# 5. Preliminary Effects of Beaver Dams on Sediment Transport and Trapping in Fanno Creek at Greenway Park


By Cassandra Smith[1], Micelis C. Doyle[1], James White[1], Erin Poor, [1] Alex Costello[2], Krista Jones[1], Stewart Rounds[1]

[1] U.S. Geological Survey, Oregon Water Science Center, Portland, OR [2] Portland State University *Correspondence: cassandrasmith@usgs.gov, jameswhite@usgs.gov: mcdoyle@usgs.gov


## Goals and Objectives

Beaver dams and associated ponding affect sediment transport and trapping by pushing water onto the floodplain and decreasing stream velocity, allowing for increased sediment deposition.

For this part of the Tualatin beaver study, USGS assessed changes in sediment dynamics along beaver-affected reaches of Fanno Creek at Greenway Park and Bronson Creek. Here, we highlight results from the Fanno Creek reach. Fanno Creek is a high-energy urban stream with sufficient velocity and turbulence to erode and transport huge loads of sediment during storms (fig.1).

**Figure 1**. Sand, silt, and loam sediment in the ponded area of Fanno Creek at Greenway Park. Photo by USGS.

Findings will be helpful for quantifying the effects of beaver dams and ponds on sediment dynamics in flashy urban streams that have the erosive power and capacity to carry large amounts of sediment during storm events.

## Data Collection Methods

Three methods were used to measure sediment transport and deposition along a beaver-affected reach of Fanno Creek:

1. Comparison field surveys of bathymetry and sediment depth to quantify the volume of sediment stored in the south pond upstream of the long dam at Greenway Park (fig. 2).
2. Turbidity, discharge, and suspended-sediment samples were collected during a range of storm events and at base flow to calculate suspended-sediment loads upstream and downstream of beaver dams at the Fanno Creek site (fig. 2).
3. Sensors to continuously measure turbidity were installed at the upstream boundary, in the ponded area, and at the downstream boundary of the study reach (fig. 2).

The continuous datasets are available online at: *https://or.water.usgs.gov/cgi-bin/grapher/graph_setup.pl?basin_id=tualbeav*


**Figure 2**. Map of the Fanno Creek at Greenway Park reach, showing the locations of water-quality sensors, selected water-level loggers, and beaver dams.

## Sediment Deposition Results

1. Comparison of the surveys of water depth and depth-to-refusal (a commonly used indicator of sediment depth) suggests that the south pond has accumulated about 1,200 cubic meters of fine sediment (fig.3). This is a volume that is approximately equivalent to 120 dump-truck loads.
2. Field observations indicate that fine sediment is depositing in the original (pre-ponded) incised channel upstream of the long dam. Beaver activity also has resulted in the excavation of new channels throughout the south pond. Beaver tend to dig these channels to allow them to swim away from danger and to transport food and building materials.

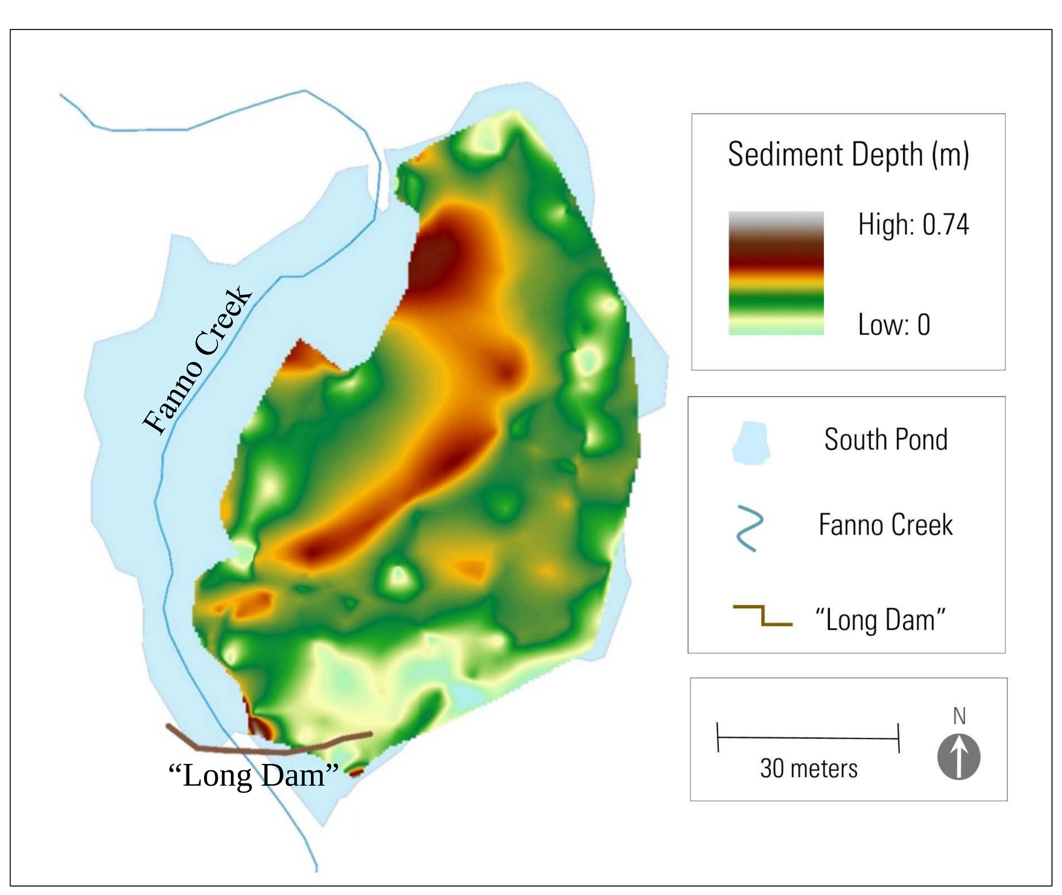


**Figure 3.** Sediment depth in the south pond as determined from the water depth and sediment depth-to-refusal surveys.

## Suspended Sediment Transport During Storm Events and Base Flow Results

1. Eight storm events and one base-flow condition were sampled for turbidity, suspended-sediment concentration, and streamflow (fig. 4-5). Storm sampling captured a wide range of conditions that occurred during the study.
2. Suspended-sediment concentration (SSC) tended to be greater at the upstream site compared to the downstream site (fig. 6), indicating that suspended sediment was being deposited in the ponded areas.
3. Stage/discharge relations were developed for each sampling site ($R^2 > 0.80$), which will allow for the estimation of continuous streamflow data from the continuous stage data. Relations between SSC and turbidity may be developed to allow the continuous turbidity data to estimate continuous SSC concentrations and fluxes.

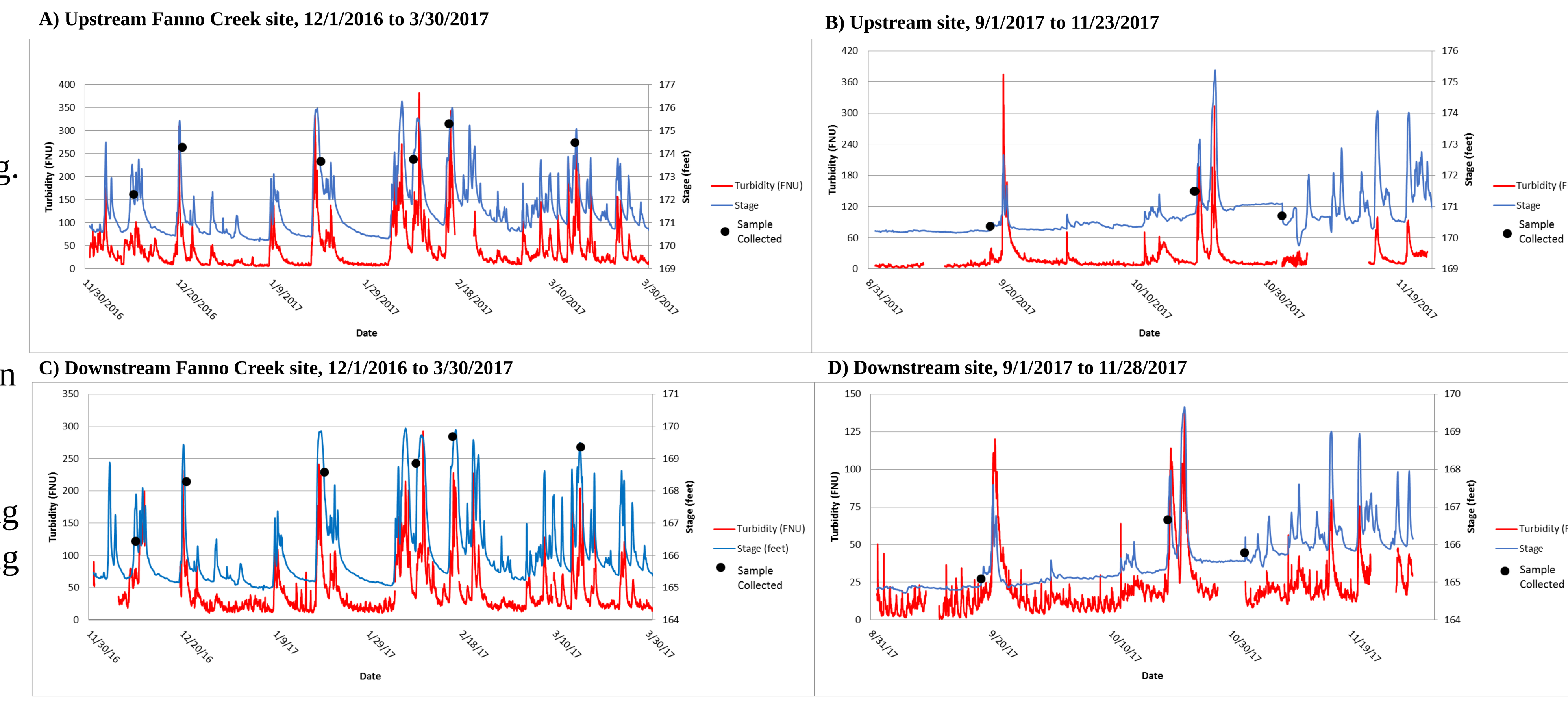


**Figure 4.** Continuous turbidity and stage collected at the upstream and downstream sites on Fanno Creek (fig. 2) with sampling events denoted.

**Figure 5.** Suspended-sediment sampler. Photo by USGS.

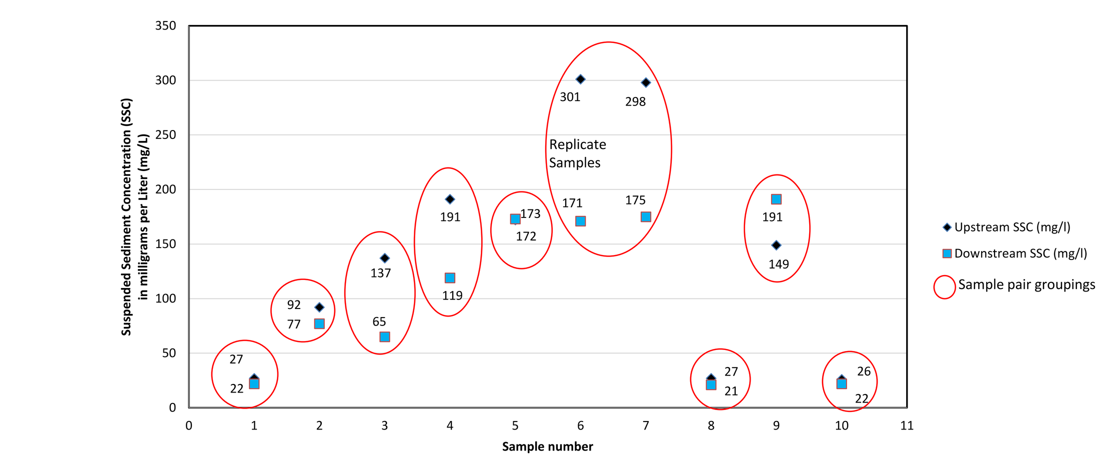

**Figure 6.** Comparison of suspended-sediment concentrations for samples collected at the upstream and downstream sites. Events are shown in chronological order.

## Continuous Turbidity Results

1. Statistical comparison of peak turbidity values using an ANalysis Of Variance (ANOVA) and post-hoc pairwise comparison (Tukey's Test) for 25 storm events revealed that peak turbidity values for the middle and downstream sites were significantly different ($p<0.05$), indicating that peak turbidity decreases as the water travels through the large south pond during storm events.
2. All peak turbidities were lower at the downstream site compared to the middle site for the 25 events (fig. 7).
3. Conversely, during periods of low flow, the downstream site tended to have higher turbidity values than the middle site (fig. 8). A diurnal trend was observed in the downstream site's turbidity, suggesting that turbidity in the area may be locally affected by animal activity (such as bioturbation by nutria and beavers). Higher turbidity values occurred between midnight and noon.

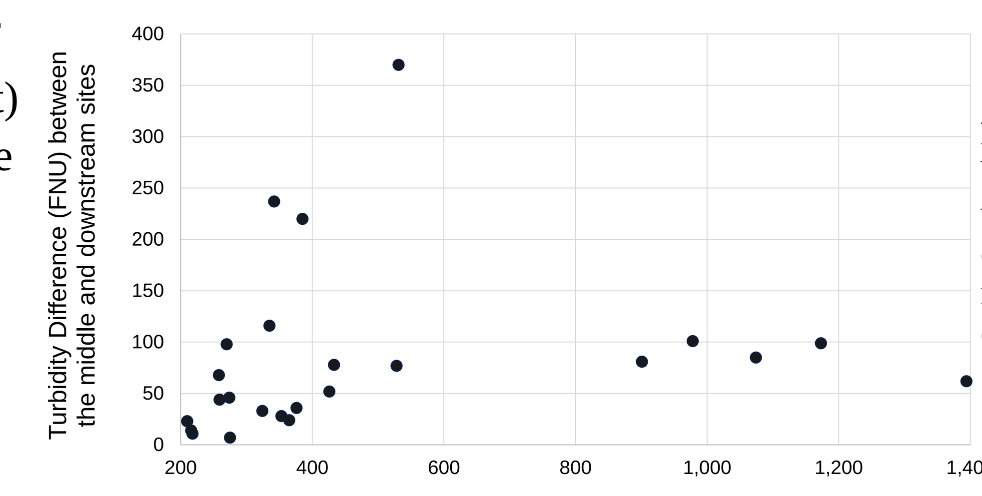


**Figure 7**. The difference between peak turbidity values for the middle and downstream sites (fig. 2) measured during 25 discrete storm events from 10/01/2016 to 11/29/2017.

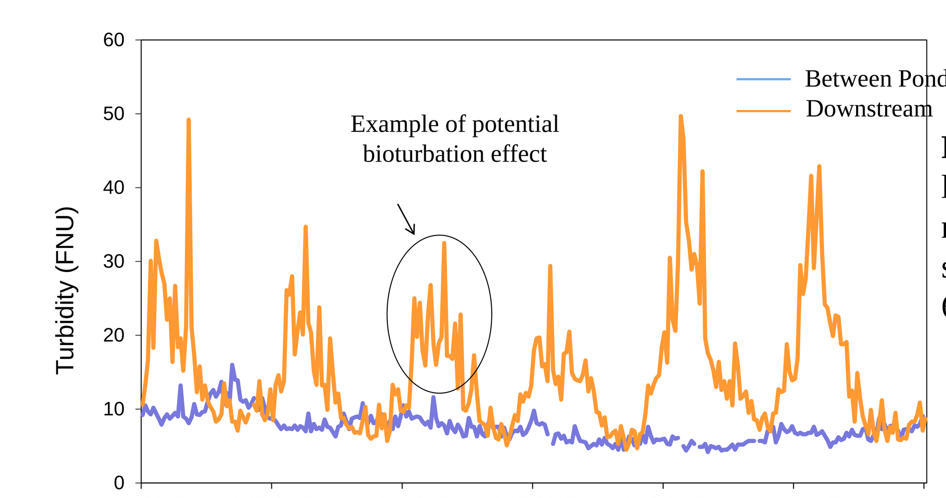


**Figure 8**. Turbidity during low flow measured at the middle and downstream sites (fig. 2) from 6/24/2017 to 6/30/2017.

## Next Steps for this Study

- Correlate SSC concentrations and turbidity measurements, and develop a regression model to compute instantaneous values of SSC.
- Estimate continuous discharge over study period using measured water-level data and discrete discharge measurements.
- Develop a regression model to compute instantaneous values of SSC.
- Investigate turbidity and SSC on the rising and falling limb of the storm hydrograph to understand when the highest periods of sediment deposition occur at different study reaches.
- Repeat the SSC and turbidity analyses for other study reaches.

## Considerations for Future Studies

- Refine models of predicting suspended-sediment concentrations and loads.
- Investigate or confirm the cause of elevated turbidity during low-flow conditions.
- Create a general approach for studying sediment transport and trapping in beaver-affected stream reaches.
- Construct a model to predict sediment deposition and resuspension for beaver-affected stream reaches.

All data and findings are provisional and subject to change.


**Smith, C., M. Doyle, J. White, E. Poor, A. Costello, K. Jones, and S. Rounds, 2018, Tualatin Beaver Poster 5 - Preliminary Effects of Beaver Dams on Sediment Transport and Trapping in Fanno Creek at Greenway Park.**

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