

Redmond Paired Watershed Study

Stormwater Work Group (SWG) Meeting

September 9, 2026



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King County



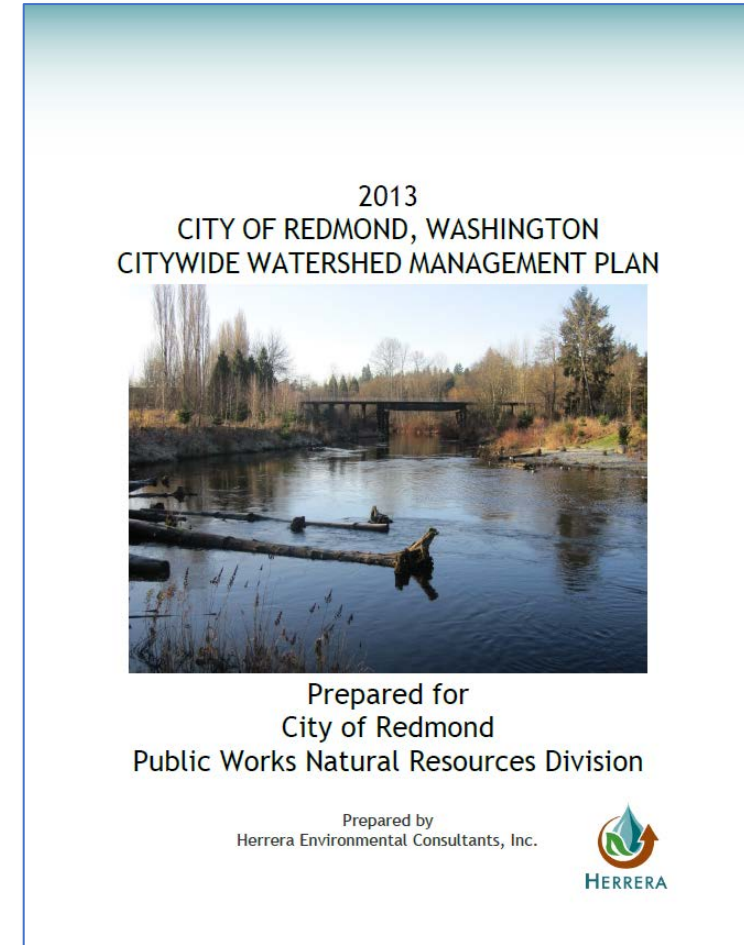
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Background

Redmond Paired Watershed Study

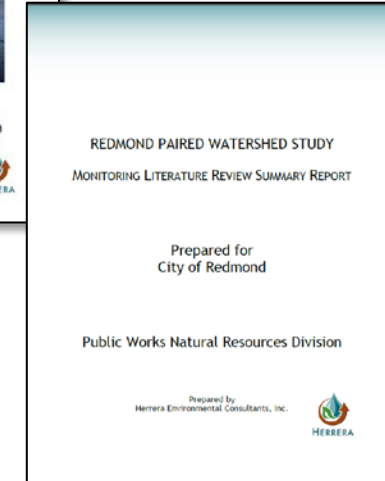
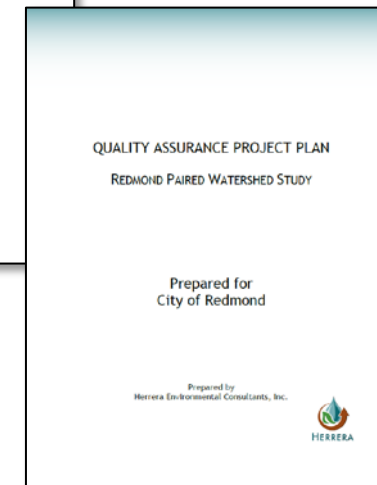
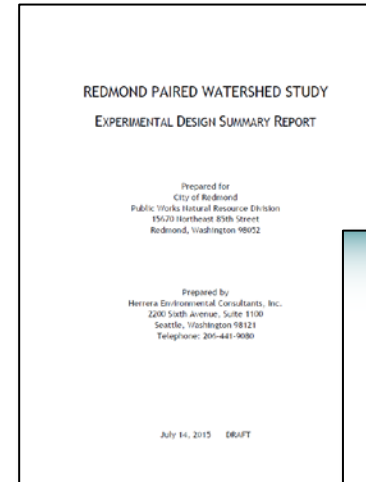
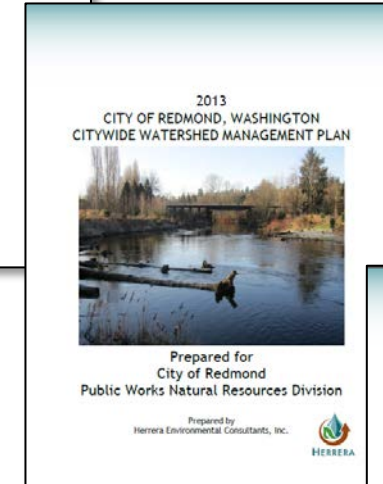
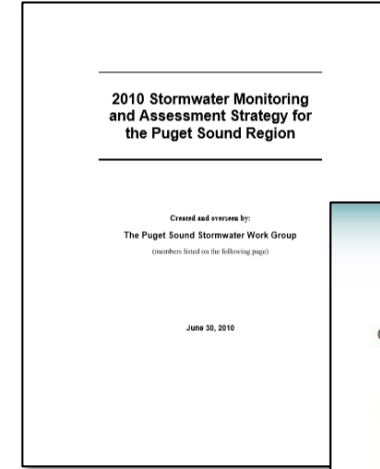
- **Redmond Citywide Watershed Management Plan**
- **Approved in February 2014**
- **Goals**
 - Provide baseline of scientific information evaluating watershed rehabilitation potential
 - Prioritize a subset of watersheds with greatest potential to respond to rehabilitation efforts
 - Identify specific tools to rehabilitate highest priority watersheds by 2060
 - Established an adaptive management framework for evaluating the effectiveness of the plan



Project History

Redmond Paired Watershed Study

- Stormwater Monitoring and Assessment Strategy for the Puget Sound Region – June 2010
- Redmond Citywide Watershed Management Plan – November 2013
- SAM Effectiveness Monitoring Study Selection - 2015
- Redmond Paired Watershed Study Monitoring and Literature Review Summary Report – April 2015
- Redmond Paired Watershed Study Experimental Design Summary Report – July 2015
- Redmond Paired Watershed Study Quality Assurance Project Plan – December 2015
- Monitoring Initiates – October 2015



Study Question

Redmond Paired Watershed Study

Are stormwater retrofits effective at rehabilitating receiving water conditions in small urbanized streams?

Study Question

Redmond Paired Watershed Study

- Shuster, W. and L. Rhea (2013). "Catchment-scale hydrologic implications of parcel-level stormwater management (Ohio USA)." *Journal of Hydrology* 485: 177-187.
- Selbig, W. R., et al. (2008). A comparison of runoff quantity and quality from two small basins undergoing implementation of conventional and low-impact-development (LID) strategies : Cross Plains, Wisconsin, water years 1999-2005. Reston, Virginia, U.S. Geological Survey.
- Roy, A. H., et al. (2014). "How Much Is Enough? Minimal Responses of Water Quality and Stream Biota to Partial Retrofit Stormwater Management in a Suburban Neighborhood." *Plos One* 9(1).
- Pitt, R., et al. (2013). Performance Results from Small- and Large-Scale System Monitoring and Modeling of Intensive Applications of Green Infrastructure In Kansas City. 2013 International Low Impact Development Symposium, Saint Paul, Minnesota.
- Bedan, E. S. and J. C. Clausen (2009). "Stormwater Runoff Quality and Quantity From Traditional and Low Impact Development Watersheds(1)." *Journal of the American Water Resources Association* 45(4): 998-1008.

Project Team

Redmond Paired Watershed Study



- Program Development and Oversight
- Funding
- Stakeholder Coordination
- Contract Administration



- Sponsor Jurisdiction
- Project Management



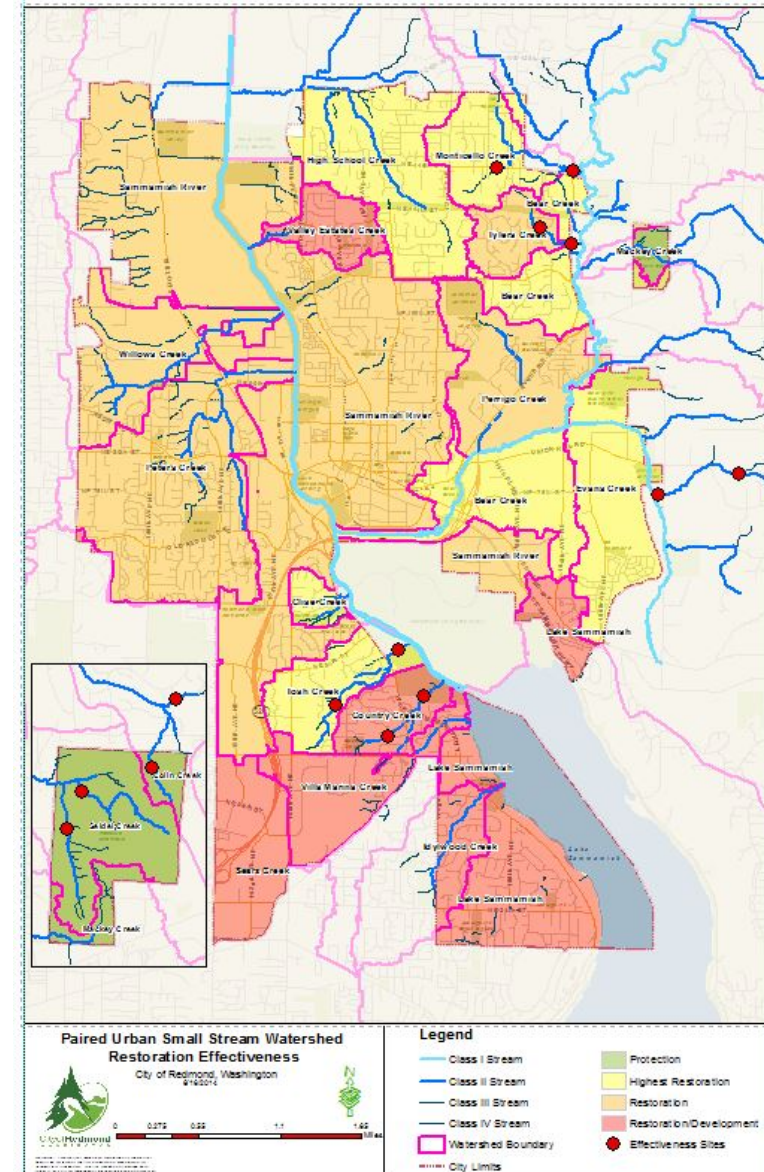
- Experimental Design
- Field Data Collection
- Quality Assurance / Quality Control
- Data Management and Analysis
- Reporting



Experimental Design

Redmond Paired Watershed Study

- **Three “Application” watersheds**
 - Moderately impacted by urbanization
 - Prioritized for rehabilitation efforts
- **Two “Reference” watersheds**
 - Relatively pristine
 - Not subject to rehabilitation efforts
- **Two “Control” watersheds**
 - Heavily impacted by urbanization
 - Not subject to rehabilitation efforts



Experimental Design

Redmond Paired Watershed Study

Watershed Type	Watershed Name	WQ & Flow Sites (#)	Physical Habitat Sites (#)	Dominant Land Use/Cover	Watershed Areas (acres)	Watershed Area in Redmond (acres)
Reference	Colin	1	1	Forest	1,990	90
Reference	Seidel	2	3	Forest	1,188	615
Application	Monticello	3	5	Residential/Commercial	345	264
Application	Tosh	2	4	Residential/Commercial	299	276
Application	Evans	2	2	Residential	397	0
Control	Tyler's	2	2	Residential/Commercial	168	167
Control	Country	2	2	Residential/Commercial	212	212

Experimental Design

Redmond Paired Watershed Study

Status and Trends Monitoring: Routine measurements of various indicators of stream health over an extended time frame to quantify improvements in receiving water conditions in response to watershed rehabilitation efforts.

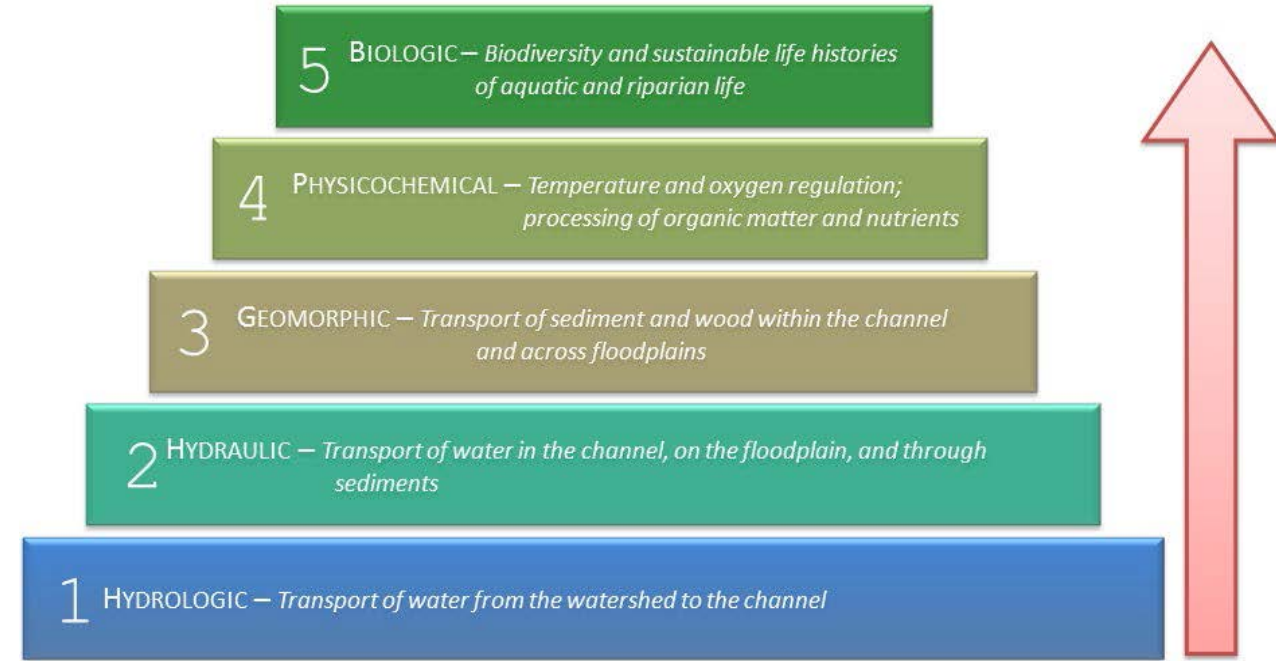
Effectiveness Monitoring: Measurements over a relatively short time frame to document the effectiveness of specific structural and nonstructural stormwater controls.



Experimental Design – Status and Trends

Redmond Paired Watershed Study

- **Hydrologic monitoring**
 - Continuous
- **Water quality monitoring**
 - 12 storm flow events annually
 - 4 base flow events annually
 - Continuous in-situ
- **Habitat quality monitoring**
 - Annually – biennially (WY2021)
- **Sediment quality monitoring**
 - Annually – biennially (WY2021)
- **Biological monitoring**
 - Annually



Rehabilitation Effort Summary

Redmond Paired Watershed Study

- **Evans Creek**
 - WY2017 – Construction of two detention vaults
- **Monticello Creek**
 - WY2025 – Habitation restoration
 - WY2024 - CMAC retrofits on two existing City ponds – Cogen Allen and Wynstone
 - WY2023 – CMAC retrofits on two existing King County ponds
 - WY2024 – Monthly street sweeping
 - WY2024 – Habitat restoration
 - WY2023 – Habitat restoration
 - WY2022 – Habitation restoration
 - WY2021 –CMAC retrofits on two existing City ponds – Curry East and Whistler Ridge
 - WY2021 – Riparian zone enhancements in three locations
 - WY2017 – WY2019 – Street Sweeping Project
 - August 2017 – September 2018: monthly
 - October 2018 – September 2019: twice per month



Rehabilitation Effort Summary

Redmond Paired Watershed Study

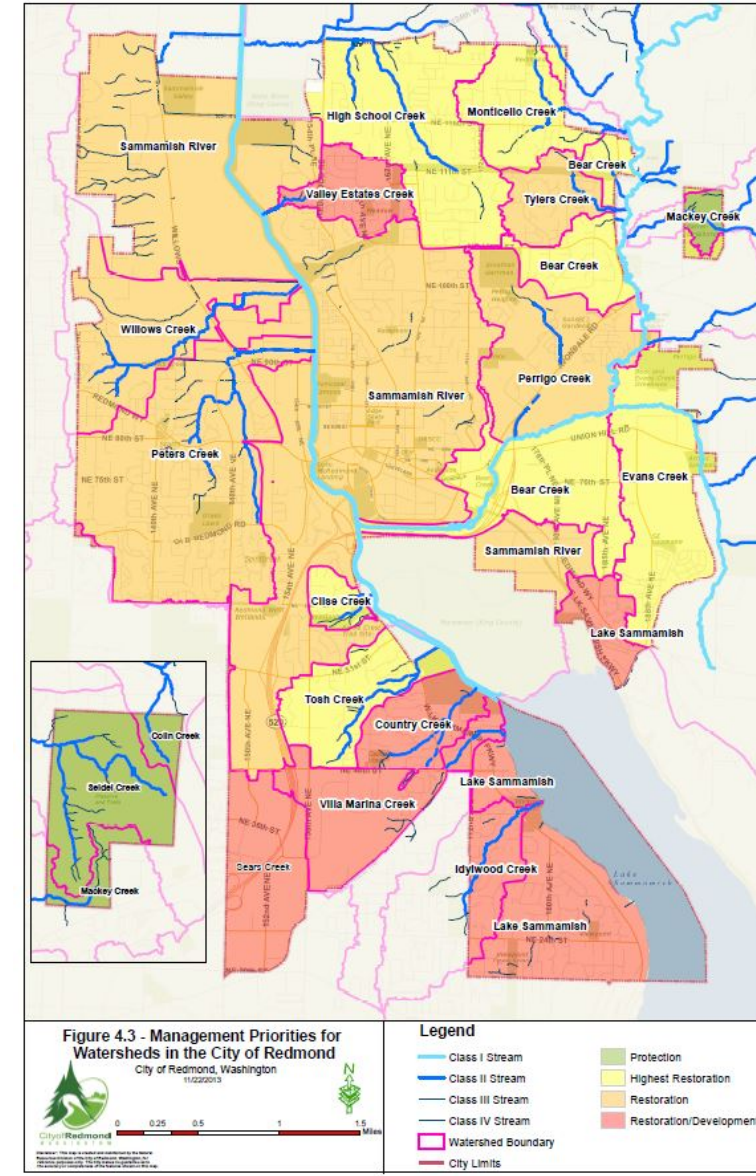
- **Tosh Creek**
 - WY2025 – Habitat enhancements at two locations
 - WY2023 – WY2024 – Street Sweeping Project
 - October 2022 – September 2023: monthly
 - October 2023 – September 2024: twice per month
 - WY2024 – Riparian zone enhancements
 - WY2021 – Maintenance of existing riparian zone enhancements
 - WY2019 – Riparian zone enhancements
 - WY2017 – High flow bypass weir adjustment
 - WY2017 – Large woody debris installation



Trend Analysis Report – WY2016 through WY2023

Redmond Paired Watershed Study

- **Pattern of Interest**
 - Receiving water conditions are improving in the Application watersheds
 - Conditions are remaining static or deteriorating in Control and Reference watersheds



Redmond Paired Watershed Study

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- Figure 3. Monticello Creek Paired Watershed Study Monitoring Locations.**
- City of Redmond, Washington
6/20/2018
- Legend**
- Class I Waters
 - Class II Waters
 - Class III Waters
 - Class IV Waters
 - Ponds
 - City Limits
 - Watershed Boundary
 - Commercial
 - Industrial
 - Multifamily
 - Park / Undeveloped
 - Public PCSD
 - Single Family High Density
 - Single Family Low Density
 - Single Family Medium Density
 - Single Family Rural Density
 - Forest / Wetland / Designated Watershed
 - Flow M/W Monitoring
- Scale: 0 0.0375 0.075 0.15 Miles

Trend Analysis Report – WY2016 through WY2023

Redmond Paired Watershed Study

- Significant decreasing trend in rainfall runoff response at majority of stations.
- Drier years observed as study has progressed.

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 ($\alpha = 0.05$).

Effectiveness Monitoring

Redmond Paired Watershed Study

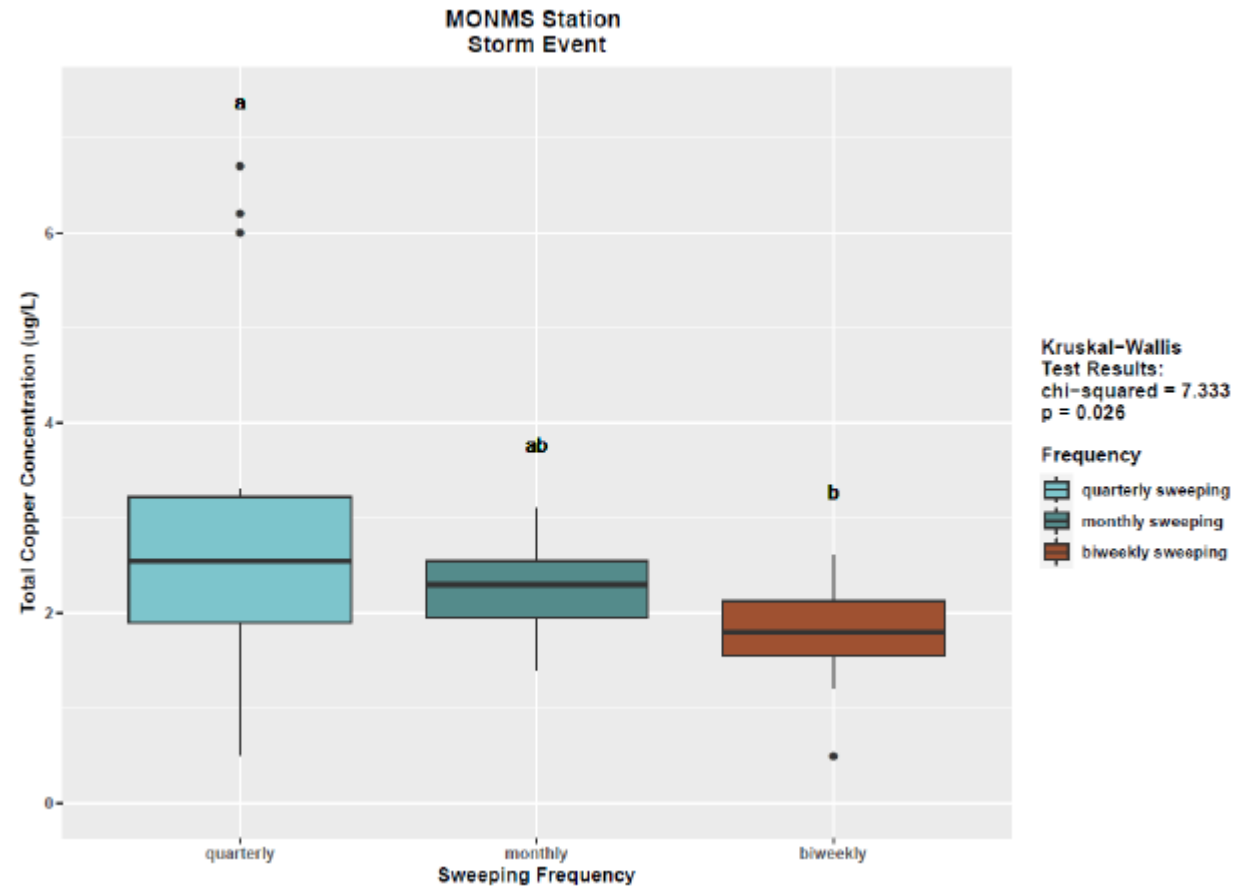
- **Evans Creek Vaults: WY2016 – WY2019**
- **Monticello Creek Street Sweeping Study: WY2017 – WY2019**
- **Monticello Creek CMAC pond retrofit study: WY2023 – WY2024**
- **Tosh Creek Street Sweeping Study: WY2023 – WY2024**



Effectiveness Monitoring – Monticello Creek Street Sweeping Study

Redmond Paired Watershed Study

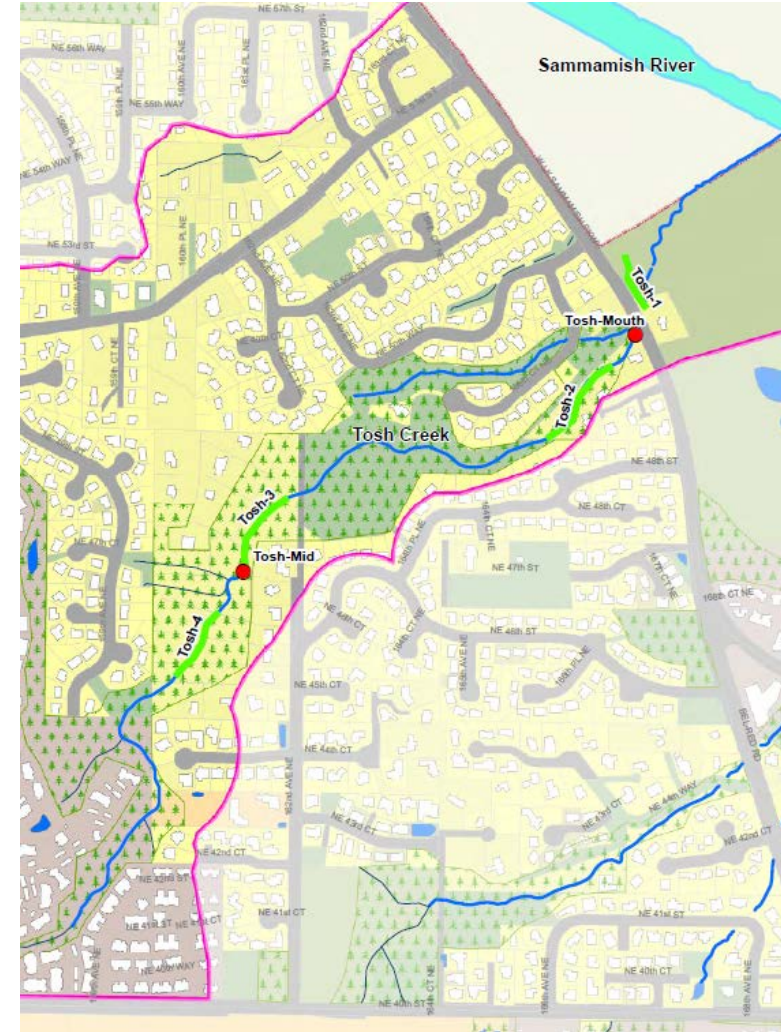
- WY2017 – WY2019
- Statistically significant reductions in copper and TSS confirmed through multiple analyses (correlation, load reduction, before and after)
 - Sampling conducted instream
- Results consistent with SPU street sweeping study
 - Significant reduction in particulate copper and coarse sediment (>250 microns)
 - Sampling conducted at edge of pavement



Effectiveness Monitoring – Tosh Creek Street Sweeping Study

Redmond Paired Watershed Study

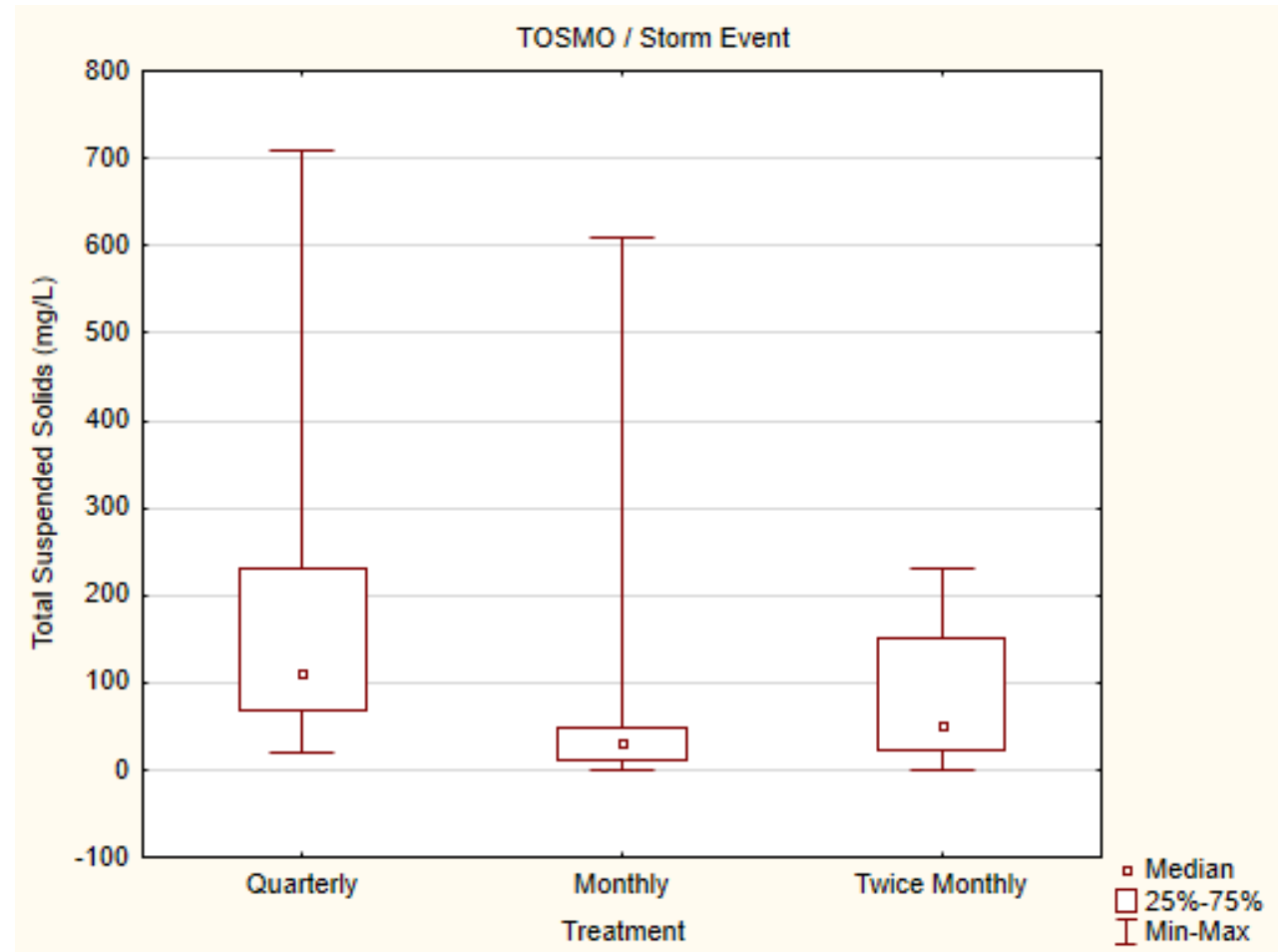
- WY2023 –WY2024
- Goals:
 - Validate the results from the Monticello Creek Street Sweeping Study
 - Evaluate the effectiveness of Street Sweeping for 6PPDQ and PAH removal
- Experimental Design
 - Augment existing status and trends monitoring with additional parameters
 - Experimental and control watersheds
 - Tosh Creek – increased street sweeping; quarterly, monthly, twice monthly
 - Country Creek – no increased street sweeping; quarterly only



Effectiveness Monitoring – Tosh Creek Street Sweeping Study

Redmond Paired Watershed Study

- TSS and particulate copper concentrations decreased slightly in both Tosh and Country Creeks between 2021 and 2024, but no measurable difference could be attributed to the increased sweeping frequency
- Consistent decreasing trend also not observed for 6PPDQ and PAHs in response to the increased street sweeping



Effectiveness Monitoring – Tosh Creek Street Sweeping Study

Redmond Paired Watershed Study

Hydrologic and land use factors likely influencing different responses to street sweeping - street-to-stream connectivity!

- **Tosh Creek Watershed**
 - **Runoff from busy public roads mostly routed through stormwater systems that discharge to wetlands north of the creek**
 - **Two large multifamily complexes not included in street sweeping program**
 - **0.8 outfalls per 1,000 feet of creek**
- **Country Creek Watershed**
 - **1.6 outfalls per 1,000 feet**
- **Monticello Creek Watershed**
 - **3.5 outfalls per 1,000 feet**

Effectiveness Monitoring – Tosh Creek Street Sweeping Study

Redmond Paired Watershed Study

Conclusions

- Results could not be used to validate results from previous studies that showed street sweeping is effective at reducing instream concentrations of TSS and total copper
- Results do not indicate street sweeping is effective at reducing instream 6PPDQ and PAHs concentrations
- Results suggest that street sweeping is potentially more effective when there is high degree of street-to-stream connectivity

Recently Completed

Redmond Paired Watershed Study

- **Effectiveness monitoring report for CMAC pond retrofits**
- **WY2025 Data Summary Report**
- **Street Sweeping Study Factsheet**

Next Steps

Redmond Paired Watershed Study

- **Final Trend Analysis Report: WY2016 – WY2025**
- **Data Dashboard**

Acknowledgements

Redmond Paired Watershed Study



King County

Department of Natural Resources and Parks
Wastewater Treatment Division



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