



LOI # 4

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Organization: Washington Stormwater Center

Study Title: Effect of Biochar Characteristics on Pollutant Removal and Hydraulic Performance in Stormwater Applications

Which topics from the SWG's priority list (Appendix A) do you propose to address?

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What type of project is being proposed?

Survey; Literature review & synthesis; Environmental sampling study; Literature review with Laboratory Isotherm Analysis and Hydraulic Column Testing

Short description of the proposed project

Biochar is an increasingly common component of bioretention soil media due to its ability to remove common pollutants, low cost compared to alternatives, and ability to support healthy plants.

Many studies have assessed biochar for removing common stormwater pollutants including nutrients and metals, but few have assessed removal of PFAS or 6PPDQ. Further, studies have often assessed individual biochars, many of which were produced under laboratory conditions, rather than commercially available biochars.

We propose a collaborative study between the Washington Stormwater Center, Geosyntec Consultants, and US Biochar Initiative to assess pollutant removal and hydraulic performance of biochars that are commercially available on the West Coast and produce practical guidance for improved use of biochar in stormwater applications. We propose the following:

- 1) Obtain samples and production information (e.g., feedstock, production temperatures, residence time, oxygen availability) from commercial biochar producers and complete analysis of common biochar properties.



2) Complete a detailed literature review to assess the effect of biochar properties on pollutant removal effectiveness of metals, nutrients, and hydrocarbons.

3) Perform batch equilibrium sorption testing to assess the effectiveness of biochars for removing PFAS and 6PPDQ from stormwater. We will preserve the option for focused testing of other pollutants if literature review reveals important data gaps.

4) Perform medium term column tests to assess the effect of biochar particle size and feedstock on hydraulic performance of blended bioretention soil media. This testing will be done with a subset of biochar samples blended in two to three different BSM blends

What type of information will be collected or analyzed for this proposed study?

Detailed information on biochar feedstock and production conditions for commercially available biochars will be collected from biochar producers. Biochar samples will be submitted for analysis of common biochar properties including carbon content, surface area, H:C ratio, ash content, elemental analysis, cation exchange capacity, salinity(electrical conductivity), and nutrients, in accordance with ANSI testing standards and Washington State Department of Ecology guidelines.

Literature review activities will be focused on identifying peer-reviewed and other studies that compared the effectiveness of different characterized biochars for removing metals, nutrients, and hydrocarbons from water and stormwater. These data will be reviewed and analyzed to identify clear trends suggesting certain commercially available biochars might be more effective than others based on biochar production conditions or biochar properties.

Laboratory sorption data will be analyzed to estimate sorption coefficients according to common sorption models (e.g., K_d for Freundlich models) which are predictive for initial performance of biochar-amended BSM but which can also predict general trends in long-term effectiveness.

Laboratory hydraulic data will be analyzed to assess whether biochar particle distribution has a meaningful and practical impact on BSM flow rates when mixed with other common components (e.g., sand, compost, coconut coir).



What are the anticipated measurable outcomes and key deliverables that will be produced by the proposed study and how will they be used by Permittees and the Washington State Department of Ecology?

We will develop an updated template specification for biochar based on the results from this effort, starting with the existing Washington Ecology specification for biochar as a component of the High Performance Bioretention Soil Media. This specification is intended to be one that is actionable for Permittees within the current commercial context of the biochar sector on the West Coast. We will pair this specification with user guidance to support Permittees and stormwater professionals to understand the rationales for the specification and, when appropriate, adapt the specification to jurisdiction- or project-specific objectives.

Beyond the template specification and guidance, the project will produce interim and final project reports that document project goals, activities, procedures, data, analysis results, and conclusions. The project report will provide a current inventory of commercially available biochar on the West Coast and comparative properties. This will directly support users in determining potential suppliers. The project report will identify any key characteristics that significantly influence pollutant removal or hydraulic performance. Perhaps as importantly, the report will identify factors that do not have significant effects, ideally expanding options for purchasers and improving cost effectiveness.

To support the broad awareness of the specification and other work products, we will present the results from this project at two to three regional conferences in the Pacific Northwest. Articles may also be developed for submission to local publications, trade journals, and/or peer-reviewed journals.

List the permittees or agencies you are proposing to coordinate with.

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