Redmond Paired Watershed Study Trend Analysis Report

Water Years 2016–2023

Prepared for
City of Redmond

Prepared by
Herrera Environmental Consultants, Inc.

HERRERA
Science + Planning + Design

Redmond Paired Watershed Study Trend Analysis Report

Water Years 2016–2023
Redmond, Washington

Prepared for
City of Redmond
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Executive Summary

The Redmond Paired Watershed Study (RPWS) is one of several effectiveness monitoring studies that was selected for implementation starting in 2014 for the Stormwater Action Monitoring (SAM) program for Puget Sound. The goal of effectiveness monitoring under the SAM program is to provide widely applicable information for improving stormwater management in the region. Phase I and Phase II Municipal Stormwater Permittees in the Puget Sound Region contribute to a Pooled Stormwater Resources Fund that supports the SAM program and associated effectiveness monitoring studies. Selection of the RPWS for implementation under the SAM program was made based on a monitoring proposal that was presented to permittee representatives at workshops that were held on March 20, 2014, and May 6, 2014. The specific study question to be addressed through the RPWS is as follows:

> *How effective are watershed rehabilitation efforts at improving receiving water conditions at the watershed scale?*

In this context, rehabilitation efforts could include any of the following practices:

- Stormwater management retrofits in upland areas that would include facilities for onsite stormwater management (e.g., low impact development [LID] practices), runoff treatment, and flow control.
- Riparian and in-stream habitat improvements.
- Programmatic practices for stormwater management.

To address this study question, a conceptual experimental design for the RPWS was subsequently developed and summarized in the Redmond Paired Watershed Study Experimental Design Report (Herrera 2015a). This conceptual experimental design was informed by a literature review (Herrera 2015b) that was conducted to identify lessons learned from past studies that have been implemented to achieve similar objectives. Building on this previous work, a Quality Assurance Project Plan (QAPP) was developed to guide the implementation of all subsequent phases of the RPWS (Herrera 2015c). As described in this QAPP, the experimental design for the RPWS has two primary components:

- **Status and Trends Monitoring:** Routine and continuous measurements of various hydrologic, chemical, physical habitat, and biological indicators of stream health over an extended time frame to quantify improvements in receiving water conditions in response to watershed rehabilitation efforts.
- **Effectiveness Monitoring:** Measurements of hydrologic and chemical parameters over a relatively short timeframe to document the effectiveness of specific structural stormwater controls that have been constructed to improve receiving water conditions.

The Status and Trends Monitoring utilizes a "paired watershed" experimental design that involves collecting these measurements in seven watersheds categorized as follows:

- Three "Application" watersheds with wadeable lowland streams that are moderately impacted by urbanization and prioritized for rehabilitation efforts. *(Note that one Application watershed was dropped from the study at the end of water year 2022.)*
- Two "Reference" watersheds with relatively pristine wadeable lowland streams that do not require rehabilitation.
- Two "Control" watersheds with wadeable lowland streams that are significantly impacted by urbanization and not currently prioritized for rehabilitation.

Fixed monitoring stations were established in each watershed for monitoring various indicators of stream health. Due to the scale of the RPWS and the anticipated lag between applying stormwater controls and resultant improvements in receiving water conditions, quantifying a cause and effect relationship between these events may take many years. Therefore, monitoring at the fixed monitoring stations will occur over an anticipated 10-year timeframe. Furthermore, because the effectiveness of watershed rehabilitation practices (e.g., stormwater retrofits, in-stream habitat improvements, and programmatic practices) may vary for different types of receiving water impairments, a broad suite of indicators for assessing potential improvements are being monitored within the following categories: hydrologic, water quality, physical habitat, sediment quality, and biological. The pattern of interest will be evidence that receiving water conditions are improving based on one or more of these indicators in the Application watersheds while conditions in the Reference and Control watersheds remain relatively static.

Roving stations will be established for the Effectiveness Monitoring component of the RPWS to verify specific structural stormwater controls are constructed properly and performing as designed. The roving stations will be moved from one year to the next once a facility's effectiveness has been verified and new facilities come online. The specific types of monitoring to be performed at each roving station will depend on the type of structural stormwater control that is being evaluated.

Data summary reports are being prepared on an annual basis to summarize compiled monitoring data collected through each of the major components of the RPWS. These reports also document any quality assurance issues associated with these data and resultant limitations (if any) on their use or interpretation. Finally, these reports document all rehabilitation efforts that have been implemented by the City of Redmond (City) or King County (County) over the previous year within the application watersheds. Each annual data summary report documents this information based on monitoring that was conducted over the previous water year (WY) spanning from October through September.

In years 4, 8, and 10 of the RPWS' implementation, trend analyses reports will also be prepared as companion documents to the data summary reports described above. These reports will summarize the results of analyses that will be performed on the compiled data from all previous years of monitoring to detect potential improving trends in receiving water conditions related to the implementation of rehabilitation efforts. Each report will also present major conclusions from these analyses.

This document represents the trend analysis report that was prepared for year 8 of the RPWS' implementation. It specifically summarizes analyses that were performed on compiled data from monitoring in WY2016 through WY2019. Data analyses procedures that were performed on the compiled data generally involved tests for correlation between the indicators for improving receiving water conditions and time. Key conclusions from these analyses are as follows:

- Few consistent trends were detected in the data for each indicator due to rehabilitation technical issues in the Application watersheds. While improving trends were detected for several indicators at stations in the Application watersheds, a roughly equivalent number of improving trends were also documented at stations located in the Reference and Control watersheds. However, when the City has implemented focused, large scale rehabilitation efforts in a particular Application watershed, improving trends that can be directly tied to these efforts have been detected. This would include a consistent and significant decrease in TSS and total copper concentrations at the MONMS station in the Monticello Creek watershed that appeared related to a progressive increase in street sweeping frequency in the watershed. The City is currently implementing several other focused, large scale rehabilitation efforts in Application watersheds that will be evaluated in the trend analysis report that will be prepared at the end of WY2025.
- An interannual hydrologic trend was detected in the rainfall runoff response across all the stations located in the Application, Reference, and Control watersheds. This trend was likely caused by relatively wet water years at the beginning of the study and drier water years as the study progressed. This resulted in less saturation of the landscape during the drier water years and thus increased evapotranspiration and reduced interflow and overland flow (Nash and Sutcliffe 1970). Hence, less water was observed exiting the watersheds via surface flow in the streams during the drier years.

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Introduction

The Redmond Paired Watershed Study (RPWS) is one of several effectiveness monitoring studies that was selected for implementation starting in 2014 for the Stormwater Action Monitoring (SAM) program for Puget Sound. The goal of effectiveness monitoring under the SAM program is to provide widely applicable information for improving stormwater management in the region. Phase I and Phase II Municipal Stormwater Permittees in the Puget Sound Region contribute to a Pooled Stormwater Resources Fund that supports the SAM program and associated effectiveness monitoring studies. Selection of the RPWS for implementation under the SAM program was made based on a monitoring proposal that was presented to permittee representatives at workshops that were held on March 20, 2014, and May 6, 2014. The specific study question to be addressed through the RPWS is as follows:

> *How effective are watershed rehabilitation efforts at improving receiving water conditions at the watershed scale?*

To address this study question, a conceptual experimental design for the RPWS was subsequently developed and summarized in the *Redmond Paired Watershed Study Experimental Design Report* (Herrera 2015a). This conceptual experimental design was informed by a literature review (Herrera 2015b) that was conducted to identify lessons learned from past studies that have been implemented to achieve similar objectives. The conceptual experimental design was also developed based on input from a technical advisory committee that was formed for the study. This technical advisory committee currently includes representation from the following jurisdictions and agencies:

- City of Redmond
- City of Kirkland
- City of Seattle
- City of Tacoma
- King County
- U.S. Geological Survey
- Washington State Department of Ecology (Ecology)

Building on this previous work, a Quality Assurance Project Plan (QAPP) was developed to guide the implementation of all subsequent phases of the RPWS (Herrera 2015c). This QAPP documents the experimental design and procedures that will be used during data collection, processing, and analysis to ensure all results obtained for the RPWS are scientifically defensible.

Monitoring pursuant to this QAPP initiated in 2016 and is anticipated to continue for a 10-year timeframe. Data summary reports are being prepared on an annual basis over this period to summarize compiled monitoring data collected through each of the major components of the RPWS. These reports also document any quality assurance issues associated with these data and resultant limitations (if any) on their use or interpretation. Finally, these reports document all rehabilitation efforts that have been implemented by the City of Redmond (City) or King County (County) over the previous year. They include detailed information on the design and operational status of structural stormwater controls and the frequency and geographic extent of nonstructural stormwater control implementation. Each annual data summary report documents this information based on monitoring that was conducted over the previous water year (i.e., October through September). Data summary reports (Herrera 2017, 2018, 2019, 2020a, 2021a, 2023a, 2023b, 2023c, 2024) were prepared previously for data collected over water year (WY) 2016 through WY2023.

In years 4, 8, and 10 of the RPWS' implementation, trend analyses reports will also be prepared as companion documents to the data summary reports described above. These reports will summarize the results of analyses that will be performed on the compiled data from all previous years of monitoring to detect potential improving trends in receiving water conditions related to the implementation of rehabilitation efforts. Each report will also present major conclusions from these analyses. The trend analysis report (Herrera 2020b) for year 4 was prepared previously for data collected over WY2016 through WY2019.

This document represents the trend analysis report that was prepared for year 8 of the RPWS' implementation. It specifically summarizes analyses that were performed on compiled data from monitoring in WY2016 through WY2023. It is organized to include the following sections:

- **Background:** An explanation of why the project is needed.
- **Experimental Design:** The sampling process design for the study, including sample types, monitoring locations, and sampling frequency.
- **Rehabilitation Effort Summary:** A summary of the rehabilitation efforts in the Application watersheds.
- **Monitoring Procedures:** A summary of deviations in monitoring procedures that have occurred during implementation of the RPWS relative to the procedures identified in the QAPP (Herrera 2015c).
- **Data Analysis Procedures:** A description of the analyses that were performed on the compiled data to detect potential trends in receiving water conditions related to the implementation of rehabilitation efforts.
- **Results:** A summary of the results from the trend analyses for each major monitoring component of the RPWS.
- **Discussion:** A discussion of the results from the trend analyses and their implications for the City's ongoing watershed rehabilitation efforts and implementation of the RPWS.
- **Conclusions:** A summary of major conclusions from the trend analyses from this phase of the RPWS' implementation.

Background

Municipal Stormwater Permits are issued by Ecology to regulate discharges from separated storm sewers owned or operated by Phase I and Phase II cities and counties. The Municipal Stormwater Permits establish the minimum requirements for permittees to address existing and future impacts to receiving waters from urbanization. Municipal Stormwater Permits require cities and counties to execute programmatic (nonstructural) activities and establish design standards for stormwater structural controls triggered by development and redevelopment (onsite stormwater management, runoff treatment, and flow control facilities). Ideally, if all developed land in a watershed is equipped with nonstructural and structural stormwater controls, the receiving water would be protected from hydrologic and water quality impacts caused by urbanization. However, while the effectiveness of nonstructural and structural controls has been well documented at the site and parcel scale, limited data exists on the effectiveness of these controls in aggregate for improving conditions in receiving waters at the watershed scale (Herrera 2015b).

In February 2014, Ecology expressed their support for a Citywide Watershed Management Plan (WMP) (Herrera 2013) that coordinates stormwater management efforts from the Municipal Stormwater Permit, Section 303(d) of the Clean Water Act, and salmon recovery to allow use of a watershed approach for improving receiving water conditions. Through the implementation of this WMP, the City will focus stormwater best management practices (BMPs) in a subset of priority watersheds that are moderately impacted by urbanization and therefore expected to respond more quickly to rehabilitation efforts. This provides a unique opportunity to study the effectiveness of stormwater BMPs for improving receiving water conditions on an accelerated time frame and at a watershed scale. Recognizing this opportunity, the City is implementing the RPWS to quantify improvements in receiving water conditions with support from the SAM program.

Experimental Design

As described in the Introduction to this report, the specific study question to be addressed through the RPWS is as follows:

> *How effective are watershed rehabilitation efforts at improving receiving water conditions at the watershed scale?*

In this context, rehabilitation efforts could include any of the following practices:

- Stormwater management retrofits in upland areas that could include facilities for onsite stormwater management (e.g., low impact development [LID] practices, runoff treatment, and flow control)
- Onsite stormwater management facilities required due to Municipal Stormwater Permit requirements for development and redevelopment
- Riparian and in-stream habitat improvements
- Programmatic practices for stormwater management

To answer the study question identified above, the experimental design for the RPWS has two primary components:

- **Status and Trends Monitoring:** Routine and continuous measurements of various hydrologic, chemical, physical habitat, and biological indicators of stream health over an extended time frame to quantify improvements in receiving water conditions in response to watershed rehabilitation efforts.
- **Effectiveness Monitoring:** Measurements of hydrologic and chemical parameters over a relatively short time frame to document the effectiveness of specific structural stormwater controls that have been constructed to improve receiving water conditions.

The Status and Trends Monitoring utilizes a "paired watershed" experimental design that involves collecting these measurements in seven watersheds categorized as follows:

- Three "Application" watersheds with wadeable lowland streams that are moderately impacted by urbanization and prioritized for rehabilitation efforts. *(Note that one Application watershed was dropped from the study at the end of WY2022.)*
- Two "Reference" watersheds with relatively pristine wadeable lowland streams that do not require rehabilitation.
- Two "Control" watersheds with wadeable lowland streams that are significantly impacted by urbanization and not currently prioritized for rehabilitation.

Table 1 identifies the name, predominant land use/cover, and size of each watershed; the location of all the watersheds is shown in Figure 1. A detailed summary of conditions within each watershed is also provided in the QAPP that was prepared for the study (Herrera 2015c) with information on planned rehabilitation efforts in the Application watersheds as applicable.

Table 1. Application, Reference, and Control Watersheds for the Redmond Paired Watershed Study.

Watershed Name	Watershed Type	Dominant Land Use/Cover	Watershed Total Area (acres)	Watershed Area Inside Redmond (acres)
Evans Creek Tributary 108[a]	Application	Residential	397	0[b]
Monticello Creek	Application	Residential/Commercial	345	264
Tosh Creek	Application	Residential/Commercial	299	276
Colin Creek[b]	Reference	Forest	1,990	90
Seidel Creek[b]	Reference	Forest	1,188	615
Country Creek	Control	Residential/Commercial	212	212
Tyler's Creek	Control	Residential/Commercial	168	167

[a] This watershed was dropped from the study at the end of WY2022.

[b] Watershed is in unincorporated King County.

Fixed monitoring stations were established in each watershed for monitoring various indicators of stream health. Due to the scale of the RPWS and the anticipated lag between applying stormwater controls and resultant improvements in receiving water conditions, quantifying a cause and effect relationship between these events may take many years. Therefore, monitoring at the fixed monitoring stations will occur over an anticipated 10-year time frame. Furthermore, because the effectiveness of watershed rehabilitation practices (e.g., stormwater retrofits, instream habitat improvements, and programmatic practices) may vary for different types of receiving water impairments, a broad suite of indicators for assessing potential improvements are being monitored within the following categories: hydrologic, water quality, physical habitat, sediment quality, and biological. The pattern of interest will be evidence that receiving water conditions are improving based on one or more of these indicators in the Application watersheds while conditions in the Reference and Control watersheds remain relatively static.

The following subsections provide more detailed information on the Status and Trends Monitoring and Effectiveness Monitoring, respectively, as originally defined in the QAPP that was prepared for the study (Herrera 2015c) including the monitoring stations, measurement frequency, indicators, and data analysis methods where applicable. Deviations from these monitoring procedures that took place in during subsequent monitoring years are noted in a subsequent section.

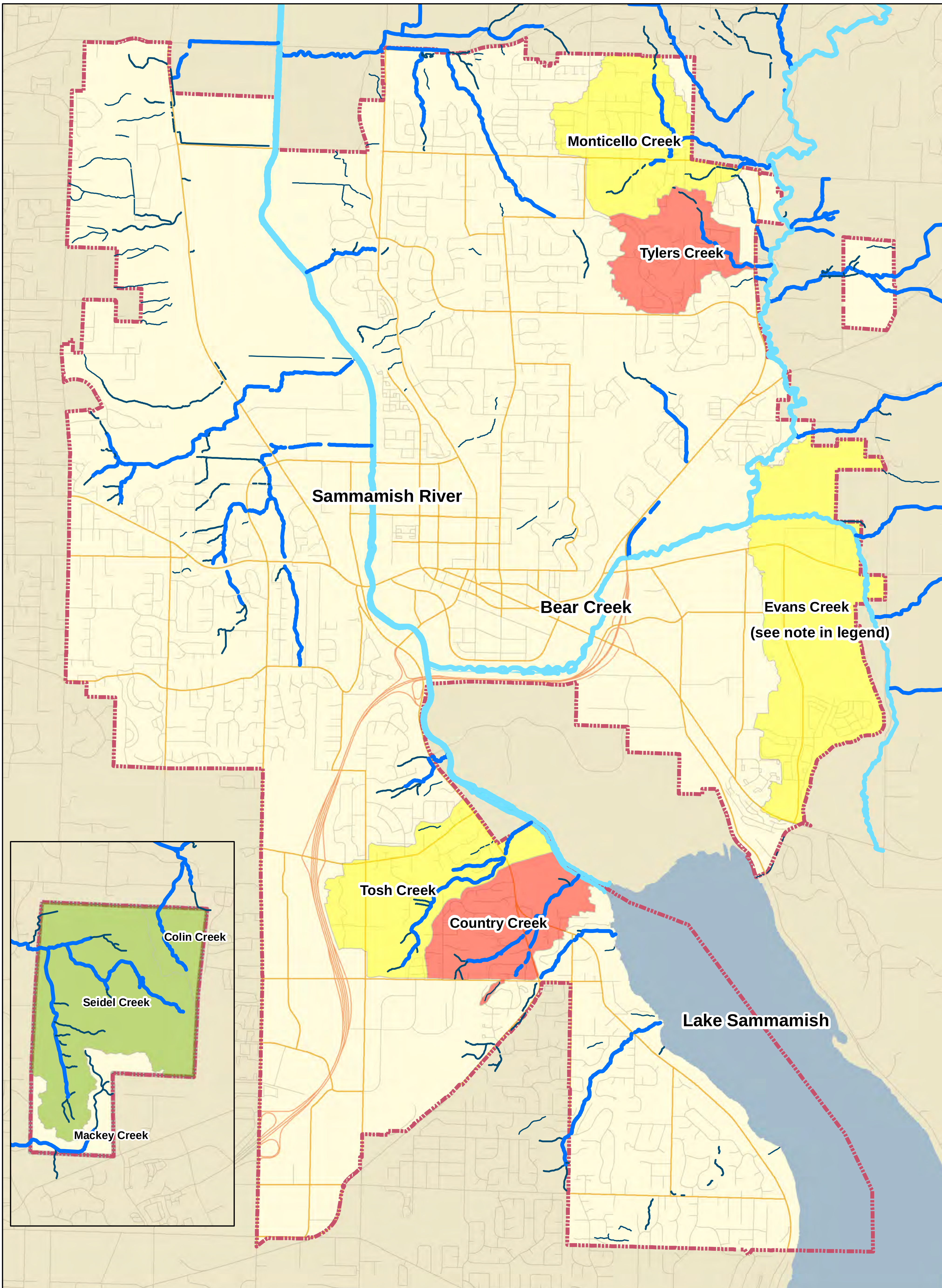

Figure 1 - Application, Reference, and Control Watersheds.

City of Redmond, Washington

06/18/2015

0 0.25 0.5 1 1.5 Miles

CityofRedmond WASHINGTON

Disclaimer: This map is created and maintained by the Natural Resources Division of the City of Redmond, Washington, for reference purposes only. The City makes no guarantee as to the accuracy or completeness of the features shown on this map.

Legend

- Class I Stream
- Class II Stream
- Class III Stream
- Class IV Stream
- City Limits
- Reference Watersheds
- Application Watersheds
- Control Watersheds

This figure shows Evans Creek watershed within Redmond. Evans 108 is east of Redmond and illustrated in Figure 2.

Status and Trends Monitoring

This section describes the monitoring stations, measurement frequency, indicators, and data analysis methods that will be used for the Status and Trends Monitoring component of the RPWS. This information is organized under separate subsections for the following monitoring categories: hydrologic, water quality, physical habitat, sediment quality, and biological. The specific indicators of stream health that are evaluated in these categories are also summarized in Table 2 with their associated measurement frequency. Note significant changes to the experimental design for the Status and Trends Monitoring were made relative to the original QAPP. These changes are described in detail in the Monitoring Procedures section (page 29).

Hydrologic Monitoring

A total of 14 fixed monitoring stations were established at the onset of the study to facilitate hydrologic monitoring in each of the study watersheds. Starting in WY2023, monitoring has occurred at 12 fixed monitoring stations; see further explanation in the Monitoring Procedures section (page 29). As noted in the literature review (Herrera 2015b) that was performed to inform the experimental design for the RPWS, numerous studies have been conducted with similar goals, but they have generally been conducted at the subbasin scale. In these studies, a hydrologic monitoring station was typically located at the outlet of the study subbasin. Therefore, efforts were made to establish hydrologic monitoring stations at the outlet of each of the study watersheds. However, because the watersheds are relatively large and because much of the rehabilitation will occur in the upper reaches of the Application watersheds, efforts were made to establish hydrologic monitoring stations at a mid-point location in each of the study watersheds as well. This goal could not be achieved for all study watersheds due to issues relating to their size and drainage patterns. The following deviations are specifically noted:

- Monticello Creek has two major tributaries that will be the target of rehabilitation efforts; therefore, three hydrologic monitoring stations were established in the watershed at the outlet and on each of the tributaries.
- The relatively pristine reach of Colin Creek that was identified for monitoring is confined to the Redmond Watershed Preserve Park. Because the watershed area within this park is relatively small, only one hydrologic monitoring station was established in this watershed.
- The relatively pristine reach of Seidel Creek that was identified for monitoring is confined to the Redmond Watershed Preserve Park. Within this area, two major tributaries of the creek flow into a large wetland complex near the border of the park. To avoid confounding hydrologic and water quality influences from this wetland, hydrologic monitoring stations were established on each tributary; and no outlet station was identified.

In addition to these considerations, the specific location of each monitoring station was also influenced by safety and property access issues. The monitoring stations established in each of the study watersheds are as follows:

Application Watersheds

- Evans Creek Tributary 108: Two stations designated Lower Stream Station (EVALSS) and Midstream Station (EVAMS), respectively (see locations in Figure 2). This watershed was dropped from the study in WY2022; see further explanation in the Monitoring Procedures section (page 29).
- Monticello Creek: One station at the mouth designated Mont-Mouth (MONM); one station at the approximate midpoint of the watershed on the north tributary designated Mont-Mid-N (MONMN); and one station at the approximate midpoint of the watershed on the south tributary designated Mont-Mid-S (MONMS) (see locations in Figure 3).
- Tosh Creek: One station at the mouth designated Tosh-Mouth (TOSMO); and one station at the approximate midpoint of the watershed designated Tosh-Mid (TOSMI) (see locations in Figure 4).

Reference Watersheds

- Colin Creek: One station at the approximate midpoint of the watershed designated Colin-Mid (COLM) (see locations in Figure 5).
- Seidel Creek: One station at the approximate midpoint of the watershed on the north tributary designated Seidel-Mid-N (SEIMN); one station at the approximate midpoint of the watershed on the south tributary designated Seidel-Mid-S (SEIMS) (see locations in Figure 6).

Control Watersheds

- Country Creek: One station at the mouth designated Country-Mouth (COUMO); and one station at the approximate midpoint of the watershed designated Country-Mid (COUMI) (see locations in Figure 7).
- Tyler's Creek: One station at the mouth designated Tylers-Mouth (TYLMO); and one station at the approximate midpoint of the watershed designated Tylers-Mid (TYLMI) (see locations in Figure 8).

Continuous flow monitoring was originally planned to occur at all 14 monitoring stations for the duration of the RPWS; however, monitoring at the stations located in the Evans Creek watershed was suspended after WY2022 (see more detailed discussion in the Monitoring Procedures section). Data from the continuous flow monitoring are processed to calculate the following indicators for evaluating hydrologic impacts from urban development as described in DeGasperi et al. (2009):

- **High flow pulse:** Occurrence of daily average flows that are equal to or greater than a threshold set at twice (two times) the long-term daily average flow rate.
  - High pulse count: Number of days each water year that discrete high flow pulses occur.
  - High pulse duration: Annual average duration (in days) of high flow pulses during a water year.
  - High pulse range: Range in days between the start of the first high flow pulse and the end of the last high flow pulse during a water year.

- **Low flow pulse:** Occurrence of daily average flows that are equal to or less than a threshold set at 50 percent of the long-term daily average flow rate.
    - Low pulse count: Number of times each calendar year that discrete low flow pulses occurred.
    - Low pulse duration: Annual average duration (in days) of low flow pulses during a calendar year.
    - Low pulse range: Range in days between the start of the first low flow pulse and the end of the last low flow pulse during a calendar year.
- **Flow Reversal:** The number of times that the flow rate changed from an increase to a decrease or vice versa during a water year. Flow changes of less than 2 percent are not considered.
- **Richards-Baker (RB) flashiness index:** A dimensionless index of flow oscillations relative to total flow based on daily average discharge measured during a water year.
- **Flashiness (TQ Mean):** The fraction of a year that mean daily discharge exceeds annual mean discharge.
- **Storm flow volume:** Total discharge volume during storm events over a water year.
- **Base flow volume:** Total discharge volume during base flow over a water year.
- **Total flow volume:** Total discharge volume over a water year.

Trends over time at each monitoring station are evaluated using statistical tests (see the Data Analysis Procedures section). The pattern of interest is evidence that receiving water conditions are improving based on the detection of statistically significant trends in the data for one or more of these indicators in the Application watersheds while these same trends are not detected in the data for the same indicators in the Reference and Control watersheds.

To facilitate interpretation of trends in the hydrologic monitoring data, continuous monitoring of precipitation depths is also occurring at three separate stations: two stations were established for the RPWS – Tosh and Monticello; and one station is maintained by the County for other purposes – Trilogy. Each station is used for measuring precipitation depths in the watershed for a specific creek as follows:

- Tosh station: Tosh Creek and Country Creek
- Monticello station: Tyler Creek and Monticello Creek
- Trilogy station: Seidel Creek and Colin Creek

Table 2. Indicators of Stream Health for the Redmond Paired Watershed Study.	
Indicator	**Measurement Frequency**
Hydrology Monitoring	
Flow	**Continuous**
High pulse count High pulse duration High pulse range Low pulse count Low pulse duration Low pulse range Flow reversal Richards-Baker (RB) flashiness index Flashiness ($T_{Q\ Mean}$) Storm flow volume Base flow volume Total flow volume	Post-processed from continuous flow measurements
Water Quality Monitoring	
Total suspended solids Turbidity Conductivity Hardness Dissolved organic carbon Fecal coliform bacteria Total phosphorus Total nitrogen Copper, total and dissolved Zinc, total and dissolved	Twelve grab samples collected annually during storm events (three each quarter) Four grab samples collected annually during base flow (one each quarter)
Temperature Conductivity (discontinued after WY2021)	Continuous
Physical Habitat Monitoring	
Bed stability Channel dimensions Fish cover Habitat dimensions Habitat unit extents Large woody debris Riparian cover Riparian Disturbance Riparian vegetation structure Sinuosity Substrate	Annually through WY2021; every other year thereafter

Table 2 (continued). Indicators of Stream Health for the Redmond Paired Watershed Study.

Indicator	Measurement Frequency
Sediment Quality Monitoring	
Total organic carbon; sieved, 2 mm Copper; sieved, 63 µm Zinc; sieved, 63 µm Polycyclic aromatic hydrocarbons; sieved, 2 mm Phthalates; sieved, 2 mm	Annually through WY2021; every other year thereafter
Biological Monitoring	
Benthic macroinvertebrates	Annually
Benthic Index of Biotic Integrity Taxa Richness Ephemeroptera Richness Plecoptera Richness Trichoptera Richness Clinger Percent Long-Lived Richness Intolerant Richness Percent Dominant Predator Percent Tolerant Percent	Post-processed from benthic macroinvertebrate data

µm = micrometers

mm = millimeters

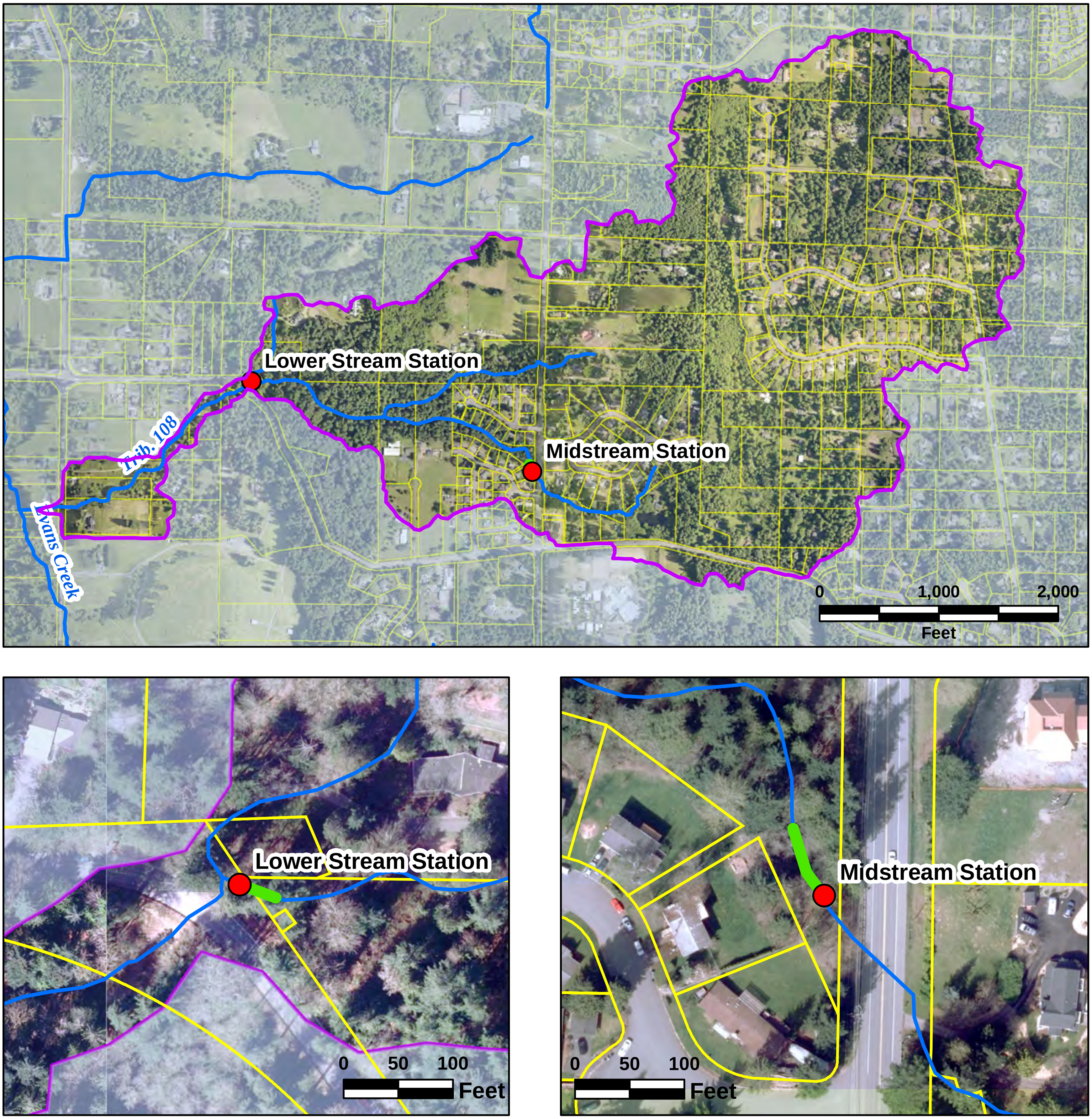

Figure 2 - Evans Trib. 108 Paired Watershed Study Monitoring Locations.

King County, Washington

Dec. 17, 2015

- Flow and WQ Monitoring
- Habitat, Biological, and Sediment Monitoring
- Streams and Rivers
- King County Parcels
- Basin Boundary

King County
Department of Natural Resources and Parks
Water and Land Resources Division

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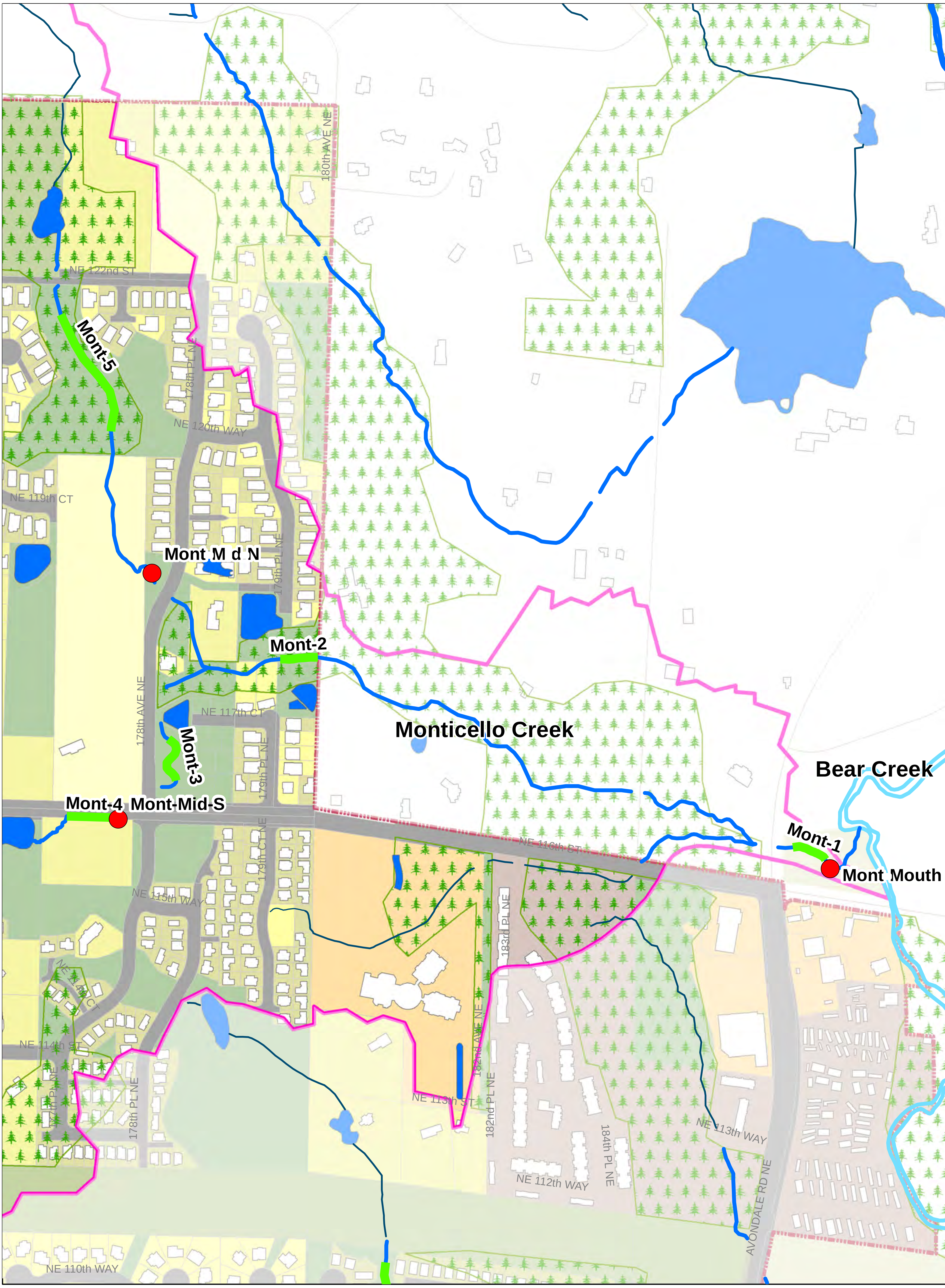

Figure 3. Monticello Creek Paired Watershed Study Monitoring Locations

City of Redmond, Washington

6/25/2015

City of Redmond WASHINGTON

0 0.0375 0.075 0.15 Miles

N

Disclaimer: This map is created and maintained by the Natural Resources Division of the City of Redmond, Washington, for reference purposes only. The City makes no guarantee as to the accuracy or completeness of the features shown on this map.

Legend

- Class I Stream
- Class II Stream
- Class III Stream
- Class IV Stream
- Ponds
- City Limits
- Watershed Boundary
- Commercial
- Industrial
- Multifamily
- Park / Undeveloped
- Public ROW
- Single Family HighDensity
- Single Family Low Density
- Single Family Medium Density
- Single Family Rural Density
- Flow & WQ Monitoring
- Habitat, Sediment & Biological Monitoring

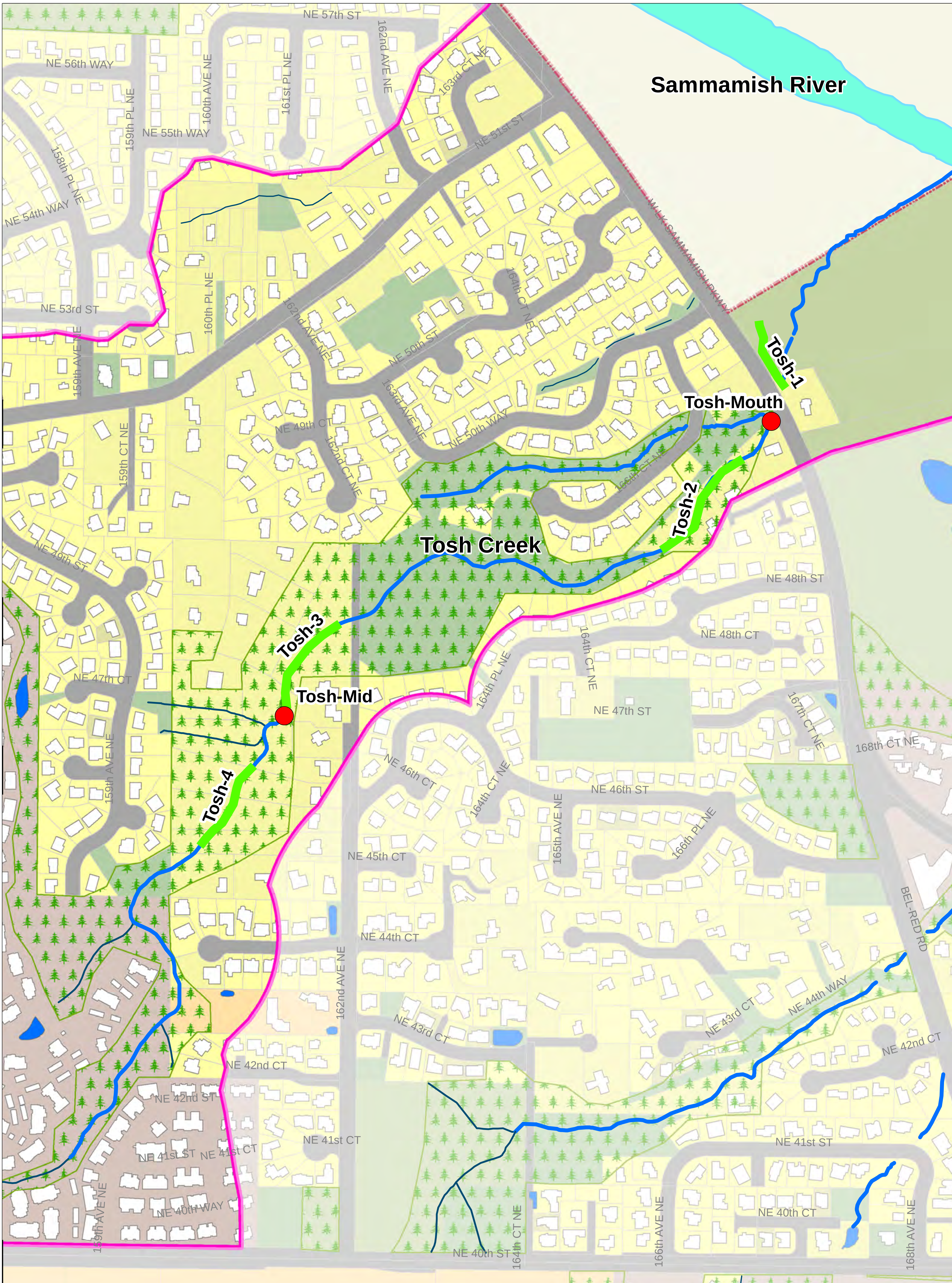

Figure 4. Tosh Creek Paired Watershed Study Monitoring Locations.

City of Redmond, Washington

11/22/2013

N

0 0.0375 0.075 0.15 Miles

City of Redmond WASHINGTON

Legend

- Class I Stream
- Class II Stream
- Class III Stream
- Class IV Stream
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- City Limits
- Watershed Boundary
- Commercial
- Industrial
- Multifamily
- Park / Undeveloped
- Public ROW
- Single Family HighDensity
- Single Family Low Density
- Single Family Medium Density
- Single Family Rural Density
- Hydrology & WQ Monitoring
- Physical Habitat, sediment & B-IBI Monitoring

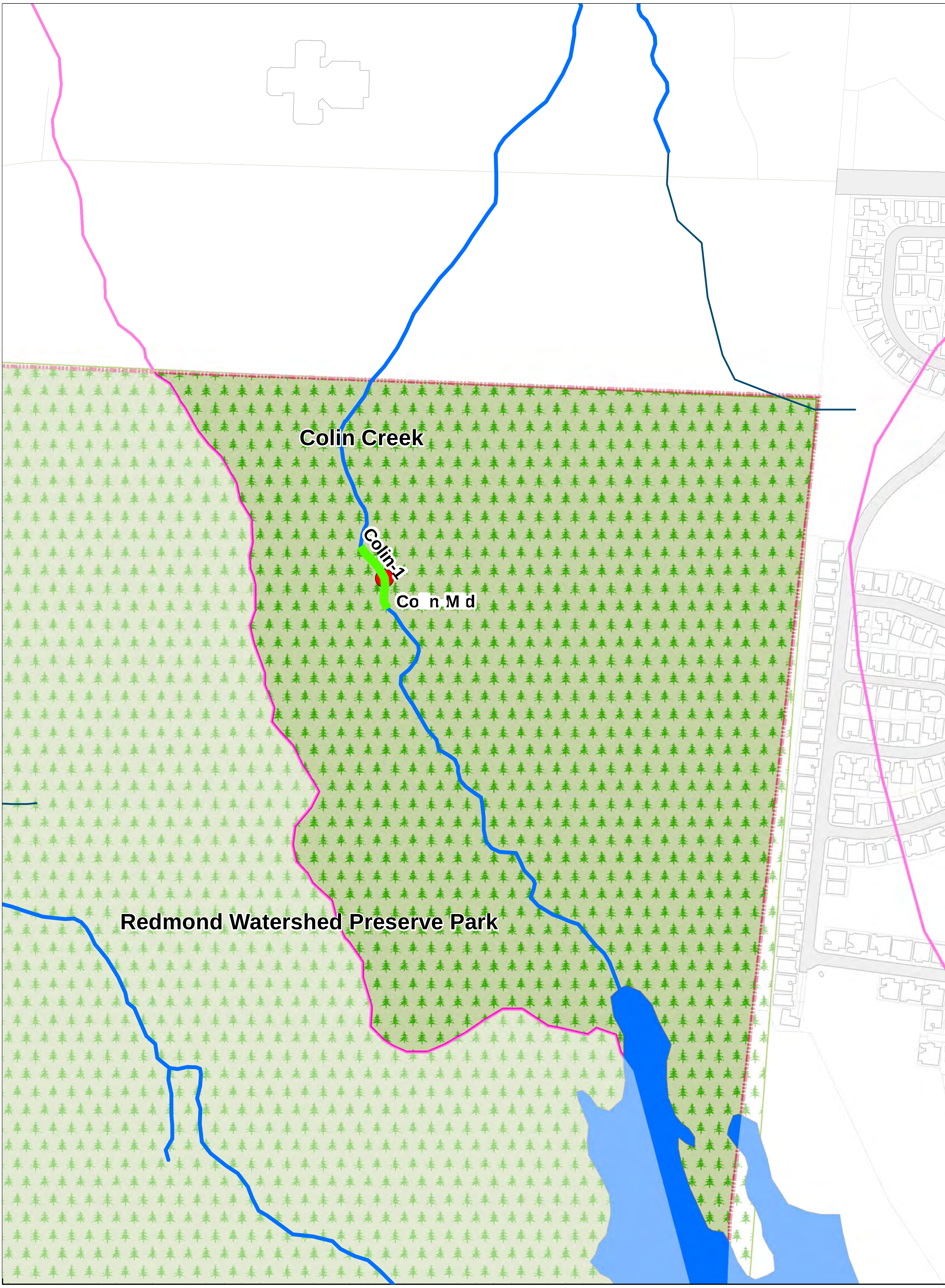

Figure 5 - Colin Creek Paired Watershed Study Monitoring Locations.

City of Redmond, Washington
6/25/2015

City of Redmond
WASHINGTON

0 0.0325 0.065 0.13 Miles

N

Legend

- Class I Stream
- Class II Stream
- Class III Stream
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- Habitat, sediment & Biological Monitoring

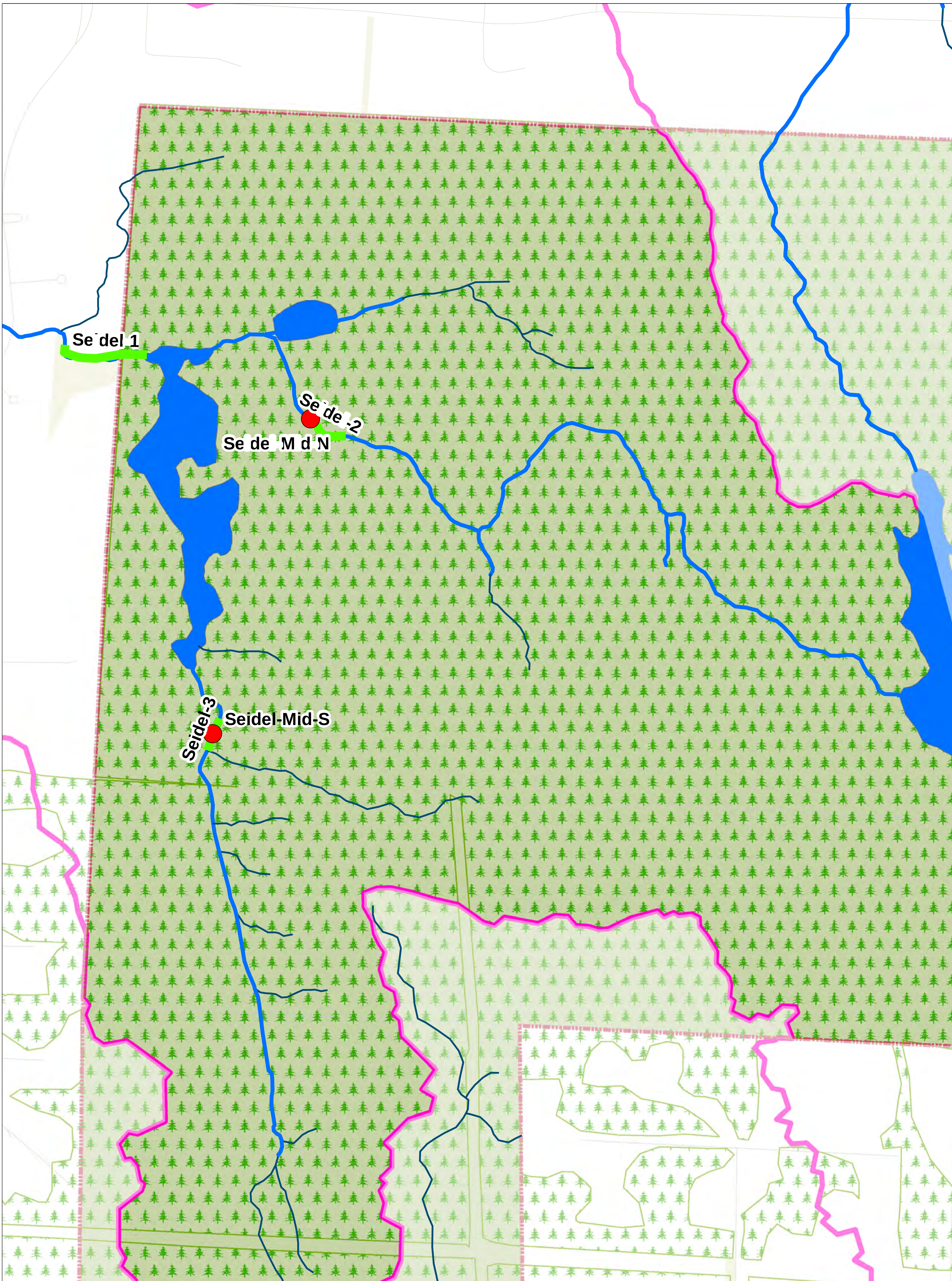

Figure 6 - Seidel Creek Paired Watershed Study Monitoring Locations.

City of Redmond, Washington

11/22/2013

N

0 0.05 0.1 0.2 Miles

City of Redmond WASHINGTON

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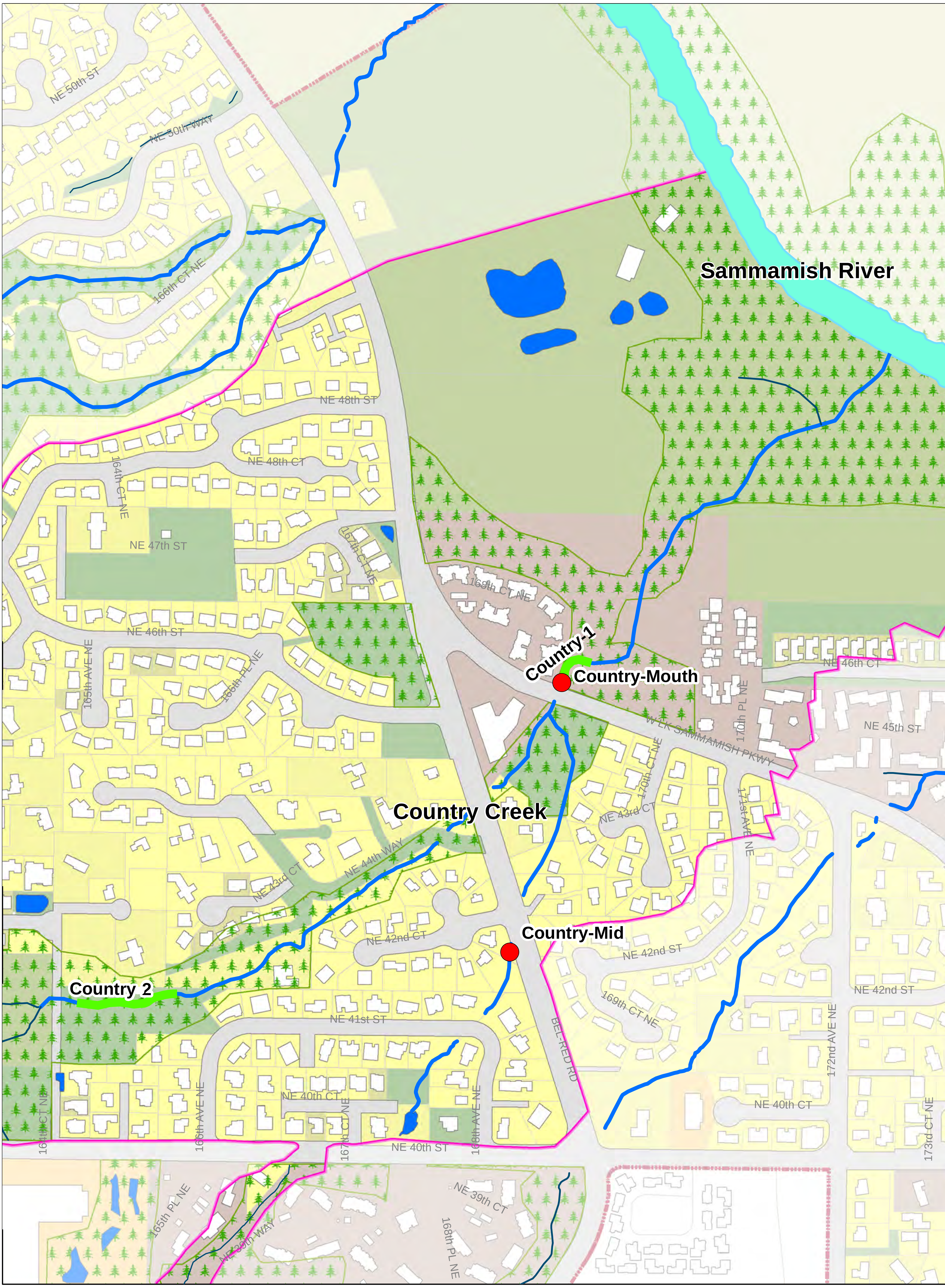

Figure 7 - Country Creek Paired Watershed Study Monitoring Locations.

City of Redmond, Washington

6/25/2015

CityofRedmond WASHINGTON

N

0 0.0325 0.065 0.13 Miles

Legend

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- Class II Stream
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- Park / Undeveloped
- Public ROW
- Single Family HighDensity
- Single Family Low Density
- Single Family Medium Density
- Single Family Rural Density
- Flow & WQ Monitoring
- Habitat, Sediment, & Biological Monitoring

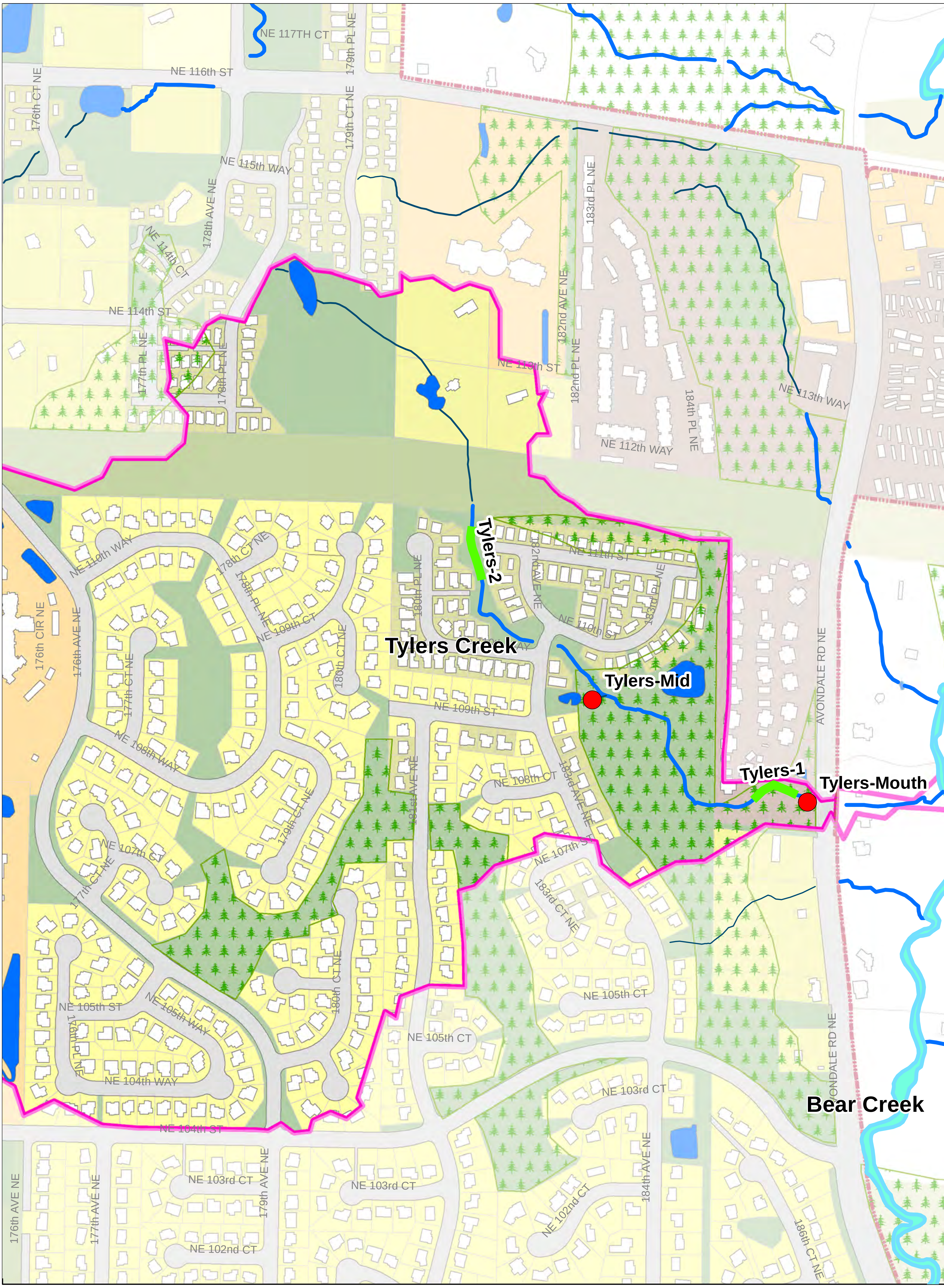

Figure 8 - Tylers Creek Paired Watershed Study Monitoring Locations.

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Water Quality Monitoring

A total of 14 fixed monitoring stations were established at the onset of the study to facilitate water quality monitoring in each of the study watersheds. Starting in WY2022, monitoring has occurred at 12 fixed monitoring stations; see further explanation in the Monitoring Procedures section (page 29). These stations were co-located with the monitoring stations described above for hydrologic monitoring (see Figure 2 through Figure 8). Twelve grab samples are collected annually during storm events (three each quarter) at each of the monitoring stations for the duration of the RPWS. In addition, four grab samples are also collected annually during base flow (one each quarter) at these stations. Each sample is analyzed for the following indicators for evaluating water quality impacts from urban development:

- Total suspended solids
- Turbidity
- Conductivity
- Hardness
- Dissolved organic carbon
- Fecal coliform bacteria
- Total phosphorus
- Total nitrogen
- Copper, total and dissolved
- Zinc, total and dissolved

In addition, *in situ* probes are used to continuously measure temperature at each station and conductivity at the following subset of stations: EVALSS, EVAMS, MONM, MONMS, TOSMO, SEIMN, SEIMS, COUMO, and TYLMO.

Trends over time at each monitoring station are evaluated using statistical tests (see the Data Analysis Procedures section). In all cases, the pattern of interest is evidence that receiving water conditions are improving based on the detection of statistically significant trends in the data for one or more of these indicators in the Application watersheds while the same trends are not detected in the data for the same indicators in the Reference and Control watersheds.

Physical Habitat Monitoring

A total of 19 fixed monitoring stations were established to facilitate physical habitat monitoring in each of the study watersheds. Starting in WY2022, monitoring has occurred at 17 fixed monitoring station; see further explanation in the Monitoring Procedures section (page 29). As described in the literature review (Herrera 2015b) that was performed to inform the experimental design for the RPWS, most past studies that have been performed to assess physical habitat response to watershed rehabilitation were conducted in reaches where channel rehabilitation measures were directly applied. Consequently, they were designed to only assess the localized effects of these efforts. The RPWS involves both localized channel rehabilitation and watershed scale rehabilitation through the application of structural and programmatic practices for stormwater management. Therefore, a synoptic approach was applied for establishing monitoring stations for physical habitat monitoring where stations were established in the Application watersheds in reaches that will be restored and in reaches where no physical alterations to the channel are planned. In this way, the RPWS can assess physical habitat response to both localized and basin-wide rehabilitation efforts. In addition to these considerations, the specific location of each monitoring station was also influenced by safety and property access issues. The monitoring stations established in each of the study watersheds are as follows:

Application Watersheds

- Evans Creek Tributary 108: Two stations designated Lower Stream Station (EVALSS) and Midstream Station (EVAMS), respectively (see locations in Figure 2). This watershed was dropped from the study in WY2022; see further explanation in the Monitoring Procedures section (page 29).
- Monticello Creek: Five stations designated MONT-1, MONT-2, MONT-3, MONT-4, and MONT-5, respectively (see locations in Figure 3).
- Tosh Creek: Four stations designated TOSH-1, TOSH-2, TOSH-3, and TOSH-4, respectively (see locations in Figure 4).

Reference Watersheds

- Colin Creek: One designated COLIN-1 (see locations in Figure 5).
- Seidel Creek: Three stations designated Seidel-1, Seidel-2, and Seidel-3, respectively (see locations in Figure 6).

Control Watersheds

- Country Creek: Two stations designated Country-1 and Country-2, respectively (see locations in Figure 7).
- Tyler's Creek: Two stations designated Tylers-1 and Tylers-2, respectively (see locations in Figure 8).

The following monitoring stations were specifically selected to measure the localized physical habitat response in reaches that have either been recently restored or are likely to be restored in the future:

- MONT-3
- MONT-4
- MONT-5
- TOSH-1
- TOSH-3
- TOSH-4

Physical habitat monitoring is conducted annually at each monitoring station for the duration of the RPWS. The characteristic bed-form type will be recorded at each monitoring station, and physical habitat quality indicators is measured at 11 cross-sections (transects) and thalweg (line of steepest descent along the streambed) profile for each habitat monitoring station.

The following indicators will be measured in connection with this monitoring:

- Bed stability
- Channel dimensions
- Fish cover
- Habitat dimensions
- Habitat unit extents
- Large woody debris
- Riparian cover
- Riparian disturbance
- Riparian vegetation structure
- Sinuosity
- Substrate

The pattern of interest is evidence that receiving water conditions are improving based on the detection of trends in the data for one or more of these indicators in the Application watersheds while the same trends are not detected in the data for the same indicators in the Reference and Control watersheds.

Sediment Quality Monitoring

A total of 19 fixed monitoring stations were established at the onset of the study to facilitate sediment quality monitoring in each of the study watersheds. Starting in WY2022, monitoring has occurred at 17 fixed monitoring stations; see further explanation in the Monitoring Procedures section (page 29). These stations were co-located with the monitoring stations described above for physical habitat monitoring (see Figure 2 through Figure 8). Sediment samples are collected annually at all 19 monitoring stations for the duration of the RPWS. Each sample is analyzed for the following indicators for evaluating sediment quality impacts from urban development:

- Total organic carbon
- Copper
- Zinc
- Polycyclic aromatic hydrocarbons
- Phthalates

Trends over time at each monitoring station are using statistical tests (see the Data Analysis Procedures section). The pattern of interest is evidence that receiving water conditions are improving based on the detection of statistically significant trends in the data for one or more of these indicators in the Application watersheds while the same trends are not detected in the data for the same indicators in the Reference and Control watersheds.

Biological Monitoring

A total of 19 fixed monitoring stations were established at the onset of the study to facilitate biological monitoring in each of the study watersheds. Starting in WY2022, monitoring has occurred at 17 fixed monitoring stations; see further explanation in the Monitoring Procedures section (page 29). These stations were co-located with the monitoring stations described above for physical habitat monitoring (see Figure 2 through Figure 8). Benthic macroinvertebrate samples are collected annually at each monitoring station for the duration of the RPWS. Each sample is processed to calculate the following indicators for use in evaluating stream health:

- Benthic Index of Biotic Integrity (B-IBI)
- Taxa Richness
- Ephemeroptera Richness
- Plecoptera Richness
- Trichoptera Richness
- Clinger Percent
- Long-Lived Richness
- Intolerant Richness
- Percent Dominant
- Predator Percent
- Tolerant Percent

Trends over time at each monitoring station are evaluated using statistical tests (see Data Analysis Procedures section). The pattern of interest is evidence that receiving water conditions are improving based on the detection of statistically significant trends in the data for one or more of these indicators in the Application watersheds while the same trends are not detected in the data for the same indicators in the Reference and Control watersheds.

Effectiveness Monitoring

Roving stations will be established for the Effectiveness Monitoring component of the RPWS to verify specific structural or programmatic stormwater controls are constructed properly, performing as designed, or providing meaningful benefit. The roving stations will be moved from one year to the next once a facility's effectiveness has been verified and new facilities come online. The specific types of monitoring to be performed at each roving station will depend on the type of structural stormwater control that is being evaluated. For example, it is anticipated that only hydrologic monitoring would be performed at roving stations for facilities that are only designed for flow control (e.g., vaults). In these cases, a facility's performance would be verified based on comparisons of measured flow from the roving station to the facility's predicted flow from models used in its design. For facilities that are designed for runoff treatment, monitoring will follow guidelines from Ecology's Technology Assessment Protocol–Ecology (TAPE) (Ecology 2024) and include both hydrologic (e.g., influent and effluent flow) and water quality monitoring. In these cases, a facility's performance would be verified based on comparisons of its measured pollutant removal efficiency relative to targets that are identified in TAPE for specific treatment categories.

Effectiveness Monitoring is currently planned or ongoing for two watershed rehabilitation projects that are being implemented by the City as described in the following subsections.

Pond Retrofit Effectiveness Monitoring

In April 2021, the City retrofitted two existing stormwater detention ponds in the Monticello Creek watershed with a continuous monitoring and adaptive control (CMAC) system to improve their performance for managing peak flows during storm events. The CMAC system is designed to optimize the performance of existing stormwater detention facilities by leveraging forecast information with onsite sensors, allowing adaptive use of the full storage volume available to more closely approximate flow patterns that existed prior to land development. Documentation related to the design and operation of these systems was provided in the WY2022 data summary report (Herrera 2023b).

Subsequent to the completion of the City's pond retrofits, the County retrofitted two additional ponds with CMAC systems in the Monticello Creek watershed that are located within its jurisdictional boundaries. These systems went online in February of 2023; however, technical issues impacted their performance until April 24, 2024, when they were subsequently deemed fully functional. Collectively, the area managed by the four ponds that have been retrofitted by the City and County represents approximately 24 percent of the Monticello Creek watershed.

A proposal (Herrera 2021b) to conduct Effectiveness Monitoring on these ponds using funding from the SAM program was approved by Ecology on December 30, 2021. This monitoring was scheduled to initiate at the start of WY2022; however, the City's CMAC systems were not fully operational during WY2021 and WY2022 due to technical issues. After installation of a solar panel, the Curry East CMAC system become fully functional on February 10, 2023. Due to battery issues, Whistler Ridge was not fully functional until WY2024. Hence, results from this monitoring will be summarized in the trend analysis report that will be prepared at the end of WY2025.

Street Sweeping Effectiveness Monitoring

The trend analysis conducted by Herrera (2020b, 2020c) documented a significant decrease in total suspended solids and total copper concentrations in Monticello Creek that appeared related to a City project that progressively increased street sweeping frequency in the associated watershed. These results were consistent with another study that was implemented by the City of Seattle (SPU 2018).

To validate the effectiveness of sweeping for improving water quality, the City has obtained grant funding from King County Wastewater Treatment Division to progressively increase street sweeping in the Tosh Creek watershed. The specific goal will be to confirm street sweeping is effective at reducing total suspended solids and total copper concentrations in receiving waters. The City also intends to evaluate whether street sweeping can be effective at removing other pollutants of concern that are associated with roadway runoff. Specifically, the City is collecting samples for evaluating concentrations of 6PPD-quinone (6PPD-Q) and polycyclic aromatic hydrocarbons (PAHs) during the routine water quality monitoring that is conducted for the RPWS. A widely used antioxidant in rubber tires, 6PPD-Q is an emerging contaminant in stormwater that was recently linked to acute mortality of coho salmon. PAHs are a common type of organic pollutant found in stormwater runoff that are known or probable human carcinogens and toxic to aquatic life.

This Effectiveness Monitoring specifically involved supplemental sampling and analysis for 6PPD-Q and PAHs beginning October 1, 2022, and ending September 30, 2024, at the two stations (TOSMO and TOSMI) in the Tosh Creek watershed (an Application watershed) and two stations (COUMO and COUMI) in the Country Creek watershed (a Control watershed) that were established for Status and Trends Monitoring (see description above). Street sweeping in the Tosh Creek watershed within Redmond city limits occurred one time per month from October 2022 through September 2023, and two times per month from October 2023 through September 2024. This is in addition to the regularly scheduled quarterly street sweeping. Street sweeping in the Country Creek watershed will only occur quarterly to serve as a control. More detailed information on this monitoring is provided in an addendum (Herrera 2022) to the QAPP for the RPWS. The additional sampling for 6PPD-Q and PAHs is being performed using Ecology funding designated for 6PPD-Q research. Results from this monitoring will be summarized in the trend analysis report that will be prepared at the end of WY2025.

Rehabilitation Effort Summary

As noted in the previous section, the pattern of interest for this study will be evidence that receiving water conditions are improving based on one or more indicators in the Application watersheds while conditions in the Reference and Control watersheds remain relatively static. To increase the likelihood of detecting this trend, conditions in the Application watersheds were characterized over a "baseline" period prior to the implementation of any rehabilitation efforts implemented during and after WY2016. Rehabilitation efforts that have subsequently been implemented by the City or County in each of the Application watersheds are described below under the following categories: structural retrofits, programmatic controls, and habitat enhancements.

Evans Creek Tributary 108

- Structural Retrofits
  - In WY2017, the County constructed two stormwater detention vaults within the Evans Creek Tributary 108 watershed; one was in front of addresses 20620 and 20626 Northeast 76th Place, and the other was in front of address 20508 Northeast 78th Street. Design details for these vaults are documented in Herrera (2023c).

Monticello Creek

- Structural Retrofits
  - In April 2021, the City retrofitted two existing stormwater detention ponds (Curry East and Whistler Ridge) in the Monticello Creek watershed with a CMAC system to improve their performance for managing peak flows during storm events. However, the CMAC systems were not fully operational during WY2021 and WY2022 due to technical issues. After installation of a solar panel, the Curry East CMAC system became fully functional on February 10, 2023. Due to battery issues, Whistler Ridge was not fully functional until WY2024. Design details for these systems are documented in WY2022 Data Summary Report (Herrera 2023b).
  - Subsequent to the completion of the City's pond retrofits, the County retrofitted two additional ponds with CMAC systems in the Monticello Creek watershed that are located within its jurisdictional boundaries. These systems went online in February of 2023; however, technical issues impacted their performance until April 24, 2024, when they were subsequently deemed fully functional. Collectively, the area managed by the four ponds that have been retrofitted by the City and County represents approximately 24 percent of the Monticello Creek watershed. Design details for these systems are documented in WY2023 Data Summary Report (Herrera 2024).

- Programmatic Controls
  - Using funding from a King County WaterWorks grant, the City implemented a street-sweeping project in the Monticello Creek watershed:
    - Street sweeping increased from quarterly to monthly in August of WY2017 and continued throughout WY2018. The street sweeping occurred on all public roads in the watershed.
    - Beginning in October of WY2019, the frequency of street sweeping increased from once per month to twice per month. This street sweeping was implemented to meet the specific goal of improving water quality in the creek and conducted in addition to street sweeping that occurs in the watershed for other operational reasons, such as collecting leaves in fall. A more detailed summary of the street sweeping is provided in Table 3.
  - *Note: Trend analyses performed by Herrera (2020b, 2020c) documented a consistent and statistically significant decrease in total suspended solids and total copper concentrations in Monticello Creek that appeared to be related to the increase in street sweeping frequency. These results are also consistent with a street sweeping study that was implemented by the City of Seattle (SPU 2018).*
- Habitat Enhancements
  - In WY2017, large woody debris was installed on an approximately 400-foot-long reach of Monticello Creek that extends downstream from Northeast 122nd Street. Approximately 400 feet of additional large woody debris was installed in July of WY2018 on the downstream end of the installation from WY2017.
  - In WY2019, invasive species removal and supplemental planting was completed in an approximately 2,000-square-foot project area located at the Fischer Village Native Growth Protection Easement downstream of 178th Avenue Northeast. Fifty-five trees and 15 shrubs were planted. Himalayan blackberry (*Rubus armeniacus*) was removed from the project area.
  - In WY2021, three separate plantings within the riparian zone of Monticello Creek were completed by the City:
    - Approximately 0.5 acre within the Fischer Village Native Growth Protective Easement (Monticello main stem, downstream of Northeast 122nd Street) was cleared of Himalayan blackberry. Two hundred trees and 200 shrubs were planted within the project area in March 2021.
    - Approximately 0.75 acre within the Ray Meadows Native Growth Protective Easement (Monticello main stem, downstream of the Fischer Village Native Growth Protective Easement) was cleared of Himalayan blackberry in March 2021. Six hundred trees were planted in the project area in October 2021.
    - Approximately 0.68 acre within the Cameron Place Native Growth Protective Easement and City-owned land (Monticello Creek—west fork, south of Northeast 116th Street) was cleared of Himalayan blackberry and reed canarygrass in January 2021. Three hundred trees and 600 shrubs were planted in the project area during March 2021.

- In WY2022, a restoration project was completed at Smith Woods as part of a fish passage and stream enhancement project north of Northeast 122nd Street. The planting area covered 11,369 square feet and included 304 trees, 281 shrubs, 1,516 groundcover plants, and 1,060 emergents.
- In WY2023, a restoration project was completed at the Ray Meadows Native Growth Protective Easement (Monticello main stem, downstream of the Fischer Village Native Growth Protective Easement). This project included cutting and grubbing blackberry more than 8,000 square feet, and planting 95 trees and 145 shrubs.

Tosh Creek

- Structural Controls
  - The high-flow bypass pipe weir for the Tosh Creek watershed was adjusted in July of WY2017 to divert more high-flow stormwater from Tosh Creek.
- Programmatic Controls
  - Using funding from a King County WaterWorks grant, the City implemented a street-sweeping project in the Tosh Creek watershed. Street sweeping increased from quarterly to monthly from October 2022 through September 2023. The street sweeping occurred on all 3.54 miles of public roads in the watershed.
- Habitat Enhancements
  - Large woody debris was installed on an approximately 300-foot-long reach of Tosh Creek in WY2017, downstream of West Lake Sammamish Parkway. In July of WY2018, adjustments were made to this large woody debris, and minor slash was added to the reach.
  - In WY2019, a planting was conducted in an approximately 40,000-square-foot project area located in the lower section of Tosh Creek, between West Lake Sammamish Parkway and the Sammamish River. Sixty-five shrubs and 627 trees were planted. Normal maintenance was performed at the site, including removal of the invasive species Himalayan blackberries and bittersweet nightshade (*Solanum dulcamara*).
  - In WY2021 ongoing maintenance of the planting that occurred in WY2019 was conducted. This included planting 15 spruce trees, mulching plants, spot treating knotweed, and grubbing Himalayan blackberries. In WY2022 and WY2023 the City performed ongoing maintenance of the planting area.

Table 3. Summary of Street Sweeping in the Monticello Creek Watershed.	
Type of Sweeper	**Regenerative**
Percent of roads swept within the basin:	83% (the City did not sweep the 1.24 miles of private roads within watershed due to access issues)
Type of public roads and percent of each:	• Principal Arterial: 4% • Collector Arterial: 9% • Connector Streets: 4% • Local Access: 83%
Miles swept per year:	• Monthly: July 2017–August 2018. A total of 83.44 miles were swept during these 14 months. • Twice Monthly: September 2018–August 2019. A total of 143.04 miles were swept during these 12 months.
Average passes per year:	• Monthly: July 2017–August 2018. The watershed was swept 14 times during this time period. The biweekly sweeping was supposed to start in July 2018; however, due to an error, the contractor continued monthly sweeping until August 2018. This was addressed by adding 2 months of sweeping twice per month to the end of the contract. • Twice Monthly: September 2018–August 2019. The watershed was swept 24 times during this time period. No months were missed.

Monitoring Procedures

The QAPP that was prepared for the RPWS (Herrera 2015c) provides detailed information on the monitoring procedures that are being used for each of the following categories: hydrologic, water quality, physical habitat, sediment quality, and biological. The following deviations from these monitoring procedures are noted for monitoring that took place through WY2023:

- The YSI Pro Model 2030 that was used to make discrete *in situ* measurements of water temperature and conductivity was calibrated using a 1,000 µS standard instead of a 100 µS standard as specified in the QAPP. This change was made based on manufacturer recommendations for meter calibration. Given this change, the calibration of the meter was subsequently checked before and after each sampling event using both the 100 and 1,000 µS standards to confirm the method quality objective identified in the QAPP for meter accuracy (±5 percent) was met. Results from these calibration checks were documented on standardized field forms.
- Guidelines in the QAPP indicate that storm sampling may only occur if the following criterion for antecedent conditions is met: a period of at least 24 hours preceding the event with less than 0.04 inch of precipitation. However, this guideline was deemed too restrictive following monitoring that occurred over WY2016. Hence, this criterion was changed to allow storm event sampling after a period of at least 12 hours preceding the event with less than 0.04 inch of precipitation.
- The QAPP for the RPWS indicates trend analyses reports should be prepared following 4, 6, 8, and 10 years of study implementation. These reports summarize the results of statistical analyses that are described in the QAPP to identify relationships between rehabilitation efforts and improving receiving water conditions. A trend analysis report (Herrera 2020b) was prepared following year 4 of the RPWS's implementation. To reduce the overall budget for the study while allowing for a longer period of data collection before conducting analyses to identify relationships between rehabilitation efforts and improving receiving water conditions, a trend analysis report following 6 years of study implementation was not prepared. Trend analysis reports will still be prepared following 8 and 10 years of study implementation.
- The Evans Creek watershed is identified as an Application Watershed in the QAPP for the RPWS because it was prioritized by the County for rehabilitation efforts at the onset of the study; specifically, the County constructed two stormwater detention ponds within the watershed in WY2017. Monitoring has subsequently occurred at individual stations within this watershed over the period extending from WY2016 through WY2021. The performance of these ponds for improving receiving water conditions was analyzed in the trend analysis report that was prepared after 4 years of study implementation. Results from this analysis indicated the ponds are generally providing no measurable benefit to the creek. Because the County is not planning to implement any additional rehabilitation efforts within the Evans Creek watershed in the short term, monitoring at all stations within this watershed has been suspended at the end of WY2022.

- The QAPP for the RPWS indicates physical habitat and sediment quality monitoring should occur every year through the anticipated 10-year time frame for study implementation. To reduce the overall budget, a decision was made to implement this monitoring every other year after WY2021. This change was deemed to be acceptable because large, year-to-year changes are not anticipated for these categories of monitoring.
- The QAPP for the RPWS indicates *in situ* probes will be used to continuously measure conductivity at the following subset of stations: EVALSS, EVAMS, MONM, MONMS, TOSMO, SEIMN, SEIMS, COUMO, and TYLMO. To reduce the overall budget, a decision was made to suspend this monitoring after WY2021. This change was deemed to be acceptable given *in situ* measurements for conductivity are still made at all stations in connection with base flow and storm event sampling.

The deviations identified above were made with concurrence from the SAM program coordinator and the TAC for the RPWS.

Data Analysis Procedures

This section describes the data analyses procedures that were performed on the compiled data from monitoring in WY2016 through WY2023 to detect potential improving trends in receiving water conditions related to the implementation of rehabilitation efforts. This information is organized under separate subsections for each of the monitoring categories: hydrologic, water quality, physical habitat, sediment, and biological monitoring. In some cases, trend analyses that were not identified in the QAPP for the RPWS (Herrera 2015c) are identified for evaluating the potential benefits of specific rehabilitation measures that have been implemented in an Application watershed. These instances are noted in the subsections for each monitoring category.

All analyses described herein were performed using the R statistical software. The raw flow, precipitation, and temperature data used in these analyses can be access via King County's Hydrologic Information Center:

<https://green2.kingcounty.gov/hydrology/Data.aspx>.

The raw water and sediment quality data used in these analyses can be accessed via Ecology's Environmental Information Management System:

<https://apps.ecology.wa.gov/eim/search/Eim/EIMSearchResults.aspx?ResultType=LocationList&StudySystemIds=99971043&StudyUserIdSearchType=Equals&StudyUserIds=RSM_EFS1>.

The raw physical habitat quality data used in these analyses can be accessed via Ecology's Watershed Health Monitoring database:

<https://apps.ecology.wa.gov/eim/search/WHM/WHMLocationResults.aspx?&StudyUserIds=efs1&StudyUserIdSearchType=Contains>

The raw data from biological monitoring used in these analyses can be accessed via Puget Sound Stream Benthos database:

<https://benthos.kingcounty.gov/Biotic-Integrity-Scores.aspx?Agency-Project=Redmond%3A%20RPWS&d=4>.

Hydrologic Monitoring

Analyses conducted for hydrologic monitoring involved correlation tests to look for trends over time. The procedures used for these analyses are described in the following subsections.

Correlation Analyses for Hydrologic Indicators Versus Time

Trends in hydrology over time at each monitoring station were evaluated using the nonparametric Kendall's tau and parametric Pearson's r tests for correlation between the indicators identified in Table 2 for hydrologic impacts and time. Statistical significance of the correlation coefficients was evaluated based on an α level of 0.05 for a one-tailed test and the following null and alternative hypotheses related to hydrologic impacts:

- Ho: hydrologic conditions remain unchanged or have deteriorated over time
- Ha: hydrologic conditions have improved over time

The following expected responses to urbanization for each indicator (DeGasperi et al. 2009) were also used in the interpretation of these results:

- High pulse count – increase
- High pulse duration – decrease
- High pulse range – increase
- Low pulse count – increase
- Low pulse duration – decrease
- Low pulse range – decrease
- Flow reversal – increase
- Richards-Baker (RB) flashiness index – increase
- Flashiness (TQ Mean) – decrease
- Storm flow volume – increase
- Base flow volume – decrease

Correlation Analyses of Rainfall Runoff Response Versus Time

The rainfall runoff response for a given watershed can be influenced by a number of factors including soil type, available storage, and amount of urban development. In general, urban development will increase the volume and peak flow rate for runoff that is generated by a storm event of a given size. Stormwater BMPs are designed to mitigate these impacts.

Using procedures described in Helsel and Hirsch (2002), potential changes in rainfall runoff response over time at each monitoring station were evaluated using the following steps:

1. Continuous flow data from each station and the applicable precipitation data were post-processed using a custom program that delineates the start and stop time of individual storm events based on user selectable storm criteria (e.g., antecedent dry period, minimum rainfall, interevent dry period, etc.). The specific precipitation monitoring station that was paired with each flow monitoring station for this analysis is described in the Experimental Design section. The program then computes the following suite of summary statistics for each storm event:
   - Precipitation start and stop times
   - Precipitation duration
   - Precipitation depth
   - Precipitation average intensity
   - Precipitation maximum intensity
   - Precipitation antecedent dry period
   - Flow start and stop times
   - Flow duration
   - Average flow rate
   - Maximum flow rate
   - Flow volume
2. The storm flow volume and precipitation depth data were then log transformed and plotted for visual inspection. Similar plots were developed for maximum flow rate versus precipitation depth.
3. Relationships between storm event precipitation depth at each station and runoff response as measured by storm flow volume and maximum flow rate were then characterized by fitting a LOcally WEighted Scatterplot Smooth (LOWESS) through the data from Step 2. LOWESS is a smoothing technique that can be used to describe the relationship between two variables without assuming linearity or normality of residuals.
4. Trends over time in the rainfall runoff response at each monitoring station were evaluated using a Seasonal Kendall test that was applied to the residuals from the LOWESS fits from Step 3. The seasonal Kendall test accounts for seasonality by computing the Mann-Kendall test on each of m seasons separately, and then combining the results. The Seasonal Kendall test was used in this analysis because the rainfall runoff response at each station varied substantially between dry and wet seasons. Seasons were therefore defined in these tests as follows:
   - Wet: November through April
   - Dry: May through October
5. Statistical significance of the correlation coefficients from the seasonal Kendall tests were evaluated based on an α level of 0.05 for a one-tailed test and the following null (Ho) and alternative (Ha) hypotheses:
   - Ho: the flow volumes or maximum flow rate has increased or not changed for a given storm precipitation depth over time
   - Ha: the flow volumes or maximum flow rate has decreased for a given storm precipitation depth over time

This analysis was not identified in the QAPP for the RPWS (Herrera 2015c); rather, it was added following discussion and approval from the technical advisory committee for the RPWS during a meeting on July 29, 2019. It was meant to replace analyses described in the QAPP that would have involved comparisons of continuous flow monitoring data to modeled flows for forested and existing conditions (i.e., the conditions when the models were developed) that were derived from existing hydrologic models that have been developed for the Tosh and Monticello. The model based analysis was deemed less useful because existing models are only available for these two watersheds; hence, trends identified through this analysis could not be evaluated relative to conditions in the Reference and Control watersheds. The analysis presented here was applied across all the watersheds and directly assessed the statistical significance of trends in hydrologic conditions without relying on modeled flows.

Water Quality Monitoring

Analyses conducted for water quality monitoring involved correlation tests to look for trends over time. The procedures used for these analyses are described in the following subsections.

Correlation Analyses for Water Quality Indicators Versus Time

Trends in water quality over time at each monitoring station were evaluated using the nonparametric Kendall's tau and parametric Pearson's r tests for correlation between the indicators identified in Table 2 for water quality and time. Separate analyses were performed on the storm event and base flow samples from each station, respectively.

For analyses performed on baseflow samples, the raw concentrations were used in the Kendall's tau and parametric Pearson's r tests. For all parameters except hardness and dissolved organic carbon, the statistical significance of the correlation coefficients was evaluated based on an α level of 0.05 for a one-tailed test and the following null and alternative hypotheses related to water quality impacts:

- Ho: concentrations remain unchanged or have increased over time
- Ha: concentrations have decreased over time

For hardness and dissolved organic carbon, the statistical significance of the correlation coefficients was evaluated based on an α level of 0.05 for a two-tailed test and the following null and alternative hypotheses related to hydrologic impacts:

- Ho: concentrations remain unchanged over time
- Ha: concentrations have decreased or increased over time

A two-tailed test was used because there is no a priori hypothesis for these parameters that would suggest their concentrations will respond in a specific direction following implementation of watershed rehabilitation efforts. This contrasts with the other parameters where the specific hypothesis is concentrations will decrease in response to these efforts.

For analyses performed on storm event samples, the following steps from Helsel and Hirsch (2002) were performed to remove variation in the indicator data related to changes in stream flow prior to performing the correlation analyses:

1. The stream flow rate at the time each storm event sample was collected was determined for all stations. The flow rates and pollutant concentrations from each storm event sample were then log transformed and plotted for visual inspection.
2. Relationships between storm event pollutant concentrations and stream flow rate at the time of sample collection were then modeled using simple linear regression. A sufficiently strong relationship was assumed if the slope of the regression model was significantly ($\alpha = 0.05$) different than zero and the associated r^2 value was greater than 0.35.
3. If the relationships between storm event pollutant concentrations and flow rate at the time of sample collection was deemed sufficiently strong for a given station based on the criteria from Step 2, the Kendall's tau and Pearson's r tests were applied to the residuals from the associated linear regression models; otherwise, these tests were performed on the raw concentrations from each sample. The statistical significance of the correlation coefficients was evaluated using the approach describe above for the analyses performed on base flow samples.

Correlation Analyses of Mass Loading Estimates Versus Time

To detect potential improvements in receiving water conditions from the combined effects of improved water quality and reduced stormwater runoff, water year mass load estimates were derived for the following subset of indicators: total suspended solids, total phosphorus, total nitrogen, total copper, and total zinc. The specific steps that were performed to develop these estimates are as follows:

- Linear regression models for predicting pollutant loads as a function of stream discharge were generated using the measured pollutant concentrations in storm event and base flow samples from each station and the stream flow rate at the time of sample collection. Because logarithmic data transformations are required to obtain a linear model for these data, a correction factor for transformation bias was added to the models using the nonparametric *smearing* approach described by Helsel et al. (2020). Separate models were developed for each station and pollutant combination using samples collected over a single water year.
- The linear regression models were then applied to the continuous flow record for each station to predict 5-minute pollutant load estimates at each station over the entire water year.
- These 5-minute pollutant load estimates were subsequently summed to quantify pollutant loads at each of the station for each water year.
- Annual loads calculated for each station-parameter pair were normalized by the total annual precipitation depth measured at the associated project rain gauge for each water year.

Based on an evaluation the linear regression models, the following pollutant load estimates were rejected for the reasons indicated:

- Load estimates generated for all pollutants at the EVALSS station over WY2016 were rejected because they were unreasonably high. Water quality monitoring in WY2016 commenced in March 2016 or approximately halfway through the water year; hence, it is possible sampling may not have occurred over a sufficient range of flows at this station to develop accurate linear regression models.
- Load estimates generated for the following pollutants at the MONMN station over WY2016 were rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero: total phosphorus, total suspended solids (TSS), and total zinc.
- Load estimates generated for the following pollutants at the COLM station over WY2016 were rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero: total nitrogen, total phosphorus, and TSS.
- The load estimates generated for TSS at the COUMI station over WY2016 was rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero.
- The load estimates generated for TSS at the EVAMS station over WY2021 was rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero.
- Load estimates generated for the following pollutants at the MONMN station over WY2023 were rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero: total phosphorus, and TSS.
- The load estimates generated for TSS at the TOSMO station over WY2023 was rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero.
- The load estimates generated for TSS at the COLM station over WY2023 was rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero.
- Load estimates generated for the following pollutants at the SEIMN station over WY2023 were rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero: total nitrogen, total phosphorus, and TSS.
- The load estimates generated for TSS at the SEIMS station over WY2023 was rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero.
- The load estimates generated for TSS at the COUMI station over WY2023 was rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero.
- The load estimates generated for TSS at the TYLMI station over WY2023 was rejected because the slope coefficients for the associated regression models were not significantly different (α = 0.05) from zero.

Excluding these rejected estimates, trends in hydrology over time at each monitoring station were subsequently evaluated using the nonparametric Kendall's tau and parametric Pearson's r tests for correlation between the normalized mass load estimates and time. Statistical significance of the correlation coefficients was evaluated based on an α level of 0.05 for a one-tailed test and the following null and alternative hypotheses related to hydrologic impacts:

- Ho: normalized loads remain unchanged or have increased over time
- Ha: normalized loads have decreased over time

Correlation Analyses of Continuous Temperature and Conductivity Data Versus Time

Continuous data for temperature and conductivity was post-processed to compute monthly average and maximum values from the time series. Trends over time at each monitoring station were evaluated using a seasonal Kendall's tau test (Helsel and Hirsch 2002) of correlation between these values and time with the seasons defined as follows:

- Spring: April through June
- Summer: July through September
- Fall: October through December
- Winter: January through March

The statistical significance of the correlation coefficients was evaluated based on an α level of 0.05 for a one-tailed test and the following null and alternative hypotheses related to water quality impacts:

- Ho: temperature/conductivity remains unchanged or has increased over time
- Ha: temperature/conductivity has decreased over time

Physical Habitat Monitoring

Over 260 indicators for physical habitat quality were calculated from the field surveys conducted at each station for the RPWS. Based on procedures from King County (2018) and guidance received from the technical advisory committee for the RPWS during a meeting on July 29, 2019, a subset of indicators was identified for evaluation in this report to assess potential improvements in physical habitat quality. These indicators are as follows with their expected response to increased urbanization:

- Riparian canopy closure: stream center densiometer measurement – decrease
- Wood: wood volume normalized to a 100-meter reach length – decrease
- Pools: residual pool area – decrease
- Substrate: median particle diameter – decrease
- Bed stability: logarithm of relative bed stability – decrease

Trends in physical habitat quality over time at each monitoring station were evaluated using the nonparametric Kendall's tau and parametric Pearson's r tests for correlation between these indicators and time. Statistical significance of the correlation coefficients was evaluated based on an α level of 0.1 for a one-tailed test and the following null and alternative hypotheses related to hydrologic impacts:

- Ho: physical habitat quality remains unchanged or have deteriorated over time
- Ha: physical habitat quality has improved over time

Sediment Quality Monitoring

Trends in sediment quality over time at each monitoring station were evaluated using the nonparametric Kendall's tau and parametric Pearson's r tests for correlation between the indicators identified in Table 2 for sediment quality and time. The statistical significance of the correlation coefficients was evaluated based on an α level of 0.05 for a one-tailed test and the following null and alternative hypotheses related to sediment quality impacts:

- Ho: concentrations remain unchanged or have increased over time
- Ha: concentrations have decreased over time

Biological Monitoring

Trends in stream health over time at each monitoring station were evaluated using the nonparametric Kendall's tau and parametric Pearson's r tests for correlation between the indicators identified in Table 2 for stream health and time. The statistical significance of the correlation coefficients was evaluated based on an α level of 0.1 for a one-tailed test and the following null and alternative hypotheses related to stream health:

- Ho: conditions remain unchanged or have declined over time
- Ha: conditions have improved over time

Results

This section describes the results from analyses that were performed to detect potential improving trends in receiving water conditions related to the implementation of rehabilitation efforts. This information is organized under separate sections for each watershed type (Application, Reference, and Control). The results are then presented for each watershed under subsections for the following monitoring categories: hydrologic, water quality, physical habitat, sediment quality, and biological monitoring. The following tables and appendices are provided to summarize these results:

- Results from the Kendall's tau and Pearson's r correlation analyses for hydrologic indicators versus time are summarized in Table 4 and Table 5, respectively.[1] The computed hydrologic indicators that were used in these tests are summarized in Appendix A for each combination of station and year.
- Results from the seasonal Kendall tau correlation analysis for rainfall runoff response versus time are summarized in Table 6.
- Results from the Kendall's tau correlation analysis for water quality indicators versus time are summarized in Table 7 and Table 8 for the storm event and base flow samples, respectively. Results from the Pearson's r correlation analysis for these indicators versus time are summarized in Table 9 and Table 10 for the storm event and base flow samples, respectively.
- Results from the Kendall's tau and Pearson's r correlation analyses for mass loading estimates versus time are summarized in Table 11. The computed mass loading estimates that were used in these tests are summarized in Appendix B for each combination of station and year.
- Results from the seasonal Kendall tau correlation analysis for continuous temperature and conductivity versus time are summarized in Table 12.
- Results from the Kendall's tau and Pearson's r correlation analyses for physical habitat quality indicators versus time are summarized in Table 13 and Table 14, respectively.
- Results from the Kendall's tau correlation analysis for the sediment quality indicators versus time are summarized in Table 15, Table 16, and Table 17 for the following groupings of pollutants, respectively:
    - Total organic carbon, copper, and zinc
    - Polycyclic aromatic hydrocarbons
    - Phthalates

[1] The tables called out in this Results section are located in the Tables 4 Through 22 subsection at the end of this section.

- Results from the Pearson's r correlation analysis for the sediment quality indicators versus time are summarized in Table 18, Table 19, and Table 20 for these same groupings of pollutants, respectively.
- Results from the Kendall's tau and Pearson's r correlation analyses for hydrologic indicators versus time are summarized in Table 21 and Table 22, respectively.

Application Watersheds

Trend analysis results are presented herein for the Application Watersheds (Evans Creek, Monticello Creek, and Tosh Creek) that are the focus of ongoing rehabilitation efforts.

Evans Creek Tributary 108

Note that data are only available for this watershed from the beginning of WY2016 through the end of WY2022.

Hydrologic Monitoring

A significant improving trend was detected for "Low Pulse Range" based on the Pearson's r test (Table 4) at the EVAMS station. No significant improving trends were detected for any of the hydrologic indicators at the EVALSS station based on the Kendall's tau and Pearson's r tests (Table 4 and Table 5, respectively).

There was a significant decreasing trend in the rainfall runoff response at the EVALSS and EVAMS stations for both flow volume and maximum flow rate (Table 6).

Water Quality Monitoring

A significant increasing trend for dissolved organic carbon during storm events was detected at the EVALSS and EVAMS stations based on the Kendall's tau and Pearson's r tests (Table 7 and Table 9, respectively). No other significant trends were detected at the EVAMS and EVALSS stations during storm events and base flow based on either test (Table 7 through Table 10).

No significant decreasing trends in water year mass loads were detected for any of the indicators at the EVALSS and EVAMS stations based on the Kendall's tau or Pearson's r tests (Table 11).

No significant decreasing trends in temperature or conductivity were detected at the EVALSS and EVAMS stations (Table 12).

Physical Habitat Monitoring

Significant increasing trends in particle diameter and bed stability were detected at the EVALSS station based on both the Kendall's tau and Pearson's r tests (Table 13 and Table 14, respectively). A significant increasing trend in wood volume was also detected at the EVALSS station based on the Pearson's r test.

A significant increasing trend in bed stability was detected at the EVAMS station based on both the Kendall's tau and Pearson's r tests; and a significant increasing trend in pool area was also detected at this station based on the Pearson's r test.

Sediment Quality Monitoring

The following significant trends were detected in the indicators for sediment quality at the stations for Evans Creek based on the Kendall's tau test (Table 15, Table 16, and Table 17) and Pearson's r test (Table 18, Table 19, and Table 20):

- Decrease in 1-methylnaphthalene at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Decrease in 2-methylnaphthalene at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Decrease in acenaphthylene at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Decrease in anthracene at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Decrease in dibenzo(a,h)anthracene at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Decrease in fluorene at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Decrease in naphthalene at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Decrease in butyl benzyl phthalate at the EVAMS station based on the Kendall's tau test.
- Decrease in di-n-octyl phthalate at the EVAMS station based on the Kendall's tau test.
- Decrease in dibutyl phthalate at the EVAMS station based on the Kendall's tau test.
- Decrease in diethyl phthalate at the EVAMS station based on the Kendall's tau test.

Biological Monitoring

The following significant improving trends were detected in the indicators for stream health at the stations for Evans Creek based on the Kendall's tau and Pearson's r tests (Table 21 and Table 22, respectively):

- Increase in Intolerant Richness score at the EVALSS station based on the Kendall's tau and Pearson's r tests.
- Increase in Plecoptera Richness score at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Increase in Percent Dominant score at the EVAMS station based on the Kendall's tau and Pearson's r tests.
- Increase in Predator Percent score at the EVAMS station based on the Pearson's r test.

Monticello Creek

Hydrologic Monitoring

A significant improving trend was detected for "Low Pulse Count" and "Low Pulse Duration" at the MONMS station based on the Kendall's tau and Pearson's r tests (Table 4 and Table 5, respectively). No significant improving trends were detected for any of the hydrologic indicators at the MONMN station based on the Kendall's tau and Pearson's r tests (Table 4 and Table 5, respectively).

There was a significant decreasing trend in the rainfall runoff response for flow volume at all the MONM, MONMN, and MONMS stations (Table 6). There was also a significant decreasing trend in the rainfall runoff response for maximum flow rate at MONM station.

Water Quality Monitoring

The following significant trends were detected during storm events at the stations for Monticello Creek based on the Kendall's tau and Pearson's r tests (Table 7 and Table 9, respectively):

- Increase in hardness during storm events at the MONMN station based on the Kendall's tau and Pearson's r tests.
- Decrease in fecal coliform bacteria during storm events at the MONMN station based on the Pearson's r test.
- Decrease in fecal coliform bacteria during storm events at the MONMS station based on the Kendall's tau test.
- Decrease in turbidity during storm events at the MONMS station based on the Kendall's tau and Pearson's r test.
- Decrease in total suspended solids during storm events at the MONMS station based on the Pearson's r test.
- Decrease in fecal coliform bacteria during storm events at the MONM station based on the Kendall's tau and Pearson's r tests.

A significant decreasing trend in hardness during base flow was also detected at the MONMN station based on the Kendall's tau and Pearson's r tests (Table 8 and Table 10, respectively).

No significant decreasing trends in water year mass loads were detected for any of the indicators at the stations for Monticello Creek based on the Kendall's tau or Pearson's r tests (Table 11).

A significant decreasing trend in maximum temperature was detected at the MONMN and MONMS stations based on the Seasonal Kendall's tau test (Table 12). No other significant decreasing trends in temperature or conductivity were detected at the Monticello Creek stations.

Physical Habitat Monitoring

The following significant trends were detected for the habitat quality indicators at the stations for Monticello Creek based on the Kendall's tau and Pearson's r tests (Table 13 and Table 14, respectively):

- Increase in bed stability at the MONT-1 station based on both the Kendall's tau and Pearson's r tests
- Increase in bed stability at the MONT-3 station based on both the Kendall's tau and Pearson's r tests.
- Increase in wood volume at the MONT-4 station based on both the Kendall's tau and Pearson's r tests.

Sediment Quality Monitoring

The following significant trends were detected in the indicators for sediment quality at the stations for Monticello Creek based on the Kendall's tau test (Table 15, Table 16, and Table 17) and Pearson's r test (Table 18, Table 19, and Table 20):

- Decrease in dibutyl phthalate at the MONT-4 station based on the Kendall's tau and Pearson's r tests.
- Decrease in diethyl phthalate at the MONT-4 station based on the Kendall's tau and Pearson's r tests.

Biological Monitoring

The following significant improving trends were detected in the indicators for stream health at the stations for Monticello Creek based on the Kendall's tau and Pearson's r tests (Table 21 and Table 22, respectively):

- Increase in Percent Dominant score at the MONT-1 station based on the Pearson's r test.
- Increase in Percent Dominant score at the MONT-2 station based on the Kendall's tau and Pearson's r tests.
- Increase in Predator Percent score at the MONT-3 station based on the Kendall's tau and Pearson's r tests.

Tosh Creek

Hydrologic Monitoring

A significant improving trend was detected for "Richards-Baker Flashiness Index" at the TOSMO station based on the Kendall's tau test (Table 4). No significant improving trends were detected for any of the hydrologic indicators at the TOSMI station based on the Kendall's tau and Pearson's r tests (Table 4 and Table 5, respectively).

There was a significant decreasing trend in the rainfall runoff response at the TOSMO and TOSMI stations for both flow volume and maximum flow rate (Table 6).

Water Quality Monitoring

The following significant trends were detected during storm events at the stations for Tosh Creek based on the Kendall's tau and Pearson's r tests (Table 7 and Table 9, respectively):

- Decrease in dissolved copper at the TOSMO station based on the Kendall's tau and Pearson's r tests.
- Decrease in fecal coliform bacteria at the TOSMO station based on the Kendall's tau test.
- Decrease in total copper at the TOSMO station based on the Kendall's tau and Pearson's r tests.
- Decrease in dissolved copper at the TOSMI station base on the Kendall's tau and Pearson's r tests.
- Decrease in fecal coliform bacteria at the TOSMI station based on the Kendall's tau and Pearson's r tests.
- Decrease in total copper at the TOSMI station based on the Kendall's tau and Pearson's r tests.
- Decrease in total nitrogen at the TOSMI station based on the Kendall's tau test.
- Decrease in total suspended solids at the TOSMI station based on the Kendall's tau and Pearson's r tests.

A significant increasing trend in hardness was also detected during base flow at the TOSMO station based on Kendall's tau and Pearson's r tests (tables 8 and 10, respectively).

A significant decreasing trend in water year mass load was detected for total suspended solids at the TOSMI station based on the Pearson's r test (Table 11). No other significant decreasing trends in water year mass loads were detected for any of the indicators at the stations for Tosh Creek based on the Kendall's tau or Pearson's r tests.

No significant decreasing trends in temperature or conductivity were detected at the TOSMO and TOSMI stations (Table 12). Similarly, no significant decreasing trends in conductivity were detected at the TOSMO station.

Physical Habitat Monitoring

The following significant trends were detected for the habitat quality indicators at the stations for Tosh Creek based on the Kendall's tau and Pearson's r tests (Table 13 and Table 14, respectively):

- Increase in densiometer measurement at the TOSH-1 station based on the Pearson's r test.
- Increase in bed stability at the TOSH-3 station based on both the Kendall's tau and Pearson's r tests.
- Increase in wood volume and residual pool area at the TOSH-4 station based on the Pearson's r test.

Sediment Quality Monitoring

The following significant trends were detected in the indicators for sediment quality at the stations for Tosh Creek based on the Kendall's tau test (Table 15, Table 16, and Table 17) and Pearson's r test (Table 18, Table 19, and Table 20):

- Decrease in dibutyl phthalate at the TOSH-2 station based on the Kendall's tau test.
- Decrease in diethyl phthalate at the TOSH-2 station based on the Kendall's tau test.
- Decrease in anthracene at the TOSH-3 station based on the Kendall's tau and Pearson's r tests.

Biological Monitoring

A significant increasing trend in the Percent Dominant score was detected at the TOSH-2 station based on the Kendall's tau and Pearson's r tests (Table 21 and Table 22, respectively). No other significant improving trends were detected in the indicators for stream health at the stations for Tosh Creek based on these tests.

Reference Watersheds

Trend analysis results are presented herein for the Reference Watersheds (Colin Creek and Seidel Creek).

Colin Creek

Hydrologic Monitoring

No significant improving trends were detected for any of the hydrologic indicators at the COLM station based on the Kendall's tau and Pearson's r tests (Table 4 and Table 5, respectively).

There was a significant decreasing trend in the rainfall runoff response at the COLM station for flow volume but not maximum flow rate (Table 6).

Water Quality Monitoring

The following significant trends were detected during storm events at the station for Colin Creek based on the Kendall's tau and Pearson's r tests (Table 7 and Table 9, respectively):

- Increase in dissolved oxygen at the COLM station based on the Kendall's tau and Pearson's r tests.
- Decrease in fecal coliform bacteria at the COLM station based on the Kendall's tau test.
- Increase in hardness of at the COLM station based on the Kendall's tau and Pearson's r tests.

The following significant trends were detected during base flow at the station for Colin Creek based on the Kendall's tau and Pearson's r tests (Table 8 and Table 10, respectively):

- Decrease in fecal coliform bacteria at the COLM station based on the Pearson's r test.
- Increase in hardness at the COLM station based on the Kendall's tau test.

No significant decreasing trends in water year mass loads were detected for any of the indicators at the COLM station based on the Kendall's tau or Pearson's r tests (Table 11).

No significant decreasing trend in temperature was detected at the COLM station (Table 12).

Physical Habitat Monitoring

A significant increasing trend in residual pool area was detected at the COLIN-1 station based on both the Kendall's tau and Pearson's r tests. (Table 13 and Table 14, respectively).

Sediment Quality Monitoring

No significant decreasing trends were detected in the indicators for sediment quality at the COLIN-1 station based on the Kendall's tau test (Table 15, Table 16, and Table 17) and Pearson's r test (Table 18, Table 19, and Table 20).

Biological Monitoring

No significant improving trends were detected in the indicators for stream health at the COLIN-1 station based on the Kendall's tau and Pearson's r tests (Table 21 and Table 22, respectively).

Seidel Creek

Hydrologic Monitoring

No significant improving trends were detected for any of the hydrologic indicators at the SEIMN and SEIMS stations based on the Kendall's tau and Pearson's r tests (Table 4 and Table 5, respectively).

There was a significant decreasing trend in the rainfall runoff response at the SEIMN station for flow volume but not maximum flow rate (Table 6). There was also a significant decreasing trend in the rainfall runoff response at the SEIMS station for both flow volume and maximum flow rate.

Water Quality Monitoring

The following significant trends were detected during storm events at the stations for Seidel Creek based on the Kendall's tau and Pearson's r tests (Table 7 and Table 9, respectively):

- Decrease in fecal coliform bacteria at the SEIMN station based on the Kendall's tau test.
- Increase in dissolved organic carbon at the SEIMS station based on the Kendall's tau test.
- Decrease of fecal coliform bacteria at the SEIMS station based on the Pearson's r test.

No significant trends were detected during base flow at the stations for Seidel creek based on the Kendall's tau and Pearson's r tests (Table 8 and Table 10, respectively).

No significant decreasing trends in water year mass loads were detected for any of the indicators at the stations for Seidel Creek based on the Kendall's tau or Pearson's r tests (Table 11).

No significant decreasing trends in temperature and conductivity were detected at the SEIMN and SEIMS stations (Table 12).

Physical Habitat Monitoring

The following significant trends were detected for the habitat quality indicators at the stations for Seidel Creek based on the Kendall's tau and Pearson's r tests (Table 13 and Table 14, respectively):

- Increase in densiometer measurement at the SIDL-1 station based on both the Kendall's tau and Pearson's r tests.
- Increase in bed stability at the SIDL-2 station based on the Pearson's r test.

Sediment Quality Monitoring

The following significant trends were detected in the indicators for sediment quality at the stations for Siedel Creek based on the Kendall's tau test (Table 15, Table 16, and Table 17) and Pearson's r test (Table 18, Table 19, and Table 20):

- Decrease in dibutyl phthalate at the SIDL-1 station based on the Kendall's tau test.
- Decrease in diethyl phthalate at the SIDL-1 station based on the Kendall's tau and Pearson's r tests.
- Decrease in diethyl phthalate at the SIDL-2 station based on the Kendall's tau test.

Biological Monitoring

The following significant improving trends were detected in the indicators for stream health at the stations for Seidel Creek based on the Kendall's tau and Pearson's r tests (Table 21 and Table 22, respectively):

- Increase in Predator Percent score at the SIDL-2 station based on the Kendall's tau test.
- Increase in Predator Percent score at the SIDL-3 station based on the Kendall's tau and Pearson's r tests.

Control Watersheds

Trend analysis results are presented herein for the Control Watersheds (Country Creek and Tyler's Creek).

Country Creek

Hydrologic Monitoring

A significant improving trend was detected for "Low Pulse Range" at the COUMO station based on the Kendall's tau and Pearson's r tests (Table 4 and Table 5, respectively). A significant improving trend was also detected for "High Pulse Range" at the COUMI station based on both tests; and a significant improving trend for "Storm Volume" was detected at this same station based on only the Pearson's r test.

There was a significant decreasing trend in the rainfall runoff response at the COUMO station for flow volume but not maximum flow rate (Table 6). There was also a significant decreasing trend in the rainfall runoff response at the COUMI station for both flow volume and maximum flow rate.

Water Quality Monitoring

The following significant trends were detected during storm events at the stations for Country Creek based on the Kendall's tau and Pearson's r tests (Table 7 and Table 9, respectively):

- Decrease in fecal coliform bacteria at the COUMO station based on the Kendall's tau and Pearson's r tests.
- Decrease in total copper at the COUMO station based on the Kendall's tau and Pearson's r tests.
- Decrease in fecal coliform bacteria at the COUMI station based on the Kendall's tau and Pearson's r tests.
- Decrease in total copper at the COUMI station based on the Kendall's tau and Pearson's r tests.

The following significant trends were detected during base flow at the stations for Country Creek based on the Kendall's tau and Pearson's r tests (Table 8 and Table 10, respectively):

- Increase in hardness at the COUMO station based on the Kendall's tau and Pearson's r tests.
- Increase in hardness at the COUMI station based on the Kendall's tau test.

No significant decreasing trends in water year mass loads were detected for any of the indicators at the stations for Country Creek based on the Kendall's tau or Pearson's r tests (Table 11).

A significant decreasing trend in average conductivity was detected at the COUMO station based on the Seasonal Kendall's tau test (Table 12). No other significant decreasing trends in temperature or conductivity were detected at the stations for Country Creek.

Physical Habitat Monitoring

No significant increasing trends were detected for any of the habitat quality indicators at the stations for Country Creek based on the Kendall's tau and Pearson's r tests (Table 13 and Table 14, respectively).

Sediment Quality Monitoring

No significant decreasing trends were detected in the indicators for sediment quality at the stations for Country Creek based on the Kendall's tau and Pearson's r tests (Table 15 through Table 20).

Biological Monitoring

A significant increasing trend in the Tolerant Percent score was detected at the CTRY-1 station based on the Kendall's tau and Pearson's r tests (Table 21 and Table 22, respectively). No other significant improving trends were detected in the indicators for stream health at the stations for Country Creek based on these tests.

Tyler's Creek

Hydrologic Monitoring

No significant improving trends were detected for any of the hydrologic indicators at the TYLMO and TYLMI stations based on the Kendall's tau and Pearson's r tests (Table 4 and Table 5, respectively).

There was a significant decreasing trend in the rainfall runoff response at the TYLMO and TYLMI stations for both flow volume and maximum flow rate (Table 6).

Water Quality Monitoring

The following significant trends were detected during storm events at the stations for Tyler's Creek based on the Kendall's tau and Pearson's r tests (Table 7 and Table 9, respectively):

- Increase in dissolved organic carbon at the TYLMO station based on the Kendall's tau and Pearson's r tests.
- Decrease in dissolved copper at the TYLMI station based on the Kendall's tau test.
- Increase in dissolved organic carbon at the TYLMI station based on the Kendall's tau and Pearson's r tests.
- Decrease in fecal coliform bacteria at the TYLMI station based on the Kendall's tau and Pearson's r tests.
- Decrease in hardness at the TYLMI station based on the Kendall's tau and Pearson's r tests.
- Decrease in specific conductivity at the TYLMI station based on the Kendall's tau and Pearson's r tests.
- Decrease in temperature at the TYLMI station based on the Kendall's tau and Pearson's r tests.

No significant trends were detected during base flow at the TYLMO and TYLMI stations based on the Kendall's tau and Pearson's r tests (Table 8 and Table 10, respectively).

No significant decreasing trends in water year mass loads were detected for any of the indicators at the stations for Tyler's Creek based on the Kendall's tau or Pearson's r tests (Table 10).

No significant decreasing trends in temperature were detected at the TYLMO and TYLMI stations (Table 12). Similarly, no decreasing trends in conductivity were detected at the TYLMO station.

Physical Habitat Monitoring

No significant increasing trends were detected for any of the habitat quality indicators at the stations for Tyler's Creek based on the Kendall's tau and Pearson's r tests (Table 13 and Table 14, respectively).

Sediment Quality Monitoring

A significant decreasing trend for total copper was detected at the TYLR-2 station based on Kendall's tau and Pearson's r tests (Table 15 and Table 18, respectively). No other significant decreasing trends were detected in the indicators for sediment quality at the stations for Country Creek base on these tests (Table 15 through Table 20)

Biological Monitoring

A significant increasing trend in the Tolerant Percent score was detected at the TYLR-2 station based on the Kendall's tau and Pearson's r tests (Table 21 and Table 22, respectively). No other significant improving trends were detected in the indicators for stream health at the stations for Tyler's Creek based on these tests.

Tables 4 Through 22

Table 4. Kendall's Tau Correlation Coefficients for Hydrologic Indicators Versus Time (WY2016 through WY2023).

Station	Watershed Type	High Pulse Count (count)		High Pulse Duration (days)		High Pulse Range (days)		Low Pulse Count (count)		Low Pulse Duration (days)		Low Pulse Range (days)		Flow Reversal (count)		Richards-Baker Flashiness Index		TQ Mean (fraction of the year)		Storm Volume (cubic feet)		Base Volume (cubic feet)	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	-0.21	0.28	-0.33	0.86	-0.33	0.23	-0.15	0.34	-0.45	0.89	-0.15	0.66	0.07	0.64	-0.2	0.36	0.00	0.50	-0.33	0.86	-0.47	0.14
EVAMS[a]	A	-0.20	0.36	0.20	0.36	-0.33	0.23	0.41	0.87	-0.07	0.64	0.6	0.07	0.33	0.86	-0.2	0.36	0.07	0.50	-0.33	0.86	-0.2	0.36
MONMN	A	0.11	0.65	-0.50	0.97	0.43	0.95	0.30	0.84	-0.29	0.86	-0.14	0.73	0.22	0.77	0.29	0.86	0.00	0.55	-0.29	0.86	-0.21	0.27
MONMS	A	-0.44	0.07	-0.29	0.86	0.36	0.91	-0.69	**0.01**	0.71	**0.01**	-0.21	0.8	0.08	0.6	0.21	0.8	0.47	0.05	-0.21	0.80	-0.29	0.2
MONM	A	-0.36	0.14	-0.29	0.86	0.29	0.86	-0.11	0.35	0.07	0.45	-0.21	0.8	0.43	0.95	-0.07	0.45	0.07	0.45	-0.21	0.80	-0.29	0.2
TOSMO	A	-0.40	0.09	0.00	0.55	0.36	0.91	-0.34	0.13	0.07	0.45	-0.07	0.64	0.18	0.73	-0.57	**0.03**	0.43	0.09	0.14	0.36	-0.36	0.14
TOSMI	A	-0.18	0.27	-0.43	0.95	0.14	0.73	0.29	0.86	-0.21	0.8	0.14	0.36	0.14	0.73	0.14	0.73	-0.43	0.95	-0.50	0.97	-0.14	0.36
COLM	R	-0.26	0.19	0.14	0.36	0.07	0.64	0.08	0.6	-0.07	0.64	-0.14	0.73	0.11	0.65	-0.21	0.27	0.07	0.45	-0.07	0.64	-0.14	0.36
SEIMN	R	-0.04	0.45	-0.14	0.73	0.07	0.64	0.08	0.6	-0.21	0.8	-0.07	0.64	-0.14	0.36	-0.5	0.05	0.04	0.45	0.21	0.27	-0.36	0.14
SEIMS	R	-0.40	0.09	-0.07	0.64	0.14	0.73	0.04	0.55	0.21	0.27	-0.11	0.65	-0.07	0.45	-0.29	0.20	0.11	0.35	-0.36	0.91	-0.43	0.09
COUMO	C	-0.18	0.27	0.07	0.45	0.64	0.99	-0.43	0.09	0.64	**0.02**	0.43	0.09	0.29	0.86	-0.43	0.09	0.11	0.35	0.00	0.55	-0.36	0.14
COUMI	C	-0.52	**0.04**	-0.07	0.64	0.50	0.97	0.25	0.81	-0.07	0.64	0.14	0.36	0.21	0.8	0.43	0.95	-0.21	0.8	-0.86	1.00	0.21	0.8
TYLMO	C	0.00	0.50	0.00	0.55	-0.21	0.27	0.04	0.55	-0.07	0.64	-0.07	0.64	0.07	0.64	0.71	1.00	-0.47	0.95	-0.29	0.86	0.21	0.8
TYLMI	C	-0.43	0.09	-0.43	0.95	0.36	0.91	-0.04	0.45	0.07	0.45	0.14	0.36	0.18	0.73	-0.36	0.14	0.07	0.45	-0.43	0.95	-0.57	1.00

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant improving trend (α = 0.05).

A = Application

R = Reference

C = Control

Table 5. Pearson's r Correlation Coefficients for Hydrologic Indicators Versus Time (WY2016 through WY2023).

Station	Watershed Type	High Pulse Count (count)		High Pulse Duration (days)		High Pulse Range (days)		Low Pulse Count (count)		Low Pulse Duration (days)		Low Pulse Range (days)		Flow Reversal (count)		Richards-Baker Flashiness Index		TQ Mean (fraction of the year)		Storm Volume (cubic feet)		Base Volume (cubic feet)	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	-0.40	0.22	-0.77	0.96	-0.44	0.19	-0.17	0.37	-0.53	0.86	0.11	0.42	0.01	0.51	-0.24	0.33	-0.2	0.65	-0.42	0.80	-0.57	0.12
EVAMS[a]	A	-0.35	0.25	0.21	0.35	-0.51	0.15	0.64	0.91	-0.31	0.72	0.79	**0.03**	0.62	0.90	-0.08	0.44	0.01	0.49	-0.49	0.84	-0.24	0.33
MONMN	A	0.08	0.57	-0.55	0.92	0.49	0.89	0.5	0.90	-0.59	0.94	-0.04	0.54	0.45	0.87	0.37	0.82	-0.19	0.67	-0.4	0.84	-0.25	0.28
MONMS	A	-0.35	0.20	-0.51	0.90	0.25	0.72	-0.83	**0.01**	0.81	**0.01**	-0.06	0.56	0.32	0.78	0.01	0.51	0.54	0.08	-0.28	0.75	-0.49	0.11
MONM	A	-0.34	0.20	-0.46	0.87	0.30	0.76	-0.07	0.43	-0.01	0.51	-0.24	0.72	0.41	0.84	-0.07	0.43	0.05	0.45	-0.44	0.86	-0.48	0.11
TOSMO	A	-0.52	0.09	0.11	0.40	0.42	0.85	-0.33	0.21	0.15	0.36	-0.28	0.75	0.33	0.78	-0.62	0.05	0.56	0.07	0.35	0.20	-0.55	0.08
TOSMI	A	-0.33	0.21	-0.54	0.92	0.27	0.74	0.4	0.84	-0.35	0.8	0.24	0.28	0.17	0.66	0.19	0.68	-0.39	0.83	-0.63	0.95	-0.26	0.27
COLM	R	-0.11	0.4	0.15	0.36	0.20	0.69	0.23	0.71	-0.18	0.66	-0.29	0.76	-0.23	0.29	-0.43	0.14	-0.12	0.61	-0.04	0.53	-0.15	0.36
SEIMN	R	-0.28	0.25	-0.14	0.63	0.02	0.52	-0.04	0.46	0.04	0.47	-0.17	0.66	-0.1	0.40	-0.53	0.09	-0.03	0.53	0.25	0.28	-0.47	0.12
SEIMS	R	-0.58	0.07	-0.05	0.55	0.29	0.75	-0.1	0.40	0.45	0.13	0.20	0.32	-0.15	0.36	-0.37	0.18	0.12	0.38	-0.59	0.94	-0.6	0.06
COUMO	C	-0.18	0.33	-0.01	0.51	0.75	0.98	-0.52	0.09	0.86	**<0.01**	0.54	0.08	0.17	0.65	-0.36	0.19	0.39	0.17	0.07	0.44	-0.39	0.17
COUMI	C	-0.68	**0.03**	-0.04	0.53	0.67	0.96	0.22	0.70	-0.07	0.57	0.17	0.34	0.32	0.78	0.4	0.83	-0.27	0.74	-0.88	**<0.01**	-0.06	0.44
TYLMO	C	-0.04	0.46	0.05	0.45	-0.27	0.26	0.03	0.52	0.09	0.42	-0.13	0.62	0.14	0.63	0.78	0.99	-0.53	0.91	-0.25	0.73	0.12	0.61
TYLMI	C	-0.46	0.13	-0.55	0.92	0.32	0.78	0.09	0.59	0.12	0.39	0.06	0.45	0.36	0.81	-0.32	0.22	0.10	0.41	-0.61	0.95	-0.69	1.00

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant improving trend (α = 0.05).

A = Application

R = Reference

C = Control

Table 6. Seasonal Kendall's Tau Correlation Coefficients for Rainfall Runoff Response (flow volume and maximum flow rate) Versus Time (WY2016 through WY2023).					
Station	**Watershed Type**	**Flow Volume Versus Precipitation Depth**		**Maximum Flow Rate Versus Precipitation Depth**	
		Coefficient	**p-Value**	**Coefficient**	**p-Value**
EVALSS[a]	A	-0.213	**<0.001**	-0.114	**<0.001**
EVAMS[a]	A	-0.185	**<0.001**	-0.079	**0.002**
MONM	A	-0.085	**<0.001**	-0.061	**0.005**
MONMN	A	-0.049	**0.027**	-0.018	0.405
MONMS	A	-0.087	**<0.001**	-0.043	0.051
TOSMO	A	-0.083	**<0.001**	-0.146	**<0.001**
TOSMI	A	-0.123	**<0.001**	-0.095	**<0.001**
COLM	R	-0.120	**<0.001**	-0.042	0.065
SEIMN	R	-0.098	**<0.001**	0.018	0.417
SEIMS	R	-0.195	**<0.001**	-0.134	**<0.001**
COUMO	C	-0.044	**0.047**	0.026	0.247
COUMI	C	-0.227	**<0.001**	-0.062	**0.005**
TYLMO	C	-0.111	**<0.001**	0.100	**<0.001**
TYLMI	C	-0.179	**<0.001**	-0.141	**<0.001**

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

Table 7. Kendall's Tau Correlation Coefficients for Storm Event Pollutant Concentrations Versus Time (WY2016 through WY2023).

Station	Watershed Type	Dissolved Copper		Dissolved Organic Carbon		Dissolved Oxygen		Dissolved Zinc		Fecal Coliform Bacteria		Hardness, Total as $CaCO_3$		Specific Conductivity		Temperature		Total Copper		Total Nitrogen		Total Phosphorus		Total Suspended Solids		Total Zinc		Turbidity	
		Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value
EVALSS[a]	A	0.19	0.96	0.30	**<0.01**	-0.12	0.90	-0.05	0.33	0.02	0.57	*-0.10*	*0.30*	-0.15	0.05	0.05	0.72	0.18	0.96	0.06	0.76	0.10	0.85	-0.06	0.27	0.08	0.78	0.11	0.89
EVAMS[a]	A	0.12	0.87	*0.33*	***<0.01***	-0.02	0.60	-0.09	0.21	-0.01	0.46	*0.04*	*0.67*	-0.13	0.08	0.01	0.55	0.23	0.99	0.14	0.93	0.27	1.00	0.19	0.98	0.09	0.80	0.24	0.99
MONMN	A	0.14	0.95	0.06	0.47	0.08	0.14	0.29	1.00	-0.11	0.08	*0.18*	***0.02***	*0.17*	*0.98*	-0.05	0.25	0.00	0.48	0.08	0.83	-0.06	0.24	-0.08	0.16	0.12	0.94	-0.06	0.22
MONMS	A	0.04	0.68	0.07	0.36	-0.03	0.66	-0.10	0.13	-0.16	**0.02**	*0.05*	*0.50*	-0.04	0.30	-0.03	0.34	-0.11	0.08	0.01	0.57	0.12	0.94	-0.11	0.08	-0.12	0.07	-0.15	**0.03**
MONM	A	*0.17*	*0.99*	0.10	0.19	0.10	0.10	0.26	1.00	-0.19	**0.01**	*0.06*	*0.40*	*0.04*	*0.68*	-0.07	0.17	0.02	0.62	0.05	0.75	0.04	0.68	-0.02	0.40	0.18	0.99	-0.06	0.23
TOSMO	A	-0.13	**0.04**	0.04	0.65	0.06	0.22	0.14	0.97	-0.22	**<0.01**	*-0.02*	*0.75*	*-0.09*	*0.13*	-0.09	0.12	-0.20	**0.01**	-0.06	0.21	-0.03	0.36	-0.10	0.09	0.04	0.70	-0.02	0.40
TOSMI	A	-0.19	**0.01**	-0.01	0.91	0.08	0.16	0.13	0.96	-0.19	**0.01**	*-0.02*	*0.75*	0.02	0.59	-0.08	0.16	-0.29	**<0.01**	-0.14	**0.04**	-0.07	0.19	-0.17	**0.01**	0.08	0.86	-0.09	0.11
COLM	R	0.04	0.66	-0.05	0.52	*0.18*	***0.01***	0.01	0.53	-0.28	**<0.01**	0.28	**<0.01**	0.44	1.00	-0.08	0.15	0.09	0.84	-0.05	0.28	-0.04	0.33	-0.04	0.31	0.04	0.67	-0.03	0.37
SEIMN	R	0.12	0.90	*0.10*	*0.18*	0.10	0.10	0.11	0.88	-0.17	**0.02**	*0.03*	*0.67*	*0.18*	*0.99*	-0.09	0.11	0.13	0.95	0.03	0.63	0.09	0.88	0.12	0.94	0.08	0.83	0.05	0.73
SEIMS	R	0.02	0.58	0.16	**0.04**	0.05	0.26	-0.09	0.16	-0.06	0.22	0.03	0.71	-0.05	0.25	-0.02	0.40	0.11	0.91	0.14	0.97	0.12	0.93	0.10	0.90	0.13	0.94	0.13	0.95
COUMO	C	-0.08	0.17	*0.12*	0.13	0.03	0.36	0.22	1.00	-0.17	**0.02**	*-0.05*	*0.50*	*-0.07*	*0.17*	-0.05	0.26	-0.14	**0.03**	0.01	0.53	0.01	0.56	-0.08	0.14	0.10	0.89	0.01	0.54
COUMI	C	-0.01	0.43	*0.04*	0.61	0.07	0.18	0.20	0.99	-0.16	**0.02**	*0.06*	*0.47*	*0.03*	*0.66*	-0.07	0.19	-0.15	**0.03**	-0.03	0.37	-0.05	0.27	-0.11	0.08	0.08	0.86	-0.04	0.30
TYLMO	C	0.05	0.75	*0.19*	**0.01**	0.04	0.30	0.13	0.96	0.01	0.57	*0.07*	*0.33*	*0.00*	*0.48*	-0.03	0.35	-0.02	0.37	0.12	0.95	-0.03	0.34	-0.01	0.44	0.03	0.64	0.05	0.73
TYLMI	C	-0.19	**0.01**	*0.35*	**<0.01**	0.11	0.09	0.08	0.85	-0.21	**<0.01**	*-0.21*	***0.01***	*-0.23*	***<0.01***	-0.15	**0.03**	-0.10	0.09	0.02	0.61	0.03	0.66	-0.12	0.06	0.15	0.97	-0.06	0.22

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05) for all parameters except Dissolved Organic Carbon, Dissolved Oxygen, and Hardness based on a one-tailed test.

Values in **bold** indicate a significant increasing trend (α = 0.05) for Dissolved Oxygen based on a one-tailed test.

Values in **bold** indicate a significant decreasing or increasing trend (α = 0.05) for Dissolved Organic Carbon and Hardness based on a two-tailed test.

Italicized values indicate coefficients were calculated using the residuals from regression models for predicting concentration as function of stream flow rate (see description in the Data Analysis Procedures section).

A = Application

R = Reference

C = Control

NC = not calculable due to high number of nondetect values.

Table 8. Kendall's Tau Correlation Coefficients for Base Flow Pollutant Concentrations Versus Time (WY2016 through WY2023).																													
		Dissolved Copper		Dissolved Organic Carbon		Dissolved Oxygen		Dissolved Zinc		Fecal Coliform Bacteria		Hardness, Total as CaCO3		Specific Conductivity		Temperature		Total Copper		Total Nitrogen		Total Phosphorus		Total Suspended Solids		Total Zinc		Turbidity	
Station	Watershed Type	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value
EVALSS[a]	A	NC	NC	0.00	0.99	0.04	0.37	NC	1.00	-0.05	0.32	0.07	0.52	0.15	0.91	0.01	0.54	0.19	0.92	0.22	0.97	0.29	0.99	-0.01	0.48	0.19	0.92	0.28	0.99
EVAMS[a]	A	-0.03	0.40	0.01	0.96	-0.03	0.62	-0.08	0.28	-0.04	0.36	0.16	0.14	0.20	0.97	0.06	0.71	0.29	0.99	0.09	0.79	0.22	0.98	0.06	0.72	0.25	0.97	0.29	1.00
MONMN	A	0.11	0.81	0.13	0.25	0.02	0.44	0.37	1.00	-0.02	0.44	0.32	**<0.01**	0.36	1.00	0.04	0.64	0.29	0.99	0.08	0.76	0.14	0.90	0.11	0.84	0.30	0.99	0.11	0.85
MONMS	A	0.27	0.97	-0.03	0.78	-0.07	0.72	-0.18	0.10	-0.14	0.11	-0.01	0.92	0.09	0.78	0.01	0.55	0.19	0.94	-0.18	0.08	0.22	0.97	0.31	1.00	0.13	0.84	0.13	0.87
MONM	A	0.20	0.93	0.06	0.62	0.05	0.34	-0.09	0.21	-0.10	0.21	0.18	0.13	0.12	0.86	0.07	0.72	0.29	0.99	-0.06	0.33	0.05	0.67	0.15	0.90	0.15	0.90	0.09	0.79
TOSMO	A	0.17	0.90	0.06	0.59	0.07	0.27	0.21	0.97	-0.09	0.23	0.33	**0.01**	0.19	0.96	0.00	0.49	0.12	0.84	0.13	0.84	0.01	0.53	0.28	0.99	0.24	0.98	0.28	0.99
TOSMI	A	0.04	0.64	0.02	0.86	0.12	0.15	0.20	0.96	-0.14	0.11	0.10	0.43	0.05	0.68	-0.01	0.46	0.30	1.00	0.16	0.90	0.09	0.80	0.26	0.99	0.41	1.00	0.31	1.00
COLM	R	-0.04	0.39	0.06	0.63	-0.07	0.73	0.23	0.95	-0.11	0.17	0.41	**<0.01**	0.49	1.00	0.14	0.89	-0.03	0.40	0.02	0.55	0.10	0.80	0.05	0.67	0.07	0.70	0.02	0.57
SEIMN	R	0.19	0.92	0.11	0.32	0.05	0.33	NC	NC	-0.11	0.17	0.04	0.72	0.02	0.59	0.03	0.60	0.40	1.00	0.00	0.50	0.12	0.86	0.11	0.85	0.10	0.77	0.24	0.98
SEIMS	R	NC	NC	0.11	0.35	0.06	0.31	NC	NC	0.08	0.76	0.11	0.35	-0.01	0.46	0.00	0.49	0.37	1.00	0.21	0.95	0.04	0.62	0.12	0.85	0.31	0.99	0.38	1.00
COUMO	C	-0.10	0.22	0.11	0.32	0.09	0.21	0.10	0.83	-0.04	0.35	0.23	**0.04**	0.04	0.66	0.03	0.62	0.16	0.90	-0.05	0.34	0.12	0.88	0.02	0.56	0.26	0.99	0.06	0.71
COUMI	C	-0.05	0.36	0.14	0.21	0.06	0.30	0.04	0.63	-0.04	0.36	0.26	**0.03**	0.05	0.67	0.05	0.69	0.19	0.94	0.02	0.56	0.12	0.86	0.09	0.80	0.22	0.97	0.08	0.76
TYLMO	C	0.34	1.00	0.06	0.64	0.13	0.14	0.01	0.53	-0.10	0.20	0.16	0.18	0.01	0.55	-0.05	0.34	0.19	0.94	0.12	0.83	0.08	0.74	0.02	0.56	0.15	0.90	0.05	0.67
TYLMI	C	0.03	0.60	-0.03	0.77	0.02	0.43	0.10	0.81	0.04	0.65	0.11	0.31	0.02	0.57	0.04	0.66	0.18	0.95	0.10	0.82	0.33	1.00	0.15	0.92	0.31	1.00	0.13	0.88

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05) for all parameters except Dissolved Organic Carbon, Dissolved Oxygen, and Hardness based on a one-tailed test.

Values in **bold** indicate a significant increasing trend (α = 0.05) for Dissolved Oxygen based on a one-tailed test.

Values in **bold** indicate a significant decreasing or increasing trend (α = 0.05) for Dissolved Organic Carbon and Hardness based on a two-tailed test.

A = Application

R = Reference

C = Control

NC = not calculable due to high number of nondetect values.

Table 9. Pearson's r Correlation Coefficients for Storm Event Pollutant Concentrations Versus Time (WY2016 through WY2023).

Station	Watershed Type	Dissolved Copper		Dissolved Organic Carbon		Dissolved Oxygen		Dissolved Zinc		Fecal Coliform Bacteria		Hardness, Total as $CaCO_3$		Specific Conductivity		Temperature		Total Copper		Total Nitrogen		Total Phosphorus		Total Suspended Solids		Total Zinc		Turbidity	
		Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value
EVALSS[a]	A	0.20	0.93	0.41	**<0.01**	-0.15	0.86	-0.07	0.30	-0.14	0.16	*-0.10*	*0.47*	-0.14	0.15	0.08	0.72	0.09	0.74	-0.08	0.29	-0.03	0.41	-0.10	0.22	0.01	0.54	0.09	0.74
EVAMS[a]	A	-0.01	0.48	*0.52*	***<0.01***	-0.01	0.53	-0.09	0.27	-0.21	0.07	*0.07*	*0.61*	-0.15	0.14	0.02	0.57	0.25	0.97	0.05	0.64	0.28	0.98	0.21	0.93	0.10	0.76	0.30	0.99
MONMN	A	0.03	0.59	0.10	0.38	0.16	0.08	0.25	0.99	-0.22	**0.03**	*0.28*	***0.01***	*0.18*	*0.94*	-0.10	0.20	0.01	0.52	0.11	0.81	0.02	0.57	0.03	0.60	0.09	0.77	0.04	0.62
MONMS	A	-0.04	0.38	0.05	0.65	-0.05	0.67	-0.09	0.20	-0.15	0.09	*0.02*	*0.89*	-0.02	0.43	-0.05	0.33	-0.18	0.05	-0.06	0.29	0.16	0.93	-0.23	**0.02**	-0.14	0.10	-0.25	**0.01**
MONM	A	*0.24*	*0.99*	0.16	0.16	0.16	0.08	0.36	1.00	-0.23	**0.02**	*0.14*	*0.22*	*0.08*	*0.76*	-0.12	0.15	0.11	0.83	0.03	0.60	0.11	0.84	0.07	0.74	0.21	0.97	0.05	0.66
TOSMO	A	-0.22	**0.03**	0.08	0.50	0.11	0.16	0.16	0.92	-0.16	0.08	*-0.02*	*0.89*	*-0.12*	*0.15*	-0.14	0.11	-0.22	**0.03**	-0.16	0.08	-0.07	0.27	-0.14	0.11	0.09	0.78	-0.02	0.42
TOSMI	A	-0.21	**0.03**	0.09	0.42	0.11	0.17	0.17	0.93	-0.23	**0.02**	*0.01*	*0.95*	0.09	0.78	-0.15	0.10	-0.34	**<0.01**	-0.18	0.06	-0.12	0.15	-0.22	**0.03**	0.14	0.88	-0.10	0.19
COLM	R	-0.07	0.27	-0.09	0.45	*0.31*	***<0.01***	0.01	0.53	-0.13	0.14	0.42	**<0.01**	0.66	1.00	-0.16	0.08	0.13	0.87	0.03	0.60	0.05	0.68	0.13	0.86	0.08	0.75	0.10	0.81
SEIMN	R	0.13	0.87	*0.13*	*0.24*	0.11	0.17	0.11	0.83	-0.04	0.37	*0.00*	*0.98*	*0.30*	*1.00*	-0.12	0.16	0.18	0.94	-0.05	0.34	0.19	0.95	0.21	0.97	0.15	0.91	0.12	0.86
SEIMS	R	-0.09	0.22	0.21	0.07	0.07	0.27	-0.12	0.14	-0.21	**0.03**	-0.10	0.36	-0.05	0.34	-0.02	0.43	0.16	0.92	0.18	0.94	0.16	0.92	0.25	0.99	0.14	0.89	0.18	0.95
COUMO	C	-0.10	0.21	0.14	0.22	0.16	0.08	0.21	0.96	-0.30	**0.01**	*-0.04*	*0.77*	*-0.15*	*0.10*	-0.10	0.19	-0.24	**0.02**	-0.15	0.10	-0.08	0.26	-0.11	0.17	0.21	0.97	-0.02	0.43
COUMI	C	-0.09	0.22	0.04	0.70	0.15	0.09	0.26	0.99	-0.25	**0.02**	*0.02*	*0.86*	*-0.07*	*0.29*	-0.12	0.15	-0.19	**0.05**	-0.16	0.09	-0.14	0.12	-0.15	0.10	0.14	0.89	-0.12	0.15
TYLMO	C	0.09	0.79	0.26	**0.02**	0.09	0.22	-0.05	0.33	-0.17	0.06	*0.12*	*0.27*	*0.01*	*0.55*	-0.06	0.31	0.04	0.63	0.15	0.91	0.07	0.73	0.15	0.91	-0.04	0.37	0.08	0.76
TYLMI	C	-0.11	0.17	0.46	**<0.01**	0.19	0.05	-0.02	0.43	-0.20	**0.04**	*-0.24*	***0.04***	*-0.29*	***0.01***	-0.21	**0.04**	0.01	0.53	-0.06	0.31	0.09	0.78	-0.05	0.33	0.16	0.92	0.04	0.62

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05) for all parameters except Dissolved Organic Carbon, Dissolved Oxygen, and Hardness based on a one-tailed test.

Values in **bold** indicate a significant increasing trend (α = 0.05) for Dissolved Oxygen based on a one-tailed test.

Values in **bold** indicate a significant decreasing or increasing trend (α = 0.05) for Dissolved Organic Carbon and Hardness based on a two-tailed test.

Italicized values indicate coefficients were calculated using the residuals from regression models for predicting concentration as function of stream flow rate (see description in the Data Analysis Procedures section).

A = Application

R = Reference

C = Control

NC = not calculable due to high number of nondetect values.

Table 10. Pearson's r Correlation Coefficients for Base Flow Pollutant Concentrations Versus Time (WY2016 through WY2023).

Station	Watershed Type	Dissolved Copper		Dissolved Organic Carbon		Dissolved Oxygen		Dissolved Zinc		Fecal Coliform bacteria		Hardness, Total as CaCO3		Specific Conductivity		Temperature		Total Copper		Total Nitrogen		Total Phosphorus		Total Suspended Solids		Total Zinc		Turbidity	
		Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value	Co-efficient	p-Value
EVALSS[a]	A	NC	NC	-0.06	0.74	0.06	0.36	NC	1.00	0.02	0.56	0.12	0.48	0.20	0.89	-0.03	0.44	0.26	0.94	0.24	0.92	0.39	0.99	0.16	0.83	0.26	0.94	0.33	0.98
EVAMS[a]	A	-0.05	0.38	-0.02	0.90	0.03	0.44	-0.09	0.29	0.27	0.95	0.23	0.16	0.23	0.93	0.04	0.59	0.32	0.98	0.01	0.52	0.33	0.98	0.14	0.80	0.28	0.96	0.37	0.99
MONMN	A	0.13	0.80	0.20	0.20	0.08	0.32	0.28	0.96	0.23	0.93	0.39	**0.01**	0.43	1.00	0.03	0.56	0.33	0.98	0.04	0.60	0.20	0.89	0.17	0.86	0.33	0.98	0.21	0.90
MONMS	A	0.32	0.97	-0.01	0.94	-0.11	0.74	-0.25	0.07	-0.23	0.09	-0.06	0.75	0.14	0.78	0.01	0.52	0.30	0.96	-0.27	0.08	0.26	0.94	0.45	1.00	0.26	0.94	0.23	0.91
MONM	A	0.24	0.92	0.09	0.62	0.21	0.10	-0.13	0.23	-0.15	0.20	0.24	0.16	0.09	0.70	0.06	0.64	0.25	0.93	-0.01	0.47	0.12	0.76	0.35	0.98	0.33	0.98	0.23	0.92
TOSMO	A	0.20	0.89	0.08	0.62	0.16	0.17	0.16	0.83	-0.06	0.35	0.41	**0.01**	0.22	0.91	-0.03	0.43	0.17	0.85	0.21	0.87	0.04	0.60	0.36	0.99	0.23	0.92	0.33	0.98
TOSMI	A	0.03	0.57	0.05	0.77	0.20	0.11	0.13	0.79	-0.22	0.09	0.05	0.78	0.00	0.51	-0.05	0.39	0.42	1.00	0.27	0.93	0.27	0.95	0.31	0.97	0.46	1.00	0.28	0.96
COLM	R	-0.03	0.43	0.07	0.68	0.00	0.50	0.30	0.97	-0.28	**0.04**	0.19	0.24	0.65	1.00	0.14	0.81	0.09	0.70	-0.16	0.18	0.11	0.75	0.19	0.88	0.11	0.74	0.15	0.82
SEIMN	R	0.25	0.94	0.17	0.28	0.10	0.27	NC	NC	-0.19	0.12	0.02	0.91	NC	NC	0.01	0.53	0.30	0.97	-0.14	0.21	0.16	0.84	0.32	0.98	0.11	0.75	0.40	1.00
SEIMS	R	NC	NC	0.12	0.51	0.05	0.39	NC	NC	0.29	0.96	0.13	0.44	0.15	0.81	0.02	0.55	0.31	0.97	0.12	0.74	0.19	0.86	0.36	0.98	0.39	0.99	0.45	1.00
COUMO	C	-0.16	0.16	0.09	0.57	0.16	0.16	-0.03	0.44	0.12	0.77	0.36	**0.02**	0.03	0.58	0.03	0.59	-0.02	0.44	-0.21	0.11	0.09	0.71	0.23	0.93	0.03	0.57	0.15	0.84
COUMI	C	-0.08	0.33	0.19	0.26	0.15	0.18	0.03	0.58	0.24	0.93	0.16	0.32	-0.14	0.20	-0.01	0.48	0.34	0.98	-0.20	0.13	0.12	0.76	-0.05	0.37	0.36	0.99	-0.03	0.42
TYLMO	C	0.44	1.00	0.13	0.46	0.20	0.13	0.16	0.82	-0.17	0.17	0.17	0.33	-0.11	0.26	-0.10	0.29	0.26	0.94	0.19	0.85	0.19	0.86	0.28	0.95	0.27	0.94	0.24	0.92
TYLMI	C	0.05	0.63	0.06	0.69	0.09	0.28	0.09	0.71	0.12	0.77	0.08	0.60	-0.09	0.28	0.02	0.54	0.17	0.86	0.12	0.76	0.37	0.99	0.25	0.95	0.11	0.76	0.23	0.93

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend ($\alpha = 0.05$) for all parameters except Dissolved Organic Carbon, Dissolved Oxygen, and Hardness based on a one-tailed test.

Values in **bold** indicate a significant increasing trend ($\alpha = 0.05$) for Dissolved Oxygen based on a one-tailed test.

Values in **bold** indicate a significant decreasing or increasing trend ($\alpha = 0.05$) for Dissolved Organic Carbon and Hardness based on a two-tailed test.

A = Application

R = Reference

C = Control

NC = not calculable due to high number of nondetect values.

Table 11. Kendall's Tau Correlation Coefficients for Mass Load Estimates Versus Time (WY2016 through WY2023).						
Station	**Parameter**	**Number of Water Years**	**Kendall's Tau Coefficient**	**Kendall's Tau p-Value**	**Pearson's r Coefficient**	**Pearson's r p-Value**
EVALSS	Total Copper	5	1.00	1.00	0.90	0.98
EVALSS	Total Nitrogen	5	0.00	0.59	0.10	0.56
EVALSS	Total Phosphorus	5	0.80	0.99	0.94	0.99
EVALSS	Total Suspended Solids	5	0.60	0.96	0.88	0.98
EVAMS	Total Copper	5	0.20	0.76	0.56	0.84
EVAMS	Total Nitrogen	5	-0.20	0.41	-0.10	0.43
EVAMS	Total Phosphorus	5	0.00	0.59	0.09	0.55
EVAMS	Total Suspended Solids	4	-0.33	0.38	-0.66	0.17
MONM	Total Copper	7	0.14	0.72	0.20	0.67
MONM	Total Nitrogen	7	0.05	0.61	0.01	0.51
MONM	Total Phosphorus	7	0.24	0.81	0.37	0.79
MONM	Total Suspended Solids	7	0.05	0.61	0.24	0.70
MONMN	Total Copper	7	0.05	0.61	0.16	0.63
MONMN	Total Nitrogen	7	0.24	0.81	0.36	0.78
MONMN	Total Phosphorus	6	0.87	1.00	0.74	0.95
MONMN	Total Suspended Solids	6	0.60	0.97	0.66	0.92
MONMS	Total Copper	7	-0.05	0.50	-0.41	0.18
MONMS	Total Nitrogen	7	-0.24	0.28	-0.32	0.24
MONMS	Total Phosphorus	7	0.43	0.93	0.71	0.96
MONMS	Total Suspended Solids	7	-0.24	0.28	-0.32	0.24
TOSMO	Total Copper	7	0.05	0.61	-0.37	0.21
TOSMO	Total Nitrogen	7	0.14	0.72	-0.21	0.33
TOSMO	Total Phosphorus	7	0.33	0.88	-0.13	0.40
TOSMO	Total Suspended Solids	6	-0.20	0.36	-0.48	0.17
TOSMI	Total Copper	7	-0.52	0.07	-0.60	0.08
TOSMI	Total Nitrogen	7	-0.33	0.19	-0.44	0.16
TOSMI	Total Phosphorus	7	0.05	0.61	-0.36	0.22
TOSMI	Total Suspended Solids	7	-0.52	0.07	-0.68	**0.05**
COLM	Total Copper	8	0.36	0.91	0.40	0.84
COLM	Total Nitrogen	7	-0.33	0.19	-0.20	0.33
COLM	Total Phosphorus	7	0.14	0.72	0.26	0.71
COLM	Total Suspended Solids	6	0.60	0.97	0.69	0.93
SEIMN	Total Copper	8	0.50	0.97	0.53	0.91
SEIMN	Total Nitrogen	7	0.24	0.81	0.36	0.78
SEIMN	Total Phosphorus	7	0.91	1.00	0.91	1.00

Table 11 (continued). Kendall's Tau Correlation Coefficients for Mass Load Estimates Versus Time (WY2016 through WY2023).						
Station	**Parameter**	**Number of Water Years**	**Kendall's Tau Coefficient**	**Kendall's Tau p-Value**	**Pearson's r Coefficient**	**Pearson's r p-Value**
SEIMN	Total Suspended Solids	7	0.71	1.00	0.91	1.00
SEIMS	Total Copper	8	0.14	0.73	0.18	0.67
SEIMS	Total Nitrogen	8	-0.14	0.36	-0.18	0.34
SEIMS	Total Phosphorus	8	0.14	0.73	0.00	0.50
SEIMS	Total Suspended Solids	7	0.14	0.72	0.36	0.79
COUMO	Total Copper	7	-0.24	0.28	-0.61	0.07
COUMO	Total Nitrogen	7	0.24	0.81	0.03	0.53
COUMO	Total Phosphorus	7	0.05	0.61	0.12	0.60
COUMO	Total Suspended Solids	7	-0.33	0.19	-0.57	0.09
COUMI	Total Copper	7	-0.33	0.19	-0.59	0.08
COUMI	Total Nitrogen	7	-0.33	0.19	-0.58	0.09
COUMI	Total Phosphorus	7	-0.33	0.19	-0.56	0.10
COUMI	Total Suspended Solids	6	-0.07	0.50	-0.58	0.12
TYLMO	Total Copper	7	0.33	0.88	0.17	0.64
TYLMO	Total Nitrogen	7	0.52	0.97	0.53	0.89
TYLMO	Total Phosphorus	7	0.24	0.81	0.32	0.76
TYLMO	Total Suspended Solids	7	0.33	0.88	0.34	0.77
TYLMI	Total Copper	7	-0.24	0.28	-0.51	0.12
TYLMI	Total Nitrogen	7	-0.43	0.12	-0.74	**0.03**
TYLMI	Total Phosphorus	7	-0.05	0.50	-0.05	0.46
TYLMI	Total Suspended Solids	6	-0.33	0.24	-0.29	0.29

Values in **bold** indicate significant decreasing trend ($\alpha = 0.05$).

Table 12. Seasonal Kendall's Tau Correlation Coefficients for Average/Maximum Monthly Temperature and Conductivity Versus Time (WY2016 through WY2023).

Station	Watershed Type	Average Monthly Temperature		Maximum Monthly Temperature		Average Monthly Conductivity		Maximum Monthly Conductivity	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	-0.02	0.40	-0.07	0.21	0.28	1.00	0.08	0.82
EVAMS[a]	A	-0.02	0.40	-0.02	0.42	0.10	0.88	0.11	0.90
MONM	A	-0.04	0.30	-0.08	0.13	0.23	1.00	0.07	0.80
MONMN	A	-0.02	0.37	-0.16	**0.01**	NA	NA	NA	NA
MONMS	A	-0.10	0.09	-0.16	**0.01**	0.04	0.68	-0.07	0.23
TOSMO	A	-0.05	0.25	-0.05	0.24	0.13	0.94	0.00	0.50
TOSMI	A	-0.06	0.20	-0.07	0.16	NA	NA	NA	NA
COLM	R	0.00	0.50	0.08	0.85	NA	NA	NA	NA
SEIMN	R	-0.01	0.47	0.02	0.60	0.05	0.71	0.07	0.80
SEIMS	R	-0.03	0.36	-0.06	0.21	-0.03	0.42	0.07	0.74
COUMO	C	-0.07	0.16	-0.02	0.42	-0.15	**0.05**	0.34	1.00
COUMI	C	-0.04	0.29	-0.04	0.30	NA	NA	NA	NA
TYLMO	C	-0.05	0.25	0.01	0.56	0.10	0.80	0.21	0.97
TYLMI	C	-0.12	**0.05**	-0.10	0.08	NA	NA	NA	NA

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

A = Application

R = Reference

C = Control

NA = not applicable

Table 13. Kendall's Tau Correlation Coefficients for Habitat Quality Indicators Versus Time (WY2016 through WY2023).											
		Stream Center Densiometer Measurement		Wood Volume Normalized to a 100 Meter Reach Length		Residual Pool Area		Median Particle Diameter		Logarithm of Relative Bed Stability	
Station	Watershed Type	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	0.20	0.36	0.33	0.23	0.20	0.36	0.73	**0.03**	0.73	**0.03**
EVAMS[a]	A	-0.47	0.93	0.47	0.14	0.47	0.14	-0.47	0.93	0.60	**0.07**
MONT-1	A	-0.33	0.88	-0.71	0.99	-0.43	0.93	-0.14	0.72	0.62	**0.03**
MONT-2	A	0.05	0.50	-0.62	0.98	0.33	0.19	-0.24	0.81	0.33	0.19
MONT-3	A	0.20	0.27	-0.24	0.81	0.24	0.28	0.14	0.39	0.62	**0.03**
MONT-4	A	-0.47	0.93	0.60	**0.07**	-0.20	0.77	-0.07	0.64	0.07	0.50
MONT-5	A	0.33	0.23	-0.47	0.93	0.07	0.50	-0.47	0.93	-0.33	0.86
TOSH-1	A	0.39	0.11	-0.43	0.93	-0.14	0.72	-0.14	0.72	-0.05	0.61
TOSH-2	A	0.33	0.19	-0.24	0.81	-0.43	0.93	-0.14	0.72	0.33	0.19
TOSH-3	A	0.33	0.19	0.05	0.50	-0.43	0.93	-0.05	0.61	0.81	**0.01**
TOSH-4	A	-0.14	0.72	0.24	0.28	0.43	0.12	-0.33	0.88	0.43	0.12
COLIN-1	R	-0.20	0.77	-0.20	0.77	0.80	**0.04**	-0.60	0.97	-0.80	0.99
SIDL-1	R	0.62	**0.03**	-0.24	0.81	-0.05	0.61	0.14	0.39	0.43	0.12
SIDL-2	R	0.24	0.28	0.05	0.50	-0.05	0.61	-0.71	0.99	0.33	0.19
SIDL-3	R	-0.05	0.61	0.33	0.19	-0.14	0.72	-0.43	0.93	0.05	0.50
CTRY-1	C	0.14	0.39	0.14	0.39	-0.62	0.98	0.24	0.28	0.33	0.19
CTRY-2	C	0.24	0.28	0.14	0.39	0.05	0.50	0.14	0.39	0.14	0.39

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant increasing trend (α = 0.1).

A = Application

R = Reference

C = Control

Table 14. Pearson's r Correlation Coefficients for Habitat Quality Indicators Versus Time (WY2016 through WY2023).

Station	Watershed Type	Stream Center Densiometer Measurement		Wood Volume Normalized to a 100-Meter Reach Length		Residual Pool Area		Median Particle Diameter		Logarithm of Relative Bed Stability	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	0.10	0.43	0.63	**0.09**	0.59	0.11	0.67	**0.07**	0.86	**0.01**
EVAMS[a]	A	-0.61	0.90	0.67	**0.07**	0.73	**0.05**	-0.46	0.82	0.89	**0.01**
MONT-1	A	-0.13	0.61	-0.74	0.97	-0.86	0.99	0.05	0.46	0.58	**0.08**
MONT-2	A	0.27	0.28	-0.81	0.99	0.41	0.18	-0.29	0.74	0.55	0.10
MONT-3	A	0.21	0.32	-0.28	0.73	0.50	0.13	-0.17	0.64	0.83	**0.01**
MONT-4	A	-0.52	0.85	0.79	**0.03**	-0.70	0.94	0.07	0.45	0.25	0.32
MONT-5	A	0.39	0.22	-0.46	0.82	0.37	0.24	-0.64	0.92	-0.72	0.95
TOSH-1	A	0.62	**0.07**	-0.52	0.88	-0.18	0.65	-0.25	0.70	0.14	0.39
TOSH-2	A	0.45	0.16	-0.53	0.89	-0.73	0.97	-0.51	0.88	0.31	0.25
TOSH-3	A	0.27	0.28	-0.11	0.60	-0.54	0.90	0.16	0.37	0.82	**0.01**
TOSH-4	A	-0.28	0.73	0.66	**0.05**	0.62	**0.07**	-0.30	0.74	0.41	0.18
COLIN-1	R	-0.28	0.70	-0.38	0.77	0.85	**0.03**	-0.81	0.97	-0.98	1.00
SIDL-1	R	0.80	**0.02**	-0.37	0.79	0.50	0.13	0.18	0.35	0.53	0.11
SIDL-2	R	0.17	0.36	0.23	0.31	-0.01	0.51	-0.75	0.97	0.72	**0.03**
SIDL-3	R	-0.14	0.62	0.30	0.26	-0.14	0.62	-0.65	0.94	-0.18	0.65
CTRY-1	C	0.17	0.36	0.52	0.12	-0.69	0.96	0.20	0.33	0.28	0.27
CTRY-2	C	0.35	0.22	0.53	0.11	0.15	0.37	0.19	0.34	0.26	0.29
TYLR-1	C	0.16	0.37	-0.37	0.79	0.26	0.29	-0.46	0.85	-0.32	0.76

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant increasing trend (α = 0.1).

A = Application

R = Reference

C = Control

Table 15. Kendall's Tau Correlation Coefficients for Sediment Quality Indicators (total organic carbon, copper, and zinc) Versus Time (WY2016 through WY2019).

Station	Watershed Type	Total Organic Carbon		Total Copper		Total Zinc	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	0.07	0.64	-0.07	0.50	0.07	0.64
EVAMS[a]	A	0.07	0.64	-0.21	0.28	0.55	0.94
MONT-1	A	-0.33	0.19	0.20	0.73	0.24	0.81
MONT-2	A	-0.29	0.18	-0.14	0.39	0.39	0.89
MONT-3	A	0.14	0.72	-0.05	0.50	0.62	0.98
MONT-4	A	-0.37	0.10	-0.05	0.50	-0.49	0.06
MONT-5	A	-0.33	0.23	-0.20	0.36	0.20	0.77
TOSH-1	A	0.33	0.88	-0.43	0.12	0.52	0.97
TOSH-2	A	-0.10	0.38	0.05	0.61	0.52	0.97
TOSH-3	A	0.05	0.61	-0.29	0.18	0.43	0.93
TOSH-4	A	0.33	0.86	0.43	0.93	0.52	0.97
COLIN-1	R	-0.60	0.12	-0.60	0.12	0.00	0.59
SIDL-1	R	0.05	0.61	0.05	0.61	0.14	0.72
SIDL-2	R	0.10	0.62	-0.05	0.50	-0.24	0.28
SIDL-3	R	0.05	0.56	-0.25	0.22	0.10	0.62
CTRY-1	C	0.05	0.61	0.14	0.72	0.52	0.97
CTRY-2	C	0.39	0.89	0.20	0.73	-0.05	0.50
TYLR-1	C	-0.05	0.50	0.33	0.88	0.62	0.98
TYLR-2	C	0.05	0.61	-0.62	**0.03**	0.43	0.93

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

A = Application

R = Reference

C = Control

Table 16. Kendall's Tau Correlation Coefficients for Sediment Quality Indicators (polycyclic aromatic hydrocarbons) Versus Time (WY2016 through WY2019).

Station	Watershed Type	1-Methylnaphthalene		2-Methylnaphthalene		Acenaphthene		Acenaphthylene		Anthracene		Benz[a]anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(ghi)perylene	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.33	0.86
EVAMS[a]	A	-0.73	**0.03**	-0.73	**0.03**	-0.47	0.14	-0.73	**0.03**	-0.73	**0.03**	-0.20	0.36	-0.07	0.50	-0.07	0.50	-0.47	0.14
MONT-1	A	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50
MONT-2	A	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61
MONT-3	A	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	-0.24	0.28	0.05	0.61	-0.14	0.39
MONT-4	A	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45
MONT-5	A	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50
TOSH-1	A	-0.14	0.39	-0.14	0.39	-0.14	0.39	-0.14	0.39	-0.24	0.28	0.10	0.62	0.10	0.62	0.05	0.61	-0.33	0.19
TOSH-2	A	-0.14	0.39	-0.14	0.39	-0.14	0.39	-0.14	0.39	-0.33	0.19	0.05	0.61	0.05	0.61	0.05	0.61	0.10	0.62
TOSH-3	A	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.71	**0.02**	-0.05	0.50	0.05	0.61	-0.05	0.50	0.00	0.50
TOSH-4	A	0.41	0.87	0.41	0.87	0.41	0.87	0.41	0.87	0.41	0.87	0.41	0.87	0.41	0.87	0.60	0.97	0.60	0.97
COLIN-1	R	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12
SIDL-1	R	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.14	0.39	-0.14	0.39	-0.24	0.28	-0.05	0.50	-0.05	0.50	-0.24	0.28
SIDL-2	R	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28
SIDL-3	R	0.29	0.82	0.29	0.82	0.29	0.82	0.39	0.89	0.39	0.89	0.24	0.81	0.14	0.72	0.24	0.81	0.39	0.89
CTRY-1	C	-0.20	0.27	-0.20	0.27	0.29	0.82	-0.10	0.38	0.10	0.62	0.00	0.50	0.05	0.61	-0.20	0.27	0.05	0.61
CTRY-2	C	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81
TYLR-1	C	0.39	0.89	0.39	0.89	0.39	0.89	0.39	0.89	0.39	0.89	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81
TYLR-2	C	0.52	0.97	0.52	0.97	0.52	0.97	0.52	0.97	0.52	0.97	-0.14	0.39	-0.20	0.27	-0.24	0.28	-0.05	0.50
EVALSS[a]	A	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77	0.20	0.77
EVAMS[a]	A	-0.60	0.07	-0.33	0.23	-0.73	**0.03**	-0.33	0.23	-0.73	**0.03**	-0.33	0.23	-0.73	**0.03**	-0.20	0.36	-0.20	0.36
MONT-1	A	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50	-0.05	0.50
MONT-2	A	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61
MONT-3	A	0.05	0.61	0.33	0.88	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	0.05	0.61	-0.05	0.50
MONT-4	A	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45	-0.04	0.45
MONT-5	A	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.07	0.50
TOSH-1	A	0.14	0.72	0.14	0.72	-0.14	0.39	0.10	0.62	-0.14	0.39	0.14	0.72	-0.14	0.39	0.05	0.61	0.05	0.61
TOSH-2	A	0.05	0.61	0.05	0.61	-0.43	0.12	-0.05	0.50	-0.14	0.39	0.05	0.61	-0.14	0.39	0.14	0.72	0.14	0.72
TOSH-3	A	0.14	0.72	-0.10	0.38	-0.43	0.12	-0.24	0.28	-0.24	0.28	0.05	0.61	-0.24	0.28	-0.24	0.28	-0.14	0.39
TOSH-4	A	0.41	0.87	0.33	0.86	0.41	0.87	0.33	0.86	0.41	0.87	0.41	0.87	0.41	0.87	0.41	0.87	0.33	0.86
COLIN-1	R	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12	-0.60	0.12
SIDL-1	R	-0.43	0.12	-0.24	0.28	-0.05	0.50	-0.24	0.28	-0.05	0.50	0.00	0.50	-0.05	0.50	-0.33	0.19	-0.14	0.39
SIDL-2	R	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28	-0.24	0.28
SIDL-3	R	0.39	0.89	0.24	0.81	0.29	0.82	0.24	0.81	0.29	0.82	0.39	0.89	0.29	0.82	0.24	0.81	-0.05	0.50

Station	Watershed Type	1-Methylnaphthalene		2-Methylnaphthalene		Acenaphthene		Acenaphthylene		Anthracene		Benz[a]anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(ghi)perylene	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
CTRY-1	C	-0.05	0.50	-0.10	0.38	0.20	0.73	0.05	0.61	0.00	0.50	0.24	0.81	0.39	0.89	0.10	0.62	-0.05	0.50
CTRY-2	C	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.24	0.81	0.33	0.88
TYLR-1	C	0.33	0.88	0.24	0.81	0.39	0.89	0.24	0.81	0.39	0.89	0.24	0.81	0.39	0.89	0.14	0.72	0.24	0.81
TYLR-2	C	0.52	0.97	0.14	0.72	0.52	0.97	-0.14	0.39	0.52	0.97	0.14	0.72	0.52	0.97	0.00	0.50	-0.10	0.38

Table 16 (continued). Kendall's Tau Correlation Coefficients for Sediment Quality Indicators (polycyclic aromatic hydrocarbons) Versus Time (WY2016 through WY2019).

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

A = Application

R = Reference

C = Control

Table 17. Kendall s Tau Correlation Coefficients for Sediment Quality Indicators (phthalates) Versus Time (WY2016 through WY2019).

Station	Watershed Type	Butyl Benzyl Phthalate		Di-n-octyl Phthalate		Di(2-ethylhexyl) Phthalate		Dibutyl Phthalate		Diethyl Phthalate		Dimethyl Phthalate	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	-0.07	0.50	-0.07	0.50	-0.07	0.50	-0.47	0.14	-0.47	0.14	-0.07	0.50
EVAMS[a]	A	-0.69	**0.03**	-0.69	**0.03**	-0.60	0.07	-0.73	**0.03**	-0.73	**0.03**	-0.60	0.07
MONT-1	A	-0.05	0.50	-0.05	0.50	-0.24	0.28	-0.43	0.12	-0.43	0.12	0.14	0.72
MONT-2	A	-0.14	0.39	-0.14	0.39	0.14	0.72	-0.33	0.19	-0.43	0.12	0.14	0.72
MONT-3	A	-0.24	0.28	-0.24	0.28	-0.10	0.38	-0.24	0.28	-0.24	0.28	-0.14	0.39
MONT-4	A	-0.30	0.16	-0.30	0.16	-0.22	0.23	-0.55	**0.03**	-0.52	**0.04**	-0.07	0.40
MONT-5	A	0.00	0.50	0.00	0.50	0.00	0.50	-0.28	0.22	-0.21	0.28	-0.07	0.50
TOSH-1	A	0.00	0.50	0.00	0.50	-0.39	0.11	-0.45	0.08	-0.45	0.08	0.05	0.61
TOSH-2	A	-0.33	0.19	-0.33	0.19	-0.24	0.28	-0.59	**0.03**	-0.59	**0.03**	0.14	0.72
TOSH-3	A	-0.24	0.28	-0.05	0.50	-0.43	0.12	-0.20	0.27	-0.33	0.19	-0.05	0.50
TOSH-4	A	0.20	0.77	0.20	0.77	0.20	0.77	-0.20	0.36	-0.07	0.50	0.33	0.86
COLIN-1	R	0.32	0.78	0.32	0.78	-0.53	0.10	-0.53	0.10	-0.53	0.10	-0.60	0.12
SIDL-1	R	-0.45	0.08	-0.45	0.08	0.05	0.56	-0.62	**0.03**	-0.68	**0.02**	0.05	0.56
SIDL-2	R	-0.43	0.12	-0.43	0.12	-0.24	0.28	-0.43	0.12	-0.78	**0.01**	-0.20	0.27
SIDL-3	R	-0.14	0.39	-0.14	0.39	-0.05	0.50	-0.43	0.12	-0.43	0.12	0.43	0.93
CTRY-1	C	0.00	0.50	0.20	0.73	-0.49	0.06	0.10	0.62	-0.20	0.27	0.10	0.62
CTRY-2	C	0.14	0.72	0.14	0.72	0.33	0.88	-0.14	0.39	-0.14	0.39	0.43	0.93
TYLR-1	C	0.00	0.50	0.00	0.50	-0.33	0.19	-0.25	0.22	-0.25	0.22	0.20	0.73
TYLR-2	C	-0.14	0.39	-0.14	0.39	-0.33	0.19	-0.52	0.07	-0.52	0.07	0.14	0.72

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

A = Application

R = Reference

C = Control

Table 18. Pearson's r Correlation Coefficients for Sediment Quality Indicators (total organic carbon, copper, and zinc) Versus Time (WY2016 through WY2019).

Station	Watershed Type	Total Organic Carbon		Total Copper		Total Zinc	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	-0.03	0.48	-0.13	0.40	0.22	0.66
EVAMS[a]	A	-0.14	0.39	-0.28	0.29	0.69	0.94
MONT-1	A	-0.51	0.12	0.36	0.79	0.62	0.93
MONT-2	A	-0.52	0.12	-0.40	0.19	0.61	0.93
MONT-3	A	0.37	0.79	-0.13	0.39	0.83	0.99
MONT-4	A	-0.48	0.12	-0.08	0.44	-0.49	0.13
MONT-5	A	-0.41	0.21	-0.41	0.21	-0.01	0.49
TOSH-1	A	0.64	0.94	-0.44	0.16	0.76	0.98
TOSH-2	A	-0.05	0.46	0.08	0.57	0.71	0.96
TOSH-3	A	-0.06	0.45	-0.32	0.24	0.50	0.88
TOSH-4	A	0.59	0.89	0.49	0.87	0.79	0.98
COLIN-1	R	-0.71	0.09	-0.46	0.22	0.39	0.74
SIDL-1	R	0.04	0.53	-0.08	0.44	0.21	0.67
SIDL-2	R	0.07	0.56	-0.32	0.24	-0.38	0.20
SIDL-3	R	-0.23	0.31	-0.35	0.22	0.63	0.94
CTRY-1	C	-0.19	0.34	0.26	0.71	0.51	0.88
CTRY-2	C	0.63	0.94	0.16	0.64	0.39	0.80
TYLR-1	C	-0.16	0.37	0.45	0.84	0.69	0.96
TYLR-2	C	0.28	0.73	-0.82	**0.01**	0.58	0.91

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

A = Application

R = Reference

C = Control

Table 19. Pearson's r Correlation Coefficients for Sediment Quality Indicators (polycyclic aromatic hydrocarbons) Versus Time (WY2016 through WY2019).																			
Station	Watershed Type	1-Methylnaphthalene		2-Methylnaphthalene		Acenaphthene		Acenaphthylene		Anthracene		Benz[a]anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(ghi)perylene	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	0.03	0.52	0.03	0.52	0.03	0.52	0.03	0.52	0.03	0.52	0.23	0.67	0.34	0.74	0.29	0.71	0.50	0.84
EVAMS[a]	A	-0.76	**0.04**	-0.76	**0.04**	-0.49	0.16	-0.76	**0.04**	-0.76	**0.04**	-0.18	0.37	-0.23	0.33	-0.17	0.37	-0.29	0.29
MONT-1	A	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.52	0.12	-0.46	0.15	-0.12	0.40
MONT-2	A	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33
MONT-3	A	0.06	0.55	0.06	0.55	0.06	0.55	0.06	0.55	0.06	0.55	0.06	0.55	-0.12	0.40	-0.09	0.43	-0.04	0.47
MONT-4	A	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.08	0.58
MONT-5	A	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49
TOSH-1	A	-0.18	0.35	-0.18	0.35	-0.18	0.35	-0.18	0.35	-0.08	0.43	0.19	0.66	0.29	0.73	0.28	0.73	-0.28	0.27
TOSH-2	A	-0.36	0.22	-0.36	0.22	-0.36	0.22	-0.36	0.22	-0.38	0.20	-0.08	0.44	-0.02	0.48	0.02	0.52	0.03	0.53
TOSH-3	A	-0.40	0.19	-0.40	0.19	-0.40	0.19	-0.40	0.19	-0.79	**0.02**	-0.11	0.40	-0.04	0.46	-0.12	0.40	-0.12	0.40
TOSH-4	A	0.59	0.89	0.59	0.89	0.59	0.89	0.59	0.89	0.59	0.89	0.59	0.89	0.59	0.89	0.66	0.92	0.83	0.98
COLIN-1	R	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27
SIDL-1	R	-0.01	0.49	-0.01	0.49	-0.01	0.49	-0.04	0.47	-0.12	0.40	-0.45	0.15	-0.21	0.32	-0.22	0.32	-0.28	0.27
SIDL-2	R	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37
SIDL-3	R	0.36	0.79	0.36	0.79	0.36	0.79	0.44	0.84	0.33	0.76	0.17	0.64	0.09	0.58	0.17	0.64	0.30	0.75
CTRY-1	C	-0.27	0.28	-0.27	0.28	0.07	0.56	-0.12	0.40	-0.07	0.44	-0.04	0.46	-0.01	0.49	-0.19	0.34	-0.02	0.48
CTRY-2	C	-0.08	0.43	0.03	0.53	-0.14	0.38	-0.14	0.38	-0.08	0.43	-0.03	0.48	-0.05	0.46	-0.03	0.47	-0.06	0.45
TYLR-1	C	0.66	0.95	0.66	0.95	0.66	0.95	0.66	0.95	0.66	0.95	0.14	0.62	0.08	0.57	0.06	0.55	0.09	0.57
TYLR-2	C	0.73	0.97	0.73	0.97	0.73	0.97	0.73	0.97	0.73	0.97	-0.02	0.48	-0.23	0.31	-0.32	0.24	-0.03	0.48
EVALSS[a]	A	0.31	0.72	0.30	0.72	0.03	0.52	0.30	0.72	0.03	0.52	0.39	0.78	0.03	0.52	0.03	0.52	0.25	0.69
EVAMS[a]	A	-0.66	0.08	-0.20	0.35	-0.76	**0.04**	-0.17	0.38	-0.76	**0.04**	-0.26	0.31	-0.76	**0.04**	0.01	0.51	-0.14	0.40
MONT-1	A	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.12	0.40	-0.44	0.16
MONT-2	A	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.21	0.33	-0.35	0.22
MONT-3	A	0.06	0.55	0.27	0.72	0.06	0.55	0.11	0.59	0.06	0.55	0.06	0.55	0.06	0.55	0.06	0.55	0.00	0.50
MONT-4	A	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52	0.02	0.52
MONT-5	A	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49	-0.02	0.49
TOSH-1	A	0.25	0.70	0.17	0.64	-0.18	0.35	0.30	0.74	-0.18	0.35	0.19	0.66	-0.18	0.35	0.09	0.57	0.20	0.67
TOSH-2	A	0.04	0.53	-0.06	0.45	-0.53	0.11	0.01	0.51	-0.36	0.22	-0.03	0.47	-0.36	0.22	-0.07	0.44	-0.03	0.47
TOSH-3	A	0.24	0.69	-0.08	0.44	-0.61	0.07	-0.20	0.33	-0.40	0.19	-0.08	0.43	-0.40	0.19	-0.18	0.35	-0.13	0.39
TOSH-4	A	0.59	0.89	0.46	0.82	0.59	0.89	0.44	0.81	0.59	0.89	0.50	0.84	0.59	0.89	0.59	0.89	0.40	0.78
COLIN-1	R	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27	-0.37	0.27

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

A = Application

R = Reference

C = Control

Table 19 (continued). Pearson's r Correlation Coefficients for Sediment Quality Indicators (polycyclic aromatic hydrocarbons) Versus Time (WY2016 through WY2019).																			
Station	Watershed Type	1-Methylnaphthalene		2-Methylnaphthalene		Acenaphthene		Acenaphthylene		Anthracene		Benz[a]anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(ghi)perylene	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
SIDL-1	R	-0.26	0.29	-0.48	0.14	-0.01	0.49	-0.29	0.26	-0.01	0.49	-0.06	0.45	-0.01	0.49	-0.47	0.14	-0.26	0.29
SIDL-2	R	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37	-0.16	0.37
SIDL-3	R	0.41	0.82	0.17	0.64	0.36	0.79	0.13	0.61	0.36	0.79	0.29	0.73	0.36	0.79	0.12	0.60	0.07	0.56
CTRY-1	C	-0.03	0.48	-0.13	0.39	0.07	0.56	-0.16	0.36	-0.01	0.49	0.03	0.53	0.71	0.96	0.08	0.57	-0.18	0.35
CTRY-2	C	-0.16	0.36	-0.05	0.45	0.10	0.59	-0.08	0.43	-0.10	0.41	-0.02	0.48	-0.01	0.49	-0.11	0.41	-0.08	0.43
TYLR-1	C	0.26	0.71	0.10	0.58	0.66	0.95	0.03	0.53	0.66	0.95	0.11	0.59	0.66	0.95	0.02	0.52	0.06	0.55
TYLR-2	C	0.73	0.97	0.18	0.65	0.73	0.97	-0.24	0.30	0.73	0.97	0.14	0.62	0.73	0.97	-0.04	0.46	-0.21	0.33

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

A = Application

R = Reference

C = Control

Table 20. Pearson's r Correlation Coefficients for Sediment Quality Indicators (phthalates) Versus Time (WY2016 through WY2019).

Station	Watershed Type	Butyl Benzyl Phthalate		Di-n-octyl Phthalate		Di(2-ethylhexyl) Phthalate		Dibutyl Phthalate		Diethyl Phthalate		Dimethyl Phthalate	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	-0.43	0.20	-0.43	0.20	-0.23	0.33	-0.49	0.16	-0.50	0.15	-0.37	0.24
EVAMS[a]	A	-0.45	0.19	-0.45	0.19	-0.49	0.16	-0.72	0.05	-0.69	0.07	-0.63	0.09
MONT-1	A	-0.09	0.42	-0.09	0.42	-0.53	0.11	-0.46	0.15	-0.63	0.06	0.45	0.85
MONT-2	A	-0.38	0.20	-0.38	0.20	-0.34	0.23	-0.41	0.18	-0.42	0.17	-0.29	0.26
MONT-3	A	-0.42	0.17	-0.42	0.17	-0.22	0.32	-0.45	0.16	-0.45	0.16	-0.26	0.28
MONT-4	A	-0.28	0.25	-0.28	0.25	-0.23	0.29	-0.76	**0.01**	-0.64	**0.04**	0.02	0.52
MONT-5	A	0.17	0.62	0.25	0.68	0.12	0.59	-0.37	0.24	-0.31	0.28	-0.01	0.49
TOSH-1	A	-0.19	0.34	-0.19	0.34	-0.26	0.29	-0.23	0.31	-0.23	0.31	-0.12	0.40
TOSH-2	A	-0.38	0.20	-0.38	0.20	-0.43	0.17	-0.48	0.14	-0.42	0.17	-0.18	0.35
TOSH-3	A	-0.47	0.15	-0.46	0.15	-0.48	0.14	-0.46	0.15	-0.49	0.13	-0.37	0.21
TOSH-4	A	-0.27	0.30	-0.27	0.30	0.00	0.50	-0.39	0.22	-0.33	0.26	0.34	0.74
COLIN-1	R	0.58	0.85	0.58	0.85	-0.68	0.10	-0.66	0.11	-0.66	0.11	-0.38	0.27
SIDL-1	R	-0.45	0.15	-0.45	0.15	0.28	0.73	-0.63	0.07	-0.85	**0.01**	-0.01	0.49
SIDL-2	R	-0.36	0.22	-0.36	0.22	-0.42	0.17	-0.31	0.25	-0.59	0.08	-0.16	0.36
SIDL-3	R	-0.18	0.35	-0.18	0.35	0.04	0.53	-0.51	0.12	-0.51	0.12	0.70	0.96
CTRY-1	C	-0.33	0.23	-0.30	0.26	-0.50	0.13	-0.34	0.23	-0.38	0.20	-0.01	0.49
CTRY-2	C	0.31	0.75	0.31	0.75	0.72	0.97	-0.19	0.34	0.07	0.56	0.61	0.93
TYLR-1	C	-0.32	0.24	-0.32	0.24	-0.48	0.14	-0.44	0.16	-0.44	0.16	0.28	0.73
TYLR-2	C	-0.37	0.21	-0.37	0.21	-0.33	0.23	-0.51	0.12	-0.47	0.14	0.09	0.58

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant decreasing trend (α = 0.05).

A = Application

R = Reference

C = Control

Station	Watershed Type	Overall Score		Taxa Richness Score		Ephemeroptera Richness Score		Plecoptera Richness Score		Trichoptera Richness Score		Clinger Richness Score		Long Lived Richness Score		Intolerant Richness Score		Percent Dominant Score		Predator Percent Score		Tolerant Percent Score	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	0.07	0.50	0.41	0.13	0.07	0.42	-0.43	0.87	0.00	0.50	0.36	0.16	0.00	0.50	0.60	**0.06**	0.14	0.35	0.20	0.36	0.41	0.13
EVAMS[a]	A	0.33	0.23	0.28	0.22	-0.21	0.72	0.77	**0.02**	-0.14	0.65	-0.47	0.93	0.00	0.50	-0.09	0.59	0.60	**0.07**	0.09	0.41	-0.07	0.64
MONT-1	A	-0.29	0.86	0.18	0.27	-0.29	0.83	-0.37	0.89	-0.16	0.70	-0.39	0.90	-0.85	1.00	-0.50	0.94	0.36	0.14	-0.04	0.55	-0.25	0.81
MONT-2	A	-0.14	0.73	-0.04	0.55	-0.15	0.70	-0.12	0.65	-0.26	0.81	-0.18	0.73	-0.23	0.78	-0.47	0.93	0.50	**0.05**	0.14	0.36	-0.55	0.97
MONT-3	A	0.36	0.14	-0.05	0.57	0.00	0.50	0.30	0.17	0.28	0.18	-0.09	0.61	0.20	0.26	NC	NC	0.34	0.13	0.40	**0.09**	0.14	0.36
MONT-4	A	-0.29	0.86	-0.11	0.65	-0.45	0.93	-0.39	0.89	-0.28	0.82	-0.32	0.86	-0.39	0.90	-0.05	0.57	-0.07	0.64	0.25	0.19	-0.29	0.86
MONT-5	A	-0.43	0.93	-0.39	0.89	-0.51	0.93	-0.73	0.98	-0.48	0.92	-0.62	0.98	-0.31	0.82	-0.36	0.84	-0.39	0.89	-0.14	0.72	-0.33	0.88
TOSH-1	A	-0.64	0.99	0.32	0.14	-0.69	0.99	-0.45	0.93	-0.31	0.85	-0.26	0.81	-0.21	0.75	NC	NC	0.18	0.27	-0.07	0.64	-0.29	0.86
TOSH-2	A	0.07	0.45	0.18	0.28	-0.50	0.94	-0.14	0.67	-0.41	0.90	-0.37	0.89	-0.23	0.77	NC	NC	0.50	**0.05**	0.00	0.55	0.25	0.19
TOSH-3	A	-0.50	0.97	-0.05	0.57	-0.07	0.59	-0.60	0.97	-0.54	0.96	-0.48	0.93	-0.42	0.92	NC	NC	-0.29	0.86	-0.19	0.74	-0.19	0.74
TOSH-4	A	0.14	0.36	NC	NC	-0.30	0.83	-0.05	0.56	-0.69	0.99	NC	NC	0.04	0.45	NC	NC	0.08	0.40	0.14	0.36	0.11	0.35
COLIN-1	R	0.07	0.50	0.14	0.35	-0.23	0.73	-0.07	0.58	0.08	0.42	-0.07	0.58	-0.14	0.65	-0.36	0.84	0.33	0.23	-0.20	0.77	-0.41	0.87
SIDL-1	R	-0.64	0.99	-0.15	0.69	-0.20	0.74	-0.59	0.97	-0.59	0.97	-0.62	0.98	-0.44	0.93	-0.34	0.85	-0.29	0.86	-0.71	1.00	0.29	0.20
SIDL-2	R	-0.36	0.91	-0.15	0.69	-0.64	0.98	-0.12	0.65	-0.12	0.65	-0.62	0.98	-0.59	0.97	-0.23	0.77	0.11	0.35	0.58	**0.04**	0.29	0.20
SIDL-3	R	-0.36	0.91	-0.18	0.72	-0.48	0.94	-0.59	0.98	-0.62	0.98	-0.54	0.96	-0.52	0.96	-0.14	0.67	0.04	0.45	0.50	**0.06**	0.33	0.13
CTRY-1	C	0.29	0.20	-0.21	0.74	NC	NC	-0.30	0.83	NC	NC	NC	NC	0.12	0.34	NC	NC	-0.16	0.69	NC	NC	0.50	**0.05**
CTRY-2	C	-0.50	0.97	-0.22	0.77	-0.56	0.96	-0.29	0.83	-0.64	0.98	-0.59	0.97	-0.12	0.66	-0.09	0.61	-0.07	0.64	-0.21	0.80	-0.07	0.64
TYLR-1	C	-0.14	0.73	0.09	0.39	-0.23	0.77	-0.29	0.83	-0.42	0.92	-0.32	0.86	-0.45	0.93	NC	NC	0.29	0.20	0.25	0.19	-0.62	0.98
TYLR-2	C	0.29	0.20	NC	NC	-0.36	0.86	-0.22	0.75	NC	NC	NC	NC	-0.07	0.59	NC	NC	-0.04	0.55	0.37	0.12	0.50	**0.05**

Table 21. Kendall's Tau Correlation Coefficients for Biological Indicators Versus Time (WY2016 through WY2019).

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant increasing trend (α = 0.1).

NC = Not Calculable

A = Application

R = Reference

C = Control

Table 22. Pearson's r Correlation Coefficients for Biological Indicators Versus Time (WY2016 through WY2019).																							
Station	Watershed Type	Overall Score		Taxa Richness Score		Ephemeroptera Richness Score		Plecoptera Richness Score		Trichoptera Richness Score		Clinger Richness Score		Long Lived Richness Score		Intolerant Richness Score		Percent Dominant Score		Predator Percent Score		Tolerant Percent Score	
		Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value	Coefficient	p-Value
EVALSS[a]	A	0.18	0.36	0.60	0.10	0.10	0.42	-0.49	0.84	-0.19	0.64	-0.12	0.59	-0.03	0.52	0.68	**0.07**	0.37	0.24	0.24	0.32	0.24	0.33
EVAMS[a]	A	0.34	0.25	0.40	0.22	-0.17	0.63	0.88	**0.01**	-0.05	0.54	-0.51	0.85	0.00	0.50	-0.05	0.54	0.76	**0.04**	0.63	**0.09**	0.03	0.48
MONT-1	A	-0.38	0.82	0.18	0.34	-0.40	0.84	-0.37	0.82	-0.24	0.72	-0.53	0.91	-0.91	1.00	-0.61	0.95	0.57	**0.07**	0.10	0.41	-0.24	0.72
MONT-2	A	-0.19	0.68	-0.27	0.74	-0.26	0.73	-0.20	0.68	-0.45	0.87	-0.40	0.84	-0.12	0.61	-0.50	0.90	0.69	**0.03**	0.20	0.32	-0.79	0.99
MONT-3	A	0.51	0.10	-0.11	0.60	0.00	0.50	0.35	0.20	0.33	0.22	-0.11	0.60	0.28	0.25	NC	NC	0.38	0.18	0.56	**0.07**	0.15	0.36
MONT-4	A	-0.38	0.82	-0.05	0.55	-0.50	0.89	-0.51	0.90	-0.37	0.81	-0.36	0.81	-0.38	0.82	-0.20	0.69	-0.08	0.57	0.48	0.11	-0.39	0.83
MONT-5	A	-0.64	0.94	-0.36	0.79	-0.57	0.91	-0.71	0.96	-0.73	0.97	-0.77	0.98	-0.40	0.82	-0.39	0.81	-0.40	0.81	-0.23	0.69	-0.60	0.92
TOSH-1	A	-0.68	0.97	0.24	0.29	-0.78	0.99	-0.57	0.93	-0.35	0.80	-0.26	0.73	-0.27	0.74	NC	NC	0.19	0.33	-0.22	0.70	-0.39	0.83
TOSH-2	A	-0.04	0.53	0.17	0.35	-0.59	0.94	-0.24	0.71	-0.49	0.89	-0.44	0.86	-0.22	0.70	NC	NC	0.60	**0.06**	-0.27	0.74	0.21	0.31
TOSH-3	A	-0.55	0.92	-0.19	0.67	-0.08	0.58	-0.67	0.96	-0.52	0.91	-0.37	0.81	-0.59	0.94	NC	NC	-0.40	0.84	-0.26	0.73	-0.19	0.67
TOSH-4	A	-0.19	0.67	NC	NC	-0.32	0.78	-0.12	0.61	-0.74	0.98	NC	NC	0.02	0.48	NC	NC	0.29	0.25	0.06	0.45	0.12	0.39
COLIN-1	R	-0.14	0.60	-0.02	0.52	-0.22	0.66	-0.15	0.61	0.16	0.38	-0.07	0.55	-0.13	0.59	-0.43	0.80	0.35	0.25	-0.09	0.57	-0.45	0.81
SIDL-1	R	-0.79	0.99	-0.23	0.71	-0.25	0.72	-0.78	0.99	-0.75	0.98	-0.72	0.98	-0.70	0.97	-0.39	0.83	-0.37	0.82	-0.89	1.00	0.04	0.46
SIDL-2	R	-0.27	0.74	-0.06	0.56	-0.76	0.99	-0.11	0.60	-0.18	0.67	-0.67	0.97	-0.62	0.95	-0.19	0.67	0.11	0.40	0.46	0.13	0.39	0.17
SIDL-3	R	-0.47	0.88	-0.11	0.60	-0.66	0.96	-0.69	0.97	-0.82	0.99	-0.74	0.98	-0.64	0.96	-0.24	0.72	0.17	0.35	0.58	**0.07**	0.21	0.31
CTRY-1	C	0.48	0.12	-0.25	0.72	NC	NC	-0.35	0.80	NC	NC	NC	NC	0.17	0.34	NC	NC	-0.18	0.67	NC	NC	0.73	**0.02**
CTRY-2	C	-0.65	0.96	-0.35	0.80	-0.62	0.95	-0.41	0.84	-0.70	0.97	-0.69	0.97	-0.35	0.80	-0.11	0.60	-0.18	0.66	-0.02	0.52	0.07	0.44
TYLR-1	C	-0.29	0.75	0.00	0.50	-0.23	0.71	-0.38	0.82	-0.55	0.92	-0.29	0.76	-0.47	0.88	NC	NC	0.43	0.15	0.49	0.11	-0.78	0.99
TYLR-2	C	0.28	0.25	NC	NC	-0.41	0.85	-0.25	0.73	NC	NC	NC	NC	-0.08	0.58	NC	NC	0.08	0.43	0.17	0.35	0.54	**0.08**

[a] Data are only available for this station from WY2016 through WY2022.

Values in **bold** indicate significant increasing trend (α = 0.1).

NC = Not Calculable

A = Application

R = Reference

C = Control

Discussion

As described in the Experimental Design section, the pattern of interest for this trend analysis was evidence that receiving water conditions are improving based on one or more indicators in the Application watersheds while conditions in the Reference and Control watersheds remain relatively static. Similar to observations made in the trend analysis report that was prepared for data collected over WY2016 through WY2019 (Herrera 2020b), there were generally few consistent trends detected in the data for each indicator across all the monitoring categories that could be directly tied to a specific rehabilitation strategy or other watershed scale influence (e.g., increased development). While improving trends were detected for several indicators at stations in the Application watersheds, a roughly equivalent number of improving trends were also documented at stations located in the Reference and Control watersheds.

As documented in the literature review (Herrera 2015b) that was conducted for the RPWS, improvements in receiving water conditions from enhanced watershed management strategies can be difficult to detect and may take many years to manifest. This is particularly true for improvements in biological indicators of stream health. To realize improvements in these indicators, all potential limiting factors must be addressed. Figure 9 (from the WMP [Herrera 2013]) provides an illustration of all the factors upon which the biological health of a stream depends. As described in Herrera (2015b), indicators for hydrologic improvement, the base of the pyramid in Figure 9, are likely to be the most sensitive to watershed alterations and have the shortest response time; indicators for water quality and physical habitat improvement are likely somewhere between the extremes of the biological and hydrologic indicators with regard to their sensitivity and response time.

As described in the Rehabilitation Effort Summary section, rehabilitation efforts have been delayed due to technical issues in the Application watersheds. However, when the City has implemented focused, large scale rehabilitation efforts in a particular Application watershed, improving trends that can be directly tied to these efforts have been detected. For example, the trend analysis report that was prepared for data collected over WY2016 through WY2019 (Herrera 2020b) documented a consistent and significant decrease in TSS and total copper concentrations at the MONMS station in the Monticello Creek watershed that appeared to be related to a progressive increase in street sweeping frequency in the watershed. As described in the Experimental Design section, the City has now implemented the following additional focused, large scale rehabilitation efforts:

- Retrofits of two existing stormwater detention ponds in the Monticello Creek watershed with CMAC systems to improve their performance for managing peak flows during storm events. With the two additional ponds that were retrofitted with CMAC systems by the County, the area managed by all four ponds collectively represents approximately 24 percent of the Monticello Creek watershed.
- Implementation of a street-sweeping project in the Tosh Creek watershed that will increase street sweeping frequency to one time per month over WY2023, and two times per month over WY2024. This will be in addition to the regularly scheduled quarterly street sweeping.

Potential receiving water improving trends from these efforts will be evaluated in the trend analysis report that will be prepared at the end of WY2025.

As shown in Table 6 in the Results section, there was a significant decreasing trend over time in the rainfall runoff response for flow volume at all 14 stations used for hydrologic monitoring. The same analysis showed there was a decreasing trend over time in the rainfall runoff response for maximum flow rate at 9 of the 14 stations. A similar pattern was documented in the trend analysis report that was prepared for data collected over WY2016 through WY2019 (Herrera 2020b). Analyses performed for this previous report and the current report show this trend is likely related to an interannual hydrologic trend of relatively wet water years at the beginning of the study and drier water years as the study progressed. Statistical analyses performed on the precipitation data collected from WY2016 through WY2023 showed there was a significant ($\alpha = 0.05$) decreasing trend in monthly precipitation depths for winter months (November–April) over this period. The progressively drier water years likely resulted in less saturation of the landscape and thus increased evapotranspiration and reduced interflow and overland flow (Nash and Sutcliffe 1970). Hence, less water was observed exiting the watersheds via surface flow in the streams during these drier water years. It is important to identify these overall trends so that the hydrologic impacts from projects can be separated from the natural hydrologic variability that occurs from year to year.

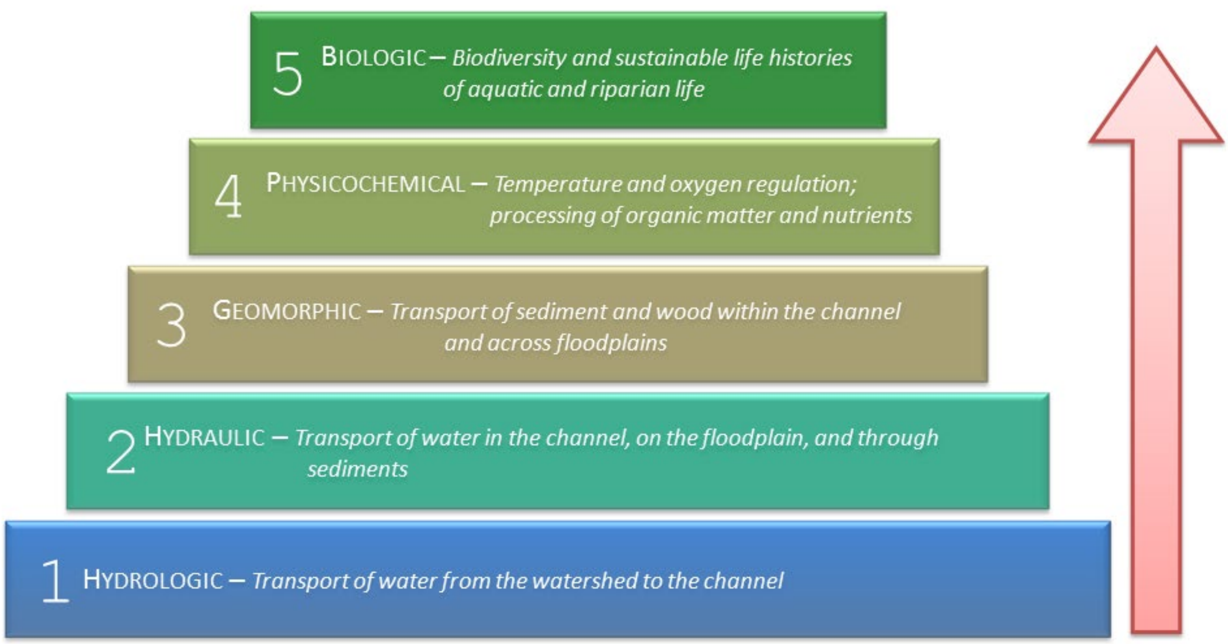

Figure 9. Stream Functions Pyramid.

Conclusions

As described in the *Introduction* to this report, the specific study question to be addressed through the RPWS is as follows:

> *How effective are watershed rehabilitation efforts at improving receiving water conditions at the watershed scale?*

Monitoring for the study initiated in WY2016 and is anticipated to continue for a 10-year timeframe. In years 4, 8, and 10 of the RPWS' implementation, trend analyses reports will be prepared to summarize analyses that were performed to detect potential improving trends in receiving water conditions related to the implementation of rehabilitation efforts. This document represents the trend analysis report that was prepared for year 8 of the RPWS' implementation. Major conclusions from this phase of the RPWS' implementation are as follows:

- Few consistent trends were detected in the data for each indicator due to rehabilitation technical issues in the Application watersheds. While improving trends were detected for several indicators at stations in the Application watersheds, a roughly equivalent number of improving trends were also documented at stations located in the Reference and Control watersheds. However, when the City has implemented focused, large scale rehabilitation efforts in a particular Application watershed, improving trends that can be directly tied to these efforts have been detected. This would include a consistent and significant decrease in TSS and total copper concentrations at the MONMS station in the Monticello Creek watershed that appeared related to a progressive increase in street sweeping frequency in the watershed. The City is currently implementing several other focused, large scale rehabilitation efforts in Application watersheds that will be evaluated in the trend analysis report that will be prepared at the end of WY2025.
- An interannual hydrologic trend was detected in the rainfall runoff response across all the stations located in the Application, Reference, and Control watersheds. This trend was likely caused by relatively wet water years at the beginning of the study and drier water years as the study progressed. This resulted in less saturation of the landscape during the drier water years and thus increased evapotranspiration and reduced interflow and overland flow (Nash and Sutcliffe 1970). Hence, less water was observed exiting the watersheds via surface flow in the streams during the drier years.

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Appendix A

Computed Hydrologic Indicators

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Table A-1. Computed Hydrologic Indicators by Station and Water Year.

Station	Water Year	High Pulse Count (count)	High Pulse Duration (days)	High Pulse Range (days)	Low Pulse Count (count)	Low Pulse Duration (days)	Low Pulse Range (days)	Flow Reversal (count)	Richards-Baker Flashiness Index	TQ Mean (fraction of year)	Storm Volume (cubic feet)	Base Volume (cubic feet)
1 EVALSS	2016	7	2.7	90	1	3	2	121	0.18	0.26	46,230,020	10,863,964
1 EVALSS	2017	14	2.2	203	0	0	0	108	0.22	0.38	52,910,595	14,976,477
1 EVALSS	2018	14	1.6	162	2	2	4	138	0.16	0.39	53,885,528	9,184,744
1 EVALSS	2019	7	1.7	135	3	2.7	75	123	0.14	0.39	48,498,849	7,054,623
1 EVALSS	2020	5	1.8	50	0	0	0	104	0.2	0.25	45,382,618	9,984,230
1 EVALSS	2021	8	1.8	96	0	0	0	127	0.17	0.29	45,917,678	8,433,106
2 EVAMS	2016	7	2.3	93	3	10.3	34	145	0.18	0.3	15,635,340	3,357,108
2 EVAMS	2017	23	1.5	203	5	5.6	56	129	0.24	0.44	18,641,475	5,261,085
2 EVAMS	2018	19	1.8	238	1	1	0	154	0.2	0.33	18,443,429	3,972,187
2 EVAMS	2019	6	1.7	135	14	4.1	210	149	0.17	0.38	14,393,131	2,489,429
2 EVAMS	2020	10	2.9	50	3	6.3	139	142	0.25	0.24	15,001,871	5,141,425
2 EVAMS	2021	8	1.9	59	19	5.8	213	169	0.16	0.41	15,297,301	2,669,579
3 MONMN	2016	13	5.1	148	12	16.8	351	110	0.39	0.28	3,769,082	7,508,710
3 MONMN	2017	24	3.5	216	16	11.9	346	110	0.51	0.34	5,718,843	9,477,189
3 MONMN	2018	12	5.7	179	16	13	306	113	0.4	0.29	6,165,482	6,738,358
3 MONMN	2019	13	2.5	316	24	10	338	100	0.47	0.3	2,448,539	4,777,093
3 MONMN	2020	10	4.9	342	21	10.1	297	100	0.5	0.25	4,664,282	7,493,926
3 MONMN	2021	13	4	163	15	14.2	344	103	0.48	0.28	3,795,725	6,577,459
3 MONMN	2022	21	3.3	229	21	10.8	356	138	0.52	0.3	3,774,631	9,506,135
3 MONMN	2023	17	2.2	330	19	10.1	329	123	0.44	0.29	3,469,307	5,024,851
4 MONMS	2016	16	5	169	20	8.4	263	126	0.32	0.34	2,893,948	1,983,332
4 MONMS	2017	25	2	215	17	8.4	303	126	0.52	0.32	2,174,403	2,329,629
4 MONMS	2018	21	2.7	244	12	10.9	188	115	0.37	0.34	3,106,449	1,814,031
4 MONMS	2019	14	1.7	316	18	11.1	260	106	0.37	0.37	1,745,727	1,243,713
4 MONMS	2020	11	3.6	222	15	8.9	235	122	0.42	0.3	2,410,332	2,001,252
4 MONMS	2021	11	2.1	96	14	10.1	221	115	0.38	0.34	2,023,814	1,392,442
4 MONMS	2022	25	2.5	229	7	17.9	329	153	0.41	0.36	3,309,968	1,936,095
4 MONMS	2023	10	1.9	327	7	21	220	126	0.39	0.4	1,555,967	1,437,217
5 MONM	2016	16	4.2	148	12	14.4	344	142	0.33	0.31	19,421,222	15,742,714
5 MONM	2017	23	3	214	16	10.6	343	130	0.42	0.37	21,979,530	19,323,126
5 MONM	2018	14	5.2	238	11	16.1	218	134	0.35	0.32	22,305,669	16,249,467
5 MONM	2019	12	2.2	317	24	8.3	322	113	0.36	0.31	12,831,284	10,859,596
5 MONM	2020	15	3.2	342	20	8.7	265	138	0.4	0.26	19,428,785	17,707,663
5 MONM	2021	9	4.3	127	13	13.2	193	139	0.35	0.31	17,569,058	12,910,270
5 MONM	2022	21	2.5	229	16	10.6	349	151	0.4	0.32	19,799,218	16,233,143
5 MONM	2023	11	2.4	293	10	15.4	287	144	0.32	0.37	14,962,001	11,089,186
6 TOSMO	2016	15	1.8	222	8	11.5	102	144	0.38	0.28	13,141,942	6,457,898
6 TOSMO	2017	29	1.6	245	10	13.4	155	137	0.55	0.27	13,342,165	10,607,915
6 TOSMO	2018	20	1.7	180	23	5.5	260	150	0.43	0.28	12,185,008	6,956,048
6 TOSMO	2019	18	1.3	317	18	4.2	213	135	0.34	0.29	12,631,932	5,122,404
6 TOSMO	2020	17	1.8	340	8	9	86	154	0.43	0.24	12,242,225	7,545,967
6 TOSMO	2021	15	1.7	246	9	12.2	165	143	0.35	0.3	13,262,224	5,909,936
6 TOSMO	2022	19	1.9	224	7	13	109	153	0.34	0.28	15,867,064	6,474,212
6 TOSMO	2023	11	1.5	326	8	10.8	110	144	0.32	0.37	12,942,963	4,452,099
7 TOSMI	2016	28	1.8	233	21	6.8	259	162	0.57	0.28	5,981,630	6,754,594
7 TOSMI	2017	31	1.9	346	12	12.3	318	139	0.62	0.28	6,742,930	7,919,150
7 TOSMI	2018	22	2	238	16	8.6	220	148	0.52	0.27	6,558,006	5,839,530
7 TOSMI	2019	18	1.7	335	31	5.7	317	147	0.38	0.33	6,689,539	3,345,821
7 TOSMI	2020	20	1.9	342	26	5.4	287	138	0.52	0.26	6,078,983	5,525,401
7 TOSMI	2021	23	1.8	355	39	5	356	153	0.55	0.28	5,117,867	6,126,229
7 TOSMI	2022	19	1.7	229	30	7.1	327	168	0.68	0.24	3,781,398	6,282,559
7 TOSMI	2023	28	1.6	341	17	8	253	149	0.58	0.27	5,713,824	5,867,613
8 COLM	2016	8	3.3	90	7	31.1	248	116	0.43	0.22	4,902,520	17,637,710
8 COLM	2017	16	5.8	198	4	43	293	80	0.31	0.39	16,330,705	27,145,469
8 COLM	2018	8	9.3	150	6	32.3	282	74	0.3	0.27	10,870,085	28,180,609
8 COLM	2019	7	2.7	75	4	51.8	254	88	0.2	0.4	7,010,258	10,317,700
8 COLM	2020	11	5.3	222	10	21.6	286	88	0.34	0.23	15,822,172	23,362,106
8 COLM	2021	6	9.2	128	4	54	236	89	0.33	0.22	11,660,094	19,293,174
8 COLM	2022	16	3.6	214	9	23.2	301	99	0.33	0.27	8,462,082	25,888,467

Table A-1. Computed Hydrologic Indicators by Station and Water Year.

Station	Water Year	High Pulse Count (count)	High Pulse Duration (days)	High Pulse Range (days)	Low Pulse Count (count)	Low Pulse Duration (days)	Low Pulse Range (days)	Flow Reversal (count)	Richards-Baker Flashiness Index	TQ Mean (fraction of year)	Storm Volume (cubic feet)	Base Volume (cubic feet)
8 COLM	2023	6	6.3	123	6	29.7	213	81	0.24	0.31	8,197,813	15,831,158
9 SEIMN	2016	7	7.9	117	5	33.8	184	124	0.21	0.36	8,899,762	4,315,118
9 SEIMN	2017	22	2.5	208	5	27.8	151	107	0.28	0.42	11,676,960	5,832,864
9 SEIMN	2018	12	5	149	6	26	174	103	0.21	0.39	12,196,917	4,461,003
9 SEIMN	2019	3	1	72	9	18.8	256	100	0.14	0.42	7,410,982	1,284,314
9 SEIMN	2020	6	6.5	153	10	13.7	162	116	0.25	0.25	12,085,093	5,385,851
9 SEIMN	2021	7	10.3	106	3	55.7	169	121	0.19	0.34	11,879,458	2,953,694
9 SEIMN	2022	13	3.2	219	6	10.3	93	102	0.2	0.38	13,710,137	3,678,315
9 SEIMN	2023	7	2.1	122	5	36.8	202	113	0.13	0.42	9,441,102	2,373,747
10 SEIMS	2016	10	2.5	104	10	5.3	128	140	0.21	0.35	11,865,404	3,530,212
10 SEIMS	2017	17	1.8	214	1	6	5	125	0.24	0.37	14,025,606	3,820,314
10 SEIMS	2018	16	2.6	174	0	0	0	128	0.2	0.33	14,246,646	3,450,666
10 SEIMS	2019	3	1	105	19	4.7	138	135	0.15	0.41	10,405,016	1,586,440
10 SEIMS	2020	7	3.7	112	1	1	0	130	0.23	0.28	12,547,469	3,753,619
10 SEIMS	2021	11	3.1	96	9	10.9	114	129	0.17	0.33	12,812,753	2,493,871
10 SEIMS	2022	8	1.9	144	3	34.3	105	138	0.22	0.35	10,688,694	2,855,478
10 SEIMS	2023	3	1.7	277	4	5	87	127	0.16	0.4	9,788,185	1,719,254
11 COUMO	2016	21	1.9	169	19	7.1	187	162	0.39	0.29	8,869,011	5,475,981
11 COUMO	2017	24	2.7	215	17	6.8	201	133	0.43	0.34	9,842,811	7,446,693
11 COUMO	2018	22	2.1	181	22	9.4	286	136	0.5	0.28	6,760,737	6,243,327
11 COUMO	2019	14	1.8	136	35	6.8	349	137	0.48	0.26	4,101,324	4,026,324
11 COUMO	2020	14	2.4	224	20	9.1	292	134	0.44	0.25	7,131,536	5,386,960
11 COUMO	2021	10	2.6	244	16	11.7	238	149	0.42	0.26	6,322,084	4,642,076
11 COUMO	2022	28	2.8	238	6	17.5	266	155	0.38	0.35	12,326,010	6,885,411
11 COUMO	2023	18	1.5	341	9	15.3	316	150	0.38	0.38	7,667,079	3,914,793
12 COUMI	2016	17	2.2	153	15	10.7	348	124	0.32	0.33	2,646,841	1,430,375
12 COUMI	2017	15	2.7	215	8	15.6	177	110	0.36	0.3	2,976,772	1,775,228
12 COUMI	2018	20	2.8	181	14	8.3	195	120	0.37	0.3	2,824,425	1,882,647
12 COUMI	2019	8	1.9	166	26	5	288	121	0.19	0.34	2,612,390	688,090
12 COUMI	2020	8	4.5	225	7	16.6	216	104	0.35	0.22	2,393,599	1,623,137
12 COUMI	2021	12	3.7	168	17	10.4	306	107	0.37	0.3	2,181,697	1,913,663
12 COUMI	2022	12	2.6	224	16	11.3	303	129	0.46	0.2	2,143,001	2,287,344
12 COUMI	2023	7	1.3	301	17	10	271	136	0.37	0.35	1,394,685	754,272
13 TYLMO	2016	21	2.4	329	31	6.1	355	148	0.56	0.27	4,574,014	8,987,330
13 TYLMO	2017	27	2.4	346	17	10.7	346	137	0.58	0.32	6,200,322	9,999,678
13 TYLMO	2018	27	2.2	244	22	9.7	299	132	0.57	0.3	5,177,710	8,232,434
13 TYLMO	2019	16	1.7	317	32	7.5	351	121	0.57	0.3	3,278,262	5,366,922
13 TYLMO	2020	18	2.8	344	26	8	314	128	0.61	0.27	4,538,106	9,153,702
13 TYLMO	2021	16	1.9	246	19	10.4	278	135	0.6	0.28	3,532,241	6,179,983
13 TYLMO	2022	29	2.3	229	17	9.2	328	154	0.64	0.27	6,590,021	10,223,599
13 TYLMO	2023	23	2.5	341	34	7.4	363	141	0.81	0.27	3,235,279	10,212,929
14 TYLMI	2016	16	2.4	152	13	14.8	352	119	0.5	0.24	1,654,311	2,661,369
14 TYLMI	2017	26	2.8	220	13	14.2	357	99	0.58	0.29	2,013,244	3,830,852
14 TYLMI	2018	25	2.6	330	27	7.6	339	122	0.6	0.26	1,815,332	3,785,980
14 TYLMI	2019	20	3.1	336	32	6.9	349	107	0.61	0.25	1,409,749	3,176,363
14 TYLMI	2020	18	2.9	338	24	8.9	315	104	0.56	0.28	1,610,140	3,311,204
14 TYLMI	2021	15	2.2	222	20	10.2	355	119	0.56	0.27	1,042,054	2,373,338
14 TYLMI	2022	23	2.2	229	11	17.4	350	149	0.54	0.31	1,838,342	2,595,871
88 TYLMI	2023	11	1.9	302	22	13.4	359	112	0.5	0.23	896,312	1,363,675

Appendix B

Computed Mass Load Estimates

Table B-1. Regression Models and Computed Mass Load Estimates.								
			Regression Model Parameters				
Station	Parameter	Water Year	slope	r2	p-value	Estimated Load (lb)	Result Evaluation
EVALSS	Total Copper	2016	3.60	0.86	<0.001	45.6	Reject
EVALSS	Total Copper	2017	1.45	0.59	0.001	3.4	
EVALSS	Total Copper	2018	1.95	0.89	<0.001	3.2	
EVALSS	Total Copper	2019	2.00	0.72	<0.001	3.0	
EVALSS	Total Copper	2020	1.99	0.86	<0.001	6.1	
EVALSS	Total Copper	2021	2.00	0.59	0.001	7.7	
EVALSS	Total Nitrogen	2016	2.18	0.80	0.003	13,431.8	Reject
EVALSS	Total Nitrogen	2017	0.88	0.71	<0.001	8,630.6	
EVALSS	Total Nitrogen	2018	1.14	0.96	<0.001	7,493.6	
EVALSS	Total Nitrogen	2019	1.10	0.93	<0.001	6,518.1	
EVALSS	Total Nitrogen	2020	1.15	0.94	<0.001	7,082.0	
EVALSS	Total Nitrogen	2021	1.12	0.94	<0.001	7,847.1	
EVALSS	Total Phosphorus	2016	3.29	0.80	<0.001	1,191.3	Reject
EVALSS	Total Phosphorus	2017	1.70	0.70	<0.001	159.9	
EVALSS	Total Phosphorus	2018	1.45	0.50	0.002	125.1	
EVALSS	Total Phosphorus	2019	1.78	0.79	<0.001	177.2	
EVALSS	Total Phosphorus	2020	1.86	0.86	<0.001	283.3	
EVALSS	Total Phosphorus	2021	1.94	0.70	<0.001	286.3	
EVALSS	Total Suspended Solids	2016	4.52	0.89	<0.001	5,012,001.4	Reject
EVALSS	Total Suspended Solids	2017	2.41	0.46	0.004	100,699.1	
EVALSS	Total Suspended Solids	2018	2.17	0.74	<0.001	73,825.8	
EVALSS	Total Suspended Solids	2019	2.83	0.77	<0.001	77,255.9	
EVALSS	Total Suspended Solids	2020	2.53	0.74	<0.001	259,158.9	
EVALSS	Total Suspended Solids	2021	2.78	0.63	0.001	273,410.6	
EVALSS	Total Zinc	2016	3.24	0.92	<0.001	104.2	Reject
EVALSS	Total Zinc	2017	1.44	0.70	<0.001	14.5	
EVALSS	Total Zinc	2018	1.52	0.77	<0.001	14.1	
EVALSS	Total Zinc	2019	1.38	0.48	0.001	14.4	
EVALSS	Total Zinc	2020	1.70	0.85	<0.001	17.0	
EVALSS	Total Zinc	2021	1.65	0.57	0.002	22.6	
EVAMS	Total Copper	2016	2.03	0.88	<0.001	1.3	
EVAMS	Total Copper	2017	1.77	0.71	<0.001	1.4	
EVAMS	Total Copper	2018	1.57	0.79	<0.001	1.1	
EVAMS	Total Copper	2019	1.55	0.74	<0.001	0.6	
EVAMS	Total Copper	2020	1.58	0.90	<0.001	1.3	
EVAMS	Total Copper	2021	1.56	0.57	0.002	1.9	
EVAMS	Total Nitrogen	2016	1.45	0.80	0.001	3,504.6	
EVAMS	Total Nitrogen	2017	0.86	0.72	<0.001	3,412.8	
EVAMS	Total Nitrogen	2018	0.99	0.96	<0.001	3,103.8	
EVAMS	Total Nitrogen	2019	1.20	0.76	<0.001	2,268.9	
EVAMS	Total Nitrogen	2020	1.00	0.91	<0.001	3,157.2	
EVAMS	Total Nitrogen	2021	0.95	0.97	<0.001	2,873.6	
EVAMS	Total Phosphorus	2016	2.35	0.83	<0.001	92.5	
EVAMS	Total Phosphorus	2017	2.27	0.64	<0.001	86.6	
EVAMS	Total Phosphorus	2018	1.24	0.49	0.003	33.1	
EVAMS	Total Phosphorus	2019	2.09	0.51	0.001	76.4	
EVAMS	Total Phosphorus	2020	1.44	0.84	<0.001	64.6	
EVAMS	Total Phosphorus	2021	1.33	0.55	0.002	66.0	
EVAMS	Total Suspended Solids	2016	2.56	0.87	<0.001	53,137.1	
EVAMS	Total Suspended Solids	2017	2.17	0.40	0.008	37,718.0	
EVAMS	Total Suspended Solids	2018	1.55	0.72	<0.001	17,456.0	
EVAMS	Total Suspended Solids	2019	1.97	0.55	<0.001	13,169.3	
EVAMS	Total Suspended Solids	2020	1.58	0.66	<0.001	21,572.4	
EVAMS	Total Suspended Solids	2021	0.89	0.15	0.166	32,981.8	Reject

Table B-1. Regression Models and Computed Mass Load Estimates.

Station	Parameter	Water Year	Regression Model Parameters				Result Evaluation
			slope	r2	p-value	Estimated Load (lb)	
EVAMS	Total Zinc	2016	1.84	0.84	<0.001	5.6	
EVAMS	Total Zinc	2017	1.89	0.80	<0.001	7.1	
EVAMS	Total Zinc	2018	1.28	0.90	<0.001	4.1	
EVAMS	Total Zinc	2019	1.48	0.53	0.001	4.0	
EVAMS	Total Zinc	2020	1.55	0.92	<0.001	6.0	
EVAMS	Total Zinc	2021	1.16	0.46	0.008	6.1	
MONM	Total Copper	2016	1.69	0.87	<0.001	7.7	
MONM	Total Copper	2017	1.46	0.84	<0.001	5.1	
MONM	Total Copper	2018	1.45	0.98	<0.001	4.4	
MONM	Total Copper	2019	1.65	0.94	<0.001	2.8	
MONM	Total Copper	2020	1.43	0.94	<0.001	5.4	
MONM	Total Copper	2021	1.66	0.92	<0.001	6.9	
MONM	Total Copper	2022	1.43	0.95	<0.001	5.3	
MONM	Total Copper	2023	1.36	0.90	<0.001	3.1	
MONM	Total Nitrogen	2016	1.54	0.98	<0.001	4,600.6	
MONM	Total Nitrogen	2017	1.12	0.82	<0.001	2,885.8	
MONM	Total Nitrogen	2018	1.22	0.99	<0.001	2,046.6	
MONM	Total Nitrogen	2019	1.15	0.93	<0.001	1,272.5	
MONM	Total Nitrogen	2020	1.14	0.96	<0.001	2,242.5	
MONM	Total Nitrogen	2021	1.26	0.96	<0.001	2,671.6	
MONM	Total Nitrogen	2022	1.14	0.96	<0.001	2,620.6	
MONM	Total Nitrogen	2023	1.12	0.93	<0.001	1,407.8	
MONM	Total Phosphorus	2016	1.19	0.68	0.003	206.2	
MONM	Total Phosphorus	2017	1.11	0.80	<0.001	136.4	
MONM	Total Phosphorus	2018	0.98	0.80	<0.001	117.3	
MONM	Total Phosphorus	2019	1.43	0.90	<0.001	119.4	
MONM	Total Phosphorus	2020	1.28	0.88	<0.001	216.5	
MONM	Total Phosphorus	2021	1.52	0.92	<0.001	231.6	
MONM	Total Phosphorus	2022	1.26	0.84	<0.001	219.1	
MONM	Total Phosphorus	2023	0.87	0.51	0.002	92.8	
MONM	Total Suspended Solids	2016	1.57	0.55	0.015	70,770.9	
MONM	Total Suspended Solids	2017	1.62	0.57	0.001	65,356.9	
MONM	Total Suspended Solids	2018	1.37	0.84	<0.001	47,899.0	
MONM	Total Suspended Solids	2019	2.18	0.91	<0.001	32,598.9	
MONM	Total Suspended Solids	2020	1.95	0.81	<0.001	151,230.9	
MONM	Total Suspended Solids	2021	2.07	0.89	<0.001	89,022.9	
MONM	Total Suspended Solids	2022	1.40	0.84	<0.001	78,288.9	
MONM	Total Suspended Solids	2023	1.57	0.66	<0.001	45,887.1	
MONM	Total Zinc	2016	1.53	0.81	<0.001	96.9	
MONM	Total Zinc	2017	1.35	0.91	<0.001	58.0	
MONM	Total Zinc	2018	1.21	0.96	<0.001	36.3	
MONM	Total Zinc	2019	1.53	0.94	<0.001	30.9	
MONM	Total Zinc	2020	1.34	0.89	<0.001	56.6	
MONM	Total Zinc	2021	1.58	0.92	<0.001	78.1	
MONM	Total Zinc	2022	1.25	0.86	<0.001	67.0	
MONM	Total Zinc	2023	1.16	0.80	<0.001	48.3	
MONMN	Total Copper	2016	1.10	0.43	0.039	1.5	
MONMN	Total Copper	2017	1.23	0.78	<0.001	1.8	
MONMN	Total Copper	2018	1.38	0.99	<0.001	1.4	
MONMN	Total Copper	2019	1.29	0.89	<0.001	1.1	
MONMN	Total Copper	2020	1.43	0.95	<0.001	2.2	
MONMN	Total Copper	2021	1.28	0.84	<0.001	2.9	
MONMN	Total Copper	2022	1.30	0.95	<0.001	2.3	
MONMN	Total Copper	2023	1.13	0.81	<0.001	0.8	

Table B-1. Regression Models and Computed Mass Load Estimates.

Station	Parameter	Water Year	Regression Model Parameters: slope	r2	p-value	Estimated Load (lb)	Result Evaluation
MONMN	Total Nitrogen	2016	1.44	0.83	0.002	1,461.8	
MONMN	Total Nitrogen	2017	1.03	0.96	<0.001	798.6	
MONMN	Total Nitrogen	2018	1.21	0.98	<0.001	684.1	
MONMN	Total Nitrogen	2019	1.16	0.88	<0.001	498.2	
MONMN	Total Nitrogen	2020	1.10	0.96	<0.001	775.7	
MONMN	Total Nitrogen	2021	1.21	0.95	<0.001	1,106.1	
MONMN	Total Nitrogen	2022	1.09	0.98	<0.001	909.4	
MONMN	Total Nitrogen	2023	1.30	0.77	<0.001	577.3	
MONMN	Total Phosphorus	2016	0.49	0.19	0.215	23.9	Reject
MONMN	Total Phosphorus	2017	0.89	0.75	<0.001	40.2	
MONMN	Total Phosphorus	2018	0.93	0.78	<0.001	46.6	
MONMN	Total Phosphorus	2019	1.23	0.84	<0.001	50.5	
MONMN	Total Phosphorus	2020	1.00	0.79	<0.001	83.8	
MONMN	Total Phosphorus	2021	1.24	0.82	<0.001	129.6	
MONMN	Total Phosphorus	2022	1.07	0.83	<0.001	83.1	
MONMN	Total Phosphorus	2023	0.42	0.15	0.133	20.3	Reject
MONMN	Total Suspended Solids	2016	0.59	0.11	0.340	6,740.8	Reject
MONMN	Total Suspended Solids	2017	1.27	0.58	0.001	13,319.6	
MONMN	Total Suspended Solids	2018	1.38	0.83	<0.001	19,924.3	
MONMN	Total Suspended Solids	2019	1.43	0.71	<0.001	14,812.7	
MONMN	Total Suspended Solids	2020	1.43	0.73	<0.001	35,097.1	
MONMN	Total Suspended Solids	2021	1.54	0.79	<0.001	57,453.8	
MONMN	Total Suspended Solids	2022	1.34	0.85	<0.001	29,232.4	
MONMN	Total Suspended Solids	2023	0.82	0.18	0.101	4,694.2	Reject
MONMN	Total Zinc	2016	0.78	0.20	0.198	7.4	Reject
MONMN	Total Zinc	2017	1.31	0.87	<0.001	8.0	
MONMN	Total Zinc	2018	1.10	0.86	<0.001	7.7	
MONMN	Total Zinc	2019	1.40	0.79	<0.001	10.9	
MONMN	Total Zinc	2020	1.31	0.87	<0.001	11.6	
MONMN	Total Zinc	2021	1.40	0.86	<0.001	30.1	
MONMN	Total Zinc	2022	1.17	0.86	<0.001	15.5	
MONMN	Total Zinc	2023	1.14	0.69	<0.001	8.3	
MONMS	Total Copper	2016	1.52	0.84	<0.001	0.8	
MONMS	Total Copper	2017	1.32	0.77	<0.001	1.0	
MONMS	Total Copper	2018	1.42	0.96	<0.001	0.5	
MONMS	Total Copper	2019	1.20	0.96	<0.001	0.3	
MONMS	Total Copper	2020	1.35	0.90	<0.001	0.6	
MONMS	Total Copper	2021	1.16	0.89	<0.001	0.5	
MONMS	Total Copper	2022	1.39	0.94	<0.001	0.6	
MONMS	Total Copper	2023	1.09	0.89	<0.001	0.4	
MONMS	Total Nitrogen	2016	1.20	0.81	0.002	297.3	
MONMS	Total Nitrogen	2017	0.92	0.66	<0.001	427.3	
MONMS	Total Nitrogen	2018	1.23	0.96	<0.001	252.9	
MONMS	Total Nitrogen	2019	0.99	0.99	<0.001	119.6	
MONMS	Total Nitrogen	2020	1.11	0.99	<0.001	232.5	
MONMS	Total Nitrogen	2021	1.08	0.98	<0.001	192.5	
MONMS	Total Nitrogen	2022	1.10	0.94	<0.001	331.3	
MONMS	Total Nitrogen	2023	1.16	0.98	<0.001	158.3	
MONMS	Total Phosphorus	2016	1.28	0.91	<0.001	15.5	
MONMS	Total Phosphorus	2017	1.09	0.80	<0.001	13.0	
MONMS	Total Phosphorus	2018	1.04	0.95	<0.001	10.0	
MONMS	Total Phosphorus	2019	0.97	0.86	<0.001	8.7	
MONMS	Total Phosphorus	2020	1.03	0.83	<0.001	19.0	
MONMS	Total Phosphorus	2021	0.93	0.75	<0.001	15.2	
MONMS	Total Phosphorus	2022	1.14	0.85	<0.001	18.3	
MONMS	Total Phosphorus	2023	1.11	0.72	<0.001	12.6	

Table B-1. Regression Models and Computed Mass Load Estimates.

Station	Parameter	Water Year	Regression Model Parameters: slope	r2	p-value	Estimated Load (lb)	Result Evaluation
MONMS	Total Suspended Solids	2016	1.24	0.68	0.004	1,997.9	
MONMS	Total Suspended Solids	2017	1.45	0.67	<0.001	2,869.8	
MONMS	Total Suspended Solids	2018	1.45	0.93	<0.001	2,069.4	
MONMS	Total Suspended Solids	2019	0.89	0.79	<0.001	888.4	
MONMS	Total Suspended Solids	2020	0.99	0.81	<0.001	1,501.1	
MONMS	Total Suspended Solids	2021	0.84	0.80	<0.001	1,348.7	
MONMS	Total Suspended Solids	2022	0.97	0.56	0.005	2,441.0	
MONMS	Total Suspended Solids	2023	0.78	0.34	0.018	1,125.0	
MONMS	Total Zinc	2016	1.18	0.80	0.001	1.7	
MONMS	Total Zinc	2017	1.28	0.89	<0.001	2.6	
MONMS	Total Zinc	2018	1.11	0.92	<0.001	1.2	
MONMS	Total Zinc	2019	0.95	0.78	<0.001	1.1	
MONMS	Total Zinc	2020	1.15	0.93	<0.001	1.1	
MONMS	Total Zinc	2021	0.81	0.78	<0.001	1.0	
MONMS	Total Zinc	2022	1.05	0.75	<0.001	2.2	
MONMS	Total Zinc	2023	0.79	0.72	<0.001	0.9	
TOSMO	Total Copper	2016	2.39	0.91	<0.001	18.1	
TOSMO	Total Copper	2017	2.19	0.90	<0.001	28.5	
TOSMO	Total Copper	2018	1.94	0.96	<0.001	6.8	
TOSMO	Total Copper	2019	1.97	0.94	<0.001	4.6	
TOSMO	Total Copper	2020	1.71	0.84	<0.001	9.3	
TOSMO	Total Copper	2021	1.71	0.81	<0.001	6.7	
TOSMO	Total Copper	2022	1.77	0.86	<0.001	7.4	
TOSMO	Total Copper	2023	2.15	0.61	<0.001	11.4	
TOSMO	Total Nitrogen	2016	1.72	0.95	<0.001	2,270.0	
TOSMO	Total Nitrogen	2017	1.26	0.89	<0.001	2,774.6	
TOSMO	Total Nitrogen	2018	1.11	0.94	<0.001	1,279.0	
TOSMO	Total Nitrogen	2019	1.21	0.91	<0.001	1,209.0	
TOSMO	Total Nitrogen	2020	1.03	0.94	<0.001	1,463.8	
TOSMO	Total Nitrogen	2021	1.26	0.97	<0.001	1,703.6	
TOSMO	Total Nitrogen	2022	1.04	0.94	<0.001	1,764.2	
TOSMO	Total Nitrogen	2023	1.15	0.65	<0.001	1,450.7	
TOSMO	Total Phosphorus	2016	1.65	0.92	<0.001	224.7	
TOSMO	Total Phosphorus	2017	1.75	0.90	<0.001	374.5	
TOSMO	Total Phosphorus	2018	1.29	0.90	<0.001	121.2	
TOSMO	Total Phosphorus	2019	1.59	0.94	<0.001	136.8	
TOSMO	Total Phosphorus	2020	1.30	0.88	<0.001	180.8	
TOSMO	Total Phosphorus	2021	1.58	0.91	<0.001	190.3	
TOSMO	Total Phosphorus	2022	1.45	0.85	<0.001	196.2	
TOSMO	Total Phosphorus	2023	1.29	0.40	0.009	200.7	
TOSMO	Total Suspended Solids	2016	2.64	0.86	<0.001	281,563.9	
TOSMO	Total Suspended Solids	2017	2.57	0.85	<0.001	510,834.6	
TOSMO	Total Suspended Solids	2018	2.57	0.93	<0.001	118,375.9	
TOSMO	Total Suspended Solids	2019	2.58	0.88	<0.001	80,575.5	
TOSMO	Total Suspended Solids	2020	2.01	0.76	<0.001	165,138.1	
TOSMO	Total Suspended Solids	2021	2.50	0.84	<0.001	240,151.7	
TOSMO	Total Suspended Solids	2022	1.94	0.85	<0.001	109,116.6	
TOSMO	Total Suspended Solids	2023	1.36	0.18	0.105	128,577.3	Reject
TOSMO	Total Zinc	2016	2.61	0.94	<0.001	229.8	
TOSMO	Total Zinc	2017	2.05	0.88	<0.001	280.1	
TOSMO	Total Zinc	2018	2.06	0.94	<0.001	66.7	
TOSMO	Total Zinc	2019	1.84	0.83	<0.001	78.2	
TOSMO	Total Zinc	2020	1.57	0.68	<0.001	156.0	
TOSMO	Total Zinc	2021	1.46	0.64	0.001	158.6	
TOSMO	Total Zinc	2022	1.43	0.82	<0.001	161.0	
TOSMO	Total Zinc	2023	1.90	0.47	0.003	200.0	

Table B-1. Regression Models and Computed Mass Load Estimates.

Station	Parameter	Water Year	Regression Model Parameters: slope	r2	p-value	Estimated Load (lb)	Result Evaluation
TOSMI	Total Copper	2016	1.85	0.95	<0.001	9.0	
TOSMI	Total Copper	2017	1.76	0.92	<0.001	13.6	
TOSMI	Total Copper	2018	1.63	0.94	<0.001	6.7	
TOSMI	Total Copper	2019	1.49	0.77	<0.001	4.6	
TOSMI	Total Copper	2020	28	0.83	<0.001	5.1	
TOSMI	Total Copper	2021	.21	0.81	<0.001	4.5	
TOSMI	Total Copper	2022	1.38	0.95	<0.001	3.9	
TOSMI	Total Copper	2023	29	77	<0.001	6.2	
TOSMI	Total Nitrogen	2016	1.18	0.99	<0.001	1,120.0	
TOSMI	Total Nitrogen	2017	1.10	0.90	<0.001	1,817.8	
TOSMI	Total Nitrogen	2018	0.99	0.92	<0.001	921.5	
TOSMI	Total Nitrogen	2019	82	0.83	<0.001	881.2	
TOSMI	Total Nitrogen	2020	0.98	0.96	<0.001	838.6	
TOSMI	Total Nitrogen	2021	1.00	0.93	<0.001	1,168.3	
TOSMI	Total Nitrogen	2022	0.95	0.97	<0.001	795.7	
TOSMI	Total Nitrogen	2023	0.91	0.87	<0.001	930.1	
TOSMI	Total Phosphorus	2016	1.30	0.97	<0.001	101.2	
TOSMI	Total Phosphorus	2017	1.43	0.85	<0.001	196.8	
TOSMI	Total Phosphorus	2018	1.19	0.88	<0.001	84.2	
TOSMI	Total Phosphorus	2019	1.26	0.85	<0.001	70.0	
TOSMI	Total Phosphorus	2020	1.08	0.93	<0.001	89.7	
TOSMI	Total Phosphorus	2021	1.25	0.91	<0.001	93.3	
TOSMI	Total Phosphorus	2022	1.24	0.93	<0.001	79.7	
TOSMI	Total Phosphorus	2023	1	.69	<0.001	103.5	
TOSMI	Total Suspended Solids	2016	1.99	0.96	<0.001	66,381.9	
TOSMI	Total Suspended Solids	2017	2.29	0.84	<0.001	237,409.7	
TOSMI	Total Suspended Solids	2018	2.01	0.94	<0.001	82,555.0	
TOSMI	Total Suspended Solids	2019	2.28	0.80	<0.001	54,349.8	
TOSMI	Total Suspended Solids	2020	.42	0.77	<0.001	44,278.4	
TOSMI	Total Suspended Solids	2021	59	0.78	<0.001	52,218.0	
TOSMI	Total Suspended Solids	2022	55	0.93	<0.001	35,923.7	
TOSMI	Total Suspended Solids	2023	57	0.51	0.002	62,045.7	
TOSMI	Total Zinc	2016	1.74	0.95	<0.001	95.8	
TOSMI	Total Zinc	2017	1.60	0.89	<0.001	38.1	
TOSMI	Total Zinc	2018	1.47	0.93	<0.001	56.9	
TOSMI	Total Zinc	2019	22	.63	<0.001	75.9	
TOSMI	Total Zinc	2020	.06	.62	<0.001	1.7	
TOSMI	Total Zinc	2021	.05	0.59	0.001	174.6	
TOSMI	Total Zinc	2022	.04	0.91	<0.001	88.6	
TOSMI	Total Zinc	2023	17	.63	<0.001	169.0	
COLM	Total Copper	2016	77	0.44	0.036	0.6	
COLM	Total Copper	2017	1.04	0.96	<0.001	1.6	
COLM	Total Copper	2018	0.99	0.97	<0.001	1.4	
COLM	Total Copper	2019	1.00	0.98	<0.001	0.7	
COLM	Total Copper	2020	0.93	0.89	<0.001	1.7	
COLM	Total Copper	2021	1.08	0.85	<0.001	2.8	
COLM	Total Copper	2022	1.07	0.95	<0.001	1.5	
COLM	Total Copper	2023	0.95	0.86	<0.001	0.9	
COLM	Total Nitrogen	2016	-0.16	0.02	0.714	222.2	Reject
COLM	Total Nitrogen	2017	1.04	0.91	<0.001	2,506.5	
COLM	Total Nitrogen	2018	0.91	0.84	<0.001	1,966.0	
COLM	Total Nitrogen	2019	1.09	0.97	<0.001	677.2	
COLM	Total Nitrogen	2020	0.92	0.98	<0.001	1,814.6	
COLM	Total Nitrogen	2021	1.05	0.95	<0.001	2,393.6	
COLM	Total Nitrogen	2022	1.03	0.98	<0.001	1,674.2	
COLM	Total Nitrogen	2023	0.94	0.89	<0.001	891.9	

Table B-1. Regression Models and Computed Mass Load Estimates.

Station	Parameter	Water Year	Regression Model Parameters: slope	r2	p-value	Estimated Load (lb)	Result Evaluation
COLM	Total Phosphorus	2016	0.48	0.13	0.309	11.7	Reject
COLM	Total Phosphorus	2017	0.63	0.52	0.003	28.8	
COLM	Total Phosphorus	2018	0.69	0.90	<0.001	20.5	
COLM	Total Phosphorus	2019	0.96	0.98	<0.001	19.8	
COLM	Total Phosphorus	2020	0.87	0.70	<0.001	77.5	
COLM	Total Phosphorus	2021	1.02	0.81	<0.001	81.0	
COLM	Total Phosphorus	2022	1.17	0.86	<0.001	49.2	
COLM	Total Phosphorus	2023	0.57	0.34	0.035	12.7	
COLM	Total Suspended Solids	2016	0.41	0.08	0.429	1,403.7	Reject
COLM	Total Suspended Solids	2017	0.69	0.41	0.011	4,755.6	
COLM	Total Suspended Solids	2018	1.03	0.74	<0.001	9,043.4	
COLM	Total Suspended Solids	2019	1.12	0.87	<0.001	2,092.0	
COLM	Total Suspended Solids	2020	0.81	0.38	0.011	24,141.7	
COLM	Total Suspended Solids	2021	1.25	0.67	<0.001	56,144.3	
COLM	Total Suspended Solids	2022	1.75	0.92	<0.001	24,825.2	
COLM	Total Suspended Solids	2023	0.27	0.04	0.496	2,990.5	Reject
COLM	Total Zinc	2016	1.28	0.87	<0.001	8.6	
COLM	Total Zinc	2017	1.08	0.93	<0.001	8.4	
COLM	Total Zinc	2018	0.93	0.99	<0.001	6.0	
COLM	Total Zinc	2019	0.98	0.99	<0.001	2.7	
COLM	Total Zinc	2020	0.94	0.96	<0.001	6.9	
COLM	Total Zinc	2021	1.11	0.88	<0.001	12.0	
COLM	Total Zinc	2022	1.00	1.00	<0.001	5.4	
COLM	Total Zinc	2023	0.86	0.96	<0.001	3.6	
SEIMN	Total Copper	2016	0.87	0.79	0.001	0.4	
SEIMN	Total Copper	2017	0.94	0.44	0.005	1.2	
SEIMN	Total Copper	2018	1.46	0.77	<0.001	1.9	
SEIMN	Total Copper	2019	1.57	0.78	<0.001	0.8	
SEIMN	Total Copper	2020	1.45	0.70	<0.001	2.7	
SEIMN	Total Copper	2021	1.72	0.73	<0.001	4.3	
SEIMN	Total Copper	2022	1.70	0.84	<0.001	3.0	
SEIMN	Total Copper	2023	1.29	0.64	<0.001	1.1	
SEIMN	Total Nitrogen	2016	1.21	0.91	0.003	881.2	
SEIMN	Total Nitrogen	2017	1.22	0.76	<0.001	1,336.3	
SEIMN	Total Nitrogen	2018	1.34	0.87	<0.001	916.3	
SEIMN	Total Nitrogen	2019	0.80	0.77	<0.001	379.2	
SEIMN	Total Nitrogen	2020	1.18	0.85	<0.001	1,083.0	
SEIMN	Total Nitrogen	2021	1.27	0.89	<0.001	1,371.0	
SEIMN	Total Nitrogen	2022	1.16	0.94	<0.001	1,013.9	
SEIMN	Total Nitrogen	2023	0.73	0.13	0.170	479.4	Reject
SEIMN	Total Phosphorus	2016	0.71	0.68	0.003	25.0	
SEIMN	Total Phosphorus	2017	0.86	0.48	0.003	50.3	
SEIMN	Total Phosphorus	2018	1.01	0.49	0.002	61.2	
SEIMN	Total Phosphorus	2019	1.02	0.54	0.001	48.5	
SEIMN	Total Phosphorus	2020	1.31	0.71	<0.001	123.9	
SEIMN	Total Phosphorus	2021	1.47	0.67	<0.001	174.8	
SEIMN	Total Phosphorus	2022	1.58	0.75	<0.001	151.3	
SEIMN	Total Phosphorus	2023	0.22	0.05	0.425	42.8	Reject
SEIMN	Total Suspended Solids	2016	0.72	0.60	0.009	5,231.9	
SEIMN	Total Suspended Solids	2017	1.05	0.27	0.039	29,656.0	
SEIMN	Total Suspended Solids	2018	1.75	0.72	<0.001	45,796.9	
SEIMN	Total Suspended Solids	2019	1.63	0.56	<0.001	19,692.8	
SEIMN	Total Suspended Solids	2020	1.74	0.65	<0.001	91,505.0	
SEIMN	Total Suspended Solids	2021	1.86	0.58	0.002	117,149.3	
SEIMN	Total Suspended Solids	2022	1.95	0.70	0.001	109,035.9	
SEIMN	Total Suspended Solids	2023	0.87	0.11	0.203	31,368.6	Reject

Table B-1. Regression Models and Computed Mass Load Estimates.							
Station	Parameter	Water Year	Regression Model Parameters				Result Evaluation
			slope	r2	p-value	Estimated Load (lb)	
SEIMN	Total Zinc	2016	1.14	0.94	<0.001	3.2	
SEIMN	Total Zinc	2017	0.98	0.90	<0.001	2.9	
SEIMN	Total Zinc	2018	1.28	0.92	<0.001	3.6	
SEIMN	Total Zinc	2019	1.04	0.81	<0.001	1.7	
SEIMN	Total Zinc	2020	1.34	0.83	<0.001	5.3	
SEIMN	Total Zinc	2021	1.44	0.77	<0.001	7.8	
SEIMN	Total Zinc	2022	1.50	0.88	<0.001	5.9	
SEIMN	Total Zinc	2023	1.10	0.92	<0.001	2.0	
SEIMS	Total Copper	2016	1.92	0.84	<0.001	1.3	
SEIMS	Total Copper	2017	1.22	0.64	<0.001	0.8	
SEIMS	Total Copper	2018	1.57	0.84	<0.001	1.0	
SEIMS	Total Copper	2019	1.41	0.64	<0.001	0.6	
SEIMS	Total Copper	2020	1.60	0.86	<0.001	1.0	
SEIMS	Total Copper	2021	1.63	0.72	<0.001	1.6	
SEIMS	Total Copper	2022	1.36	0.73	<0.001	1.3	
SEIMS	Total Copper	2023	1.58	0.54	0.002	0.7	
SEIMS	Total Nitrogen	2016	1.78	0.75	0.005	1,346.9	
SEIMS	Total Nitrogen	2017	1.32	0.82	<0.001	1,308.2	
SEIMS	Total Nitrogen	2018	1.34	0.97	<0.001	790.6	
SEIMS	Total Nitrogen	2019	1.05	0.59	<0.001	741.8	
SEIMS	Total Nitrogen	2020	1.32	0.89	<0.001	1,041.3	
SEIMS	Total Nitrogen	2021	1.51	0.93	<0.001	1,137.4	
SEIMS	Total Nitrogen	2022	1.07	0.80	<0.001	1,200.0	
SEIMS	Total Nitrogen	2023	1.63	0.39	0.013	709.1	
SEIMS	Total Phosphorus	2016	1.34	0.60	0.009	103.1	
SEIMS	Total Phosphorus	2017	1.43	0.68	<0.001	66.4	
SEIMS	Total Phosphorus	2018	1.16	0.83	<0.001	49.7	
SEIMS	Total Phosphorus	2019	1.19	0.68	<0.001	57.3	
SEIMS	Total Phosphorus	2020	1.53	0.86	<0.001	83.2	
SEIMS	Total Phosphorus	2021	1.72	0.86	<0.001	76.9	
SEIMS	Total Phosphorus	2022	1.21	0.68	0.001	85.5	
SEIMS	Total Phosphorus	2023	1.27	0.32	0.028	53.3	
SEIMS	Total Suspended Solids	2016	1.76	0.67	0.004	40,068.8	
SEIMS	Total Suspended Solids	2017	2.25	0.66	<0.001	45,209.1	
SEIMS	Total Suspended Solids	2018	1.96	0.84	<0.001	19,645.3	
SEIMS	Total Suspended Solids	2019	1.68	0.48	0.001	16,349.9	
SEIMS	Total Suspended Solids	2020	1.94	0.83	<0.001	34,564.3	
SEIMS	Total Suspended Solids	2021	2.37	0.87	<0.001	31,240.0	
SEIMS	Total Suspended Solids	2022	1.31	0.53	0.007	55,577.1	
SEIMS	Total Suspended Solids	2023	1.46	0.17	0.127	33,210.0	Reject
SEIMS	Total Zinc	2016	1.72	0.87	<0.001	5.5	
SEIMS	Total Zinc	2017	1.01	0.65	<0.001	3.6	
SEIMS	Total Zinc	2018	0.89	0.80	<0.001	3.3	
SEIMS	Total Zinc	2019	1.22	0.45	0.002	4.4	
SEIMS	Total Zinc	2020	1.44	0.92	<0.001	3.8	
SEIMS	Total Zinc	2021	1.46	0.68	<0.001	5.2	
SEIMS	Total Zinc	2022	1.07	0.63	0.002	5.3	
SEIMS	Total Zinc	2023	1.34	0.37	0.016	4.3	
COUMO	Total Copper	2016	2.14	0.89	<0.001	9.1	
COUMO	Total Copper	2017	2.07	0.77	<0.001	10.9	
COUMO	Total Copper	2018	1.63	0.90	<0.001	3.8	
COUMO	Total Copper	2019	1.71	0.92	<0.001	2.4	
COUMO	Total Copper	2020	1.54	0.86	<0.001	4.0	
COUMO	Total Copper	2021	1.52	0.83	<0.001	3.7	
COUMO	Total Copper	2022	1.51	0.88	<0.001	4.1	
COUMO	Total Copper	2023	1.58	0.77	<0.001	2.7	

Table B-1. Regression Models and Computed Mass Load Estimates.

Station	Parameter	Water Year	Regression Model Parameters				Result Evaluation
			slope	r2	p-value	Estimated Load (lb)	
COUMO	Total Nitrogen	2016	1.26	0.73	0.004	1,936.3	
COUMO	Total Nitrogen	2017	1.25	0.89	<0.001	1,513.6	
COUMO	Total Nitrogen	2018	1.14	0.98	<0.001	773.9	
COUMO	Total Nitrogen	2019	1.08	0.96	<0.001	472.7	
COUMO	Total Nitrogen	2020	1.12	0.98	<0.001	845.2	
COUMO	Total Nitrogen	2021	1.11	0.97	<0.001	887.7	
COUMO	Total Nitrogen	2022	1.10	0.97	<0.001	1,391.6	
COUMO	Total Nitrogen	2023	1.13	0.85	<0.001	731.2	
COUMO	Total Phosphorus	2016	1.59	0.94	<0.001	155.8	
COUMO	Total Phosphorus	2017	1.39	0.74	<0.001	119.3	
COUMO	Total Phosphorus	2018	1.02	0.89	<0.001	61.6	
COUMO	Total Phosphorus	2019	1.29	0.84	<0.001	83.9	
COUMO	Total Phosphorus	2020	1.14	0.91	<0.001	86.2	
COUMO	Total Phosphorus	2021	1.26	0.91	<0.001	84.9	
COUMO	Total Phosphorus	2022	1.16	0.83	<0.001	130.9	
COUMO	Total Phosphorus	2023	1.07	0.62	<0.001	65.2	
COUMO	Total Suspended Solids	2016	2.16	0.97	<0.001	52,156.0	
COUMO	Total Suspended Solids	2017	2.18	0.80	<0.001	81,619.3	
COUMO	Total Suspended Solids	2018	1.78	0.94	<0.001	25,993.8	
COUMO	Total Suspended Solids	2019	1.99	0.92	<0.001	18,637.4	
COUMO	Total Suspended Solids	2020	1.70	0.80	<0.001	36,571.3	
COUMO	Total Suspended Solids	2021	1.77	0.84	<0.001	31,179.1	
COUMO	Total Suspended Solids	2022	1.78	0.89	<0.001	27,519.5	
COUMO	Total Suspended Solids	2023	1.26	0.30	0.027	22,205.5	
COUMO	Total Zinc	2016	1.83	0.86	<0.001	54.4	
COUMO	Total Zinc	2017	1.86	0.81	<0.001	57.1	
COUMO	Total Zinc	2018	1.62	0.92	<0.001	24.2	
COUMO	Total Zinc	2019	1.49	0.90	<0.001	26.3	
COUMO	Total Zinc	2020	1.17	0.63	<0.001	76.2	
COUMO	Total Zinc	2021	1.54	0.91	<0.001	42.9	
COUMO	Total Zinc	2022	1.42	0.59	0.004	254.4	
COUMO	Total Zinc	2023	2.12	0.68	<0.001	242.7	
COUMI	Total Copper	2016	1.95	0.40	0.049	3.4	
COUMI	Total Copper	2017	2.18	0.82	<0.001	3.5	
COUMI	Total Copper	2018	1.72	0.93	<0.001	1.2	
COUMI	Total Copper	2019	1.71	0.70	<0.001	0.7	
COUMI	Total Copper	2020	1.71	0.89	<0.001	1.7	
COUMI	Total Copper	2021	1.48	0.83	<0.001	1.7	
COUMI	Total Copper	2022	1.26	0.80	<0.001	1.4	
COUMI	Total Copper	2023	1.08	0.53	0.001	0.4	
COUMI	Total Nitrogen	2016	2.14	0.82	0.005	1,926.3	
COUMI	Total Nitrogen	2017	1.30	0.56	0.001	927.7	
COUMI	Total Nitrogen	2018	1.18	0.93	<0.001	290.4	
COUMI	Total Nitrogen	2019	1.28	0.77	<0.001	182.1	
COUMI	Total Nitrogen	2020	1.16	0.96	<0.001	274.9	
COUMI	Total Nitrogen	2021	1.23	0.96	<0.001	427.3	
COUMI	Total Nitrogen	2022	1.14	0.95	<0.001	359.6	
COUMI	Total Nitrogen	2023	0.86	0.49	0.002	121.6	
COUMI	Total Phosphorus	2016	1.32	0.52	0.019	59.1	
COUMI	Total Phosphorus	2017	1.59	0.73	<0.001	85.0	
COUMI	Total Phosphorus	2018	0.96	0.79	<0.001	33.3	
COUMI	Total Phosphorus	2019	1.24	0.84	<0.001	35.2	
COUMI	Total Phosphorus	2020	1.26	0.93	<0.001	49.9	
COUMI	Total Phosphorus	2021	1.31	0.90	<0.001	56.2	
COUMI	Total Phosphorus	2022	1.17	0.87	<0.001	43.4	
COUMI	Total Phosphorus	2023	0.67	0.46	0.004	16.5	

Table B-1. Regression Models and Computed Mass Load Estimates.

Station	Parameter	Water Year	Regression Model Parameters				Result Evaluation
			slope	r2	p-value	Estimated Load (lb)	
COUMI	Total Suspended Solids	2016	1.85	0.39	0.052	26,336.2	Reject
COUMI	Total Suspended Solids	2017	2.50	0.75	<0.001	139,878.4	
COUMI	Total Suspended Solids	2018	1.46	0.75	<0.001	19,397.2	
COUMI	Total Suspended Solids	2019	1.87	0.80	<0.001	11,870.7	
COUMI	Total Suspended Solids	2020	1.78	0.90	<0.001	25,375.5	
COUMI	Total Suspended Solids	2021	1.83	0.88	<0.001	34,697.5	
COUMI	Total Suspended Solids	2022	1.52	0.81	<0.001	20,923.7	
COUMI	Total Suspended Solids	2023	0.94	0.22	0.066	4,855.1	Reject
COUMI	Total Zinc	2016	2.03	0.75	0.001	27.5	
COUMI	Total Zinc	2017	1.85	0.77	<0.001	19.7	
COUMI	Total Zinc	2018	1.71	0.92	<0.001	6.3	
COUMI	Total Zinc	2019	1.85	0.85	<0.001	8.0	
COUMI	Total Zinc	2020	1.49	0.83	<0.001	16.4	
COUMI	Total Zinc	2021	1.52	0.87	<0.001	22.1	
COUMI	Total Zinc	2022	1.16	0.61	0.003	25.4	
COUMI	Total Zinc	2023	1.24	0.58	0.001	7.2	
TYLMO	Total Copper	2016	1.95	0.93	<0.001	15.4	
TYLMO	Total Copper	2017	1.66	0.78	<0.001	10.8	
TYLMO	Total Copper	2018	1.39	0.97	<0.001	4.4	
TYLMO	Total Copper	2019	1.43	0.93	<0.001	3.6	
TYLMO	Total Copper	2020	1.56	0.94	<0.001	5.7	
TYLMO	Total Copper	2021	1.20	0.87	<0.001	4.6	
TYLMO	Total Copper	2022	1.30	0.91	<0.001	6.8	
TYLMO	Total Copper	2023	1.28	0.89	<0.001	7.9	
TYLMO	Total Nitrogen	2016	1.29	0.94	<0.001	1,083.2	
TYLMO	Total Nitrogen	2017	1.10	0.92	<0.001	1,252.6	
TYLMO	Total Nitrogen	2018	1.10	0.97	<0.001	735.5	
TYLMO	Total Nitrogen	2019	0.99	0.96	<0.001	432.7	
TYLMO	Total Nitrogen	2020	0.96	0.96	<0.001	845.9	
TYLMO	Total Nitrogen	2021	1.03	0.97	<0.001	774.1	
TYLMO	Total Nitrogen	2022	1.03	0.97	<0.001	1,184.3	
TYLMO	Total Nitrogen	2023	1.11	0.96	<0.001	1,126.7	
TYLMO	Total Phosphorus	2016	1.27	0.90	<0.001	86.2	
TYLMO	Total Phosphorus	2017	1.36	0.84	<0.001	100.8	
TYLMO	Total Phosphorus	2018	1.02	0.90	<0.001	61.5	
TYLMO	Total Phosphorus	2019	1.16	0.92	<0.001	55.7	
TYLMO	Total Phosphorus	2020	1.11	0.93	<0.001	64.4	
TYLMO	Total Phosphorus	2021	1.06	0.88	<0.001	86.4	
TYLMO	Total Phosphorus	2022	1.26	0.91	<0.001	95.0	
TYLMO	Total Phosphorus	2023	1.01	0.81	<0.001	66.2	
TYLMO	Total Suspended Solids	2016	1.95	0.93	<0.001	36,390.6	
TYLMO	Total Suspended Solids	2017	1.82	0.71	<0.001	57,583.7	
TYLMO	Total Suspended Solids	2018	1.48	0.90	<0.001	24,426.1	
TYLMO	Total Suspended Solids	2019	1.51	0.85	<0.001	19,741.4	
TYLMO	Total Suspended Solids	2020	1.47	0.85	<0.001	21,389.7	
TYLMO	Total Suspended Solids	2021	1.36	0.74	<0.001	48,204.0	
TYLMO	Total Suspended Solids	2022	2.02	0.93	<0.001	33,023.4	
TYLMO	Total Suspended Solids	2023	1.33	0.57	0.001	49,954.6	
TYLMO	Total Zinc	2016	1.75	0.95	<0.001	41.0	
TYLMO	Total Zinc	2017	1.70	0.82	<0.001	58.7	
TYLMO	Total Zinc	2018	1.32	0.94	<0.001	19.8	
TYLMO	Total Zinc	2019	1.56	0.81	<0.001	53.3	
TYLMO	Total Zinc	2020	1.30	0.97	<0.001	18.4	
TYLMO	Total Zinc	2021	1.24	0.90	<0.001	33.5	
TYLMO	Total Zinc	2022	1.27	0.94	<0.001	34.1	
TYLMO	Total Zinc	2023	1.22	0.88	<0.001	24.8	

Table B-1. Regression Models and Computed Mass Load Estimates.								
Station	Parameter	Water Year	Regression Model Parameters				Result Evaluation
			slope	r2	p-value	Estimated Load (lb)	
TYLMI	Total Copper	2016	1.35	0.73	0.002	3.1	
TYLMI	Total Copper	2017	1.26	0.85	<0.001	1.6	
TYLMI	Total Copper	2018	1.27	0.97	<0.001	1.5	
TYLMI	Total Copper	2019	1.00	0.85	<0.001	1.5	
TYLMI	Total Copper	2020	1.03	0.79	<0.001	2.1	
TYLMI	Total Copper	2021	1.05	0.84	<0.001	1.6	
TYLMI	Total Copper	2022	1.04	0.87	<0.001	1.2	
TYLMI	Total Copper	2023	0.89	0.76	<0.001	0.5	
TYLMI	Total Nitrogen	2016	1.07	0.85	0.001	337.6	
TYLMI	Total Nitrogen	2017	0.98	0.89	<0.001	532.8	
TYLMI	Total Nitrogen	2018	0.95	0.98	<0.001	386.7	
TYLMI	Total Nitrogen	2019	0.92	0.92	<0.001	286.1	
TYLMI	Total Nitrogen	2020	0.96	0.98	<0.001	337.1	
TYLMI	Total Nitrogen	2021	0.98	0.97	<0.001	323.0	
TYLMI	Total Nitrogen	2022	1.02	0.97	<0.001	381.5	
TYLMI	Total Nitrogen	2023	0.95	0.93	<0.001	135.8	
TYLMI	Total Phosphorus	2016	1.43	0.80	0.001	39.0	
TYLMI	Total Phosphorus	2017	1.31	0.88	<0.001	21.6	
TYLMI	Total Phosphorus	2018	1.18	0.92	<0.001	17.0	
TYLMI	Total Phosphorus	2019	1.29	0.91	<0.001	25.6	
TYLMI	Total Phosphorus	2020	1.18	0.92	<0.001	26.5	
TYLMI	Total Phosphorus	2021	1.11	0.75	<0.001	37.0	
TYLMI	Total Phosphorus	2022	1.11	0.81	<0.001	21.2	
TYLMI	Total Phosphorus	2023	0.88	0.58	0.001	8.5	
TYLMI	Total Suspended Solids	2016	1.89	0.73	0.002	46,449.9	
TYLMI	Total Suspended Solids	2017	1.73	0.78	<0.001	13,871.4	
TYLMI	Total Suspended Solids	2018	1.28	0.84	<0.001	6,901.1	
TYLMI	Total Suspended Solids	2019	1.48	0.89	<0.001	6,333.0	
TYLMI	Total Suspended Solids	2020	1.11	0.76	<0.001	6,679.1	
TYLMI	Total Suspended Solids	2021	1.33	0.73	<0.001	11,416.9	
TYLMI	Total Suspended Solids	2022	0.99	0.72	<0.001	5,044.5	
TYLMI	Total Suspended Solids	2023	0.71	0.23	0.059	1,386.0	Reject
TYLMI	Total Zinc	2016	1.17	0.41	0.045	6.8	
TYLMI	Total Zinc	2017	1.08	0.56	0.001	6.6	
TYLMI	Total Zinc	2018	1.28	0.80	<0.001	11.8	
TYLMI	Total Zinc	2019	0.93	0.69	<0.001	4.9	
TYLMI	Total Zinc	2020	0.95	0.70	<0.001	5.7	
TYLMI	Total Zinc	2021	1.07	0.58	0.002	51.7	
TYLMI	Total Zinc	2022	1.02	0.81	<0.001	8.3	
TYLMI	Total Zinc	2023	0.72	0.52	0.002	3.0	