



LOI # 12

Name: Abby Barnes

Organization: Washington State Department of Natural Resources

Study Title: Using low-cost sensors to determine tree water use under drought conditions

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?

Environmental sampling study

Short description of the proposed project

Trees in parks, natural areas, street-side, and on private lands, combined with other stormwater control elements, provide excellent opportunities to mitigate the effects of stormwater runoff. While the runoff mitigation potential of forest or large tree stands is well known, there is still a need to quantify stormwater mitigation values associated with individual trees, particularly drought-tolerant trees growing in BMPs. We propose to build on two phases of previously-funded SAM work that focused on native trees in western Washington. That work showed that trees can divert significant runoff away from the stormwater system, through canopy interception and leaf transpiration. We also developed a mobile sensor to measure tree transpiration anywhere. Prior work also highlighted differences in tree species and suggested that drought-tolerant trees may have different effects on stormwater compared to those from prior work. With our new work, we will quantify tree water use, focusing on drought-tolerant tree species in both the east and west regions of Washington state. Fixed and mobile sap flux sensors will be used at two locations in the state – Olympia and Pullman. The combination of fixed and mobile sensors enables us to establish a continuous record at a single location in each climatic zone, while moving the mobile units to multiple landscape positions. Mobile data will allow us to sample trees more widely within each area. These data will provide a more holistic picture of how various drought-tolerant trees manage water in the root zone, through transpiration and interception of incident rainfall.

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



Information collected for this work involves measuring tree water use as sap flux and canopy interception. These data will be collected for six species of drought-tolerant trees growing in two climatic zones – eastern and western Washington. Potential species include ponderosa pine, Douglas-fir, lodgepole pine, and honey locust, but the final selection will be made with the help of a technical advisory committee. In addition, we will collect microclimate data, including rainfall, temperature, humidity, solar radiation, photosynthetically active radiation, wind speed and direction, and soil moisture in the root zone. Physiological tree data, such as diameter at breast height, canopy volume, canopy area, and leaf area index, will also be measured.

We will request a permittee in eastern Washington for a location with power and security to install a fixed sapflux sensor unit.

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?

Measurable outcomes will include tree water use for six species of drought-tolerant trees from each side of the Cascades, growing in different climatic zones, over three growing seasons. Quantifying the water use of specific drought-tolerant trees across two climatic seasons over several growing seasons provides permittees with a suite of options when choosing trees to be grown either as street trees or planted in a BMP. Species differ in their ability to intercept and transpire well when it's raining, and their ability to survive with minimal irrigation when it's not raining. A tree with high drought tolerance may have minimal transpiration during dry seasons but may still provide stormwater benefits through high canopy interception and re-evaporation of precipitation. Our work will quantify both, allowing us to develop a "water balance ranking" for individual trees based on their capacity to conserve water in the dry season while contributing maximally to stormwater mitigation during extreme events.

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

Washington Department of Natural Resources

Washington Stormwater Center

Washington State University

The Evergreen State College