Marsh Creek Watershed Project Phase 2

DEQ NPS Subgrant S295

Monitoring Report, Attachment A

January 2011

Prepared by:

Portneuf Soil and Water Conservation District

In Cooperation with

Idaho Association of Soil Conservation Districts

Idaho Department of Environmental Quality

Portneuf Watershed Partnership and Three Rivers RC & D

Marsh Creek Monitoring Program

The objective of Phase 2 monitoring was to quantify water quality improvement as a result of BMP implementation in the watershed, to track long-term trends at the watershed scale, and to further bracket sediment sources in the watershed in order to guide future implementation.

The monitoring program design allowed for upstream – downstream comparisons of water quality to determine the effectiveness of individual BMPs or clusters of BMPs. Water quality trends at the watershed scale were tracked using data collected by the continuous monitoring stations run by the Portneuf Watershed Partnership (PWP) on lower Marsh Creek and the Portneuf River. In order to direct future project decisions, additional sediment sources in the upper watershed are being investigated by collecting turbidity data via continuously deployed YSI data sondes in cooperation with Idaho State University (ISU).

This approach of collecting qualitative project data along with quantitative water quality data allows for a comprehensive evaluation of BMP effectiveness and facilitates adaptive management in the watershed.

Monitoring Program

PSWCD has implemented the Marsh Creek Monitoring Program with assistance from IASCD, ISWC, IDEQ, ISU, and PWP. Sampling began in April 2009 and is still underway.

Comprehensive evaluation of BMP effectiveness requires the integration of three types of monitoring: onsite evaluation of practice effectiveness; pollutant source and transport monitoring; and in stream beneficial use assessment and water quality monitoring. IASCD is conducting BMP effectiveness monitoring at two levels: site specific or field scale and watershed scale.

Site Specific Assessment

Water Quality

Water quality monitoring sites were chosen above and below individual BMPs or clusters of BMPs as applicable on a quarterly recurrence interval. Water samples were taken bi-weekly (late July-September) and Monthly (October-December) at three sites along Marsh Creek: Upper Marsh Creek (below the rat pond), Middle Marsh Creek and Lower Marsh Creek (PWP continuous monitoring station). See figure 1 for site locations. The Portneuf Watershed Partnership (PWP) collects monthly water samples on lower Marsh Creek that are analyzed for nutrient, sediment, and fecal coliform concentrations (Three Rivers RC&D, 2004), this data will be used in conjunction with the data collected by IASCD at the remaining sample sites.

Sample timing was based on area hydrology; specifically during lower basin runoff, upper basin runoff, base flow during irrigation season, and base flow after irrigation season. Constituents included nitrate/nitrite (TN), total kjeldahl nitrogen (TKN), ammonia, ortho-phosphorous (O-Phos), total phosphorous (TP), suspended sediment concentration (SSC), and *Escherichia coli* (*E. Coli*). Flow data and field parameters including temperature, specific conductance, dissolved oxygen (DO), pH, and optical turbidity were also collected at each monitoring event.

Water Quality Sampling Methods

Samples for stream water TN, TKN, ammonia, O-Phos, TP, and SSC were collected by integrated water sampling methods. Multiple grab samples were collected at equal intervals across the stream's cross-section to provide a representative sample. For shallow water sites (1 foot deep or less) grab samples were collected by using a clean one-liter stainless steel container. At sites where the water depth was greater than one foot, a DH-81 integrated sampler was used for water collection throughout the water column.

Each of the grab samples are combined in a 2.5-gallon polyethylene churn. The resultant composite sample is then thoroughly homogenized and poured off into sample containers. For samples requiring filtration (ortho-phosphorous), a portion of the sample water will be transferred into the filtration unit and pressure filtered though a 0.45µm GN-6 Gelman Metricel Filter. The resultant filtrate is transferred directly into a sterile sample bottle. To avoid contamination, at each location the filtration unit is thoroughly rinsed with deionized water and equipped with a new 0.45 µm filter and the polyethylene churn is thoroughly rinsed with deionized water and source water at each location prior to sample collection. Samples were delivered to Intermountain Analytical Services-EnviroChem (IAS-EnviroChem) in Pocatello, Idaho.

Watershed Scale Assessment

Continuous Monitoring: PWP Continuous Monitoring Stations

A watershed-scale assessment allows for an integrated or cumulative measure of BMP effectiveness. Data collected by the continuous monitoring station located on Lower Marsh Creek is used to evaluate the cumulative effects of BMPs implemented in the watershed. The PWP collects temperature, specific conductivity, dissolved oxygen, pH, and optical turbidity at a ten-minute interval during ice-free periods throughout the year.

The Lower Marsh Creek Continuous Monitoring Station has been in operation since July 2003 and is an ongoing effort. These data will not only provide a robust baseline for watershed conditions but will also allow for cumulative BMP project effectiveness analysis when coupled with spatial and temporal landscape change data.

In addition to data collected at the Lower Marsh Creek station, data collected at monitoring sites operated by the PWP is used to evaluate the effects work in the Marsh Creek watershed have on the Portneuf River subbasin. Specifically, data collected at the Portneuf River above the Marsh Creek station and Topaz station is used to compare trends in pollutant loads to those at the Lower Marsh Creek station. The Portneuf River below Marsh Creek station is used to show the effects of load reductions in the Marsh Creek watershed on the Portneuf River subbasin.

Due to the expected longevity of monitoring efforts by the PWP, effects of BMPs implemented in the Marsh Creek watershed will be able to be evaluated years after funding for more specific monitoring ceases. This is essential for evaluating BMPs that take several years to begin to have an effect on water quality.

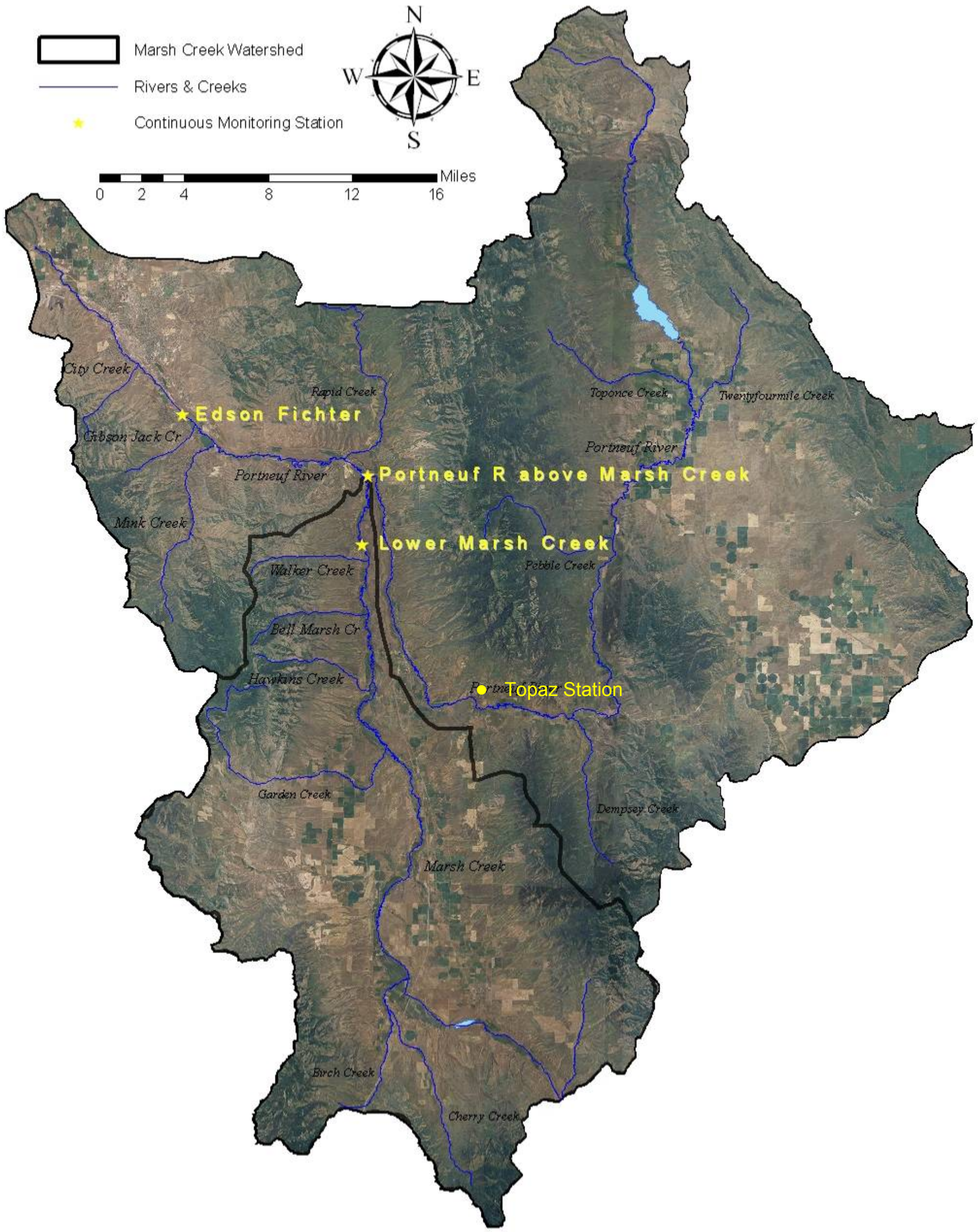


Figure 1. Portneuf River Subbasin with PWP Continuous Monitoring Stations

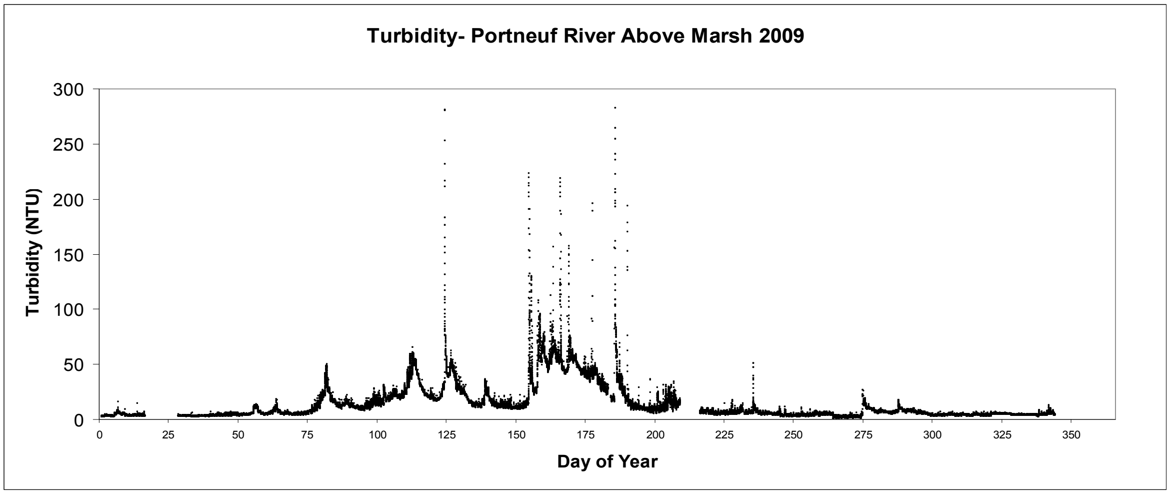


Figure 2. PWP Continuous Monitoring Station: Above Marsh. *The 2009 turbidity data on the Portneuf River just upstream of the confluence with Marsh Creek.*

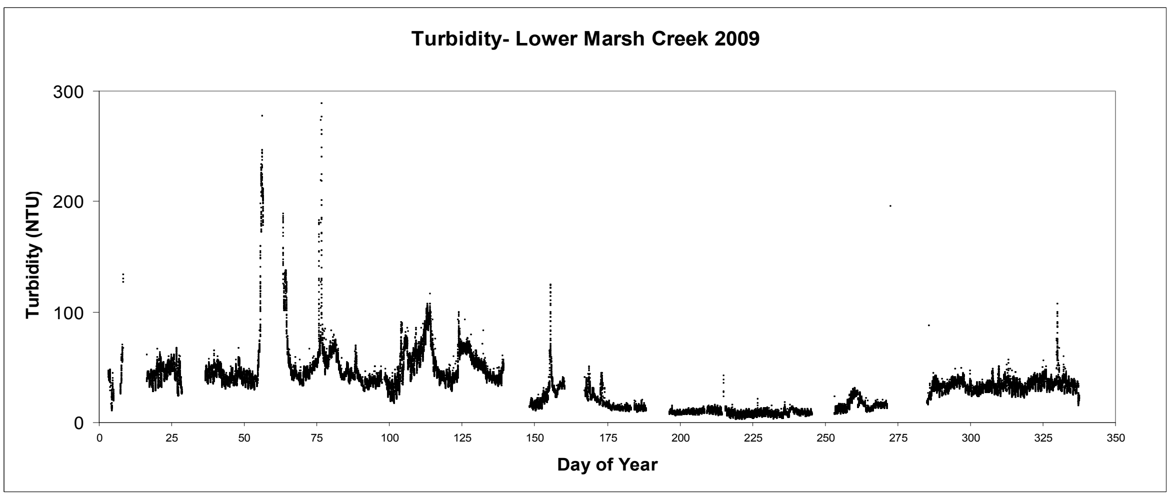


Figure 3. PWP Continuous Monitoring Station: Lower Marsh Creek. *The 2009 turbidity data on Marsh Creek just upstream of the confluence with the Portneuf River*.

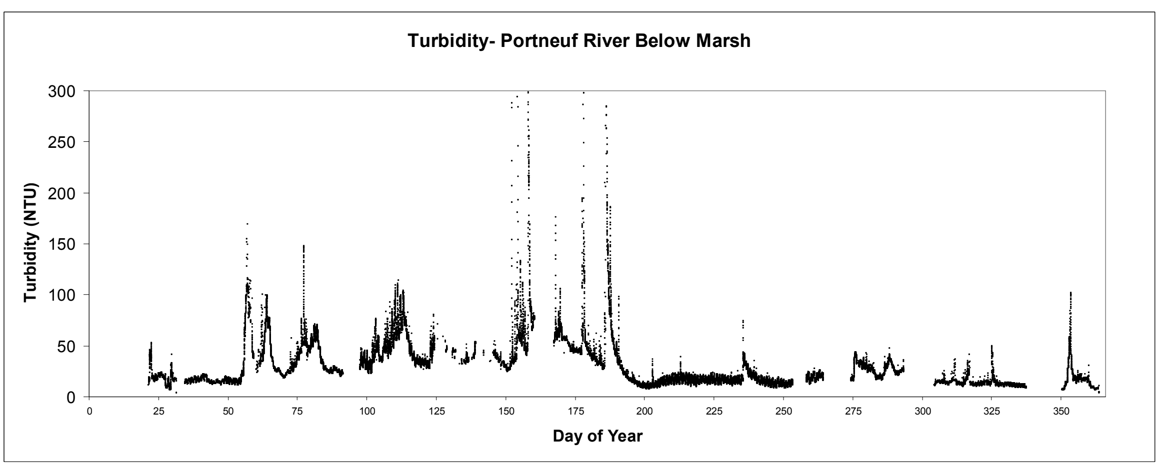
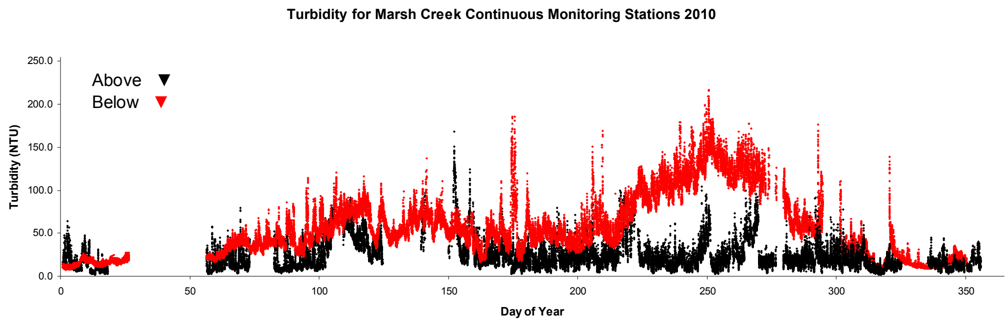
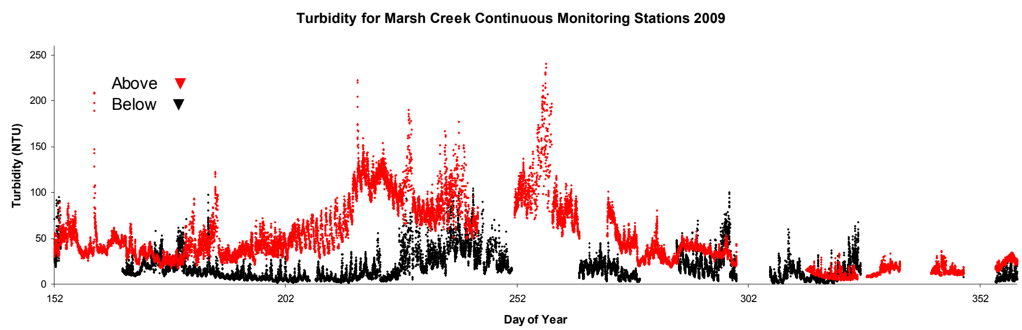


Figure 4. PWP Continuous Monitoring Station: Below Marsh Creek. *The 2009 turbidity data on the Portneuf River below Marsh Creek confluence.*

Continuous Monitoring: Upper Marsh Creek Continuous Monitoring Sondes

Continuous water quality data is collected in the upper watershed at two sites, one above and one below the water retention pond upstream of the Old Malad Highway near Downey, Idaho. These data allows analysis of the retention ponds effect on the upper watershed. Parameters include temperature, specific conductance, DO, pH, and optical turbidity at a ten-minute interval during ice-free periods throughout the year.





Figures 6-7. Upper Marsh Creek Continuous Monitoring Sites: Above and Below the Downey Rat Pond 2009-2010.

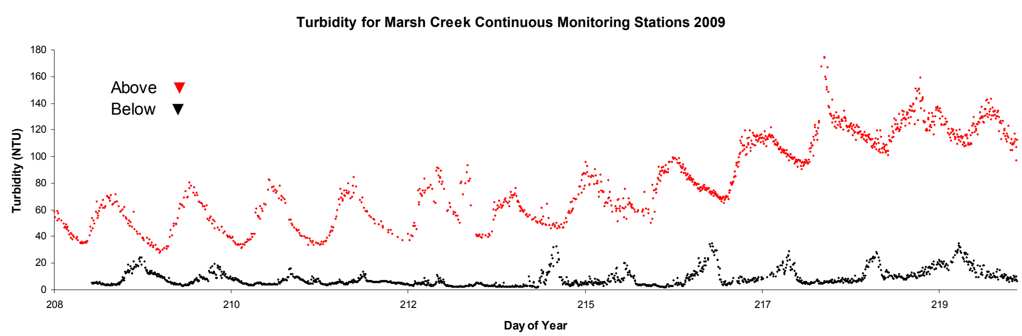


Figure 8. Turbidity data Above and Below the Rat Pond days 208-220. *This graph focuses in on the diurnal turbidity changes that occur at both of the upper continuous monitoring sites. The turbidity*

readings below the Rat Pond show uncommonly large diel differences (some days show doubling turbidity values). Explanation of the causes of these differences will require further monitoring.

Discrete Monitoring

Pollutant source and transport monitoring was collected via optical turbidity data on a daily basis. Sondes were changed out weekly (April-October) and semiweekly (November-March) and during runoff events. Turbidity can be used as a surrogate measure for suspended sediment concentration as well as total phosphorous concentration. Correlations will be developed between the constituents using data collected at the Lower Marsh Creek PWP continuous monitoring station. Site locations for turbidity monitoring will include: Lower Marsh Creek PWP continuous monitoring station, Marsh Creek at Merrill Rd, Marsh Creek at East Goodenough Rd, Marsh Creek at East Arimo Rd, Marsh Creek at Hawkins Rd, Marsh Creek at Ford Rd, Marsh Creek at Old Malad Hwy, and Marsh Creek at Downata.

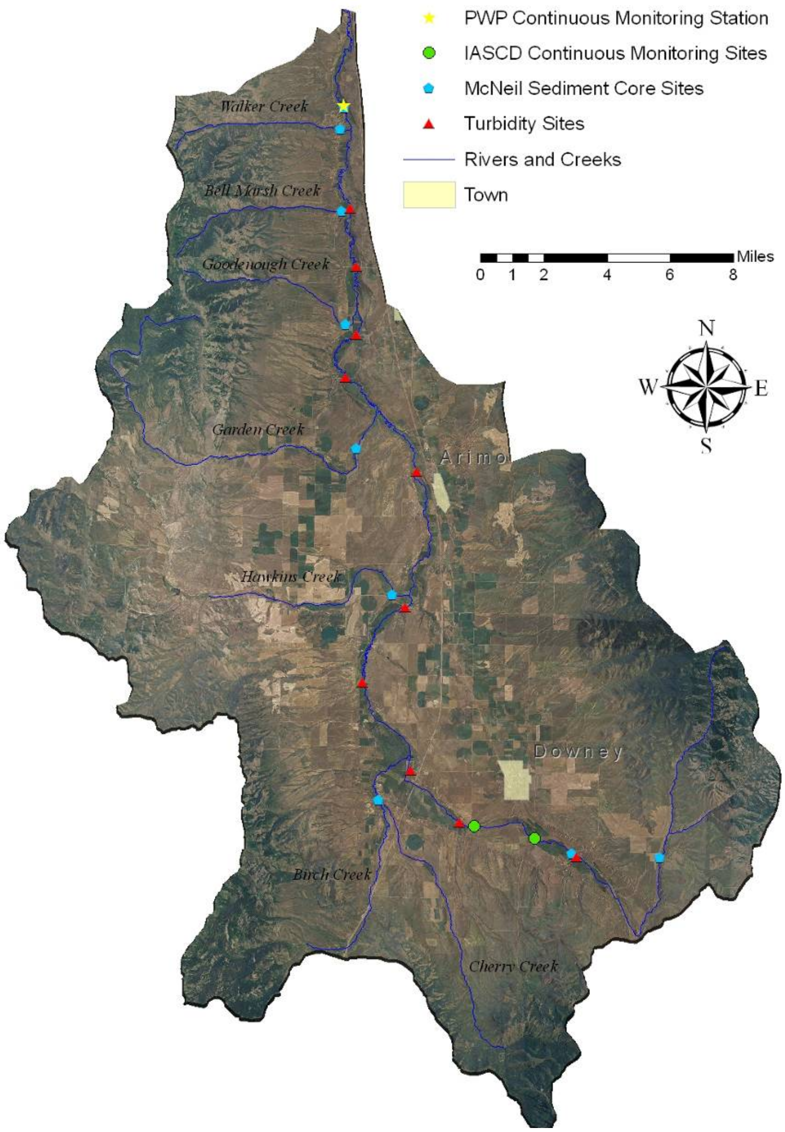


Figure 9. Marsh Creek Watershed with Phase 2 Monitoring Sites.

Field Measurements

At each location, field parameters for dissolved oxygen, specific conductance, pH, temperature, and total dissolved solids were measured. Calibration of all field equipment was in accordance with the manufacture specifications.

Flow Measurements

At each sample site, a transect line is established across the width of the stream perpendicular to stream flow. Stream depth and current velocity measurements are made across the transect at the midpoint of a minimum of 15 equally spaced cross sections. The discharge is computed by summation of the products of the area of the partial sections of the flow cross-sections (ft^2) and the average velocities (ft/s) for each of those sections. This method is used to calculate cubic feet per second at each of the monitoring stations. Flow measurements are made with a Marsh McBirney Flow Mate Model 2000 flow meter. The six-tenth-depth method (0.6 of the total depth below water surface) will be used when the depth of water is less than or equal to three feet. For depths greater than three feet the two-point method (0.2 and 0.8 of the total depth below the water surface) will be employed. Additionally, if the 0.8 depth velocity is > the 0.2 depth velocity, or the 0.2 depth velocity is > 2 X the 0.8 depth velocity, a third reading will be taken at 0.6 depth. Generally, flow measurements will follow Davis et al. (2001).

Turbidity Measurements

Turbidity measurements are made using YSI 6-series environmental monitoring systems, including sondes and 650 Multi-parameter Display System (650 MDS) microcomputers. Prior to each sampling event, the sondes are calibrated in the lab following the manufacturer's recommendations. Once in the field, measurements are taken adjacent to the sonde deployed at the PWP Lower Marsh Creek station. If readings from two sondes are within the manufacturer's specifications, then the readings can be considered accurate. At each site a minimum of three measurements are taken along the cross section.

To ensure that readings generated by data sondes are accurate, both at deployment and retrieval, an independently calibrated sonde is used to compare measurements of the data sonde in the water. If readings from two sondes are consistent (differing by less than 10% for temperature, conductivity, DO, and turbidity or ± 0.2 pH units for the negative logarithm of the hydronium ion) the readings will be considered accurate. If any of the parameters exceeds this difference, that parameter will be excluded from the final dataset.

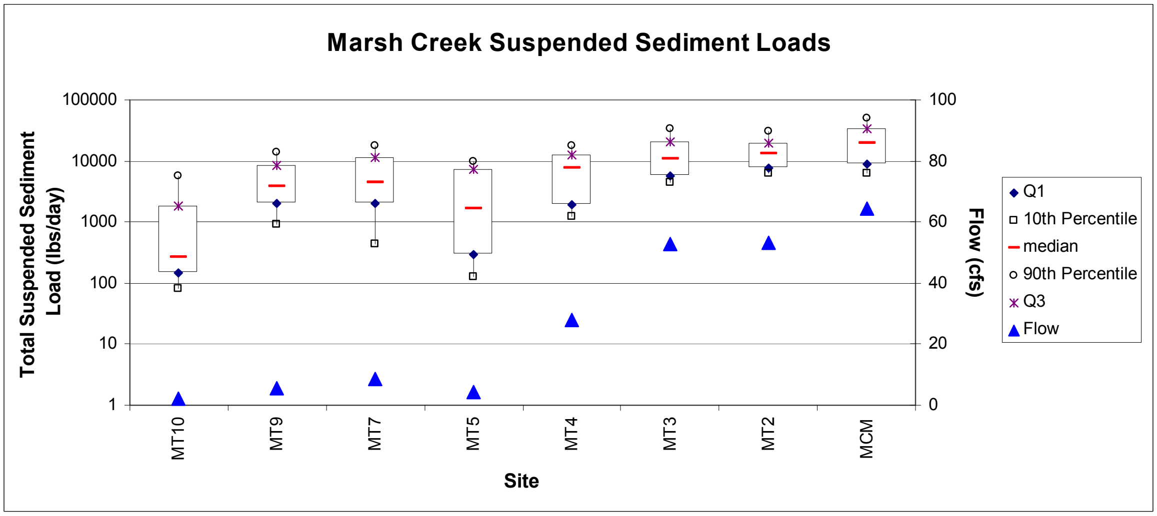


Figure 10. Marsh Creek Discrete Sampling Suspended Sediment Loads (lbs/day) and Flow Data. *Irrigations activities affect the flow on Upper Marsh Creek. TSS levels increase with flow from MT10 to MCM. Large inputs of sediment from the Rat Pond may explain the increase in TSS between MT10 and MT9.*

Parameters	MT10	MT9	MT7	MT5	MT4	MT3	MT2	MCM
Q1	148.37	2000.20	1972.89	288.83	1913.86	5672.80	7670.18	8955.35
10th Percentile	81.35	934.98	428.97	123.87	1249.53	4516.21	6164.46	6349.26
median	261.45	3843.10	4440.44	1633.85	7617.21	10711.18	12893.03	19438.03
90th Percentile	5759.62	13529.29	17580.68	10028.09	17535.05	33916.78	30377.98	49297.37
Q3	1858.46	8531.65	11131.29	7205.57	12294.39	20693.53	19960.71	33869.72
Sample size	35	37	36	35	46	46	46	43
Min	26.09	120.18	202.88	33.52	965.97	3479.11	3979.77	3157.25
Max	7869.46	28813.42	46489.44	30651.20	62236.41	447592.05	74267.35	76891.53
mean	1525.95	5978.42	7410.20	4416.71	9824.50	28172.62	16890.87	23698.07

Table 1. Data table for Marsh Creek Discrete Sampling Sites: TSS

Literature Cited

Fischer, C. 2002. Portneuf River Subbasin Water Quality Monitoring Report. Idaho Association of Soil Conservation Districts, Pocatello, Idaho.

Idaho Department of Environmental Quality (IDEQ). 1999. Portneuf River Subbasin Assessment and TMDLs. Pocatello, Idaho.

Idaho Soil Conservation Commission (ISCC). 2002. Portneuf River TMDL Agricultural Implementation Plan. Pocatello, Idaho.

Jenkins, A. 2005. Portneuf River Subbasin Water Quality Monitoring Report. Idaho Association of Soil Conservation Districts, Pocatello, Idaho.

Resource Planning Unlimited (RPU). 2003. Idaho Agricultural Best Management Practices *A Field Guide for Evaluating BMP Effectiveness*. Idaho Soil Conservation Commission. Boise, Idaho.