# SEDIMENT LOAD, TRANSPORT AND ACCUMULATION IN LOWER GRANITE RESERVOIR ON THE SNAKE RIVER

**Gregg N. Teasdale, PE, PhD, Lead Hydraulic Engineer; Walla Walla District, U.S. Army Corps of Engineers; Walla Walla, WA; (509) 527-7291**
**Gregg.N.Teasdale@usace.army.mil**

**Abstract** The U.S. Army Corps of Engineers (USACE) is evaluating sediment accumulation and sediment load in the reservoir system of the lower Snake River in Idaho and Washington as part of an Environmental Impact Statement (EIS) for the Corp's Programmatic Sediment Management Plan (PSMP). Sediment deposition in Lower Granite reservoir impairs navigation and reduces the flood capacity of the federal levee system in Lewiston, ID and Clarkston, WA. Concern for the possible impact of long-term dredging on the anadramous fishery and recent litigation caused the Corps to expand the investigation to include consideration of possible alternatives to dredging such as watershed measures to reduce sediment inflow. The Corps engaged the U.S. Geological Survey (USGS), the U.S. Forest Service (USFS) and regional university researchers in a collaborative study of the dominant sources of sediment, sediment yield and an evaluation of the effectiveness of sediment reduction measures in the 27,130 square mile watershed that delivers sediment to Lower Granite Reservoir. A sediment impact analysis of this scale is unprecedented in the Snake River basin.

The Corps recognized the deleterious impact of sediment accumulation when Lower Granite Lock and Dam were constructed in the early 1970's. The Walla Walla District funded an eight year campaign by USGS through the 1970's to measure suspended sediment and bedload in the Snake and Clearwater Rivers upstream from Lower Granite reservoir. This work showed that suspended silt and sand dominate the sediment load and that about 80 of the total load was delivered by the Snake River. The district also embarked on an aggressive program of sediment range surveys and hydraulic modeling to monitor the effect of sediment accumulation on the capacity of the levee system. Since the dam was completed in 1975, approximately 75 million cubic yards of sediment have accumulated below the confluence of the Snake and Clearwater Rivers. The sediment ranges show that the annual suspended sediment influx to Lower Granite Reservoir averages about 2.3 million cubic yards per year and varies with the seasonal patterns of the snowmelt and rainfall runoff of the basin.

The Corps has again funded the USGS to measure suspended sediment load and bedload on the Snake and Clearwater Rivers. Sediment load measurements began in the winter of 2008 and will continue through at least 2011. Conventional sediment load measurements at the Anatone stream gage on the Snake River and the Spalding gage on the Clearwater River are being augmented with electronic surrogate technology including turbidity monitoring, acoustic Doppler velocity measurements (ADVM) and laser diffraction (LISST) particle measurements. Provisional data show that silt and sand still dominate the sediment load of Lower Granite reservoir and that the relative contribution of the Snake and Clearwater Rivers has not significantly changed. As in the 1970's, suspended sediment load in the Snake and Clearwater Rivers correlates reasonably well with discharge.

In 2009, the conventional sediment measurements were extended to the main tributary rivers of the Clearwater and Lower Snake River basins to help identify the dominant sources of sediment for Lower Granite reservoir. Regression analysis of the sediment load data demonstrates a reasonable correlation of suspended sediment load with discharge and that well-timed conventional sediment load measurements are an effective means to partition the total sediment accumulation in Lower Granite to the tributary basins. Results of the first year sediment load regression indicate relative contributions among the tributary rivers that agree with previous short-term measurements and sediment yield modeling (Figure 1). The measurements and analysis suggest that transient sediment in the river channels is important in the sediment budget.

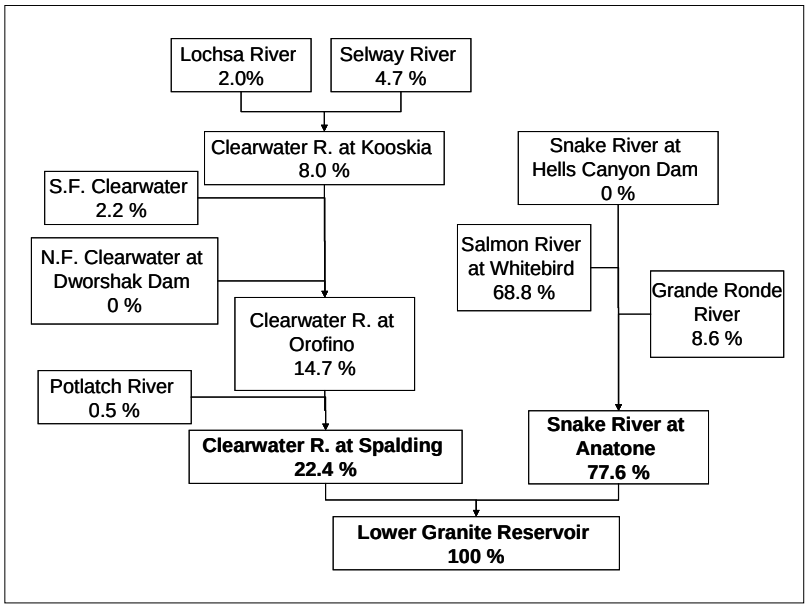


Figure 1 Relative sediment delivery to Lower Granite Reservoir in 2009.

The historic sediment ranges indicate that the effect of sediment accumulation on the flood capacity of the federal levee system may be approaching equilibrium – a hypothesis that is being examined with detailed sediment transport modeling. Recent high-resolution bathymetric and sediment core surveys near the confluence by USGS are being used by the Corps to develop one and two dimensional hydraulic and sediment transport models. Results from initial sediment transport modeling support the hypothesis that an equilibrium hydraulic capacity is being attained. Evaluation of risk and uncertainty is a key element of this analysis.

More frequent wildfires since the 1970's, wide adoption of soil conservation practices and climate change may be altering the long-term sediment budget of the lower Snake River. Researchers with the USFS, Washington State University and the University of Idaho are evaluating these potential impacts in a best-science analysis of watershed sediment yield. The collaborative analysis is intended to determine if practical sediment management practices can be operable and effective at a scale that is relevant to Lower Granite reservoir.