Evergreen StormH2O

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MEETING MINUTES

Project: Stormwater Particle Size Distribution & Implications for BMP Effectiveness

Meeting Topic: TAC Meeting #2

Date & Time: 9:00 to 10:00am 9/7/22

Location: Microsoft Teams

Attendees:

Technical Advisory Committee

- Erika Shaffer, Department of Natural Resources
- Dana DeLeon, City of Tacoma
- Michael Henao, City of Pasco
- Carla Milesi, University of Washington

Evergreen StormH2O Team

- Aimee Navickis-Brasch
- Taylor Hoffman-Ballard
- Mark Maurer
- Patrick Volsky

KEY DISCUSSION TOPICS

TAC suggestions:

- The Phase I Permit Section S8E data – Permittees had to do testing on two BMPs and their data is on the international BMP data base. Phase 1 has to do two different BMPs.
- Did WSDOT have to this testing similar to S8D or E? If so they may have useful data we can look at.
- Consider looking at Phase I Permit Section S8D Outfall Data to see if it would be helpful. Carla will send the data, there is 48,000 data points.

Next Meeting

- Erika will send out a doodle poll early next year for TAC meeting #3.

Stormwater Particle Size Distribution & Implications for BMP Effectiveness

TAC Meeting #2

December 6, 2022

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Presentation Overview

- Welcome
- Review Project Goal & Scope
- Review Work Complete
  - D2.1 Synthesis of Literature
  - D2.2 List of Data Sources
  - D2.3 Data Summary Tables
  - D3.1 White Paper Outline
  - D3.3 Draft White paper
- Review Instructions
- Next Steps
- Action Items

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Welcome

Technical Advisory Committee

Erika Shaffer, Department of Natural Resources

Dana DeLeon, City of Tacoma

Michael Henao, City of Pasco

Ani Jayakaran, Washington State University

Carla Milesi, University of Washington

Ben Stryker, City of Des Moines

Evergreen StormH2O Team

Aimee Navickis-Brasch, PhD, PE

Taylor Hoffman-Ballard, PE

Mark Maurer, PE, PLA

Patrick Volsky, EIT

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Project Goal

Evaluate how pollutant types and loads vary with particle size and summarize the pollutant removal mechanisms and effectiveness of a range of BMP types to develop guidance that will assist permittees towards selecting the most effective BMP for their site based on the anticipated particle size distribution (PSD).

- Does PSD Matter? If so, where/why does it matter?
- What are options for measuring PSD besides TAPE method that could provide comparable results and are more readily available?
- What BMPs are effective for reducing specific particle sizes and where should they be located?
- What are approaches for applying this information?

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Project Scope

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Task 1
Project Management

- Status Reports
- 3 TAC Meetings

Task 2
Literature Search & Synthesis

- Synthesis of Literature
- List of Data Sources
- Data Summary Tables

Task 3
Summarize & Communicate Findings

- Whitepaper
- Flow Charts
- Fact Sheets
- SWG Presentation

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Project Scope

Task 2 Literature Search & Synthesis

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Conduct a systematic review of available literature, databases, and regional reports on PSD and suspended sediment. Synthesize information, data, and sources collected into tables which will be used to develop the Task 3 summary and guidance documents.
Focus areas for literature review:

1. Identify methods for measuring PSD
2. Characterize sources of particulates to stormwater
3. Identify the influence of PSD on stormwater chemistry
4. Identify detrimental impacts of different particle sizes to receiving water bodies
5. Determine BMP effectiveness as a function of PSD

D2.2 List of Data Sources – Summary of all sources reviewed
D2.1 Synthesis of Literature – 00 Lit. Search Summary Table

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Task 2 Literature Search & Synthesis
1. Identify methods for measuring PSD

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- **Goal:** Identify/compare testing methods for measuring PSD and suspended sediment concentration (SSC) of TSS; recommend methods that maybe more readily available than TAPE method.
- **Summary of Findings:**
  - 27 articles were located
  - 14 articles described details about testing methods
  - PSD & SSC testing methods identified:
    - 4 routinely used in water
      - Includes TAPE method
    - 1 alternative method for soil samples

D2.1 Synthesis of Literature – 01 Methods for Measuring PSD
D3.4 Draft Whitepaper – PSD Test Methods

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Task 2 Literature Search & Synthesis
1. Identify methods for measuring PSD

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Method	Method Overview	Pros	Cons
Modified SSC Method – ASTM D3977-97D (Sieve Method) TAPE Method	Uses various sieves to determine the particle size distribution.	> Simple to perform > Sieve sizes are known and the particles on that sieve are in the size range between that sieve size and the one above it > Uses whole sample, not a sub-sample	> No known accredited labs > Time-consuming > Sieves used to measure very fine particles are very fragile > Fragile particles reduced during sieving process, thus skewing results
Sedimentation (Hydrometer) Analysis	Uses a column of water and a hydrometer to measure change of water density over time. Stokes Law is used to determine the particle size settlement over time.	> Long history of use > Relatively inexpensive > Lab equipment is easy to obtain and inexpensive	> Uses sub-sample > Good for only fine-grained soils > Time consuming (over 24 hours) > Overestimates silt & clay fractions
Laser Diffraction	Uses the scatter pattern of laser light shot through a sample to determine particle sizes.	> Quick (5–10 minutes/sample) > Uses small samples > Repeatable > Wide fraction range → smooth PSD curve	> High cost of LD equipment > Insufficient confidence in results due to relatively low number of LD analyses vs the hydrometer method
Optical Method	Uses a camera to record particles and a computer to analyze the image to determine particle sizes.	> Fast > Highly accurate for particles sizes greater than 1 µm	> High cost of equipment
Electron Resistance (Impedance)	Uses changes in solution conductivity to measure particle numbers suspended in solution. Particle size range determined by using different aperture sizes.	> Fast > Highly accurate for particles sizes greater than 1 µm > Uses small sample aliquots	> Size determined partially by particle orientation as it passes through aperture (i.e., size may not be truly represented for elongated particles)

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Task 2 Literature Search & Synthesis
1. Identify methods for measuring PSD

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Test Method	Overall Score	Repeatable Results	Detection Levels
Modified SSC Method – ASTM D3977-97D (Sieve Method) TAPE Method	★★★	★★	★★★
Sieve Method ASTM SSC Method D3977-97B	★★	★★	★★
Sieve Method EPA's TSS Method 160.2	★★	★★	★★
Sieve Method - Standard TSS Method (APHA's TSS Method 2540 D)	★★	★★	★★
Laser Diffraction	★★	★★★	★★
Optical Method	★	★	★★
Sedimentation (Hydrometer) Analysis	★	★	★
Electron Resistance (Impedance) Method	★	★	★

★★★ - TAPE Method, High Repeatability
★★ - Detection levels between 3.9-62.5 microns, Medium Repeatability
★ - Detection levels 0-100 microns, Low Repeatability

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Task 2 Literature Search & Synthesis
1. Identify methods for measuring PSD

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- **Recommendations:**
  - ATSM SSC Method D3977-97B with Laser Diffraction
    - Method B is more widely done than Method D (TAPE Method)
    - Larger particle sizes accounted for with ASTM sieve test
    - Laser Diffraction gives smoother representation of fine fraction particles
  - SSC and TSS can be correlated at given location
    - Need 30 concurrent samples for proper correlation
    - TSS testing is inexpensive
    - Correlation may make sense for sites with frequent testing
- **Future Research Recommendation:**
  - Correlate Laser Diffraction PSD results with ASTM method
    - Laser diffraction – short time analysis, high repeatability, small sample size, wide range of size fractions into which the particles can be divided

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Task 2 Literature Search & Synthesis

2. Characterize sources of particulates to stormwater

- **Goal:** Identify how site-specific conditions could influence particle size distributions
- **Summary of Findings:**
  - 12 articles were located
  - All field studies
  - Majority of articles studied PSD on roadways
    - 11 articles studied roadways
    - 4 articles studied Residential
    - 3 articles studied Mixed Use
    - 2 articles studied parking lots, industrial, or commercial land uses
  - Majority studied urban areas

D2.1 Synthesis of Literature – 02 Characterize Sources to SW Template

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Task 2 Literature Search & Synthesis

2. Characterize sources of particulates to stormwater

- **Characterization of PSD using jurisdictional conditions**
  - Land Zoning
  - Urban vs Rural
  - Others: Receiving Waterbody Conditions, Infiltration, Developed vs. Undeveloped, Climate Conditions
- **Statistical analysis**
  - Pearson's R
    - Correlation exists between conditions and PSD if R is close to -1 or 1
  - No correlations found for land zoning
    - Same for basin area, AADT

D2.1 Synthesis of Literature – 02 Characterize Sources to SW Template
See worksheet titled D2.3 Data Summary Table

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Task 2 Literature Search & Synthesis
3. Identify PSD influence on stormwater chemistry

- **Goal:** Evaluate stormwater chemistry as a function of PSD to aid in estimation sediment transport
- **Summary of Findings:**
  - 8 articles were reviewed
  - Majority studied PSD and pollutants on roadways
  - Majority studied PSD with relation to heavy metals
    - Reported "total" of each metal
    - Highest concentrations in clay and silt particle sizes
    - Additional pollutants studied: nutrients, bacteria, oils, PAHs, etc.
  - Articles studied what was present; did not tie to transport, impacts to water bodies, or treatment mechanism

D2.1 Synthesis of Literature – 03 Influence on SW Chemistry template

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Task 2 Literature Search & Synthesis
3. Identify PSD influence on stormwater chemistry

- **Develop weight factors for land-use based loads**
  - No correlation between land use and PSD
  - Limited data for pollutants according to particle size
  - Could potentially calculate pollutant load per gram of a certain size particle, with great uncertainty
- **Statistical Analysis**
  - Insufficient data to estimate Pearson's R
  - Potential to supplement dataset with BMP influent data
    - Other studies aware of?

D2.1 Synthesis of Literature – 03 Influence on SW Chemistry template
See worksheet titled D2.3 Data Summary Table

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Task 2 Literature Search & Synthesis

4. Identify PSD detrimental impacts to receiving waters

- **Goal:** Identify what is known about stormwater related impacts on receiving waters based on specific particles size ranges.
- **Summary of Findings:**
  - 3 somewhat relevant articles located
  - Limited data on what PSD, pollutants, etc. reach water bodies from roadway, land use, etc.
  - Reason for TAPE requirement to test particles smaller than 500 microns
    - No known evaluation of PSD impact on receiving waters
    - Collect PSD to understand how it affects BMP performance
    - TAPE Guidance Manual: *PSD analysis is a required screening parameter to determine if influent PSD to treatment system consists primarily of silt-sized particles (i.e., 3.9 to 62.5μ) and thus is representative of PNW stormwater.*

D2.1 Synthesis of Literature – 04 Impacts to Waterbodies Template

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Task 2 Literature Search & Synthesis

4. Identify PSD detrimental impacts to receiving waters

- **Assess if thresholds or categories of impact can be determined**
  - Insufficient data to determine when/where to target removal of PSD
  - Insufficient data to conduct statistical analyses
  - Potential sources of supplemental information:
    - Pollutants according to particle size in storm sewer pipes
    - Pollutant loading at outfalls, assuming additional information is located for influence of PSD on stormwater chemistry

D2.1 Synthesis of Literature – 04 Impacts to Waterbodies Template
See worksheet titled D2.3 Data Summary Table

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Task 2 Literature Search & Synthesis

5. BMP effectiveness as a function of PSD

- **Goal:** For structural, operational, and source control BMPs, report on BMP effectiveness based on PSD.
- **Summary of literature search**:
  - Sources identified:
    - Databases: International BMP Database, Highway Runoff Database, P8 Model
    - Literature: ~ 2 dozen sources
    - Other: Phase 1 Monitoring Reports, TAPE BMP data
  - Most sources appear to study structural BMPs, or sweeping
- **Next steps:**
  - Review and filter datasets
  - Compile PSD data by BMP & separate by source/land use
  - Use statistical analyses if feasible to evaluate BMP performance

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Project Scope

Task 3 Summarize & Report Findings

Summarize and recommend how to incorporate study findings into the current BMP selection process in the Ecology Stormwater Manuals. Specifically, provide guidance for selecting the most effective BMP for the respective PSD based on the contributing basin area (source) and discharge location (water body vs. infiltration).

- Flow Charts
- White paper
- Fact Sheet
- SWG Presentation

- D3.1 Whitepaper Outline
- D3.3 Draft White Paper – PSD Testing Methods only

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Review instructions

- **Documents to Review - Comment Due Friday 12/16/22**
  - **D2.1 Synthesis of Literature** – review 00 Literature Search Summary Table for overview of what we found; anything missing or suggestions for other articles?
    - 00 Literature Search Summary Table
    - 01 Methods for Measuring PSD
    - 02 Characterize Sources of particulates to Stormwater
    - 03 Identify the influence of PSD on Stormwater Chemistry
    - 04 Identify detrimental impacts of different particle sizes to Receiving Waterbodies
  - **D2.2 List of Data Sources –** any articles missing we should look at?
  - **D2.3 Data Summary Tables** – included in D2.1 topics (02-04) Excel files and labeled *D2.3 Data Summary Table – Review Tables for 02-04*
  - **D3.1 White paper Outline** – suggestions for any additional items or revisions?
  - **D3.3 – Draft White paper** – PSD Testing methods only; review & provide comments

D1.9 TAC Meeting #2 Agenda & Minutes
Use Comment form or track changes/comment option in Word

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Next Meeting

TAC Meeting #3 - Focus on applying results

- D2.1 & D2.3.
  - BMP effectiveness as a function of PSD
- D3.2 Draft Flow Charts

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Action Items

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#	Action Item	Responsible Party	Due Date

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