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HYDROLOGIC YEAR 2019

HYDROLOGY MONITORING REPORT

Elk River

Freshwater Creak

Bear Creek

January 2020

PROJECT TITLE:

ELK RIVER WATERSHED WASTE DISCHARGE PERMIT R1-2016-0004 (HRC, 2004a)

FRESHWATER CREEK WATERSHED WASTE DISCHARGE PERMIT R1-2006-0041 (HRC, 2004b)

HY 2019 ANNUAL TURBIDITY TREND STATION DATA SUBMITTAL AND SUMMARY REPORT

ORGANIZATION IMPLEMENTING THE PROJECT:

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HYDROLOGY TEAM LEADER FOR THIS PROJECT

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1. INTRODUCTION

Suspended sediment concentration (SSC) and streamflow were measured at eight (8) hydrologic monitoring stations in the Elk River watershed, nine (9) locations in the Freshwater Creek watershed, and one (1) location in the lower Eel River watershed (Table 1). This network is in place to monitor sediment and streamflow conditions in each watershed.

The following data were collected at each monitoring station during the 2019 water year (October 1, 2018 – May 15, 2019):

1. 15-minute electronic recording of turbidity, water depth, and water temperature.
2. Water Samples.
    a. 100-500 mL water samples pumped by ISCO auto-samplers during storm events or collected manually by periodic depth-integrated sampling and grab sampling. These samples are analyzed for SSC, turbidity, and/or both.
3. Manual measurement of streamflow area and velocity are collected using wading and non-wading techniques in order to calculate discharge.

The above datasets were used to produce the following derived products:

- 15-minute SSC record.
- Annual suspended sediment load.

Data collected and produced through this monitoring network support the following goals:

- Monitor SSC and turbidity trends over time on an annual and stormflow basis.
- Assess how management practices applied in each watershed through the North Coast Region Water Quality Control Board (NCRWQCB) permits and Humboldt Redwood

Company's (HRC) Habitat Conservation Plan and Company Policies affect trends in SSC and turbidity.

Each year, raw and processed data are submitted to the North Coast Regional Water Quality Control Board per requirements of the Watershed Waste Discharge Permit for Elk River (R1-2016-0004) and Freshwater Creek (R1-2006-0041). This report supports the data submission for hydrologic year 2019 reporting data collected from October 1, 2018 to May 15, 2019.

Table 1: HRC hydrologic monitoring stations for the 2019 hydrologic year.

Watershed	Station Number	Station Location	Basin Area (km^2)
Elk River	509	Mainstem Elk River	111.83
	510	South Fork Elk River	50.34
	511	Lower North Fork Elk River	56.91
	517	Bridge Creek	5.75
	522	Corrigan Creek	4.31
	532	Upper North Fork Elk River	35.08
	535	Little South Fork Elk River	9.42
	683	West Branch Railroad Gulch	1.48
	684	East Branch Railroad Gulch	1.28
Freshwater	500	Beck's Tributary	2.17
	504	Cloney Gulch	12.04
	505	Graham Gulch	6.16
	506	South Fork Freshwater Creek	8.19
	523	Lower Freshwater Creek	22.83
	526	Freshwater Creek McCready	5.12
	527	Gulch Upper	4.71
	528	Little Freshwater Creek	12
Lower Eel	530	Bear Creek	20.95

2. METHODS

2.1 Site Operations

2.1.1 Instrumentation

All hydrology monitoring stations are equipped with the following instrumentation:

- Automatic pump sampler (ISCO by Teledyne Technologies, Inc.)

- Turbidimeter (DTS-12 by FTS)
- Pressure transducer (Druck by GE) or a Gas Bubbler system
- Datalogger (WaterLOG by YSI)

Table 2 through 4 provide complete details regarding field and lab infrastructure.

Table 2: Standard watershed operating protocols – describing field and laboratory methods used in hydrology station monitoring.

SOP	Title	Current Version	Description
SOP – 01 (HRC, 2004c)	Hydrologic Site Selection, Monumenting and Documentation	2.3	Establishing and documenting a permanent monitoring station.
SOP – 02 (HRC, 2004d)	Gaging Streams for Estimating Discharge	3	Installing a staff plate, measuring streamflow, constructing a stage-discharge rating curve.
SOP – 03 (HRC, 2004e)	Instrumentation Methodology	1.2	Turbidimeters, water samplers, pressure transducers, and rain gauge manuals.
SOP – 04 (HRC, 2004f)	Water Quality Grab Sampling and Field Turbidity Measurement	2.1	Depth-integrated sampling methods and portable turbidimeter manual.
SOP – 05 (HRC, 2006)	Laboratory Analysis of Suspended Sediment Using Electronic Data Collection Methods	4.3	Turbidity and sediment concentration laboratory measurement.
SOP – 19 (HRC, 2004g)	Establishing and Maintaining the Physical Infrastructure of a Hydrologic Monitoring Station	1.1	Hydrologic monitoring station set-up.

Table 3: Equipment used in the field and laboratory for hydrologic monitoring and inspection schedule.

Instrument	Model / Manufacturer	Instrument Range/Accuracy	Inspection Frequency	Inspection Type	Inspector
Datalogger	WaterLOG by YSI	NA	Weekly	Check Data Download	Field Crew
Field Turbidimeter	DTS-12 by FTS	Range: 0 – 1600 NTU Zero, Offset ± 0.2 NTU Accuracy: ± 2% (0 – 500), ± 4% (501 – 1600 Temp: ± 0.20 °C	Weekly	Proper Operation	Field Crew
Water Sampler	ISCO 6100/6712 by Teledyne	NA	Weekly	Proper Operation	Field Crew
Pressure Transducer	Druck 1830/8388 by GE	Range: 75 mbar to 60 bar; Accuracy: ± 0.1%	Weekly	Check Data Download	Filed Crew
Flow Meter	Flo-Mate by Marsh-McBirney	Range: -0.15 – 6 m/s Zero Stability: ± 0.15 m/s Accuracy: ± 2% Reading + Zero Stability	Each Use	Proper Operation	Field Crew
Lab Turbidimeter	HACH 2100N	Range: 0 – 4000 NTU Accuracy: ¡100 NTU ± 2%, 100 – 4000 NTU ± 5%	Daily When Used	Calibration, Proper Operation.	Lab Leader
Analytical Balance	APX – 100 by Denver Instruments	Range: 0.0001 to 100.0 g Accuracy: ± 0.0001 g	Daily When Used	Standard Weight	Lab Leader
Top Loading Balance	XP-3000	Range: 0.1 to 1000.0 g Accuracy: ± 0.1 g	Daily When Used	Standard Weight	Lab Leader
Lab Oven	Quincy Lab	Accuracy: 1°C	Each Use	Proper Operation	Lab Leader
Vacuum Filtration	NA	NA	Each Use	Proper Operation	Lab Leader

Table 4: Instrumentation deployment at HCR hydrologic monitoring stations during the 2019 hydrologic year.

Station	Stream Name	Turbidimeter	Turbidimeter Range (NTU)	Water Level	Data Recorder	High Streamflow Sampling Method
509	Mainstem Elk River	DTS-12	0 – 1,400	Gas Bubble	WaterLOG	Bridge
510	Lower South Fork Elk River	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
511	Lower North Fork Elk River	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
517	Bridge Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
522	Corrigan Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
532	Upper North Fork Elk River	DTS-12	0 – 1,400	Druck	WaterLOG	Bridge
535	Little South Fork Elk River	DTS-12	0 – 1,400	Druck	WaterLOG	None
683	West Branch Railroad Gulch	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
684	East Branch Railroad Gulch	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
500	Beck's Tributary	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
504	Cloney Gulch	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
505	Graham Gulch	DTS-12	0 – 1,400	Druck	WaterLOG	None
506	South Fork Freshwater Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
523	Lower Freshwater Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
526	Upper Freshwater Creek	DTS-12	0 – 1,400	Druck	WaterLOG	None
527	McCready Gulch	DTS-12	0 – 1,400	Druck	WaterLOG	Platform
528	Little Freshwater Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Cable System
530	Bear Creek	DTS-12	0 – 1,400	Druck	WaterLOG	Bridge

2.2 Data Collection

1. *15-minute electronic recording of turbidity, water depth, water temperature.*

    a. Turbidity – measured in nephelometric turbidity units (NTU), is recorded with the DTS-12 turbidimeter suspended in the stream at approximately 6/10 water depth. Measurement ranges are listed for each turbidimeter in Table 3. Instruments are secured to a boom arm that may be raised or lowered within the water column as water stage changes.

    b. Water Depth – measured using Druck pressure transducers or Gas Bubblers which are mounted to the streambed. HRC has devised an apparatus at each site that firmly holds the instrument in place and allows the operator to return the device to the same position after servicing.

    c. Water Temperature (°C) – measured within the water column at the same location as turbidity.

2. *100 – 500 mL water samples pumped by ISCO auto-samplers.*

    a. Each WaterLOG datalogger contains a program that triggers the ISCO auto-sampler to begin sampling based on a specified sustained rise in stage. The program runs two segments ('A' and 'B') that fill bottles based on a set time interval. The objective is to sample on both the rising and falling limbs of storm hydrographs in sufficient detail to record SSC and hysteresis. Hysteresis is defined here as a different sediment concentration at a given stage on the falling limb as compared to the same stage on the rising limb. Samples are collected within one week following sampling and submitted to the HRC laboratory. Samples are identified by the Lead Hydrologist or

Hydrologic Technician and sent to the lab for turbidity and SSC analysis. During laboratory processing, turbidity is measured with a HACH 2100N bench turbidimeter (range of measurement = 0 – 2000 NTU) and SSC is determined through vacuum filtration methodologies.

   b. Sweep depth-integrated samples are collected across the range of flows and submitted for lab analysis of turbidity and SSC. These depth-integrated pint samples are used to develop a relationship for correcting biases in the point samples taken by ISCO auto-samplers.
   c. Grab samples are collected within proximity to the DTS-12 turbidimeter at a single point within the water column and submitted for lab analysis of turbidity. These point samples are used to compare with turbidimeter data for calibration and correction of field turbidity to turbidity analyzed in the laboratory.

3. *Manual measurement of streamflow area and velocity are collected using wading and non-wading techniques in order to calculate discharge.*
   a. Discharge is calculated by the velocity-area technique for a range of flows. Low flow velocities are measured with a wading rod and high flow velocities are measured using a variety of cableway and platform techniques (Table 3). High flows that exceed bankfull stage are less common and are generally under-represented in the measured data at nearly all the sampling sites. High flows are estimated by extrapolating rating curves beyond the range of empirical data, which introduces a degree of uncertainty into high flow discharge estimates.

2.3 Data Processing

2.3.1 Stage-Discharge Relationships

Stage-discharge relationships (Figure 1) are essential in estimating discharge (a complicated task) from more frequent stage readings (a simple task, often automated). In stable, well defined channels, discharge can be predicted from stage measurements based on a power relationship. Stage-discharge relationships for our hydrology monitoring sites are updated on a yearly basis to reflect channel changes that often occur. Channel changes are tracked by yearly cross-section topographic surveys. It is common for some scour or aggradation to occur within the discharge cross-section at most sites since they are not controlled by weirs or flumes. Stations were originally selected to minimize change through the local reach. Most sites are sufficiently stable to allow the use of the same rating curve for multiple years. A few stations have been very unstable and require considerable measurement each year; most notably Railroad Gulch and Bear Creek.

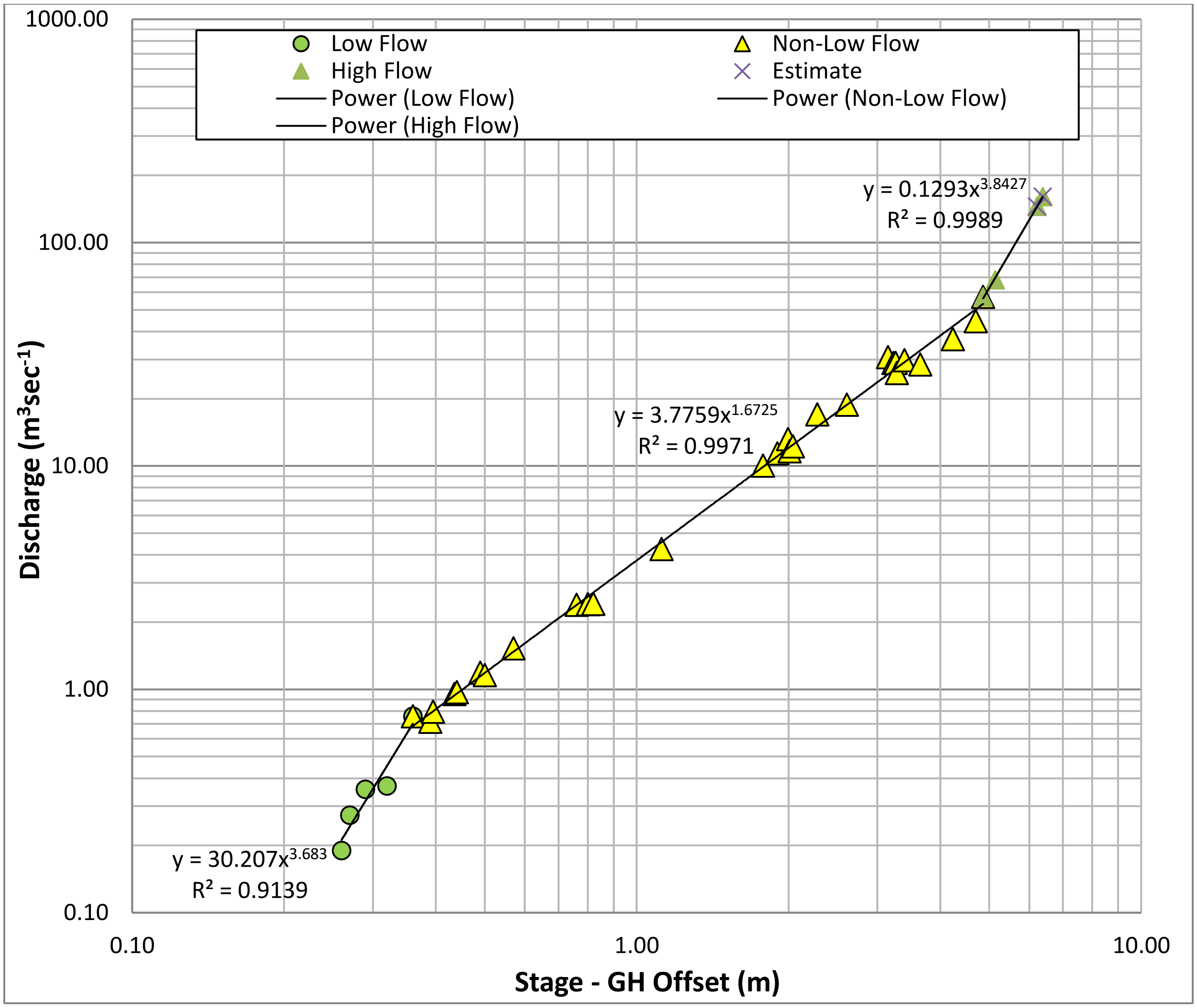

Figure 1: Stage-discharge relationship for Mainstem Elk River (Station 509). The offset, estimated for the point of zero flow, is 0.09m.

2.3.2 Data Validation and Correction

Validation and correction of 15-minute measurement records are conducted using TTS Adjuster Software (Lewis) to produce continuous, 15-minute, monitoring records for water year 2019. The corrected data file contains codes for stage and turbidity data records to indicate which, if any, correction methods were applied in the TTS Adjuster Program (Table 5). QAQC procedures remove outliers or spikes that appear to be anomalies of the data collection process. Missing data are filled using a variety of techniques at the discretion of the data processor. Data may be filled from physically measured data, interpolated between recorded data, or reconstructed from another site best matched to that site. Figure 4 provides an example of raw and corrected continuous data from a hydrology monitoring station using TTS Adjuster Software.

Table 5: Stage and Turbidity Codes that Document Edits Made to Hydrology Data in the TTS Adjuster Program.

Code	Definition
-1	Unedited, unapproved
0	Raw data, accepted as good
1	Raw data, accepted but questionable
2	Bad data, replaced with NA
3	Constant shift was applied
4	Variable (linear) shift was applied
5	Interpolated (linearly)
6	Reconstructed from another site
7	Free-hand reconstruction
8	Y-proportional shift was applied
9	Replaced with lab-measured value

2.3.3 Stage Validation and Correction

Site specific correlations are developed between pairs of instrument recorded water depth and observed stage (recorded by observation at the staff plates). 15-minute water depths are then adjusted to water stage that correlates to staff plate readings prior to data correction in TTS Adjuster. The number of water depth pairs ranged from 29 to 60 and varied based on the frequency of site visits. An example correlation is shown for monitoring Station 509 in Figure 2.

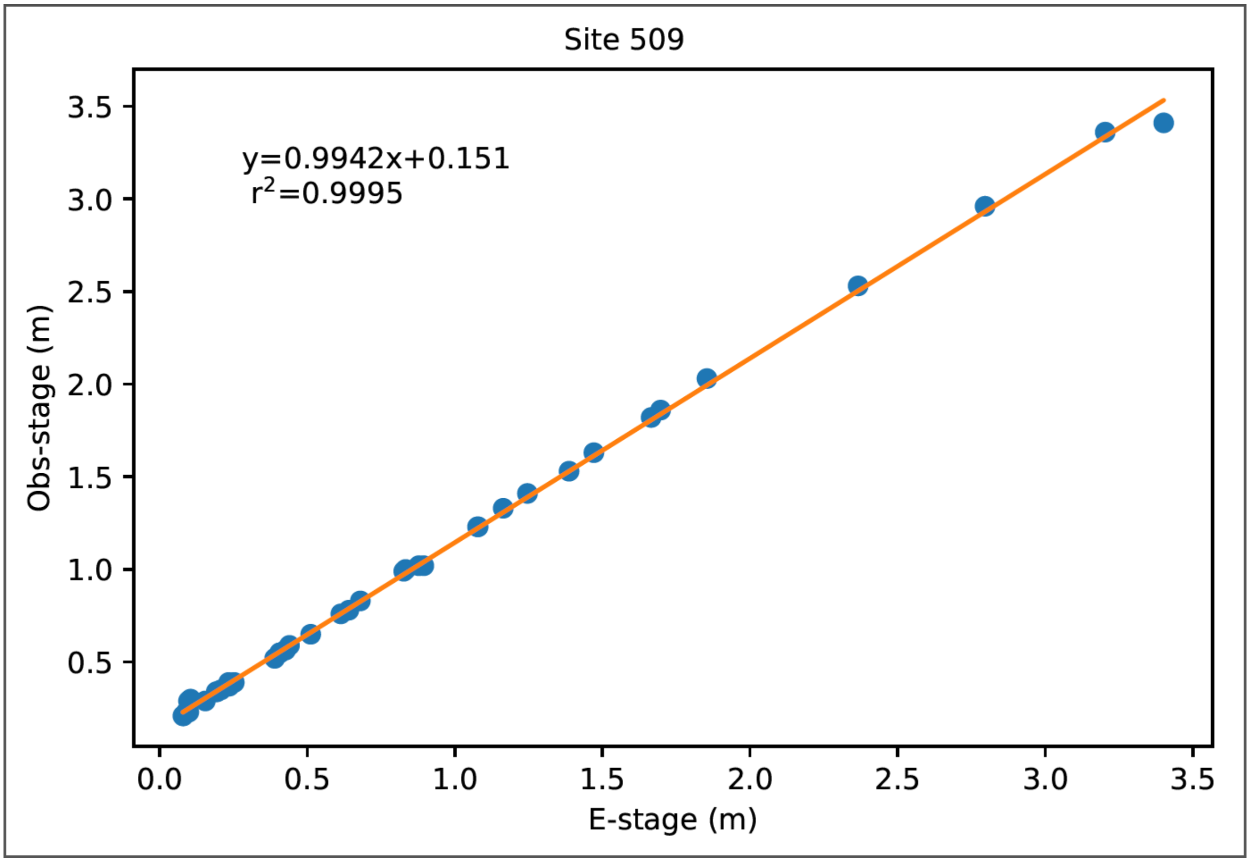

Figure 2: Example Relationship Between 15-Minute Stage (E-Stage) and Observed Stage, Mainstem Elk River (Station 509).

2.3.4 Turbidity Validation and Correction

Field turbidity is used to model continuous SSC at each monitoring site. Field Turbidimeters are calibrated to 1,400 NTU (Figure 3). Turbidity peaks are replaced with lab turbidity values when field turbidity exceeds 1,400 NTU. Relationships are established between field and lab turbidity but are often complicated by grain size distributions and settling that introduce error in lab turbidity measurements. Field-lab turbidity regressions are still used to reconstruct turbidity peaks when stream turbidity exceeds the limit of field turbidimeters. An example field-lab turbidity relationship is shown in Figure 2. Field turbidimeter is corrected and validated in TTS adjuster, using the same QAQC codes that are used for stage corrections.

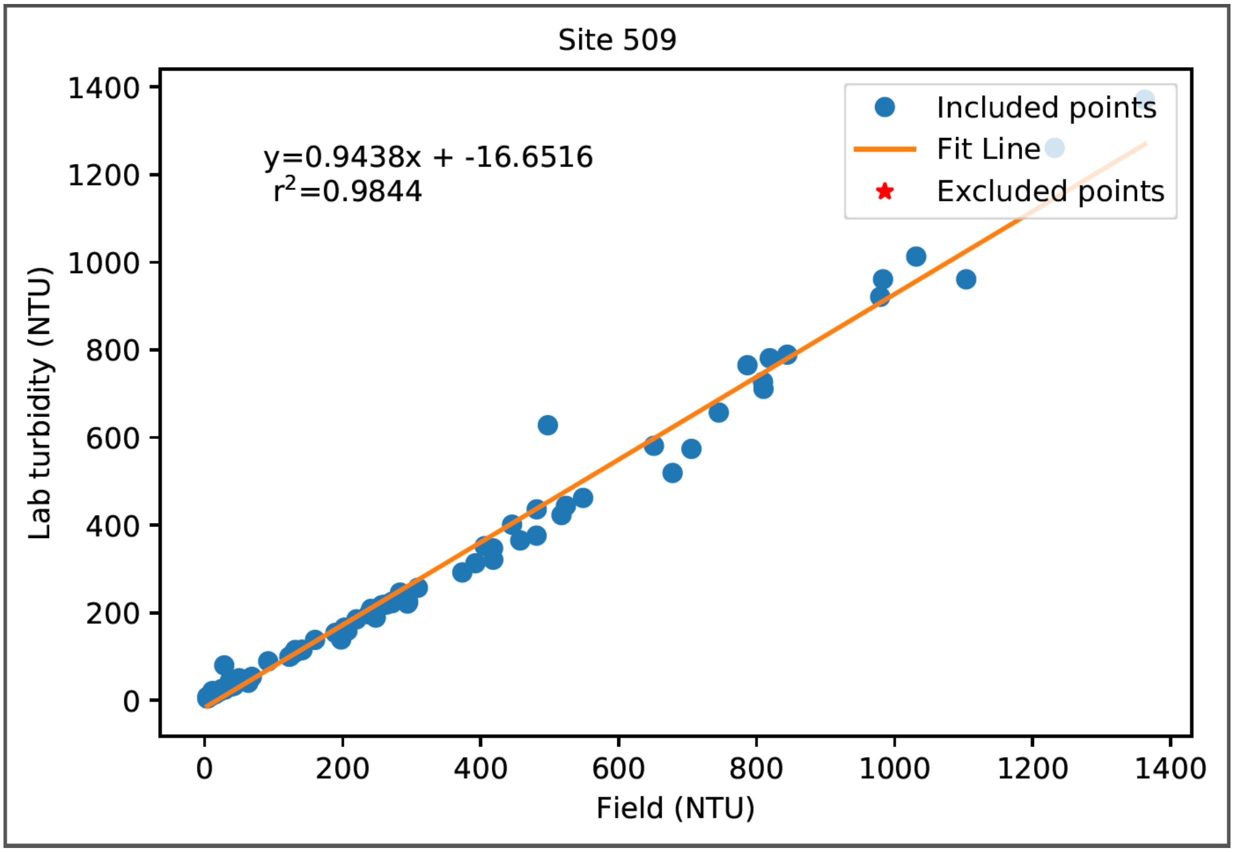

Figure 3: Example Field Turbidity (NTU) vs. Laboratory Turbidity (NTU) for the Mainstem Elk River (Station 509).

Once all data correction and validation with TTS adjuster is complete, discharge values are calculated for every 15-minute stage measurements (using the stage-discharge relationships described above) and the corrected data file is saved. A graphical example of the corrected data file is shown in Figure 4.

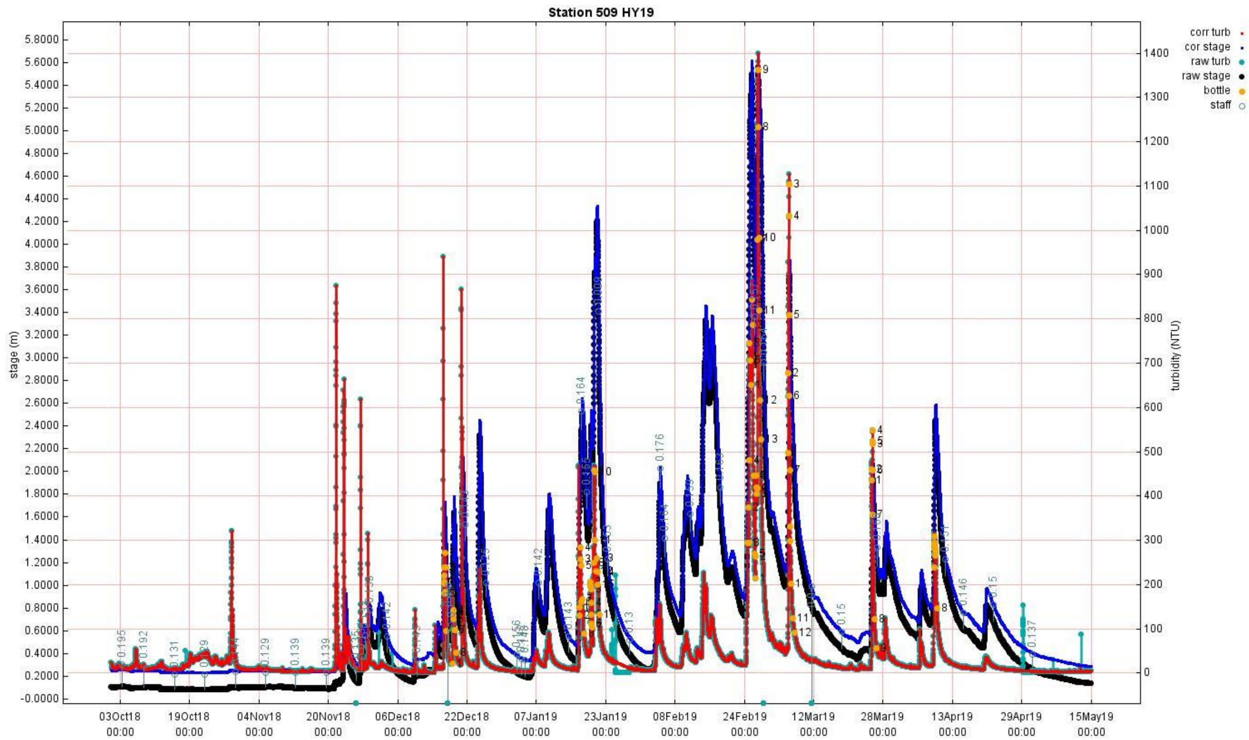

Figure 4: Example Corrected Hydrologic Data Measured at Southfork Elk River (Station 509) for WY 2019.

2.3.5 SSC Modeling Using R Software Packages

Continuous suspended sediment concentrations are calculated from composited field turbidity/SSC relationships using R software packages developed by Jack Lewis. All discrete SSC measurements (i.e. pumped samples, ISO samples, and grab samples) are combined for this analysis. See Figure 5 for a graphical example. For some monitoring sites, SSC is modeled after combining all turbidity/SSC pairs throughout the water year. This is done in cases where there is not much inter-storm variability between turbidity and SSC relationships. When there is such inter-storm variability, SSC is modeled on a storm event basis. These decisions are described in individual data files and are made on a site-by-site basis depending on the trends observed in the data. Sediment mass is calculated for each 15-minute interval using the appropriate 15-minute discharge. Total annual suspended sediment yield is then derived by accumulating the sediment mass throughout the measurement record. Sediment loads reported here are computed for generally the same interval for all stations and start/end dates are include for each calculation.

Additional details regarding HRC's methods for site installation, equipment, field measurements of sediment and streamflow, and sediment laboratory processing are provided as Standard Watershed Operating Protocols (SOPs) listed in Table 2.

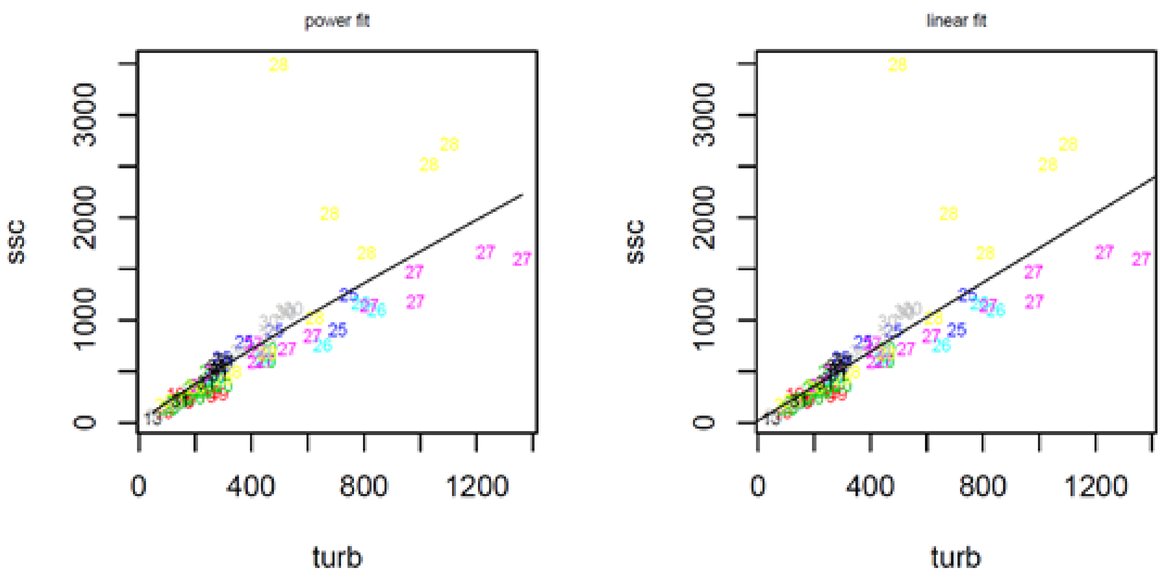

Figure 5: Example Field Turbidity (NTU) vs. SSC (mg/L) relationships at Mainstem Elk River (Station 509). Numbers indicate groups of samples (or data dumps) collected during distinct storm events throughout the water year.

2.4 Sources of Error

2.4.1 Rating Curves

Total sediment loads were calculated as the product of suspended sediment concentrations and discharge, estimated at 15-minute intervals based on models derived from measured data. High discharges, if estimated from rating curve extrapolation, included more uncertainty than lower discharges, and that error was propagated through to sediment load estimations during the highest flows. Therefore, differences in high flow estimates due to rating curve creation could have large impacts on sediment yields, even in situations where small or no changes in actual sediment concentrations occurred.

For each monitoring site, the file titled "###_stage.pdf," within the "flow_ssc_turb_duration_data_plots" – folder, includes an indication of the highest discharge measurement that was included in the site's rating curve. In WY2019, the percentage of time that flows exceeded those values was exceedingly small (< 1.5%) for all sites except Bridge Creek (Station 517), which was 5.5%. For flows that fall within the well constrained rating curves (most flows), the uncertainty in estimated discharge values is likely below ±5% (Whiting, 2016). For flows above the highest measured discharge, uncertainty may be greater. 95% confidence intervals (CI) are reported for peak flows but are based on the measured points used to construct the high end of the rating curve. Therefore, the actual 95% CI for peak flows may be greater. HRC is in the process of improving high flow discharge estimated by comparing rating curve extrapolations to additional indirect measurement techniques.

2.4.2 Suspended Sediment Sampling

The combination of substrate characteristics, common rainfall intensities, and small size of many of our monitoring basins often produces streamflow responses that rise and fall quickly during and after a rainfall event. Ideally, point suspended sediment samples would be collected at flow depths associated with the average suspended sediment load for a given channel, which changes as a function of flow depth and sediment size. The sampling infrastructure used at HRC monitoring sites allows for adjustment in the SSC input tube, but changes must be completed manually. In practice, the SSC input locations are adjusted as base flow rises throughout the winter season but are rarely adjusted on a storm-event basis. At times during certain storms, the input tube may end up close enough to the riverbed to collect bed load in addition to suspended sediment. Samples with obvious bedload are flagged during lab analysis and excluded from predictive sediment models. When samples are less obvious and not flagged, suspended sediment concentrations may be biased high. Suspended sediment concentrations may therefore over-predict total sediment yields. Sediment values are reported to no more than two significant figures to account for this uncertainty.

3. WATER YEAR 2019 DATA SUMMARY

Suspended sediment yields and peak flows are summarized by site in Table 6. Data analysis conducted for WY2019 shows an increase in sediment yields compared to WY2018 except at Station 684. When compared to WY2016 and WY 2017, 11 Stations show a decrease in sediment yields and 7 Stations show an increase. Data for each monitoring station have been stored on CD's that are to accompany this report. Please reference these data files for a complete summary of each monitoring station. Supporting data are filed by watershed and sites are described below:

Table 6: Summary of annual sediment load and discharge HCR hydrologic monitoring stations during the 2019 hydrologic year.

Station	Stream Name	Watershed	Upper Drainage Area (*km^2*)	Total Suspended Sediment Yield (*Mg*)	Total Suspended Sediment Yield (*Mg/km^2*)	Instantaneous Ann. Peak Discharge (*m^3sec^{-1}*) (95% CI)	Instantaneous Ann. Peak Discharge (*m^3sec^{-1}/km^2*)
509	Mainstem Elk River	Elk River	111.83	23000	210	96.3 (92.7 - 100.0)	0.86
510	Lower South Fork Elk River	Elk River	50.34	14000	280	37.6 (28.7 - 49.2)	0.75
511	Lower North Fork Elk River	Elk River	56.91	13000	230	53.2 (34.2 - 82.7)	0.93
517	Bridge Creek	Elk River	5.75	430	74	4 (2.4 - 6.6)	0.69
522	Corrigan Creek	Elk River	4.31	710	160	5.6 (3.4 - 9.0)	1.29
532	Upper North Fork Elk River	Elk River	35.08	16000	450	54.9 (42.1 - 71.7)	1.57
535	Little South Fork Elk River	Elk River	9.42	2200	230	6.6 (2.9 - 14.7)	0.7
683	West Branch Railroad Gulch	Elk River	1.48	1700	1100	0.8 (0.7 - 1.1)	0.56
684	East Branch Railroad Gulch	Elk River	1.28	300	230	0.3 (0.2 - 0.7)	0.25
500	Beck's Tributary	Freshwater Creek	2.17	210	99	2.4 (1.8 - 3.1)	1.1
504	Cloney Gulch	Freshwater Creek	12.04	1300	110	10.2 (6.8 - 15.2)	0.85
505	Graham Gulch	Freshwater Creek	6.16	1800	300	10.3 (5.7 - 18.7)	1.68
506	South Fork Freshwater Creek	Freshwater Creek	8.19	1400	170	14.3 (10.2 - 19.9)	1.74
523	Lower Freshwater Creek	Freshwater Creek	22.83	4600	200	37.1 (25.3 - 54.4)	1.63
526	Upper Freshwater Creek	Freshwater Creek	5.12	910	180	10.4 (5.6 - 19.1)	2.01
527	McCready Gulch	Freshwater Creek	4.71	650	140	5.9 (4.4 - 7.9)	1.25
528	Little Freshwater	Freshwater Creek	12	2200	180	16.5 (11.8 - 23.1)	1.38
530	Bear Creek	Lower Eel River	20.95	5400	260	27.7 (15.0 - 50.9)	1.32

3.1 Each Monitoring SiteContains the Following Folders – Where ### = Station Number:

1. “continuous_data_plots”

    a. Full year (allTurb(X)), inter-storm (interstormWY2019(X)), and individual storm event folders named by storm (i.e. 1901(X), 1902(X), 1903(X), etc.) where X = regression model used in R software.

        i. “allTurb(X).pdf” = SSC (estimated and samples), turbidity, and Q plots for the entire water year where X = regression model used in R software.

        ii. “interstormWY2019(X).pdf” = SSC (estimated and samples), turbidity, and Q plots for inter-storm events where X = regression model used in R software.

        iii. “storm19##(X).pdf” = SSC (estimated and samples), turbidity, and Q plots for each storm event where X = regression model used in R software.

        iv. “predData.csv” = 15-minute date, turbidity, and predicted SSC data.

        v. “q.csv” = 15-minute date, estimated discharge, and corrected stage data.

        vi. “sed.csv” = date, dump, bottle #, SSC, turbidity, and estimated discharge used to model SSC for the full year, inter-storm, and individual storm events.

        vii. “total.csv” = summary with storm start and end date/time, type of model, SSC predictor (“surr”), total sediment load (kg), number of SSC samples used to model SSC (“n”), r^2 for the model, and standard deviation.

        viii. “turbssc_fits.pdf” = plot of turb vs SSC correlation for full year and inter-storm events.

ix. "turbssc_(X)_fit.pdf" = plot of turb vs SSC correlation for the storm event where X = regression model used in R software.

x. "###_dischargeSSCPlot.pdf" = discharge and 15-minute modeled SSC (15-minute SSC values are compiled from storm event models unless otherwise indicated).

b. "###_continuousData.csv"= 15-minute flow (discharge, m^3sec^{-1}), turbidity (NTU), and SSC (mg/L).

c. "###_dischargeRainPlot.pdf" = 15-minute discharge and precipitation over the entire measurement period.

d. "###_dischargeSSCPlot.pdf" = 15-minute discharge and SSC over the entire measurement period.

e. "###_StageTurbPlot.pdf" = 15-minute stage and turbidity data with observed stage readings and lab samples included. NOTE: not all lab NTU samples were also ran for SSC.

f. "peaks.csv" = peak discharge (m^3sec^{-1}/35.315) and associate date/time by storm.

g. "peakStage.csv" = peak stage (m) and associated date/time by storm.

2. "cross_section_data"

a. "plots_allYears" = plot of cross sections at each monitoring site for all available years.

b. "plots_change" = plot of change in area for all available years.

c. "summaryTables" = summary table for all available years.

3. "field_lab_turbidity_relationship"

    a. “###_ntu.pdf” = field vs lab turbidity regression plot.
    b. “###19_NTU_Data.csv” = data used in field/lab NTU regression.
    c. “###19_NTU_DataExcluded.csv” = data excluded from field/lab NTU regression.
    d. “###19_NTU_Stats.csv” regression equation information.
4. “flow_ssc_turb_duration_data_plots”
    a. “###_(X).pdf” = exceedance probability plots for discharge (X = flow), NTU and SSC combined (X = ntu_ssc), field turbidity at index probabilities (X = NTUExceed), and stage (X = stage).
    b. “###_(X)Exceed.csv” = exceedance data files for discharge (X = flow), field turbidity at index probabilities (X = NTU), suspended sediment concentration (X = SSC), stage (X = stage), and field turbidity (X = turb).
        i. Counts number of 15-minute measurements in a given category (X). % of total time, total days, and total hours above each threshold are also included.
5. “instrument_observer_stage_relationship”
    a. “###_OR.pdf” = plot of E-stage (instrument stage) vs. Obs-Stage (observer stage) regression.
    b. “###19_orData.csv” = data used in instrument/observer stage regression.
    c. “###19_orDataExcluded.csv” = data excluded from instrument/observer stage regression.
    d. “###19_orStats.csv” = regression equation information.
6. “other_model_input_files”

a. “###.sdr” = stage discharge relationship file used by TTS adjuster to calculate 15-minute discharge.

b. “###19.isc” = bottle dump, bottle number, and SSC (mg/L) value used by TTS adjuster.

c. “###19.or” = date, time, observed stage (m) used by TTS adjuster.

d. “###19_SSC.csv” = datetime and SSC (mg/L) values used by R software.

7. “peak_flow_estimate_data”

   a. “Duan_bias_factors.csv” = nonparametric smearing estimator factor used to correct for retransformation (Duan, 1983).

   b. “Qmax_###.csv” = estimate Q max with 95% CI (Clarke, 1999).

   c. “Qmax_data.csv” = rating data used to predict max Q.

   d. “Qmax_duan_cor_eq_###.txt” = Duan coefficient and associated Q equation.

3.2 Each Monitoring Site Contains the Following Files – Where ### = Station Number:

1. “###_Streamflow_Stats.csv” = relevant streamflow statistics.
2. “###_Summary_Info.csv” = relevant station metrics and summary information on sediment load, yield, turbidity, and discharge.
3. “###_totalAll.csv” = comprehensive list of totals, with additional information, including:
   i. Storm sediment yields/watershed area, predicted peak Q by storm, and estimated water volume by storm.
4. “Station###_RatingData_WY2019.xlsx” = Excel workbook with stage discharge rating data. At a minimum, it includes tabs with all year’s rating data, rating data used for

WY2019 discharge calculations, and notes on developing/updating the WY2019 rating curves.

3.3 Additional Data Included:

1. “FlowExceedance_above_measuredRatingQ” = max measured Q exceedance per site.
2. “OR_counts_site.csv” = counts of E-stage/Obs-stage pairs per monitoring site.
3. “rainfall_eureka.csv” = rainfall recorded at the Eureka NWS station between 10/01/2018 and 09/30/2019.
4. “storms19.csv”= storm event time periods used by R to calculate storm event sediment yields.

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