Revised Willamette Basin Mercury Total Maximum Daily Load Implementation

Water Quality, TMDL Program

June 13, 2019
Executive Building, Salem

Gene Foster, Janani Govindan, Alex Liverman, Andrea Matzke, Priscilla Woolverton, Paula Calvert | Oregon Department of Environmental Quality

Instream Total Suspended Solids (TSS)-Total Mercury (THg) Surrogate Analysis for the Willamette River Basin

Water Quality, TMDL Program

Janani Govindan and Dan Sobota

June 13, 2019

Executive Building, Salem

Introduction

- **Why did ODEQ conduct this analysis?**
  - To assess if TSS concentration can be used to predict instream THg concentration across the Willamette River Basin

- **Why would we want to use TSS (surrogate) instead of THg?**
  - Easier to collect and measure
  - Less expensive to analyze

Big Picture

The TMDL is being developed to protect the most sensitive beneficial uses for mercury, which are: Fish and Aquatic Life; Wildlife and Hunting; and Fishing (fish consumption).

Source: Oregon Department of Fish and Wildlife

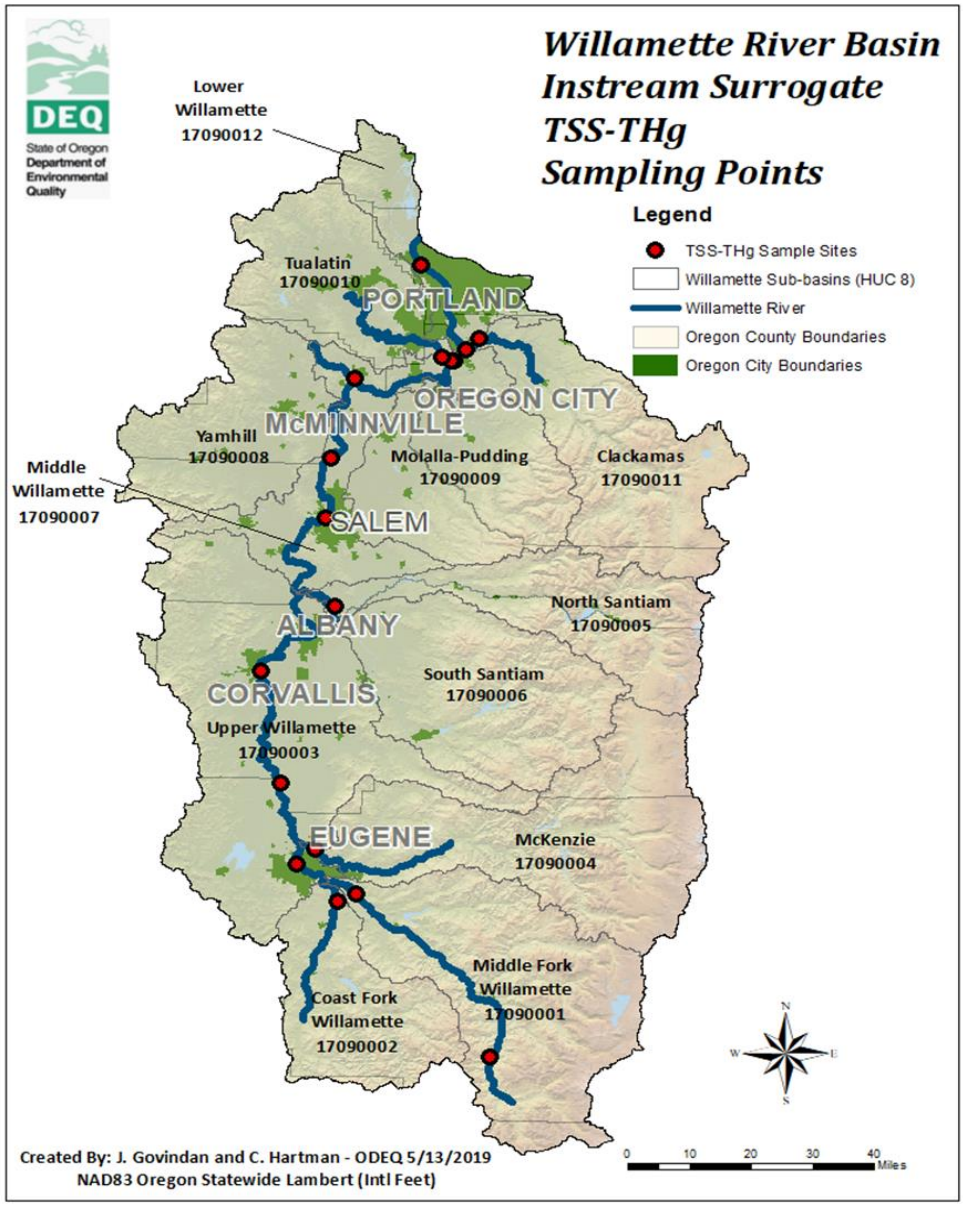
Source: KGW News

Dataset Information

- **63 instream paired samples of TSS and THg concentrations collected at the same time and date**
  - Willamette River Basin Mercury Database (WRB Hg database)
  - Provided by TetraTech
  - All paired samples had detected mercury concentrations

- **Samples came from 17 sites within nine HUC 8 subbasins in the Willamette River Basin**

Sampling Sites Map



Number of Samples	HUC 8 Code	HUC 8 Description
3	17090001	Middle Fork Willamette
4	17090001	Middle Fork Willamette
4	17090002	Coast Fork Willamette
3	17090003	Upper Willamette
4	17090003	Upper Willamette
4	17090003	Upper Willamette
4	17090004	McKenzie
4	17090005	North Santiam
4	17090007	Middle Willamette
4	17090007	Middle Willamette
4	17090007	Middle Willamette
4	17090007	Middle Willamette
1	17090007	Middle Willamette
4	17090010	Tualatin
4	17090011	Clackamas
4	17090011	Clackamas
4	17090012	Lower Willamette

Methodology

Three models were assessed in the analysis:

1. **Ordinary Least Squares Model ("Traditional Regression Model")**
   - TSS as Predictor Variable (fixed effect)
   - THg as the Predicted Variable

   Linear Mixed Effects Model with Sites as a Random Effect

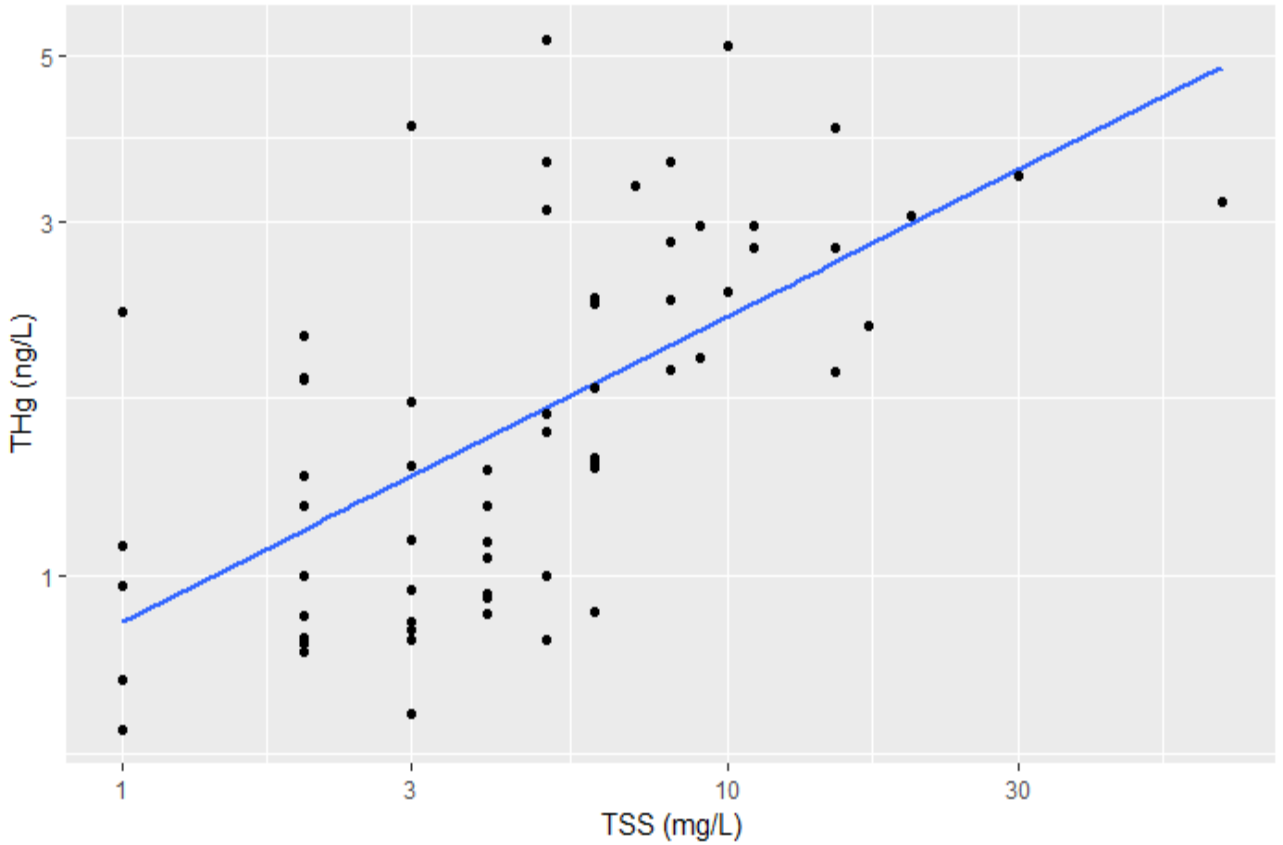
2. **Excluded Seasons**
   - TSS as Predictor Variable (fixed effect)
   - Sites differences (random effect)
   - THg as the Predicted Variable

3. **Included Seasons**
   - TSS, Seasons (dry/wet seasons) as Predictor Variables (fixed effects)
   - Site differences (random effect)
   - THg as the Predicted Variable

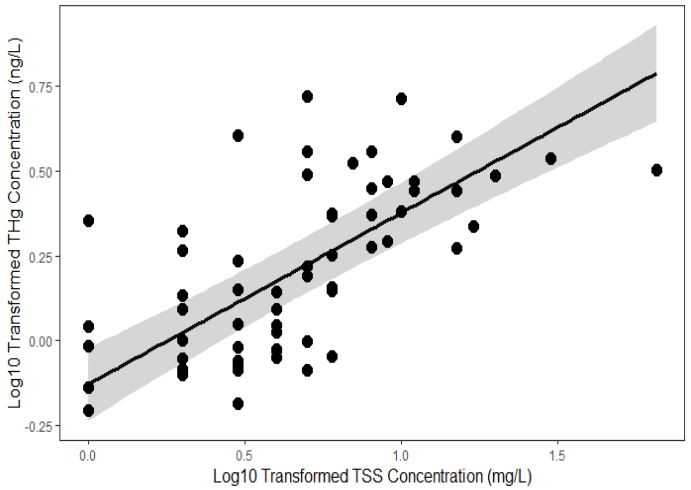
Results

(1) Ordinary Least Squares Model

Explained 32% of the variance in THg



Results Continued…



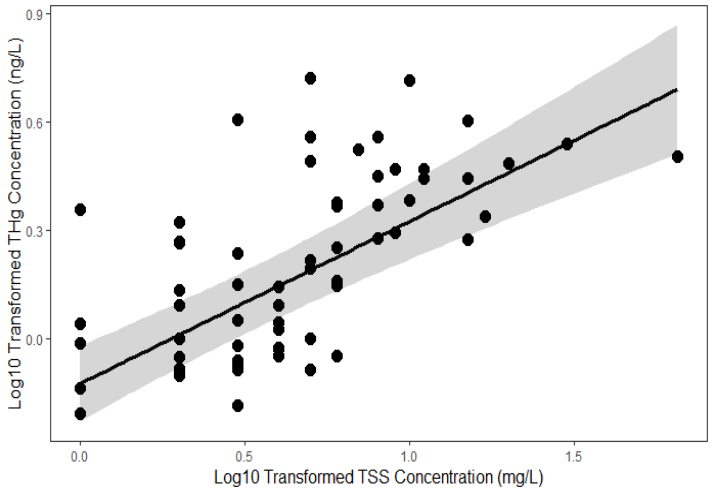
Linear Mixed Effects Model with Sites as a Random Effect

(2) Sites only

(3) Sites and Seasons (dry/wet)

Explained 81% of the variance in THg

Explained 80% of the variance in THg



Conclusion

- Site location plays a more significant role than seasonal difference (dry vs. wet period)

- **DEQ selected the Linear Mixed Effects model with sites only for the instream analysis**

Recommendations

- **The Linear Mixed Effects Model with Sites Only:**

  log_{10}(THg conc.) = 0.506 x log_{10}(TSS conc.) - 0.089

- **The LME model equation can be used to:**
  - Estimate TSS concentrations and percent reductions in THg concentrations to meet instream TMDL targets for the Willamette River Basin

Update on the additional paired samples

- Initially planned on using surrogate TSS-THg sample pairs collected from several MS4 permit holders (i.e. City of Portland, Clean Water Services) in order to do a cross-validation of the LME model excluding seasons

- Found spatial patterns within the dataset that would require us to create another linear model for the additional paired samples

- **A separate analysis will be done using the additional paired TSS-THg samples from several MS4 permit holders**

Questions?

References

- Hajduk. G.K. (2017). Introduction to linear mixed models. Retrieved from https://ourcodingclub.github.io/2017/03/15/mixed-models.html

- Helwig, N.E. (2017). Linear-Mixed Effects Regression. Retrieved from http://users.stat.umn.edu/~helwig/notes/lmer-Notes.pdf R Core Team (2018). R: A language and environment for statistical computing. R Foundation for Statistical. Computing, Vienna, Austria. URL https://www.R-project.org/.

- Kalnejais, L. H., Martin, W. R., Signell, R. P., & Bothner, M. H. (2007). Role of sediment resuspension in the remobilization of particulate-phase metals from coastal sediments. Environmental Science & Technology, 41(7), 2282-2288.

- Nakagawa, S., Schielzeth, H. (2013) A general and simple method for obtaining R2 from Generalized Linear Mixed-effects Models. Methods in Ecology and Evolution 4: 133–142

- State of Oregon: Oregon Department of Environmental Quality. (2006). Willamette Basin Mercury TMDL

- TetraTech.(2018). Draft Memorandum: Potential THg Surrogate Measures.

Revised Willamette Basin Mercury Total Maximum Daily Load Waste Load Allocations Approach

Water Quality, TMDL Program

June 13, 2019
Executive Building
Salem

Alex Liverman | Oregon Department of Environmental Quality

Willamette Mercury TMDL Allocations

Sector	Allocation (% Reduction)	LA/WLA
General Nonpoint Source • Forestry • Agriculture • Water Impoundments/dams • Water Conveyance entities • Background sources of mercury* (see definitions)	88%	LA
Mining (NPS)	95%	LA
Non-Permitted Urban Stormwater (NPS)	75%	LA
Atmospheric deposition (NPS)	10%	LA
NPDES wastewater dischargers (PS)	10%	WLA
MS4 stormwater dischargers (PS)	75%	WLA

Waste Load Allocation Implementation Approach

- Application of mercury and erosion minimization and control measures appropriate to the sector, facility, land use, or activity will be most effective for optimizing reductions.
- Permittees are responsible for applying controls with measurable objectives linked to activities that contribute to the total mercury load from their facilities/jurisdictions. Goal is to show progress towards 10% and 75% reduction as overall sectors.

Stormwater WLA Implementation

MS4 Phase I

- Implement mercury minimization and erosion control measures
- Monitor paired Total Mercury and Total Suspended Solids (TSS)
- Report data and BMP effectiveness analysis

MS4 Phase II

- Implement the MS4 Phase II general permit, effective March 2019, or
- For individual Phase II permit coverage:
  - Develop and implement mercury minimization and erosion control measures
  - Monitor and report BMP effectiveness

General Stormwater (1200A, 1200Z, 1200C/CN/CA)

- Loads implicit to MS4 loads – existing requirements to control erosion and TSS

Wastewater WLA Implementation

<u>Major STPs and Industrials</u> with activities that may increase Hg in discharge and adequate data

- determine effluent level currently being achieved
- implement mercury minimization plan (MMP)
- monitor Total mercury
- report data & MMP effectiveness measures

<u>Industrials</u> with activities that may increase Hg in discharge, but insufficient data

- monitor Total mercury
- after 2 years, determine potential load and level currently being achieved
- MMP, if warranted – implement at next permit renewal
- report data and, if applicable, MMP effectiveness measures

<u>700PM</u>

- In addition to prohibition of suction dredging in streams 303(d) listed for mercury also prohibit suction dredging in streams tributary to Dorena Reservoir

SIC Categories that may increase mercury in discharge:

- **timber products**
- **paper products**
- **chemical products**
- **glass/clay/cement/concrete/gypsum products**
- **primary metal industries**
- **fabricated metal products**
- **electronics and instruments**

Variances

- Wastewater permits require Water Quality Based Effluent Limit – WQBEL based either on the standard or a TMDL WLA
- 0.14 ng/L would be the numeric WQBEL in permits if there were no TMDL and no variance.
- Multi Discharger Variance allows DEQ to issue permits in the Willamette Basin, if TMDL is delayed.
- DEQ's proposed TMDL implementation and MDV both include application of mercury minimization plans.

Water Quality Management Plan

Nonpoint Source Implementation: Questions & Answers

June 13, 2019

Urban Stormwater Sector

(non MS4 and MS4 communities)

ACWA Questions

- Why were the Port of Portland, Clean Water Services and Oak Lodge Water Services District called out separately?

- Questions around how the 6 minimum SW control measures would be applied to MS4s and how TMDL implementation plans would apply

Proposed Approach: Implement Six Stormwater Control Measures

1. Pollution Prevention and Good Housekeeping for Municipal Operations
2. Public Education and Outreach
3. Public Involvement and Participation
4. Illicit Discharge Detection and Elimination
5. Construction Site Runoff Control
6. Post-Construction Site Runoff for New Development and Redevelopment

Proposed Approach: Applicable Communities (21)

According to PSU's 2018 certified population estimates (>5K):

1. Canby
2. Columbia County
3. Cottage Grove
4. **Dallas**
5. Lebanon
6. McMinnville
7. **Newberg**
8. St. Helens
9. **Woodburn**
10. Sandy
11. Silverton
12. Yamhill County
13. Creswell
14. Independence
15. Junction City
16. Molalla
17. Monmouth
18. Scappoose
19. Sheridan
20. Stayton
21. Sweet Home

+ MS4s outside of "urbanized areas"

Bolded text = had stormwater requirements in 2006 TMDL

TMDL Designated Management Agency

Phase I and Phase II MS4s

TMDL implementation plan must address a MS4 permittee's **entire** jurisdiction, including within and outside of the urbanized area.

The urbanized area is regulated by a MS4 permit, which is prescriptive about what strategies and actions must be implemented. Permit- related strategies and actions are included in a TMDL implementation plan by reference.

Strategies and actions that are implemented outside of the urbanized area are included in detail in the TMDL implementation plan.

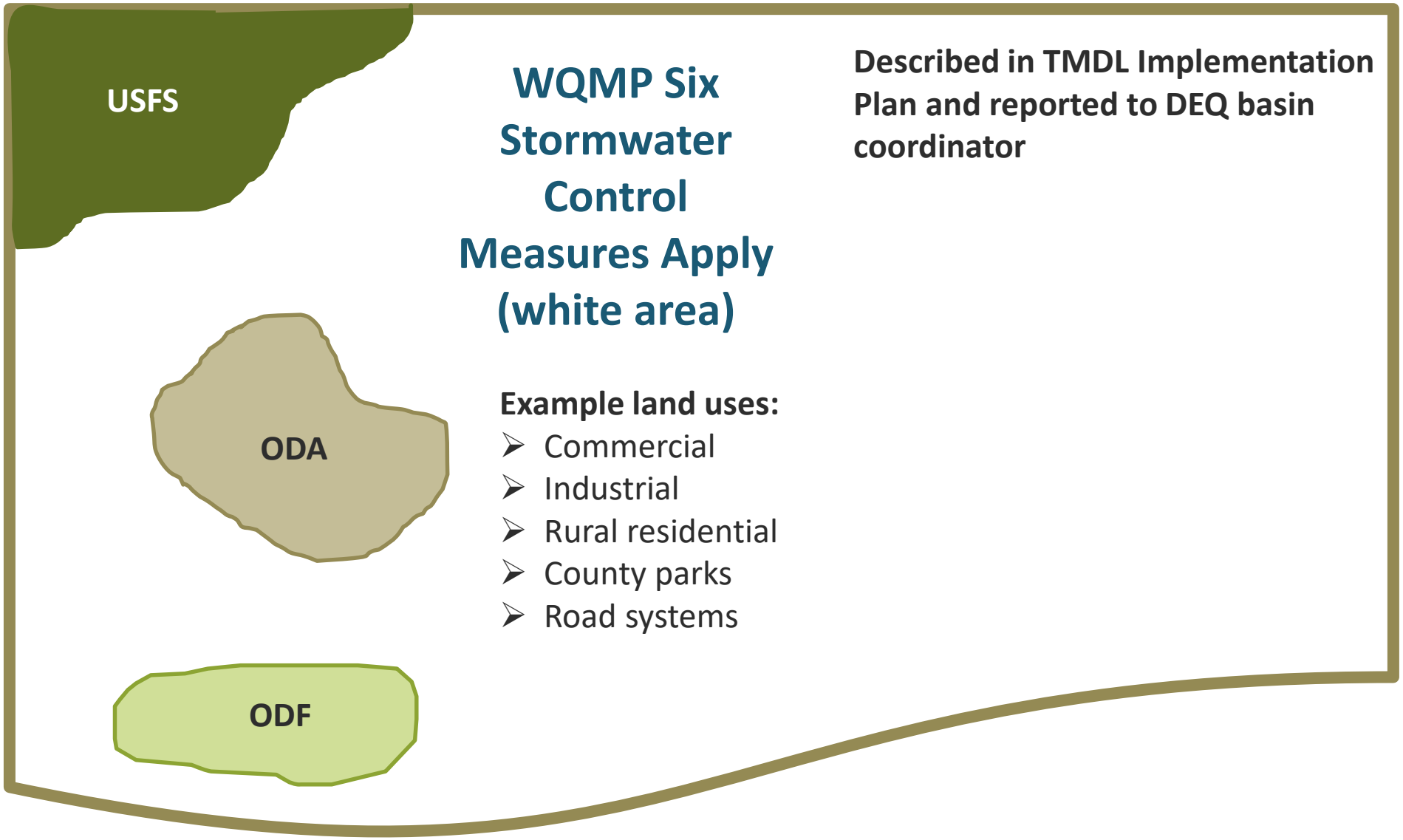
Strategies and actions that address a TMDL pollutant(s) that is not addressed in the MS4 permit are described in detail in the TMDL implementation plan and implemented throughout the entire MS4s jurisdiction, e.g. strategies to reduce solar loading.

Non-permitted urban stormwater

TMDL implementation plan must address a city's or county's **entire** jurisdiction

There are no MS4 permit requirements that can be referenced in the TMDL implementation plan, so **all** strategies and actions are included in detail in the implementation plan.

Non-Permitted MS4 DMA County Example



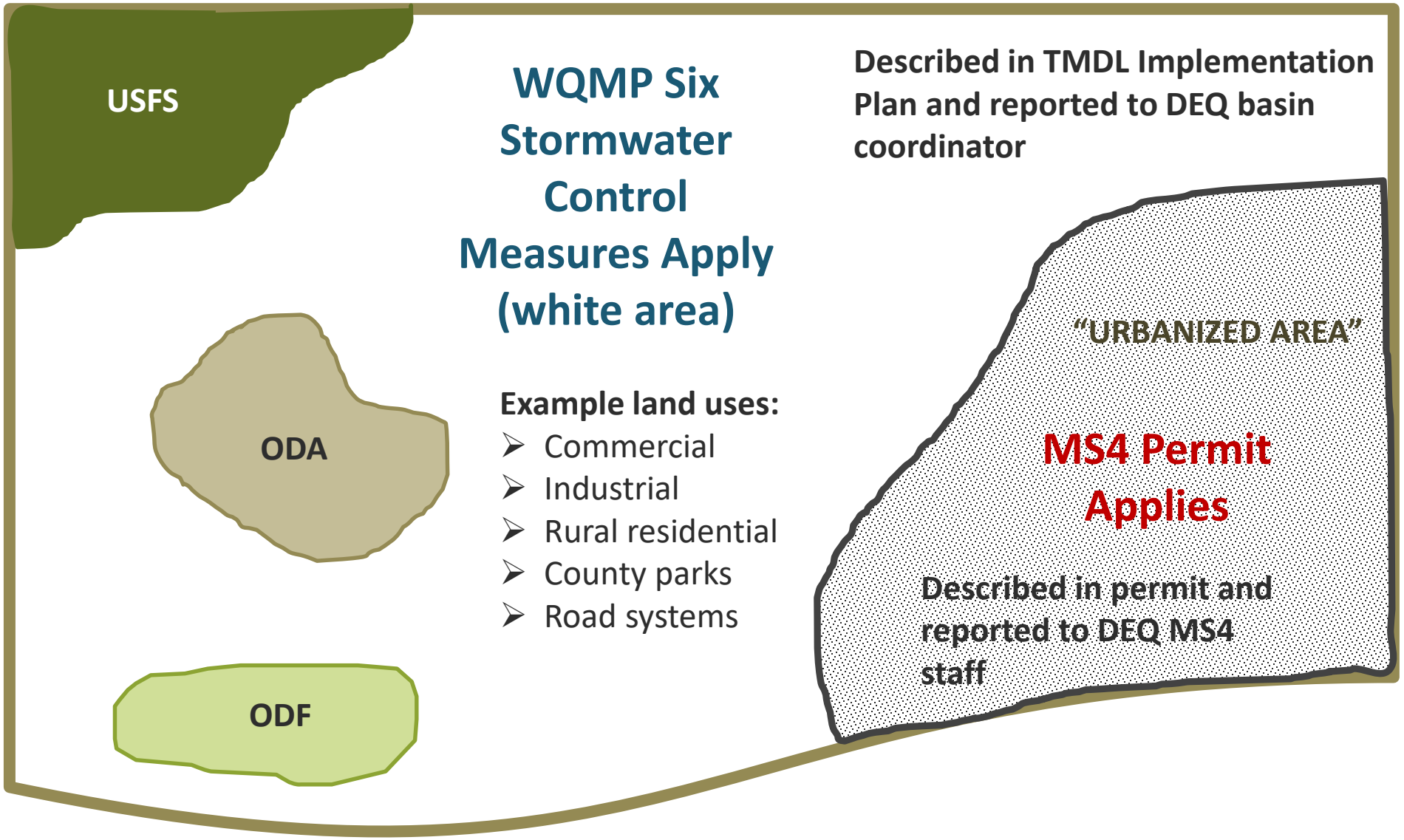
WQMP Six Stormwater Control Measures Apply (white area)

Example land uses:

- Commercial
- Industrial
- Rural residential
- County parks
- Road systems

Described in TMDL Implementation Plan and reported to DEQ basin coordinator

MS4 County Example



Implementation Plans and Reporting

- TMDL implementation plans—submitted within 18 months of TMDL issuance
- Annual reports—required for cities, counties, and most special districts, and may include state, federal and responsible persons
- Five year reviews—all NPS DMAs and responsible persons

ODF Questions

- Tracking WQ over time
- Natural disturbance impacts on WQ targets
- Revisiting foundational concepts and knowledge of mercury, assumptions
- NPS program coordination with local, state, federal agencies and organizations (who?). Direct coordination with landowners?
- Feasibility of adopting subbasin rules if additional ODF actions are needed to meet TMDL

Agriculture Sector

ODA: TMDL Implementation Framework

- Regulatory
  - Agricultural Water Quality Area Rules
- Voluntary
  - Agricultural Water Quality Area Plans

Responsible Persons: Water Conveyance Entities

- Entities that own and/ or operate water conveyance systems that have the potential to discharge to waters of the state (return flows)
  - Previously not included in WB Hg TMDL

- Upcoming informational meeting at NRCS field office in Tangent on July 17, 2019 from 6pm-8pm.

- DEQ expects to receive information about water conveyance systems' potential to discharge to waters of the state (return flows) during the public comment period.

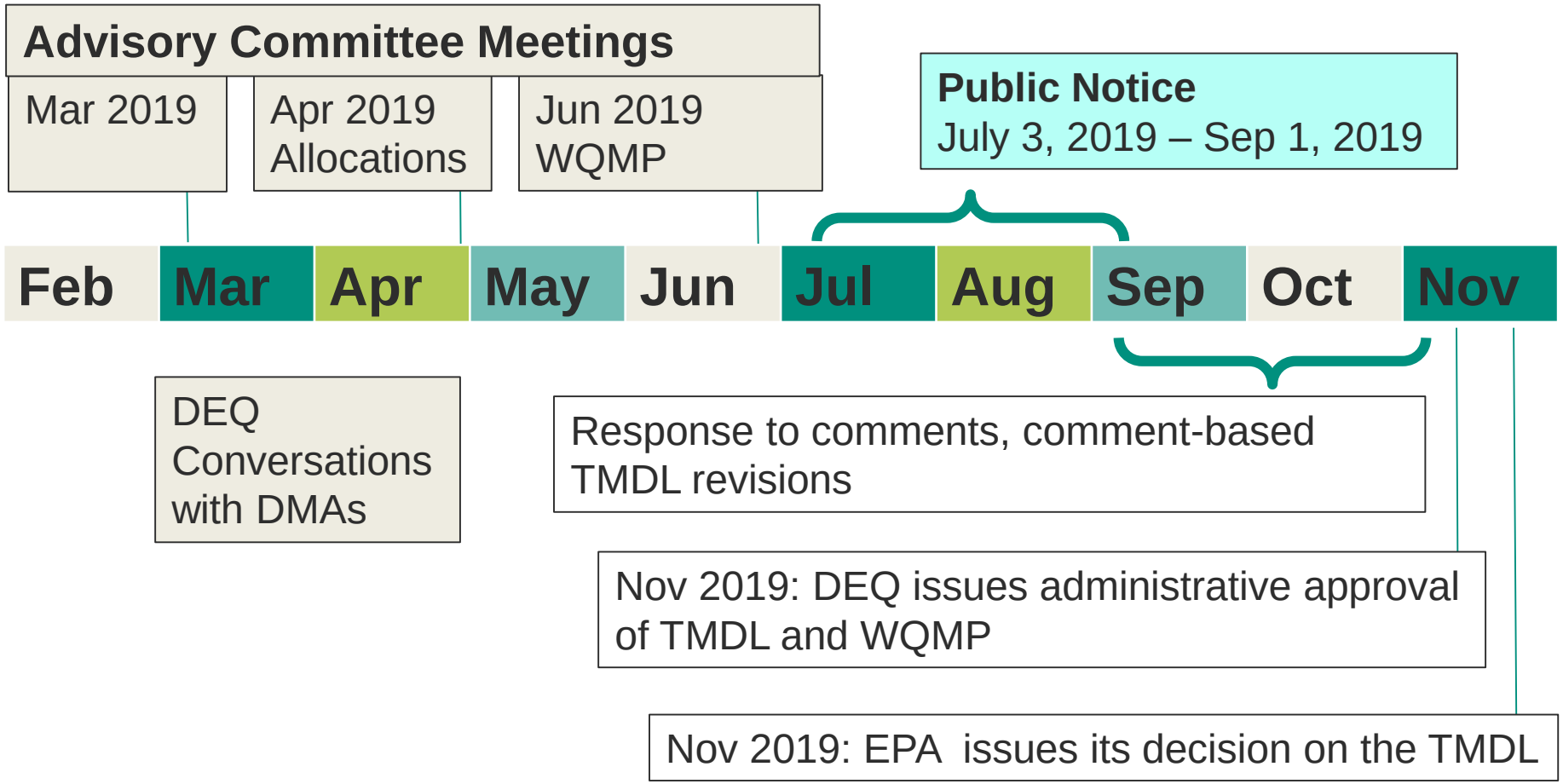
Reservoirs

Reservoir Operators

- Largest reservoir operators
  - U.S. Army Corps of Engineers
  - Portland General Electric
  - U.S. Bureau of Reclamation
  - Eugene Water and Electric Bureau

- Requirements
  - Assess factors affecting methylation rate in reservoirs
  - Evaluate approaches to reduce methylmercury production
  - Implement management strategy

Timeline


Advisory Committee Meetings
Mar 2019
Apr 2019
Allocations
Jun 2019
WQMP
Public Notice
July 3, 2019 – Sep 1, 2019
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
DEQ
Conversations
with DMAs
Response to comments, comment-based
TMDL revisions
Nov 2019: DEQ issues administrative approval
of TMDL and WQMP
Nov 2019: EPA issues its decision on the TMDL

Next Steps

- Upcoming dates
  - July – August: Public Comment Period
  - November: EPA Decision