Evergreen StormH2O
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Subject: Stormwater Particle Size Distribution & Implications for BMP Effectiveness
D3.3 & D3.4 Draft & Final Flow Charts

The purpose of this memo is to document when and why the decision was made not to develop deliverables D3.3 and D3.4 the draft and final flow charts. Per our scope of work, the following was defined for these deliverables "*Flow charts will be developed that can be integrated into the BMP selection process defined in the Ecology Stormwater Management Manual for Western Washington (SWMMWW). The flow charts will assist permittees with selecting the most effective BMP based on site specific conditions and discharge locations*." **Figure 1** is the concept for the flow charts. Our team had planned to add something like the red boxes to the decision flow charts in the SWMMWW to make recommendations for how to apply the flow. However, the following is why this did not occur. Attached **Figure 1** provides a concept of what the flow charts would have looked like. Also reference a copy of the final report for additional details: D3.5 Stormwater Particle Size Distribution & Implications for BMP Effectiveness White Paper.

- The flow chart shown on the left in **Figure 1** would have provided guidance for locations where treatment of PSD was recommended based on the study results. However, it was not possible to develop these recommendations because there was insufficient data located during our literature search that could be used to identify what conditions (e.g., basin characteristics and receiving water conditions) are more likely to have specific PSD sizes and subsequently where treatment is more likely to be needed. This was determined based on the discussion and conclusions written in Chapters 3 and 5 of the White Paper.
- The flow chart shown on the right in **Figure 1** would have provided guidance for which BMPs can provide treatment of silt size and smaller particles based on the study results. Our team located influent and effluent PSD data that could be analyzed for 19 types structural and 1 type operational BMPs (no data was located for source control BMPs). However, most of the data for a BMP was from a single study and some of the BMPs only had a few data points (number of samples) that our team used to evaluate the BMP effectiveness for reducing different particle size ranges. In addition, data for several BMPs that were included in the analysis were collected on BMPs from other states. BMPs from other states that have the same or similar name as BMPs in the SWWMMWW may be (i.e., design criteria) which could impact the treatment performance. Evaluating whether these BMPs were the same as the BMPs in the SWMMWW was not part of our scope of work and

would have taken substantial time. After reviewing the White Paper Chapter 6 discussion and conclusions sections as well as the tables at the end of the chapter, it seemed like it would be misleading to add a table with the BMPs to the flow chart until more research is done or data was located to confirm the treatment performance for Washington BMPs. Also, the BMPs with the highest removal rates were proprietary, adding them to the flow chart could be construed as endorsing them, which did not seem appropriate.

Because the flow charts could were not developed, **Table 1** was created and included in the White Paper Chapter 7. The intent of **Table 1** was to explain what we had intended to do, why recommendations for applying the results (in the form of a flow chart) could not be developed, and what research was needed to be able to develop these recommendations. The work that was budgeted for developing the flow charts still occurred, which was reviewing/interpreting the data and results, discussions with our team to try and decide what we could do with the data/results we had, and developing **Table 1**. In addition, our team spent more time than we had budgeted in our contract on the literature search trying to collect more data with the hope that we would find enough data to be able to provide meaningful recommendations for applying the results.

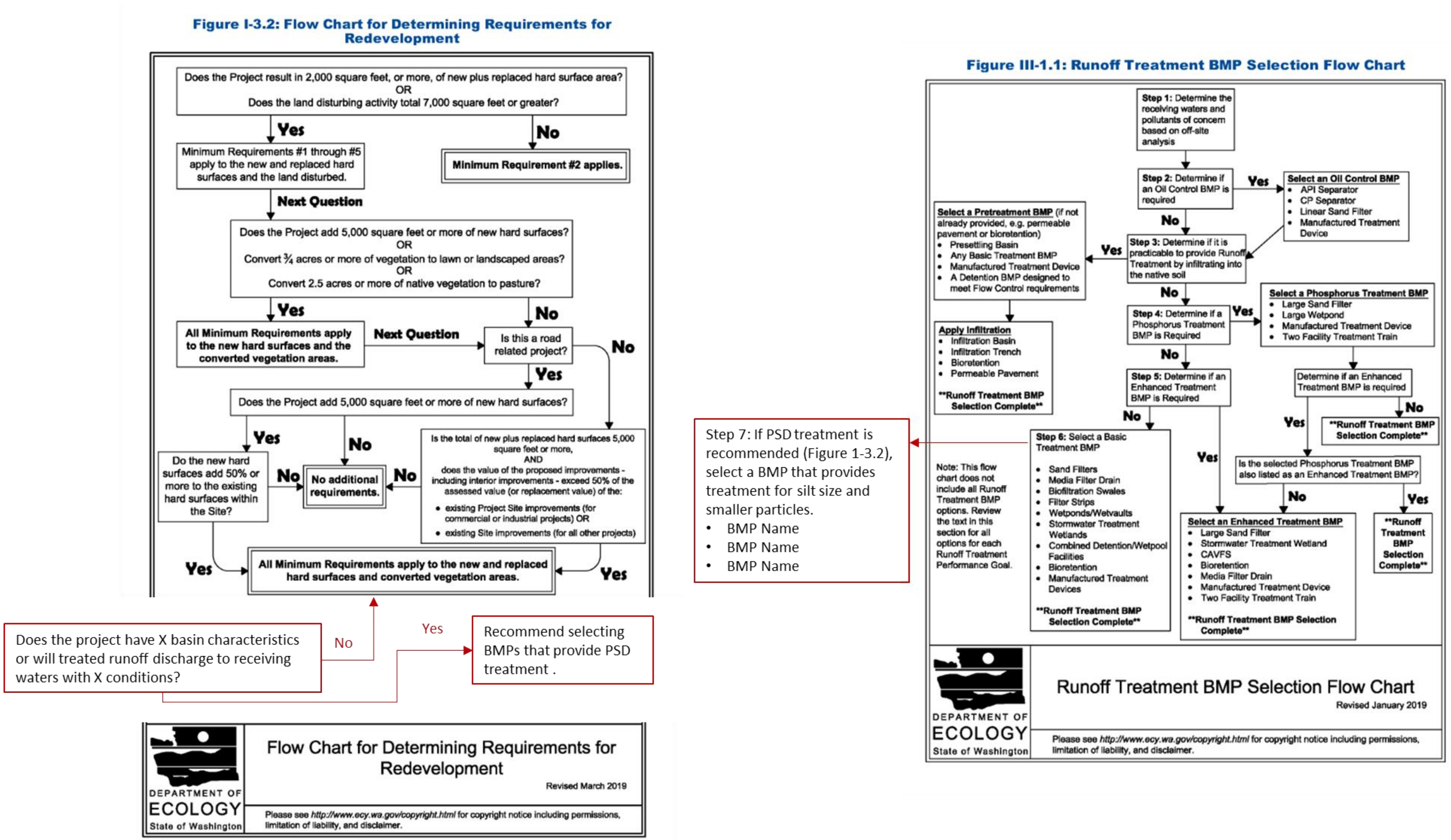

Figure 1 Concept Flow Charts

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Table 1. White Paper Table 7-1. Summary of Intended Application of Study Findings

Chapter	Intended Application of Chapter Findings	Existing Application of Chapter Findings	Data Gaps to Address to Achieve Intended Application
2	Use ranked test methods to develop recommendations for future testing methods.	Using the ASTM method with the LD is likely to produce the best results for analyzing PSD in a given water sample. ASTM's SSC Method D3977-97B used with LD would produce the most precise results because the larger particles would be accounted for with the ASTM sieve test, and the LD would give a smoother representation of the fine fraction particles.	Further research is needed to determine whether LD PSD results correlate, or can be correlated with, the ASTM method.
3	Characterize PSD using common Washington basin conditions (e.g., land use, basin area).	Insufficient basin condition data was reported to characterize PSD in terms of typical Washington basin conditions. The particle size with the highest concentration was silt, regardless of land use. It is likely that most basins can expect to find high quantities of silt-sized particles on impervious surfaces, specifically roadways.	Encouraged researchers to report more details about the basin conditions such as AADT, land use, basin area, etc. Additionally, larger range/wider distribution of basin areas are needed to assess whether trends exist between basin area and PSD.
4	Using the intended application from Error! Reference source not found., develop weight factors for different basin conditions to predict pollutant loading and select an appropriate BMP for a site. Provide guidance regarding how this information could be used in watershed plans, total daily maximum load (TMDL) studies, and for estimating BMP credits.	Basin condition-based pollutant loads were not able to be estimated as insufficient data were located in the literature for different land use types or other basin conditions. Pollutant concentrations are generally higher for finer (clay- and silt-sized) particles, but the size associated with the majority of the particle load to surface waters was not consistent in the literature. Continuing to target these particle sizes is anticipated to remove pollutants before they reach water bodies.	If more data points reporting particle size distribution of pollutants were available, determining land-based pollutant loads might be more feasible. Additional studies related to pollutants of emerging concern may inform strategies for treatment of those pollutants.
5	Assess whether a threshold or qualitative categories of impact can be determined for if/when there is a benefit to receiving waters for targeting removal of different PSDs and selecting BMPs based on PSD effectiveness. Use the results to develop guidance regarding how this information could be used to identify receiving water bodies that need to be protected and when/where to locate BMPs that are more effective for reducing specific PSD ranges upstream of these water bodies.	A threshold or category of impact related to PSD in water bodies could not be determined and subsequently the application of the information, because no studies were located that focus on the specific impacts of PSD ranges on receiving water bodies. The size ranges of particles most commonly transported to water bodies include clay- and silt-sized particles. Continuing to target these particle sizes is anticipated to remove pollutants before they reach water bodies.	Research is needed to understand how different particles sizes impact receiving waters. In addition, more data are needed regarding particle sizes and concentrations of pollutants attached to specific particle sizes that reach water bodies, especially while suspended in the water column. These data would help to determine whether certain sizes should be targeted to remove certain pollutants.
6	Identify BMPs that are more effective at removing specific ranges of particles.	Of the 20 identified, BMPs generally appeared to achieve the highest removal in the silt and fine sand sizes. Because these particles appear to contain high amounts of pollutants and have the highest concentrations in the built environment, BMPs are targeting an appropriate particle size. BMPs that removed over 50% of each particle size range include: proprietary BMPs (StormGarden Biofilter System and Kraken), bioinfiltration swales and ponds, bioretention, and wet vaults.	Additional data for some of the BMPs that were identified in the chapter are needed to better understand their performance related to specific particle sizes. There are structural, operational, and source control BMPs in the Ecology SWMMEW and SWMMWW for which no data were located. Data for these BMPs will further inform BMP effectiveness for PSD.