FEDERAL INTERAGENCY SEDIMENTATION PROJECT

IDEA FORM

Idea Title: Development of a dual sensor densiometric suspended sediment measuring station

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PI Location and Study Location (if different): Grand Junction, Colorado

Introduction: The Nation faces critical water resources concerns that include the influence of fluvial sediment on the navigation of rivers, reservoir storage, aquatic environments, municipal water treatment, streambed and bank stability, and flood impacts. Expanding capabilities to monitor suspended sediment during conditions where current techniques are unable is important for science and public agency decisions. One of the most pressing conditions to monitor suspended sediment is under conditions of extreme concentrations. These conditions occur in areas affected by wildfire, floods, and debris flows; but also occur in areas of erodible geologies. Accurate knowledge of sediment characteristics and transport vitally affects the ability of public agencies to properly respond to sediment related impacts. This study aims to develop a dual-sensor densiometric suspended-sediment measuring station using co-located non-contact stage radar and submersible pressure transducer that can monitor suspended sediment conditions during extreme events.

Background: Projects in the Grand Junction area which have used emerging technologies to measure suspended sediment concentrations in real time via surrogates or direct measurement include: Paonia Reservoir sediment monitoring project, NGWOS acoustic sediment study at Cameo, NGWOS algae and sediment cameras at Cameo, and numerous turbidity-sediment stations around Western Colorado (Pine Gulch Burn QW). Difficulties and limitations with these technologies have included: acoustic sensors not functioning well when sediments are dominated by fine particles at concentrations greater than 30,000 mg/L; turbidity sensors reaching saturation and the sensor reading randomly inverting measurement values; and an inability to utilize camera deployments during periods of darkness (night).

Purpose and Scope: This study would develop a new method for real-time suspended-sediment concentration measurements. Several projects in the Grand Junction area have attempted to measure suspended-sediment concentrations in real time using a variety of methods, as noted above. Each of these methods have demonstrated limitations when measuring the extreme sediment conditions in Western Colorado resulting from the erodible landscapes and post-fire conditions. This study would build upon previous efforts and experience and provide a potential solution to some of the challenges we have struggled with in the past related to maximum concentrations.

Previous studies have employed the use of dual pressure sensors and “dual orifice” pressure sensing systems to measure suspended-sediment concentrations. This study would build up that principle using different technology. A pressure sensing system would be installed on or adjacent to the streambed, providing a measurement of the water pressure exerted at that point by the water column above it. A co-located non-contact radar stage sensor would also measure the water surface elevation directly above the pressure sensor. Any differential between the pressure-sensed water depth and the radar-derived water depth will be a function of the water density, directly attributable to the suspended-

sediment concentration and the water-temperature. A water-temperature sensor will be employed to further refine the density computation. This combination of sensors will reduce the uncertainty and limitations inherent to dual-pressure sensor derived systems.

Data produced by the radar stage, water pressure, and water temperature sensors will be recorded by a data logger employing python scripting functionality. A micro-python script will be developed to compute the suspended-sediment concentrations in real time at the station and telemeter the concentration value via satellite or cellular connection. In instances where python can not be deployed at the site, the raw values from the sensors could be telemetered, and the computations completed by computers at the water science center. Regardless, the result would be real-time suspended sediment concentration data served to NWIS Web.

Technical Requirements:

- Site selection – Determination of a location where the sensors can be deployed
- Sensor/Logger Installation – Installation of pressure, temperature, and radar stage sensors; and associated appurtenant data logging equipment at selected site.
- Python programming – Development of python program to compute the real-time suspended-sediment concentration based on the measured values from the sensors.
- Database integration – Configure Aquarius and NWIS Web to serve the data.

Deliverables: Real-time data served to NWIS Web would be the final deliverable. If the method proves sound, a short report documenting the instrumentation deployment and python code development could be published in a future effort.

Timeline: Project duration is roughly 12 months. This would allow time to complete installation tasks, data collection during snowmelt-runoff and the monsoon rainfall seasons, and subsequent QA of the collected data.

- Month 1 – Site selection and installation; preliminary development of python code
- Months 2-10 – Data collection and refinement of python code
- Months 11-12 – QA of collected data and finalization of the record

Unique Qualifications: The Grand Junction Projects Office has a long history of sediment data collection activities in Western Colorado. This study would leverage many years of experience in an environment which is likely to demonstrate the feasibility of the proposed method. Some recent studies we have participated in which have honed the skills and qualifications to be successful with this effort are:

- Grizzly Creek post-fire QW monitoring – Turbidity surrogates, SS sampling, python coding
- Grizzly Creek post-fire precipitation network – Python coding and high-level data processing
- Paonia Reservoir sediment monitoring – Acoustic sediment records, turbidity surrogates, SS sampling
- Pine Gulch post-fire monitoring - Turbidity surrogates, SS sampling, python coding
- Cameo dual-frequency NGWOS study – Acoustic sediment data collection
- Cameo Sediment Camera NGWOS study – Noncontact image-derived SS data collection
- NGWOS under-ice discharge study – Python coding and high-level data processing
- NGWOS non-contact discharge – Noncontact radar installations and high-level data processing

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