin Dichloroethylene[1,2] Trichloroethylene[1] Tetrachloroethylene[1,2] [1] = Amazon Creek [2] = A3 Channel	

2. MONITORING PLAN - The permittee must develop and implement an approved monitoring plan by July 1, 2011. Prior to submission of the monitoring plan to the Department, the permittee must provide an opportunity to receive comments from the public. The monitoring plan must be submitted to the Department for review no later than May 1, 2011, and incorporate the following elements:

   a. Identifies how each monitoring objective identified in **Schedule B.1.a.** is addressed and the sources of information used. The permittee may use Stormwater Management Plan measurable goals, environmental monitoring activities, historical monitoring data, stormwater modeling, national stormwater monitoring data, stormwater research or other applicable information to address the monitoring objectives.

   b. Describes the role of the monitoring program in the adaptive management of the stormwater program.

   c. Describes the relationship between environmental monitoring and a long-term monitoring program strategy.

   d. Describes the following information for each environmental monitoring project/task:

      i. Project/task organization

      ii. Monitoring objectives, including:
         a. Monitoring question and background;
         b. Data analysis methodology and quality criteria; and,
         c. Assumptions and rationale;

      iii. Documentation and record-keeping procedures;

      iv. Monitoring process/study design, including monitoring location, description of sampling event or storm selection criteria, monitoring frequency and duration, and responsible sampling coordinator;

      v. Sample collection methods and handling/custody procedures;

      vi. Analytical methods for each water quality parameter to be analyzed;

      vii. Quality control procedures, including quality assurance, the testing, inspection, maintenance, calibration of instrumentation and equipment; and,

      viii. Data management, review, validation and verification.

   e. The monitoring plan may be modified without prior Department approval if the following conditions are met. For conditions not covered in this section, the permittee must provide the Department with a 30-day notice of the proposed modification to the monitoring plan, and receive written approval from the Department prior to implementation of the proposed

modification. If the Department does not respond to the permittee within 30 days, the permittee may proceed with implementation of the proposed modification without written approval.

i. The permittee is unable to collect or analyze any sample, pollutant parameter, or information due to circumstances beyond the permittee's control. These circumstances may include, but are not limited to, abnormal climatic conditions, unsafe or impracticable sampling conditions, equipment vandalism or equipment failures that occur despite proper operations and maintenance; or,

ii. The modification does not reduce the minimum number of data points, which are a product of monitoring location, frequency, and length of permit term, or eliminate pollutant parameters identified in **Table B-1**.

f. Modifications to the monitoring plan in accordance with **Schedule B.2.e.** must be documented in the subsequent annual report by describing the rationale for the modification, and how the modification will allow the monitoring program to remain compliant with the permit conditions.

3. SAMPLING AND ANALYSIS – The permittee must exercise due diligence in collecting and analyzing all environmental monitoring samples required by this permit. All monitoring must be conducted in accordance with the design and procedures identified in **Schedule B.2.d**.

a. In-stream monitoring

i. A minimum of 50 percent of the water quality sample events must be collected during the wet season (October 1 to April 30).

ii. Each unique sample event must occur at a minimum of 14 days apart.

b. Stormwater monitoring

i. All water quality samples must be collected during a storm event that is greater that 0.1 inch of rainfall.

ii. When possible, samples must be collected after an antecedent dry period of a minimum of 24 hours.

iii. The intra-event dry period must not exceed 6 hours, unless a 24-hr flow-weighted composite sample collection method is employed.

iv. Sample Collection Method: A flow-weighted composite sample must be collected during stormwater runoff producing events that represent the local or regional rainfall frequency and intensity, including event types that may be expected to yield high pollutant loads/concentrations.

1. A time-composite sampling method or grab sampling method may be used for an environmental monitoring type, project or task, if the monitoring plan

identifies the infeasibility of the flow-weighted composite sampling method or flow-weighted composite sampling is scientifically unwarranted based upon the development of plan requirements identified in **Schedule B.2.d**. For time composite sampling or grab sampling to be considered valid for the purpose of this permit requirement, the rationale for the use of these alternative sampling methods and sampling procedures must be described in the monitoring plan.

2. The flow-weighted sampling method requirement is not applicable to the collection of samples for the pollutant parameters requiring the grab sampling method, such as bacteria, oil & grease, pH, volatiles or for samples collected for purposes of insecticide, herbicide or fungicide monitoring.

3. Grab samples may be collected during any part of a storm event that produces sufficient runoff for sampling. The grab samples must be collected in a manner to minimize any potential bias in the results.

v. Flow or rainfall data must be collected, estimated or modeled for each stormwater monitoring event. If flow or rainfall is modeled or estimated, the procedure shall be described in the monitoring plan.

c. Samples must be analyzed in accordance with EPA approved methods listed in the most recent publication of 40 CFR 136. Sample analysis for total recoverable and dissolved mercury and methyl mercury must adhered to the methods referenced in DEQ's December 23, 2010 "Mercury Monitoring Requirements for Willamette Basin Permittees" memo. The analysis must utilize appropriate Quality Assurance/Quality Control protocols, such as routinely analyzing replicates, blanks, laboratory control samples and spiked samples, and quantitation limits appropriate for the sampling objective. Field analytical kits are acceptable if the kits use a method approved under 40 CFR 136. This requirement does not apply to illicit detection and discharge elimination field screening activities conducted by the permittee as required by **Schedule A.4.a.iv**. Use of alternative test procedures must be done in accordance with 40 CFR 136.

d. If an approved analytical method is not identified in 40 CFR 136, the permittee may use a suitable analytical method if the method is described in the monitoring plan, and submitted to the Department for review and approval prior to use.

e. Analyzed samples must comply with preservation, transportation and holding time recommendations cited in 40 CFR 136, in the most recent edition of Standard Methods for the Examination of Water and Wastewater, or as applicable to the analytical method if no approved analytical method in 40 CFR 136 or the most recent edition of Standard Methods for the Examination of Water and Wastewater exists.

f. Analytical data must be available to the Department in a useable electronic format.

4. COORDINATED ENVIRONMENTAL MONITORING – Environmental monitoring conducted to meet a permit condition in **Table B-1** may be coordinated among permittees or conducted on

behalf of a permittee by a third party. Each permittee is responsible for environmental monitoring in accordance with **Schedule B** requirements. The permittee may utilize data collected by another permittee, a third party, or in another permittee's jurisdiction to meet a permit condition in **Table B-1** provided the permittee establishes an agreement prior to conducting the coordinated environmental monitoring.

5. ANNUAL REPORTING REQUIREMENT - The permittee must submit, by December 1 of each year, an annual report for the time period July 1 of the previous year through June 30 of the same year. Prior to submission of the annual report to the Department, the permittee must provide an opportunity to receive comments from the public. One printed copy and an electronic copy must be submitted to the appropriate Department regional office. An electronic copy must also be made available on the permittee's website and/or other similar method approved by the Department. Each annual report must contain:

    a. The status of implementing the stormwater management program and each SWMP program element, including progress in meeting the measurable goals identified in the SWMP.

    b. Status or results, or both, of any public education program effectiveness evaluation conducted during the reporting year and a summary of how the results were or will be used for adaptive management.

    c. A summary of the adaptive management process implementation during the reporting year, including any proposed changes to the stormwater management program (e.g., new BMPs) identified through implementation of the adaptive management process.

    d. Any proposed changes to SWMP program elements that are designed to reduce TMDL pollutants.

    e. A summary of total stormwater program expenditures and funding sources over the reporting fiscal year, and those anticipated in the next fiscal year.

    f. A summary of monitoring program results, including monitoring data that are accumulated throughout the reporting year and/or assessments or evaluations.

    g. Any proposed modifications to the monitoring plan that are necessary to ensure that adequate data and information are collected to conduct stormwater program assessments.

    h. A summary describing the number and nature of enforcement actions, inspections, and public education programs, including results of ongoing field screening and follow-up activities related to illicit discharges.

    i. An overview, as related to MS4 discharges, of concept planning, land use changes and new development activities that occurred within the Urban Growth Boundary (UGB) expansion areas during the reporting year, and those forecast for the following year, including the number of new post-construction permits issued, and the estimate of the total new or replaced impervious surface area related to new development and redevelopment projects

commenced during the reporting year.

j. Results of ongoing field screening and follow-up activities related to illicit discharges.

k. In addition to the elements listed under **Schedule B.5.a.** through **B.5.j.**, the annual report submitted by December 1, 2014 must include:
   i. The TMDL Pollutant Load Reduction Evaluation as described in Schedule D.3.c.
   ii. The Wasteload Allocation Attainment Assessment as described in Schedule D.3.b.
   iii. The 303(d) evaluation as described in Schedule D.2.

6. MS4 PERMIT RENEWAL APPLICATION PACKAGE - At least 180 days prior to permit expiration, the permittee must submit a permit renewal application package to support its proposed modifications to the SWMP for the renewed permit. One printed copy and an electronic copy must be submitted to the appropriate DEQ regional office. An electronic copy must also be made available on the permittee's website and/or other similar method approved by the Department. The application package must include an evaluation of the adequacy of the proposed SWMP in reducing pollutants in discharges from the MS4 to MEP. The application package must contain:

   a. Proposed program modifications including the modification, addition or removal of BMPs incorporated into the SWMP, and associated measurable goals.

   b. The information and analysis necessary to support the Department's independent assessment that the permittee's stormwater management program addressed the requirements of this permit. The permittee must describe how the proposed management practices, control techniques, and other provisions implemented as part of the stormwater program were evaluated using a permittee-defined and standardized set of objective criteria relative to the following MEP general evaluation factors:

      i. Effectiveness – program elements effectively address stormwater pollutants
      ii. Local Applicability – technically feasible considering local soils, geography, etc.
      iii. Program Resources – program elements are being implemented considering availability to resources and the permittees stormwater management program priorities.

   c. An updated estimate of total annual stormwater pollutant loads for applicable TMDL pollutants or applicable surrogate parameters, and the following pollutant parameters: BOD_5, COD, nitrate, total phosphorus, dissolved phosphorus, cadmium, copper, lead and zinc. The estimates must be accompanied by a description of the procedures for estimating pollutant loads and concentrations, including any modeling, data analysis and calculation methods.

   d. A proposed monitoring program objectives matrix and proposed monitoring plan including the information required in **Schedule B.2.d.** for each proposed monitoring project/task.

e. A description of any service area expansions that are anticipated to occur during the following permit term and a finding as to whether or not the expansion is expected to result in a substantial increase in area, intensity or pollutant loads.

f. A fiscal evaluation summarizing program expenditures for the current permit cycle and projected program allocations for next permit cycle.

g. Updated MS4 maps, including the service boundary of the MS4, projected changes in land use and population densities, projected future growth, location of permittee-owned operations, facilities, or properties with storm sewer systems, and the location of facilities issued an industrial NPDES permit that discharge to the MS4.

h. If applicable, the established TMDL pollutant load reduction benchmarks, as required in **Schedule D.3.d**.

SCHEDULE C
Compliance Conditions and Dates

Compliance conditions and dates have not been included at this time.

SCHEDULE D
Special Conditions

1. **Legal Authority**
   The permittee must maintain adequate legal authority through ordinance(s), interagency agreement(s) or other means to implement and enforce the provisions of this permit.

2. **303(d) Listed Pollutants**
   a. The requirements of this section apply to receiving waters listed as impaired on the 303(d) list without established TMDL waste load allocations to which the permittee's MS4 discharges. The permittee must:
      i. Review the applicable pollutants that are on the 2004/2006 303(d) list, or the most recent USEPA list if approved within three years of the issuance date of this permit, that are relevant to the permittee's MS4 discharges by December 1, 2014. Based on a review of the most current 303(d) list, evaluate whether there is a reasonable likelihood for stormwater from the MS4 to cause or contribute to water quality degradation of receiving waters.
      ii. Evaluate whether the BMPs in the existing SWMP are effective in addressing and reducing the 303(d) pollutants. If the permittee determines that the BMPs in the existing SWMP are ineffective in addressing and reducing the applicable 303(d) pollutants, the permittee must describe how the SWMP will be modified or updated to address and reduce these pollutants to the MEP.
      iii. Submit a report summarizing the results of the review and evaluation, and identifies any modifications or updates to the SWMP that are necessary to reduce applicable 303(d)

pollutants to the MEP by December 1, 2014.

3. **Total Maximum Daily Loads (TMDLs)**
   a. Applicability: The requirements of this section apply to the permittee's MS4 discharges to receiving waters with established TMDLs or to receiving waters with new or modified TMDLs approved by EPA within three years of the issuance date of this permit. Established TMDLs are noted on page 1 of this permit. Pollutant discharges for those parameters listed in the TMDL with applicable wasteload allocations (WLAs) must be reduced to the maximum extent practicable through the implementation of BMPs and an adaptive management process.

   b. Wasteload Allocation Attainment Assessment: The permittee must complete an assessment of WLA attainment, including identifying information related to the type and extent of BMPs necessary to achieve pollutant load reductions associated with an established TMDL WLA and the financial costs and other resources that may be associated with the implementation, operation and maintenance of BMPs. The results of the assessment must be submitted to the Department by December 1, 2014.

   c. TMDL Pollutant Load Reduction Evaluation: Progress towards reducing TMDL pollutant loads must be evaluated by the permittee through the use of a pollutant load reduction empirical model, water quality status and trend analysis, and other appropriate qualitative or quantitative evaluation approaches identified by the permittee. The results of this TMDL pollutant load reduction evaluation must be described in a report and submitted to the Department by December 1, 2014. The report must contain the following:

      i. The rationale and methodology used to evaluate progress towards reducing TMDL pollutant loads.
      ii. An estimate of current pollutant loadings without considering BMP implementation, and an estimate of current pollutant loadings considering BMP implementation for each TMDL parameter with an established WLA. The difference between these two estimated loads is the pollutant load reduction.
      iii. A comparison of the estimated pollutant loading with and without BMP implementation to the applicable TMDL WLA.
      iv. A comparison of the estimated pollutant load reduction to the estimated TMDL pollutant load reduction benchmark established for the permit term, if applicable.
      v. A description of the estimated effectiveness of structural BMPs.
      vi. A description of the estimated effectiveness of non-structural BMPs, if applicable, and the rationale for the selected approach.
      vii. A water quality trend analysis, as sufficient data are available, and the relationship to stormwater discharges for receiving waterbodies within the permittee's jurisdictional area with an approved TMDL. If sufficient data to conduct a water quality trend analysis is unavailable for a receiving waterbody, the permittee must describe the data limitations. The collection of sufficient data must be prioritized and reflected as part of the monitoring project/task proposal required in **Schedule B.6.d**.
      viii. A narrative summarizing progress towards the applicable TMDL WLAs and existing TMDL benchmarks, if applicable. If the permittee estimates that an existing TMDL

benchmark was not achieved during the permit term, the permittee must apply their adaptive management process to reassess the SWMP and current BMP implementation in order to address TMDL pollutant load reduction over the next permit term; and,

ix. If the permittee estimates that TMDL WLAs are achieved with existing BMP implementation, the permittee must provide a statement supporting this conclusion.

d. Establishment of TMDL Pollutant Reduction Benchmarks: A TMDL pollutant reduction benchmark must be developed for each applicable TMDL parameter where existing BMP implementation is not achieving the WLA. The TMDL pollutant reduction benchmark must be submitted with the permit renewal application, as follows:

i. The TMDL pollutant load reduction benchmark must reflect:
   1. Additional pollutant load reduction necessary to achieve the benchmark estimated for the permit term, if not achieved per **Schedule D.3.c.iv.**; and,
   2. The pollutant load reduction proposed to achieve additional progress towards the TMDL WLA during the next permit term.

ii. The TMDL pollutant load reduction benchmark submittal must include the following:
   1. An explanation of the relationship between the TMDL waste load allocations and the TMDL benchmark for each applicable TMDL parameter;
   2. A description of how SWMP implementation contributes to the overall reduction of the TMDL pollutants during the next permit term;
   3. Identification of additional or modified BMPs that will result in further reductions in the discharge of the applicable TMDL pollutants, including the rationale for proposing the BMPs; and,
   4. An estimate of current pollutant loadings that reflect the implementation of the current BMPs and the BMPs proposed to be implemented during the next permit term.

4. Adaptive Management

The permittee must follow an adaptive management approach to assess and modify, as necessary, any or all existing SWMP components and adopt new or revised SWMP components to achieve reductions in stormwater pollutants to the MEP. The adaptive management approach must include routine assessment of the need to further improve water quality and protection of beneficial uses, review of available technologies and practices, review of monitoring data and analyses required in **Schedule B**, review of measurable goals and tracking measures, and evaluation of resources available to implement the technologies and practices. The permittee must submit a description of the process for conducting this adaptive management approach during the permit term by December 1, 2011.

5. SWMP Revisions

The permittee may revise their SWMP during the permit term in accordance with the following procedures:

i. Adding BMPs, controls or requirements to the SMWP may be made at any time. The permittee must provide notification to the Department prior to implementation, and submit a summary of such revisions to the Department in the subsequent annual report.

ii. Reducing, replacing or eliminating BMP components, controls or requirements from the SWMP require submittal of a written request to the Department at least 60 days prior to the planned reduction, replacement, and/or elimination. The permittee's request must provide information that will allow the Department to determine within 60 days if the nature or scope of the SWMP is substantially changed, and include the following:
   1. Proposed reduction, replacement or elimination of the BMP(s), control, or requirement and schedule for implementation.
   2. An explanation of the need for the replacement, reduction or elimination.
   3. An explanation of how the replacement or reduction is expected to better achieve the goals of the stormwater management program or how the elimination is a result of the satisfactory completion of the BMP component, control or requirement.

iii. The permittee must not implement a reduction, replacement or elimination of a BMP until approved by the Department. If a request is denied, the Department must send the permittee a written response providing a reason for the decision.

iv. Adding, reducing, replacing or eliminating BMPs in the SWMP are considered permit revisions, and such revisions are minor or major permit modifications. Revisions that substantially change the nature and scope of the BMP component, control or requirement will be considered a major permit modification. Revisions requested by the permittee or initiated by the Department will be made in accordance with 40 CFR §§124.5, 122.62, or 122.63, and OAR 340-045-0040 and 0055.

v. Revisions initiated by the Department will be made in writing, set forth the time schedule for the permittee to develop the revisions, and offer the permittee the opportunity to propose alternatives to meet the objective of the requested revisions.

6. SWMP Measurable Goals

The following conditions must be incorporated into the City of Eugene SWMP by April 1, 2011:

a. BMP M4: During the repair/clean-up process, analyze the type and cause of the spills associated with repairs conducted by Fleet staff, and evaluate whether training may be helpful with spill minimization.

b. BMP M4: Include a spill procedure card in all vehicles and equipment by December 1, 2011.

c. BMP P4: Review Integrated Pest Management manual at least once during permit term, and update and refine the IPM policy document and operations manual in accordance with integrated pest management principles.

d. BMP P4: All newly developed playgrounds, pools, sprayplay features, recreational areas and other park areas must be evaluated during design or within one year of initial public use.

e. BMP E4: Review stormwater management proposals at the land use and/or development permit stage.

f. BMP P6: Review annual reports for privately-owned vegetated stormwater facilities.

g. BMP M6: Review annual reports for privately-owned underground stormwater structures.

7. Implementation Schedule: The following implementation schedule provides a summary of due dates for the permit conditions identified in **Schedule B** & **Schedule D**.

PERMIT CONDITION	SUMMARY OF IMPLEMENTATION SCHEDULE ACTIVITIES	DUE DATE
Monitoring Plan and Environmental Monitoring – B.1.b, B.2. & **Table B-1**	1. Submit monitoring plan	May 1, 2011
	2. Implement an approved monitoring plan	July 1, 2011
Annual Report – B.5	1. Submit annual report	December 1 – annually
Permit Renewal Application Package – B.6	1. Submit permit renewal application	180 days prior to permit expiration
303(d) List Evaluation – D.2	1. Submit 303(d) list evaluation report	December 1, 2014
Total Maximum Daily Load (TMDL) – D.3	1. Submit Wasteload Allocation Attainment Assessment	December 1, 2014
	2. Submit TMDL Pollutant Load Reduction Evaluation	December 1, 2014
	3. Submit TMDL Pollutant Load Reduction Benchmark	180 days prior to permit expiration
Adaptive Management – D.4	1. Submit Adaptive Management Approach	December 1, 2011
SWMP Measurable Goals – D.6	1. Incorporate SWMP Measurable Goal conditions	April 1, 2011

8. Definitions:

a. **Adaptive Management:** A structured, iterative process designed to refine and improve stormwater programs over time by evaluating results and adjusting actions on the basis of what has been learned.

b. **Antecedent dry period:** The period of dry time between precipitation events that include less than 0.1 inch of precipitation.

c. **Best Management Practices (BMPs):** The schedule of activities, controls, prohibition of practices, maintenance procedures and other management practices designed to prevent or reduce pollution. BMPs also include treatment requirements, operating procedures and practices to control stormwater runoff.

d. **Dry-weather field screening pollutant parameter action levels**: Pollutant concentrations or concentration ranges used by a permittee to identify an illicit discharge may be present and further investigation is needed.

e. **Green Infrastructure (GI):** A comprehensive approach to water quality protection defined by a range of natural and built systems and practices that use or mimic natural hydrologic processes to infiltrate, evapotranspirate, or reuse stormwater runoff on the site where it is generated.

f. **Illicit Discharge**: Any discharge to a municipal separate storm sewer system that is not composed entirely of stormwater except discharges authorized under Section A.4.a.xii., discharges permitted by a NPDES permit or other state or federal permit, or otherwise authorized by the Department.

g. **Impervious Surface:** Any surface resulting from development activities that prevents the infiltration of water or results in more runoff than in the undeveloped condition. Common impervious surfaces include: building roofs, traditional concrete or asphalt paving on walkways, driveways, parking lots, gravel roads, and packed earthen materials.

h. **Low Impact Development (LID):** 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 natural systems for infiltration, evapotranspiration, and reuse of rainwater, and can occur at a wide range of landscape scales (i.e., regional, community and site scales).

i. **Maximum Extent Practicable (MEP):** The statutory standard that establishes the level of pollutant reductions that operators of regulated MS4s must achieve. This standard is considered met if the conditions of the permit are met.

j. **Measurable Goals:** BMP objectives or targets used to identify progress of SWMP implementation. Measurable goals are prospective and, wherever possible, quantitative. Measurable goals describe *what* the co-permittee intends to do and *when* they intend to do it.

k. **Redevelopment:** A project on a previously developed site that results in the addition or replacement of impervious surface.

l. **Replace or Replacement:** The removal of an impervious surface that exposes soil followed by the placement of an impervious surface. Replacement does not include repair or maintenance activities on structures or facilities taken to prevent decline, lapse or cessation in the use of the existing impervious surface as long as no additional hydrologic impact results from the repair or maintenance activity.

m. **Stormwater Management Program:** A comprehensive set of activities and actions, including policies, procedures, standards, ordinances, criteria, and best management practices established to reduce the discharge of pollutants from the Municipal Separate Storm Sewer System to the Maximum Extent Practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act.

n. **Time of Concentration:** Travel time for a drop of water to travel from most hydrologically remote location in a defined catchment to the outlet for that catchment where remoteness relates to time of travel rather than distance.

o. **TMDL Pollutant Load Reduction Benchmark (TMDL benchmark):** An estimated total pollutant load reduction target for each parameter or surrogate, where applicable, for waste load allocations established under an EPA-approved TMDL. A benchmark is the anticipated

pollutant load reduction goal to be achieved during the permit cycle through the implementation of the stormwater management program and BMPs identified in the SWMP. A benchmark is used to measure the effectiveness of the stormwater management program in making progress toward the waste load allocation, and is a tool for guiding adaptive management. A benchmark is not a numeric effluent limit; rather it is an estimated pollutant reduction target that is subject to the maximum extent practicable standard. Benchmarks may be stated as a pollutant load range based upon the results of a pollutant reduction empirical model.

p. **Water Quality Trend Analysis:** A statistical analysis of in-stream water quality data to identify improvement or deterioration.

q. **Waters of the State:** Lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon, and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that do not combine or effect a junction with natural surface or underground waters) that are located wholly or partially within or bordering the state or within its jurisdiction.

SCHEDULE F
NPDES Permit General Conditions for Municipal Separate Storm Sewer Systems

SECTION A. STANDARD CONDITIONS

1. Duty to Comply with Permit
   The permittee must comply with all conditions of this permit. Failure to comply with any permit condition is a violation of the Clean Water Act and Oregon Revised Statutes (ORS) 468B.025, and 40 Code of Federal Regulations (CFR) §122.41(a), and grounds for an enforcement action. Failure to comply is also grounds for the Department to modify, revoke, or deny renewal of a permit.

2. Penalties for Water Pollution and Permit Condition Violations
   a. ORS 468.140 allows the Department to impose civil penalties up to $10,000 per day for violation of a term, condition, or requirement of a permit. Additionally 40 CFR §122.41(a) provides that any person who violates any permit condition, term, or requirement may be subject to a federal civil penalty not to exceed $32,500 per day for each violation.

   b. Under ORS 468.943 and 40 CFR §122.41(a), unlawful water pollution, if committed by a person with criminal negligence, is punishable by a fine of up to $25,000 imprisonment for not more than one year, or both. Each day on which a violation occurs or continues is a separately punishable offense.

   c. Under ORS 468.946, a person who knowingly discharges, places, or causes to be placed any waste into the waters of the state or in a location where the waste is likely to escape or be carried into the waters of the state is subject to a Class B felony punishable by a fine not to exceed $200,000 and up to 10 years in prison. Additionally, under 40 CFR §122.41(a) any

person who knowingly discharges, places, or causes to be placed any waste into the waters of the state or in a location where the waste is likely to escape into the waters of the state is subject to a federal civil penalty not to exceed $100,000, and up to 6 years in prison.

3. Duty to Mitigate
The permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment. In addition, upon request of the Department, the permittee must correct any adverse impact on the environment or human health resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the non-complying discharge.

4. Duty to Reapply
If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply to have the permit renewed. The application must be submitted at least 180 days before the expiration date of this permit.

The Department may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

5. Permit Actions
This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:
   a. Violation of any term, condition, or requirement of this permit, a rule, or a statute
   b. Obtaining this permit by misrepresentation or failure to disclose fully all material facts
   c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge
   d. The permittee is identified as a Designated Management Agency or allocated a waste load under a Total Maximum Daily Load (TMDL)
   e. New information or regulations
   f. Modification of compliance schedules
   g. Requirements of permit reopener conditions
   h. Correction of technical mistakes made in determining permit conditions
   i. Determination that the permitted activity endangers human health or the environment
   j. Other causes as specified in 40 CFR §§122.62, 122.64, and 124.5

The filing of a request by the permittee for a permit modification, revocation or reissuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition. The permittee must comply with all terms, conditions of the permit pending approval.

6. Toxic Pollutants
The permittee must comply with any applicable effluent standards or prohibitions established under Oregon Administrative Rules (OAR) 340-041-0033 for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

7. Property Rights and Other Legal Requirements
The issuance of this permit does not convey any property rights of any sort, or any exclusive privilege, or authorize any injury to persons or property or invasion of any other private rights, or any infringement of federal, tribal, state, or local laws or regulations.

8. Permit References
Except for effluent standards or prohibitions established under OAR 340-041-0033 for toxic pollutants and standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act, all rules and statutes referred to in this permit are those in effect on the date this permit is issued.

9. Permit Fees
The permittee must pay the fees required by OAR 340-045-0070 to 0075. The permittee must pay annual compliance fees by the last day of the month prior to when the permit was issued. For example, if the permit was issued or last renewed in April, the due date will be March 31st. If the payment of annual fees is 30 days or more past due, the permit registrant must pay 9% interest per annum on the unpaid balance. Interest will accrue until the fees are paid in full. If DEQ does not receive payment of annual fees when they are due, DEQ will refer the account to the Department of Revenue or to a private collection agency for collection.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance
The permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems that are installed by the permittees only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Need to Halt or Reduce Activity Not a Defense
It must not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with this permit.

3. Removed Substances
Solids or other pollutants removed in the course of maintaining the MS4 must be disposed of in such a manner as to prevent any pollutant from such materials from entering waters of the state, causing nuisance conditions, or creating a public health hazard.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling
Sampling and measurements taken as required under this Permit must be representative of the volume and nature of the monitored discharge. All samples must be taken at the monitoring points

specified in this permit, and must be taken, unless otherwise specified, before the effluent joins or is diluted by any other waste stream, body of water, or substance. Monitoring points may not be changed without notification to and the approval of the Department.

2. Monitoring Procedures
   Monitoring must be conducted according to test procedures approved under 40 CFR part 136, unless other test procedures have been specified in this permit or subsequent permit actions.

3. Penalties of Tampering
   The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit may, upon conviction, be punished by a fine of not more than $10,000 per violation, imprisonment for not more than two years, or both. If a conviction of a person is for a violation committed after a first conviction of such person, punishment is a fine not more than $20,000 per day of violation, or by imprisonment of not more than four years, or both.

4. Additional Monitoring by the Co-permittees
   If the permittee monitor any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR part 136 or as specified in this permit, the results of this monitoring must be included in the calculation and reporting of the data submitted in annual reports required by **Schedule B**. Such increased frequency must also be indicated.

5. Retention of Records
   The permittee must retain records of all monitoring information, including: all calibration, maintenance records, all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Department at any time.

6. Records Contents
   Records of monitoring information must include:
   a. The date, exact place, time, and methods of sampling or measurements;
   b. The individual(s) who performed the sampling or measurements;
   c. The date(s) analyses were performed;
   d. The individual(s) who performed the analyses;
   e. The analytical techniques or methods used; and
   f. The results of such analyses.

7. Inspection and Entry
   The permittee must allow the Department representative upon the presentation of credentials to:
   a. Enter upon a permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
   b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
   c. Inspect at reasonable times any facilities, equipment (including monitoring and control

equipment), practices, or operations regulated or required under this permit, and

d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by state law, any substances or parameters at any location within the MS4.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes
   The permittee must comply with OAR chapter 340, division 52, "Review of Plans and Specifications" and 40 CFR §122.41(1)(l). Except where exempted under OAR chapter 340, division 52, no construction, installation, or modification involving disposal systems, treatment works, sewerage systems, or common sewers may be commenced until the plans and specifications are submitted to and approved by the Department. The permittee must give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility.

2. Anticipated Noncompliance
   The permittee must give advance notice to the Department of any planned changes in the permitted facility or activities that may result in noncompliance with permit requirements.

3. Transfers
   This permit may be transferred to a new permittee provided the transferee(s) acquires a property interest in the permitted activity and agrees in writing to fully comply with all the terms and conditions of the permit and the rules of the Commission. No permit may be transferred to a third party without prior written approval from the Department. The Department may require modification, revocation, and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act (see 40 CFR §122.61; in some cases, modification or revocation and reissuance is mandatory). The permittee must notify the Department when a transfer of property interest takes place that results in a change of co-permittee(s).

4. Compliance Schedule
   Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than 14 days following each schedule date. Any reports of noncompliance must include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements.

5. Duty to Provide Information
   The permittee must furnish to the Department within a reasonable time any information that the Department requests to determine compliance with this permit. The co-permittees must also furnish to the Department, upon request, copies of records required to be kept by this permit.

   Other Information: When a permittee becomes aware that it has failed to submit any relevant facts or has submitted incorrect information in a permit application or any report to the Department, it must promptly submit such facts or information.

6. Signatory Requirements
   All applications, reports or information submitted to the Department must be signed and certified in accordance with 40 CFR §122.22.

7. Falsification of Information
   Under ORS 468.953, any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, is subject to a Class C felony punishable by a fine not to exceed $100,000 per violation and up to 5 years in prison. Additionally, according to 40 CFR §122.41(k)(2), any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit including monitoring reports or reports of compliance or non-compliance must, upon conviction, be punished by a federal civil penalty not to exceed $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

SECTION E. DEFINITIONS

1. *CFR* means Code of Federal Regulations.
2. *Clean Water Act* or *CWA* means the Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483 and 97-117; 33 U.S.C. 1251 et seq.
3. *Department* means Department of Environmental Quality.
4. *Director* means Director of the Department of Environmental Quality.
5. *Flow-Weighted Composite Sample* means a sample formed by collection and mixing discrete samples taken periodically and based on flow.
6. *Grab Sample* means an individual discrete sample collected over a period of time not to exceed 15 minutes.
7. *Illicit Discharges* means any discharge to a municipal separate storm sewer that is not composed entirely of stormwater except discharges pursuant to a NPDES permit (other than the NPDES permit for discharges from the municipal separate storm sewer) and discharges resulting from fire fighting activities.
8. *Major Outfall* means a municipal separate storm sewer outfall that discharges from a single pipe with an inside diameter 36 inches or more or its equivalent (discharge from a single conveyance other than circular pipe which is associated with a drainage area of more than 50 acres); or for municipal separate storm sewers that receive stormwater from lands zoned for industrial activities (based on comprehensive zoning plans or the equivalent), an outfall that discharges from a single pipe with an inside diameter of 12 inches or more or from its equivalent (discharge from other than a circular pipe associated with a drainage area of 2 acres or more).
9. *mg/L* means milligrams per liter.
10. *mL/L* means milliliters per liter.
11. *MS4* means a municipal separate storm sewer system.
12. *Municipal Separate Storm Sewer* means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains):
    a. Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State Law) having jurisdiction over disposal of sewage,

industrial wastes, stormwater or other wastes, including special districts under State Law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian Tribal organization, or a designated and approved management agency under §208 of the CWA that discharges to waters of the United States;

b. Designed or used for collection or conveying stormwater;
c. Which is not a combined sewer; and
d. Which is not part of a Publicly Owned Treatment Works (POTW) as defined by 40 CFR §122.2.

13. *Outfall* means a point source as defined by 40 CFR §122.2 at the point where a municipal separate storm sewer discharges to waters of the United States and does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels or other conveyances which connect segments of the same stream or other waters of the United States and are used to convey waters of the United States.
14. *Permit* means the NPDES municipal separate storm sewer system (MS4) permit specified herein, authorizing the permittees listed on Page 1 of this permit to discharge from the MS4.
15. *Stormwater* means stormwater runoff, snowmelt runoff, and surface runoff and drainage.
16. *Year* means calendar year except where otherwise defined.

APPENDIX D

Stormwater Management Plan (December 2012)

CITY OF EUGENE, OREGON
STORMWATER MANAGEMENT PLAN

APRIL 2011

Updated DECEMBER 2012

CITY OF EUGENE
STORMWATER
MANAGEMENT PROGRAM

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STORMWATER MANAGEMENT PLAN

This Stormwater Management Plan (SWMP) describes the set of best management practices (BMPs) that the City of Eugene has committed to conducting to reduce pollutant discharges from the municipal stormwater system to the maximum extent practicable. This plan is incorporated by reference into the City's National Pollutant Discharge Elimination System Municipal Separate Storm Sewer Discharge Permit #101244 re-issued December 30, 2010.

Section 1 of the plan includes an explanation of the SWMP BMP identification numbers and general categories and the relationship between the BMPs and specific federal requirements that govern stormwater management plans nation-wide. Section 2 includes a set of fact sheets that provide a description of each BMP, specific tasks and timelines, measurable goals and tracking measures.

1 Stormwater Management Plan BMP Identification and Categories

Eugene's SWMP includes 24 BMPs designed to reduce the discharge of stormwater pollutants to the maximum extent practicable. Each BMP is given an ID (for example, A1) for tracking and reporting purposes; the ID's are based on the City work section with lead responsibility, as follows:

A = Administration Division of Public Works Department
B = Building Division of Planning and Development Department
E = Engineering Division of Public Works Department
M = Maintenance Division of Public Works Department
P = Parks and Open Space Division of Public Works Department
W = Wastewater Division of Public Works Department

The 24 BMPs, listed in Table 1, fall into eight general categories:

- Public Education
- Operations and Maintenance
- Illicit Discharge Controls
- Waste Management
- Construction and New Development
- Planning, Capital Improvements and Data Management
- Industrial Facilities
- Permit Management

Fact sheets describing each BMP, specific tasks conducted, prospective and numeric measurable goals where practicable, and tracking measures are provided in Section 2.

Table 2 indicates which BMPs address the specific SWMP elements required by Schedule A.4 of the MS4 permit.

Table 1. Stormwater Management Plan Best Management Practices

BMP ID	BMP Title	BMP Category
A1	Stormwater Education	Public Education
E1	Stormwater Capital Improvement Projects	Planning, Capital Improvements, Data Mgt.
E2	Erosion Prevention & Construction Site Management Program	Construction and New Development
E3	Stormwater System Mapping and Data Management	Planning, Capital Improvements, Data Mgt.
E4	Stormwater Development Standards	Construction and New Development
E5	Permit Management & Reporting	Permit Management
M1	Management of Illicit Discharges to the Municipal Stormwater System	Illicit Discharge Controls
M2	Spill Response	Illicit Discharge Controls
M3	Street Sweeping Program and Leaf Pick-up	Operations & Maintenance
M4	Prevent Leaks and Spills from Municipal Vehicles and Equipment	Operations & Maintenance
M5	Public Stormwater System Cleaning Program – Piped System	Operations & Maintenance
M6	Regulation of Inspection, Maintenance and Reporting of Private Underground Stormwater Structures	Construction and New Development
M7	Systematic Stormwater Field Screening and Investigation	Illicit Discharge Controls
M8	Winter Road Sanding and De-Icing Program	Operations & Maintenance
P1	Educational Volunteer Program	Public Education
P2	Bacteria Pilot Study	Planning, Capital Improvements, Data Mgt.
P3	Tree Planting and Information Programs	Operations & Maintenance
P4	Public Stormwater System Maintenance – Developed Parks and Rights-of-Way	Operations & Maintenance
P5	Public Stormwater System Maintenance – Open Waterways	Operations & Maintenance

BMP ID	BMP Title	BMP Category
P6	Compliance Program for Maintenance of Privately Owned Vegetated Stormwater Facilities	Construction and New Development
P7	Litter and Illegal Dumping Control	Illicit Discharge Controls
B1	Household Hazardous Waste Disposal	Waste Management
B2	Solid Waste Management	Waste Management
W1	Industrial Stormwater Management Program	Industrial Facilities

Table 2. Stormwater Management Plan Requirements[1]

MS4 Permit Schedule A.4	Requirement (See permit for specific language.)	Public Education		Operations & Maintenance							Illicit Discharge Controls				Waste Mgt.		Construction and New Development				Planning, Capital Improvements and Data Management			Industrial Controls	Permit Mgt.
		Stormwater Education	Educational Volunteer Program	Street Sweeping Program and Leaf Pick-up	Prevent Leaks and Spills from Municipal Vehicles & Equip.	Public Stormwater System Cleaning – Piped System	Winter Road Sanding and De-Icing Program	Tree Planting and Information Programs	Public Stormwater System Maintenance – Developed Parks and Rights-of-Way	Public Stormwater System Cleaning – Open Waterways	Management of Illicit Discharges to the Municipal Stormwater System	Spill Response	Systematic Stormwater Field Screening and Investigation	Litter and Illegal Dumping Control	Household Hazardous Waste	Solid Waste Management	Erosion Prevention & Construction Site Management	Stormwater Development Standards	Regulation of Private Underground Facilities	Compliance Program for Private Vegetated Facilities	Stormwater Capital Improvement Projects	Stormwater System Mapping and Data Management	Bacteria Pilot Study	Industrial Stormwater Management Program	Permit Management and Reporting
		A1	**P1**	**M3**	**M4**	**M5**	**M8**	**P3**	**P4**	**P5**	**M1**	**M2**	**M7**	**P7**	**B1**	**B2**	**E2**	**E4**	**M6**	**P6**	**E1**	**E3**	**P2**	**W1**	**E5**
a. Illicit Discharge Detection and Elimination: Continue to implement a comprehensive program to detect, remove, and eliminate illicit discharges to the MS4. The program must:																									
i.	Prohibit illicit discharges into the City's MS4.										X														
ii.	Document enforcement response procedures.										X														
iii.	Develop or identify pollutant parameter action levels.										X														
iv.	Identify and map dry-weather screening priority locations. Conduct and document annual dry-weather screening inspections.										X		X									X			
v.	Identify response procedures to investigate portions of MS4 with likely presence of an illicit discharge										X														
vi.	Maintain system for documenting illicit discharge complaints or referrals.										X						X							X	
vii.	Once identified, eliminate illicit discharge [within timeframes outlines in permit].										X														
viii.	Describe and implement procedures to prevent, contain, respond to and mitigate spills into the MS4.				X						X	X													
ix.	Notify [downstream] municipality of illicit discharges from Eugene's MS4 area.										X														
x.	Notify contributing [upstream] municipality of illicit discharges to Eugene's MS4.										X														
xi.	Maintain maps of MS4 outfalls. Identify dry weather screening locations (see iv). Updated maps (permit timeline).										X		X									X			
xii.	Unless a significant source of pollutants, certain non stormwater discharges are allowed. If any of them become significant sources of pollutants, implement BMPs to address.										X		X												X
b. Industrial and Commercial Facilities: Continue to implement a program to reduce pollutants in stormwater discharges to the MS4 from [industrial and commercial facilities].																									
i.	Screen existing and new industrial facilities.																							X	
ii.	Notify facilities potentially subject to industrial SW permit.																							X	
iii.	Implement updated industrial and commercial facility inspection and stormwater control program.										X													X	
c. Construction Site Runoff Control: Continue to implement a program to reduce pollutants in stormwater runoff to the MS4 from construction activities.																									
i.	Include ordinances and other enforceable regulatory mechanisms for land disturbances of 1,000 sq ft or greater.																X								
ii.	Require erosion prevention and sediment control BMPs.																X								
iii.	Require control of non-stormwater construction waste.																X								

[1] Table 2 updated December 2012 to reflect December 2010 MS4 Permit SWMP requirements (Schedule A.4.); replaces previous Table 2 which referenced 40 CFR 122.26(d)(iv).

MS4 Permit Schedule A.4	Requirement (See permit for specific language.)	Public Education		Operations & Maintenance							Illicit Discharge Controls				Waste Mgt.		Construction and New Development				Planning, Capital Improvements and Data Management			Industrial Controls	Permit Mgt.
		Stormwater Education	Educational Volunteer Program	Street Sweeping Program and Leaf Pick-up	Prevent Leaks and Spills from Municipal Vehicles & Equip.	Public Stormwater System Cleaning – Piped System	Winter Road Sanding and De-Icing Program	Tree Planting and Information Programs	Public Stormwater System Maintenance – Developed Parks and Rights-of-Way	Public Stormwater System Cleaning – Open Waterways	Management of Illicit Discharges to the Municipal Stormwater System	Spill Response	Systematic Stormwater Field Screening and Investigation	Litter and Illegal Dumping Control	Household Hazardous Waste	Solid Waste Management	Erosion Prevention & Construction Site Management	Stormwater Development Standards	Regulation of Private Underground Facilities	Compliance Program for Private Vegetated Facilities	Stormwater Capital Improvement Projects	Stormwater System Mapping and Data Management	Bacteria Pilot Study	Industrial Stormwater Management Program	Permit Management and Reporting
		A1	**P1**	**M3**	**M4**	**M5**	**M8**	**P3**	**P4**	**P5**	**M1**	**M2**	**M7**	**P7**	**B1**	**B2**	**E2**	**E4**	**M6**	**P6**	**E1**	**E3**	**P2**	**W1**	**E5**
iv.	Ensure that BMPs are appropriate and address the construction activities being proposed.																X								
v.	Conduct and document on-site inspections.																X								
vi.	Describe enforcement response procedures.										X						X								
d. Education and Outreach: Implement an education and outreach program designed to achieve measurable goals based on target audiences, specific water quality issues, or identified pollutants of concern.																									
i.	Continue to implement a documented public education and outreach strategy.	X	X																						
ii.	Provide educational materials or conduct outreach re: impacts of SW to water quality and actions public can take.	X	X					X																	
iii.	Provide public education on proper use and disposal of pesticides, herbicides, fertilizers, household chemicals.	X	X					X	X						X										
iv.	Provide education on proper operation and maintenance of privately owned or operated water quality facilities	X																X	X	X					
v.	Provide notice to construction site operators re: where erosion program education and training can be obtained.	X															X								
vi.	Conduct or participate in effectiveness evaluation to measure the success of public education activities.	X																							
vii.	Training for City employees involved in MS4-related activities, as appropriate including municipal operations (e.g. parks maintenance, fleet and building maintenance, design and construction of storm drain systems, emergency firefighting activities, etc).	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
viii.	Promote, publicize, and facilitate public reporting of illicit discharges.	X									X														
e. **Public Involvement and Participation: Implement a public participation approach that provides opportunities for the public to effectively participate in the development, implementation and modification of the permittee's stormwater management program.**[2]																									
f. **Post-Construction Site Runoff: Continue to implement post-construction stormwater pollutant and runoff control program.**																									
i.	Update post-construction runoff control program to incorporate site specific practices that mimic predevelopment hydrology, optimize retention, reduce post-development runoff volumes, duration and rates, prioritize LID and green infrastructure approaches, and capture/treat 80% annual average runoff volume.					X			X	X								X	X	X					
ii.	Identify and minimize or eliminate barriers to implementing LID and green infrastructure approaches.					X			X	X								X	X	X					
iii.	Identify applicable LID, GI approaches, conditions where implementing these approaches may be impracticable, BMP design requirements, and pollutant removal efficiency performance goals.					X			X	X								X	X	X					

[2] Public involvement and participation applicable to most BMPs, variously, as appropriate.

MS4 Permit Schedule A.4	Requirement (See permit for specific language.)	Public Education		Operations & Maintenance							Illicit Discharge Controls				Waste Mgt.		Construction and New Development				Planning, Capital Improvements and Data Management			Industrial Controls	Permit Mgt.
		Stormwater Education	Educational Volunteer Program	Street Sweeping Program and Leaf Pick-up	Prevent Leaks and Spills from Municipal Vehicles & Equip.	Public Stormwater System Cleaning – Piped System	Winter Road Sanding and De-Icing Program	Tree Planting and Information Programs	Public Stormwater System Maintenance – Developed Parks and Rights-of-Way	Public Stormwater System Cleaning – Open Waterways	Management of Illicit Discharges to the Municipal Stormwater System	Spill Response	Systematic Stormwater Field Screening and Investigation	Litter and Illegal Dumping Control	Household Hazardous Waste	Solid Waste Management	Erosion Prevention & Construction Site Management	Stormwater Development Standards	Regulation of Private Underground Facilities	Compliance Program for Private Vegetated Facilities	Stormwater Capital Improvement Projects	Stormwater System Mapping and Data Management	Bacteria Pilot Study	Industrial Stormwater Management Program	Permit Management and Reporting
		A1	**P1**	**M3**	**M4**	**M5**	**M8**	**P3**	**P4**	**P5**	**M1**	**M2**	**M7**	**P7**	**B1**	**B2**	**E2**	**E4**	**M6**	**P6**	**E1**	**E3**	**P2**	**W1**	**E5**
iv.	Review, approve, and verify proper implementation of plans applicable to updated post-construction requirements.																	X	X	X					
v.	Establish off-site stormwater quality management alternative(s) for where project sites limit ability to achieve post-construction runoff program requirements (e.g. may include off-site mitigation or payment-in-lieu program).					X			X	X								X	X	X	X				
vi.	Describe inspection/enforcement response procedures for post-construction runoff program.																	X	X	X					
g. **Pollution Prevention for Municipal Operations**																									
i.	Operate and maintain City streets to minimize the discharge of stormwater pollutants to the MS4.			X	X		X																		
ii.	Implement program to control and minimize the use of pesticides, herbicides and fertilizers on city property.		X					X	X	X															
iii.	Implement a strategy to reduce the impact of municipal facilities that treat, store and transport solid waste.			X	X	X				X				X	X	X									
iv.	Limit infiltration of seepage from the municipal sanitary sewer system to the MS4.										X												X		
v.	Implement a program to prevent or control the release of materials related to fire-fighting training activities.										X														
vi.	Identify impact of public flood control projects on water quality and determine feasibility of retrofitting structural flood control devices for stormwater pollutant removal.																				X				
h. **Structural Stormwater Controls O&M Activities**																									
i.	Inventory and map stormwater structural facilities and controls and implement a program to verify that they are inspected, operated and maintained for effective pollutant removal, infiltration and/or flow control.					X			X	X								X	X	X	X	X			
ii.	Develop and implement a strategy that guides the long-term maintenance and management of all City-owned and identified privately owned stormwater structural facilities.					X			X	X								X	X	X					

2 Best Management Practices Fact Sheets

This section includes the set of 24 fact sheets that provide descriptions of each BMP, associated tasks and timelines, measurable goals and tracking measures. A brief description of the purpose of each general BMP category is included, followed by the list of BMPs representing the category and the BMP fact sheets themselves.

2.1 Public Education

The purpose of public education BMPs is to inform the public, the commercial/industrial sector, and in-house personnel about the sources and causes of stormwater pollution, its effect on the local receiving waters, and to encourage active involvement (e.g. behavioral changes, volunteerism, etc.) in the effort to reduce pollution. The following BMPs represent the public education elements of the SWMP:

A1 Stormwater Education
P1 Educational Volunteer Program

A1	**Stormwater Education**
Responsible Department/Division	Public Works / Administration Division
Description	Plan, develop, implement and revise as necessary a program to provide stormwater information and education to homeowners, school children, City and other agency staff and the general public about the impacts to stormwater quality and natural resource values from both point and non-point sources of pollution. In addition, educate professional, commercial, and industrial businesses about best management practices that can help prevent and reduce stormwater quality impacts to the public stormwater system and local receiving waters.
Tasks	1. Update and improve upon educational materials through assorted print material, videos, web, audio and visual media. 2. Prepare and staff booths at special events to reach community members. 3. Develop on-going campaigns as appropriate to support projects, programs, special opportunities and targeted pollutants.
Measurable Goals	• Conduct surveys every two years with Eugene residents to determine attitudes and opinions of residents about the stormwater management program. • Provide SPLASH educational curriculum to teachers and administrators in local school districts. • Develop and implement internal stormwater education to city staff through new employee orientation, “green team” presentations, work group presentations and audio/visual presentation. • Increase catch basin markers with “dump no waste” messages and storm drain covers installed on public improvement projects. • Work collaboratively on education campaigns with other local agencies.
Tracking Measures	• Number of information materials (all media) prepared and distributed to the public. • Number of students and teachers who use SPLASH curriculum annually. • Number of attendees at public outreach events. • Number of employees attending stormwater education sessions. • Track quantity of installed catch basin markers and storm drain covers. • Identify collaborative campaigns, target audience and summary of campaign. • Documentation of stormwater survey responses.

P1	**Educational Volunteer Program**[3]
Responsible Department/Division	Public Works / Parks & Open Space Division
Description	Manage and support the City's Eugene Park Stewards volunteer program that promotes stormwater education. Provide opportunities to involve citizens of all ages and socio-economic backgrounds in meaningful, hands-on and educationally oriented stormwater related projects. Such projects are aimed at providing both physical benefits and participant awareness related to protecting stormwater quality, fostering citizen stewardship of the City's water resources, promoting the use of native-vegetation, and enhancing fish and wildlife habitat within the local urban watershed.
Tasks	1. Recruit, support, and coordinate activities for groups or organizations to adopt portions of the City's stormwater system, such as creeks, ponds, and drainage channels. 2. Investigate inclusion of publicly owned vegetated stormwater facilities within developed parks and right of way into the volunteer program. 3. Advertise, coordinate and conduct periodic work parties for regular and drop-in volunteers aimed at waterway clean-up, invasive species removal, native vegetation salvage and native vegetation planting in riparian areas. 4. Partner with local agencies, organizations, businesses and/or corporate sponsors to plan, promote, coordinate and implement annual large scale waterway clean-up volunteer events. 5. Inform the public about the purpose of the volunteer program through public presentations, distribution of program information materials, event related press releases and news media articles and news stories. Include in the communication the challenges and benefits of managing stormwater properly.
Measurable Goals	• As attrition occurs continue to recruit replacement adoption groups to maintain current levels of participation. • Conduct one volunteer work party annually that will address maintenance needs at publicly owned vegetated stormwater facilities with developed parks or the right of way. • On average, conduct 12 volunteer work parties per year. • Conduct at least one partnership based large-scale water resource clean-up or enhancement volunteer project per year. • Correspond with the city's stormwater education program coordinator on a regular basis to determine if there are opportunities to better inform the public regarding the challenges and benefits of stormwater management.

[3] Description for BMP P1 updated December 2012 to reference consolidated volunteer program "Eugene Park Stewards," which incorporates the program previously called "Neighborwoods." No substantive changes to BMP tasks, measurable goals, or tracking measures.

Tracking Measures	• Number of adoption groups that are retained and continue to participate in the volunteer program. Track number of new adoption groups brought into the program. • Number of volunteer work parties conducted that involve maintenance of publicly owned vegetated stormwater facilities and number of volunteer participants. • Number of work parties conducted and number of volunteer participants. • Document annual large-scale project(s), participating partners and number of volunteer participants. • Document annually efforts to educate the public about the city's volunteer programs and the protection of water quality as it relates to stormwater.

2.2 Operations and Maintenance

The purpose of operations and maintenance BMPs is to maintain the publicly managed stormwater system (e.g. pipes, culverts, open waterways, water quality facilities), balancing flood control, drainage services, water quality, and natural resource protection needs, and to adaptively manage for continuous improvement of current operations and maintenance practices. Operations and maintenance BMPs are also focused on planning and performing other City services, such as landscape maintenance or road repair projects for example, in a manner that minimizes the potential for stormwater pollution from these activities. The following BMPs represent the operations and maintenance element of the SWMP:

M3 Street Sweeping Program and Leaf Pick-up
M4 Prevent Leaks and Spills from Municipal Vehicles and Equipment
M5 Public Stormwater System Cleaning Program – Piped System
M8 Winter Road Sanding and De-Icing Program
P3 Tree Planting and Information Programs
P4 Public Stormwater System Maintenance – Developed Parks and Right-of-Ways
P5 Public Stormwater System Maintenance – Open Waterways

M3	**Street Sweeping Program and Leaf Pick-up**
Responsible Department/Division	Public Works /Maintenance Division
Description	Undertake both mechanical brush and vacuum sweeping of publicly maintained roads, bike paths, and parking lots in accordance with the Stormwater Operations and Maintenance Manual. Monitor and evaluate new technology and methods related to street sweeping, and make appropriate adjustments to the current sweeping program when feasible to maximize water quality benefits.
Tasks	1. Follow sweeping frequencies as outlined in the Stormwater Operation and Maintenance Manual. 2. Collect sweeping data such as amount of debris swept, curb miles swept, streets and/or areas swept. 3. Conduct annual curbside pickup of leaves on City streets.
Measurable Goals	Follow sweeping frequencies as outlined in the Stormwater Operation and Maintenance Manual, more specifically described as follows: • Sweep downtown core twice per week. • Sweep university and industrial areas once per week. • Sweep arterial streets every 2 weeks. • Sweep residential streets every 6-8 weeks. • Sweep bike paths and improved alleys twice per year. • Coordinate and manage two seasonal opportunities for the citizen's leaves to be picked up and managed by the SW operations crew.
Tracking Measures	• Lane miles swept. • Amount of debris collected. • Amount of leaves picked up.

M4	**Prevent Leaks and Spills from Municipal Vehicles and Equipment**
Responsible Department/Division	Public Works / Maintenance Division
Description	Undertake preventive maintenance program for all municipal vehicles and equipment in order to prevent or correct sources of vehicle fluid leaks. Implement employee education practices and field operations procedures to detect and report leaks and to prevent incidences of fluid and material spills from municipal vehicles. Equip municipal trucks and large mechanized equipment with renewable spill response kits.
Tasks	1. Maintain training competencies for Fleet Services employees. 2. Maintain a preventative maintenance schedule for all vehicles and equipment. 3. Maintain a supply of spill kit materials for designated vehicles and equipment.
Measurable Goals	• Include a spill procedure card in all City vehicles and equipment by December 1, 2011. • Perform preventative maintenance service on all City vehicles and equipment annually, at a minimum. • During the repair/clean-up process, analyze the type and cause of the spills associated with the repairs conducted by Fleet staff, and evaluate whether operator training maybe helpful with spill minimization.
Tracking Measures	• Track the number of spill procedure cards issued annually. • Track the number of vehicle related leaks repaired annually. • Track the percentage of vehicles which receive preventative maintenance service annually.

M5	**Public Stormwater System Cleaning Program – Piped System**
Responsible Department/Division	Public Works / Maintenance Division
Description	Undertake frequent, systematic cleaning of the components of the public stormwater system such as catch basins, pipes, culverts, inlets, and stormwater quality devices in accordance with the adopted Stormwater Operations and Maintenance (O&M) Manual. Document quantities of material removed from each structure. Using the maintenance management system, refine the regular cleaning schedule for pipes, catch basins and stormwater quality devices. Research and monitor developments in maintenance technology and operations and maintenance methods for the closed systems which will further increase the effectiveness of our cleaning practices and water quality improvement practices.
Tasks	1. Follow cleaning procedures as outlined in the Stormwater O&M Manual. 2. Collect loading information for individual structures and facilities.
Measurable Goals	• Clean 50% of the all of the public catch basins and inlet structures annually unless increased efficiencies are shown through adaptive management. • Clean all of the public underground stormwater quality structures as outlined in the Stormwater O&M Manual.
Tracking Measures	• Track the number of structures cleaned. • Track the amount of debris recovered. • Track the lineal footage of stormwater lines cleaned.

M8	**Winter Road Sanding and De-icing Program**
Responsible Department/Division	Public Works / Maintenance Division
Description	Apply and clean up winter traction sand on publicly maintained roads and parking areas in conjunction with the application of a pre-wetting agent designed to reduce the need for repeat sanding. Conduct research efforts to identify and evaluate new technology and strategies for application of environmentally friendly chemical anti-icing and de-icing agents. Conduct research into new methods, practices, and efficiencies which may further limit the runoff of sanding related pollutants to the storm system. Conduct preseason staff training on the proper application methods of sand and chemical agents.
Tasks	1. Apply sand to roadways in accordance with the Public Works Snow and Ice Plan. 2. Apply chemical agents in accordance to Guidelines for Anti-icing/Deicing included in the Public Works Snow and Ice Plan. 3. Respond to priority routes as outlined in Public Works Snow and Ice Plan. 4. Collect data such as streets plowed and sanded, material used, and other data related to snow/ice events.
Measurable Goals	• Minimize the use of abrasive materials for snow and ice control through adaptive management practices. • Begin clean up of abrasive materials when streets become free of ice and snow, and the forecast does not call for more ice and snow within the next 24 hours.
Tracking Measures	• Document the quantities of sanding materials applied and collected during each storm event. • Document the volume used for deicing/anti-icing operations.

P3	**Tree Planting and Information Programs**[4]
Responsible Department/Division	Public Works / Parks & Open Space Division
Description	Manage and support both governmental and community tree planting programs. Provide information to the public about the multiple benefits that trees provide for protecting and enhancing stormwater quality.
Tasks	1. Manage and support the City's community focused Eugene Park Stewards volunteer program. 2. Manage and support the City's internally focused tree planting programs that regulate new development so they are fully planted with street trees and that ensure City-engineered street improvement projects include street trees in appropriate plantable areas. 3. Seek opportunities to provide and/or present information to the community regarding stormwater related benefits of trees.
Measurable Goals	• On average, conduct 12 Eugene Park Stewards volunteer program tree planting projects per year. • Include the planting of street trees with all new private developments and with all new public street improvement projects as opportunities arise. • Plant 600 trees per year through the Eugene Park Stewards program and the City's regulatory tree planting program. • Provide information about the stormwater benefits of trees at major publicly attended events at least 4 times per year.
Tracking Measures	• Track the number of Eugene Park Stewards volunteer program planting projects and the resulting number of trees planted. • Track the number of trees planted through new development tree planting requirements and through City-engineered street improvements. • Track the number and type of publicly attended events where stormwater related tree information was provided or where a presentation was made.

[4] Tasks, Measurable Goals and Tracking Measures for BMP P3 updated in December 2012 to reference consolidated volunteer program "Eugene Park Stewards," which incorporates the program previously called "Neighborwoods." No substantive changes to BMP tasks, measurable goals, or tracking measures.

P4	**Public Stormwater System Maintenance – Developed Parks and Rights-of-Way**
Responsible Department/Division	Public Works / Parks & Open Space Division
Description	Evaluate and, as necessary, adapt or revise turf, landscape and natural area vegetation management programs for public lands under the City's jurisdiction. Such areas include developed parkland and public right-of-way. The focus of this BMP is to minimize and further limit the discharge of pollutant laden runoff from these areas.
Tasks	1. Update and refine the Integrated Pest Management (IPM) policy document and operations manual as new techniques are researched and the results of implementation of these techniques are uncovered. 2. Research, evaluate and implement park and landscaped area design practices and new vegetation management techniques to minimize impervious surfaces; reduce pesticide and fertilizer use; and maximize the use of native vegetation, where appropriate. 3. Complete stormwater inspections utilizing inspection checklist for all publicly-maintained vegetated stormwater facilities within the right-of-way and developed parks. Update the new stormwater facility tracking system database with information gathered in field. 4. Evaluate the Pesticide Free Parks Program. Revise, adapt, and expand program as appropriate. 5. Utilize the IPM policy document to continue adding Pesticide Free Zones within Eugene's seven stormwater basins.
Measurable Goals	• Review IPM manual at least once during the permit term, and update and refine the IPM policy document and operations manual in accordance with integrated pest management principles. • Conduct periodic inspection of each publicly maintained vegetated stormwater management facility within the right-of-way and developed parks. Populate the stormwater facility tracking system database with current information for each facility that is inspected. • Continue to provide services to existing Pesticide Free Parks. • All newly developed playgrounds, pools, sprayplay features, recreational areas and other park areas will be evaluated during design or within one year of initial public use for addition into the Pesticide Free Zone program.
Tracking Measures	• Document updates of IPM policy document and operations manual. • Document new techniques and practices that are incorporated into park and landscape design. • Document the number of publicly maintained vegetated stormwater facilities inspected and information entered into the stormwater facility

	tracking system database annually. • Track the condition of existing parks that are currently maintained using the Pesticide Free Parks protocol. • Calculate the total acreage that has been placed in the Pesticide Free Zone Program per year. Utilize Chem Track program to track how much chemical (pound per acre) were used each year and determine total reduction of chemicals used annually.

P5	**Public Stormwater System Maintenance – Open Waterways**
Responsible Department/Division	Public Works / Parks and Open Space Division
Description	Maintain and manage open waterways consistent with adopted Open Waterway Maintenance Plans. These plans are intended to protect and enhance stormwater quality and natural resources values while continuing to maintain sufficient conveyance capacity in the waterways.
Tasks	1. Follow written procedures for on-going maintenance of open waterways: Open Waterway Maintenance Plans (for all open waterways) and U.S. Army Corps of Engineers Levee Owner's Manual (for portions of Amazon Creek). 2. Establish native trees and shrubs along portions of open waterways that are lacking shade. 3. Repair channel banks as erosion or slumping issues occur. 4. Revise Open Waterways Maintenance Plans to incorporate new information and techniques to further advance the goal of maximizing water quality and habitat benefits while also maintaining sufficient conveyance. 5. Implement storm event monitoring at potential choke points in the open waterway system. 6. Complete stormwater inspections utilizing inspection checklist for all publicly-maintained vegetated stormwater facilities (e.g., detention ponds, wetlands, bioswales). Update the stormwater facility tracking system database with information gathered during inspection.
Measurable Goals	• Implement "green piping" (i.e., pruning woody vegetation within active channel zone) on 5 miles of open waterway annually to maintain conveyance. • Establish native trees and shrubs on 5000 lineal feet of waterway annually to help shade streams, lower water temperatures, and increase slope stability. • Revise all Open Waterway Maintenance Plans by December,2012. • Conduct periodic inspections for publicly-maintained vegetated stormwater facilities (e.g., detention ponds, wetlands, bioswales). Populate the stormwater facility tracking system database with current information for each facility.
Tracking Measures	• Miles of open waterways that are green-piped each year. • Track the number of riparian vegetation planting projects, including the number of lineal feet planted, and the number and general type of native species planted (i.e. trees, shrubs, grasses, etc.).Number of channel bank repair projects (e.g., to reduce erosion or slumping) completed each year. • Number of times each year that the storm event monitoring program for open waterways is activated. • Number of publicly maintained vegetated stormwater facilities inspected and information entered into the stormwater facility tracking system database annually.

2.3 Illicit Discharge Controls

The purpose of illicit discharge control BMPs is to become aware of, investigate, detect, mitigate, and enforce the elimination of illicit (non-stormwater) discharges and illegal dumping to the stormwater system. The following BMPs represent the illicit discharge control element of the SWMP:

M1 Management of Illicit Discharges to the Municipal Stormwater System
M2 Spill Response
M7 Systematic Stormwater Field Screening and Investigation
P7 Litter and Illegal Dumping Control

M1	**Management of Illicit Discharges to the Municipal Stormwater System**
Responsible Department/Division	Public Works / Maintenance Division
Description	Discourage and reduce improper discharges into the stormwater system through operation of a stormwater discharge compliance enforcement program. The primary goals of this program are to protect the quality of the receiving waters of the City's stormwater system and to ensure that discharges to the City's stormwater system are in compliance with local, state, and federal regulations to the maximum extent practicable. The City will conduct periodic review of enforcement program practices and procedures and make revisions as deemed necessary.
Tasks	1. Use CCTV inspection, dye testing, smoke testing and field investigation to identify illegal connections, cross connections with the wastewater system and failures in the pipe system. 2. Inspect stormwater outfalls to identify illicit discharges, as well as track outfalls added or removed from the stormwater system. 3. Implement the City's Stormwater System Administrative Rule, 58-02-01-F, with the intent to prohibit improper connections and illegal discharges to the City's stormwater system utilizing an effective enforcement program .
Measurable Goals	• Work to reduce the number of improper discharges into the municipal stormwater system through public outreach and a reasonable enforcement of regulations.
Tracking Measures	• Track the number of stormwater pollution complaints received by the City. • Track the number of outfalls inspected annually. • Track the number of requests-for-service (RFS) related to illicit discharges to the municipal stormwater system which required enforcement.

M2	**Spill Response**
Responsible Department/Division	Public Works / Maintenance Division
Description	Maintain an on-call team trained in spill response procedures involving environmentally hazardous materials and a vehicle equipped for such spill mitigation. Coordinate efforts with other local response teams such as the City of Eugene Fire and Police Departments, Lane County, and state agencies.
Tasks	1. Maintain an on-call list of personnel trained in spill response procedures. 2. Maintain an inventory of equipment and supplies necessary to mitigate improper discharges to the municipal stormwater system. 3. Coordinate in conjunction with Fire Department / Hazmat Team on mitigation efforts including hazardous material clean-up and disposal. 4. Update the City of Eugene's Public Works Maintenance Spill Response and Illicit Discharge Operations Plan.
Measurable Goals	• Maintain a list of HAZWOPER trained personnel that are available for 24-hour emergency response. • Maintain and update, as necessary, the City's On-Call Emergency Roster for Environmental Spills.
Tracking Measures	• Up-to-date list of employees trained for spill response. • Track number of spills and follow-up details.

M7	**Systematic Stormwater Field Screening and Investigation**
Responsible Department/Division	Public Works / Maintenance Division
Description	The Stormwater Field Screening and Investigation program inspects the public stormwater system for condition assessment and the private stormwater system to assess water quality impacts to the municipal stormwater system. Where illicit discharges are found, attempt to identify the source and eliminate the discharge.
Tasks	1. Work with the Sub Surface Maintenance Crew to assess, inspect and map the details of the public and private stormwater system. 2. Conduct annual dry-weather field screening inspections per the City of Eugene Field Screening manual. 3. Work with the inspection and enforcement staff to continue to educate and regulate the users on the proper use of the stormwater system.
Measurable Goals	• Improve accuracy of the Stormwater System layer in our Geographic Information Systems (GIS) through map update requests. • Identify and remove illicit discharges to the municipal stormwater system through the dry-weather field screening process. • Utilize interaction with the public as an educational opportunity to increase stormwater user awareness. • Develop “map update” requests based on field inspections and forward this information to the GIS manager for inclusion into the citywide GIS system.
Tracking Measures	• Track the number of map update requests forwarded to the GIS team. • Track and create work orders for the system repairs discovered through the inspection process. • Track the number of dry-weather field screening inspections and follow-up details.

P7	**Litter and Illegal Dumping Control**
Responsible Department/Division	Public Works / Parks & Open Space Division and Maintenance Division
Description	Manage and support efforts to reduce impacts to stormwater runoff and local receiving waters by controlling litter and debris in public spaces and by removing illegally dumped refuse and debris as well as garbage and trash from illegal camp sites. There are two primary focal points of this BMP. The first is to provide opportunities for proper disposal of litter and trash at strategic publicly owned sites to prevent it from being washed into the public stormwater system. The second is to clean-up illegal dump sites and illegal camp sites prior to pollutants from the trash and debris being washed into the public storm system or the local receiving waters.
Tasks	1. Place trash receptacles in parks, public areas and at venues for public events which are likely to generate garbage, litter and other throw-away items. Provide frequent collection service to prevent over filling. 2. Require up-front clean-up deposits for large events in City parks, for rental of City park shelters, and for rental of other City owned and operated recreation or outdoor cultural facilities. 3. Conduct routine debris inspections of significant waterways under the City's jurisdiction and remove illegally dumped or discarded debris and other items as appropriate. 4. Conduct routine inspections along riverbanks and in other undeveloped lands under the City's jurisdiction to locate, dismantle, and clean-up illegal camp sites and their associated trash, garbage, debris and bio-hazardous materials. 5. Identify and monitor known historic dump sites in remote areas of the public right-of-way (such as undeveloped cul-de-sacs, dead-end streets, etc.), attempt to identify a responsible party for significant piles of dumped debris, and remove the dumped material as soon as possible to discourage additional dumping by others.
Measurable Goals	• Ensure all parks, all public space areas managed by the City and all venues for outdoor public events on City lands have adequate trash receptacles. Empty trash receptacles frequently enough to prevent spillage due to being over filled. • Ensure at least 75% of all rentals of parks, park shelters, and other City operated outdoor facilities will result in no loose litter and debris left behind. • Inspect all major waterways and riverbanks weekly for dumped or discarded debris and illegal campsites. When found, remove dumped materials within two working days. When found, dismantle illegal campsites and clean-up as soon as is physically and legally possible.

	• Monitor all identified historic dumping sites in the public right-of-way and clean-up as necessary at least twice per month.
Tracking Measures	• Track the collection frequency for trash receptacles in City parks and other public space areas managed by the City. • Document the number or percentage of rentals of parks, park shelters, and other outdoor venues held on City managed land that forfeit all or part of their clean-up deposit due to excessive litter left behind. • Track the number of illegal campsites cleaned-up along riverbanks, waterways, or other public space areas managed by the City. • Track the frequency of collection and the amount of debris collected from waterways and from the public right-of-way.

2.4 Waste Management

The purpose of the waste management BMPs is to educate the public, regulate waste management services, and to ensure that proper facilities are available in order to minimize the potential of negative stormwater impacts from solid waste collection, improper disposal of toxic materials, and illegal dumping of garbage and debris. The following BMPs represent the waste management element of the SWMP:

B1 Household Hazardous Waste Program
B2 Solid Waste Management Program

B1	**Household Hazardous Waste Disposal**
Responsible Department/Division	Planning and Development / Building and Permit Services Division
Description	Support existing efforts and programs within the Eugene metro area to inform citizens of local opportunities for the proper discard and disposal of their household hazardous waste materials. Support and promote facilities and programs that provide such opportunities. The improper disposal of household hazardous waste poses a serious threat to local stormwater quality. Old paint, solvents and thinners, pesticides, bleach, drain cleaners, antifreeze, gasoline, used motor oil and other motor vehicle fluids can easily be flushed into the stormwater system if disposed of in yards, left uncovered in the rain, or poured down driveways or into the street. Supporting efforts to inform homeowners and tenants about where they can properly dispose of these products as well as supporting local household hazardous waste management facilities and efforts is an effective way to reduce the amount of these products that inadvertently make their way into the stormwater system and local receiving waters.
Tasks	1. Collaborate with Lane County Waste Management Division staff on educational outreach via the development and distribution of brochures, fact sheets, and community outreach events. 2. Require solid waste haulers to notify their customers of the Special Wastes Program offered through the Lane County Waste Management Division. 3. Develop information on a City website page that provides education on household hazardous waste and explains how to set up an appointment with Lane County Solid Waste to dispose of materials properly. 4. Collaborate with local metro area partners to publish information in local phone books regarding waste prevention, recycling, composting, and disposal of household hazardous waste.
Measurable Goals	• Work with Lane County and City of Springfield to annually update "Brown Pages" in the US Dex directory to include new electronics requirements. • Update the City's web site periodically to direct residents to the latest information about recycling and waste prevention news, resources, and local events.
Tracking Measures	• Document completion of "Brown Pages" update. • Document materials disbursed about household hazardous materials

B2	Solid Waste Management
Responsible Department/Division	Planning and Development / Building and Permit Services Division
Description	Evaluate and revise, as necessary, existing solid waste and recycling collection rules to address stormwater quality. Improper and/or unregulated collection and recycling of solid waste has a serious potential for creating negative impacts to stormwater quality. High collection fees, infrequent or spotty collection service may lead to illegal dumping activity. Unregulated waste containers may be prone to leaking or spilling allowing pollutants to wash into the storm system. By continuing to monitor and evaluate local solid waste management collection efforts, the City will be better able to improve local regulations so that stormwater quality is taken into account.
Tasks	1. Regulate solid waste and recycling collection activities within the city limits to curb possible impacts to the stormwater systems from leachate of garbage, yard debris, and recycling materials. 2. Support a minimum of biweekly collection service for organic materials and provide backyard composting classes for residents with or without collection service. 3. Implement the nuisance abatement enforcement program that provides rapid response to illegal dumping of garbage, yard debris, or other solid waste materials.
Measurable Goals	• Review Administrative Rule to ensure regulations are up to date and include requirements to support appropriate waste management and prevention. • Contract with Oregon DEQ for a waste composition study.
Tracking Measures	• Document total tons of yard debris collected through the curbside program. • Document the number of compost demonstration workshops and participants. • Document number of enforcement cases related to inappropriate garbage handling. • Compare waste composition study with the prior one.

2.5 Construction and New Development

The purpose of the construction and new development BMPs is to ensure that appropriate control measures are considered, implemented, and maintained during and after the planning, design, and construction phases for new public and private development and significant re-development projects. The following BMPs represent the new construction and new development related elements of the SWMP:

- E2 Erosion Prevention and Construction Site Management Program
- E4 Stormwater Development Standards
- P6 Compliance Program for Maintenance of Privately Owned Vegetated Stormwater Facilities
- M6 Regulation of Inspection, Maintenance and Reporting of Private Underground Stormwater Structures

E2	**Erosion Prevention and Construction Site Management Program**
Responsible Department/Division	Public Works / Engineering Division
Description	Administer and monitor an Erosion Prevention and Construction Site Management Program in compliance with Eugene Code 6.625-6.645, preventing and mitigating pollutant and sediment discharges into the city's stormwater system due to construction activities and land disturbance.
Tasks	1. Screen all development permits for sensitive area status, conduct plan reviews, issue erosion permits, conduct erosion inspections, and provide compliance enforcement as appropriate. 2. Issue Erosion Permits for activities which disturb an area one acre or greater in size or disturb an area 500 square feet or greater within a sensitive area (i.e. adjacent to a water feature or its buffer, ground slopes greater than 10%, having highly erodible soils). 3. Conduct education and outreach related to new erosion techniques/practices. 4. Act as 1200-C Agent for DEQ.
Measurable Goals	• Conduct one inspection prior to the commencement of work for all erosion permitted sites. • Inspect non-erosion-permitted sites at least twice during the life of the building/construction permit or as necessary to assure compliance with the program. • Inspect permitted sites monthly or as necessary to assure compliance with the program. • Conduct one annual erosion prevention training event.
Tracking Measures	• Number of compliance orders issued. • Number of permits issued. • Number of inspections. • Number of training/outreach events.

E4	**Stormwater Development Standards**
Responsible Department/Division	Public Works / Engineering Division
Description	Administer and monitor a program that implements the city's Stormwater Development Standards, Eugene Code 9.6790-9.6796, Eugene Code 7.143 (3), and associated Stormwater Management Manual. The Stormwater Development Standards regulate the location, design, construction and maintenance of private and public stormwater facilities for flood control, water quality, and natural resource protection.
Tasks	1. Screen development permits for post-construction stormwater management, conduct plan reviews, approve stormwater facilities, conduct inspections, and provide compliance enforcement as appropriate. 2. Maintain an up-to-date Stormwater Management Manual for new development. 3. Track, evaluate, and develop new technologies and practices for post-construction stormwater management. 4. Provide training and technical assistance on water quality facilities to city staff and the public. 5. Conduct a review of policies, practices and regulations to identify potential barriers to implementing low impact development techniques.
Measurable Goals	• Review stormwater management proposals at the land use and/or development permit stage (i.e. earliest level of review). • Review and approve construction plans for stormwater management facilities for all development sites which create 1000 square feet or more impervious surface. • Update Eugene's Stormwater Management Manual every two years or as needed to provide new information or practices for post-construction stormwater management.
Tracking Measures	• Number of private water quality facilities permitted with building permits. • Number of land use applications reviewed. • Number and type of public water quality facilities constructed. • Number of training/outreach events held.

P6	**Compliance Program for Maintenance of Privately Owned Vegetated Stormwater Facilities**
Responsible Department/Division	Public Works / Parks & Open Space Division
Description	Develop, implement and manage a program to ensure that privately owned and operated vegetated stormwater treatment facilities are maintained so that they function as designed and constructed. The program will employ a combination of rules, protocols and procedures to require: that each private vegetated facility is routinely inspected; that routine and corrective maintenance actions are performed in a timely manner; and that completion of both such activities are regularly reported to City staff. Based on Eugene Municipal Code requirements, penalties and/or other legal remedies will be employed to enforce compliance with these requirements when necessary.
Tasks	1. Continue to document pertinent information for new privately owned and operated vegetated stormwater facilities. This includes photo documentation of newly constructed facilities and populating the stormwater facility tracking system database with all new facility information. 2. Develop an administrative rule that details the policy guidelines, practices, procedures, specific authorities, permitted actions, and penalties to be used by City staff in managing the program. 3. Establish criteria for when maintenance audits, corrective actions, and/or enforcement actions are warranted. 4. Maintain mechanisms, processes and procedures to track BMP ownership, maintenance inspections, required reports, corrective maintenance activity and enforcement actions. 5. Develop templates for written correspondence to BMP owners, such as inspection notification, reporting reminder, notice of non-compliance, notice of violation, and enforcement documents. 6. Review required inspection and maintenance logs submitted by BMP owners
Measurable Goals	• Inspect all new vegetated private stormwater facilities at the time of construction and log pertinent information into the stormwater facility tracking database system. Adopt and implement an administrative rule to enforce the maintenance of private stormwater facilities by February 2011. • Ensure the inspection of each vegetated private stormwater facility is conducted at least once per year by the owner/operator and an inspection and maintenance log documenting the necessary corrective actions is submitted to City staff annually. • Review annual reports for privately-owned vegetated stormwater facilities.

Tracking Measures	• Number of private vegetated stormwater facility inspections completed at time of construction. • Number of owner/operator inspection and maintenance logs received and reviewed annually. • Number of notices of non-compliance and subsequent enforcement.

M6	**Regulation of Inspection, Maintenance and Reporting of Private Underground Stormwater Structures**
Responsible Department/Division	Public Works / Maintenance Division
Description	Develop, implement and manage a program to ensure that privately owned and operated underground stormwater treatment structures are properly maintained. The program will employ the guidance provided by the required individual Operations and Maintenance (O&M) plan for each structure.
Tasks	1. Develop templates for written correspondence to the private operator, such as inspection notifications, reporting reminders, notices of non-compliance, notices of violation, and enforcement documents. 2. Establish criteria for when maintenance audits, corrective actions, and/or enforcement actions are warranted. 3. Develop and maintain mechanisms, processes and procedures to track structure type, ownership, maintenance inspections, required reports, corrective maintenance activity and enforcement actions. 4. Collect and file the required annual reports as provided by the private operator.
Measurable Goals	• Inspect all new private underground stormwater structures at the time of construction and log pertinent information into a database. • Establish a correspondence file for each structure/operator. • Ensure that each private underground stormwater structure is inspected, maintained and reported on as required by the O&M plan for the specific device. • Review annual reports for privately-owned underground stormwater facilities.
Tracking Measures	• Track the number of O&M plans obtained. • Track the number of private inspection, maintenance and reporting activities conducted. • Track any enforcement activities related to the individual structures.

2.6 Planning, Capital Improvements and Data Management

The purpose of planning, capital improvements and data management is to develop and implement comprehensive stormwater basin plans, evaluate potential sources of specific pollutants and related BMPs to address them, and maintain up to date data on the stormwater system. The following BMPs represent the planning, capital improvements and data management elements of the SWMP:

- E1 Stormwater Capital Improvement Projects
- E3 Stormwater System Mapping and Data Management
- P2 Bacteria Pilot Study

E1	**Stormwater Capital Improvement Projects**
Responsible Department/Division	Public Works / Engineering Division
Description	Implement the Stormwater capital improvement program (CIP), including projects identified in the City's *Stormwater Basin Master Plans* (Basin Plans) for Amazon, Willow Creek, Bethel-Danebo, Willakenzie, Laurel Hill, and Willamette River and the River Road – Santa Clara basins. The Basin Plans describe a multiple-objective strategy for managing stormwater that addresses water quality protection and improvement, conveyance and flood control, and waterway protection and restoration. The basin strategies reflect the unique characteristics, problems and opportunities in each basin. Volume I contains a prioritized city-wide capital projects list including: water quality facilities in high pollutant source areas, streambank stabilization, stream restoration, and capacity enhancement projects. The Basin Plan capital projects are one of the main sources of capital projects that comprise the City's CIP. In addition to the Basin Plans, CIP projects also originate from a list of maintenance and rehabilitation needs, from focused planning studies such as the Metro Waterways Restoration Study, and other partnership opportunities. The prioritized Basin Plan capital projects are combined with projects from these other sources, re-ranked, and incorporated into the CIP in a timeframe in-line with available budget.
Tasks	1. Incorporate projects from the Basin Plans into the City's bi-annual Capital Improvement Program and annual budget processes. 2. Include water quality criteria in the ranking of capital projects from multiple sources for the CIP. 3. Maintain a GIS coverage of capital improvement projects including such attributes as location, project or facility type, drainage area and cost. 4. Maintain up-to-date Basin Plans web site, make hard copies available to the public in key locations (Library, Public Works offices).
Measurable Goals	• Incorporate into the CIP projects list the projects identified in the recently completed 2010 River Road-Santa Clara Basin Plan, by September 2010. • Implement Stormwater CIP projects including at least one "water quality facilities in high source areas" project over the five-year permit term, and other retrofits as opportunities arise.
Tracking Measures	• Document completion of River Road-Santa Clara Basin Plan. • Track the number, type, watershed location and total drainage area of capital improvement projects constructed for water quality.

E3	**Stormwater System Mapping and Data Management**
Responsible Department/Division	Public Works / Engineering Division
Description	Keep up-to-date inventories and maps of the public and private, natural and constructed, stormwater system. Include mapping of public and private water quality and flow control facilities such as grassy swales and detention basins. Develop and integrate asset inventory data and geographic information system (GIS) systems which describe the conveyance system, water quality attributes and related natural resource information. Integrate information generated through BMPs such as E1 (Capital Improvement Projects) and E4 (Development Standards) which create or modify system components and/or change the attributes of the stormwater system.
Tasks	1. Update stormwater system inventory and GIS on a weekly and monthly basis. 2. Develop, upgrade and maintain software applications which make system information available to staff. 3. Update stormwater infrastructure paper map sets annually. 4. Along with adoption of Stormwater Development Standards (E4), help to ensure that data management needs are identified and protocols established for documenting appropriate information to ensure that operations and maintenance, inspection and enforcement, and BMP effectiveness objectives are met. 5. In implementing the capital improvement projects outlined in the 2002 Stormwater Basin Master Plans, help to ensure documentation of location, type and other attributes of stormwater capital projects for purposes of evaluating their effectiveness and reporting progress under our permit.
Measurable Goals	• Enter 95% of all newly constructed stormwater system features into inventory databases and GIS within six months of final construction approval. • Ensure that 90% of GIS and data application users surveyed rate the GIS/data systems as satisfactory or better.
Tracking Measures	• Report on map and database update activities annually. • Survey map and data system users bi-annually.

P2	Bacteria Pilot Study
Responsible Department/Division	Public Works / Parks & Open Space Division and Wastewater Division
Description	Amazon Creek is water quality limited for bacteria and load reductions of 84% are necessary as specified in the 2006 Willamette Basin Bacteria TMDL. The Bacteria Pilot Study includes three phases: Phase I focuses on efforts to identify source(s) of bacteria, followed by Phase II which focuses on the application of Bacteria Pilot Study BMPs ("BMPs") aimed at reducing bacteria, and followed by Phase III which focuses on evaluating the effectiveness of BMPs that are implemented. Based on monitoring and site assessment work initiated with the 2005 Stormwater Management Plan the overall strategy for continuation of the Bacteria Pilot Study will be a more targeted approach that will narrow down the number of probable sources for investigation of the root of bacterial pollution within a selected study area. This more targeted approach will lead the City towards implementing Phase II and Phase III of the study.
Tasks	1. Conduct storm sampling and data analysis efforts aimed at specific monitoring locations within the study area that are suspected high source areas. 2. Continue to assess field conditions to confirm or rule out potential bacteria sources. 3. Develop and implement appropriate strategies that will help further identify or rule out potential sources of bacteria to MS4 system. Such strategies may include, but are not limited to: strategies for reducing the use of local waterways by waterfowl and rodents, evaluating historical maintenance activities including street sweeping and catch basin cleaning at commercial properties and the public system, expanding the current study area to incorporate discrete sites outside of the sub-basin which may assist in meeting study objectives. 4. Evaluate alternative investigative methods, techniques or methodologies including microbial source tracking and sediment analysis. 5. Improve internal communication by creating an electronic case history file that contains all documents generated as a result of field condition assessments and data collection and analysis. 6. When enough information is acquired to logically conclude that a particular condition or activity is a significant contributing source of bacteria, develop and implement BMPs as appropriate to target the specific source. Such BMPs, in the context of this Bacteria Pilot Study, may include, but are not limited to: door-to-door contact with residents and business owners; direct informational mailings; modifications to catch basin cleaning priorities and frequencies in specific areas; modifications to parks rules associated with wildlife feeding; and habitat

	management and tolerance policies for targeted wildlife species. 7. Conduct follow up stormwater sampling and data analysis to evaluate effectiveness of selected BMPs.
Measurable Goals	• Collect and analyze stormwater samples within the study area during at least three (3) significant wet weather storm events per year for the duration of the permit cycle. • Report on all field condition assessments completed during the permit year. Show how collected field data is used to confirm or eliminate bacteria sources. Initiate at least two (2) new BMPs by December 2011 that will either identify or rule out specific sources of bacterial contributions to the MS4 within the study area. • Starting in July 2012, initiate at least one new BMP per year that will address identified specific sources of bacteria with the study area. • Develop an electronic case history file by February 2011 that contains documentation of findings and results that can be utilized by staff to evaluate overall success of study. • Report on results of stormwater sampling and analysis in association with implemented BMPs with emphasis on showing the effectiveness of the BMP selected.
Tracking Measures	• Track the number of sampling events, samples collected, and resulting bacteria analysis results. • Track results of field condition assessments conducted and the corresponding outcome of the assessment. Attempt to correlate noted conditions with results of sampling analysis. Document additional strategies that will identify or rule out potential sources of bacteria. Report on any conclusions derived as a result of implementing these strategies. • Document the use of alternative investigative approaches such as microbial source tracking and sediment sampling. • Document all follow up sampling and analysis and conclusions derived regarding BMP effectiveness.

2.7 Industrial Facilities

The purpose of industrial controls is to provide oversight of stormwater discharges from industrial facilities, including screening, inspections, technical assistance, and response to spills at permitted facilities. The following BMP represents the industrial element of the SWMP:

W1 Industrial Stormwater Management Program

W1	**Industrial Stormwater Management Program**
Responsible Department/Division	Public Works / Wastewater Division
Description	Provides oversight of stormwater discharges and washing activities from industrial facilities, screening new businesses for those that may require NPDES Permits, conducting inspections and providing technical assistance to industries with NPDES Permits, and responding to spills at facilities with permits.
Tasks	1. Manage 1200Z and 1700A NPDES permit files. 2. Evaluate new and existing facilities for requiring NPDES permits. 3. Determine permit compliance with existing NPDES permitted facilities. 4. Issue Request for Corrective Action letters for permit noncompliance. 5. Conduct periodic monitoring for compliance determination. 6. Provide technical assistance to permitted facilities. 7. Retain copies of Stormwater Pollution Control Plans for each permitted industry. 8. Retain copies of facility inspections.
Measurable Goals	• Conduct site inspections on 20% of permitted facilities annually.
Tracking Measures	• Percentage of permitted facilities inspected. • Number of corrective action letters sent and follow up responses. • Number of Action Plans prepared by permit registrants.

2.8 Permit Management

The purpose of permit management is to ensure effective permit management, coordination, and reporting. The following BMP represents the administrative element of the SWMP:

E5 Permit Management and Reporting

E5	Permit Management & Reporting
Responsible Department/Division	Public Works / Engineering
Description	Administration of the overall NPDES permit compliance effort, including permit renewals, annual reports, program evaluations and documentation of the City's adaptive management processes, and updates to the City's TMDL benchmark assessment.
Tasks	1. Coordinate with all City divisions and groups that administer BMPs described within the SWMP to review program commitments, gather tracking data, and where appropriate, assist with program evaluation and additional goal setting or BMP enhancements. 2. Evaluate programs and BMPs as described in the SWMP to ensure that the overall NPDES permit objectives are being met, including reduction of pollutants on the DEQ 2004/2006 303(d) list and established TMDLs as compared to the pollutant load reduction benchmarks. 3. Conduct appropriate public involvement efforts related to various NPDES permit elements such as SWMP/Monitoring plan updates or proposed adaptive management. May include presentations to advisory groups, elected officials, and public notices.
Measurable Goals	• Submit Annual Reports to DEQ, that summarize implementation of the requirements as described in the City's MS4 permit, Schedule B. • Evaluate progress towards meeting TMDL pollution reduction benchmarks for each five year renewal submittal. • Conduct public involvement within an appropriate time to meet legal requirements for the five year renewal submittals, and for on-going adaptive management as appropriate.
Tracking Measures	• Track public involvement events and number of people reached. • Post Annual Reports on City's web site.

APPENDIX E

Summary of Legal Authority

STORMWATER RELATED PROVISIONS AND AUTHORITY

City Charter: Eugene Municipal Charter 2002, Chapter II, Section 4

Eugene Code

EC 2.018 (Authority to Impose Administrative Civil Penalty)
EC 2.019 (Administrative Authority)
EC 2.021 (Appeal Procedures)
EC 2.582 (Modification, Compromise or Cancellation of Claims)
EC 2.1996 (Administrative Civil Penalty)
EC 6.005 – 6.115 (Nuisances)
EC 6.340 – 6.380 (Hazardous Substance Discharge)
EC 6.401 (Intention to Operate Sewerage Systems)
EC 6.406 (Definitions)
EC 6.411 (Ratemaking)
EC 6.416 – 6.436 (Charges)
EC 6.441 (Locations Outside of City)
EC 6.446 (Discharge of Foreign Matter)
EC 6.451 (Admin Regulations and Methodology)
EC 6.501 – 6.596 (Industrial Pretreatment)
EC 6.600 – 6.615 (Stormwater Service)
EC 6.625 – 6.645 (Erosion Prevention)
EC 6.805 (Littering in Waterways)
EC 6.810 (Prohibited Deposits in Millrace)
EC 6.990 – 6.995 (Penalties)
EC 9.0200 – 9.0280 (Enforcement and Penalties)
EC 9.4700 – 9.4980 (Waterway Protections)
EC 9.6790 – 9.6797 (Stormwater Development Standards)

Administrative Orders

Rules:

Admin Order 58-02-28-F (Industrial Pretreatment Rule)
Admin Order 58-03-01-F (Erosion Prevention Rule)
Admin Order 58-06-12-F (Stormwater Service Methodology)
Admin Order 58-09-07-F (Water Quality Overlay Zone)
Admin Order 58-11-09-F (Stormwater System Rule)
Admin Order 58-14-01-F (Stormwater Management Manual)

Fees:

Admin Order 58-94-03-F (Stormwater Service Chrg. Appeal Fee)
Admin Order 58-00-16-F (Open Waterway Exempt. Permit Fees)
Admin Order 58-11-04-F (Industrial Pretreatment Program Fees)
Admin Order 58-16-08-F (Stormwater User Fees)
Admin Order 58-16-09-F (Wastewater User Fees)

Administration:

Admin Order 58-99-13 (Authority delegated to PW Executive Director to sign NPDES documents)
Admin Order 58-99-17 (Authority delegated to Wastewater Treatment Division Director to sign NPDES documents)
Admin Order 58-00-20 (Authority delegated to City Engineer to administer stormwater, erosion prevention, open waterway programs)
Admin Order 58-00-21 (Authority delegated to PW Eng. Div. Development Review Manager to administer open waterway program)
Admin Order 58-00-28 (Authority delegated to PW Eng. Div. Development Review Manager to administer erosion prevention program)
Admin Order 58-03-06 (Approving Stormwater Basin Master Plans -- *amended by 58-14-03*)
Admin Order 58-09-13 (Industrial pretreatment delegating of duties under industrial pretreatment program)
Admin Order 58-12-14 (River Road-Santa Clara Stormwater Basin Master Plan)
Admin Order 58-14-03 (Amends 58-03-06 - Stormwater Basin Master Plan Table 5-3 in Vol. 1)
Admin Order 58-14-06 (Design Standards for Stormwater Facilities in Public Improvement Projects)
Admin Order 58-16-01 (Public Improvement Design Standards Manual)

(Updated 09/2016)

APPENDIX F

Adaptive Management Evaluation Tool

This BMP Evaluation Tool is for use in the City of Eugene's annual stormwater program adaptive management process.

Annual Adaptive Management BMP Evaluation Tool

BMP #:	**BMP Title:**
Date of Evaluation:	***Instructions:*** *BMP Leads or otherwise responsible staff person will answer the following questions for each BMP annually, after the reporting period has ended, and before the annual report is generated.*
Evaluator Name, Title:	***Adaptive Management defined:*** *"A structured, iterative process designed to refine and improve stormwater programs over time by evaluating results and adjusting actions on the basis of what has been learned."*

Were the BMP measurable goals (or related milestones) attained?
For BMPs with multi-year implementation, were milestones or timelines met?
If a BMP measurable goal or milestone was not met, describe circumstances why (including external influences beyond your control), what actions were taken, and how progress will be made to meet and/or exceed the goal in the future. Consider policy, public input, weather, coordination, etc.
Are you considering new technologies related to this BMP that could improve its implementation, and what are they? Are you aware of limitations in acquiring/implementing this technology?
Are there improvements that can be made to this BMP that may increase its effectiveness in removing pollutants in stormwater? Are there efficiencies that can be made (cost, labor, materials, etc.)?
Do you anticipate any changes in available resources that are necessary to attain this BMP in the future? Consider staff, resources, budget/funding, equipment, etc.

Is there opportunity for the effectiveness of this BMP to increase as a result of increased outreach/education efforts? If so, describe how.
Has information/data obtained through inspection, operation, or maintenance activities been acquired that may influence how the effectiveness or efficiency of this BMP could be improved?
Were there pilot studies or data collected through the stormwater monitoring program that provides you with information about how effective this BMP is? What do these studies/data suggest? Are there data trends or anomalies worth consideration?
Have any public involvement events, open comment periods, or outreach effectiveness studies occurred that suggest a need to revise or change implementation of this BMP?
Is there a need to propose any changes to the BMP description, tasks, measurable goals or tracking measures? If so, indicate proposed change and explain.

APPENDIX G

Public Review

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I, **Wendy Raz**, being first duly affirmed, depose and say that I am the Advertising Manager, or his principal clerk, of The Register-Guard, a newspaper of general circulation as defined in ORS 193.010 and 193.020; published at Eugene in the aforesaid county and state; that the **Public Notice** printed copy of which is hereto annexed, is publishing in the entire issue of said newspaper for **one** successive and consecutive **Day(s)** in the following issues:

October 31, 2016

PUBLIC REVIEW NOTICE

The City of Eugene has prepared a Stormwater Annual Report in accordance with the requirements of its National Pollutant Discharge Elimination System (NPDES) permit. Discharges from municipal stormwater systems, including Eugene's, are regulated under the federal Clean Water Act. In Oregon, the NPDES permitting program is administered by the Oregon Department of Environmental Quality (DEQ).

The Annual Report provides information on stormwater program activities conducted during the reporting period (July 1, 2015 through June 30, 2016) including the implementation of best management practices, water quality monitoring, and program management.

The draft Annual Report is available on the internet at: www.eugene-or.gov/stormwater (see "Planning, Permits & Regulations" and select "NPDES Municipal Stormwater Permit") or by calling Therese Walch, Water Resources Manager at 541-682-5549.

Comments received by 5 p.m. November 14, 2016 will be summarized in the document submitted to the DEQ. Comments received after November 14, 2016 will be taken into consideration for possible future modifications to the City's stormwater program. Send written comments to NPDES Permit, Eugene Public Works, 99 East Broadway, Suite 400, Eugene, OR 97401. Send e-mail comments to: therese.walch@ci.eugene.or.us.

No. 6770634 - October 31, 2016

Wendy Raz

Subscribed and affirmed to before me this October 31, 2016

Rosemary Jean Cochrane
Notary Public of Oregon

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