MAY CREEK SEDIMENT TRANSPORT STUDY

REPORT

Prepared for
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1 PROJECT BACKGROUND

The May Creek drainage basin is situated on the east side of Lake Washington in King County, Washington (Figures 1 and 2). Over the past several decades, the May Creek basin has been subject to numerous issues derived from development and other human influences. For example, the May Valley area is presently subject to frequent episodes of long-duration flooding, the ravine section (downstream from May Valley) is subject to increased erosion, and the entire length of the stream has experienced reduced usage by salmonids and wildlife.

Development within the May Creek basin has been taking place since the mid-1800s, including logging, mining, road building, and agricultural practices. Channel straightening, channel clearing, dredging, and clearing of natural riparian and floodplain vegetation have occurred as a result of these practices. In recent decades, farming, residential development, and municipal projects in the stream have led to the installation of riprap and in-stream structures such as log weirs and further modification of the stream channel and banks. Within the project reach, a series of log weirs was observed just upstream of the 143rd Avenue crossing. Riprap and ornamentary rock along the banks is also present between approximately 143rd and 146th Avenues. Overall, the effects of human practices within the basin are considerable, and have significant implications to geomorphic processes within the project reach.

King County developed the May Creek Basin Action Plan (2001) in order to address the many issues and problems facing the May Creek basin. The Plan was based on several supporting studies that reflect existing and future conditions as viewed in 1995. The purpose of the May Creek Sediment Transport Study is to analyze the erosion threshold in the May Creek reach between 148th Street and Coal Creek Parkway, commonly known as the ravine (Figure 3). The results of the project analysis have been collated into this report, which presents a fluvial geomorphic characterization of May Creek, results of the data collection and monitoring program, modeling results, and results of the sediment mobility evaluation. This report is structured to allow flexibility with respect to incorporating future design scenarios. The eventual goal is to evaluate proposed drainage improvement options in May Valley and evaluate the potential erosive impacts in the ravine reach.

The sediment transport analysis has been completed in two phases:

- Phase I included selection of a study reach and initial data collection and assessment measures such as establishing cross-sections, pebble count analysis, and installation of bed pins/hooks and water level sensors.
- Phase II included collection and analysis of monitoring data, preparation of a HEC-RAS model of the reach, and evaluation of a “critical discharge” (the discharge at which the bed sediment begins to move.)

In the first phase of work, an initial geomorphic site assessment and stream channel evaluation was performed and an in situ monitoring plan was established for the project reach. Three cross-sections were identified where erosion and sediment transport issues could potentially be evaluated based on observed channel and bank condition and likely hydraulics of the system (Figure 3). Water level sensors were installed at all three identified cross-sections along with soil nails and bed hooks in the channel bed and banks, respectively. Sediment grain-size analyses (pebble count) and channel profile surveys were conducted at each cross-section to document existing condition and allow for the identification of changes to the channel bed within the timeframe of the monitoring period. Monitoring activities, triggered by significant flow events, were performed by King County personnel. Data and results presented in the report are based on monitoring that began in November 2007 and was completed in January 2009.

The second phase of the May Creek Sediment Transport Study builds on the work completed in Phase I. The goals for Phase II were to complete the geomorphic evaluation of the site, develop baseline data (through the monitoring program) and utilize those data to perform a sediment stability analysis for the May Creek study reach. This report compiles those data collected during the monitoring program and summarizes the sediment stability analyses completed in Phase II.

2 GEOMORPHIC ASSESSMENT

2.1 Geologic Setting

The May Creek basin is located in the greater Cedar-Sammamish River basin and outlets into Lake Washington. The basin is composed of high-relief sedimentary and volcanic bedrock on the northeastern side of the valley and Vashon glacial sediments that have infilled a bedrock trough throughout the remainder of the valley (Figure 4). Following Eocene bedrock formation, several periods of glaciation, most notably the Vashon Stade beginning 16,500 years ago, began infilling the valley. Pre-Vashon deposits are present near the mouth of May Creek; the remainder of glacial deposits originated during the Vashon Stade. Glacial Vashon till deposited during glacial occupation underlies the valley bottom and is present at the surface throughout much of the basin. As the ice retreated, massive quantities of meltwater flowed through the May Creek valley, creating the wide May Creek valley of the present day. As the volume of water lessened and the capacity to flush sediment through the system decreased, the valley bottom was filled with glacial recessional outwash deposits. Incision into the glacial sediments led to the creation of steep valley walls through stream erosion and landsliding processes. Continued incision and ongoing present-day geomorphic processes have led to the current geomorphic condition of May Creek.

2.2 Basin-Scale Geomorphology

May Creek originates in the Cascade Foothills in the Newcastle Hills (Figure 1). The longitudinal profile of the stream has a distinct change in gradient near River Mile (RM) 7.5, where it flows out of the steeply-sloped foothills into a wide, shallow valley, resembling a plateau in profile view (Figure5). Unlike a typical stream profile that tends to develop a gentler slope towards the mouth, May Creek drops off steeply into a canyon near RM 3.5, where it eventually flows through a ravine and over a delta until it outlets into Lake Washington.

The longitudinal profile displayed in Figure 5 is indicative of the incision of the stream into the glacial deposits that filled the valley during the last glaciation. This incision has advanced up the valley in the form of a headcut. Left unchecked, this headcut will continue to move up the valley floor in the form of a dynamic transition point from the low-gradient upper valley to the steep canyon below. Currently, headcutting may be impaired for a number of reasons, which are open for debate. An outcrop of bedrock has been described in previous reports as the dominant grade control feature that limits headcutting up the valley. Anchor QEA did not observe this bedrock during field reconnaissance, rather a series of log weirs just upstream of 143rd Avenue was observed, which control the local grade and prevent incision and headcutting from potentially migrating up the valley (Figure 3). It is unclear whether or not the bedrock knob is present, but it is apparent that the log weirs are currently controlling the channel local grade.

2.3 Reach-Scale Geomorphology

The project reach is located between approximately RM 2.9 and RM 4.1, where the stream transitions from the wide, low-gradient, May Valley reach to the steep reach through the canyon (Figure 5). The grade control transition point is located within the project reach.

The project reach can be described in multiple parts, each with distinct features related to geomorphic and anthropogenic influences. In the upstream segment of the reach, from 148th to 146th Avenues, the channel is straight, narrow, and deep with a relatively flat gradient (Photograph 1). The stream has low banks with easy floodplain access. Flooding occurs frequently and the floodplain is typically wet and marshy much of the year. The floodplain and banks are thickly vegetated with reed canary grass, a few shrubs, and small trees.

Photograph 1. Upstream portion of the project reach near 148th Street.

At 146th Avenue, May Creek begins to flow through a residential area where it is typically confined by riprap along the banks (Photograph 2). The bridge at 146th Avenue may act as a constriction point within this reach. The log weirs mentioned previously are located through this area down to the 143rd Avenue crossing. The stream is relatively flat (gradient of approximately 0.05%) through this section, the active channel is relatively narrow, and no gravel bar accumulations were observed. The creek is well connected to the floodplain and routine flooding occurs in this area.

Photograph 2. May Creek between the 146th and 143rd Avenue crossings, looking downstream at a log weir and rip-rap banks.

Downstream of the 143rd Avenue Bridge, the effect of incision is more apparent and influences the geomorphic conditions of May Creek. The stream takes a sharp turn to the southwest and again to the west, and the active channel is relatively wide and riffle-dominated. Active channel migration was observed through this segment. The floodplain area is reduced because the banks tend to be steep where the stream has headcut and eroded into ancient glacial terraces (present at Monitoring Site 3, as shown in Photograph 3). The largest amount of woody debris was observed in this part of the reach; much of the wood was contributed to the system by bank erosion.

Photograph 3. Glacial terrace banks at Monitoring Site 3, looking downstream.

Between Monitoring Sites 3 and 2, the channel transitions from meandering and riffle-dominated to a straight and entrenched run-dominated system. The difference between the bed and top of bank height is greater and progressively increases moving down the valley. May Creek continues to become increasingly entrenched as it travels down the canyon through the downstream end of the project area (Photograph 4), including Station 1. Throughout the canyon and ravine areas, the channel has little ability to migrate because it is confined by steep banks composed of glacial deposits.

Photograph 4. The May Creek ravine at the Coal Creek Parkway crossing.

3 DATA COLLECTION AND MONITORING PROGRAM

3.1 Description

A data collection and monitoring program was developed for the May Creek Sediment Transport Study to document baseline conditions and provide data for the sediment mobility analysis. Data collection and monitoring was focused on three stations (cross-sections of the creek) located throughout the project reach at approximately RMs 2.9, 3.4 and 3.6 (Figure 3). Survey data, including elevations, and pebble count information were collected at each of the monitoring sites in November 2007 (the start of the monitoring period) and survey data was collected again in January 2009 (the end of the monitoring period).

A monitoring program was developed to perform on-site documentation of significant flow events and visible erosion and deposition at the three monitoring locations from November 2007 through January 2009. King County personnel performed the on-site inspections and completed the monitoring documentation. A set of spreadsheets was provided to King County for use in documenting each monitoring visit.

Each monitoring station included bed hooks to monitor sediment transport of the streambed and bank pins to monitor erosion of the streambanks. Pressure transducers with internal data loggers were also installed in the creek channel at each monitoring station to collect daily maximum water surface elevation data. Transducer data was collected periodically by King County personnel. The location and condition of bed hooks and bank pins were documented during each site visit. Bed hooks consisted of eye bolts driven into the streambed at 2-foot intervals. Colored flagging was attached to each eye bolt to improve visibility during monitoring. Bank pins consist of 2-foot lengths of rebar driven flush into the bank. Each monitoring station also included a left and right bank rebar with cap. The rebar represented benchmark points along the specific cross-section. All measured distances in the monitoring spreadsheets were measured from the left bank rebar benchmark. Figures 6 through 8 in Appendix A show the initial geometry of the monitored stations and the location and spacing of all monitoring hardware.

After every selected storm event, each site was investigated for the presence or absence of each of the bed hooks (eye bolts), and exposure of the bank pins (rebar) was measured and documented using the specified spreadsheets (monitoring forms). A step-by-step description of the protocol for each monitoring events is provided below:

1. Assess the site for obvious storm effects or potential vandalism and note in the site conditions sections of the monitoring forms
2. Attach the measuring tape to the left bank benchmark, confirm the presence or absence of all bed hooks, and document the findings in the monitoring forms
   a. If bed hooks are present, mark "P" under the correct column in the form
   b. If bed hooks are absent, mark "A" under the correct column in the form
   c. Replace any bed hooks that were missing and attach flagging to each
      i. Using the attached measuring tape, measure out the required replacement distance necessary to replace the missing bed hooks
      ii. Bed hooks should be flush with the channel bottom and securely placed using a sledge hammer, as necessary
3. Evaluate bank pins, measure the length of exposure, and document in the monitoring forms
   a. If bank pins are flush to the bank, record 0 in the length of exposure column in the monitoring form
   b. If bank pins are exposed, measure the length of exposure and record in the corresponding column in the monitoring form
   c. Re-mark each bank pin using spray paint for easy location during the next monitoring visit
   d. If rebar is missing, replace by measuring down from rebar cap to correct elevation (given on the monitoring form), reinstall into bank, and re-mark
4. Repeat steps 1 through 3 for each of the three monitoring sites

Completed monitoring forms, as well as any photographs or other observations, were sent by King County personnel to Anchor QEA for analysis. Completed monitoring forms for the project are provided in Appendix D.

3.2 Summary of Collected Data

3.2.1 Survey Data

King County personnel collected survey information, including elevations, for the three monitored cross-sections at the beginning and end of the monitoring period (November 2007 through January 2009). At each monitoring station, three different cross-sections were surveyed, an upstream, middle, and downstream cross-section, spaced approximately 50 feet apart. The middle cross-section has been used to characterize each of the monitoring stations for the bulk of this analysis. However, the slope of the channel at each cross-section was calculated as the slope from the upstream to the downstream cross-section for each monitored station. The locations of each of the water level sensors were also surveyed.

The initial and final cross-section geometry for each of the monitored stations (middle cross-section) is provided in Figures 9 though 11, in Appendix A. From November 2007 to January 2009, Station 1 exhibited approximately 0.5 feet of deposition in the channel and now occupies a side channel off the right bank. It is not apparent from the survey data if that side channel existed prior to the January 2009 survey due to lack of resolution in the earlier survey data. Station 2 appears to be relatively stable over the same time period, with slight degrading (maximum of 0.5 feet) of the left side of the channel bottom. Station 3 exhibited the most dramatic change over the course of the monitoring period, where the thalweg moved toward the right bank approximately 15 feet and the right bank moved approximately 10 to15 feet. The original thalweg location shows about 1 to 1.5 feet of deposition.

3.2.2 Sediment Data

Pebble count surveys were completed for each of the three monitored stations using the Wolman method (Wolman 1954). At each sampling location, one pebble/rock was sampled every 6 inches across the creek with an additional 10 pebbles/rocks sampled randomly within the cross-section. Table 1 provides a summary of the particle size distributions for each of the three monitoring locations developed from the pebble count analysis.

Table 1
Particle Size Distribution from Pebble Count Results

Monitoring Station	d_{10} (mm)	d_{30} (mm)	d_{50} (mm)	d_{70} (mm)	d_{90} (mm)
1	11	28	64	128	181
2	10	21	32	48	90
3	12	21	28	42	70

3.2.3 Monitoring Inspection Reports

There were a total of eight flow events that triggered monitoring events during the timeframe of this project, from November 2007 through January 2009. Data was collected for Stations 2 and 3 for the entire length of the monitoring time period; however, Station 1 was monitored from November 2007 through November 2008 only. Table 2 provides summary information for each of those events. Monitoring forms for each event are provided in Appendix D of this report.

Table 2
Summary of Documented Monitoring Events

Monitoring Date	Flow Event Date	Estimated Flow in Reach[a] (cfs)	Data Collected		
			Station 1	Station 2	Station 3
November 16, 2007	November 16, 2007	26	X	X	X
December 11, 2007	December 3, 2007	339	X	X	X
December 20, 2007	December 20, 2007	37	X	X	X
December 27, 2007	December 23, 2007	35	X	X	X
April 1, 2008	March 31, 2008	33	X	X	X
June 13, 2008	June 11, 2008	23	X	X	X
November 10, 2008	November 7, 2008	72	X	X	X
January 8, 2009	January 7, 2009	348		X	X

Notes:
a See Section 4.2.1 for additional information on flow data.

Of the eight events that triggered monitoring, two produced visual erosion of the bed or banks; the December 3, 2007 event (339 cubic feet per second [cfs]) and the January 7, 2009 event (348 cfs). All of the other events had flows estimated to be 70 cfs or below. The

December 3, 2007 event was characterized in general by the loss of some of the bed hooks and bank pins at each of the cross-sections. The January 7, 2009 event was characterized by loss of many of the bed hooks and bank pins at each of the Stations 1 and 2. Table 3 summarizes the documented observations for both of these events.

Table 3
Summary of Documented Bed Moving Events

Monitoring Date	Flow Event Date	Est. Flow (cfs)	Observations		
			Bed Hooks	Bank Pins	Notes
December 22, 2007	December 3, 2007	339			
Station 1			Loss of two bed hooks on far right bank	No change	Bed hooks still presently covered with ~1 inch of sediment
Station 2			Loss of two bed hooks on far right bank	~1 inch of scour visible at 2 pins	n/a
Station 3			Loss of two bed hooks on far right bank	~5 to 24 inches of scour visible at all pins	Bank pins reset flush

Monitoring Date	Flow Event Date	Est. Flow (cfs)	Observations		
			Bed Hooks	Bank Pins	Notes
January 8, 2009	January 7, 2009	348			
Station 1			n/a	n/a	n/a
Station 2			6 of 12 bed hooks missing	No visible scour of bank pins	n/a
Station 3			8 of 10 bed hooks missing	All bank pins missing	11 feet of bank lost

Notes:
See Section 4.2.1 for additional information on flow data.

3.2.4 Water Level and Flow Data

Water level and flow data were compiled from two existing, long-term gages along the project reach (Gages 37a and 37b) and three additional water level gages installed at each of the monitored stations (Gages May 1, May 2, and May 3) as part of the monitoring program developed specifically for this project. Figures 2 and 3 show the locations for these gages. Water level data are available for the May 1 gage from November 2007 through the middle of November 2009. Water level data are available for the May 2 and 3 gages from November 2007 through most of February 2009.

Gage 37b is located between the two monitoring stations, Stations 1 and 2. This gage was to be used to provide flow data for the sediment mobility study. However, a drift in the water surface elevation data was found in the gage data through inspection of flow events from 1999 through 2009. Figure 12 shows a plot of the water surface elevation data recorded by Gage 37b for each 100-cfs flow from November 13, 1999 through January 9, 2009. The water surface elevation data are consistent through January 13, 2006, where a distinct jump occurs. Following this jump, the water surface elevation continues to rise for each subsequent 100-cfs flow event until January 9, 2009, where another significant jump occurs. These perturbations are likely caused by wood debris depositing in the channel adjacent to the gage affecting the measured water surface elevations. Therefore, following January 13, 2006, the stage flow relationship for this gage was not a constant. Since the project monitoring period occurs within this window of time, the flow data directly from Gage 37b could not be reliably used in this study.

In an effort to extract as much relevant information as possible from Gage 37b data prior to the January 13, 2006 jump, data from Gage 37b was compared to data from Gage 37a (located downstream) for that same time period. A scaling relationship was developed and was used to create a synthetic flow record at the Gage 37b location for the monitoring time period. This procedure is described in greater detail in the following section.

3.2.5 Gage Scaling of Flow Data

The purpose of the gage scaling between Gages 37a and 37b was to extend the flow record from Gage 37b beginning at January 11, 2006 (just prior to the initial jump shown in Figure 12) through the current extent of flow record at the time of this analysis for Gage 37a (February 5, 2009). The data obtained from both gages include mean hourly flow and corresponding stage for various periods of record. Where some hourly data were missing for a particular day, peak daily flows were calculated from the data that were available. If an entire day was missing data, those data from that day were removed from the analysis.

The specific datasets utilized and the procedure that was followed to perform the data extrapolation (Gordon, et. al. 1992 and Gupta, R. 2001) is described in detail below:

1. Compile data and extract daily peak flow for Gages 37a and 37b (removing dates where data was missing) the following time periods:
    a. November 1, 1998 through April 13, 2000
    b. June 29, 2000 through September 19, 2000
    c. October 24, 2000 through January 31, 2008
    d. March 17, 2008 through February 5, 2009
2. Develop two log-linear regression relations between flow data for Gage 37a and 37b, one for low flow events and one for high flow events. Figure 13 provides plots and equations for both of the regression relations developed.
3. Produce a synthetic flow record for Gage 37b from January 11, 2006 through February 5, 2009 using the flow data from Gage 37a for the same time period and the linear regression equations shown in Figure 13.
4. Perform quality assurance/quality control (QA/QC) checks of the extended data record for Gage 37b through comparison of the synthetic record and the actual data recorded by the gage.

In general, the QA/QC of the synthetic record showed good agreement with measured data; however, significant differences for discreet data points within the record do exist. From inspection of Figure 13, it is apparent that agreement between measured and extrapolated water surface elevation at Gage 37b is better for the higher flows than the lower flows. Since high flow events are more critical to the current evaluation than the lower flow events (where bed movement does not occur), the synthetic flow record is considered appropriate for use in the sediment mobility study.

4 SEDIMENT MOBILITY ANALYSIS

The data collected and compiled in Section 3.2 were used to perform a sediment mobility analysis for the project reach (RM 2.9 to RM 4.1). The goals of the analysis were to evaluate flow conditions under which sediment would become mobile for each of the monitoring cross-sections.

The sediment mobility analyses consisted of a comparison of three elements:

1. A one-dimensional (1-D) model (HEC-RAS) was used to develop flow velocities and shear stresses within the project reach for a variety of high flow events as well as the flows present for each of the monitoring events summarized in Table 2.
2. An estimate of the threshold of sediment motion (critical shear stress) for each of the monitoring sites was completed using several theoretical approximations and data provided by the monitoring program.
3. Direct calculation of bed shear stress using available monitoring data developed as part of this study (cross-section survey, water level data, and flow data).

4.1 Methodology

4.1.1 Hydraulic Modeling

An existing 1-D HEC-RAS model developed for King County for a previous study was utilized for the May Creek modeling effort. The existing model was updated with the geometry from the three monitoring locations and initially run using the same basin hydrology, bed roughness values, and boundary conditions that were used in the original model. Table 4 summarizes the basin hydrology used for the both the existing and present modeling effort. These data are from HSPF modeling developed for the May Creek Current and Future Conditions Report (King County and City of Renton 1995).

Table 4
Basin Hydrology Utilized in Model

Return Period	Flow (cfs)
Mean Annual	13.6
2-Year	208
5-Year	243
10-Year	347
20-Year	429
50-Year	442
100-Year	535

The HEC-RAS model was calibrated using the water surface elevations (WSE) measured at each of the monitoring sites. This was done through modification of the bed roughness at the monitoring site locations within the model until the WSE produced by the model were in good agreement with measured data. Table 5, below, shows a comparison of modeled and measured WSE. The model results at Station 1 were found to be unreliable due to a large gap in survey data upstream of that location. The next cross-section is located approximately 2,000 feet upstream which results in a misrepresentation of the slope along that reach and an associated inaccuracy in the one-dimensional model results.

Agreement between modeled and measured WSE is good for lower flow events (less than 70 cfs), except for the flow event that occurred on June 11, 2008 (23 cfs). This event produced lower WSE than were predicted by the model. However, this could be an outlier due to an error in the synthetic flow record. Agreement between modeled and measured WSE for the two high flow events (greater than 300 cfs) was not as good (in general) as the lower flow events. WSE at Station 2 were generally 1 foot lower than predicted by the model. WSE at Station 3 were slightly lower than modeled for one event and approximately 0.5 foot higher than modeled for the other event. These differences for the high flow events can be attributed to bed movement during those events that is not taken into account in the HEC-RAS model. Since the HEC-RAS model cannot simulate changes to a cross-section during high flow events (which is occurring in the field), further calibration of the model to force agreement in WSE for the higher flow events is not recommended.

Table 5
Water Surface Elevation from Model and Monitoring Data

Flow Event Date	Estimated Flow[a] (cfs)	Station 1[b]		Station 2		Station 3	
		Model WSE (ft)	Data WSE f(t)	Model WSE (ft)	Data WSE f(t)	Model WSE (ft)	Data WSE f(t)
November 16, 2007	26	n/a	235.9	286.2	286.1	296.0	296.0
December 3, 2007	339	n/a	237.3	**288.4**	**287.1**	**297.7**	**297.4**
December 20, 2007	37	n/a	236.5	286.3	286.2	296.2	296.0
December 23, 2007	35	n/a	236.5	286.3	286.2	296.2	296.0
March 31, 2008	33	n/a	236.6	286.3	286.3	296.2	296.0
June 11, 2008	23	n/a	236.3	286.1	285.9	296.0	295.7
November 7, 2008	72	n/a	236.9	286.7	286.3	296.5	296.2
January 7, 2009	348	n/a	n/a[c]	**288.5**	**287.6**	**297.8**	**298.3**

Notes:
a See Section 4.2.1 for additional information on flow data
b Model data for Station 1 are considered unreliable
c No data collected at Station 1 for these monitoring events

4.1.2 Initiation of Sediment Motion

The monitoring data and data produced through the modeling effort were used to complete an evaluation of the initiation of sediment motion in the study reach. This evaluation included a comparison between theoretical estimates of critical bed shear stress estimated from the pebble count information at each monitoring station and bed shear stress estimated for extreme and monitoring flow events at each monitoring station.

Theoretical Estimates of Critical Shear Stress

Critical shear stress, the shear stress under which a sediment bed will become mobile, is challenging to determine. There are several processes that affect the value of critical shear stress (such as changes in bed composition over time, bed armoring, shape of bed material, etc.) that are not easy to predict or quantify. However, there are several explicit relationships for critical shear stress available in literature generally used to evaluate bed mobility of a system for engineering purposes based on the particle size distribution of the bed. There are numerous other relationships for critical shear stress that are not utilized in this study due to extensive site-specific data requirements for those calculations. The following relationships for critical shear stress were used for this study, and produced six different estimates for sediment mobility in the project reach:

- Shields relation (Shields 1936) using the explicit formation by Cao (2006). Characteristic diameters used were d_{50}, d_{70}, and an effective diameter (d_{eff}) calculated from the particle size distribution using Christensen (1969).
- Empirical relationship developed by Ashworth and Ferguson (1989) for gravel streams based on the authors Dubhaig data set. Three characteristic diameters were considered in the analysis; d_{10} (low range), d_{50} (mid-range) and d_{70} (high range).

The values of critical shear stress estimated through each of these methods for each monitoring station are summarized in Table 6.

Table 6
Theoretical Estimates of Critical Shear Stress (lbs/ft^2) for Monitoring Stations[a]

	Shields Relation			Ashworth and Ferguson (1989)		
	d_{eff}	d_{50}	d_{70}	d_{10}	d_{50}	d_{70}
Station 1	0.8	1.0	1.9	1.0	1.8	2.4
Station 2	0.5	0.5	0.7	0.6	0.9	1.1
Station 3	0.5	0.4	0.6	0.6	0.8	0.9

Note:
a Sediment gradation based on pebble count data

Estimates of Bed Shear Stress for High Flows

Bed shear stress during high flow events were estimated from the HEC-RAS model at each monitoring station. The hydraulic radius and bed shear stress provided by the model for the high flow events for each station is shown in Table 7.

Table 7
Hydraulic Radius and Total Shear Stress for High Flow Events (Modeled)

Return Period (years)	Flow in Creek (cfs)	Station 1[a]		Station 2		Station 3	
		Rh (ft)	Ts (lb/ft^2)	Rh (ft)	Ts (lb/ft^2)	Rh (ft)	Ts (lb/ft^2)
Mean Annual	13.6	n/a	n/a	0.4	0.3	0.4	0.7
2	208	n/a	n/a	1.7	1.5	1.2	1.9
5	243	n/a	n/a	1.9	1.6	1.4	2.1
10	347	n/a	n/a	2.3	1.9	1.7	2.6
20	429	n/a	n/a	2.6	2.0	1.9	2.8
50	442	n/a	n/a	2.6	2.0	1.9	2.8
100	535	n/a	n/a	2.9	2.2	2.2	3.1

Note:
a Model data for Station 1 are considered unreliable

Estimates of Bed Shear Stress – Monitoring Flow Events

Bed shear stress for each of the monitoring flow events was calculated using two different procedures. The first set of values, shown in Table 8, was provided by the HEC-RAS model (post-calibration) run for each of the monitoring flow events calculated from gage data (Section 4.2.1). The second set of values, shown in Table 9, was produced by analytical calculations using water surface elevation and flows measured during monitoring events at each station. The water surface elevation gage data for each flow event, along with the survey data for each monitoring station, was used to calculate the flow area and wetted perimeter. This information was used to calculate the hydraulic radius for each flow event at each monitoring station. The slope of the energy grade line for the flow was estimated as the slope of the channel from upstream to downstream of each of the monitoring stations. The slope values for each of the three monitoring stations were estimated as 0.015 for Station 1, 0.012 for Station 2, and 0.008 for Station 3.

From this information, the bed shear stress was calculated using Equation 1 (Leopold et al. 1964), where τ_s is the bed shear stress in pounds per square feet (lb/ft^2), R_h is the hydraulic radius in feet, and s is the slope as described above.

$$\tau_s = \gamma_w R_h s \quad \text{Equation 1}$$

Table 8

Hydraulic Radius and Total Shear Stress for Monitoring Events (Modeled)

Flow Event Date	Estimated Flow[a] (cfs)	Station 1[b]		Station 2		Station 3	
		Rh (ft)	Ts (lb/ft^2)	Rh (ft)	Ts (lb/ft^2)	Rh (ft)	Ts (lb/ft^2)
November 16, 2007	26	n/a	n/a	0.6	0.5	0.5	0.8
December 3, 2007	339	n/a	n/a	2.3	1.8	1.7	2.5
December 20, 2007	37	n/a	n/a	0.7	0.6	0.5	0.8
December 23, 2007	35	n/a	n/a	0.7	0.6	0.5	0.8
March 31, 2008	33	n/a	n/a	0.7	0.6	0.5	0.9
June 11, 2008	23	n/a	n/a	0.5	0.5	0.5	0.4
November 7, 2008	72	n/a	n/a	0.9	0.9	0.6	1.0
January 7, 2009	348	n/a	n/a	2.3	1.8	1.7	2.5

Notes:
a See Section 4.2.1 for additional information on flow data
b Model data for Station 1 are considered unreliable

Table 9

Hydraulic Radius and Total Shear Stress for Monitoring Events (from Data)

Flow Event Date	Estimated Flow[a] (cfs)	Station 1		Station 2		Station 3	
		Rh (ft)	Ts (lb/ft^2)	Rh (ft)	Ts (lb/ft^2)	Rh (ft)	Ts (lb/ft^2)
November 16, 2007	26	0.1	0.4	0.5	0.4	0.7	0.4
December 3, 2007	339	1.0	1.3	1.1	0.9	1.5	0.8
December 20, 2007	37	0.4	0.4	0.6	0.5	0.9	0.5
December 23, 2007	35	0.4	0.4	0.6	0.5	0.6	0.4
March 31, 2008	33	0.8	0.8	0.9	0.7	0.9	0.5
June 11, 2008	23	0.4	0.4	0.3	0.3	0.7	0.4
November 7, 2008	72	0.6	0.6	0.7	0.6	0.7	0.4
January 7, 2009[b]	348	n/a	n/a	1.6	1.3	1.8	1.0

Notes:
a See Section 4.2.1 for additional information on flow data
b No data collected at Station 1 for these monitoring events

The bed shear stress calculated for the monitoring flow events by the HEC-RAS model (Table 8) are generally higher than that those calculated directly from data (Table 9). This could be due to several factors that are not taken into account in the model, but are implicitly involved in calculation from measured data. These factors could include dynamic changes to sediment bed size gradation, channel movement and/or debris accumulation at or near the monitoring site during the flow event, or flow attenuation along the reach,

Estimate of Threshold of Motion

The estimates of critical shear stress for each station, bed shear stress for each station and monitored flow event, and monitoring notes concerning visual observations of erosion were used to evaluate the approximate threshold of motion at each monitoring section.

From monitoring data and notes, it is clear that the threshold of motion lies somewhere between 70 and 350 cfs, as no erosion was observed during the 70 cfs event and erosion was observed during the two 350 cfs events. Since there are no monitoring flow events in between those two bookends, the data set must be interpolated to provide estimates of bed shear stress (at each station) for flows between 70 and 350 cfs. This interpolation was done using a graphical approximation to define a trend for the data. Plots were created for each station (Figures 14 through 16) that includes the following data:

1. Critical shear stress estimates (shown as colored lines on the plots)
2. Bed shear stress for high flow events provided by the HEC-RAS model (shown as blue circles on the plots labeled with associated return period). Note: These values were not shown for Station 1 as they were found to be unreliable.
3. Bed shear stress for monitoring flow events provided by the HEC-RAS model (shown as green squares on the plots)
4. Bed shear stress for monitoring flow events calculated directly from data (shown as blue triangles on the plots)

A simple trend line was developed to represent the bed shear stress for monitoring flows calculated directly from data (blue triangles). This is represented as a blue dashed line on the plots. This trend line was used to provide an estimate of the bed shear stress for flows between 70 and 350 cfs for each monitoring station.

In order to evaluate the flow at which the sediment bed at each monitoring station becomes mobile, it is necessary to determine which estimate of critical shear stress is most likely applicable to each station. It is not practical to develop a range based on several possible estimates because of the wide range of values produced by the different approximations (see Table 6). Since each of these reaches is characterized by a large gravel to cobble bed, as opposed to sand, the Ashford and Ferguson (1989) approximation was used. The characteristic diameter was chosen as the d_{50} of the sediment bed (from pebble count information). The d_{50} of the sediment bed is generally used as the standard parameter for shear stress calculations in channels, unless site specific data suggests otherwise (Carson and Griffiths 1987). In this case, the data gap in measured flows between 70 and 350 cfs does not provide enough information to suggest use of a different characteristic diameter.

The critical shear stress for each station (in lbs/ft^2) using Ashford and Ferguson (1989) and the d_{50} of the bed is 1.8 for Station 1, 0.9 for Station 2, and 0.8 for Station 3 (Table 6). The flow discharge in each station that corresponds to this estimated critical shear stress was found using the trend lines plotted in Figures 14 through 16. The procedure for this is described below:

1. The critical shear stress value for the station is found on the vertical axis of the plot (Figures 14 through 16)
2. A line is drawn horizontally on the plot at that critical shear stress value (shown as the thick grey line labeled A&F D50)
3. From the intersection of that horizontal line with the data trend line a corresponding value of discharge (Q) along the x-axis can be determined.

Using this methodology, the flow discharge which corresponds to the threshold of sediment bed motion for Stations 2 and 3 is approximately 280 cfs and 275 cfs, respectively. Station 1, however, shows a different behavior than Stations 2 and 3. The trend line plot (Figure 14) shows that the estimated critical shear stress for the section (1.8 lbs/ft^2) is larger than the calculated shear stress from the monitoring event where erosion was observed (1.3 lbs/ft^2). This could imply that a different estimate of critical shear stress is applicable for Station 1. However, there are several complicating factors present at Station 1. During the course of the monitoring period, and shown in the pre- and post- survey data provided in Figure 9, the original channel has filled in with approximately 0.5 feet of sediment and a deeper narrower side channel has developed along the right bank. The pebble count information, on which the critical shear stress estimates are based, was taken from the original channel location. The sediment size distribution within the new side channel is most likely different and may potentially have a smaller median diameter (since this area has eroded while the original channel bed has not). Due to these complexities, it would be challenging to interpolate a more precise threshold of sediment motion for Station 1. However, from the reach scale geomorphic evaluation, monitoring event notes and observations, and the existing pebble count information for Station 1, it can be assumed that the threshold of sediment motion for Station 1 is at least equal if not higher than Stations 2 or 3. Therefore, when evaluating the project reach in its entirety, a discharge of 275 cfs or higher should be considered to be erosive to discrete areas within the reach. However, it should be noted that there is a fair degree of uncertainty in this discharge value since it was developed from an interpolation due to the lack of monitoring data points between 70 and 350 cfs. This data gap leaves a broad range for interpretation of an estimate of the precise flow at which initiation of bed sediment motion begins.

Other general observations, which were noted during the course of this work, are summarized below:

- Based on the hydrology provided in the HEC-RAS model for the May Creek basin, the two erosion events that occurred during the monitoring period (December 3, 2007 and January 7, 2009) were approximately 10-year return period events.
- Bed shear stress calculated from data is slightly higher on average at Station 1 than at Stations 2 and 3. However, this difference is most likely within the error of the calculation.
- The extent of erosion during the January 7, 2009 event was much more expansive that the December 11, 2007 event even though the estimated discharge for both events was approximately the same (348 and 339 cfs, respectively). A review of flows in the reach (from the data developed in Section 3.2.5) shows that both events were 6 days in duration, with peak flows occurring 2 days into the event. However, the December 11th event was characterized by low flows (< 25 cfs) for the month ahead of the event. The January 7th event, on the other hand, was preceded by a smaller flow event which was characterized by flows between 50 and 65 cfs from December 29, 2008 through January 3, 2009. While the effects of flood events in series were not

explicitly considered within the context of this study, they may have an attributable effect on the scale of erosion within the reach.

5 CONCLUSIONS

The HEC-RAS model developed for the project reach (RM 2.9 to RM 4.1) through the course of this work provides reasonable estimates of water surface elevations for lower flow events (less than approximately 70 cfs), when compared to monitoring data. However, for higher flow events, bed movement begins to occur which cannot be properly accounted for in the present model. This is due to limitations of the HEC-RAS model itself, which is a steady state model and does not take into account any dynamic changes to the model geometry or other factors, such as debris accumulation. Therefore, estimates of water surface elevation from the model for these higher flow events tend to be higher than those calculated from monitoring data. Bed shear stress predicted by the model is generally higher than bed shear stress calculated from monitoring data. This is most likely due to the same limitations of the HEC-RAS model as previously discussed. Therefore, this suggests that results from the model will tend to over-predict sediment movement in the project reach.

Data were collected and observations were recorded for eight monitoring events during the study period; six lower flow events (less than 75 cfs) and two higher flow events (greater than 335 cfs). Due to the data gap in monitored flows, the data was interpolated to provide estimates for bed shear stress at each monitored station between 70 and 350 cfs. From an analysis of these data, it can be surmised that the flow at which erosion will begin to occur at discreet locations within the project reach is approximately 275 cfs. It is important to note that there is a fair amount of uncertainty with this value. While the data collected during the monitoring program were accurate, the range of flow data points was not comprehensive enough to provide a precise result.

Additional Considerations

The portion of May Creek examined in this study lacks an upstream sediment source for gravels and sands. As flow events impact the reach, the sediment size distribution along the channel bed will tend to coarsen over time; due to the transport of finer sediments out of the reach with no incoming sediment supply to replenish these materials. This armoring effect will tend to increase the threshold of sediment motion for the channel bed. On the other hand, bank sediments, which are likely of finer gradation than the bed sediments, will remain unchanged and are not affected by a natural armoring effect. Therefore, future erosion events may be characterized by bank migration (movement of the stream channel from its current location) as opposed to channel incising.

6 RECOMMENDED NEXT STEPS

The results of this study are directly related to the quality and quantity of data that were collected. As stated in the above section, the range of flow data points was not comprehensive enough to provide a precise result, although the data that were collected were accurate. It is potentially possible to increase the precision of the estimate of initiation of motion for the project reach through addition and continued data collection, such as the following:

- Continued monitoring, as described in this report, at Station 2 where bed pins, bank hooks, and the water level sensor are still deployed.
- Reestablish bed pins, bank hooks, and water level sensor for Station 3 upstream of its current location, and continue with monitoring Station 3 as described in this report.
- Consider relocating Gage 37b to a location that may be less effected by accumulation of sediment or debris, which can affect the data recorded by the sensor.

In addition, several actions are recommended that would allow the results of this study to be used more effectively for the evaluation of potential actions within the reach. These activities include the following:

- Combine the upstream and downstream models, which have been developed separately, to produce a cohesive model for the reach.
- Develop accurate hydrologic data for the upstream watershed.
- Develop and implement an unsteady state flow model inclusive of both the upstream and downstream of 148th Avenue, which can be utilized to evaluate the long-term potential for changes to hydraulics throughout the length of the reach. This would allow simulations of successive flood events in order to evaluate the downstream effects of upstream modifications.

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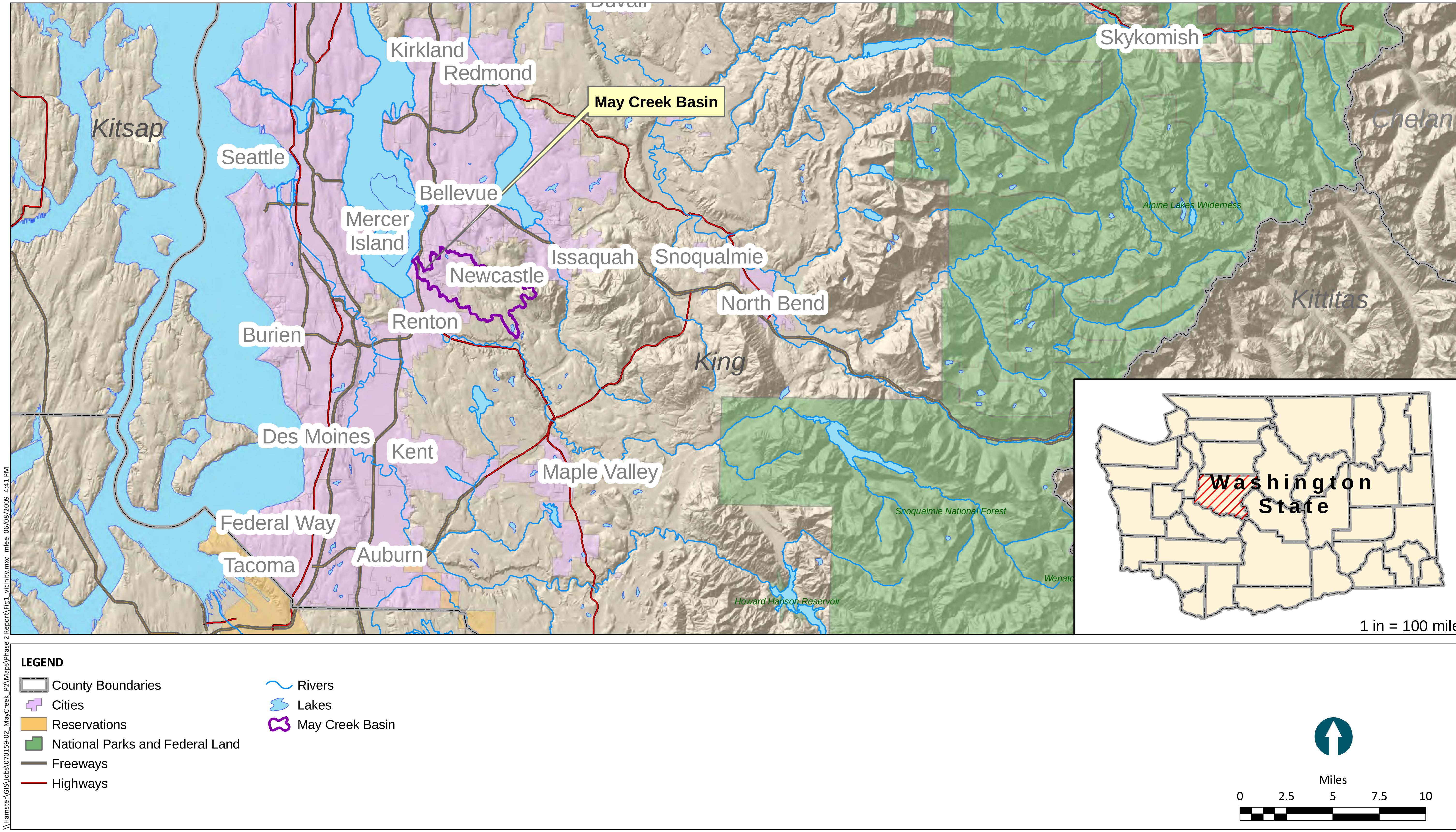
APPENDIX A
MAPS AND FIGURES



\\Hamster\GIS\Jobs\070159-02_MayCreek_P2\Maps\Phase 2 Report\Fig1_vicinity.mxd mlee 06/08/2009 4:41 PM

Figure 1
Vicinity Map
Sediment Transport Study Report
King County/ May Creek Sediment Transport Study Phase 2

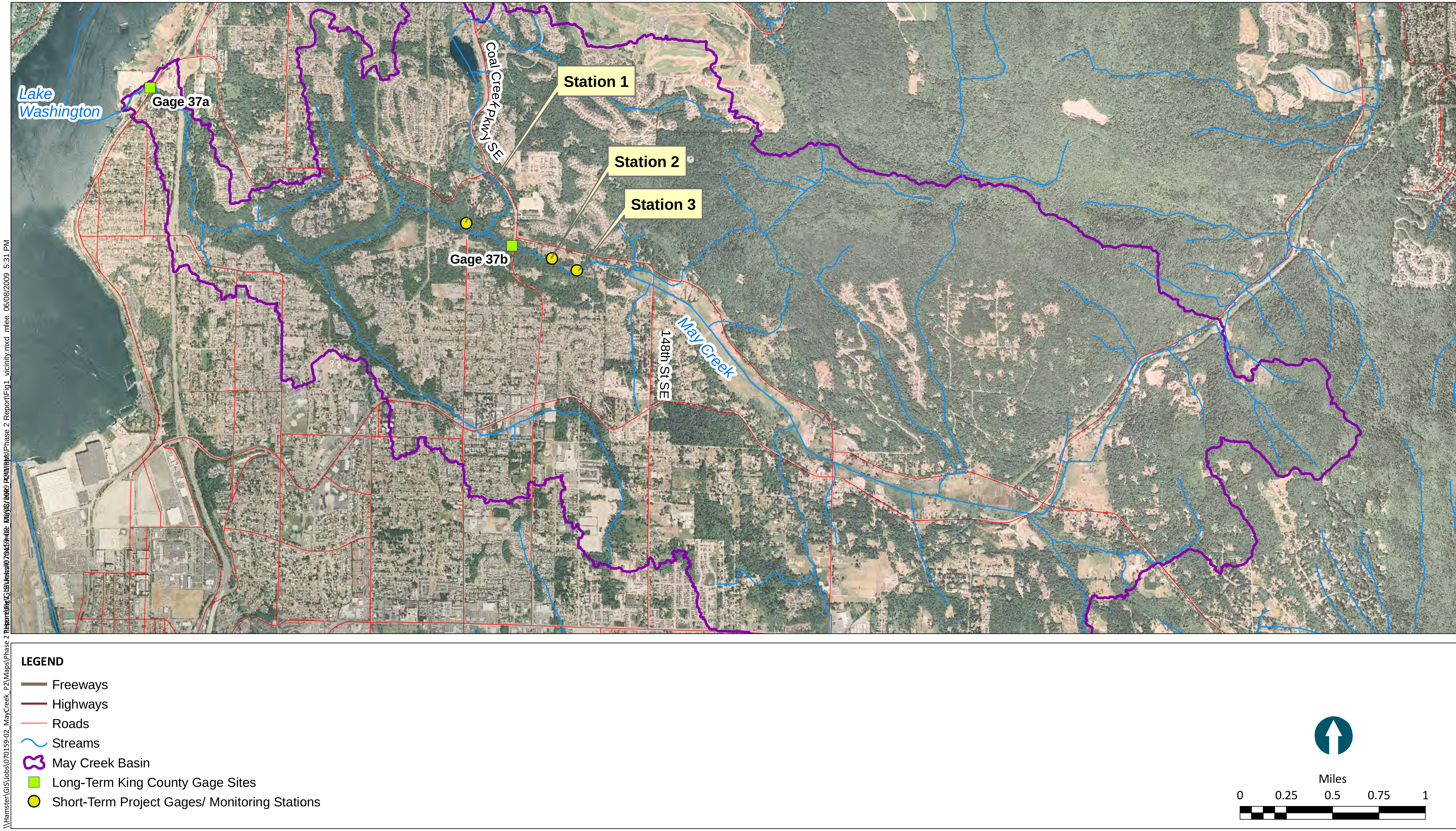


Figure 2
Basin-Scale Site Map
Sediment Transport Study Report
King County/ May Creek Sediment Transport Study Phase 2

LEGEND

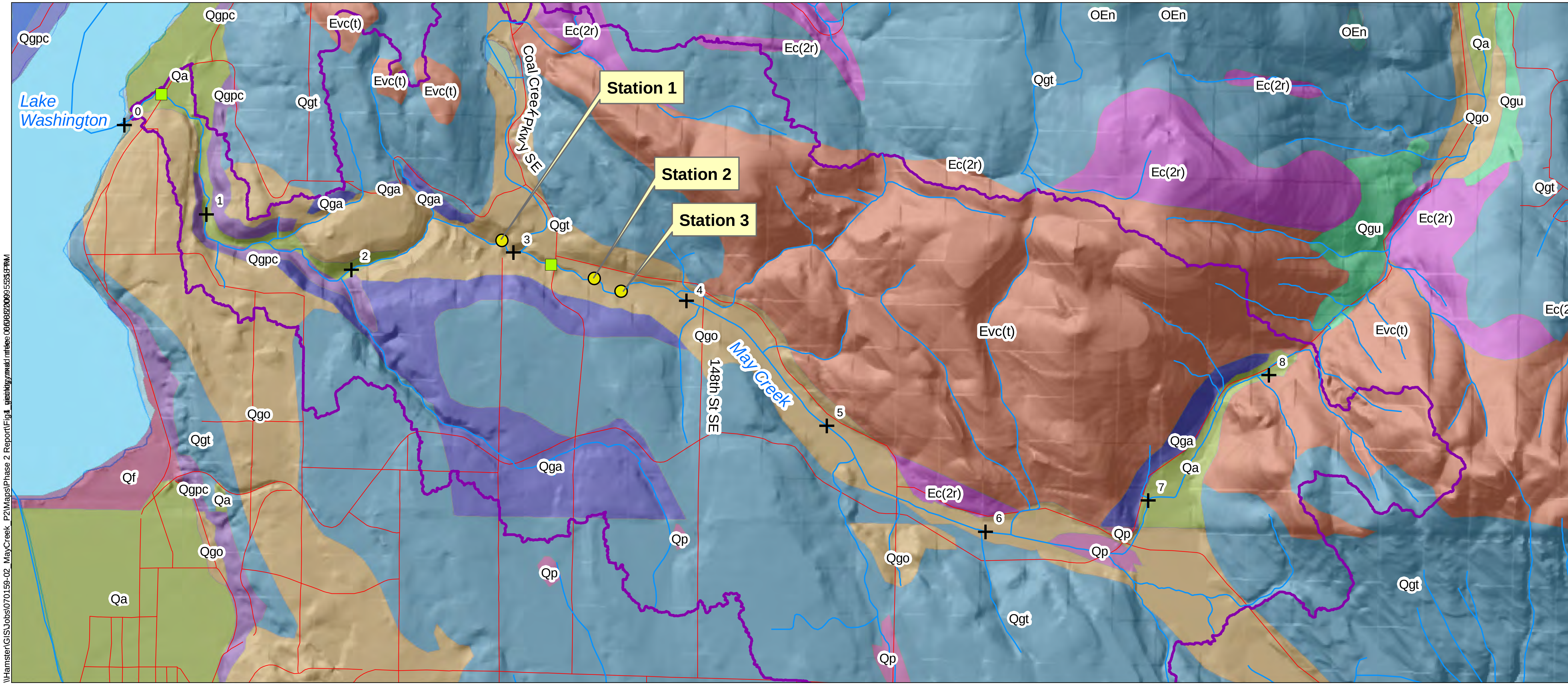
- Approx. River Miles
- Roads
- Streams
- Long-Term King County Gage Sites
- Short-Term Project Gages/ Monitoring Stations

NOTES:
Channel alignment from WA DNR may not resemble current position of the stream.

Feet
0 250 500 750 1,000

ANCHOR QEA

Figure 3
Reach-Scale Site Map
Sediment Transport Study Report
King County/ May Creek Sediment Transport Study Phase 2



LEGEND

- + Approx. River Miles
- Streams
- Roads
- May Creek Basin
- Long-Term King County Gage Sites
- Short-Term Project Gages/ Monitoring Stations
- Qf - Artificial Fill
- Qp - Peat Deposits/Peat Bog
- Qa - Alluvium
- Qls - Landslide Deposits
- Qgu - Glacial Drift, Undivided
- Qgt - Glacial Till
- Qgo - Undiff. Glacial Outwash
- Qga - Glacial Advance Outwash
- Qgpc - Continental Glacial Drift
- OEn - Nearshore Sedimentary Rocks
- OEm - Marine Sedimentary Rocks
- Ec(2r) - Continental Sed. Deposits/Rocks
- Evc(t) - Volcaniclastic Deposits/Rocks
- Water

Miles

0 0.25 0.5 0.75 1

ANCHOR QEA

Figure 4

Surficial Geology Map

Sediment Transport Study Report

King County/ May Creek Sediment Transport Study Phase 2

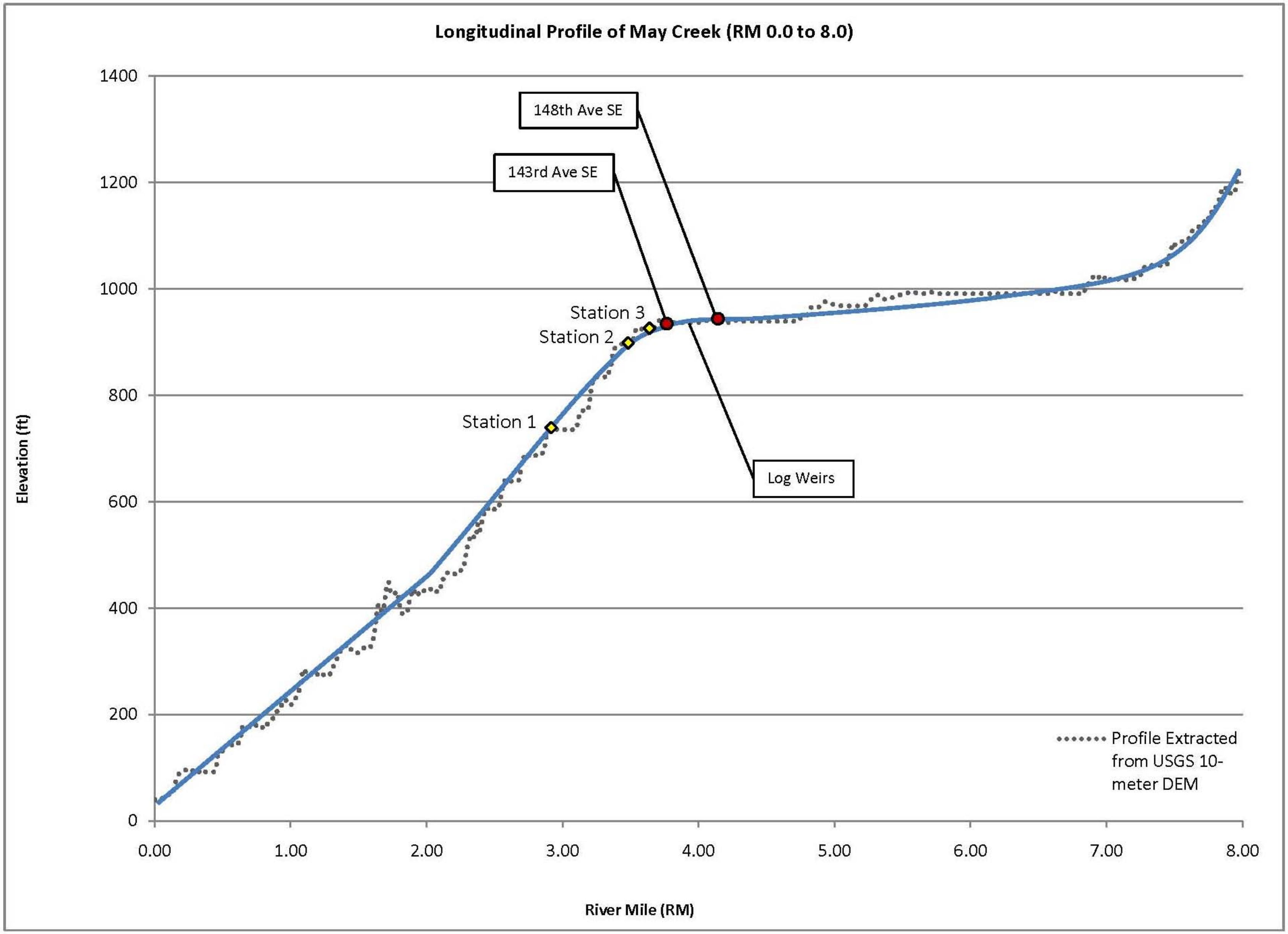


Figure 5: Profile of Thalweg of May Creek (RM 0.0 to 8.0)

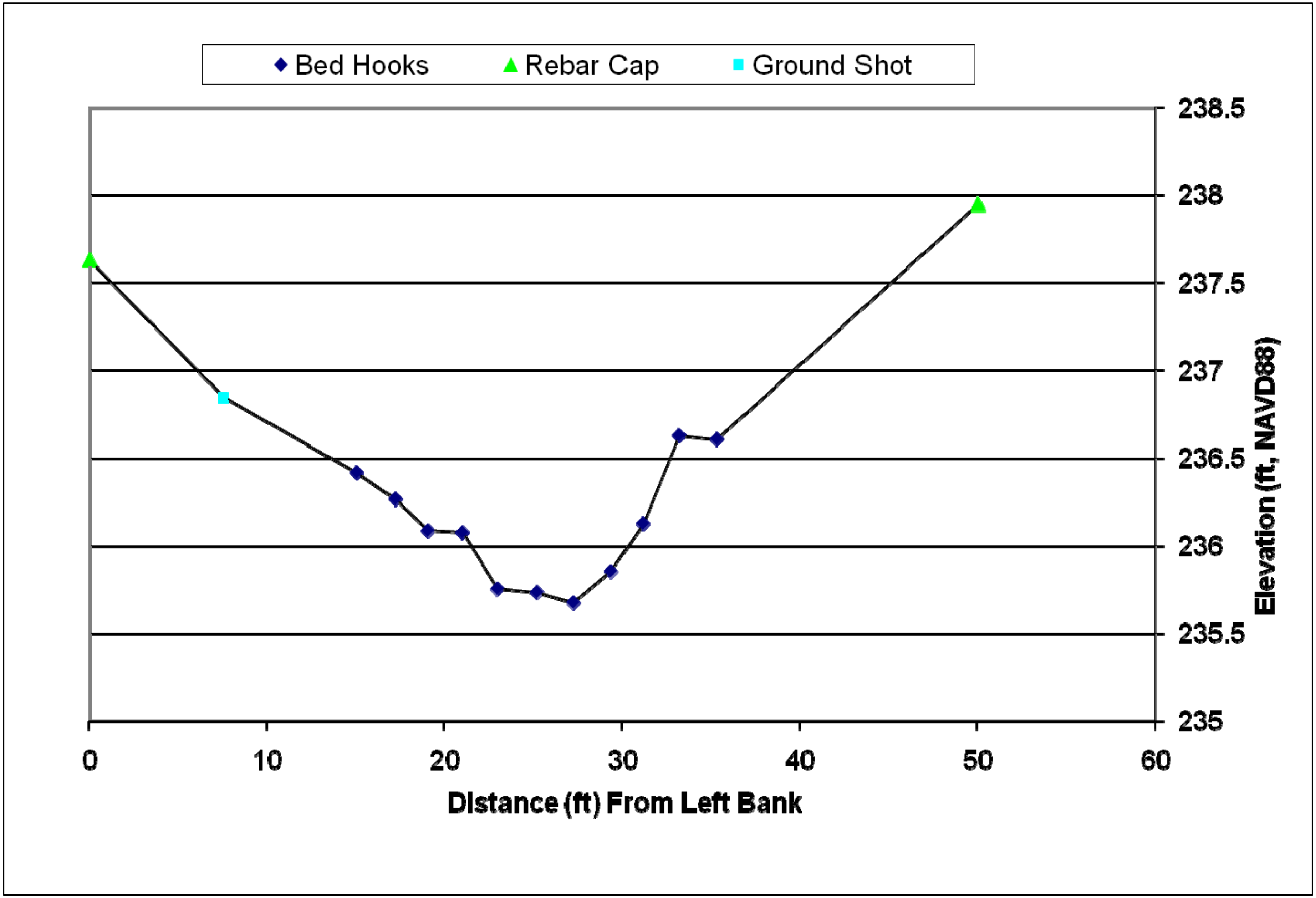


Figure 6: Station 1, Initial Elevation and Monitoring Pin/Hook Locations

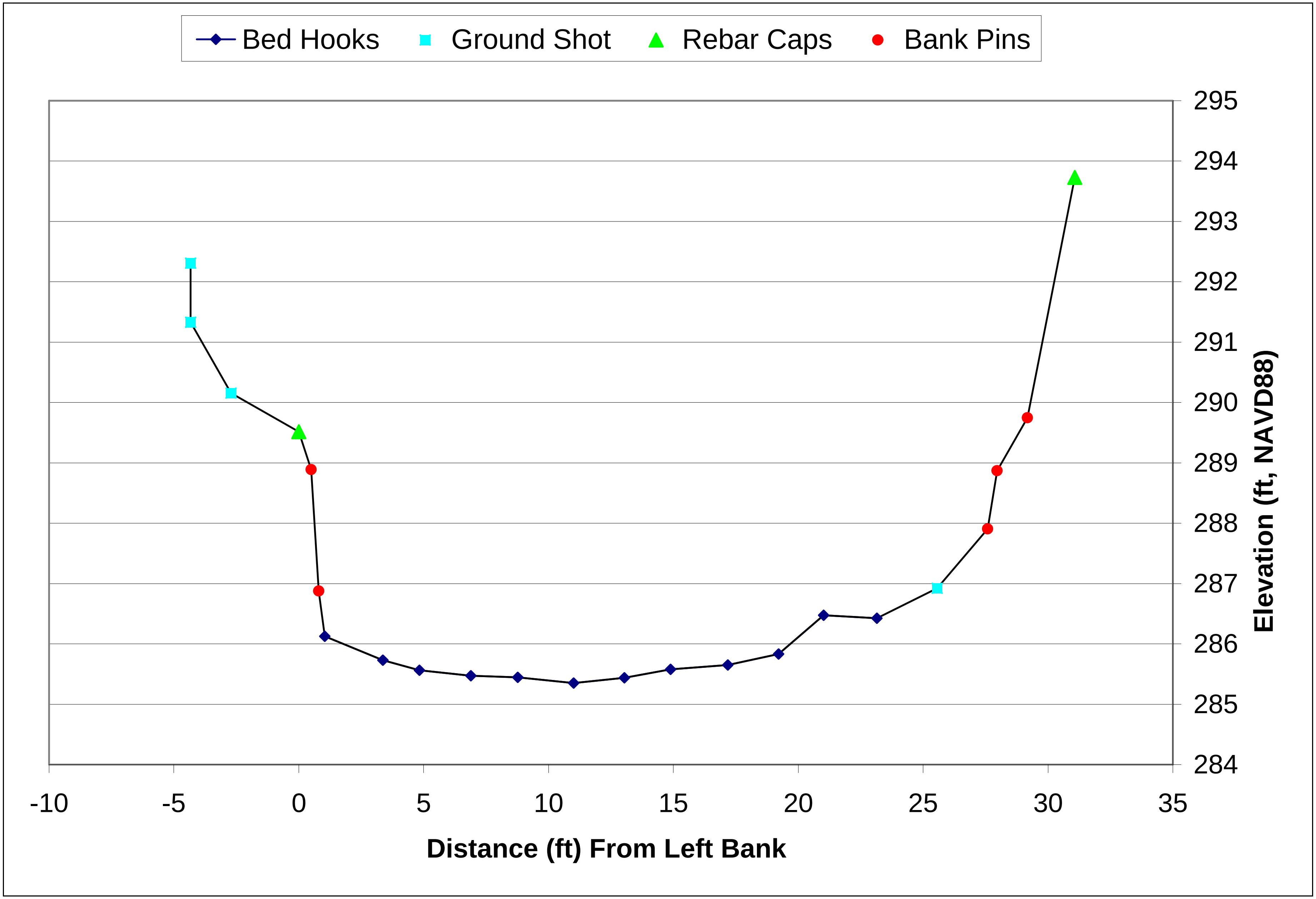


Figure 7: Station 2, Initial Elevation and Monitoring Pin/Hook Locations

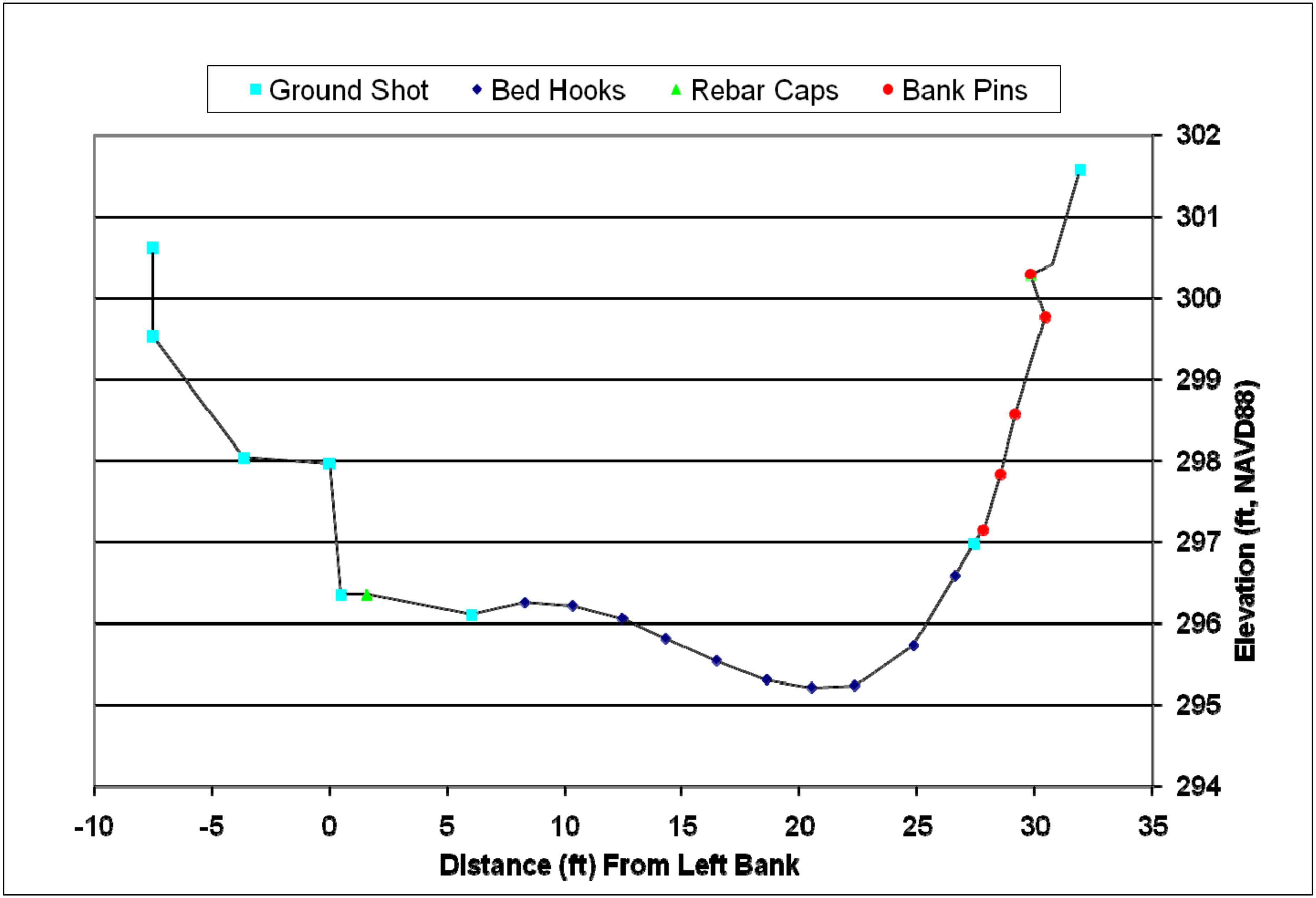


Figure 8: Station 3, Initial Elevation and Monitoring Pin/Hook Locations

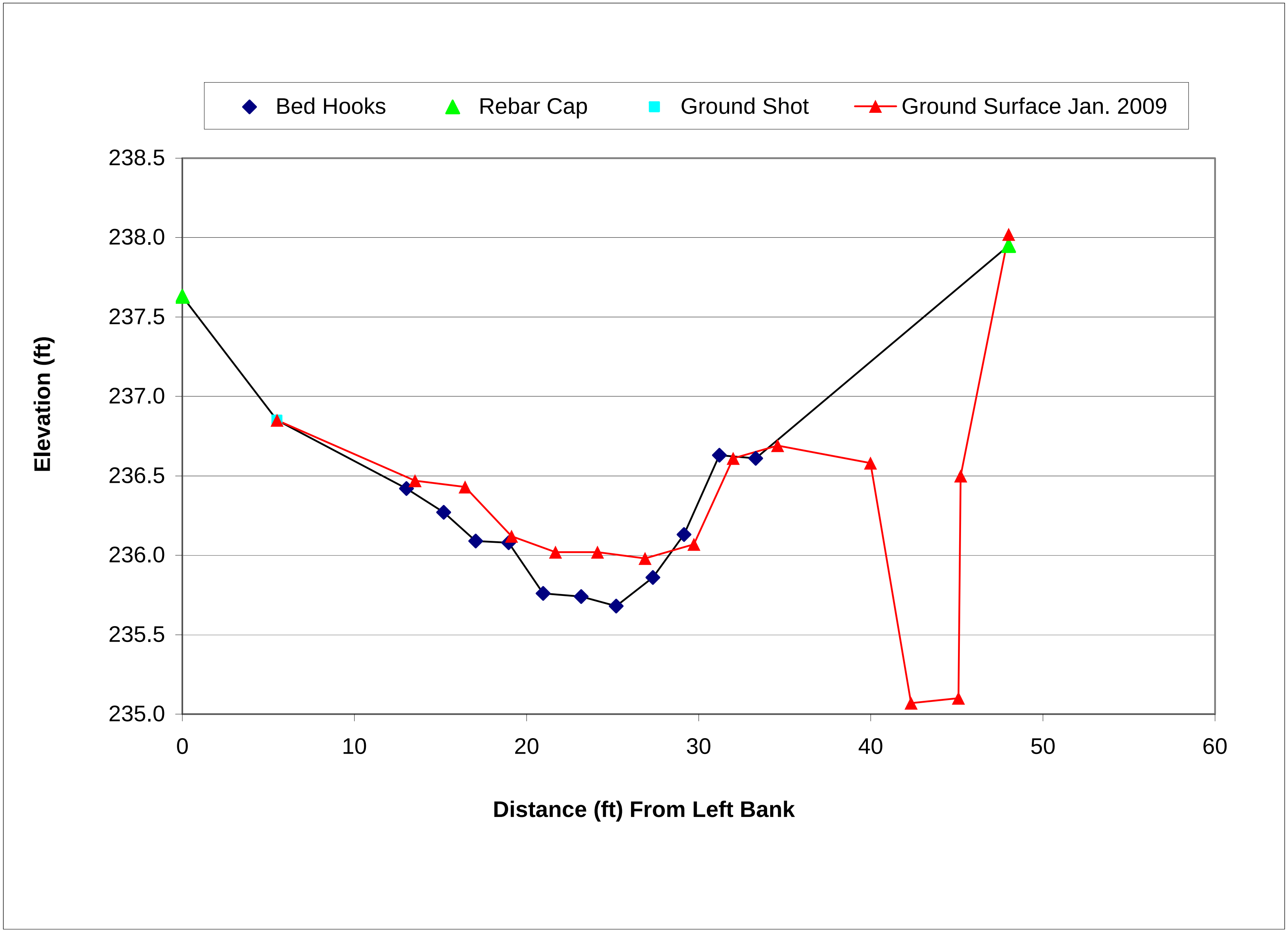


Figure 9: Station 1, Initial and Final Bed Elevations

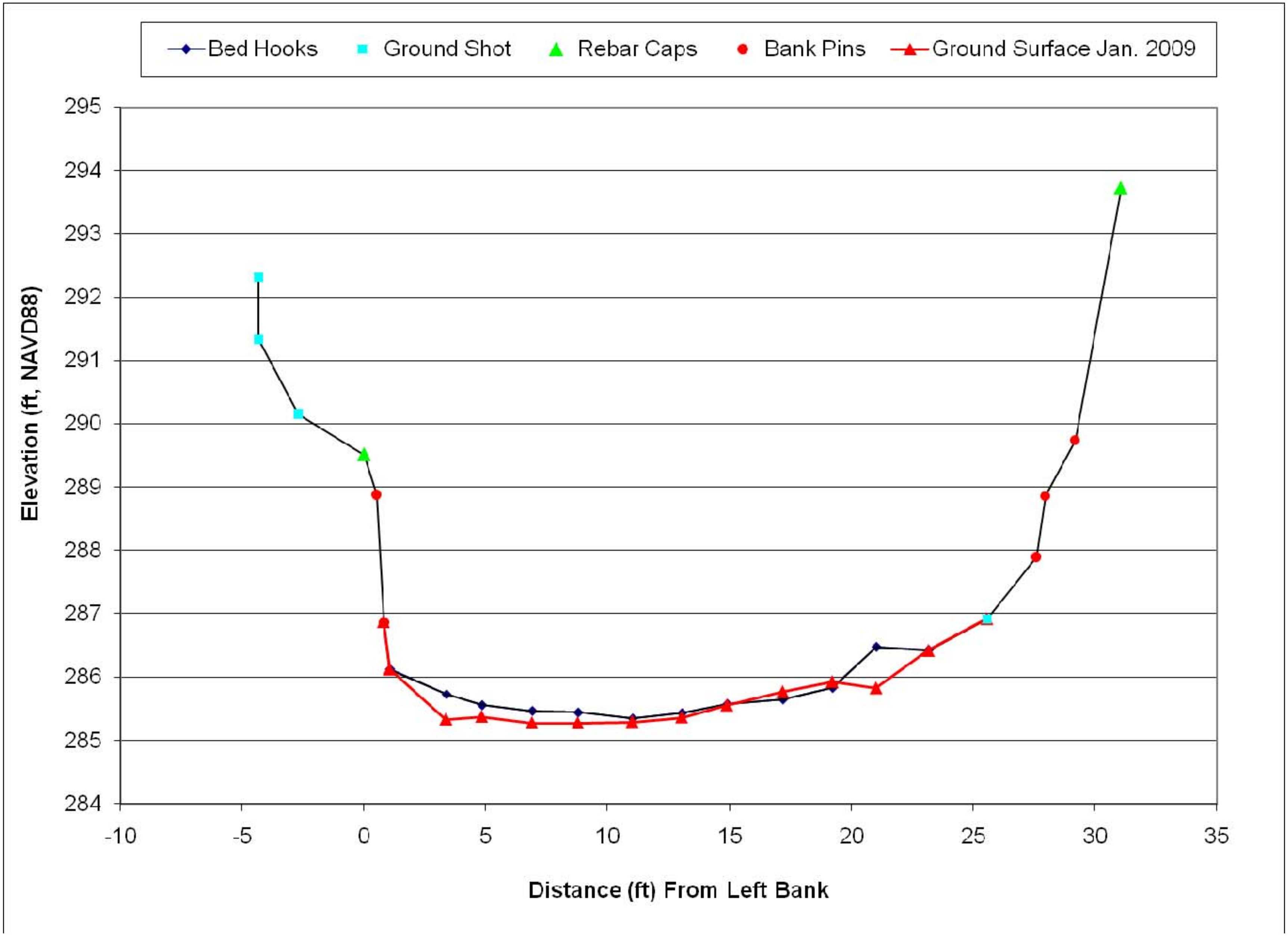


Figure 10: Station 2, Initial and Final Bed Elevations

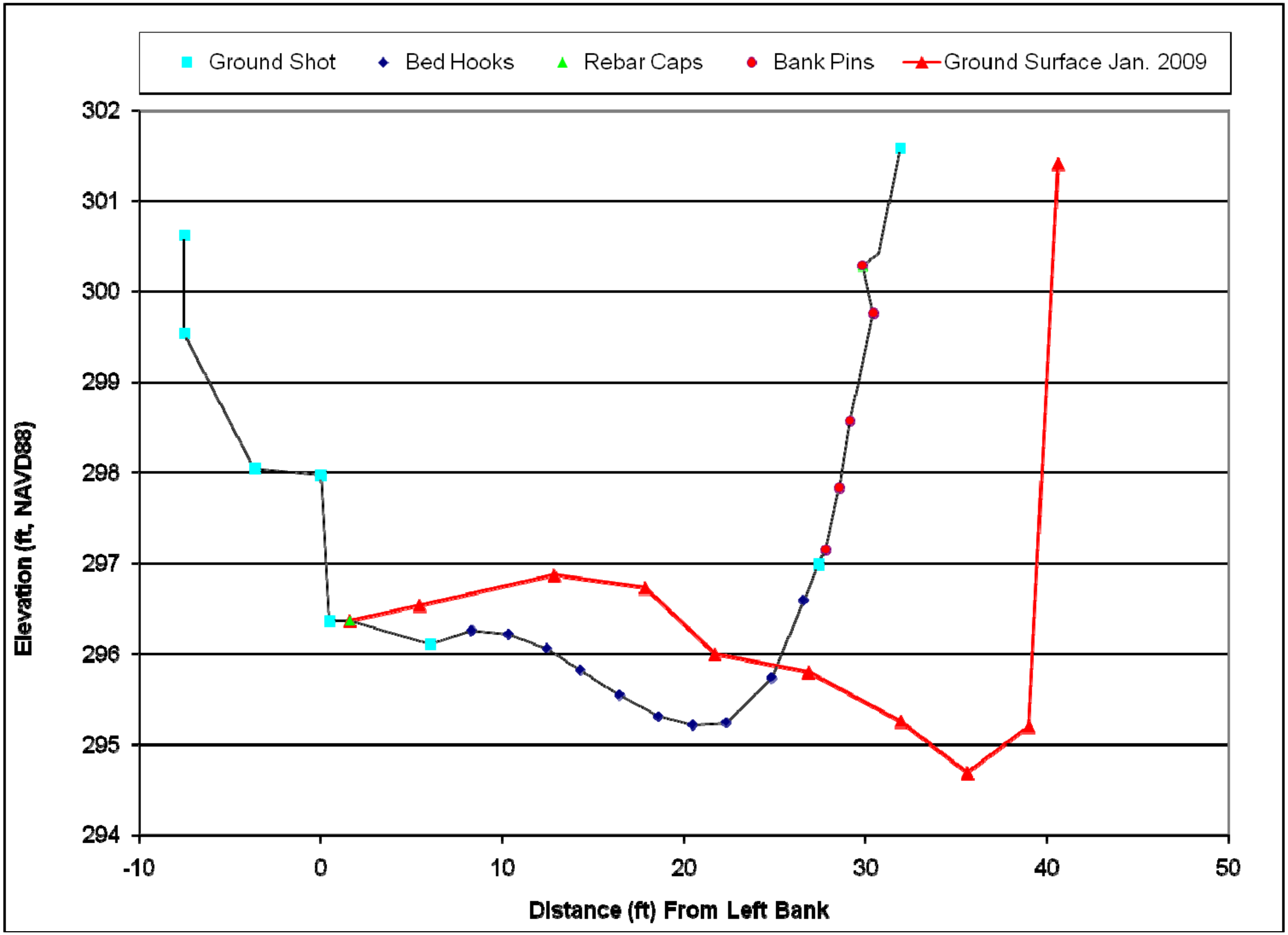


Figure 11: Station 3, Initial and Final Bed Elevations

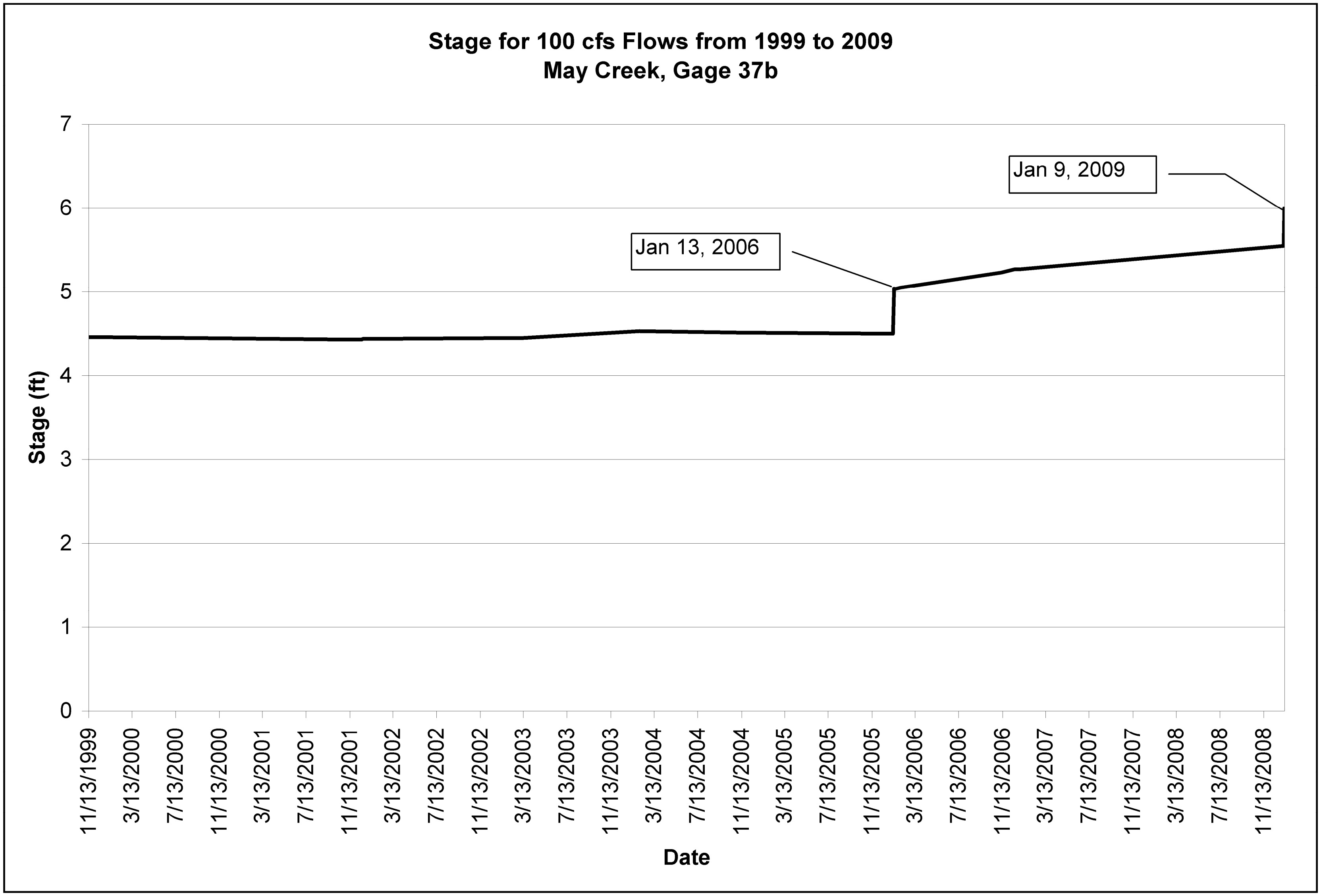
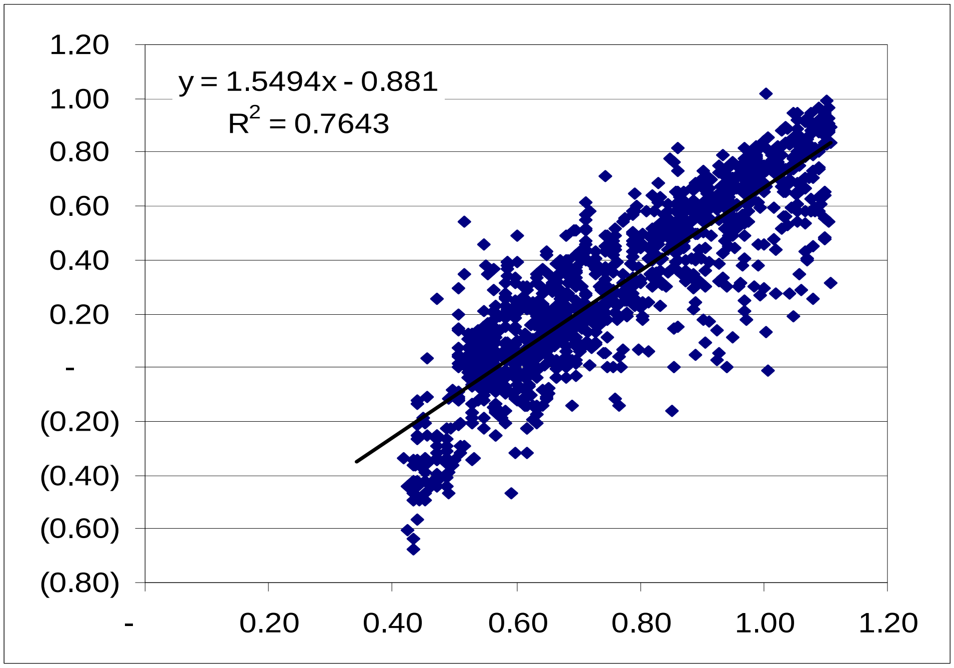
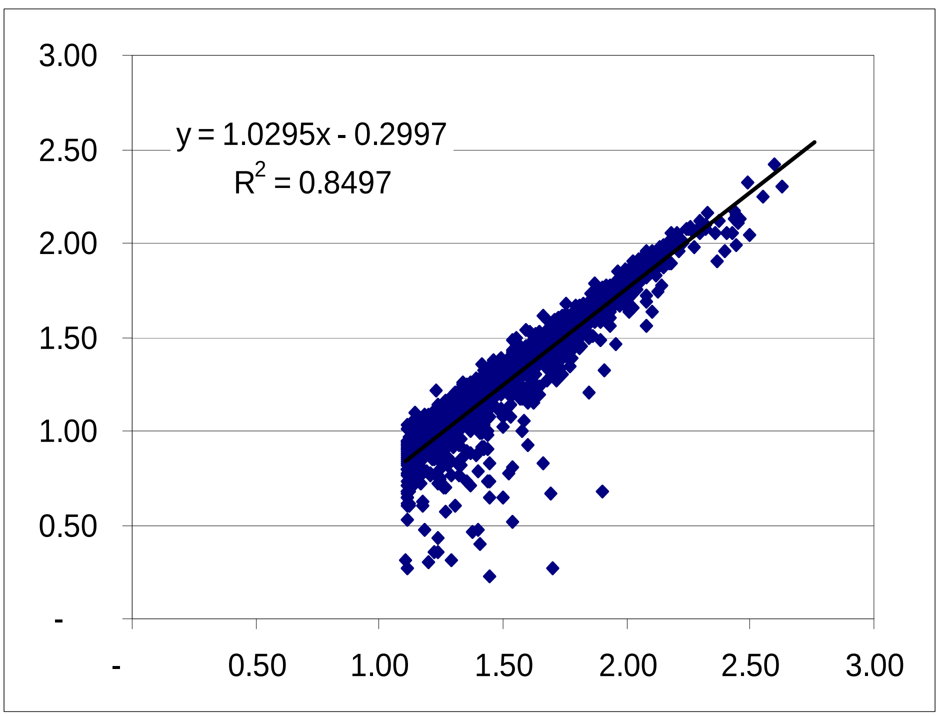


Figure 12: Comparison of Water Surface Elevation for 100 cfs Flows for Gage 37b



(A)



(B)

Figure 13: Relationships between Flow Events at Gages 37a and 37b for

(A) Low Flow Events and (B) High Flow Events

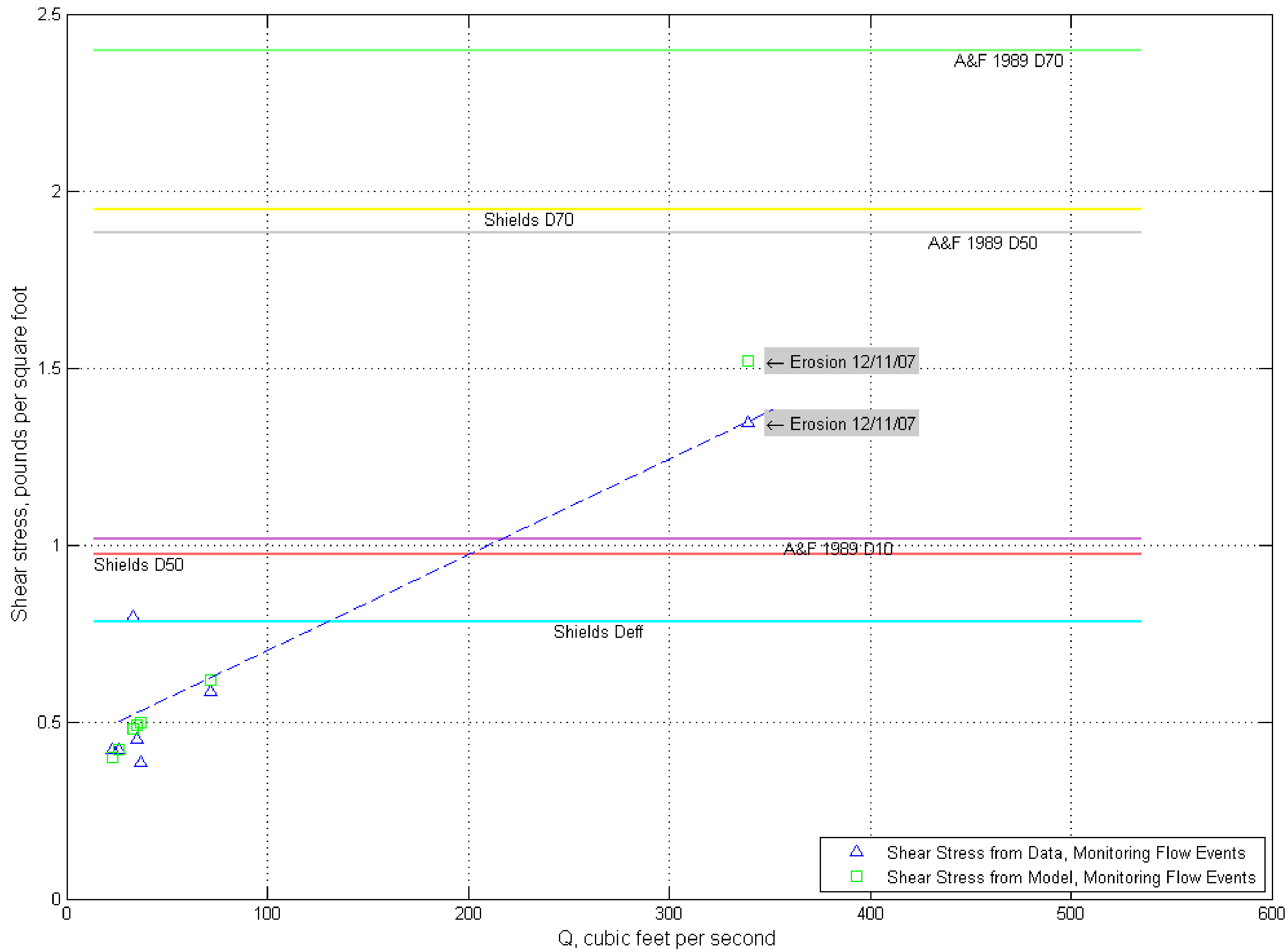
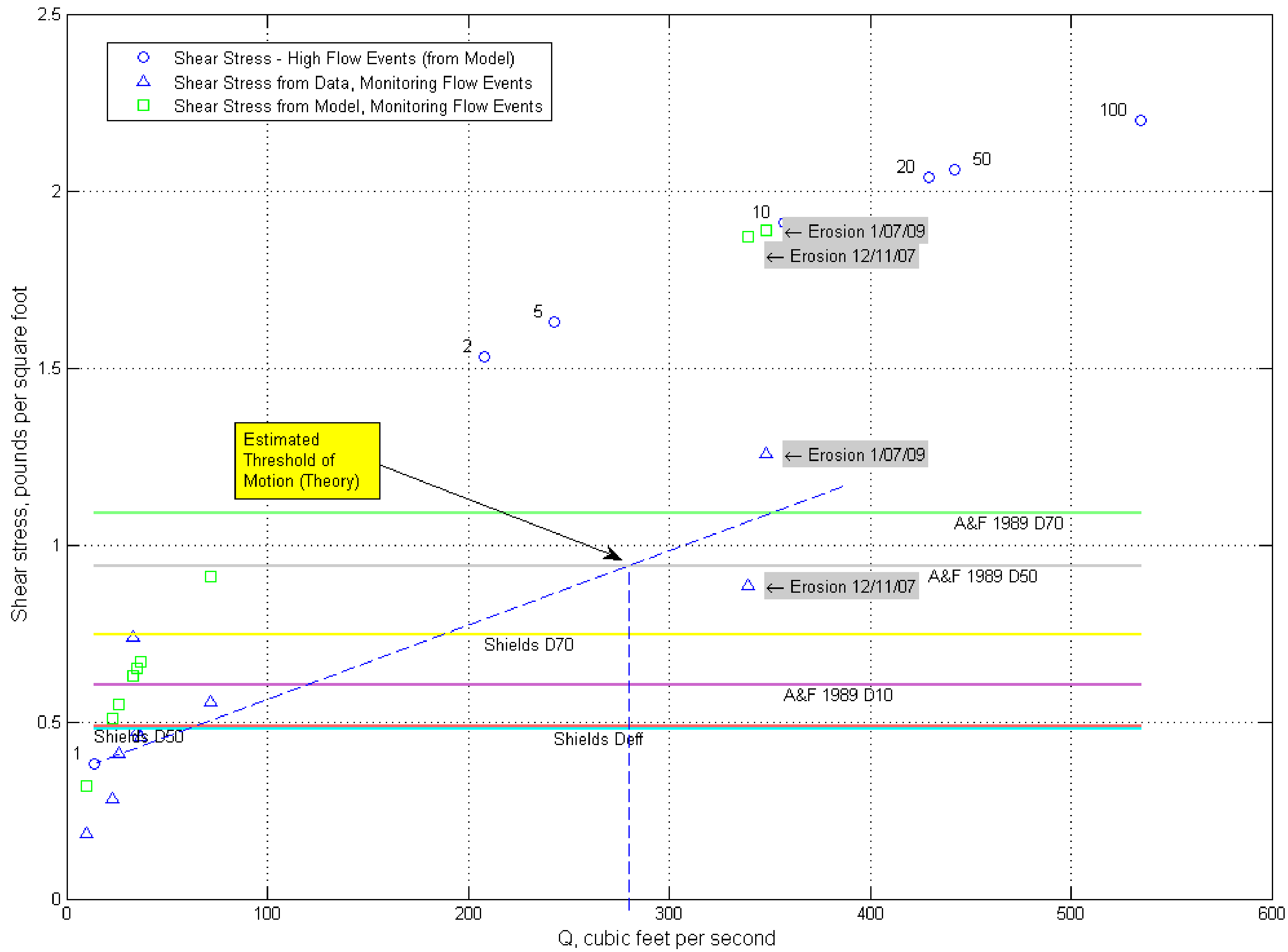


Figure 14: Station 1, Relationship between Flow and Shear Stress



This Figure 15: Station 2, Relationship between Flow and Shear Stress

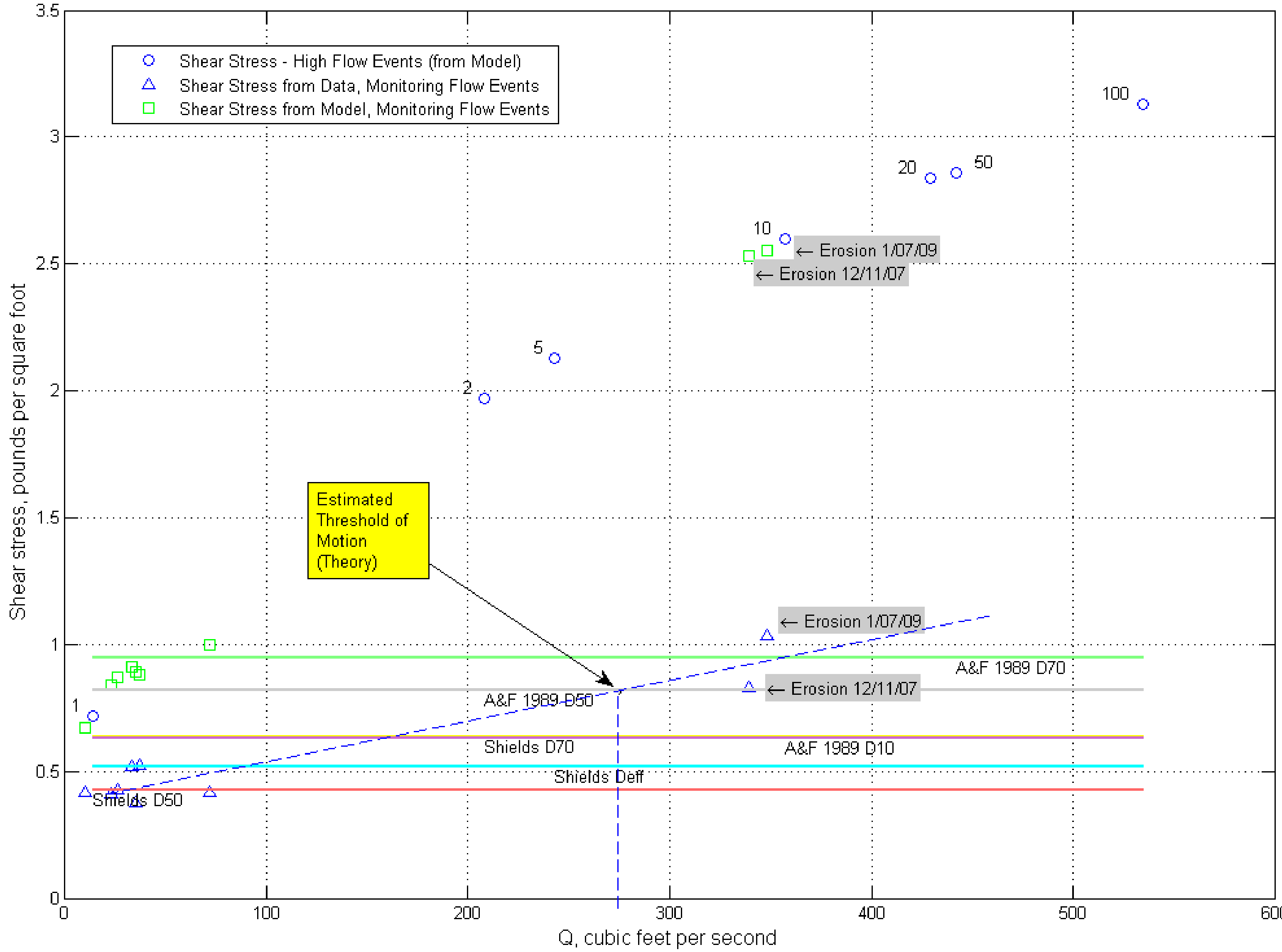


Figure 16: Station 3, Relationship between Flow and Shear Stress

APPENDIX B
HEC-RAS RESULTS – PEAK FLOWS

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	2-yr	0.4	304.3	308.27		308.49	0.003718	3.7	56.2	31.75	0.49
4530	2-yr	0.46	304.3	308.15	307.26	308.39	0.004461	3.98	52.22	30.26	0.53
4518.5		Bridge									
4507	2-yr	0.27	304.3	308.12	306.61	308.28	0.002189	3.15	65.94	30.66	0.38
4397	2-yr	0.2	303.2	307.82		307.9	0.001388	2.75	149.59	223.16	0.3
4047	2-yr	0.04	304.3	307.76		307.78	0.000657	1.07	193.98	197.18	0.19
3622	2-yr	0.45	304.4	307.28		307.54	0.003314	4.12	50.53	20.41	0.46
3602	2-yr	0.32	303.2	307.28	305.57	307.47	0.001984	3.55	58.64	17.5	0.34
3596.5		Bridge									
3591	2-yr	0.54	303.2	307.24	305.57	307.44	0.003383	3.58	58.03	17.5	0.35
3571	2-yr	0.55	303.3	307.17		307.37	0.003454	3.62	57.39	19.26	0.37
3061	2-yr	1.06	302.5	305.04		305.34	0.014776	4.4	47.3	39.93	0.71
2756	2-yr	0.61	298.3	302.34		302.56	0.00404	3.77	55.23	20.71	0.41
2746	2-yr	0.89	298.4	302.19	300.92	302.5	0.006216	4.53	46.06	17.57	0.46
2741		Bridge									
2736	2-yr	0.96	298.4	302.08		302.42	0.006869	4.68	44.43	15	0.48
2725	2-yr	1.99	299.3	301.61	301.45	302.23	0.020804	6.32	32.9	20.44	0.88
2440	2-yr	0.14	295.3	299.37		299.42	0.000806	1.81	114.79	39.2	0.19
1964	2-yr	0.88	294.88	298.15		298.45	0.005176	4.62	52.37	22.36	0.49
1916	2-yr	2.42	295.22	297.26	297.26	297.95	0.024697	7.01	34.57	25.54	0.98
1870	2-yr	1.45	294.06	296.52		296.92	0.014311	5.45	45.11	31.75	0.74
1440	2-yr	0.17	284.5	290.17		290.21	0.000865	1.54	135.01	40.68	0.15
1246	2-yr	1.92	286.16	288.76		289.14	0.013218	5.01	43.87	20.82	0.58
1168	2-yr	1.79	285.35	287.74	287.13	288.08	0.013719	4.74	46.1	24.01	0.58
1121	2-yr	2.78	284.38	286.71		287.23	0.023475	5.82	36.88	20.68	0.74
650	2-yr	1.48	274.3	276.57		276.83	0.014509	4.13	50.37	29.72	0.56
30	2-yr	0.36	263.2	266.51		266.58	0.002276	2.18	99.76	53.4	0.24
0.1	2-yr	4.32	262.9	265.17	265.17	265.89	0.051967	6.83	30.45	21.46	1.01
-1990	2-yr	0.56	236.79	238.83		239	0.004545	3.51	67.11	36.87	0.44
-2000	2-yr	3.87	235.68	237.56	237.56	238.07	0.038136	6.69	41.97	42.92	0.92
-2010	2-yr	0.73	234.35	237.37	236.27	237.51	0.005001	3.08	77.95	45.06	0.35

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	5-yr	0.41	304.3	308.52		308.74	0.003622	3.78	64.33	34.58	0.49
4530	5-yr	0.47	304.3	308.4	307.49	308.65	0.004288	4.04	60.14	33.15	0.53
4518.5		Bridge									
4507	5-yr	0.3	304.3	308.37	306.78	308.53	0.002291	3.29	73.78	33.37	0.39
4397	5-yr	0.14	303.2	308.08		308.13	0.000966	2.36	215.63	268.4	0.25
4047	5-yr	0.03	304.3	308.02		308.03	0.000474	0.97	249.52	229.54	0.16
3622	5-yr	0.5	304.4	307.53		307.83	0.003378	4.36	55.74	20.76	0.47
3602	5-yr	0.37	303.2	307.52	305.73	307.75	0.0022	3.86	62.94	17.5	0.36
3596.5		Bridge									
3591	5-yr	0.63	303.2	307.48	305.73	307.72	0.003757	3.9	62.25	17.5	0.36
3571	5-yr	0.63	303.3	307.41		307.64	0.003772	3.92	62.03	19.63	0.39
3061	5-yr	1.17	302.5	305.16		305.5	0.015701	4.65	52.29	42.58	0.74
2756	5-yr	0.68	298.3	302.59		302.84	0.00437	4.01	60.52	21.87	0.43
2746	5-yr	1.04	298.4	302.4	301.12	302.78	0.006945	4.93	49.88	17.99	0.48
2741		Bridge									
2736	5-yr	1.14	298.4	302.27		302.68	0.007846	5.15	47.53	17.99	0.51
2725	5-yr	2.21	299.3	301.76	301.63	302.47	0.021696	6.74	36.03	20.9	0.91
2440	5-yr	0.15	295.3	299.64		299.7	0.000836	1.93	125.73	39.9	0.19
1964	5-yr	1.01	294.88	298.35		298.7	0.005566	5.01	56.74	22.48	0.51
1916	5-yr	2.6	295.22	297.41	297.41	298.17	0.024218	7.38	38.53	25.67	0.98
1870	5-yr	1.56	294.06	296.68		297.12	0.014074	5.74	50.23	32.16	0.75
1440	5-yr	0.19	284.5	290.44		290.48	0.000936	1.66	146.14	41.58	0.16
1246	5-yr	2.14	286.16	288.97		289.4	0.013548	5.36	48.14	21.18	0.59
1168	5-yr	1.93	285.35	287.95	287.29	288.32	0.013467	5	51.22	24.31	0.58
1121	5-yr	3.12	284.38	286.88		287.47	0.024234	6.25	40.29	20.93	0.76
650	5-yr	1.59	274.3	276.75		277.04	0.01451	4.35	55.88	30.44	0.57
30	5-yr	0.39	263.2	266.74		266.82	0.002311	2.3	112.31	54.33	0.24
0.1	5-yr	4.53	262.9	265.35	265.35	266.12	0.050627	7.08	34.31	22.47	1.01
-1990	5-yr	0.66	236.79	238.96		239.17	0.004973	3.83	72.01	37.1	0.46
-2000	5-yr	3.51	235.68	237.76		238.23	0.030792	6.5	51.05	45.93	0.84
-2010	5-yr	0.79	234.35	237.58	236.41	237.73	0.005006	3.25	87.46	47.37	0.35

HEC-RAS Modeling Results, May Creek, 10-Year High Flow Event

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	10-yr	0.44	304.3	309.15		309.4	0.003476	4.03	88.51	41.89	0.49
4530	10-yr	0.5	304.3	309.04	308.02	309.32	0.00401	4.27	83.7	40.54	0.52
4518.5		Bridge									
4507	10-yr	0.36	304.3	309	307.28	309.21	0.002533	3.68	97.05	40.38	0.42
4397	10-yr	0.06	303.2	308.83		308.85	0.000341	1.65	445.99	332.91	0.16
4047	10-yr	0.02	304.3	308.79		308.8	0.000193	0.78	462.01	329.79	0.11
3622	10-yr	0.62	304.4	308.24		308.63	0.003519	5	74.18	34.01	0.49
3602	10-yr	0.54	303.2	308.2	306.27	308.56	0.002876	4.77	74.85	17.5	0.41
3596.5		Bridge									
3591	10-yr	0.93	303.2	308.15	306.27	308.51	0.004929	4.83	73.91	17.5	0.41
3571	10-yr	0.89	303.3	308.06		308.41	0.004716	4.75	75.17	20.67	0.44
3061	10-yr	1.46	302.5	305.49		305.93	0.017757	5.29	67.5	49.79	0.8
2756	10-yr	0.87	298.3	303.31		303.64	0.005016	4.61	77.46	25.21	0.46
2746	10-yr	1.53	298.4	302.98	301.71	303.55	0.009148	6.09	60.38	17.99	0.55
2741		Bridge									
2736	10-yr	1.77	298.4	302.75		303.4	0.011026	6.5	56.22	17.99	0.6
2725	10-yr	2.95	299.3	302.17	302.17	303.14	0.025917	7.93	45	23.31	1.01
2440	10-yr	0.2	295.3	300.41		300.49	0.000929	2.27	157.11	41.85	0.21
1964	10-yr	1.41	294.88	298.91		299.42	0.006577	6.1	69.42	22.83	0.57
1916	10-yr	3.18	295.22	297.85	297.85	298.83	0.023687	8.47	49.89	26.04	1.01
1870	10-yr	1.99	294.06	297.1		297.7	0.014627	6.71	63.85	33.23	0.79
1440	10-yr	0.26	284.5	291.2		291.26	0.001127	2	178.56	44.08	0.18
1246	10-yr	2.78	286.16	289.55		290.15	0.014282	6.32	60.86	22.22	0.63
1168	10-yr	2.33	285.35	288.57	287.74	289.06	0.012838	5.72	66.58	25.17	0.59
1121	10-yr	4.21	284.38	287.32		288.18	0.026846	7.49	49.85	21.61	0.83
650	10-yr	1.92	274.3	277.28		277.65	0.01451	4.93	72.45	32.48	0.58
30	10-yr	0.48	263.2	267.39		267.49	0.002386	2.63	148.46	56.95	0.25
0.1	10-yr	5.11	262.9	265.84	265.84	266.77	0.047865	7.75	46.08	25.29	1.01
-1990	10-yr	0.96	236.79	239.33		239.65	0.006162	4.76	85.99	37.74	0.53
-2000	10-yr	2.87	235.68	238.34		238.74	0.019146	6.14	78.51	48	0.7
-2010	10-yr	0.95	234.35	238.14	236.82	238.32	0.005001	3.69	114.27	48.14	0.36

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	25-yr	0.47	304.3	309.47		309.74	0.003459	4.19	102.3	45.54	0.49
4530	25-yr	0.53	304.3	309.35	308.3	309.65	0.003957	4.42	97.1	44.2	0.53
4518.5		Bridge									
4507	25-yr	0.39	304.3	309.31	307.64	309.55	0.002663	3.89	110.22	43.85	0.43
4397	25-yr	0.05	303.2	309.24		309.26	0.000228	1.45	587.06	351.94	0.13
4047	25-yr	0.01	304.3	309.21		309.22	0.000119	0.72	630.29	433.03	0.09
3622	25-yr	0.66	304.4	308.64		309.06	0.003376	5.25	89.11	39.55	0.48
3602	25-yr	0.66	303.2	308.56	306.58	308.99	0.003306	5.29	81.06	17.5	0.43
3596.5		Bridge									
3591	25-yr	1.12	303.2	308.49	306.58	308.94	0.005685	5.37	79.95	17.5	0.44
3571	25-yr	1.06	303.3	308.4		308.82	0.005284	5.22	82.25	21.2	0.47
3061	25-yr	1.52	302.5	305.71		306.17	0.0173	5.45	78.7	54.49	0.8
2756	25-yr	0.95	298.3	303.7		304.07	0.005045	4.9	88.26	32.06	0.47
2746	25-yr	1.88	298.4	303.26	302.04	303.96	0.010754	6.79	65.36	17.99	0.59
2741		Bridge									
2736	25-yr	2.35	298.4	302.88		303.75	0.014301	7.52	58.58	17.99	0.68
2725	25-yr	3.09	299.3	302.46	302.46	303.51	0.025346	8.22	52.18	25.16	1.01
2440	25-yr	0.23	295.3	300.82		300.91	0.000987	2.46	174.36	42.89	0.22
1964	25-yr	1.66	294.88	299.21		299.83	0.007119	6.7	76.44	23.01	0.6
1916	25-yr	3.5	295.22	298.11	298.11	299.22	0.023325	9.04	56.51	26.25	1.02
1870	25-yr	2.34	294.06	297.28		298	0.015859	7.38	70.18	33.72	0.83
1440	25-yr	0.3	284.5	291.61		291.68	0.001227	2.18	196.89	45.44	0.18
1246	25-yr	3.14	286.16	289.88		290.57	0.014583	6.83	68.26	22.8	0.65
1168	25-yr	2.55	285.35	288.93	288.01	289.47	0.012495	6.09	75.63	25.67	0.59
1121	25-yr	4.86	284.38	287.57	287.34	288.58	0.028316	8.18	55.15	21.98	0.87
650	25-yr	2.1	274.3	277.57		277.99	0.014558	5.23	82.04	33.61	0.59
30	25-yr	0.53	263.2	267.72		267.84	0.002455	2.82	167.6	58.61	0.26
0.1	25-yr	4.96	262.9	266.18	266.13	267.12	0.040742	7.8	55.4	30.04	0.95
-1990	25-yr	1.13	236.79	239.55		239.94	0.006661	5.24	94.37	38.11	0.56
-2000	25-yr	2.76	235.68	238.65		239.04	0.016371	6.15	93.28	48	0.66
-2010	25-yr	1.05	234.35	238.45	237.04	238.65	0.005007	3.92	129.18	48.28	0.37

HEC-RAS Modeling Results, May Creek, 50-Year High Flow Event

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	50-yr	0.47	304.3	309.53		309.8	0.003424	4.2	105.17	50.23	0.49
4530	50-yr	0.52	304.3	309.41	308.34	309.72	0.003903	4.42	99.91	44.92	0.52
4518.5		Bridge									
4507	50-yr	0.4	304.3	309.37	307.7	309.61	0.002655	3.91	112.99	44.55	0.43
4397	50-yr	0.05	303.2	309.31		309.33	0.000215	1.43	612.1	355.22	0.13
4047	50-yr	0.01	304.3	309.28		309.29	0.000111	0.71	661.54	434.26	0.09
3622	50-yr	0.66	304.4	308.71		309.14	0.003339	5.29	91.86	40.05	0.48
3602	50-yr	0.68	303.2	308.61	306.63	309.06	0.003391	5.39	82.04	17.5	0.44
3596.5		Bridge									
3591	50-yr	1.16	303.2	308.55	306.63	309.01	0.005836	5.46	80.89	17.5	0.45
3571	50-yr	1.09	303.3	308.45		308.89	0.00538	5.3	83.38	21.72	0.47
3061	50-yr	1.52	302.5	305.75		306.21	0.017132	5.47	80.86	55.35	0.8
2756	50-yr	0.96	298.3	303.76		304.14	0.005023	4.95	90.52	34.32	0.47
2746	50-yr	1.94	298.4	303.31	302.13	304.04	0.011047	6.91	66.2	17.99	0.6
2741		Bridge									
2736	50-yr	2.48	298.4	302.89		303.81	0.015086	7.73	58.72	17.99	0.7
2725	50-yr	3.12	299.3	302.51	302.51	303.57	0.025266	8.27	53.44	25.47	1.01
2440	50-yr	0.23	295.3	300.89		300.98	0.000997	2.49	177.33	43.06	0.22
1964	50-yr	1.71	294.88	299.26		299.9	0.007226	6.81	77.59	23.04	0.61
1916	50-yr	3.53	295.22	298.16	298.16	299.28	0.023088	9.12	57.81	26.29	1.02
1870	50-yr	2.41	294.06	297.32		298.06	0.016101	7.5	71.22	33.8	0.84
1440	50-yr	0.31	284.5	291.68		291.75	0.001244	2.21	200.06	45.67	0.19
1246	50-yr	3.2	286.16	289.94		290.64	0.014627	6.91	69.56	22.9	0.65
1168	50-yr	2.58	285.35	288.99	288.05	289.55	0.012434	6.15	77.23	25.75	0.59
1121	50-yr	4.98	284.38	287.61	287.39	288.65	0.028593	8.3	56.05	22.04	0.87
650	50-yr	2.13	274.3	277.62		278.05	0.014567	5.28	83.72	33.8	0.59
30	50-yr	0.54	263.2	267.78		267.89	0.002462	2.85	170.9	58.99	0.26
0.1	50-yr	4.94	262.9	266.24	266.18	267.18	0.03973	7.82	57.16	30.95	0.95
-1990	50-yr	1.15	236.79	239.59		239.99	0.006734	5.31	95.86	38.18	0.57
-2000	50-yr	2.75	235.68	238.7		239.09	0.015998	6.16	95.84	48	0.65
-2010	50-yr	1.06	234.35	238.5	237.08	238.71	0.005006	3.96	131.79	48.3	0.37

HEC-RAS Modeling Results, May Creek, 100-Year High Flow Event

River Sta	Profile	Shear Chan (lb/sq ft)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
4553	100-yr	0.45	304.3	309.96		310.22	0.003007	4.18	140.35	113.63	0.47
4530	100-yr	0.5	304.3	309.85	308.64	310.15	0.003419	4.39	129.29	98.24	0.5
4518.5		Bridge									
4507	100-yr	0.4	304.3	309.8	308.08	310.05	0.002532	4	139.55	91.58	0.43
4397	100-yr	0.04	303.2	309.8		309.81	0.000153	1.3	789.76	377.61	0.11
4047	100-yr	0.01	304.3	309.77		309.78	0.000074	0.67	877	442.67	0.07
3622	100-yr	0.69	304.4	309.19		309.63	0.003076	5.5	111.78	43.48	0.47
3602	100-yr	0.84	303.2	308.98	307	309.55	0.004004	6.04	88.53	17.5	0.47
3596.5		Bridge									
3591	100-yr	1.44	303.2	308.9	307	309.49	0.006929	6.14	87.11	17.5	0.49
3571	100-yr	1.31	303.3	308.8		309.34	0.006034	5.89	91.59	25.36	0.5
3061	100-yr	1.49	302.5	306.03		306.5	0.015459	5.48	97.54	61.59	0.77
2756	100-yr	0.95	298.3	304.33		304.71	0.004381	5.03	115.22	53.39	0.45
2746	100-yr	2.28	298.4	303.72	302.59	304.59	0.01223	7.57	73.68	17.99	0.62
2741		Bridge									
2736	100-yr	3.37	298.4	303.01		304.27	0.020094	9.05	60.91	17.99	0.81
2725	100-yr	3.28	299.3	302.85	302.85	303.99	0.024724	8.59	62.28	27.55	1.01
2440	100-yr	0.26	295.3	301.36		301.47	0.001059	2.7	197.95	44.26	0.23
1964	100-yr	2.02	294.88	299.61		300.39	0.00785	7.52	85.74	23.12	0.64
1916	100-yr	3.89	295.22	298.46	298.46	299.74	0.022679	9.76	65.84	26.55	1.03
1870	100-yr	2.91	294.06	297.51		298.42	0.018075	8.35	77.77	34.29	0.9
1440	100-yr	0.36	284.5	292.14		292.23	0.001356	2.41	221.76	47.21	0.2
1246	100-yr	3.61	286.16	290.33		291.15	0.014864	7.47	78.6	23.59	0.67
1168	100-yr	2.82	285.35	289.42	288.37	290.05	0.012029	6.56	88.39	26.35	0.59
1121	100-yr	5.81	284.38	287.89	287.73	289.14	0.030329	9.11	62.23	22.47	0.91
650	100-yr	2.34	274.3	277.95		278.44	0.014632	5.61	95.35	35.12	0.6
30	100-yr	0.61	263.2	268.16		268.29	0.002507	3.07	193.89	61.55	0.27
0.1	100-yr	5.08	262.9	266.57	266.51	267.57	0.036409	8.08	68.45	36.26	0.92
-1990	100-yr	1.33	236.79	239.88		240.35	0.006999	5.8	107.08	38.68	0.59
-2000	100-yr	2.72	235.68	239.06		239.47	0.014007	6.25	113.27	48	0.62
-2010	100-yr	1.17	234.35	238.87	237.33	239.1	0.005	4.22	149.56	48.47	0.37

APPENDIX C
HEC-RAS RESULTS – MONITORING EVENT FLOWS

HEC-RAS Modeling Results, May Creek, Monitoring Event 11/10/2008, Q = 72 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	11/10/2008	0.23	304.3	307.08		307.19	0.002815	2.73	26.36	18.94	0.41
4530	11/10/2008	0.27	304.3	306.99	306.25	307.12	0.003345	2.91	24.75	18.41	0.44
4518.5		Bridge									
4507	11/10/2008	0.11	304.3	306.99	305.77	307.04	0.001012	1.9	37.84	20.95	0.25
4397	11/10/2008	0.12	303.2	306.82		306.89	0.00096	2.09	34.41	14.88	0.24
4047	11/10/2008	0.07	304.3	306.75		306.78	0.001753	1.32	54.62	84.46	0.29
3622	11/10/2008	0.3	304.4	305.91		306.05	0.003913	3.01	23.9	18.5	0.47
3602	11/10/2008	0.12	303.2	305.92	304.71	305.99	0.001124	2.06	34.99	17.49	0.26
3596.5		Bridge									
3591	11/10/2008	0.21	303.2	305.91	304.71	305.97	0.001909	2.08	34.67	17.49	0.26
3571	11/10/2008	0.22	303.3	305.86		305.93	0.001982	2.14	33.59	17.19	0.27
3061	11/10/2008	0.86	302.5	304.07		304.3	0.014454	3.84	18.76	18.71	0.68
2756	11/10/2008	0.23	298.3	301.16		301.23	0.002116	2.19	32.85	17.57	0.28
2746	11/10/2008	0.28	298.4	301.12	299.96	301.21	0.002671	2.4	29.96	14.99	0.3
2741		Bridge									
2736	11/10/2008	0.29	298.4	301.08		301.18	0.002818	2.45	29.44	14.99	0.31
2725	11/10/2008	1	299.3	300.8	300.61	301.07	0.016976	4.13	17.45	18.02	0.74
2440	11/10/2008	0.07	295.3	297.91		297.93	0.0007	1.2	60.25	35.49	0.16
1964	11/10/2008	0.34	294.88	297.13		297.24	0.003147	2.67	29.97	21.73	0.35
1916	11/10/2008	1.33	295.22	296.56	296.54	296.89	0.024068	4.72	16.87	24.9	0.88
1870	11/10/2008	0.87	294.06	295.75		295.96	0.015976	3.81	21.55	29.77	0.71
1440	11/10/2008	0.07	284.5	288.71		288.72	0.000511	0.91	79.15	35.85	0.11
1246	11/10/2008	0.91	286.16	287.74		287.9	0.011094	3.13	23.61	19.02	0.48
1168	11/10/2008	1.02	285.35	286.74	286.37	286.9	0.014873	3.22	22.88	22.63	0.54
1121	11/10/2008	1.42	284.38	285.84		286.06	0.022061	3.76	19.4	19.35	0.65
650	11/10/2008	0.85	274.3	275.67		275.8	0.014619	2.85	25.26	26.59	0.52
30	11/10/2008	0.17	263.2	265.25		265.28	0.001844	1.4	51.42	32.7	0.2
0.1	11/10/2008	3.04	262.9	264.28	264.28	264.71	0.062234	5.25	13.72	16.39	1.01
-1990	11/10/2008	0.27	236.79	237.97		238.04	0.00379	2.2	36.25	35.42	0.37
-2000	11/10/2008	2.67	235.68	236.85	236.85	237.19	0.046249	5.06	17.06	27.57	0.92
-2010	11/10/2008	0.41	234.35	236.3	235.55	236.37	0.005	2.1	36.05	32.62	0.31

HEC-RAS Modeling Results, May Creek, Monitoring Event 11/16/2007, Q = 26 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	11/16/2007	0.11	304.3	306.39		306.44	0.001681	1.74	14.92	14.29	0.3
4530	11/16/2007	0.12	304.3	306.34	305.59	306.39	0.001891	1.82	14.28	13.98	0.32
4518.5		Bridge									
4507	11/16/2007	0.04	304.3	306.34	305.29	306.36	0.000489	1.05	24.66	19.75	0.17
4397	11/16/2007	0.03	303.2	306.29		306.3	0.000249	0.97	26.81	13.49	0.12
4047	11/16/2007	0.04	304.3	306.23		306.25	0.000791	1.05	24.86	29.3	0.2
3622	11/16/2007	0.5	304.4	305.01	304.97	305.18	0.017919	3.32	7.84	17.25	0.87
3602	11/16/2007	0.06	303.2	305.07	304.21	305.09	0.000845	1.3	19.96	17.49	0.21
3596.5		Bridge									
3591	11/16/2007	0.1	303.2	305.05	304.21	305.08	0.00145	1.32	19.72	17.49	0.22
3571	11/16/2007	0.09	303.3	305.02		305.05	0.001292	1.32	19.75	15.86	0.21
3061	11/16/2007	0.69	302.5	303.28		303.44	0.017225	3.24	8.03	11.91	0.69
2756	11/16/2007	0.08	298.3	300.5		300.52	0.000946	1.2	21.75	16.16	0.18
2746	11/16/2007	0.09	298.4	300.49	299.42	300.51	0.00112	1.27	20.49	14.99	0.19
2741		Bridge									
2736	11/16/2007	0.09	298.4	300.47		300.5	0.001155	1.28	20.29	14.99	0.19
2725	11/16/2007	0.57	299.3	300.31	300.14	300.44	0.015742	2.88	9.04	15.38	0.66
2440	11/16/2007	0.03	295.3	296.99		297	0.00039	0.8	32.57	22.57	0.12
1964	11/16/2007	0.14	294.88	296.49		296.52	0.001909	1.57	17.12	17.16	0.26
1916	11/16/2007	0.87	295.22	296.09	296.02	296.29	0.025798	3.51	7.4	13.57	0.84
1870	11/16/2007	0.58	294.06	295.24	295.05	295.38	0.015107	2.94	9.28	17.71	0.65
1440	11/16/2007	0.02	284.5	287.79		287.8	0.000195	0.51	50.71	26.11	0.06
1246	11/16/2007	0.46	286.16	287.17		287.23	0.009984	2.03	12.96	18	0.41
1168	11/16/2007	0.55	285.35	286.23	285.97	286.31	0.014236	2.15	12.08	19.33	0.48
1121	11/16/2007	0.88	284.38	285.32		285.43	0.025037	2.68	9.73	17.34	0.63
650	11/16/2007	0.46	274.3	275.22		275.28	0.013959	1.92	13.51	25.03	0.46
30	11/16/2007	0.09	263.2	264.53		264.54	0.001581	0.92	28.38	30.81	0.17
0.1	11/16/2007	2.17	262.9	263.78	263.78	264.04	0.071505	4.09	6.36	12.35	1.01
-1990	11/16/2007	0.15	236.79	237.47		237.51	0.003792	1.49	18.82	33.95	0.33
-2000	11/16/2007	1.93	235.68	236.41	236.41	236.63	0.057698	3.92	7.28	17.08	0.94
-2010	11/16/2007	0.23	234.35	235.67	235.18	235.7	0.005004	1.42	18.26	23.79	0.29

HEC-RAS Modeling Results, May Creek, Monitoring Event 12/11/2007, Q = 339 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	12/11/2007	0.43	304.3	309.08		309.32	0.003442	3.97	85.34	41	0.49
4530	12/11/2007	0.49	304.3	308.96	307.94	309.23	0.003969	4.2	80.7	39.68	0.52
4518.5		Bridge									
4507	12/11/2007	0.34	304.3	308.92	307.2	309.13	0.002464	3.6	94.12	39.57	0.41
4397	12/11/2007	0.07	303.2	308.72		308.74	0.000386	1.72	410.29	327.92	0.17
4047	12/11/2007	0.02	304.3	308.67		308.68	0.000223	0.79	426.73	305.69	0.12
3622	12/11/2007	0.6	304.4	308.14		308.51	0.003534	4.92	70.72	32.19	0.49
3602	12/11/2007	0.52	303.2	308.1	306.19	308.44	0.002771	4.63	73.14	17.5	0.4
3596.5		Bridge									
3591	12/11/2007	0.88	303.2	308.05	306.19	308.4	0.004746	4.69	72.24	17.5	0.41
3571	12/11/2007	0.85	303.3	307.97		308.3	0.004575	4.63	73.25	20.52	0.43
3061	12/11/2007	1.42	302.5	305.45		305.87	0.017557	5.21	65.1	48.72	0.79
2756	12/11/2007	0.84	298.3	303.21		303.53	0.004915	4.52	74.99	24.76	0.46
2746	12/11/2007	1.44	298.4	302.91	301.62	303.44	0.008741	5.9	59.07	17.99	0.53
2741		Bridge									
2736	12/11/2007	1.65	298.4	302.7		303.31	0.010369	6.27	55.31	17.99	0.58
2725	12/11/2007	2.91	299.3	302.09	302.09	303.04	0.026086	7.86	43.16	22.81	1.01
2440	12/11/2007	0.19	295.3	300.3		300.38	0.000915	2.22	152.54	41.57	0.2
1964	12/11/2007	1.35	294.88	298.82		299.31	0.00643	5.94	67.57	22.78	0.56
1916	12/11/2007	3.1	295.22	297.79	297.79	298.73	0.023813	8.32	48.16	25.98	1.01
1870	12/11/2007	1.91	294.06	297.04		297.61	0.014359	6.55	62.09	33.1	0.78
1440	12/11/2007	0.25	284.5	291.09		291.15	0.001099	1.95	173.77	43.72	0.17
1246	12/11/2007	2.69	286.16	289.47		290.03	0.014189	6.18	58.95	22.07	0.62
1168	12/11/2007	2.28	285.35	288.48	287.68	288.95	0.012922	5.62	64.26	25.04	0.59
1121	12/11/2007	4.05	284.38	287.26		288.07	0.026538	7.32	48.4	21.51	0.82
650	12/11/2007	1.87	274.3	277.2		277.57	0.014496	4.84	69.97	32.19	0.58
30	12/11/2007	0.46	263.2	267.29		267.39	0.002377	2.58	143.1	56.57	0.25
0.1	12/11/2007	5.01	262.9	265.77	265.77	266.68	0.048037	7.65	44.34	24.9	1.01
-1990	12/11/2007	0.91	236.79	239.28		239.58	0.006003	4.63	83.89	37.64	0.52
-2000	12/11/2007	2.91	235.68	238.26		238.66	0.020149	6.16	74.58	48	0.71
-2010	12/11/2007	0.93	234.35	238.06	236.76	238.23	0.005002	3.62	110.33	48.11	0.36

HEC-RAS Modeling Results, May Creek, Monitoring Event 12/20/2007, Q = 37 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	12/20/2007	0.14	304.3	306.61		306.68	0.001965	2.02	18.34	15.84	0.33
4530	12/20/2007	0.15	304.3	306.56	305.79	306.63	0.002234	2.12	17.48	15.47	0.35
4518.5		Bridge									
4507	12/20/2007	0.05	304.3	306.56	305.44	306.58	0.0006	1.28	29.01	20.16	0.19
4397	12/20/2007	0.04	303.2	306.48		306.51	0.000388	1.25	29.49	14	0.15
4047	12/20/2007	0.05	304.3	306.42		306.44	0.001323	1.15	32.16	48.97	0.25
3622	12/20/2007	0.32	304.4	305.3		305.43	0.007415	2.89	12.82	17.65	0.6
3602	12/20/2007	0.07	303.2	305.32	304.36	305.36	0.0009	1.51	24.47	17.49	0.23
3596.5		Bridge									
3591	12/20/2007	0.12	303.2	305.31	304.36	305.35	0.001536	1.53	24.22	17.49	0.23
3571	12/20/2007	0.12	303.3	305.28		305.31	0.001476	1.55	23.81	16.26	0.23
3061	12/20/2007	0.78	302.5	303.48		303.68	0.015558	3.55	10.42	12.34	0.68
2756	12/20/2007	0.11	298.3	300.7		300.73	0.00127	1.48	24.93	16.58	0.21
2746	12/20/2007	0.13	298.4	300.68	299.57	300.72	0.001524	1.59	23.31	14.99	0.22
2741		Bridge									
2736	12/20/2007	0.13	298.4	300.66		300.7	0.001579	1.61	23.03	14.99	0.23
2725	12/20/2007	0.68	299.3	300.46	300.28	300.62	0.016337	3.23	11.45	16.76	0.69
2440	12/20/2007	0.04	295.3	297.27		297.29	0.000527	0.93	39.71	27.46	0.14
1964	12/20/2007	0.18	294.88	296.7		296.75	0.002259	1.87	20.89	19	0.28
1916	12/20/2007	0.97	295.22	296.25	296.18	296.48	0.025194	3.8	9.77	17.21	0.85
1870	12/20/2007	0.68	294.06	295.4		295.56	0.015753	3.23	12.39	21.7	0.68
1440	12/20/2007	0.03	284.5	288.07		288.08	0.000285	0.63	58.33	29.06	0.08
1246	12/20/2007	0.59	286.16	287.33		287.42	0.010336	2.36	15.94	18.29	0.44
1168	12/20/2007	0.68	285.35	286.38	286.09	286.48	0.014457	2.47	15	19.8	0.5
1121	12/20/2007	1.01	284.38	285.48		285.62	0.023813	2.95	12.61	18.81	0.63
650	12/20/2007	0.57	274.3	275.35		275.42	0.01415	2.21	16.77	25.47	0.48
30	12/20/2007	0.11	263.2	264.74		264.76	0.001624	1.05	35.11	31.38	0.18
0.1	12/20/2007	2.45	262.9	263.92	263.92	264.23	0.068375	4.47	8.28	13.6	1.01
-1990	12/20/2007	0.18	236.79	237.62		237.66	0.003739	1.7	23.8	34.81	0.34
-2000	12/20/2007	2.19	235.68	236.54	236.54	236.8	0.055159	4.3	9.62	19.05	0.95
-2010	12/20/2007	0.28	234.35	235.85	235.3	235.9	0.005004	1.63	22.91	26.77	0.3

HEC-RAS Modeling Results, May Creek, Monitoring Event 12/27/2007, Q = 35 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	12/27/2007	0.13	304.3	306.58		306.64	0.001907	1.97	17.79	15.61	0.32
4530	12/27/2007	0.14	304.3	306.53	305.76	306.59	0.002162	2.06	16.97	15.24	0.34
4518.5		Bridge									
4507	12/27/2007	0.05	304.3	306.52	305.42	306.55	0.000577	1.23	28.35	20.09	0.18
4397	12/27/2007	0.04	303.2	306.45		306.48	0.00036	1.2	29.09	13.92	0.15
4047	12/27/2007	0.05	304.3	306.39		306.41	0.001255	1.13	30.87	46.1	0.24
3622	12/27/2007	0.34	304.4	305.25		305.38	0.008134	2.91	12.03	17.58	0.62
3602	12/27/2007	0.07	303.2	305.28	304.34	305.31	0.000889	1.48	23.72	17.49	0.22
3596.5		Bridge									
3591	12/27/2007	0.12	303.2	305.27	304.34	305.3	0.001517	1.49	23.47	17.49	0.23
3571	12/27/2007	0.12	303.3	305.24		305.27	0.001443	1.51	23.13	16.2	0.22
3061	12/27/2007	0.76	302.5	303.45		303.64	0.015753	3.5	10.01	12.27	0.68
2756	12/27/2007	0.11	298.3	300.66		300.69	0.001214	1.44	24.39	16.51	0.21
2746	12/27/2007	0.12	298.4	300.64	299.55	300.68	0.001451	1.53	22.84	14.99	0.22
2741		Bridge									
2736	12/27/2007	0.13	298.4	300.63		300.66	0.001503	1.55	22.58	14.99	0.22
2725	12/27/2007	0.66	299.3	300.44	300.26	300.59	0.016232	3.17	11.03	16.53	0.68
2440	12/27/2007	0.04	295.3	297.23		297.24	0.000505	0.91	38.42	26.62	0.13
1964	12/27/2007	0.17	294.88	296.66		296.71	0.002196	1.82	20.26	18.71	0.28
1916	12/27/2007	0.93	295.22	296.23	296.15	296.45	0.024847	3.7	9.46	16.23	0.84
1870	12/27/2007	0.67	294.06	295.37	295.19	295.53	0.015779	3.19	11.8	21	0.68
1440	12/27/2007	0.03	284.5	288.02		288.03	0.000269	0.61	56.98	28.56	0.08
1246	12/27/2007	0.57	286.16	287.3		287.39	0.010315	2.31	15.41	18.24	0.43
1168	12/27/2007	0.66	285.35	286.36	286.07	286.45	0.014409	2.41	14.5	19.72	0.5
1121	12/27/2007	0.99	284.38	285.46		285.59	0.024029	2.91	12.11	18.58	0.63
650	12/27/2007	0.55	274.3	275.33		275.4	0.014106	2.16	16.21	25.4	0.48
30	12/27/2007	0.11	263.2	264.7		264.72	0.001631	1.03	33.85	31.27	0.18
0.1	12/27/2007	2.41	262.9	263.9	263.9	264.2	0.069217	4.41	7.93	13.38	1.01
-1990	12/27/2007	0.18	236.79	237.59		237.63	0.003761	1.67	22.92	34.77	0.34
-2000	12/27/2007	2.14	235.68	236.51	236.51	236.77	0.055477	4.24	9.21	18.73	0.95
-2010	12/27/2007	0.27	234.35	235.82	235.28	235.86	0.005005	1.6	22.09	26.57	0.29

HEC-RAS Modeling Results, May Creek, Monitoring Event 4/1/2008, Q = 33 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	4/1/2008	0.12	304.3	306.54		306.6	0.001852	1.92	17.2	15.35	0.32
4530	4/1/2008	0.14	304.3	306.49	305.72	306.55	0.002095	2.01	16.43	15	0.34
4518.5		Bridge									
4507	4/1/2008	0.05	304.3	306.49	305.39	306.51	0.000555	1.19	27.63	20.03	0.18
4397	4/1/2008	0.04	303.2	306.42		306.44	0.000334	1.15	28.65	13.84	0.14
4047	4/1/2008	0.05	304.3	306.36		306.38	0.001179	1.12	29.51	42.89	0.24
3622	4/1/2008	0.35	304.4	305.21		305.34	0.009073	2.94	11.21	17.52	0.65
3602	4/1/2008	0.07	303.2	305.24	304.31	305.27	0.000877	1.44	22.94	17.49	0.22
3596.5		Bridge									
3591	4/1/2008	0.11	303.2	305.22	304.31	305.25	0.0015	1.45	22.69	17.49	0.22
3571	4/1/2008	0.11	303.3	305.19		305.23	0.00141	1.47	22.42	16.13	0.22
3061	4/1/2008	0.74	302.5	303.41		303.6	0.015925	3.44	9.6	12.2	0.68
2756	4/1/2008	0.1	298.3	300.63		300.66	0.001156	1.38	23.83	16.44	0.2
2746	4/1/2008	0.11	298.4	300.61	299.52	300.65	0.001377	1.48	22.35	14.99	0.21
2741		Bridge									
2736	4/1/2008	0.12	298.4	300.6		300.63	0.001426	1.49	22.1	14.99	0.22
2725	4/1/2008	0.64	299.3	300.41	300.23	300.56	0.016106	3.11	10.61	16.29	0.68
2440	4/1/2008	0.04	295.3	297.18		297.19	0.000482	0.89	37.12	25.75	0.13
1964	4/1/2008	0.17	294.88	296.63		296.67	0.002132	1.77	19.6	18.4	0.27
1916	4/1/2008	0.91	295.22	296.21	296.12	296.41	0.024915	3.64	9.07	15.34	0.83
1870	4/1/2008	0.65	294.06	295.35	295.17	295.5	0.015618	3.14	11.26	20.34	0.67
1440	4/1/2008	0.03	284.5	287.98		287.98	0.000253	0.59	55.64	28.06	0.07
1246	4/1/2008	0.54	286.16	287.28		287.36	0.010126	2.24	14.94	18.19	0.43
1168	4/1/2008	0.64	285.35	286.33	286.05	286.42	0.01436	2.36	13.99	19.64	0.49
1121	4/1/2008	0.97	284.38	285.43		285.55	0.024266	2.86	11.58	18.31	0.63
650	4/1/2008	0.53	274.3	275.3		275.37	0.014055	2.11	15.64	25.32	0.47
30	4/1/2008	0.1	263.2	264.67		264.68	0.001621	1.01	32.69	31.18	0.17
0.1	4/1/2008	2.37	262.9	263.87	263.87	264.17	0.07001	4.36	7.57	13.15	1.01
-1990	4/1/2008	0.17	236.79	237.57		237.61	0.003746	1.63	22.09	34.73	0.34
-2000	4/1/2008	2.1	235.68	236.49	236.49	236.74	0.055824	4.17	8.8	18.4	0.94
-2010	4/1/2008	0.26	234.35	235.79	235.26	235.83	0.005005	1.56	21.24	26.35	0.29

HEC-RAS Modeling Results, May Creek, Monitoring Event 6/13/2008, Q = 23 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	6/13/2008	0.1	304.3	306.3		306.35	0.001636	1.67	13.75	13.72	0.29
4530	6/13/2008	0.11	304.3	306.26	305.53	306.31	0.001843	1.75	13.15	13.42	0.31
4518.5		Bridge									
4507	6/13/2008	0.03	304.3	306.26	305.25	306.27	0.00047	1	23.03	19.48	0.16
4397	6/13/2008	0.02	303.2	306.21		306.22	0.000217	0.89	25.77	13.29	0.11
4047	6/13/2008	0.03	304.3	306.16		306.17	0.000543	1	23	21.57	0.17
3622	6/13/2008	0.6	304.4	304.93	304.93	305.13	0.025712	3.53	6.51	17.14	1.01
3602	6/13/2008	0.05	303.2	304.98	304.16	305.01	0.000835	1.24	18.55	17.49	0.21
3596.5		Bridge									
3591	6/13/2008	0.09	303.2	304.97	304.16	305	0.001435	1.26	18.32	17.49	0.22
3571	6/13/2008	0.09	303.3	304.95		304.97	0.001238	1.24	18.49	15.74	0.2
3061	6/13/2008	0.68	302.5	303.22		303.37	0.018429	3.17	7.27	11.77	0.71
2756	6/13/2008	0.07	298.3	300.44		300.46	0.000852	1.11	20.76	16.03	0.17
2746	6/13/2008	0.07	298.4	300.43	299.38	300.45	0.001009	1.17	19.6	14.99	0.18
2741		Bridge									
2736	6/13/2008	0.08	298.4	300.42		300.44	0.001037	1.18	19.42	14.99	0.18
2725	6/13/2008	0.54	299.3	300.26	300.1	300.38	0.015726	2.77	8.3	14.94	0.65
2440	6/13/2008	0.03	295.3	296.9		296.91	0.000369	0.75	30.56	22.28	0.11
1964	6/13/2008	0.12	294.88	296.42		296.45	0.001793	1.47	16.02	16.59	0.25
1916	6/13/2008	0.84	295.22	296.04	295.97	296.22	0.026135	3.43	6.71	12.86	0.84
1870	6/13/2008	0.56	294.06	295.19	294.99	295.31	0.015092	2.85	8.34	16.32	0.65
1440	6/13/2008	0.02	284.5	287.71		287.71	0.000169	0.47	48.51	25.19	0.06
1246	6/13/2008	0.43	286.16	287.12		287.18	0.009847	1.92	12.07	17.91	0.41
1168	6/13/2008	0.51	285.35	286.19	285.94	286.25	0.01418	2.05	11.21	19.19	0.47
1121	6/13/2008	0.84	284.38	285.27		285.38	0.025495	2.59	8.9	16.88	0.63
650	6/13/2008	0.43	274.3	275.18		275.23	0.013689	1.83	12.6	24.91	0.45
30	6/13/2008	0.08	263.2	264.46		264.47	0.001563	0.87	26.38	30.65	0.17
0.1	6/13/2008	2.11	262.9	263.73	263.73	263.97	0.07396	3.99	5.76	11.95	1.01
-1990	6/13/2008	0.14	236.79	237.43		237.46	0.003793	1.42	17.37	33.4	0.33
-2000	6/13/2008	1.88	235.68	236.36	236.36	236.58	0.060453	3.83	6.53	16.24	0.95
-2010	6/13/2008	0.21	234.35	235.61	235.14	235.64	0.005004	1.36	16.93	23.69	0.28

HEC-RAS Modeling Results, May Creek, Monitoring Event 1/8/2009, Q = 348 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	1/8/2009	0.44	304.3	309.11		309.36	0.003456	4	86.96	41.46	0.49
4530	1/8/2009	0.49	304.3	309	307.98	309.28	0.003986	4.23	82.24	40.12	0.52
4518.5		Bridge									
4507	1/8/2009	0.35	304.3	308.96	307.24	309.17	0.002497	3.64	95.63	39.99	0.41
4397	1/8/2009	0.07	303.2	308.78		308.8	0.000362	1.68	428.21	330.43	0.16
4047	1/8/2009	0.02	304.3	308.73		308.74	0.000208	0.78	444.15	315.84	0.11
3622	1/8/2009	0.61	304.4	308.19		308.57	0.003527	4.97	72.44	33.11	0.49
3602	1/8/2009	0.53	303.2	308.15	306.22	308.5	0.002822	4.7	74	17.5	0.4
3596.5		Bridge									
3591	1/8/2009	0.9	303.2	308.1	306.22	308.45	0.004837	4.76	73.08	17.5	0.41
3571	1/8/2009	0.87	303.3	308.01		308.35	0.004646	4.69	74.21	20.59	0.44
3061	1/8/2009	1.44	302.5	305.47		305.9	0.017664	5.25	66.3	49.25	0.8
2756	1/8/2009	0.85	298.3	303.26		303.59	0.004967	4.57	76.23	24.99	0.46
2746	1/8/2009	1.48	298.4	302.95	301.67	303.5	0.008949	5.99	59.73	17.99	0.54
2741		Bridge									
2736	1/8/2009	1.71	298.4	302.73		303.35	0.010692	6.38	55.78	17.99	0.59
2725	1/8/2009	2.93	299.3	302.13	302.13	303.09	0.025988	7.89	44.09	23.06	1.01
2440	1/8/2009	0.19	295.3	300.36		300.44	0.000922	2.25	154.82	41.71	0.21
1964	1/8/2009	1.38	294.88	298.86		299.37	0.006518	6.02	68.45	22.8	0.57
1916	1/8/2009	3.12	295.22	297.83	297.83	298.78	0.023546	8.37	49.16	26.01	1
1870	1/8/2009	1.95	294.06	297.07		297.65	0.014489	6.63	62.98	33.17	0.79
1440	1/8/2009	0.26	284.5	291.14		291.2	0.001113	1.98	176.17	43.9	0.17
1246	1/8/2009	2.74	286.16	289.51		290.09	0.014237	6.25	59.91	22.14	0.63
1168	1/8/2009	2.31	285.35	288.52	287.71	289	0.012883	5.67	65.42	25.11	0.59
1121	1/8/2009	4.12	284.38	287.29		288.12	0.026661	7.4	49.15	21.56	0.83
650	1/8/2009	1.9	274.3	277.24		277.61	0.014503	4.89	71.22	32.33	0.58
30	1/8/2009	0.47	263.2	267.34		267.44	0.002381	2.61	145.79	56.76	0.25
0.1	1/8/2009	5.06	262.9	265.8	265.8	266.72	0.047944	7.7	45.21	25.1	1.01
-1990	1/8/2009	0.93	236.79	239.31		239.61	0.006083	4.69	84.94	37.69	0.53
-2000	1/8/2009	2.89	235.68	238.3		238.7	0.019626	6.15	76.56	48	0.7
-2010	1/8/2009	0.94	234.35	238.1	236.79	238.28	0.005001	3.65	112.31	48.13	0.36

HEC-RAS Modeling Results, May Creek, Monitoring Event 1/29/2009, Q = 10 cfs

River Sta	Profile	Shear Chan	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(lb/sq ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4553	1/29/2009	0.06	304.3	305.82		305.85	0.001343	1.26	7.93	10.42	0.25
4530	1/29/2009	0.07	304.3	305.79	305.18	305.81	0.001524	1.32	7.56	10.17	0.27
4518.5		Bridge									
4507	1/29/2009	0.02	304.3	305.78	304.97	305.79	0.000363	0.7	14.29	17.3	0.14
4397	1/29/2009	0.01	303.2	305.76		305.76	0.000083	0.5	20.03	12.11	0.07
4047	1/29/2009	0.01	304.3	305.72		305.73	0.000201	0.62	16.19	14.8	0.1
3622	1/29/2009	0.42	304.4	304.77	304.77	304.88	0.029442	2.7	3.7	16.28	1
3602	1/29/2009	0.03	303.2	304.53	303.89	304.54	0.000773	0.92	10.88	15.61	0.19
3596.5		Bridge									
3591	1/29/2009	0.06	303.2	304.52	303.89	304.53	0.00134	0.94	10.69	15.48	0.2
3571	1/29/2009	0.05	303.3	304.5		304.51	0.00101	0.86	11.58	15.03	0.17
3061	1/29/2009	0.58	302.5	302.91	302.86	303.02	0.028048	2.65	3.77	11.09	0.8
2756	1/29/2009	0.02	298.3	300.11		300.12	0.00038	0.64	15.61	15.14	0.11
2746	1/29/2009	0.03	298.4	300.11	299.11	300.11	0.000429	0.67	14.85	14.13	0.12
2741		Bridge									
2736	1/29/2009	0.03	298.4	300.1		300.11	0.000435	0.68	14.78	14.11	0.12
2725	1/29/2009	0.34	299.3	300.01	299.88	300.08	0.014388	2.07	4.82	12.62	0.59
2440	1/29/2009	0.02	295.3	296.38		296.38	0.000278	0.52	19.42	20.56	0.09
1964	1/29/2009	0.06	294.88	296.05		296.06	0.001201	0.96	10.43	13.29	0.19
1916	1/29/2009	0.67	295.22	295.76	295.72	295.89	0.031181	2.86	3.5	10.13	0.86
1870	1/29/2009	0.39	294.06	294.87	294.7	294.95	0.014018	2.29	4.36	9.51	0.6
1440	1/29/2009	0.01	284.5	287.22		287.23	0.000056	0.27	37.59	20.02	0.03
1246	1/29/2009	0.26	286.16	286.85		286.88	0.010004	1.39	7.22	17.42	0.38
1168	1/29/2009	0.32	285.35	285.94	285.76	285.98	0.013362	1.5	6.65	17.39	0.43
1121	1/29/2009	0.62	284.38	285.02		285.08	0.029185	2.05	4.87	14.31	0.62
650	1/29/2009	0.27	274.3	274.96		274.99	0.012652	1.37	7.27	20.82	0.41
30	1/29/2009	0.05	263.2	264.12		264.12	0.001489	0.62	16.01	29.75	0.15
0.1	1/29/2009	1.58	262.9	263.48	263.48	263.64	0.084871	3.22	3.1	9.91	1.01
-1990	1/29/2009	0.09	236.79	237.2		237.22	0.00387	1.03	10.09	30.49	0.3
-2000	1/29/2009	1.41	235.68	236.14	236.14	236.29	0.071875	3.07	3.35	12.66	0.96
-2010	1/29/2009	0.14	234.35	235.31	234.92	235.33	0.005007	1.01	9.86	21.58	0.26

APPENDIX D
MONITORING REPORT FORMS

Date:__11-16-07_______________

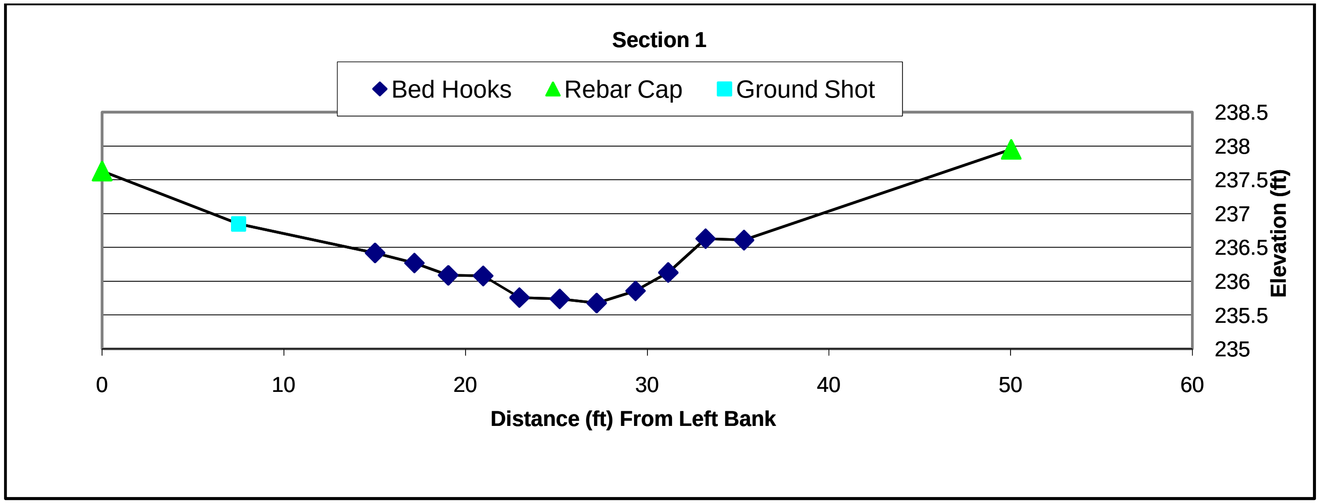
Time:_____10 am______

Recorder: Jenni P., Tim K., Larry G._____

Weather: not recorded

Site Conditions: Creek slightly turbid and up a few inches from the site visit. Eyebolts were impossible to detect visually

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27
Monitoring Date											
11/16/2007	P	P	P	P	P	P	P	P	P	P	P

Date:__11-16-07______________

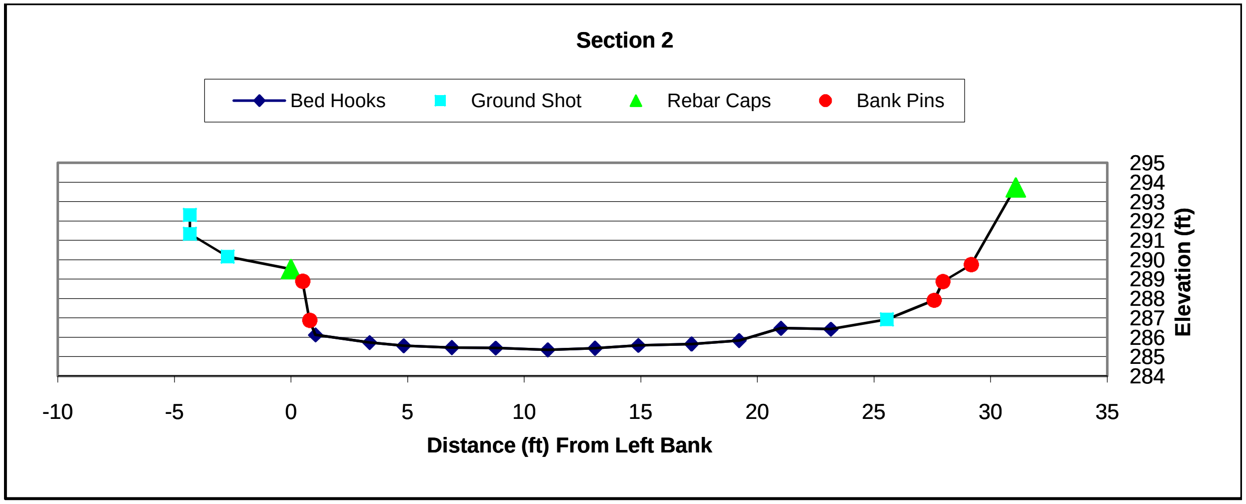
Time:____10 am______

Recorder: Jenni P., Tim K., Larry G._____

Weather: not recorded

Site Conditions: Creek slightly turbid
and up a few inches from the site visit.
Eyebolts were impossible to detect visually

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the left and right banks.
Bank Pins are numbered left to right along the section.
Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	11	12		Pin number			1	2	3	4	5		
Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location			LB	LB	RB	RB	RB		
Monitoring Date																							
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		

Date:__11-16-07______________

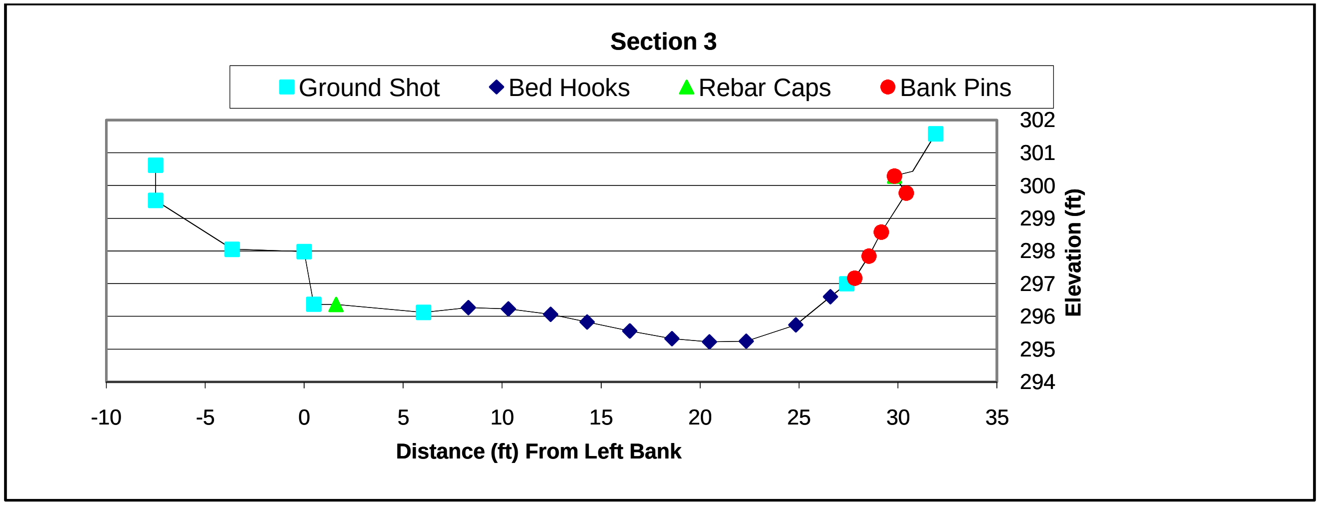
Time:____10 am______

Recorder: Jenni P., Tim K., Larry G._____

Weather: not recorded

Site Conditions: Creek slightly turbid and up a few inches from the site visit. Eyebolts were impossible to detect visually

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 7 feet from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the right bank. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10		Pin number			1	2	3	4	5				
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25		Location			RB	RB	RB	RB	RB				
Monitoring Date																							
11/16/2007	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-				

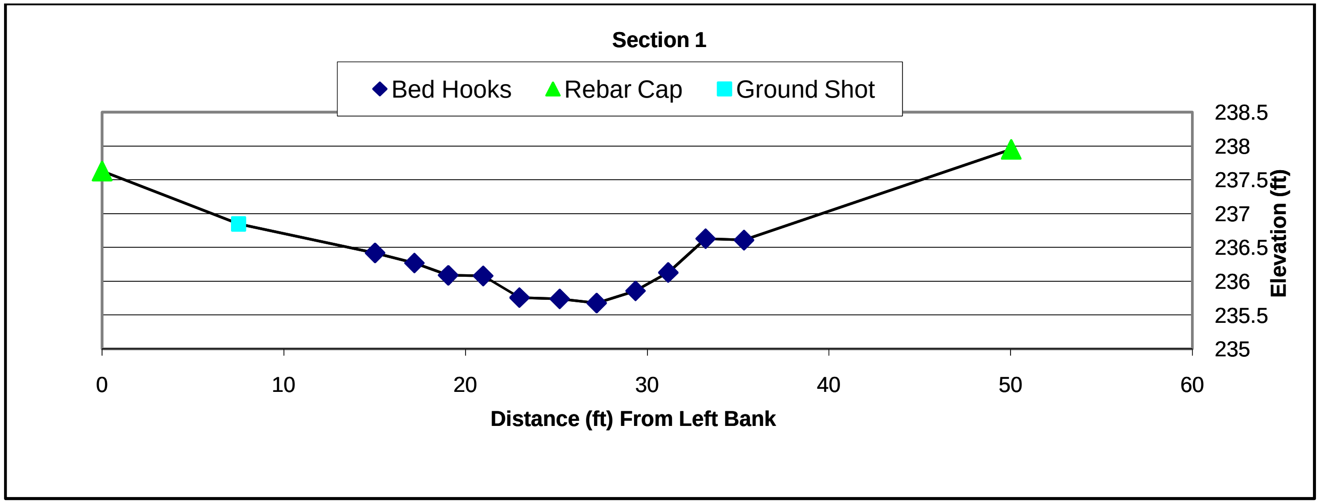
Date:__12-11-07______________

Time:__11 am_____

Recorder:Jenni P., Tim K., Larry G., Tracy D.

Weather:__not recorded___

Site Conditions:__not recorded___________



Bed Hooks: 12
Bank Pins: 5

Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27
Monitoring Date											
11/16/2007	P	P	P	P	P	P	P	P	P	P	P
12/11/2007	P	P	P	P	P	P	P	P	P	A	A

No pins were observable. All were covered with ~1' of sediment

Date:__12-11-07______________

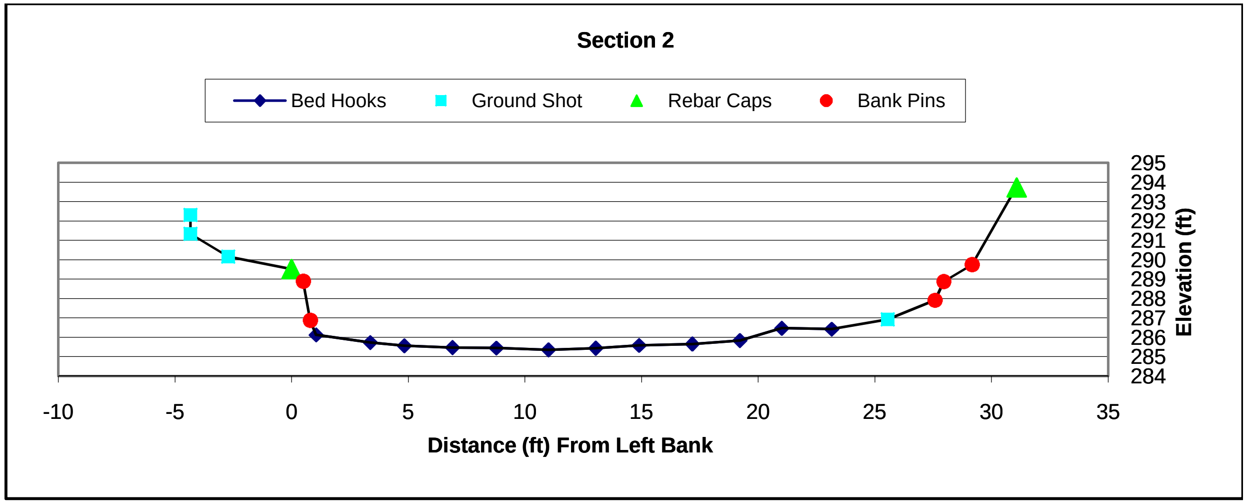
Time:__11 am_____

Recorder:Jenni P., Tim K., Larry G., Tracy D.

Weather:__not recorded___

Site Conditions:__not recorded___________

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the left and right banks. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	11	12		Pin number			1	2	3	4	5		
Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location			LB	LB	RB	RB	RB		
Monitoring Date																							
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
12/11/2007	P	A	A	P	P	P	P	P	P	P	P	P					-	1"	1"	-	-		

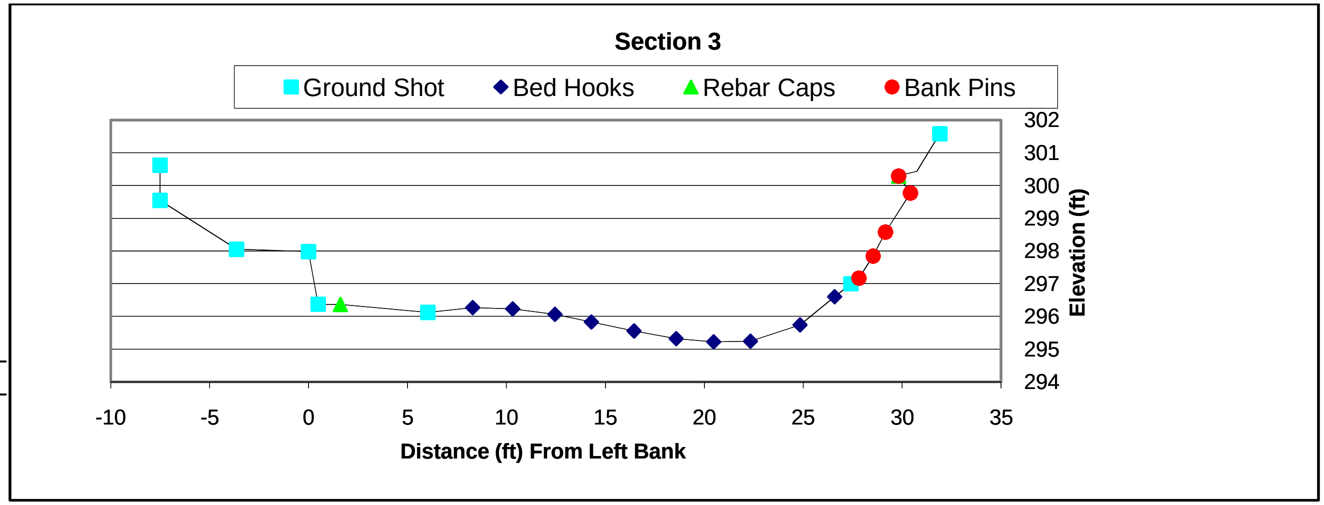
Date:__12-11-07_______________

Time:__11 am_____

Recorder:Jenni P., Tim K., Larry G., Tracy D.

Weather:__not recorded___

Site Conditions:__not recorded___________



Bed Hooks: 12
Bank Pins: 5

Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 7 feet from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the right bank. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10		Pin number	1	2	3	4	5				
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25		Location	RB	RB	RB	RB	RB				
Monitoring Date																					
11/16/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-				
12/11/2007	P	P	P	P	P	P	P	P	A	A			24"	17.5"	24"	10"	5"	***Bank pins reset flush***			

Date:__12-20-2007_____

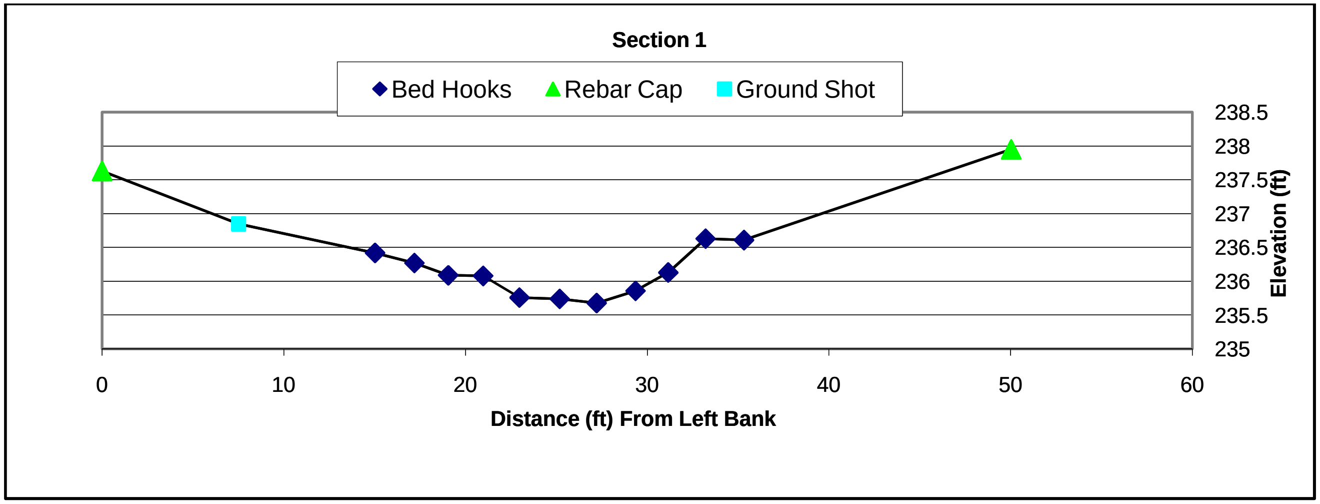
Time:___11:20am_____________

Recorder:___Tim Kelly and Larry Goulet

Weather:___42 degrees and overcast______

Site Conditions:___water slightly turbid______
___channel bottom visible_________________
_flows about 3/4' higher than last visit________

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27
Monitoring Date											
11/16/2007	P	P	P	P	P	P	P	P	P	P	P
12/11/2007	P	P	P	P	P	P	P	P	P	A	A
12/20/2007	P	P	P	P	P	P	P	P	P	P	P

No pins were observable. All were covered with ~1' of sediment
Flows appear to be migrating to the braided channel along the right bank.

Date:__12-20-2007_____

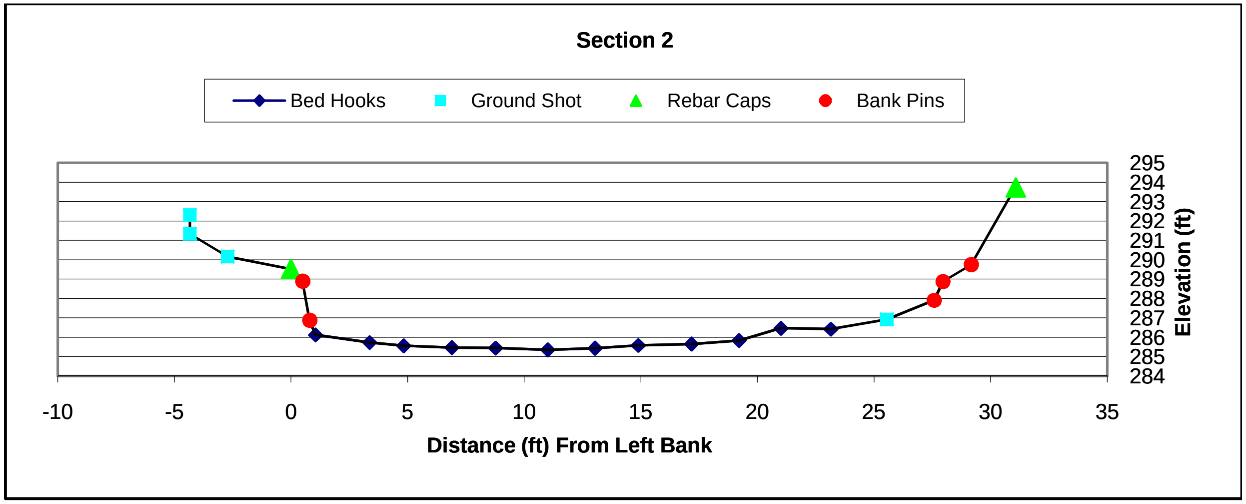
Time:___11:20am_____________

Recorder:___Tim Kelly and Larry Goulet

Weather:___42 degrees and overcast______

Site Conditions:___water slightly turbid______
___channel bottom visible________________
_flows about 3/4' higher than last visit________

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the left and right banks. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	11	12		Pin number		1	2	3	4	5		
Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location		LB	LB	RB	RB	RB		
Monitoring Date																						
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
12/11/2007	P	A	A	P	P	P	P	P	P	P	P	P				-	1"	1"	-	-		
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		

Date:__12-20-2007_____

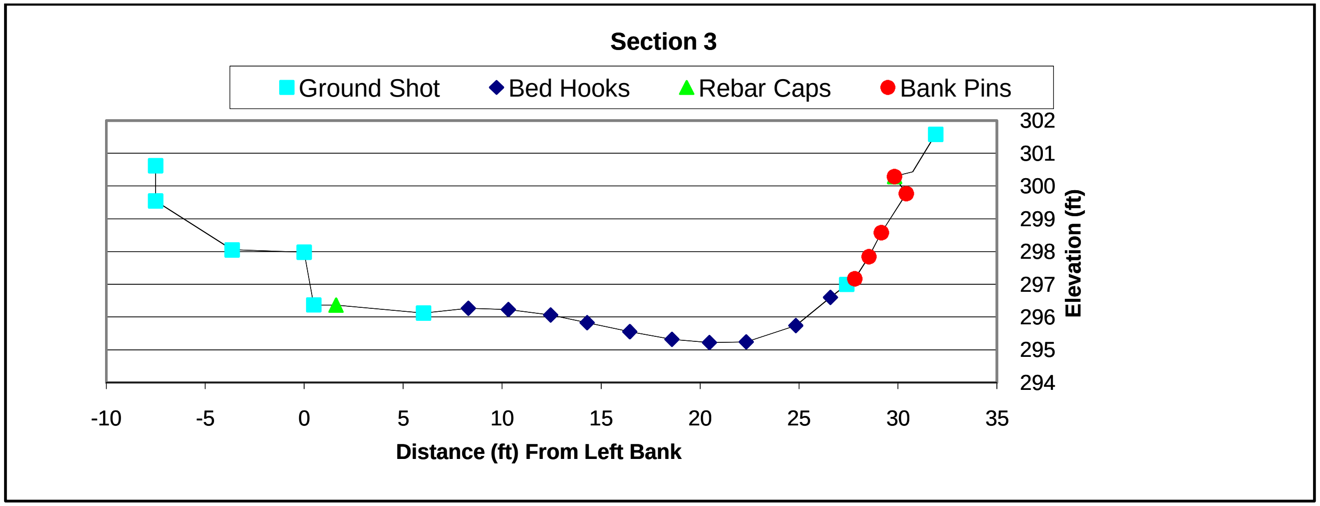
Time:___11:20am_____________

Recorder:___Tim Kelly and Larry Goulet

Weather:___42 degrees and overcast______

Site Conditions:___water slightly turbid______
___channel bottom visible________________
_flows about 3/4' higher than last visit_________

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 7 feet from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the right bank. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10		Pin number	1	2	3	4	5	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25		Location	RB	RB	RB	RB	RB	
Monitoring Date																		
11/16/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
12/11/2007	P	P	P	P	P	P	P	P	A	A			24"	17.5"	24"	10"	5"	***Bank pins reset flush***
12/20/2007	P	P	P	P	P	P	P	P	A	P			-	-	-	-	-	***Bed hooks 1-4 covered***

Notes: 12/20/07 - The channel has deposited sediment along the left bank covering bed hooks 1-4 with about 0.1 to 0.2' of sediment. The channel is visibly downcutting at bed hook #9 (which was scoured out of place). Hook #9 was located less than a foot from where it was set. No change in exposure of bank pins.

Date:_12/27/2007_____________

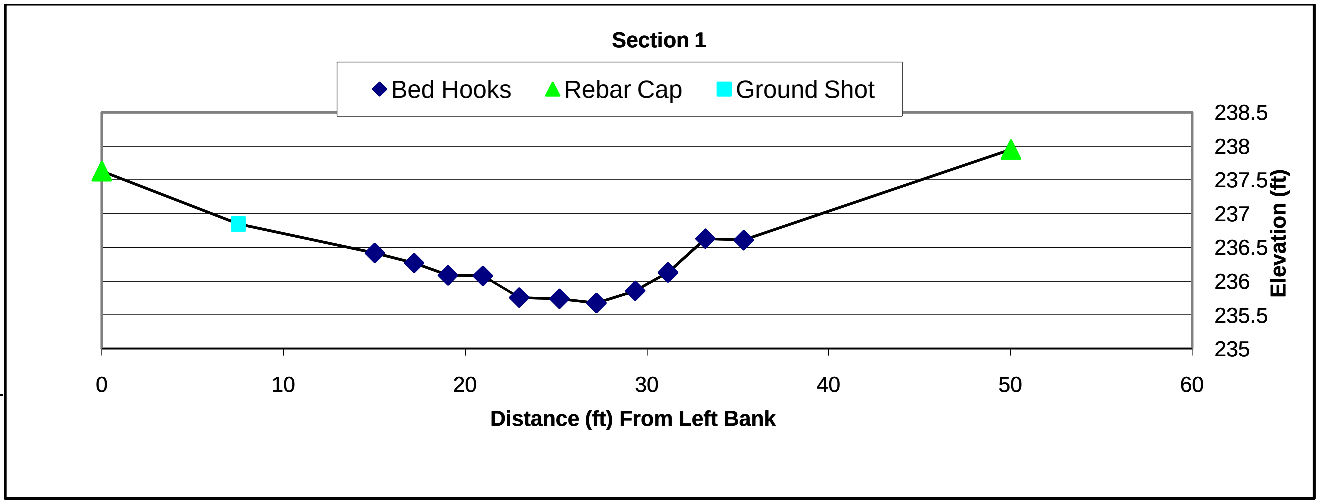
Time:___3 pm___________

Recorder:_Tim Kelley__________________

Weather:_34 degrees w/ rain turning to snow_

Site Conditions:___water clear_____________
__running about 1/5 inch lower than last visit
____

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27
Monitoring Date											
11/16/2007	P	P	P	P	P	P	P	P	P	P	P
12/11/2007	P	P	P	P	P	P	P	P	P	A	A
12/20/2007	P	P	P	P	P	P	P	P	P	P	P
12/27/2007	P	P	P	P	P	P	P	P	P	P	P

No pins were observable. All were covered with ~1' of sediment
Flows appear to be migrating to the braided channel along the right bank.
Flows appear to be migrating to the braided channel along the right bank.

Date:_12/27/2007_____________

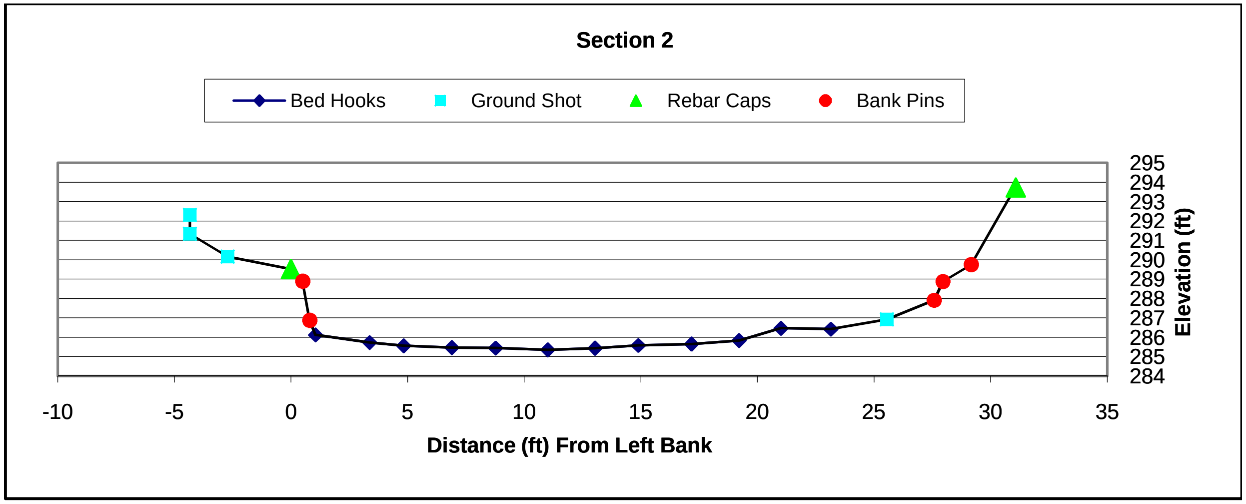
Time:___3 pm__________

Recorder:_Tim Kelley_________________

Weather:_34 degrees w/ rain turning to snow_

Site Conditions:___water clear____________
__running about 1/5 inch lower than last visit
____

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the left and right banks. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	11	12		Pin number	1	2	3	4	5		
Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location	LB	LB	RB	RB	RB		
Monitoring Date																					
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-		
12/11/2007	P	A	A	P	P	P	P	P	P	P	P	P			-	1"	1"	-	-		
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-		
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-		

Date:_12/27/2007____________

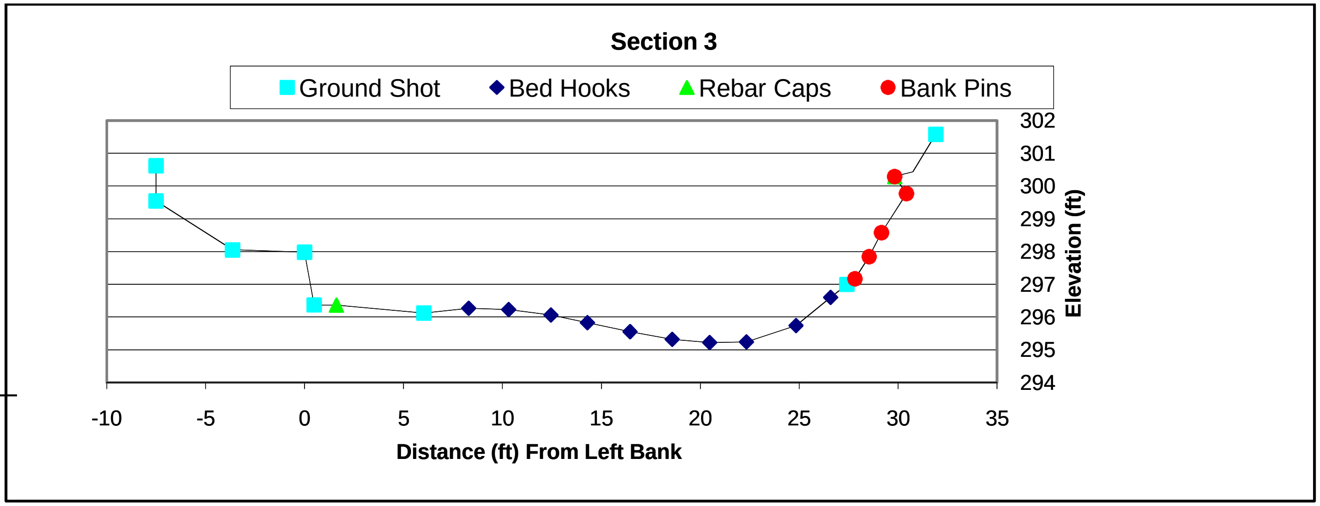
Time:___3 pm__________

Recorder:_Tim Kelley_________________

Weather:_34 degrees w/ rain turning to snow_

Site Conditions:___water clear____________
__running about 1/5 inch lower than last visit
____

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 7 feet from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the right bank. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10		Pin number	1	2	3	4	5	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25		Location	RB	RB	RB	RB	RB	
Monitoring Date																		
11/16/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
12/11/2007	P	P	P	P	P	P	P	P	A	A			24"	17.5"	24"	10"	5"	***Bank pins reset flush***
12/20/2007	P	P	P	P	P	P	P	P	A	P			-	-	-	-	-	***Bed hooks 1-4 covered***
12/27/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	***No changes***

Notes: 12/20/07 - The channel has deposited sediment along the left bank covering bed hooks 1-4 with about 0.1 to 0.2' of sediment. The channel is visibly downcutting at bed hook #9 (which was scoured out of place). Hook #9 was located less than a foot from where it was set. No change in exposure of bank pins.

Date:_4/1/2008____________

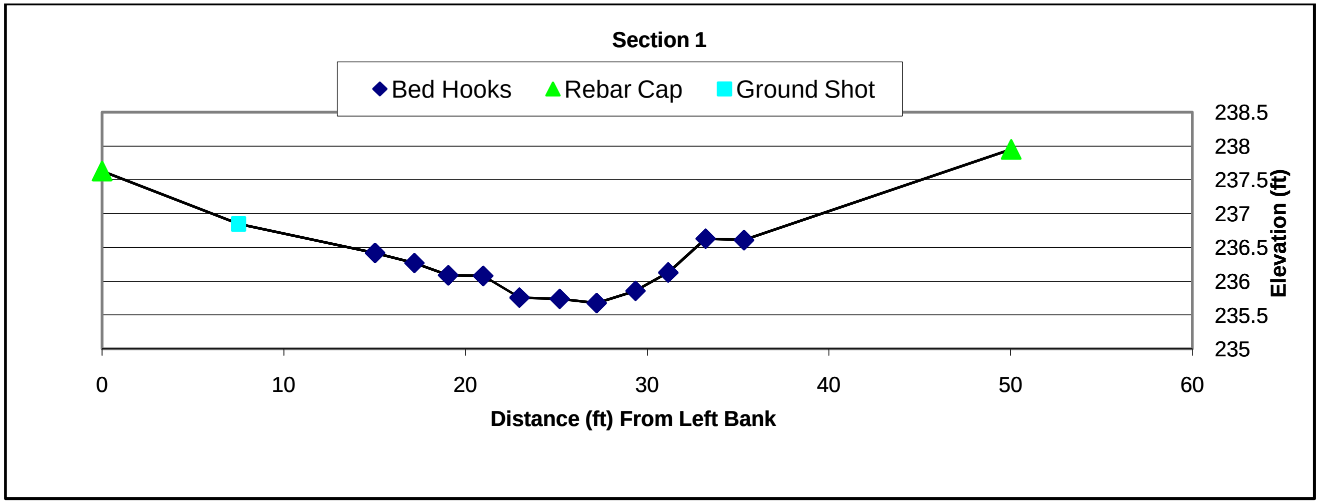
Time:___1:20 pm__________

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:_50 degrees and sunny

Site Conditions:___water clear & cold_____ channel bottom visible, flows higher than anticipated

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27	
Monitoring Date												
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	No pins were observable. All were covered with ~1' of sediment
12/11/2007	P	P	P	P	P	P	P	P	P	A	A	Flows appear to be migrating to the braided channel along the right bank.
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	Flows appear to be migrating to the braided channel along the right bank.
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	Flows still migrating to right, Sed dep on left. Vandalism of two pins.
4/1/2008	A*	A*	P	P	P	P	P	P	P	P	P	

* Pulled out due to vandalism. They were not replaced.

Date:_4/1/2008____________

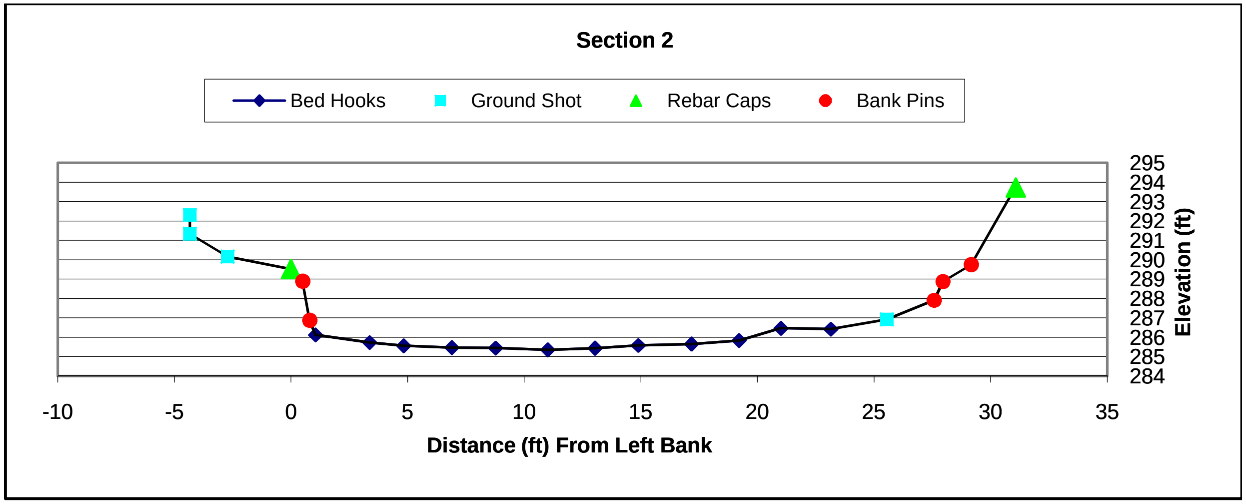
Time:___1:20 pm__________

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:_50 degrees and sunny

Site Conditions:___water clear & cold_____
channel bottom visible, flows higher than anticipated

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the left and right banks. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	11	12		Pin number		1	2	3	4	5		
Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location		LB	LB	RB	RB	RB		
Monitoring Date																						
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
12/11/2007	P	A	A	P	P	P	P	P	P	P	P	P				-	1"	1"	-	-		
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
4/1/2008	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		

Date:_4/1/2008____________

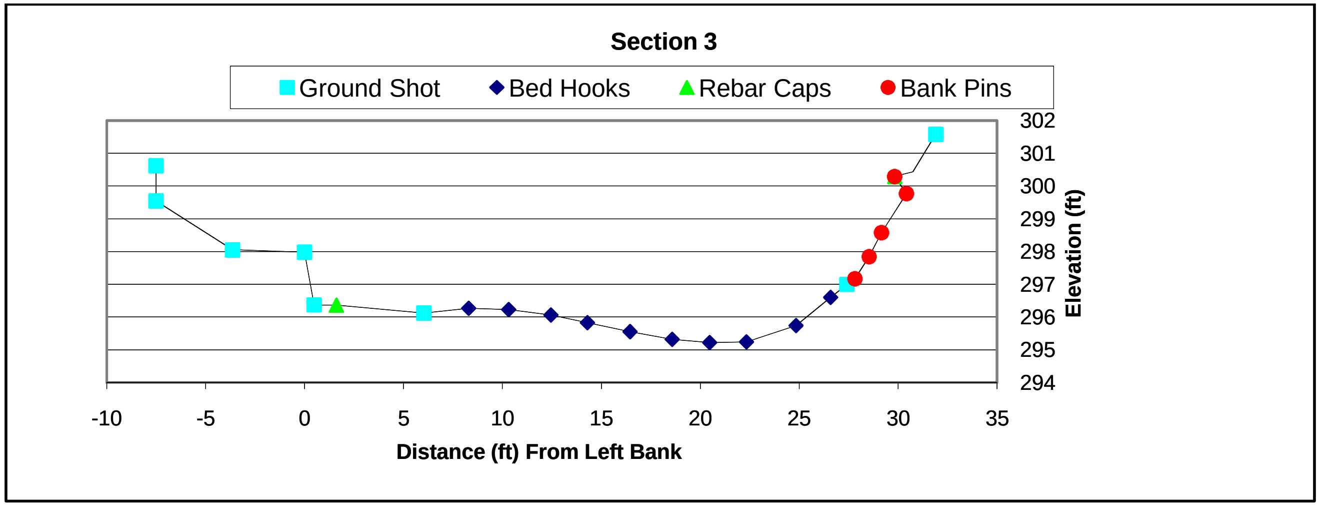
Time:___1:20 pm__________

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:_50 degrees and sunny

Site Conditions:___water clear & cold_____ channel bottom visible, flows higher than anticipated

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 7 feet from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the right bank. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10		Pin number	1	2	3	4	5	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25		Location	RB	RB	RB	RB	RB	
Monitoring Date																		
11/16/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
12/11/2007	P	P	P	P	P	P	P	P	A	A			24"	17.5"	24"	10"	5"	***Bank pins reset flush***
12/20/2007	P	P	P	P	P	P	P	P	A	P			-	-	-	-	-	***Bed hooks 1-4 covered***
12/27/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	***No changes***
4/1/2008	P	P	P	P	P	P	P	P	A*	P			-	-	-	-	-	***No changes***

Notes: 12/20/07 - The channel has deposited sediment along the left bank covering bed hooks 1-4 with about 0.1 to 0.2' of sediment. The channel is visibly downcutting at bed hook #9. Hook #9 was located less than a foot from where it was set.

* Notes: 4/1/08 - Channel downcutting at #9,10. Deposition at #4,5. #9 missing and not replaced

Date:6/13/2008____________

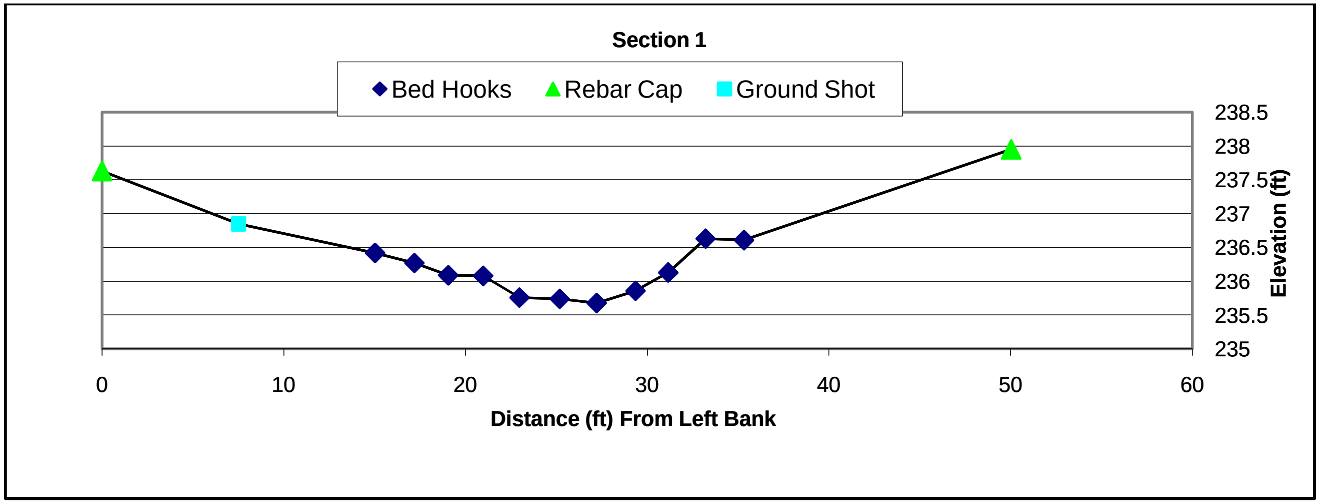
Time: not recorded

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:_60 degrees and overcast

Site Conditions:___water clear & cold_____
channel bottom visible

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27
Monitoring Date											
11/16/2007	P	P	P	P	P	P	P	P	P	P	P
12/11/2007	P	P	P	P	P	P	P	P	P	A	A
12/20/2007	P	P	P	P	P	P	P	P	P	P	P
12/27/2007	P	P	P	P	P	P	P	P	P	P	P
4/1/2008	A*	A*	P	P	P	P	P	P	P	P	P
6/13/2008	A*	A*	P	P	P	P	P	P	P	P	P

No pins were observable. All were covered with ~1' of sediment
Flows appear to be migrating to the braided channel along the right bank.
Flows appear to be migrating to the braided channel along the right bank.
Flows still migrating to right, Sed dep on left. Vandalism of two pins.
Flow split into two channels. Sediment depositing along left bank.

* Pulled out due to vandalism. They were not replaced.

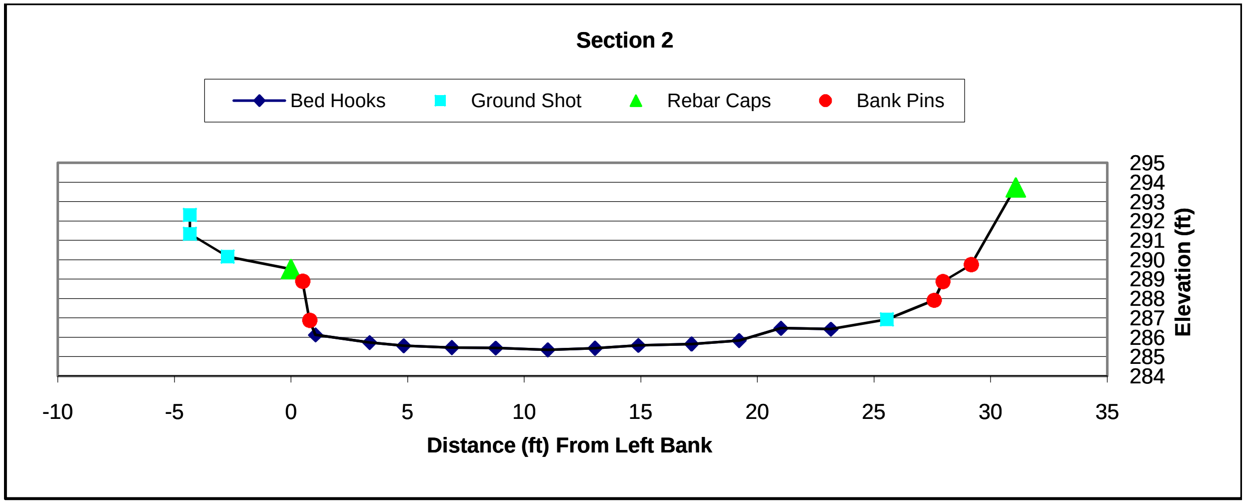
Date:6/13/2008____________

Time: not recorded

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:_60 degrees and overcast

Site Conditions:___water clear & cold_____
channel bottom visible



Bed Hooks: 12
Bank Pins: 5

Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the left and right banks. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	11	12		Pin number			1	2	3	4	5		
Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location			LB	LB	RB	RB	RB		
Monitoring Date																							
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
12/11/2007	P	A	A	P	P	P	P	P	P	P	P	P					-	1"	1"	-	-		
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
4/1/2008	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
6/13/2008	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		

Date:6/13/2008____________

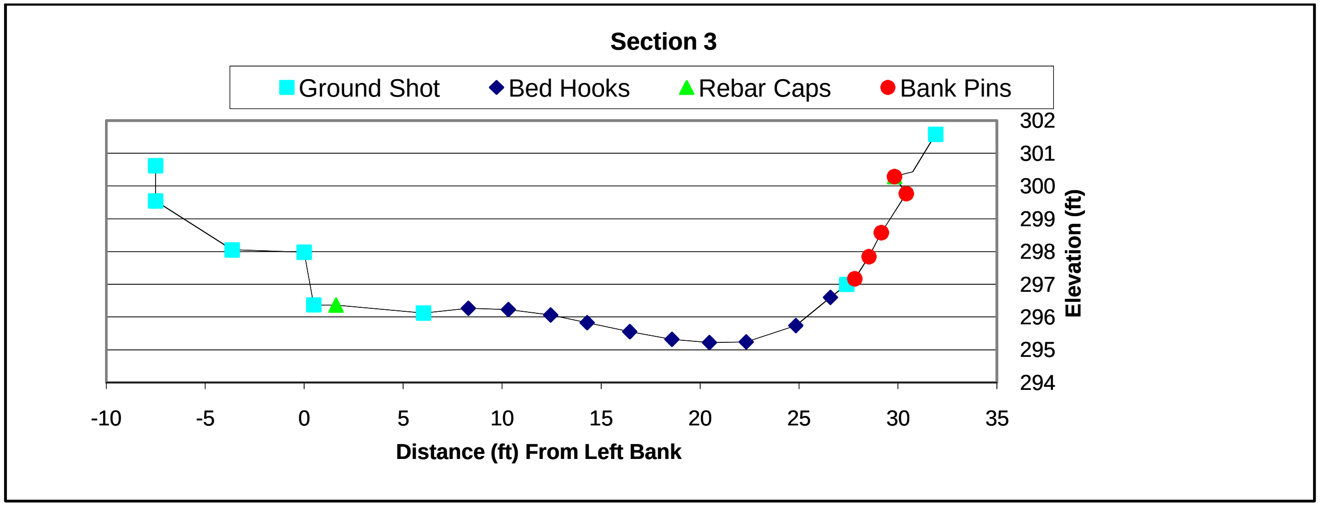
Time: not recorded

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:_60 degrees and overcast

Site Conditions:___water clear & cold_____
channel bottom visible

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 7 feet from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the right bank. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10		Pin number	1	2	3	4	5	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25		Location	RB	RB	RB	RB	RB	
Monitoring Date																		
11/16/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
12/11/2007	P	P	P	P	P	P	P	P	A	A			24"	17.5"	24"	10"	5"	***Bank pins reset flush***
12/20/2007	P	P	P	P	P	P	P	P	A	P			-	-	-	-	-	***Bed hooks 1-4 covered***
12/27/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	***No changes***
4/1/2008	P	P	P	P	P	P	P	P	A*	P			-	-	-	-	-	***No changes***
6/13/2008	P	P	P	P	P	P	P	P	A*	P			-	-	-	-	-	***Bed hooks 3-6 covered***

Notes: 12/20/07 - The channel has deposited sediment along the left bank covering bed hooks 1-4 with about 0.1 to 0.2' of sediment. The channel is visibly downcutting at bed hook #9. Hook #9 was located less than a foot from where it was set.

* Notes: 4/1/08 - Channel downcutting at #9,10. Deposition at #4,5. #9 missing and not replaced

Notes: 6/13/08 - Some sloughing of right bank. All pins were in place.

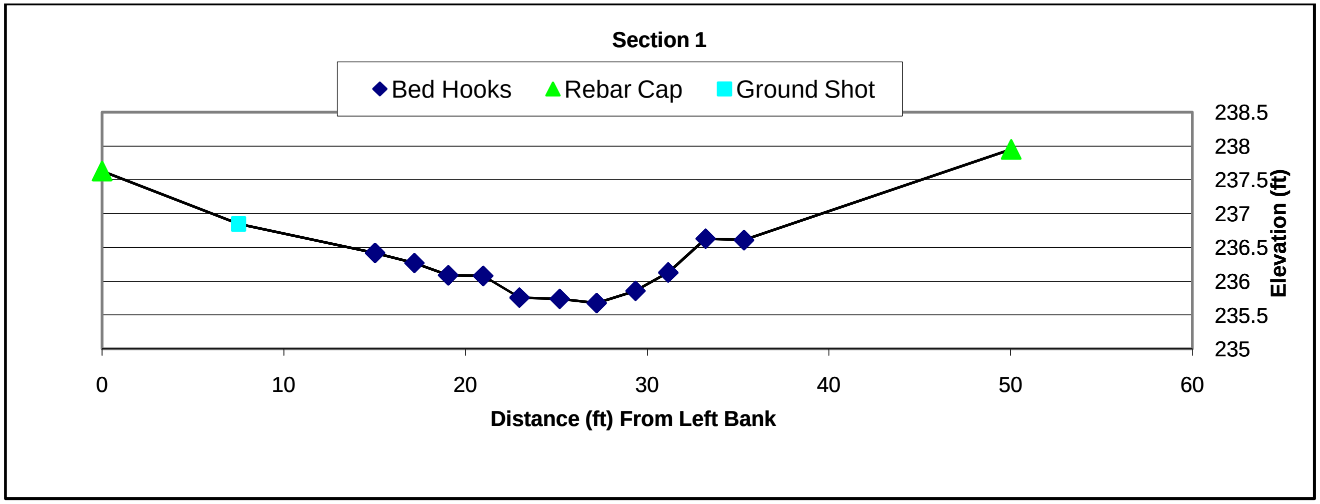
Date: 11/10/2008

Time: not recorded

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:_not recorded

Site Conditions:__not recorded



Bed Hooks: 12
Bank Pins: 5

Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27
Monitoring Date											
11/16/2007	P	P	P	P	P	P	P	P	P	P	P
12/11/2007	P	P	P	P	P	P	P	P	P	A	A
12/20/2007	P	P	P	P	P	P	P	P	P	P	P
12/27/2007	P	P	P	P	P	P	P	P	P	P	P
4/1/2008	A*	A*	P	P	P	P	P	P	P	P	P
6/13/2008	A*	A*	P	P	P	P	P	P	P	P	P
11/10/2008**	A*	A*	P	P	P	P	P	P	P	P	P

No pins were observable. All were covered with ~1' of sediment
Flows appear to be migrating to the braided channel along the right bank.
Flows appear to be migrating to the braided channel along the right bank.
Flows still migrating to right, Sed dep on left. Vandalism of two pins.
Flow split into two channels. Sediment depositing along left bank.
Split flow continues, side channel enlarging. # 10,11 covered 0.5" soil.

* Pulled out due to vandalism. They were not replaced.
** All hooks pulled out and this reach is no longer going to be monitored

Date: 11/10/2008

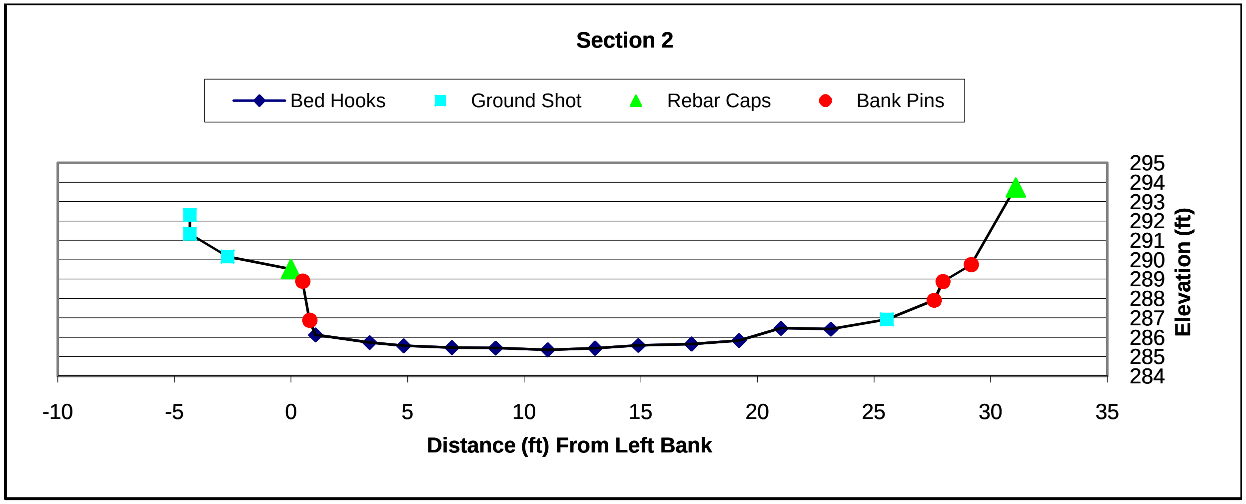
Time: not recorded

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:

Site Conditions:__not recorded

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the left and right banks.
Bank Pins are numbered left to right along the section.
Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	11	12		Pin number		1	2	3	4	5		
Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location		LB	LB	RB	RB	RB		
Monitoring Date																						
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
12/11/2007	P	A	A	P	P	P	P	P	P	P	P	P				-	1"	1"	-	-		
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
4/1/2008	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
6/13/2008	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		
11/10/2008	P	P	P	P	P	P	P	P	P	P	P	P				-	-	-	-	-		

Date: 11/10/2008

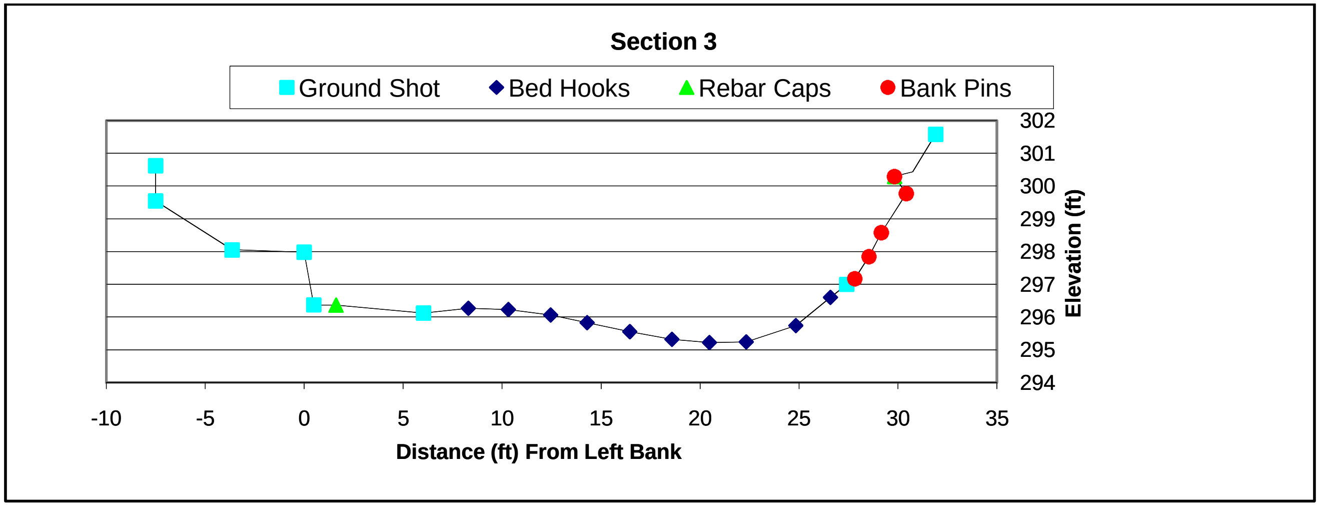
Time: not recorded

Recorder:_Tim Kelley_& Larry Goulet_____

Weather:_not recorded

Site Conditions:__not recorded

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 7 feet from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the right bank. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	Pin number	1	2	3	4	5	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	Location	RB	RB	RB	RB	RB	
Monitoring Date																	
11/16/2007	P	P	P	P	P	P	P	P	P	P		-	-	-	-	-	
12/11/2007	P	P	P	P	P	P	P	P	A	A		24"	17.5"	24"	10"	5"	***Bank pins reset flush***
12/20/2007	P	P	P	P	P	P	P	P	A	P		-	-	-	-	-	***Bed hooks 1-4 covered***
12/27/2007	P	P	P	P	P	P	P	P	P	P		-	-	-	-	-	***No changes***
4/1/2008	P	P	P	P	P	P	P	P	A*	P		-	-	-	-	-	***No changes***
6/13/2008	P	P	P	P	P	P	P	P	A*	P		-	-	-	-	-	***Bed hooks 3-6 covered***
11/10/2008	P	P	P	P	P	P	P	A	A*	P							***Bed hooks 1-5 covered***

Notes: 12/20/07 - The channel has deposited sediment along the left bank covering bed hooks 1-4 with about 0.1 to 0.2' of sediment. The channel is visibly downcutting at bed hook #9. Hook #9 was located less than a foot from where it was set.

* Notes: 4/1/08 - Channel downcutting at #9,10. Deposition at #4,5. #9 missing and not replaced

Notes: 6/13/08 - Some sloughing of right bank. All pins were in place.

Date: 1/08/2009

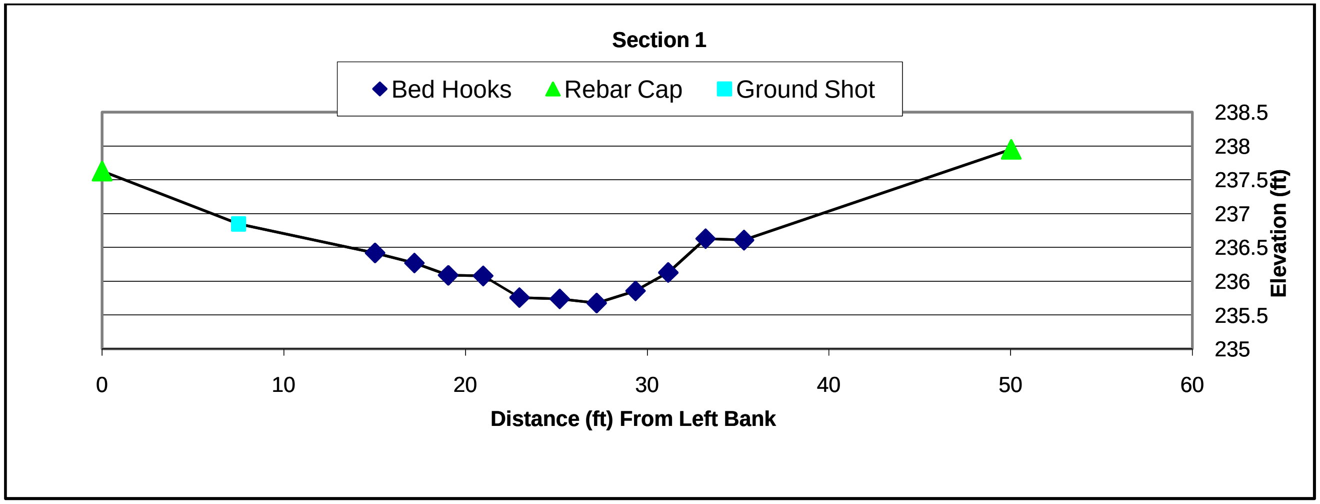
Time: not recorded

Recorder: Tim Kelley

Weather:_overcast, large flood event

Site Conditions:_large flood event
no monitoring was possible. Pictures only.

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27	
Monitoring Date												
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	
12/11/2007	P	P	P	P	P	P	P	P	P	A	A	No pins were observable. All were covered with ~1' of sediment
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	Flows appear to be migrating to the braided channel along the right bank.
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	Flows appear to be migrating to the braided channel along the right bank.
4/1/2008	A*	A*	P	P	P	P	P	P	P	P	P	Flows still migrating to right, Sed dep on left. Vandalism of two pins.
6/13/2008	A*	A*	P	P	P	P	P	P	P	P	P	Flow split into two channels. Sediment depositing along left bank.
11/10/2008**	A*	A*	P	P	P	P	P	P	P	P	P	Split flow continues, side channel enlarging. # 10,11 covered 0.5" soil.
1/8/2009	-	-	-	-	-	-	-	-	-	-	-	Huge Flow Event. Pictures only, no bed monitoring possible

* Pulled out due to vandalism. They were not replaced.
** All hooks pulled out and this reach is no longer going to be monitored

Date: 1/08/2009

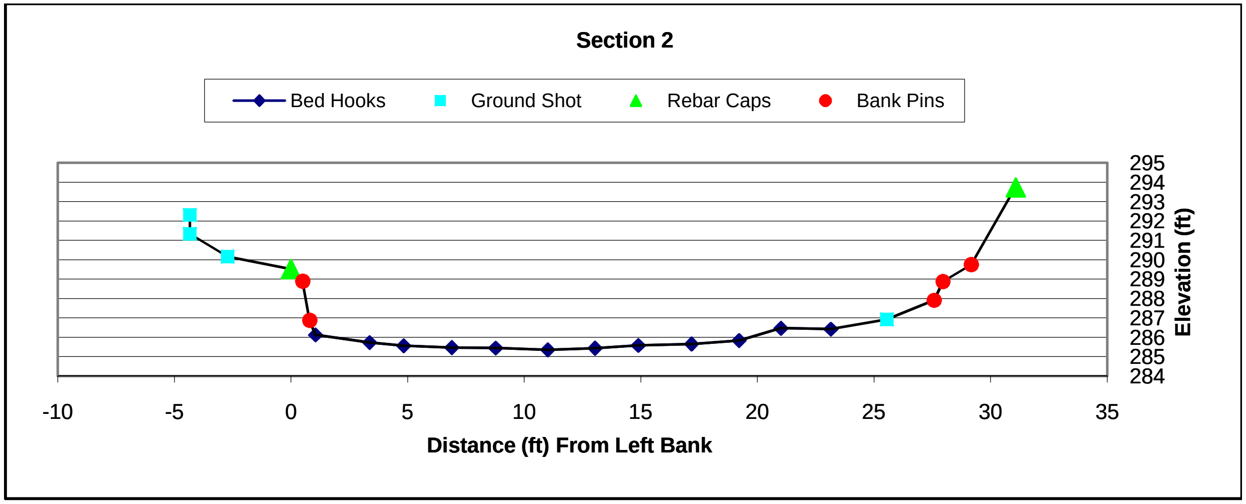
Time: not recorded

Recorder: Tim Kelley

Weather:_overcast, large flood event

Site Conditions:_large flood event
no monitoring was possible. Pictures only.

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the left and right banks. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10	11	12		Pin number	1	2	3	4	5	
Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location	LB	LB	RB	RB	RB	
Monitoring Date																				
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
12/11/2007	P	A	A	P	P	P	P	P	P	P	P	P			-	1"	1"	-	-	
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
4/1/2008	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
6/13/2008	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
11/10/2008	P	P	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
1/8/2009	-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	flow event
																				no data

Date: 1/08/2009

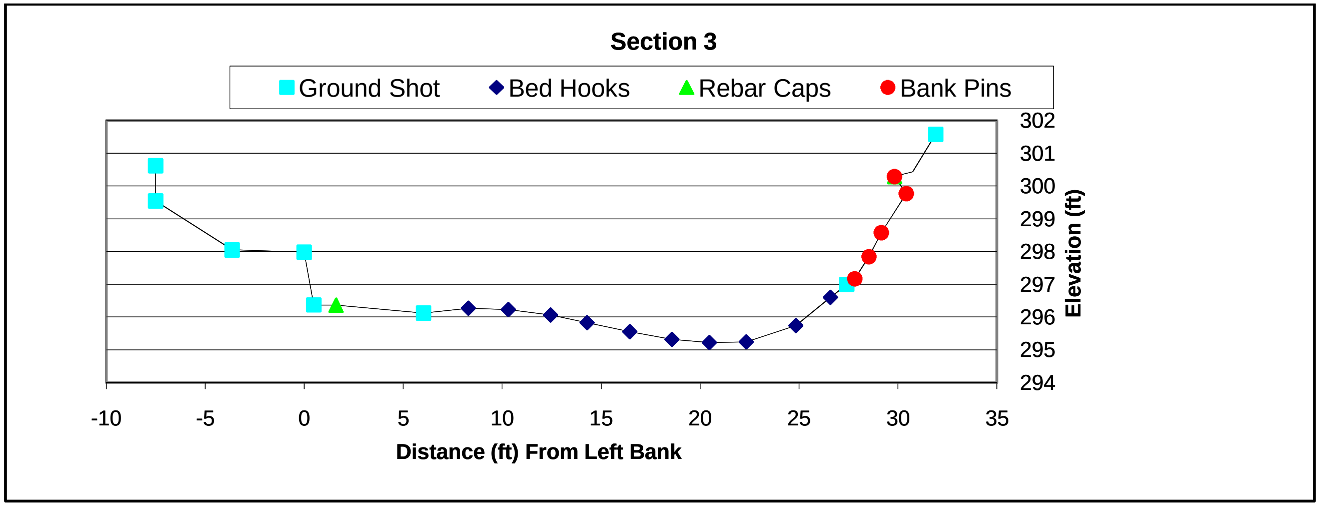
Time: not recorded

Recorder: Tim Kelley

Weather:_overcast, large flood event

Site Conditions:_large flood event
no monitoring was possible. Pictures only.

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 7 feet from the left side Rebar Cap. Field entry represents presence or absence

Bank Pins were installed along the right bank. Bank Pins are numbered left to right along the section. Field entry represent length of exposed rebar (inches)

Hook number	1	2	3	4	5	6	7	8	9	10		Pin number	1	2	3	4	5	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25		Location	RB	RB	RB	RB	RB	
Monitoring Date																		
11/16/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
12/11/2007	P	P	P	P	P	P	P	P	A	A			24"	17.5"	24"	10"	5"	***Bank pins reset flush***
12/20/2007	P	P	P	P	P	P	P	P	A	P			-	-	-	-	-	***Bed hooks 1-4 covered***
12/27/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	***No changes***
4/1/2008	P	P	P	P	P	P	P	P	A*	P			-	-	-	-	-	***No changes***
6/13/2008	P	P	P	P	P	P	P	P	A*	P			-	-	-	-	-	***Bed hooks 3-6 covered***
11/10/2008	P	P	P	P	P	P	P	A	A*	P			-	-	-	-	-	***Bed hooks 1-5 covered***
1/8/2009	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	***flow event, no data***

Notes: 12/20/07 - The channel has deposited sediment along the left bank covering bed hooks 1-4 with about 0.1 to 0.2' of sediment. The channel is visibly downcutting at bed hook #9. Hook #9 was located less than a foot from where it was set.

* Notes: 4/1/08 - Channel downcutting at #9,10. Deposition at #4,5. #9 missing and not replaced

Notes: 6/13/08 - Some sloughing of right bank. All pins were in place.

Date: 1/29/2009 (followin 01/07 storm)

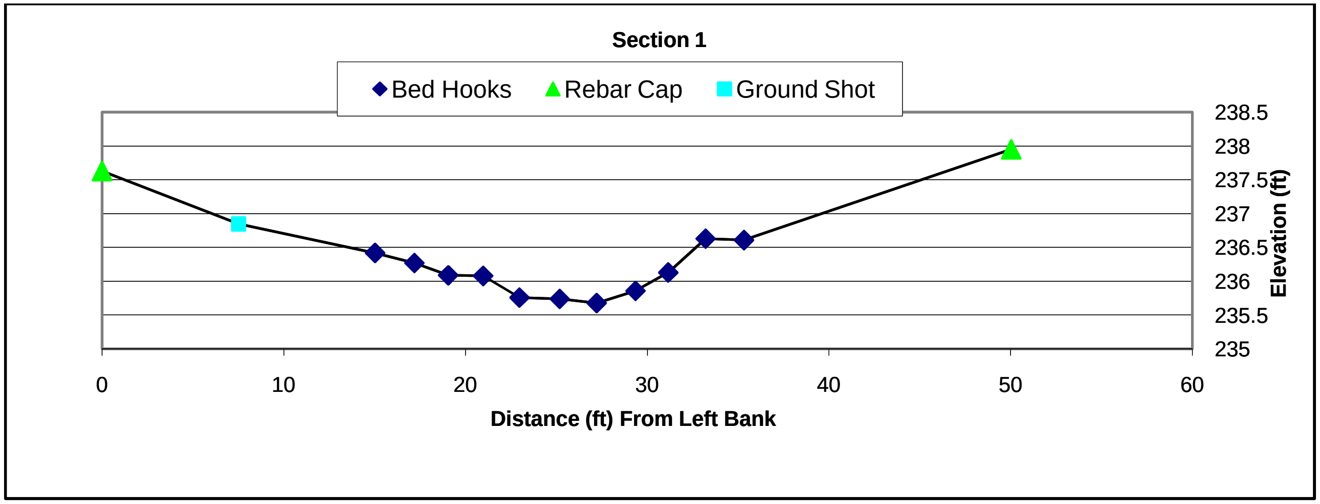
Time: not recorded

Recorder: Tim Kelley & Larry Goulet

Weather: 42 degrees and overcast

Site Conditions: water was clear and channel bottom was visible.

Bed Hooks: 12
Bank Pins: 5



Bed Hooks were installed approximately every 2 feet across the creek bottom beginning at approximately 1 foot from the left side Rebar Cap. Field entry represents presence or absence

Hook number	1	2	3	4	5	6	7	8	9	10	11	
Distance from left (ft)	7	9	11	13	15	17	19	21	23	25	27	
Monitoring Date												
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	No pins were observable. All were covered with ~1' of sediment
12/11/2007	P	P	P	P	P	P	P	P	P	A	A	Flows appear to be migrating to the braided channel along the right bank.
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	Flows appear to be migrating to the braided channel along the right bank.
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	Flows still migrating to right, Sed dep on left. Vandalism of two pins.
4/1/2008	A*	A*	P	P	P	P	P	P	P	P	P	Flow split into two channels. Sediment depositing along left bank.
6/13/2008	A*	A*	P	P	P	P	P	P	P	P	P	Split flow continues, side channel enlarging. # 10,11 covered 0.5" soil.
11/10/2008**	A*	A*	P	P	P	P	P	P	P	P	P	Huge Flow Event. Pictures only, no bed monitoring possible
1/8/2009	-	-	-	-	-	-	-	-	-	-	-	New survey data taken, hooks had already been pulled out
1/29/2009	-	-	-	-	-	-	-	-	-	-	-	

* Pulled out due to vandalism. They were not replaced.
** All hooks pulled out and this reach is no longer going to be monitored

Date: 1/08/2009

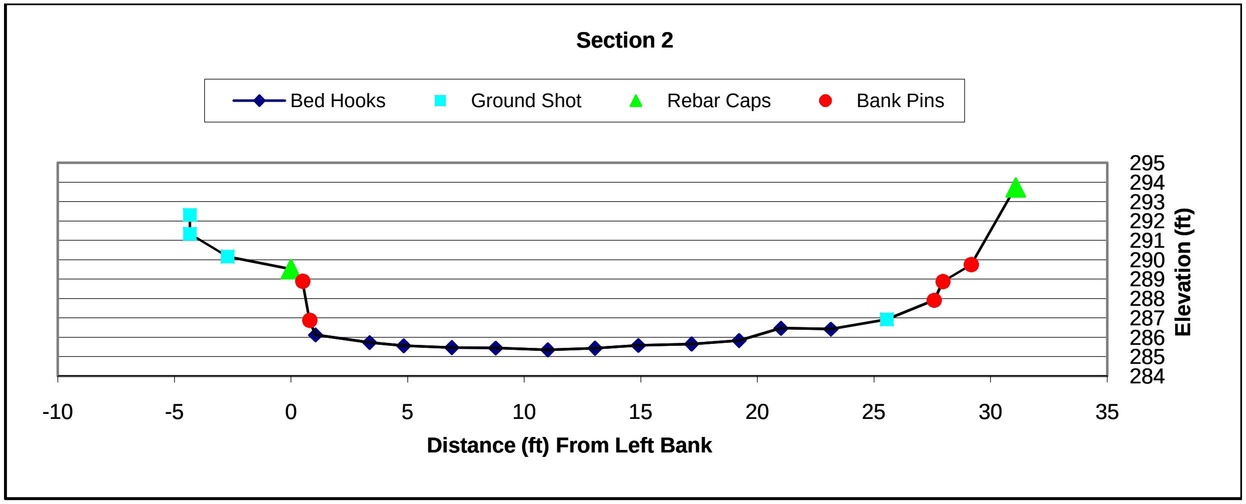
Time: not recorded

Recorder: Tim Kelley

Weather:_overcast, large flood event

Site Conditions:_large flood event
no monitoring was possible. Pictures only.

Bed Hooks: 12
Bank Pins: 5



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Distance from left (ft)	1	3	5	7	9	11	13	15	17	19	21	23		Location			LB	LB	RB	RB	RB		
Monitoring Date																							
11/16/2007	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
12/11/2007	P	A	A	P	P	P	P	P	P	P	P	P					-	1"	1"	-	-		
12/20/2007	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
12/27/2007	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
4/1/2008	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
6/13/2008	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
11/10/2008	P	P	P	P	P	P	P	P	P	P	P	P					-	-	-	-	-		
1/8/2009	-	-	-	-	-	-	-	-	-	-	-	-					-	-	-	-	-		
1/29/2009	A	A	A	A	P	P	P	A	A	A	P	P					-	-	-	-	-		

Date: 1/08/2009

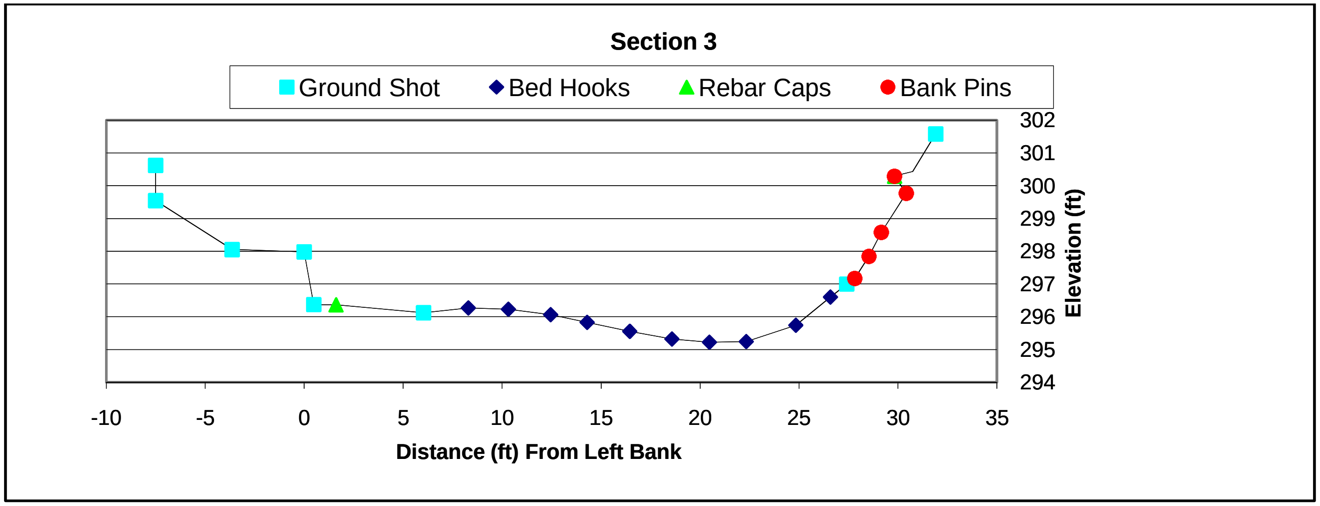
Time: not recorded

Recorder: Tim Kelley

Weather:_overcast, large flood event

Site Conditions:_large flood event
no monitoring was possible. Pictures only.

Bed Hooks: 12
Bank Pins: 5



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Distance from left (ft)	7	9	11	13	15	17	19	21	23	25		Location	RB	RB	RB	RB	RB	
Monitoring Date																		
11/16/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	
12/11/2007	P	P	P	P	P	P	P	P	A	A			24"	17.5"	24"	10"	5"	***Bank pins reset flush***
12/20/2007	P	P	P	P	P	P	P	P	A	P			-	-	-	-	-	***Bed hooks 1-4 covered***
12/27/2007	P	P	P	P	P	P	P	P	P	P			-	-	-	-	-	***No changes***
4/1/2008	P	P	P	P	P	P	P	P	A*	P			-	-	-	-	-	***No changes***
6/13/2008	P	P	P	P	P	P	P	P	A*	P			-	-	-	-	-	***Bed hooks 3-6 covered***
11/10/2008	P	P	P	P	P	P	P	A	A*	P			-	-	-	-	-	***Bed hooks 1-5 covered***
1/082009	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	***flow event, no data***
1/29/2009	A	P	A	A	A	A	A	A	A*	A			A	A	A	A	A	***11' of bank was lost***

Notes: 12/20/07 - The channel has deposited sediment along the left bank covering bed hooks 1-4 with about 0.1 to 0.2' of sediment. The channel is visibly downcutting at bed hook #9. Hook #9 was located less than a foot from where it was set.
* Notes: 4/1/08 - Channel downcutting at #9,10. Deposition at #4,5. #9 missing and not replaced
Notes: 6/13/08 - Some sloughing of right bank. All pins were in place.
Notes: 1/29/09 - Pin 2 buried under 1/2' of gravel. No hooks were found. One bank pin was found 15' downstream.