UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4

Science and Ecosystem Support Division
Enforcement and Investigations Branch
980 College Station Road
Athens, Georgia 30605-2720

August 12, 2013

4SESD-EAB

MEMORANDUM

SUBJECT: Nevada Goldfields Barite Hill Storm Event Sampling
Project Number13-0262: Final Report

FROM: Derek Little, Environmental Engineer
Water Quality Section

THRU: Stacey Box, Chief
Water Quality Section

TO: Candice Teichert
Superfund Division

Attached is the final report and supplemental data for the Nevada Goldfields Barite Hill Storm Event Sampling conducted by SESD in May of 2013. An electronic copy of the report will also be sent via email.

If you have any questions, please call me at (706)355-8717.

Attachment:

Nevada Goldfields Barite Hill Storm Event Sampling Final Report
CD of supplemental data

United States Environmental Protection Agency
Region 4
Science and Ecosystem Support Division
980 College Station Road
Athens, Georgia 30605-2720

NEVADA GOLDFIELDS INC BARITE HILL
Storm Event Sampling
August 12, 2013
Report
SESD Project Identification Number: 13-0262

Prepared by:

Derek Little
Environmental Engineer

8/12/13
Date

Approvals:

Stacey Box, Chief
Water Quality Section
Ecological Assessment Branch

8/12/13
Date

Distribution List for Nevada Goldfields Inc. Barite Hill Storm Event Sampling

Requestor:

Candice Teichert
United States Environmental Protection Agency
Region 4, Superfund
61 Forsyth St SW
Atlanta, Georgia 30303

Analytical Support:

Mike Wasko
Analytical Support Branch
United States Environmental Protection Agency
Region 4, Science and Ecosystem Support Division
980 College Station Road
Athens, Georgia 30605

Table of Contents

Table of Figures 4
List of Tables 5
1.0 Introduction 6
2.0 Study Area 6
3.0 Field Methods 6
3.1.1 Cross Sectional Survey and Flow Measurements 7
3.1.2 Rainfall 12
3.1.3 Runoff Volume 12
3.1.4 Unit Hydrographs 14
3.1.5 Automated Sampling 19
4.0 Results 19
4.1.1 Rain Event 19
4.1.2 Stage 21
4.1.3 Analytical Results 25
5.0 Quality Control 47
6.0 Conclusions 49
Works Cited 49
Appendix A: Flow Tracker Files 50
Appendix B: Survey Data 61
Appendix C: Rating Curve Data 64
Appendix D: Stage Data from BH119 68

Table of Figures

Figure 1: Map of Study Area....8
Figure 2: BH118 Cross Section....9
Figure 3: BH119 Cross Section....10
Figure 4: BH136 Cross Section....11
Figure 5: BH118 Hydrograph....16
Figure 6: BH119 Hydrograph....17
Figure 7: BH136 Hydrograph....18
Figure 8: Rainfall data....20
Figure 9: Stage Data....22
Figure 10: BH119 Stage and Rainfall....23
Figure 11: BH119 Flow Estimates....24
Figure 12: Acidity....35
Figure 13: Chloride....35
Figure 14: Sulfate....36
Figure 15: Alkalinity....36
Figure 16: Solids....37
Figure 17: Aluminum....37
Figure 18: Arsenic....38
Figure 19: Barium....38
Figure 20: Cadmium....39
Figure 21: Calcium....39
Figure 22: Cobalt....40
Figure 23: Copper....40
Figure 24: Iron....41
Figure 25: Lead....41
Figure 26: Magnesium....42
Figure 27: Manganese....42
Figure 28: Nickel....43
Figure 29: Potassium....43
Figure 30: Selenium....44
Figure 31: Sodium....44
Figure 32: Strontium....45
Figure 33: Titanium....45
Figure 34: Vanadium....46
Figure 35: Yttrium....46
Figure 36: Zinc....47

List of Tables

Table 1: Station Locations 6
Table 2: Flow Measurements 7
Table 3: Effective Rainfall Calculations 12
Table 4: Curve Numbers 13
Table 5: Effective Rainfall Calculations 13
Table 6: Peak Discharge 14
Table 7: Time of Concentration 15
Table 8: Sampling Triggers 19
Table 9: Sample Times 21
Table 10: Dominant Metals Summary 26
Table 11: Metals Data 26
Table 12: Metals Data (continued) 27
Table 13: Metals Data (continued) 27
Table 14: Metals Data (continued) 28
Table 15: Acidity 28
Table 16: Alkalinity, Total (as $CaCO_3$) 29
Table 17: Chloride 29
Table 18: Sulfate as SO_4 30
Table 19: Total Dissolved Solids 30
Table 20: Total Suspended Solids 31
Table 21: Metals Minimum Reporting Limit 32
Table 22: Metal Data Qualifiers 33
Table 23: Metal Data Qualifier (continued) 34
Table 24: QC samples 47

1.0 Introduction

The EPA Region 4 Science and Ecosystems Support Division (SESD), Enforcement and Investigations Branch (EIB) on behalf of the Superfund Division requested the assistance of the Ecological Assessment Branch (EAB) in performing rain event sampling on the Barite Hill Goldfields site in McCormick County, South Carolina. The goal of the study was to collect first flush samples from a rain event at 3 sites for the following analyses:

- Total Suspended Solids (TSS)
- Total Dissolved Solids (TDS)
- Dissolved Metals with Mercury
- Total Metals with Mercury
- Total Alkalinity as $CaCO_3$
- Chloride
- Sulfate
- Total Acidity

This report provides the results of sampling conducted following a rain event in May 2013 to support Superfund Divisions mitigation assessment of the site.

2.0 Study Area

The Barite Hill Goldfields site is a former gold and silver mining facility located in McCormick County, South Carolina. The site is located approximately three miles southwest of the town of McCormick between highways US-378 and US-221, see Figure 1. Sampling requested was conducted on the north tributary above and below the spillway of the retention pond near BH118 and BH119 respectively. Sampling efforts at a third location, BH136 a southern tributary, were unsuccessful. See Table 1 for site location data.

Table 1: Station Locations

Station	Latitude	Longitude
BH118	33.877567	-82.295124
BH119	33.876447	-82.304775
BH136	33.86666	-82.30345

3.0 Field Methods

Initial field reconnaissance was conducted to assess sampling locations, collect flow data and cross sectional areas. Field data was combined with existing land use data, elevation data, rain data and GIS applications to yield hydrological estimates for

predicting first flush sampling regimens. These estimates were used in designing the deployment of automatic sampling equipment described later in this report.

3.1.1 Cross Sectional Survey and Flow Measurements

On March 20th, 2013 SESD performed flow measurements and cross sectional surveys of the three sample locations in accordance with SESD Operating Procedure for Hydrological Studies (SESDPROC-501-R3, 2012). Instantaneous flow measurements, made with Acoustic Doppler Velocimeters (ADV), are summarized in Table 2; complete data from the measurements is located in Appendix A: Flow Tracker Files. Cross sections are presented graphically in Figure 2 through Figure 4, full data for survey points is located in Appendix B: Survey Data.

Estimated rating curves were developed from the cross sections and flow measurements using Manning's equation (see Equation 1) and assuming a Manning's *n* of 0.40 to solve for S. Detailed rating curves for each station can be found in Appendix C: Rating Curve Data. Ideally, multiple flow measurements at various stages would have been collected to verify S and *n* estimates but time and resource limitations did not allow for such data collection. Additional flow and cross sectional data will be collected as time permits for further validation of rating curve estimations.

Table 2: Flow Measurements

Station	Flow (cfs)	Mean Velocity (fps)	Total Area (ft^2)
BH118	0.16	0.06	2.76
BH119	0.25	0.04	6.58
BH136	0.17	0.06	2.72

Equation 1

$$Q = \frac{1.49}{n} A R^{2/3} S^{2/3}$$

Q= Flow in cfs
A= Area in square feet
R= Wetted perimeter in feet
S= Slope in ft/ft
n= Manning's n

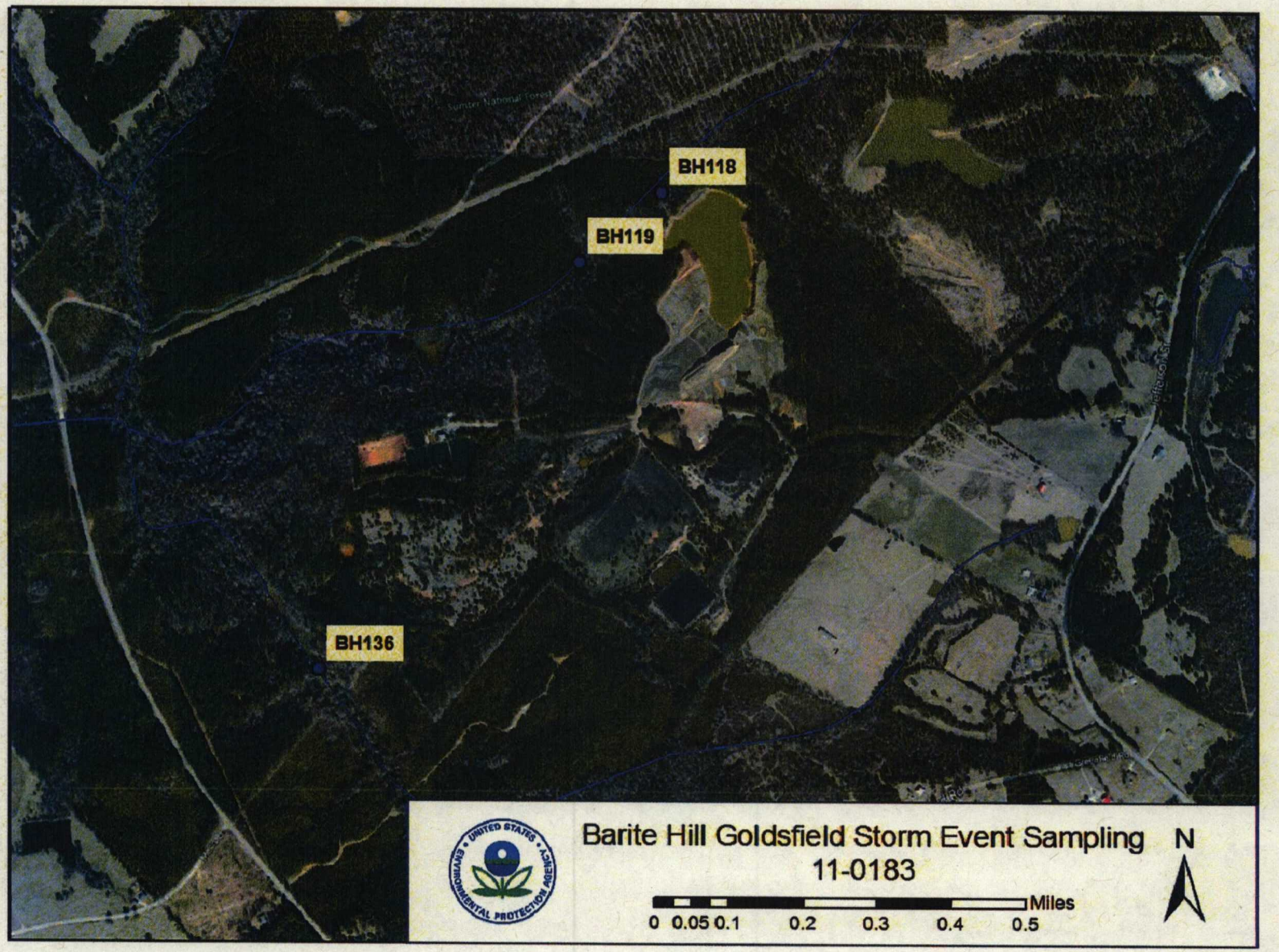


Figure 1: Map of Study Area

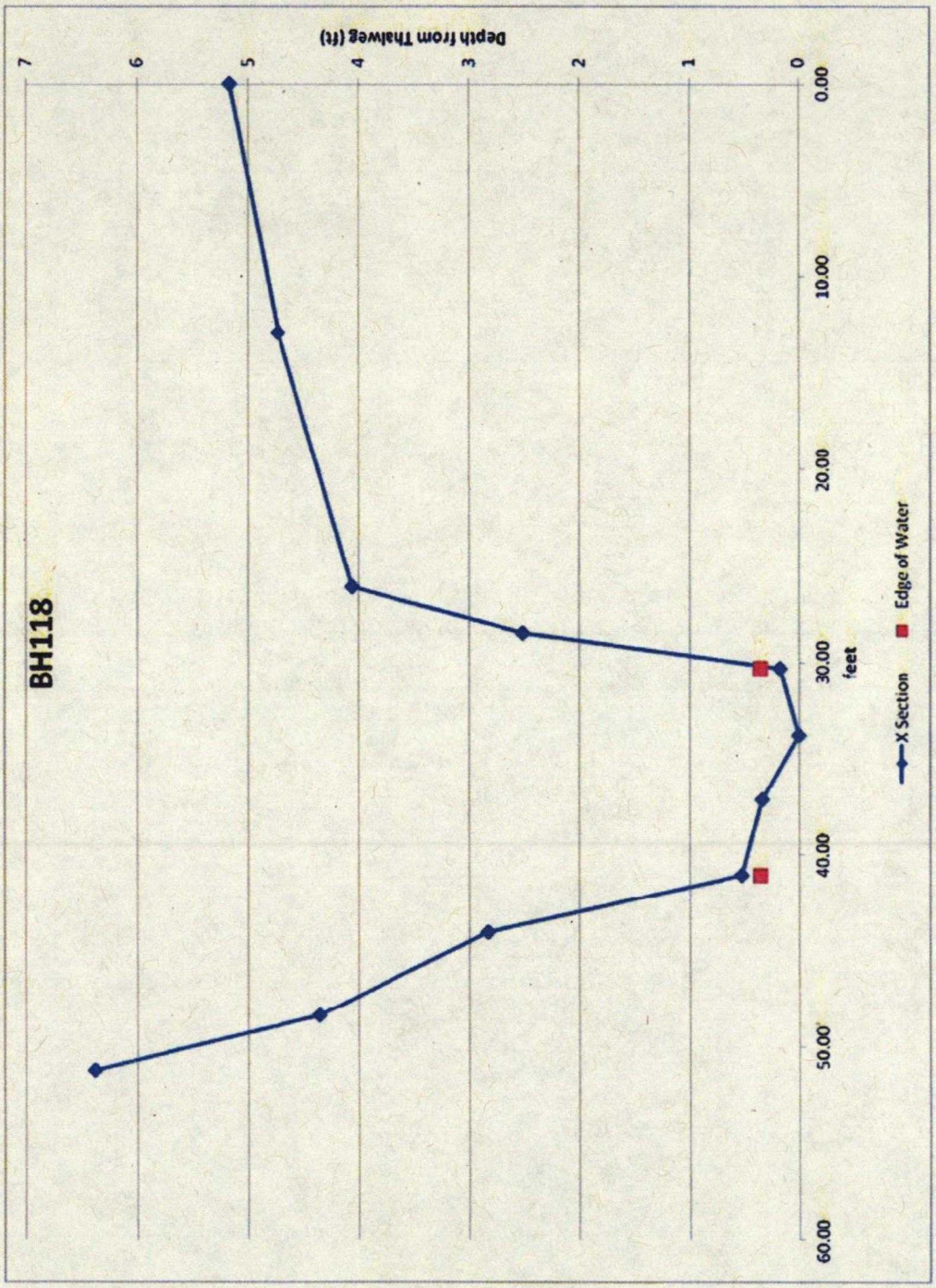


Figure 2: BH118 Cross Section

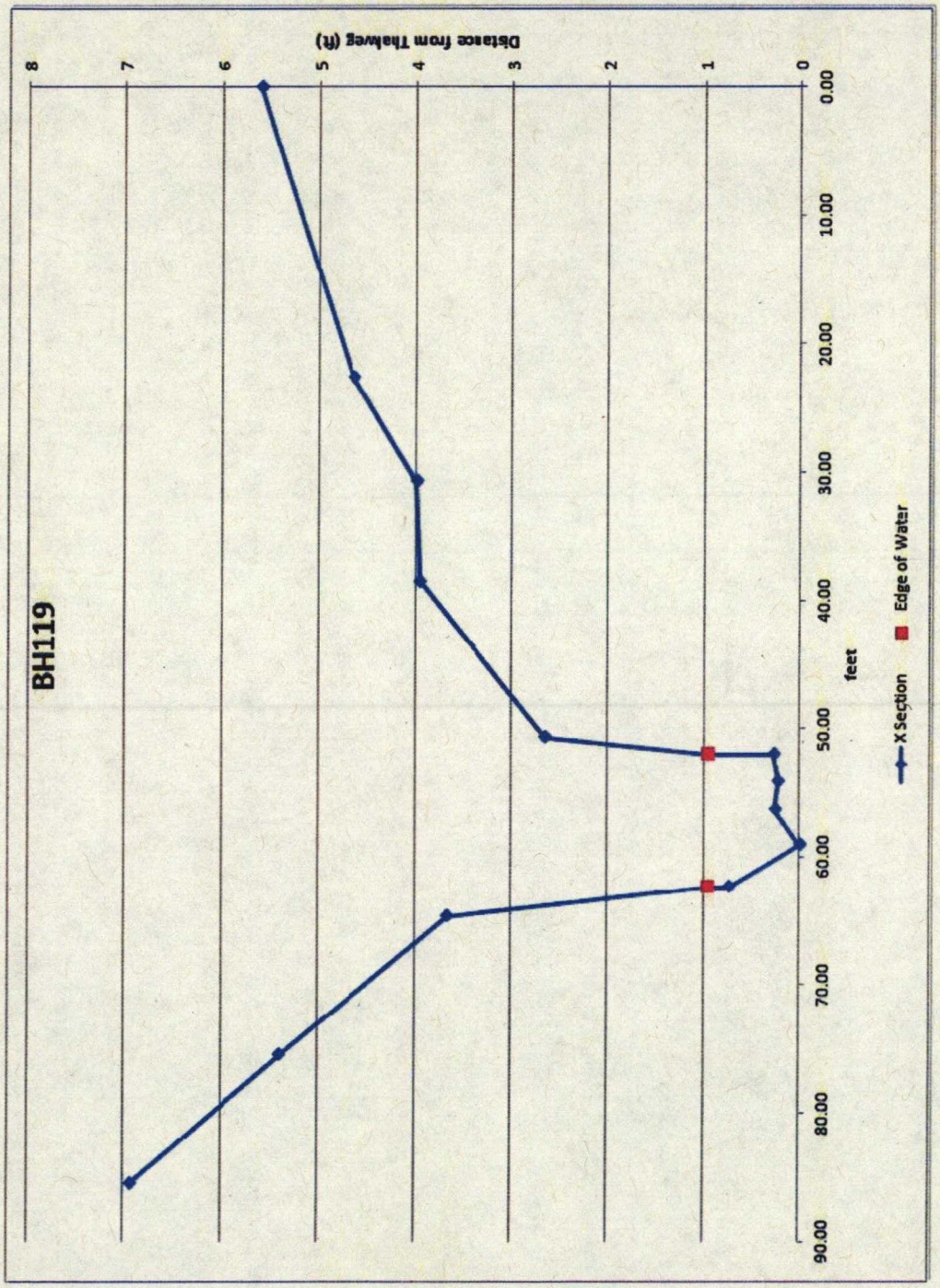


Figure 3: BH119 Cross Section

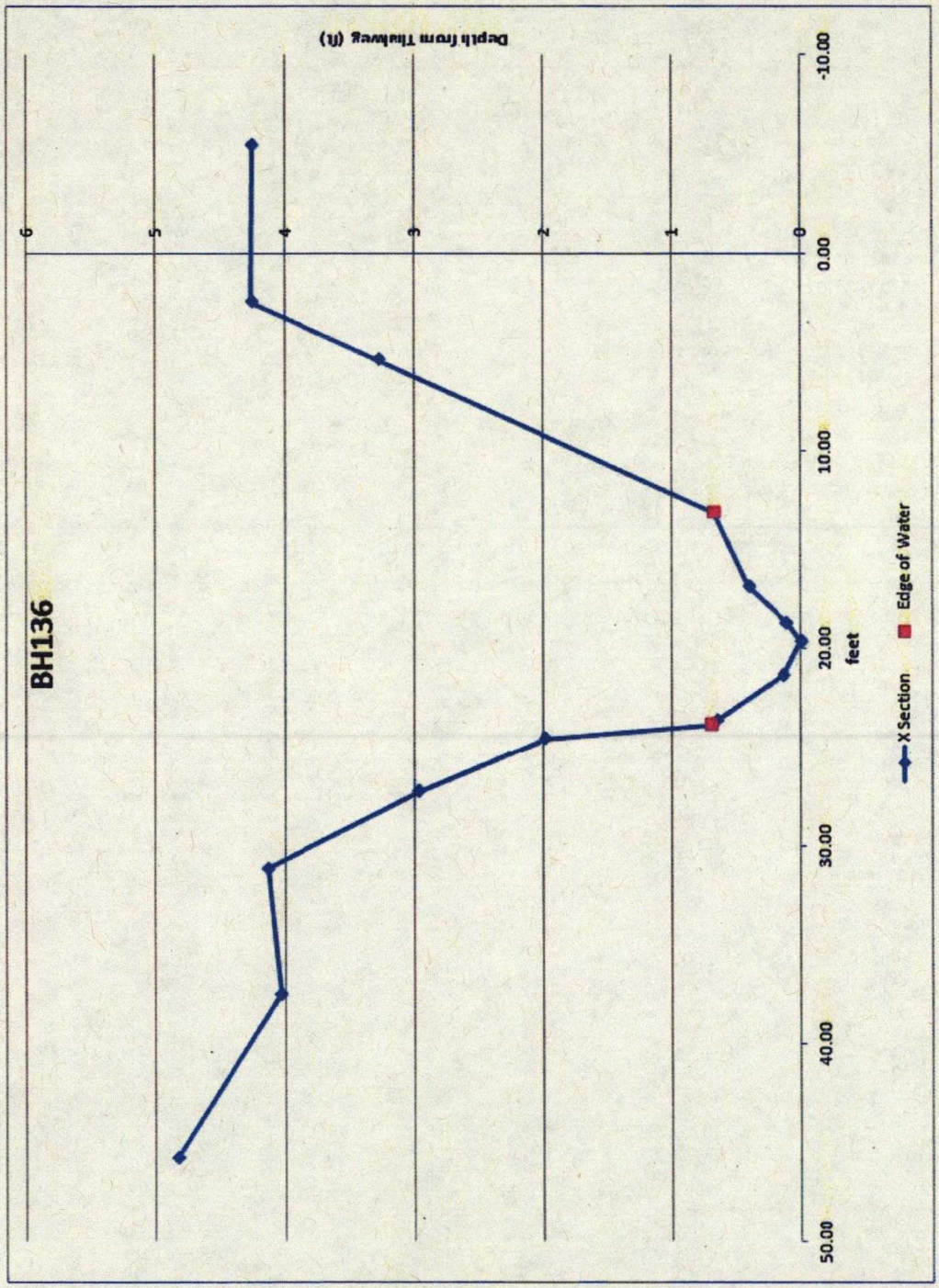


Figure 4: BH136 Cross Section

3.1.2 Rainfall

Soil Conservation Services (SCS) methods for estimating rainfall patterns were used (Barfield, Haain, & Hayes, 1994). The site location dictated a Type II SCS Curve. For this study, a 3 hour intensity storm was used as the basis for interpretation. A 2 year, 3 hour intensity storm would yield 3.75 inches of rain for the study area. Since there has been a pronounced drough,t a design storm of 2 inches over 3 hours was used to ensure that a storm event would be captured. Table 3 presents the accumulated rainfall for a 2 inch 3 hour intense storm based on SCS Type II Curve.

Table 3: Effective Rainfall Calculations

hr	SCS Type II Coordinates	Incremental Rainfall (inches)	Accumulated Rainfall (inches)
10.5	0.204	0.00	0
10.75	0.219	0.03	0.03
11	0.235	0.03	0.06
11.25	0.257	0.04	0.11
11.5	0.283	0.05	0.16
11.75	0.387	0.21	0.37
12	0.663	0.55	0.92
12.25	0.712	0.10	1.02
12.5	0.735	0.05	1.06
12.75	0.758	0.05	1.11
13	0.772	0.03	1.14
13.25	0.786	0.03	1.16
13.5	0.799	0.03	1.19

3.1.3 Runoff Volume

SCS methods were employed again to estimate the runoff volume for each sampling catchment. The accumulated runoff volume or rainfall excess is defined by the equations 2 and 3 (Barfield, Haain, & Hayes, 1994):

Equation 2

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

Equation 3

$$S = \frac{1000}{CN} - 10$$

Here Q is the accumulated runoff volume in inches, P is the accumulated precipitation in inches, S is a parameter and CN is the curve number. Curve numbers indicate the runoff potential for a given area. The equations take into consideration infiltration losses to give an estimated volume of runoff for a given precipitation.

Land use and soil maps were analyzed through GIS applications to determine average curve numbers for each given catchment based on SCS guidelines. Results of CN calculations are presented in Table 4. Effective rainfall calculations and results are presented in Table 5.

Table 4: Curve Numbers

Station	Curve Number CN	S	Area (acres)
BH118	64	5.63	350
BH119	65	5.38	418
BH136	70	4.29	410

Table 5: Effective Rainfall Calculations

Time (hrs)	BH118 (in)	BH19 (in)	BH136 (in)
0.00	0.00	0.00	0.00
0.25	0.26	0.25	0.20
0.50	0.25	0.24	0.18
0.75	0.23	0.21	0.16
1.00	0.20	0.19	0.14
1.25	0.12	0.11	0.06
1.50	0.01	0.00	0.00
1.75	0.00	0.00	0.01
2.00	0.00	0.00	0.01
2.25	0.00	0.00	0.01
2.50	0.00	0.00	0.02
2.75	0.00	0.00	0.02
3.00	0.00	0.00	0.02
Total	**1.07**	**1.01**	**0.83**

3.1.4 Unit Hydrographs

Using the SCS-TR55 method (Barfield, Haain, & Hayes, 1994), peak flow was estimated for all three catchments. Calculated drainage area and runoff volume of each catchment were utilized with graphical solutions to find the unit peak discharge (q_u). The peak discharge (q_p) and time to peak (T_P) were calculated from Equation 4 and Equation 5 respectively and summarized in Table 6. Where q_u is the unit peak discharge in cubic feet per second per inch of runoff per square mile (cfs/in/mi^2), A is the drainage area in square miles, Q is the runoff in inches, and F_p is a ponding factor (set to 1 for this study area).

Equation 4

$$q_p = q_u A Q F_p$$

Equation 5

$$T_P = \frac{T_C \times 0.133}{2} + (0.6 \times T_C)$$

Table 6: Peak Discharge

Station	q_p (cfs)	T_p (hrs)
BH136	10.70	0.87
BH118	7.22	0.88
BH119	5.35	1.63

Time of concentration (T_C) was estimated with guidance from the National Engineering Handbook (NEH) (USDA NRCS, 2010) and analysis of watersheds through GIS applications. The NEH defines time of concentration by Equation 6. Calculated times of concentrations are summarized in Table 7.

Equation 6

$$T_C = \frac{l^{0.8}(S+1)^{0.7}}{1{,}140Y^{0.5}}$$

T_c = time of concentration, hours
l = longest flow path, feet
Y = average watershed land slope, %

Table 7: Time of Concentration

Station	Longest Flow (ft)	Average Slope %	T_c (Hrs)
BH136	22,604	6.51	1.30
BH118	19,375	6.76	1.32
BH119	24,165	6.76	1.24

Peak discharges and time of concentrations were used in the development of hydrographs based on a dimensionless unit hydrograph (USDA NRCS, 2007) and routed through each cross section to determine stage change. Hydrographs are presented in Figures 5-7. Estimates of rating curves and hydrographs were used in the programming of automated samplers.

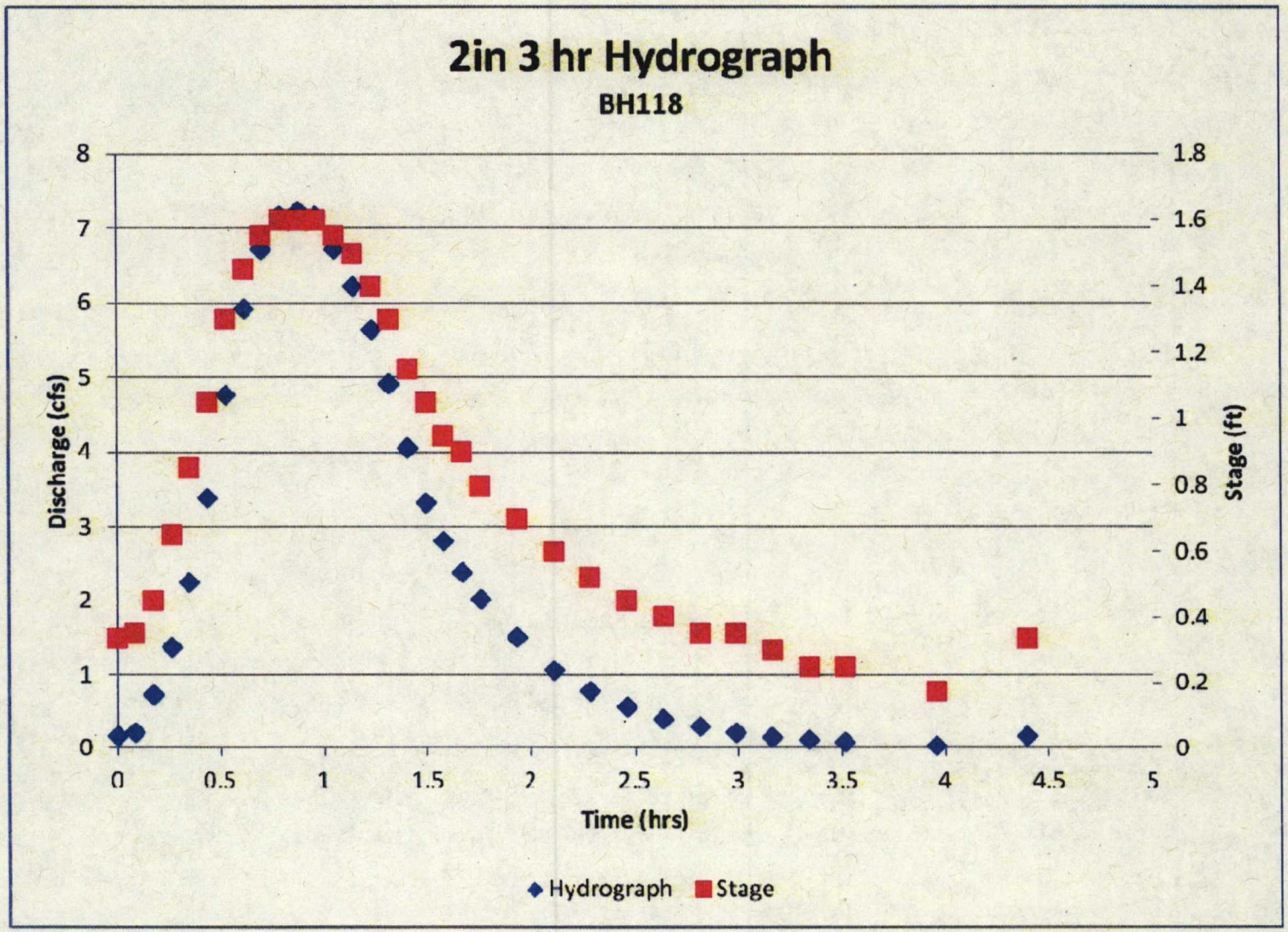


Figure 5: BH118 Hydrograph

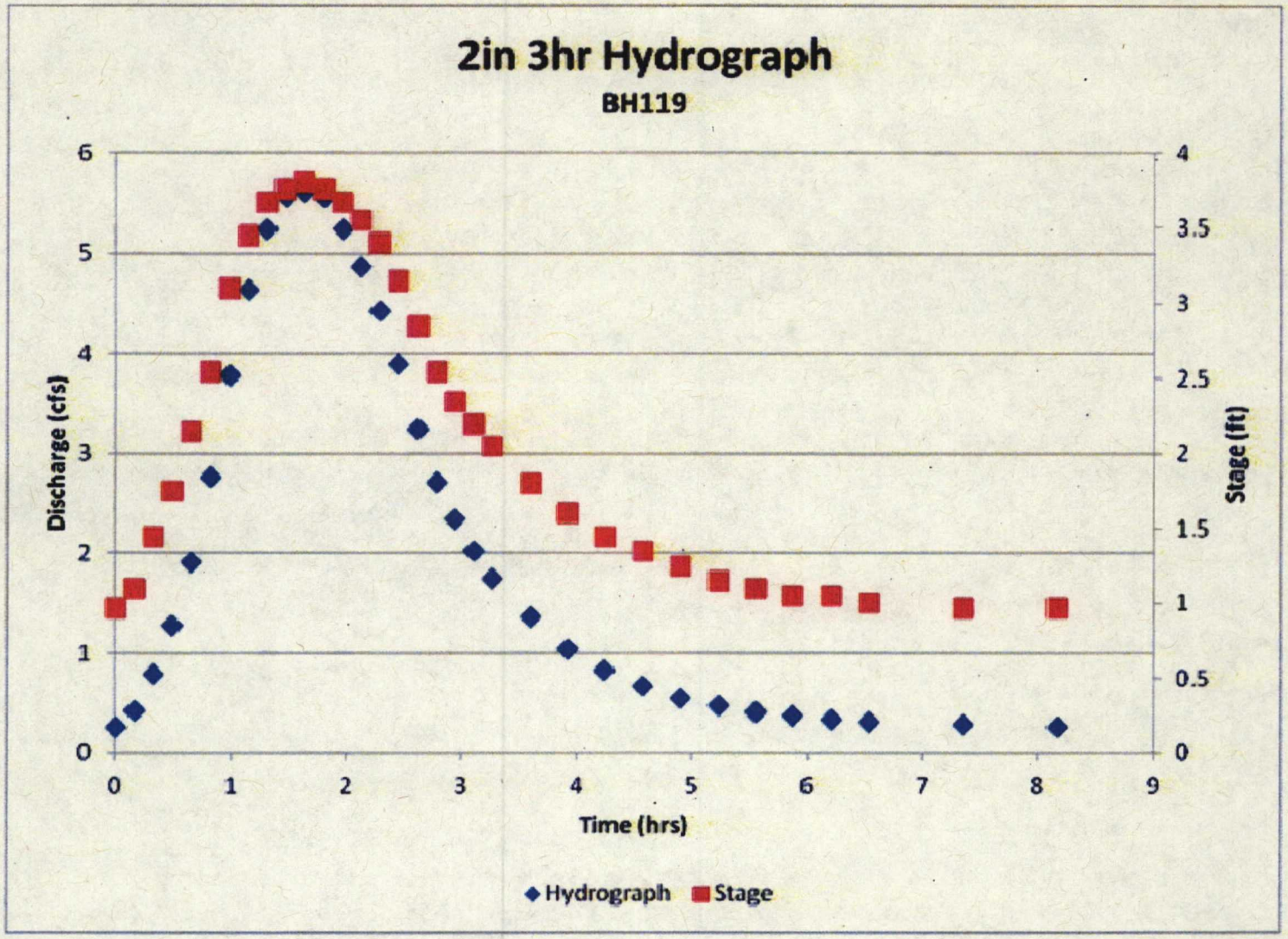


Figure 6: BH119 Hydrograph

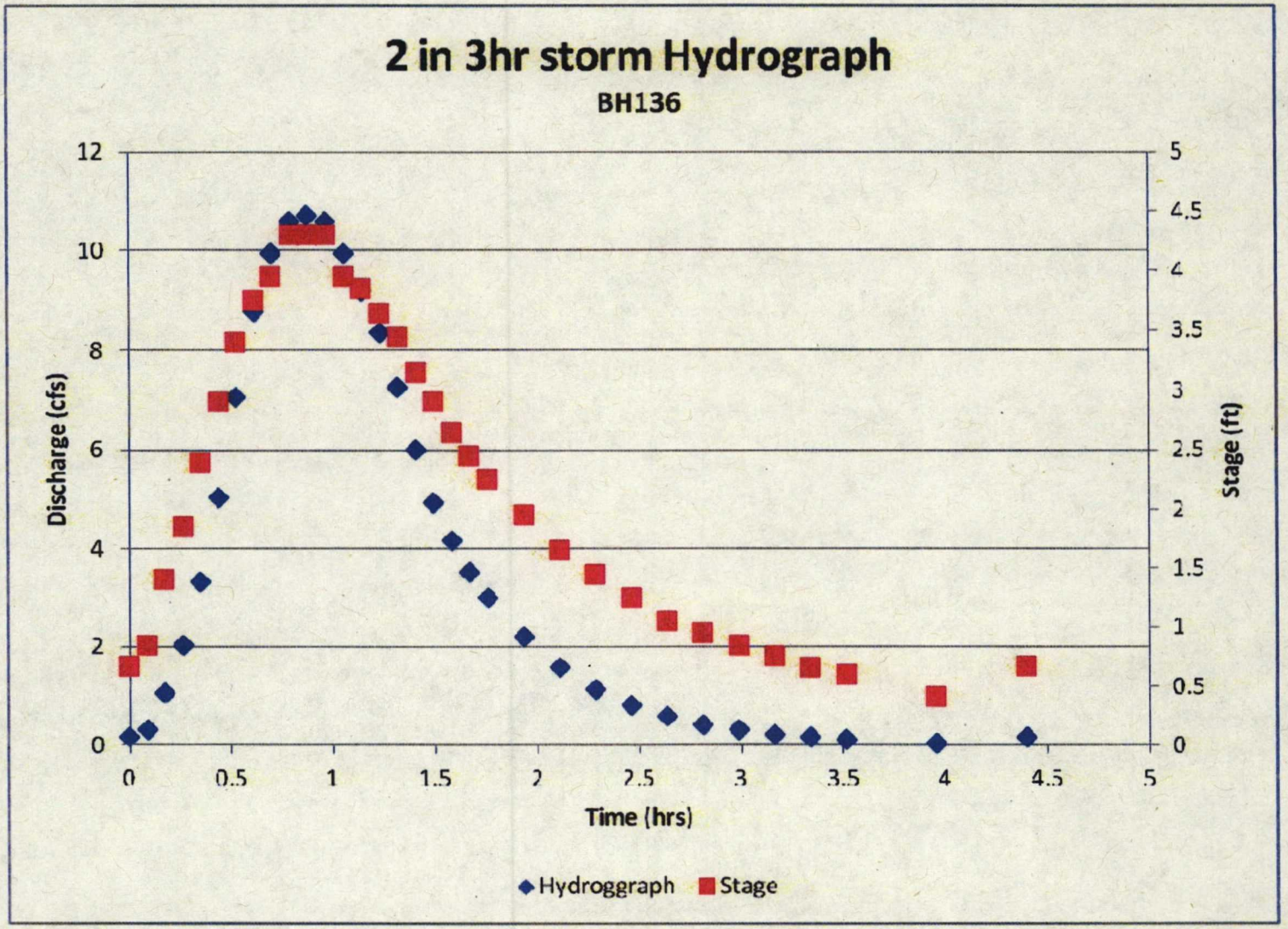


Figure 7: BH136 Hydrograph

3.1.5 Automated Sampling

Sampling was conducted through the use of programmable automated samplers, specifically ISCO 6713 Portable Samplers, in conjunction with ISCO 4220 Submerged Probes all in accordance with SESD Operating Procedure for Surface Water Sampling (SESDPROC-201-R3, 2013). Each site was equipped with a submerged probe and an automated sampler, stations BH119 and BH136 also had chart plotters while BH118 used an inline ISCO 720 interface. ISCO 4220 Submerged probes measured stage which was used as a sampling trigger. Stages at the time of installation and trigger stages are summarized in Table 8.

Table 8: Sampling Triggers

Station	Stage at Install (ft)	Trigger Stage (ft)
BH118	0.223	0.40
BH119	1.158	1.40
BH136	0.385	1.10

ISCO samplers are capable of collecting twenty-four 1 liter samples. Pacing of sampling was set at 2 bottles per sample at 5 minute intervals giving a total sampling window of 1 hour once triggered. Lab analysis requires 2 liters per sampling event; yielding 12 samples per site but constraints of the lab on volume only allowed 6 samples per site.

4.0 Results

4.1.1 Rain Event

At approximately 12:00 on May 4, 2013 a rain event occurred that triggered two of the three ISCO samplers. A possible wiring malfunction at BH136 prevented sampling from occurring. The rain event lasted approximately 25.5 hours with a total of 2.67 inches of rainfall. Sampler BH119 and BH118 were triggered at 21:15 and 21:45 respectively, or 9.5 and 10.5 hours after initial rainfall. EIB rain data is graphed in Figure 8. The weather station is located southwest of the mine pit (-82.295101, 33.873820). Sample times are presented in Table 9.

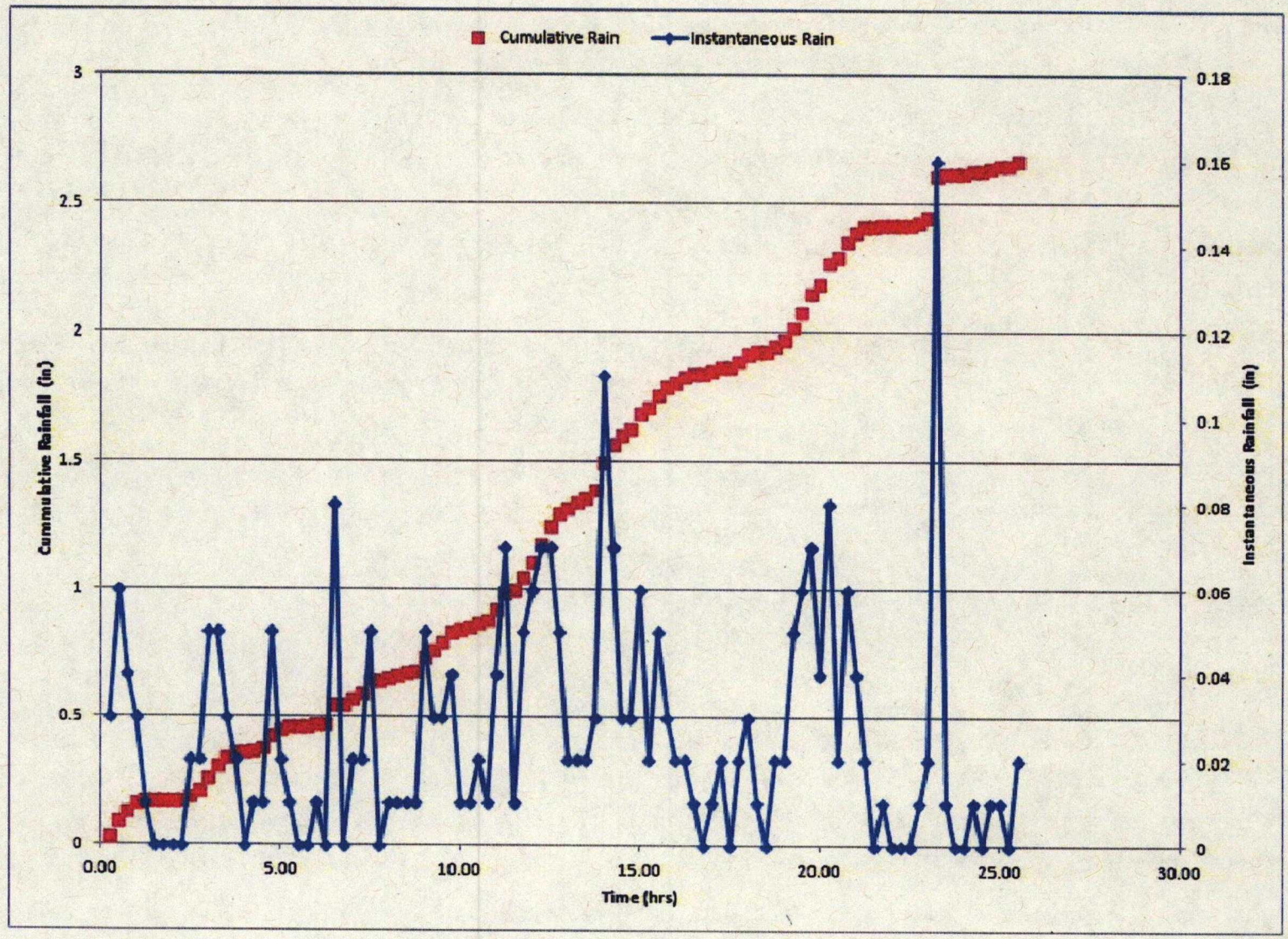


Figure 8: Rainfall data

Table 9: Sample Times

Sample ID	Sample Date
BH118-01	5/4/2013 21:43
BH118-03	5/4/2013 21:48
BH118-05	5/4/2013 21:53
BH118-07	5/4/2013 21:58
BH118-09	5/4/2013 22:03
BH118-11	5/4/2013 22:08
BH119-13	5/4/2013 21:41
BH119-15	5/4/2013 21:46
BH119-17	5/4/2013 21:51
BH119-19	5/4/2013 21:56
BH119-21	5/4/2013 22:01
BH119-23	5/4/2013 22:06

4.1.2 Stage

Stage equipment malfunctioned at BH118 leading to only daily stage minimum and maximum data obtained from the ISCO. Data is provided graphically for stations BH118 and BH119 in Figure 9 and Figure 10. See Appendix D: Stage Data for complete stage data. Flow estimates were made using the previous slope-area calculations and are presented graphically for BH119 in Figure 11. An estimate for the maximum flow is 2.70 cfs occurring at 3:45 AM on May 5, 2013.

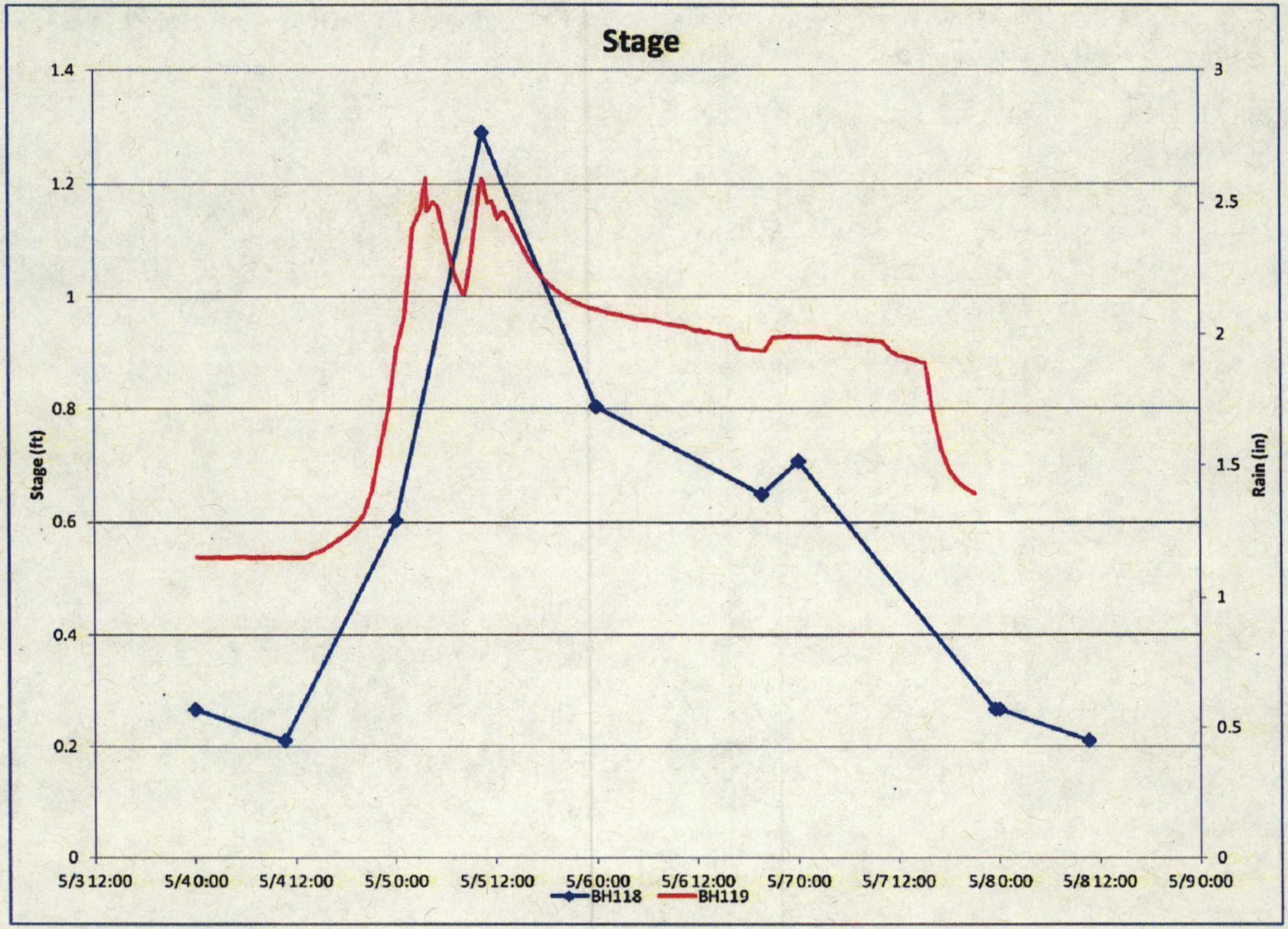


Figure 9: Stage Data

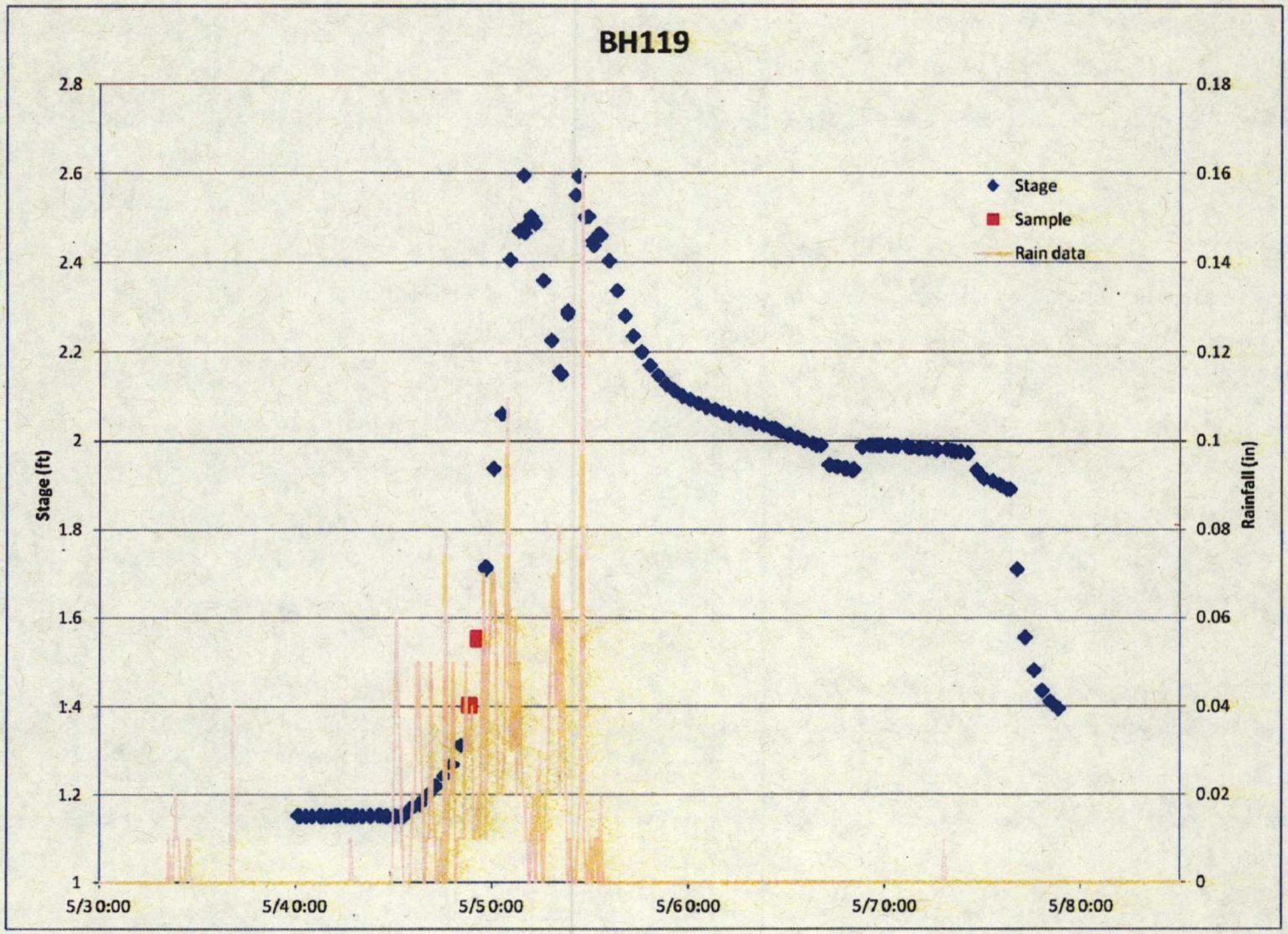


Figure 10: BH119 Stage and Rainfall

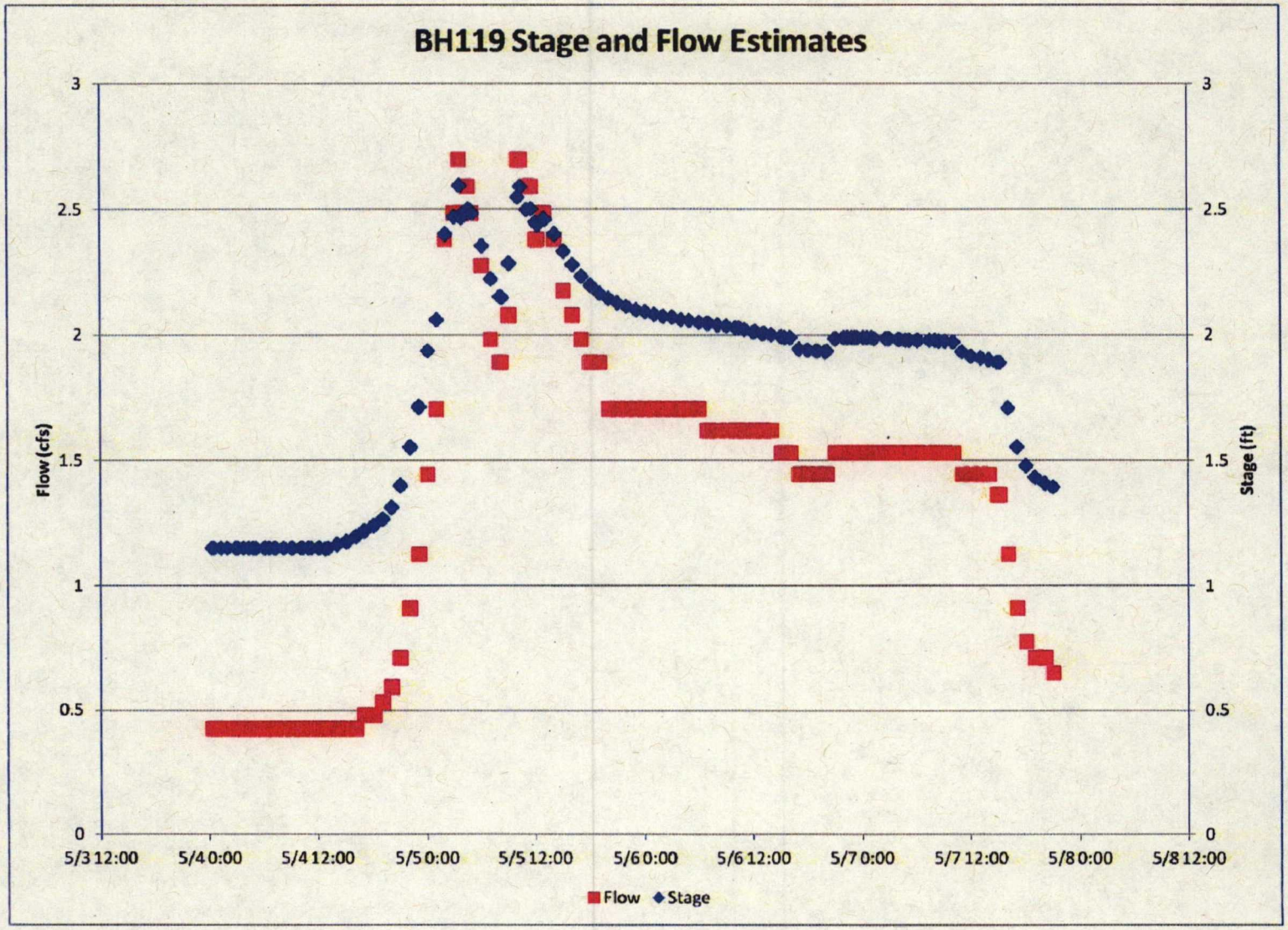


Figure 11: BH119 Flow Estimates

4.1.3 **Analytical Results**

Analytical results are presented in Tables 10-20 and Figures 16-36. For metals data, Tables 10-14, qualifiers were not included in summary tables for ease of presentation. Those results with qualifiers are summarized separately, Tables 22 and 23. Antimony, Beryllium, Chromium, Mercury, Molybdenum, Silver, Thallium and Tin were not detected at or above the reporting limit for either station.

Qualifiers to data are:

- U: The analyte was not detected at or above the reporting limit.
- B-2: Reporting level elevated due to trace amounts of analyte present in the method blank.
- H-4: Holding time expired prior to receipt by laboratory.
- NA-12: Sample has no measureable alkalinity. Original sample pH is less than 4.5
- J: The identification of the analyte is acceptable; the reported value is an estimate.
- QM-1: Matrix Spike Recovery less than method control limits
- QR-1: MRL verification recovery less than lower control limits.

As suggested in the Quality Assurance Protection Plan, holding times were exceeded due to the nature of the site and sampling requirements.

A breakdown of overall metals trends is presented in Table 10. The first column indicates the station with the higher constituent concentration with an X, subsequent columns show the dominant form for each station. U retains the qualifier definition that the analyte was not detected at or above the reporting limits. As shown in Table 10, BH119 had the majority of higher metals concentrations, of which soluble forms were dominant, except for iron, lead, titanium and vanadium.

There was a lack of measureable alkalinity at station BH119 with station BH118 having alkalinities less than 4.0 mg/L as $CaCO_3$. BH119 showed elevated acidity, chloride, sulfate and total dissolved solids compared to BH118.

Table 10: Dominant Metals Summary

Analyte	Overall		Insoluble	Soluble	Insoluble	Soluble
	BH118	BH119	BH118	BH118	BH119	BH119
Aluminum		X	X	U		X
Arsenic	X		X	U	U	U
Barium	X	X	X			X
Cadmium		X		X		X
Calcium		X		X		X
Cobalt		X		X		X
Copper		X	X			X
Iron	X		X	U	X	
Lead	X		X	U		X
Magnesium		X		X		X
Manganese		X		X		X
Nickel		X	U	U		X
Potassium		X		X		X
Selenium		X	U	U		X
Sodium		X		X		X
Strontium		X		X		X
Titanium	X		X	U	U	U
Vanadium	X		X	U	U	U
Yttrium		X	X	U		X
Zinc		X		X		X

Table 11: Metals Data

Station	Aluminum		Arsenic		Barium		Cadmium		Calcium	
	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L
BH118-02	4,300	*100 U,J,O*	1	*1 U*	52	44	26	23	22,000	21,000
BH118-04	4,000	*100 U,J,O*	1	*1 U*	49	39	24	21	21,000	19,000
BH118-06	4,400	*100 U,J,O*	1	*1 U*	50	42	23	22	21,000	20,000
BH118-08	4,100	*100 U,J,O*	1	*1 U*	48	41	23	21	20,000	19,000
BH118-10	4,000	*100 U,J,O*	1	*1 U*	46	40	22	21	19,000	19,000
BH118-12	4,300	*100 U,J,O*	1	*1 U*	48	40	23	21	19,000	18,000
BH119-14	10,000	10,000	*1 U*	*1 U*	50	49	120	120	88,000	88,000
BH119-16	10,000	9,800	*1 U*	*1 U*	52	51	120	120	88,000	87,000
BH119-18	9,800	9,400	*1 U*	*1 U*	51	49	120	120	88,000	85,000
BH119-20	8,800	8,800	*1 U*	*1 U*	54	54	110	100	79,000	79,000
BH119-22	8,300	8,200	*1 U*	*1 U*	55	55	99	100	76,000	76,000
BH119-24	7,800	7,700	*1 U*	*1 U*	55	54	97	99	73,000	73,000
MRL	100		1		5		5		250	

Table 12: Metals Data (continued)

Station	Cobalt		Copper		Iron		Lead		Magnesium	
	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L
BH118-02	30	27	560 J, O	200	16000	*100 U*	7	*1 U*	8,100	7,700
BH118-04	28	25	530	170	15000	*190*	6	*1 U*	7,800	7,000
BH118-06	27	26	560	190	16000	*100 U*	7	*1 U*	7,700	7,500
BH118-08	27	26	550	190	15000	*100 U*	6	*1 U*	7,500	7,300
BH118-10	26	25	560	210	15000	*100 U*	5	*1 U*	7,400	7,200
BH118-12	27	25	580	220	15000	*100 U*	6	*1 U*	7,200	7,100
BH119-14	330	330	3,000	3,000	8600	2300	6	5	30,000	30,000
BH119-16	310	290	3,000	3,000	9000	1300	6	5	29,000	29,000
BH119-18	320	310	2,900	2,800	8800	1200	6	5	30,000	29,000
BH119-20	210	210	2,600	2,700	9600	1400	5	5	24,000	24,000
BH119-22	190	190	2,500	2,500	9600	2500	5	5	22,000	22,000
BH119-24	180	190	2,400	2,400	9400	1200	5	4	22,000	22,000
MRL	5		10		100		1		250	

Table 13: Metals Data (continued)

Station	Manganese		Nickel		Potassium		Selenium		Sodium	
	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L
BH118-02	*1,200*	*1,100*	*10 U*	10 U	*1200*	*1000 U*	*2 U*	*2 U*	12000	11000
BH118-04	*1,200*	*1,000*	10 U	10 U	*1000 U*	*1000 U*	*2 U*	*2 U*	12000	10000
BH118-06	*1,100*	*1,000*	10 U	10 U	*1000 U*	*1000 U*	*2 U*	*2 U*	11000	11000
BH118-08	*1,100*	*1,000*	10 U	10 U	*1000 U*	*1000 U*	*2 U*	*2 U*	11000	11000
BH118-10	*1,000*	*970*	10 U	10 U	*1000 U*	*1000 U*	*2 U*	*2 U*	11000	11000
BH118-12	*1,000*	*960*	10 U	10 U	*1000 U*	*1000 U*	*2 U*	*2 U*	11000	11000
BH119-14	13,000	13,000	49	49	3100	3100	7	6	28000	29000
BH119-16	12,000	12,000	47	45	3200	3200	6	6	29000	28000
BH119-18	13,000	12,000	47	47	3100	2900	7	6	29000	28000
BH119-20	8,400	8,300	35	35	3000	3200	6	5	28000	27000
BH119-22	7,200	7,300	32	32	3000	3100	5	5	26000	26000
BH119-24	7,300	7,300	30	31	2900	2900	5	5	26000	26000
MRL	5		10		1000		2		1000	

Table 14: Metals Data (continued)

Station	Strontium		Titanium		Vanadium		Yttrium		Zinc	
	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L	Total µg/L	Diss µg/L
BH118-02	68	*65*	15	*5 U*	6	*5 U*	10	*3 U*	880 J, O	790
BH118-04	69	*62*	15	*5 U*	6	*5 U*	10	*3 U*	820	720
BH118-06	66	*64*	15	*5 U*	6	*5 U*	10	*3 U*	800	760
BH118-08	68	*65*	14	*5 U*	5	*5 U*	9	*3 U*	760	800
BH118-10	66	*63*	15	*5 U*	6	*5 U*	9	*3 U*	730	730
BH118-12	68	*62*	16	*5 U*	6	*5 U*	9	*3 U*	770	720
BH119-14	*140*	*140*	*5 U*	*5 U*	*5 U*	*5 U*	66	67	4800	4800
BH119-16	*140*	*140*	*5 U*	*5 U*	*5 U*	*5 U*	64	62	4700	4600
BH119-18	*150*	*140*	*5 U*	*5 U*	*5 U*	*5 U*	66	63	4700	4600
BH119-20	*130*	*130*	*5 U*	*5 U*	*5 U*	*5 U*	51	50	3900	3900
BH119-22	*130*	*130*	*5 U*	*5 U*	*5 U*	*5 U*	46	46	3700	3700
BH119-24	*130*	*120*	*5 U*	*5 U*	*5 U*	*5 U*	45	45	3500	3600
MRL	5		5		5		3		10	

Table 15: Acidity

Sample ID	Results	Qualifiers	Units	MRL
BH118-01	30	U, B-2	mg/L	30
BH118-03	32	U, B-2	mg/L	32
BH118-05	29	U, B-2	mg/L	29
BH118-07	24	U, B-2	mg/L	24
BH118-09	26	U, B-2	mg/L	26
BH118-11	27	U, B-2	mg/L	27
BH119-13	110		mg/L	10
BH119-15	110		mg/L	10
BH119-17	77		mg/L	10
BH119-19	100		mg/L	10
BH119-21	91		mg/L	10
BH119-23	82		mg/L	10

Table 16: Alkalinity, Total (as $CaCO_3$)

Sample ID	Results	Qualifiers	Units	MRL
BH118-01	2.1		mg/L	1
BH118-03	2.4		mg/L	1
BH118-05	2.9		mg/L	1
BH118-07	3.1		mg/L	1
BH118-09	2.9		mg/L	1
BH118-11	2.7		mg/L	1
BH119-13	1	U,NA-12	mg/L	1
BH119-15	1	U,NA-12	mg/L	1
BH119-17	1	U,NA-12	mg/L	1
BH119-19	1	U,NA-12	mg/L	1
BH119-21	1	U,NA-12	mg/L	1
BH119-23	1	U,NA-12	mg/L	1

Table 17: Chloride

Sample ID	Results	Qualifiers	Units	MRL
BH118-01	8.6		mg/L	0.1
BH118-03	8.6		mg/L	0.1
BH118-05	8.6		mg/L	0.1
BH118-07	8.3		mg/L	0.1
BH118-09	8.2		mg/L	0.1
BH118-11	8.5		mg/L	0.1
BH119-13	11		mg/L	0.1
BH119-15	12		mg/L	0.1
BH119-17	11		mg/L	0.1
BH119-19	11		mg/L	0.1
BH119-21	11		mg/L	0.1
BH119-23	11		mg/L	0.1

Table 18: Sulfate as SO_4

Sample ID	Results	Qualifiers	Units	MRL
BH118-01	110		mg/L	0.1
BH118-03	100		mg/L	0.1
BH118-05	99		mg/L	0.1
BH118-07	95		mg/L	0.1
BH118-09	93		mg/L	0.1
BH118-11	95		mg/L	0.1
BH119-13	520		mg/L	0.1
BH119-15	490		mg/L	0.1
BH119-17	470		mg/L	0.1
BH119-19	470		mg/L	0.1
BH119-21	410		mg/L	0.1
BH119-23	380		mg/L	0.1

Table 19: Total Dissolved Solids

Sample ID	Results	Qualifiers	Units	MRL
BH118-01	210	H-4	mg/L	40
BH118-03	210	H-4	mg/L	40
BH118-05	210	H-4	mg/L	40
BH118-07	210	H-4	mg/L	40
BH118-09	200	H-4	mg/L	40
BH118-11	190	H-4	mg/L	40
BH119-13	810	H-4	mg/L	40
BH119-15	730	H-4	mg/L	40
BH119-17	710	H-4	mg/L	40
BH119-19	700	H-4	mg/L	40
BH119-21	620	H-4	mg/L	40
BH119-23	580	H-4	mg/L	40

Table 20: Total Suspended Solids

Sample ID	Results	Qualifiers	Units	MRL
BH118-01	91	H-4	mg/L	4
BH118-03	100	H-4	mg/L	4
BH118-05	85	H-4	mg/L	4
BH118-07	99	H-4	mg/L	4
BH118-09	87	H-4	mg/L	4
BH118-11	100	H-4	mg/L	4
BH119-13	20	H-4	mg/L	4
BH119-15	22	H-4	mg/L	4
BH119-17	21	H-4	mg/L	4
BH119-19	21	H-4	mg/L	4
BH119-21	23	H-4	mg/L	4
BH119-23	23	H-4	mg/L	4

Table 21: Metals Minimum Reporting Limit

Analyte	MRL (µg/L)
Aluminum	100
Antimony	1
Arsenic	1
Barium	5
Beryllium	3
Cadmium	5
Calcium	250
Chromium	5
Cobalt	5
Copper	10
Iron	100
Lead	1
Magnesium	250
Manganese	5
Mercury	0
Molybdenum	10
Nickel	10
Potassium	1,000
Selenium	2
Silver	5
Sodium	1,000
Strontium	5
Thallium	1
Tin	15

Table 22: Metal Data Qualifiers

Sample	Analyte	Qualifiers
BH119-14	Arsenic	U
BH119-16	Arsenic	U
BH119-18	Arsenic	U
BH119-20	Arsenic	U
BH119-22	Arsenic	U
BH119-24	Arsenic	U
BH118-02	Nickel	U
BH118-04	Nickel	U
BH118-06	Nickel	U
BH118-08	Nickel	U
BH118-10	Nickel	U
BH118-12	Nickel	U
BH118-08	Potassium	U
BH118-10	Potassium	U
BH118-12	Potassium	U
BH118-02	Selenium	U
BH118-04	Selenium	U
BH118-06	Selenium	U
BH118-08	Selenium	U
BH118-10	Selenium	U
BH118-12	Selenium	U
BH119-14	Titanium	U
BH119-16	Titanium	U
BH119-18	Titanium	U
BH119-20	Titanium	U
BH119-22	Titanium	U
BH119-24	Titanium	U
BH119-14	Vanadium	U
BH119-16	Vanadium	U
BH119-18	Vanadium	U
BH119-20	Vanadium	U
BH119-22	Vanadium	U
BH119-24	Vanadium	U

Sample	Analyte	Qualifiers
BH118-02F	Arsenic	U
BH118-04F	Arsenic	U
BH118-06F	Arsenic	U
BH118-08F	Arsenic	U
BH118-10F	Arsenic	U
BH118-12F	Arsenic	U
BH119-14F	Arsenic	U
BH119-16F	Arsenic	U
BH119-18F	Arsenic	U
BH119-20F	Arsenic	U
BH119-22F	Arsenic	U
BH119-24F	Arsenic	U
BH118-02F	Iron	U
BH118-06F	Iron	U
BH118-08F	Iron	U
BH118-10F	Iron	U
BH118-12F	Iron	U
BH118-02F	Lead	U
BH118-04F	Lead	U
BH118-06F	Lead	U
BH118-08F	Lead	U
BH118-10F	Lead	U
BH118-12F	Lead	U
BH118-02F	Nickel	U
BH118-04F	Nickel	U
BH118-06F	Nickel	U
BH118-08F	Nickel	U
BH118-10F	Nickel	U
BH118-12F	Nickel	U
BH118-04F	Potassium	U
BH118-06F	Potassium	U
BH118-08F	Potassium	U

Table 23: Metal Data Qualifier (continued)

Sample	Analyte	Qualifiers
BH118-10F	Potassium	U
BH118-12F	Potassium	U
BH118-02F	Selenium	U
BH118-04F	Selenium	U
BH118-06F	Selenium	U
BH118-08F	Selenium	U
BH118-10F	Selenium	U
BH118-12F	Selenium	U
BH118-02F	Titanium	U
BH118-04F	Titanium	U
BH118-06F	Titanium	U
BH118-08F	Titanium	U
BH118-10F	Titanium	U
BH118-12F	Titanium	U
BH119-14F	Titanium	U
BH119-16F	Titanium	U
BH119-18F	Titanium	U
BH119-20F	Titanium	U
BH119-22F	Titanium	U
BH119-24F	Titanium	U
BH118-02F	Vanadium	U
BH118-04F	Vanadium	U
BH118-06F	Vanadium	U
BH118-08F	Vanadium	U
BH118-10F	Vanadium	U
BH118-12F	Vanadium	U
BH119-14F	Vanadium	U
BH119-16F	Vanadium	U
BH119-18F	Vanadium	U
BH119-20F	Vanadium	U
BH119-22F	Vanadium	U
BH119-24F	Vanadium	U
BH118-02F	Yttrium	U
BH118-04F	Yttrium	U
BH118-06F	Yttrium	U
BH118-08F	Yttrium	U
BH118-10F	Yttrium	U
BH118-12F	Yttrium	U

Sample	Analyte	Qualifiers
BH118-02	Copper	J,QM-1
BH118-02	Zinc	J,QM-1
BH118-08F	Aluminum	J,QR-1
BH118-02F	Aluminum	U,J,QR-1
BH118-04F	Aluminum	U,J,QR-1
BH118-06F	Aluminum	U,J,QR-1
BH118-10F	Aluminum	U,J,QR-1
BH118-12F	Aluminum	U,J,QR-1

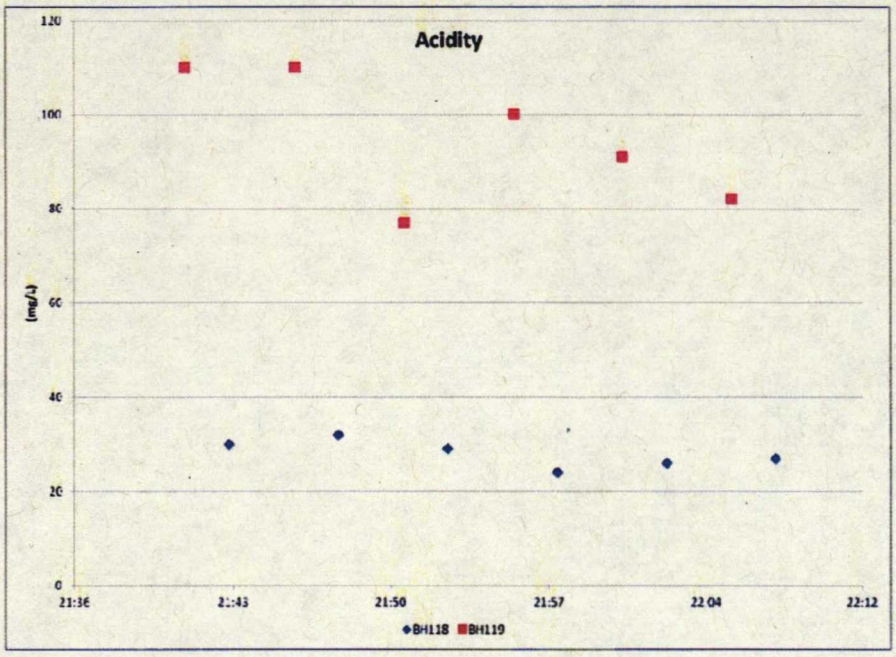


Figure 12: Acidity

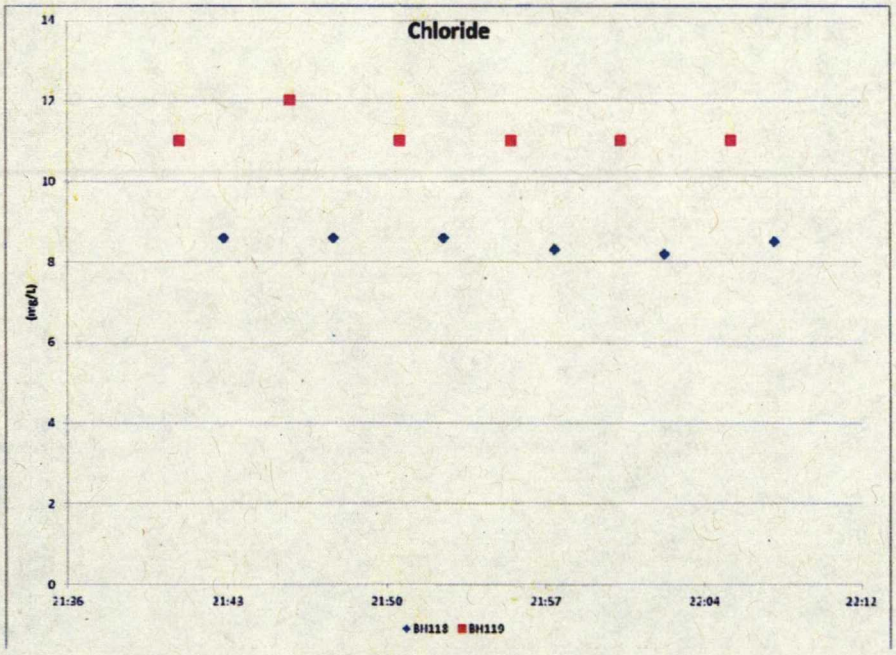


Figure 13: Chloride

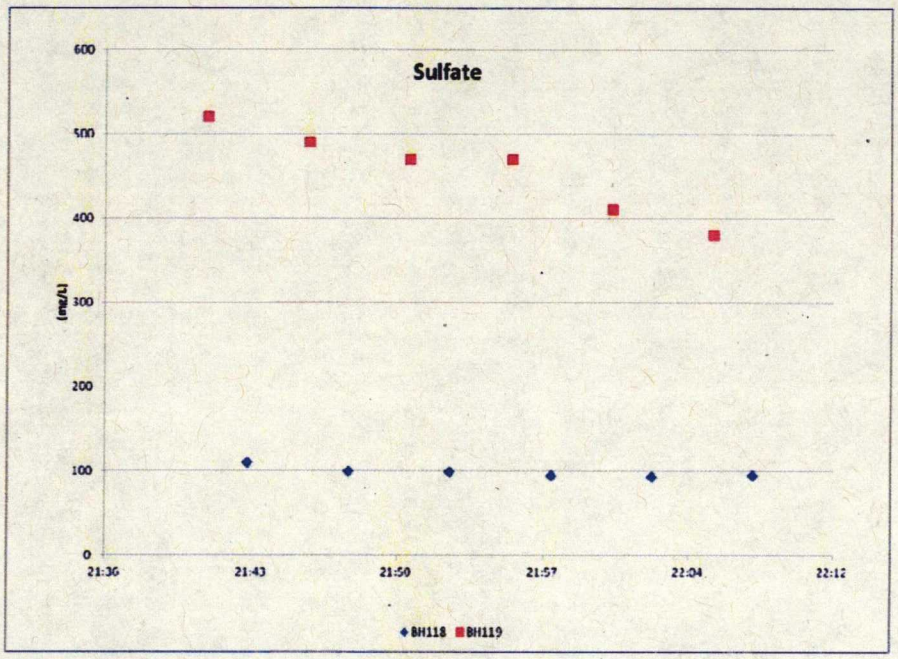


Figure 14: Sulfate

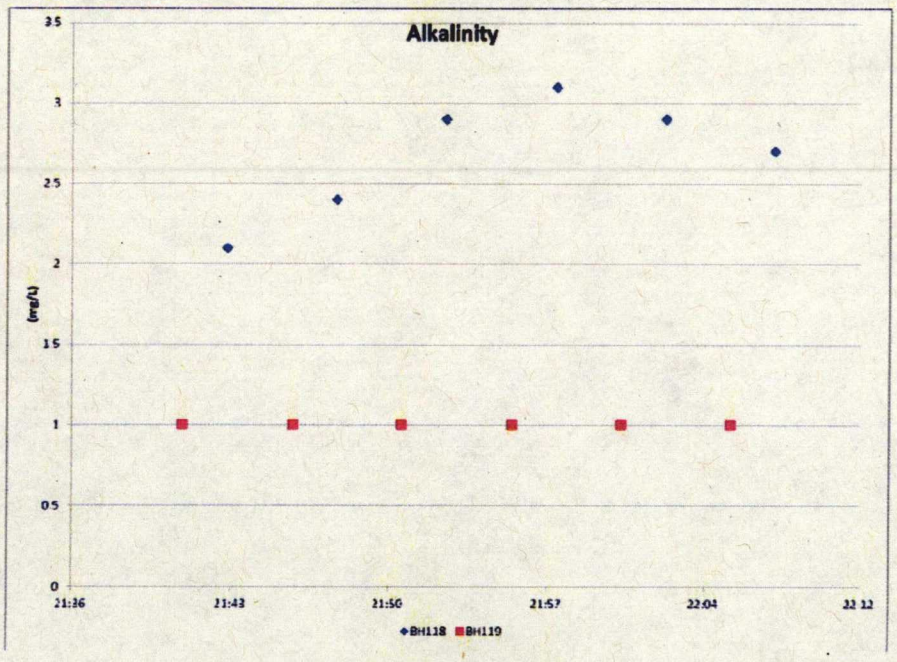


Figure 15: Alkalinity

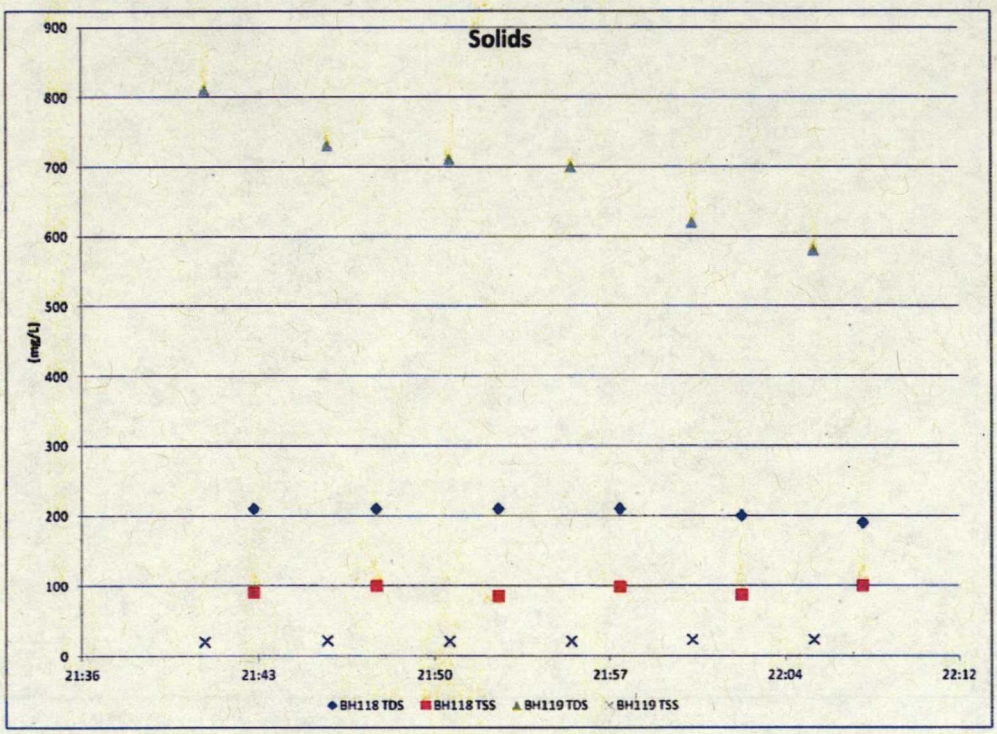


Figure 16: Solids

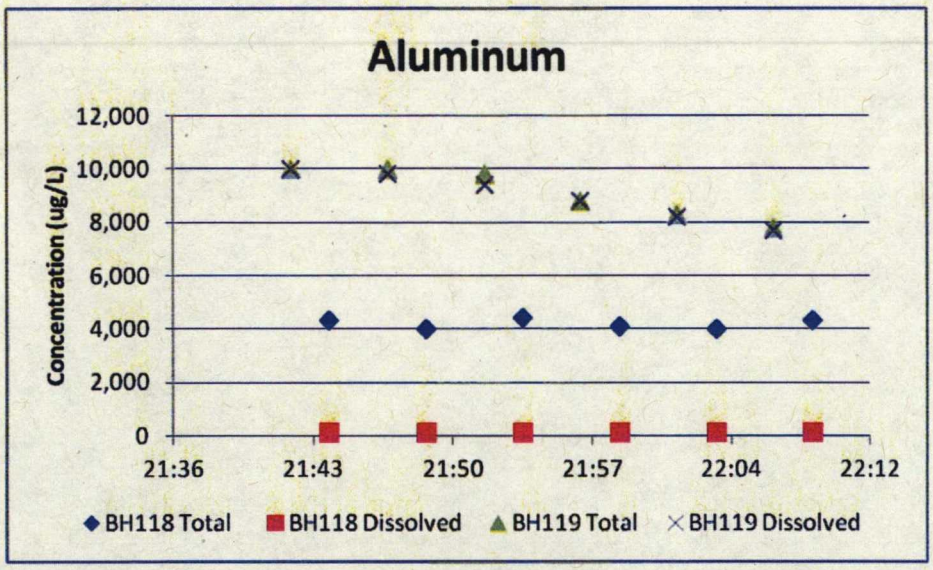


Figure 17: Aluminum

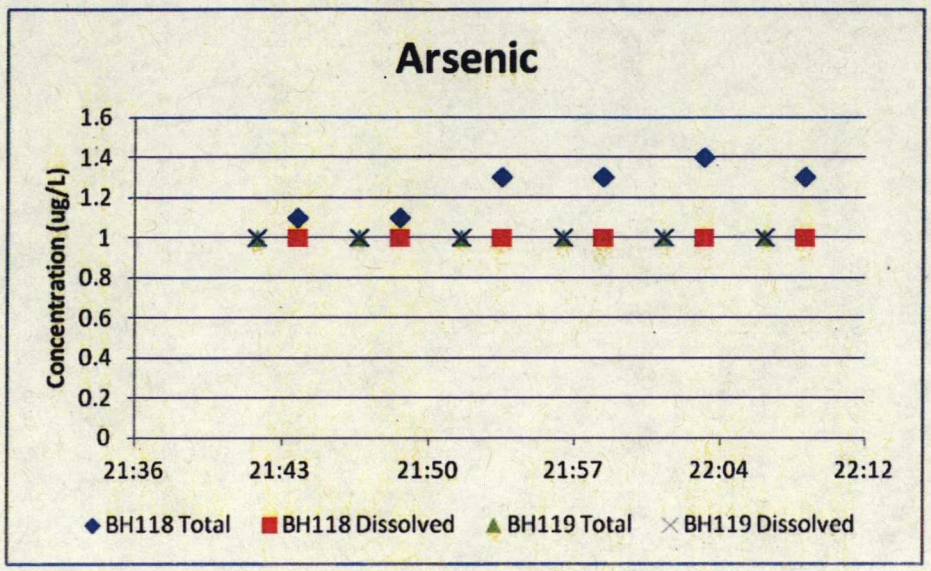


Figure 18: Arsenic

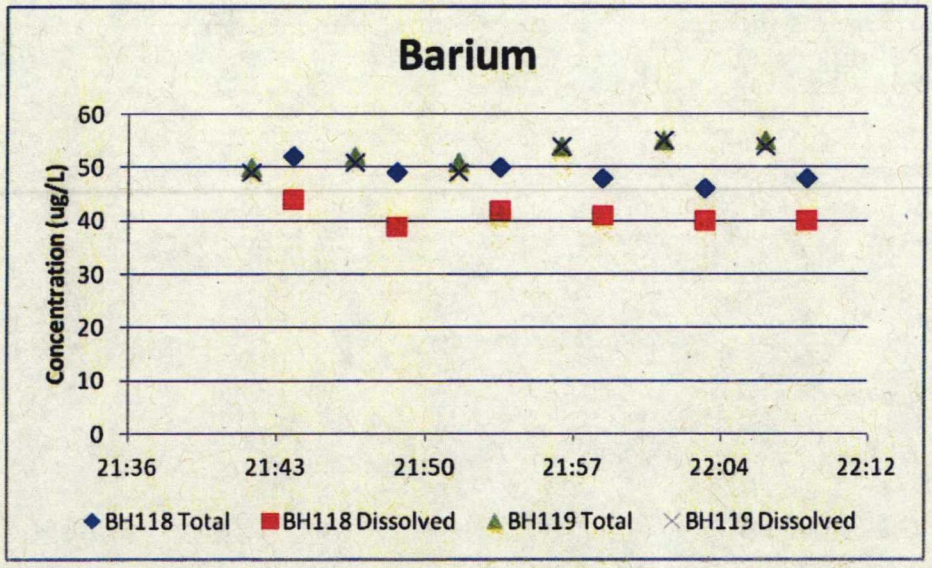


Figure 19: Barium

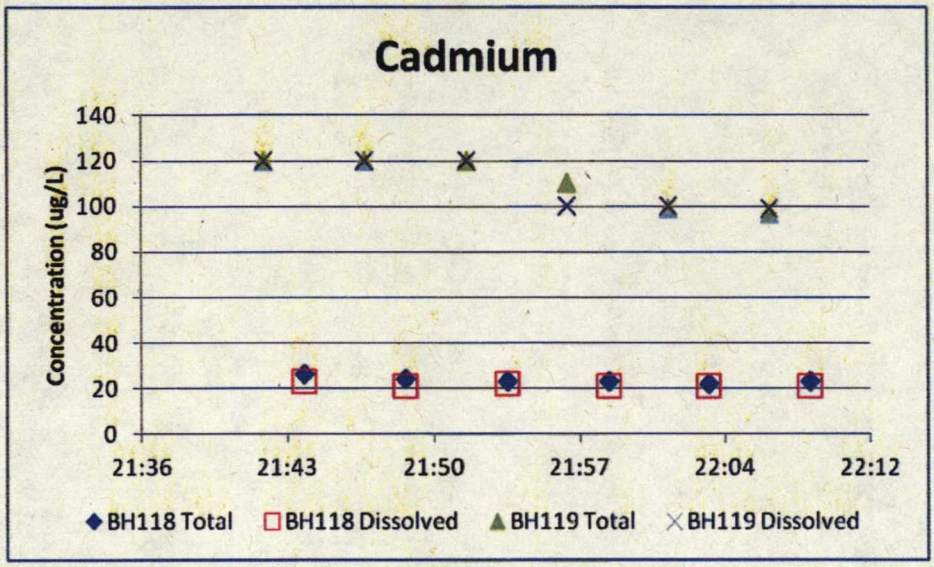


Figure 20: Cadmium

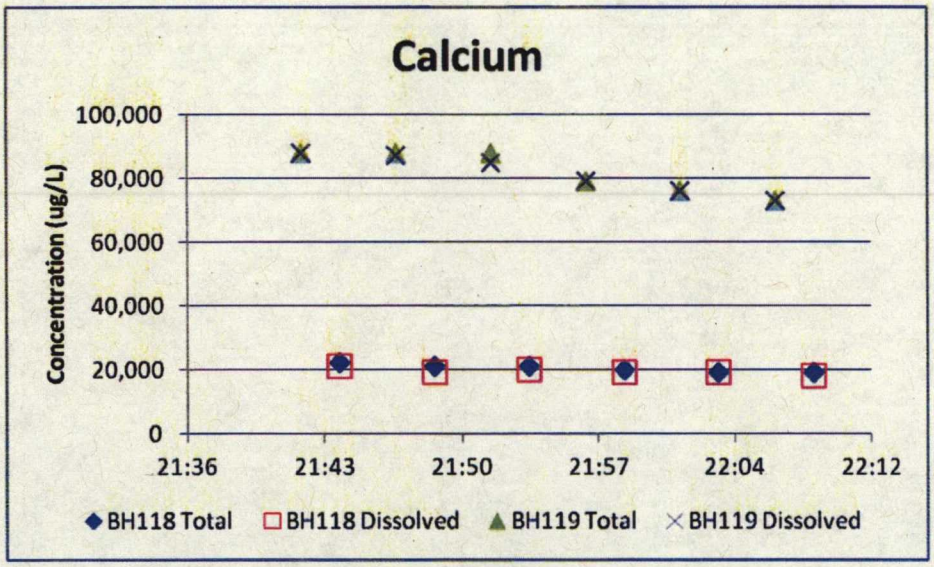


Figure 21: Calcium

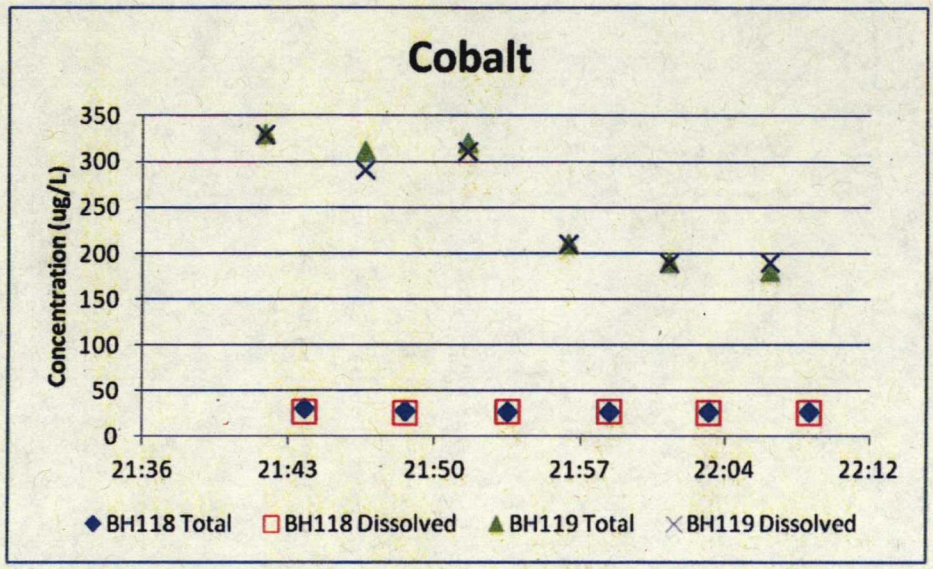


Figure 22: Cobalt

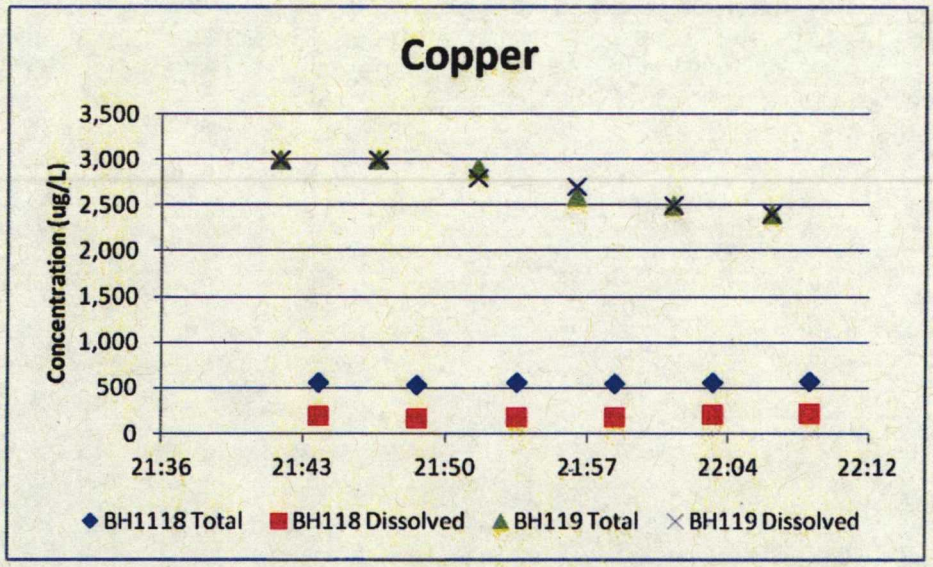


Figure 23: Copper

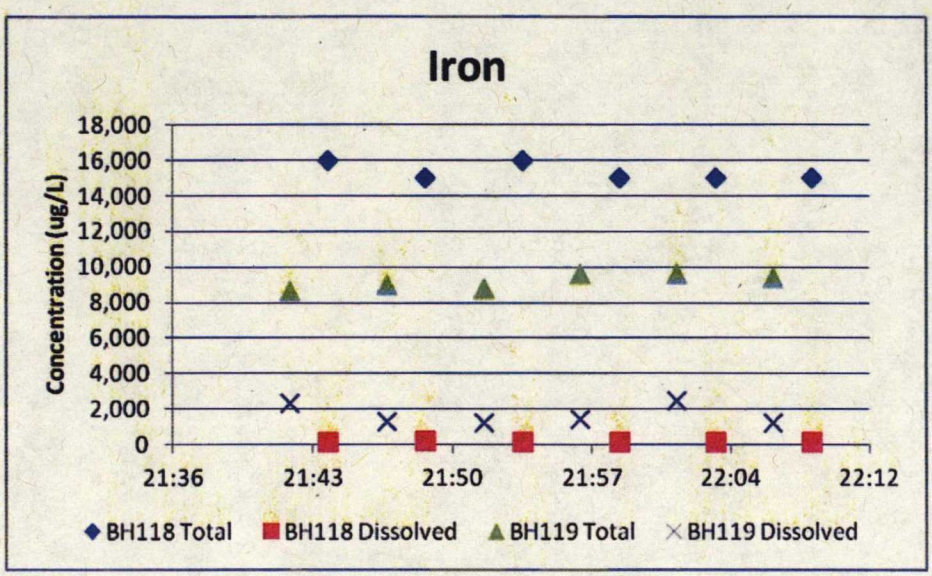


Figure 24: Iron

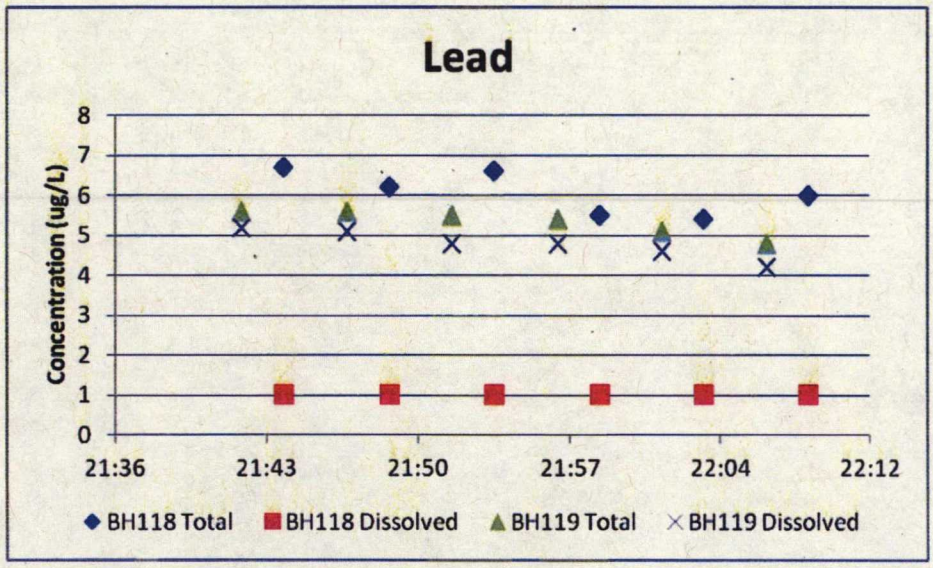


Figure 25: Lead

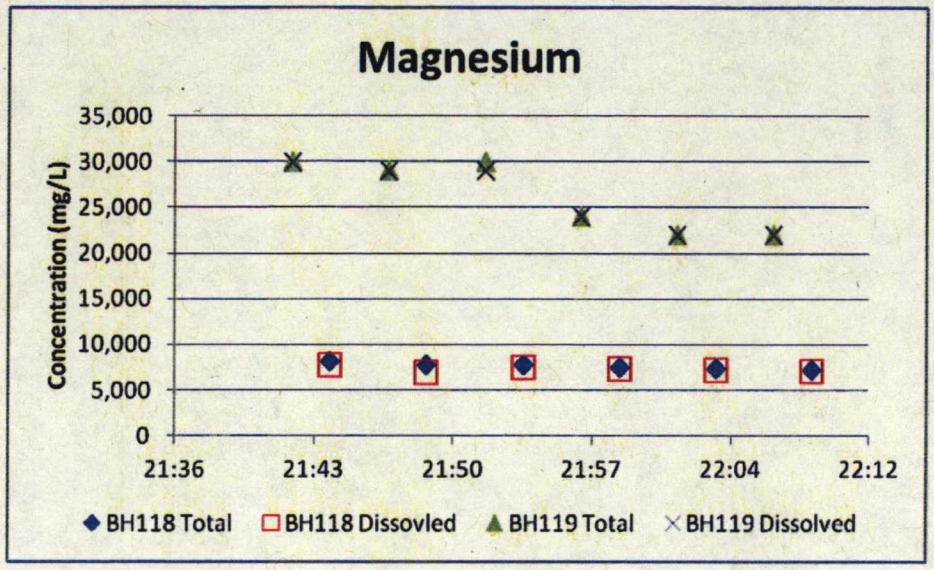


Figure 26: Magnesium

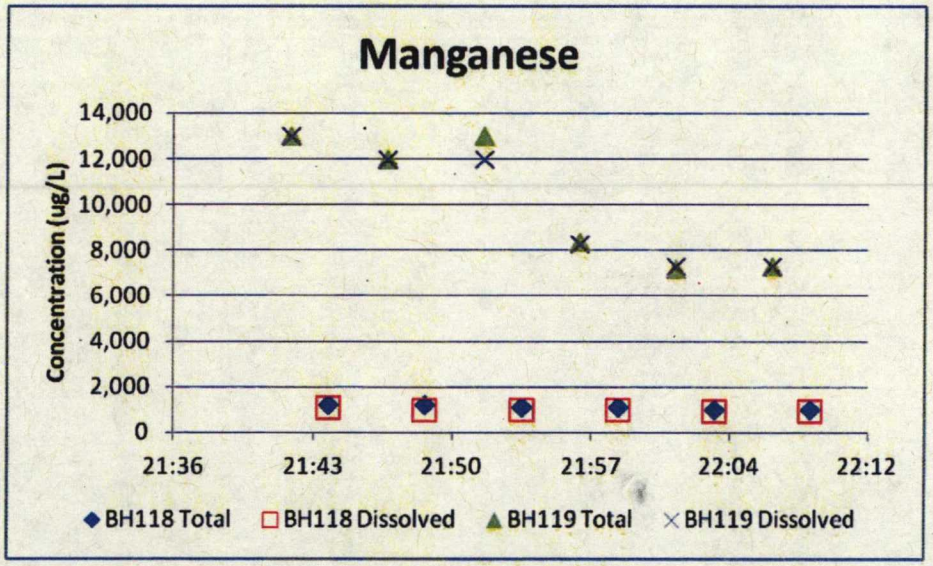


Figure 27: Manganese

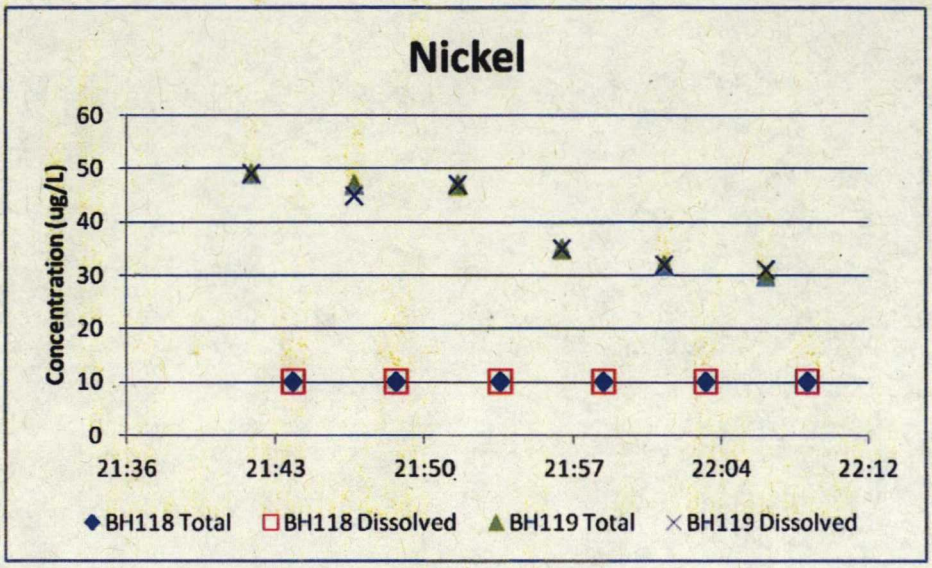


Figure 28: Nickel

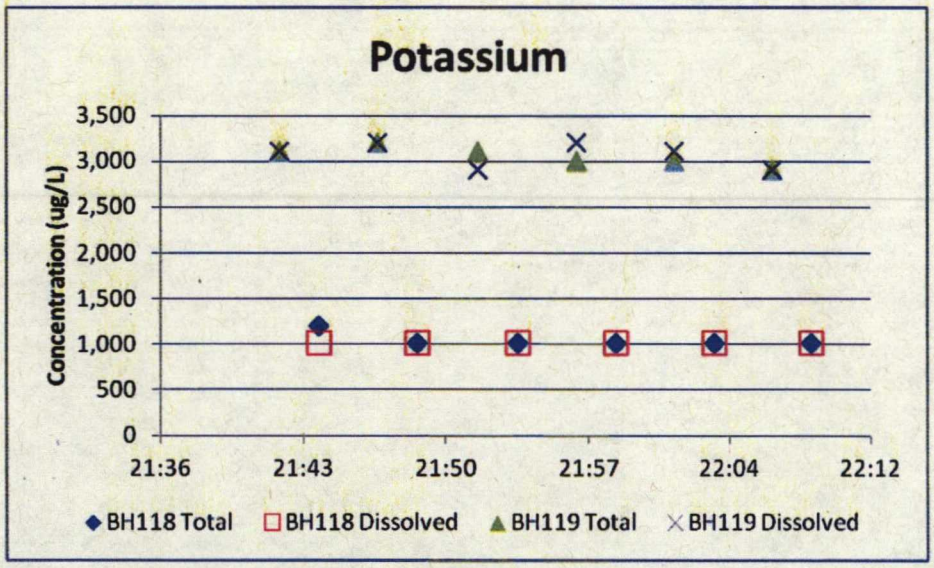


Figure 29: Potassium

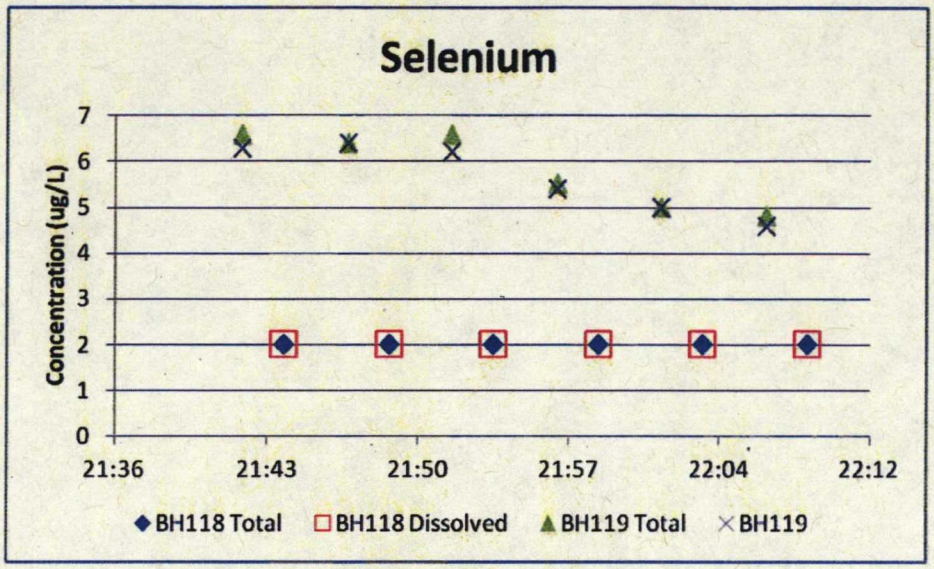


Figure 30: Selenium

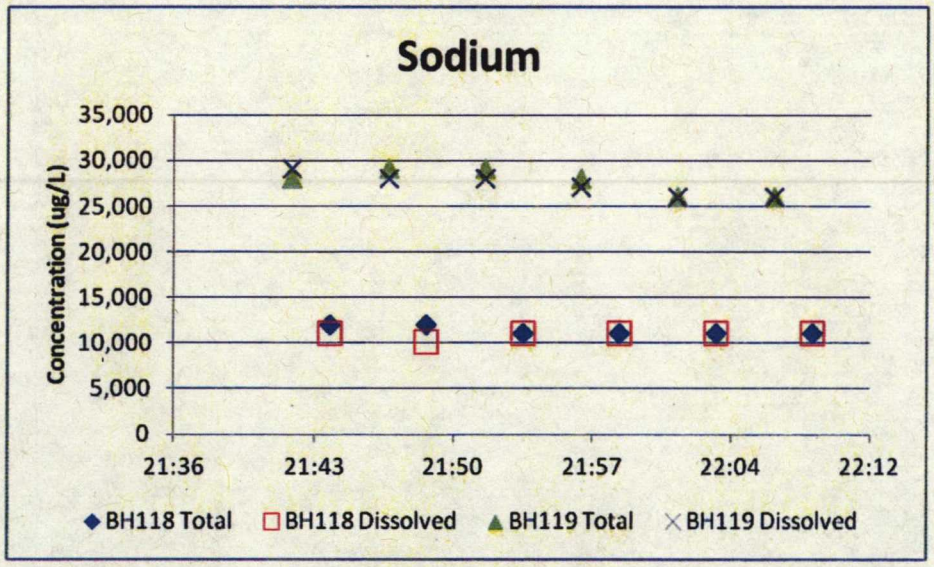


Figure 31: Sodium

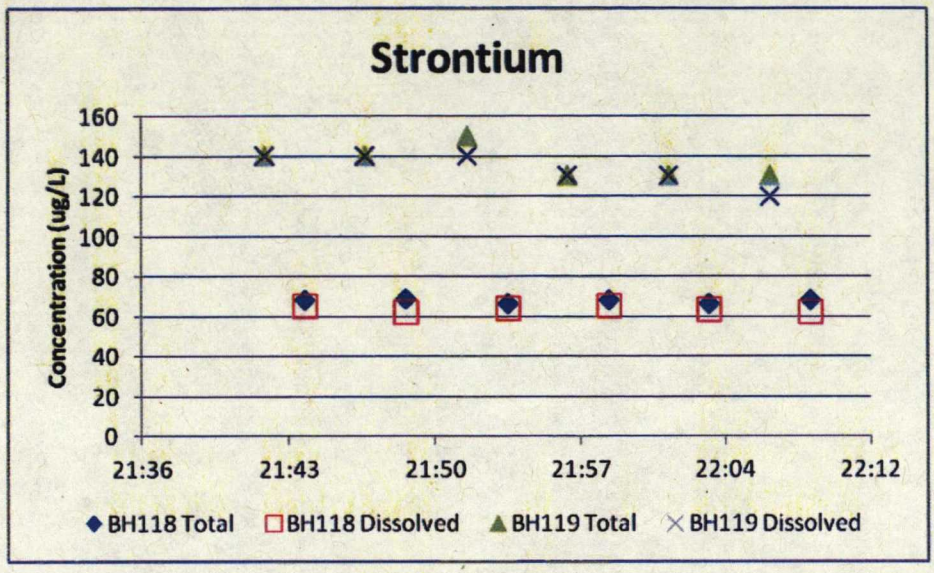


Figure 32: Strontium

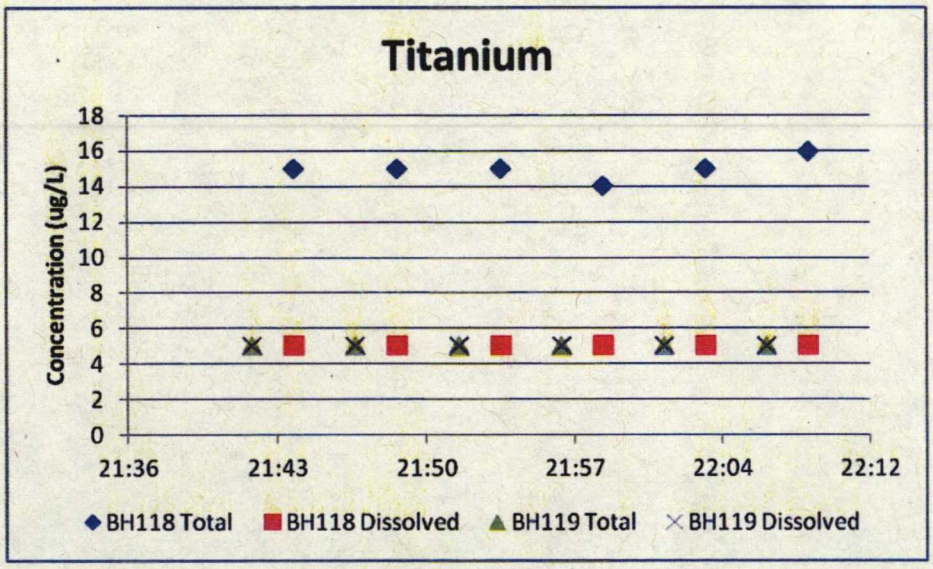


Figure 33: Titanium

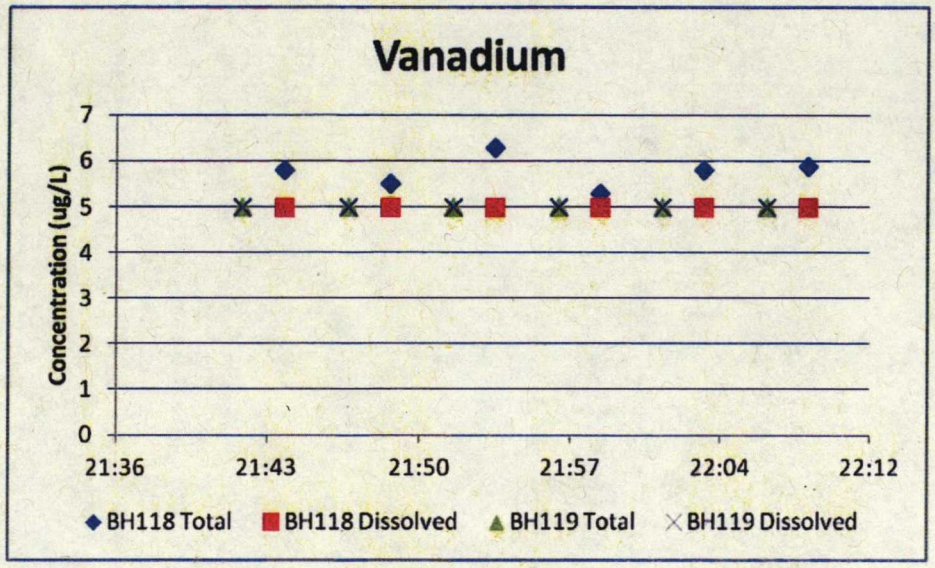


Figure 34: Vanadium

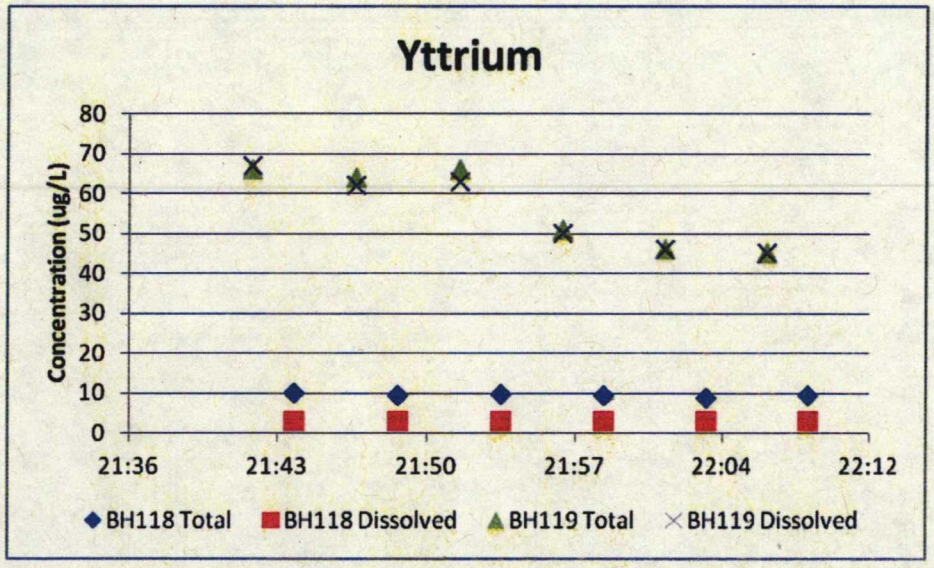


Figure 35: Yttrium

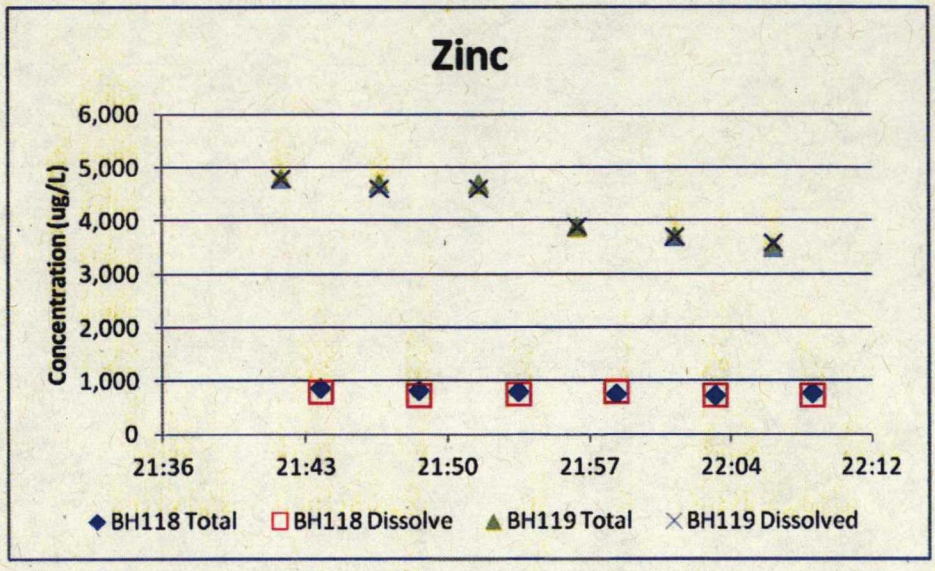


Figure 36: Zinc

5.0 Quality Control

Quality control procedures were used in the field to ensure that reliable data was obtained. Prior to sampling, deionized water was pumped through the ISCOs as sample blanks. Results from equipment blanks are listed in Table 24. At BH119, Cadmium, Manganese, and Zinc were present just above the MRL. Results from those analytes were much greater negating any concern of interference.

All documents and records are maintained in accordance with SESD Operating Procedure for Control of Records (SESDPROC-002-R5, 2010).

Table 24: QC samples

Sample ID	Station	Analyte	Result	Qualifier	Units	MRL
QCBH118	BH118	Aluminum	100	U,J,QR-1	µg/L	100
QCBH119	BH119	Aluminum	100	U	µg/L	100
QCBH118	BH118	Antimony	1	U	µg/L	1
QCBH119	BH119	Antimony	1	U	µg/L	1
QCBH118	BH118	Arsenic	1	U	µg/L	1
QCBH119	BH119	Arsenic	1	U	µg/L	1
QCBH118	BH118	Barium	5	U	µg/L	5
QCBH119	BH119	Barium	5	U	µg/L	5
QCBH118	BH118	Beryllium	3	U	µg/L	3
QCBH119	BH119	Beryllium	3	U	µg/L	3
QCBH118	BH118	Cadmium	0.5	U	µg/L	0.5
QCBH119	**BH119**	**Cadmium**	**0.65**		**µg/L**	**0.5**

QCBH118	BH118	Calcium	250	U	µg/L	250
QCBH119	BH119	Calcium	250	U	µg/L	250
QCBH118	BH118	Chromium	5	U	µg/L	5
QCBH119	BH119	Chromium	5	U	µg/L	5
QCBH118	BH118	Cobalt	5	U	µg/L	5
QCBH119	BH119	Cobalt	5	U	µg/L	5
QCBH118	BH118	Copper	10	U	µg/L	10
QCBH119	BH119	Copper	10	U	µg/L	10
QCBH118	BH118	Iron	100	U	µg/L	100
QCBH119	BH119	Iron	100	U	µg/L	100
QCBH118	BH118	Lead	1	U	µg/L	1
QCBH119	BH119	Lead	1	U	µg/L	1
QCBH118	BH118	Magnesium	250	U	µg/L	250
QCBH119	BH119	Magnesium	250	U	µg/L	250
QCBH118	BH118	Manganese	5	U	µg/L	5
QCBH119	**BH119**	**Manganese**	**5.7**		**µg/L**	**5**
QCBH118	BH118	Mercury	0.1	U	µg/L	0.1
QCBH119	BH119	Mercury	0.1	U	µg/L	0.1
QCBH118	BH118	Molybdenum	10	U	µg/L	10
QCBH119	BH119	Molybdenum	10	U	µg/L	10
QCBH118	BH118	Nickel	10	U	µg/L	10
QCBH119	BH119	Nickel	10	U	µg/L	10
QCBH118	BH118	Potassium	1000	U	µg/L	1000
QCBH119	BH119	Potassium	1000	U	µg/L	1000
QCBH118	BH118	Selenium	2	U	µg/L	2
QCBH119	BH119	Selenium	2	U	µg/L	2
QCBH118	BH118	Silver	5	U	µg/L	5
QCBH119	BH119	Silver	5	U	µg/L	5
QCBH118	BH118	Sodium	1000	U	µg/L	1000
QCBH119	BH119	Sodium	1000	U	µg/L	1000
QCBH118	BH118	Strontium	5	U	µg/L	5
QCBH119	BH119	Strontium	5	U	µg/L	5
QCBH118	BH118	Thallium	1	U	µg/L	1
QCBH119	BH119	Thallium	1	U	µg/L	1
QCBH118	BH118	Tin	15	U	µg/L	15
QCBH119	BH119	Tin	15	U	µg/L	15
QCBH118	BH118	Titanium	5	U	µg/L	5
QCBH119	BH119	Titanium	5	U	µg/L	5
QCBH118	BH118	Vanadium	5	U	µg/L	5
QCBH119	BH119	Vanadium	5	U	µg/L	5
QCBH118	BH118	Yttrium	3	U	µg/L	3

QCBH119	BH119	Yttrium	3	U	µg/L	3
QCBH118	BH118	Zinc	10	U	µg/L	10
QCBH119	**BH119**	**Zinc**	**15**		**µg/L**	**10**

6.0 Conclusions

Results show an increased presence of metals, solids, sulfate, and chloride downstream of the spillway. Comparison to other unimpaired streams along with BH136 in the area could help elucidate natural versus anthropomorphic causes of surface water conditions. Flow measurement at high stages would also be of use to verify hydrograph assumptions and calculation of loading rates.

Works Cited

Barfield, B., Haain, C., & Hayes, J. (1994). *Design Hydrology and Sedimentology for Small Catchements.* San Diego: Academic Press, Inc.

SESDPROC-002-R5. (2010). *SESD Operating Procedure for Control of Records.* Athens: Region 4.

SESDPROC-201-R3. (2013). *SESD Operating Procedure for Surfacewater Sampling.* Athens: Region 4.

SESDPROC-501-R3. (2012). *SESD Operating Procedure for Hydrological Studies.* Athens: Region 4.

USDA NRCS. (2010). *National Engineering Handbook Part 630 Chpt 15.* Washington DC.

USDA NRCS. (2007). *National Engineering Handbook Part 630 Chpt 16 Hydrographs.* Washington DC.

Appendix A: Flow Tracker Files

Discharge Measurement Summary

Date Generated: Mon Jul 8 2013

File Information

File Name	1181.118.WAD
Start Date and Time	2013/03/20 09:36:25

Site Details

Site Name	
Operator(s)	

System Information

Sensor Type	FlowTracker
Serial #	P161
CPU Firmware Version	2.3
Software Ver	2.30
Mounting Correction	0.0%

Units	(English Units)
Distance	ft
Velocity	ft/s
Area	ft^2
Discharge	cfs

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.3%	38.4%
Velocity	3.5%	13.5%
Width	0.3%	0.3%
Method	3.8%	-
# Stations	3.0%	-
Overall	**6.1%**	**40.7%**

Summary

Averaging Int.	15	# Stations	17
Start Edge	LEW	Total Width	8.400
Mean SNR	27.3 dB	Total Area	4.334
Mean Temp	48.48 °F	Mean Depth	0.516
Disch. Equation	Mid-Section	Mean Velocity	0.0651
		Total Discharge	**0.2824**

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD	Vel	CorrFact	MeanV	Area	Flow	%Q
0	09:36	2.60	None	0.400	0.0	0.000	0.0000	1.00	-0.0033	0.000	0.0000	0.0
1	*09:36*	*2.60*	*0.6*	*0.400*	*0.6*	*0.160*	*-0.0033*	*1.00*	*-0.0033*	*0.080*	*-0.0003*	*-0.1*
2	09:37	3.00	0.6	0.400	0.6	0.160	0.0636	1.00	0.0636	0.180	0.0115	4.1
3	09:38	3.50	0.6	0.400	0.6	0.160	0.0489	1.00	0.0489	0.200	0.0098	3.5
4	09:39	4.00	0.6	0.400	0.6	0.160	0.0453	1.00	0.0453	0.200	0.0091	3.2
5	09:39	4.50	0.6	0.400	0.6	0.160	0.0630	1.00	0.0630	0.200	0.0126	4.5
6	09:40	5.00	0.6	0.400	0.6	0.160	0.0643	1.00	0.0643	0.200	0.0129	4.6
7	09:40	5.50	0.6	0.400	0.6	0.160	0.1119	1.00	0.1119	0.200	0.0224	7.9
8	09:41	6.00	0.6	3.500	0.6	1.400	0.0781	1.00	0.0781	1.750	0.1366	48.4
9	09:42	6.50	0.6	0.400	0.6	0.160	0.0912	1.00	0.0912	0.200	0.0182	6.5
10	09:43	7.00	0.6	0.400	0.6	0.160	0.0951	1.00	0.0951	0.200	0.0190	6.7
11	09:44	7.50	0.6	0.300	0.6	0.120	0.0522	1.00	0.0522	0.150	0.0078	2.8
12	09:45	8.00	0.6	0.300	0.6	0.120	0.0679	1.00	0.0679	0.150	0.0102	3.6
13	09:46	8.50	0.6	0.300	0.6	0.120	0.0633	1.00	0.0633	0.150	0.0095	3.4
14	*09:46*	*9.00*	*0.6*	*0.200*	*0.6*	*0.080*	*0.0052*	*1.00*	*0.0052*	*0.100*	*0.0005*	*0.2*
15	09:47	9.50	0.6	0.300	0.6	0.120	0.0069	1.00	0.0069	0.300	0.0021	0.7
16	09:47	11.00	None	0.100	0.0	0.000	0.0000	1.00	0.0069	0.075	0.0005	0.2

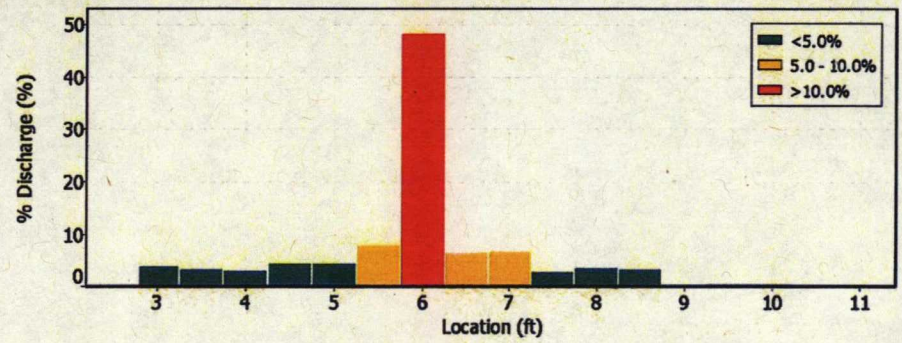
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

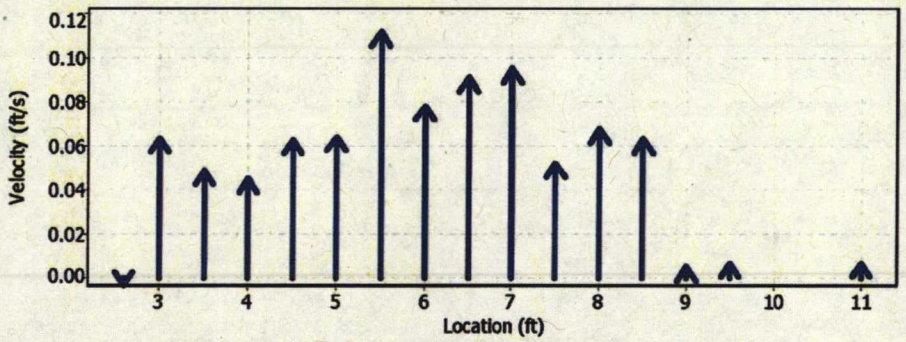
Discharge Measurement Summary

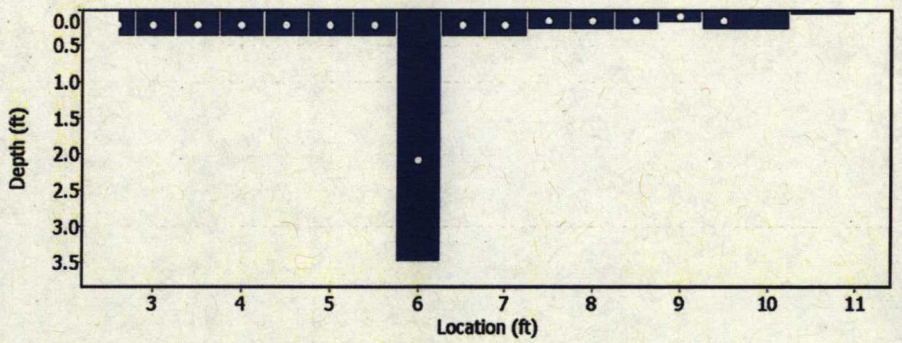
Date Generated: Mon Jul 8 2013

File Information	
File Name	1181.118.WAD
Start Date and Time	2013/03/20 09:36:25

Site Details	
Site Name	
Operator(s)	







Discharge Measurement Summary

Date Generated: Mon Jul 8 2013

File Information		Site Details	
File Name	1181.118.WAD	Site Name	
Start Date and Time	2013/03/20 09:36:25	Operator(s)	

Quality Control

St	Loc	%Dep	Message
1	2.60	0.6	High differences in beam SNR: 33.5,12.0
		0.6	Boundary QC is Fair; possible boundary interference
14	9.00	0.6	SNR (47.1) is different from typical SNR (27.3)

Discharge Measurement Summary

Date Generated: Mon Jul 8 2013

File Information

File Name	119.WAD
Start Date and Time	2013/03/20 10:10:32

Site Details

Site Name	
Operator(s)	

System Information

Sensor Type	FlowTracker
Serial #	P161
CPU Firmware Version	2.3
Software Ver	2.30
Mounting Correction	0.0%

Units	(English Units)
Distance	ft
Velocity	ft/s
Area	ft^2
Discharge	cfs

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.6%	2.3%
Velocity	2.2%	8.5%
Width	0.2%	0.2%
Method	3.2%	-
# Stations	2.4%	-
Overall	**4.7%**	**8.8%**

Summary

Averaging Int.	15	# Stations	21
Start Edge	LEW	Total Width	11.000
Mean SNR	28.5 dB	Total Area	6.574
Mean Temp	48.66 °F	Mean Depth	0.598
Disch. Equation	Mid-Section	Mean Velocity	0.0388
		Total Discharge	**0.2549**

Measurement Results

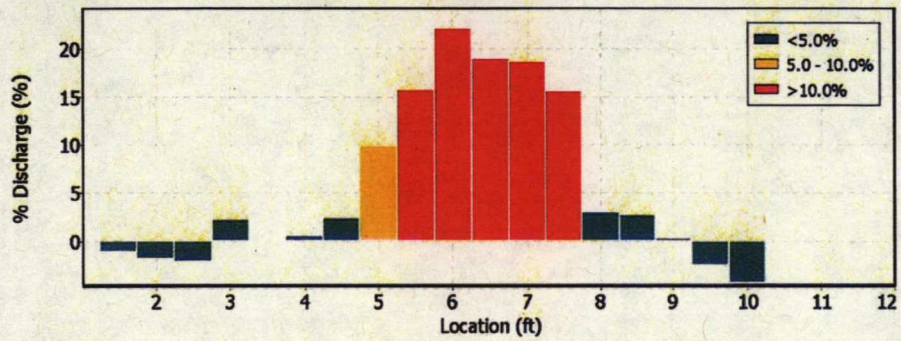
St	Clock	Loc	Method	Depth	%Dep	MeasD	Vel	CorrFact	MeanV	Area	Flow	%Q
0	10:10	1.00	None	0.000	0.0	0.000	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	10:11	1.50	0.6	0.350	0.6	0.140	-0.0164	1.00	-0.0164	0.175	-0.0029	-1.1
2	10:12	2.00	0.6	0.500	0.6	0.200	-0.0194	1.00	-0.0194	0.250	-0.0048	-1.9
3	*10:13*	*2.50*	*0.6*	*0.500*	*0.6*	*0.200*	*-0.0226*	*1.00*	*-0.0226*	*0.250*	*-0.0057*	*-2.2*
4	10:14	3.00	0.6	0.600	0.6	0.240	0.0187	1.00	0.0187	0.300	0.0056	2.2
5	10:14	3.50	0.6	0.600	0.6	0.240	-0.0023	1.00	-0.0023	0.300	-0.0007	-0.3
6	10:15	4.00	0.6	0.600	0.6	0.240	0.0052	1.00	0.0052	0.300	0.0016	0.6
7	10:16	4.50	0.6	0.600	0.6	0.240	0.0203	1.00	0.0203	0.300	0.0061	2.4
8	10:17	5.00	0.6	0.650	0.6	0.260	0.0778	1.00	0.0778	0.325	0.0253	9.9
9	10:18	5.50	0.6	0.650	0.6	0.260	0.1240	1.00	0.1240	0.325	0.0403	15.8
10	10:19	6.00	0.6	0.700	0.6	0.280	0.1617	1.00	0.1617	0.350	0.0566	22.2
11	10:20	6.50	0.6	0.700	0.6	0.280	0.1378	1.00	0.1378	0.350	0.0482	18.9
12	10:20	7.00	0.6	0.700	0.6	0.280	0.1365	1.00	0.1365	0.350	0.0478	18.7
13	*10:21*	*7.50*	*0.6*	*0.800*	*0.6*	*0.320*	*0.0994*	*1.00*	*0.0994*	*0.400*	*0.0398*	*15.6*
14	10:22	8.00	0.6	0.750	0.6	0.300	0.0200	1.00	0.0200	0.375	0.0075	2.9
15	10:22	8.50	0.6	0.800	0.6	0.320	0.0171	1.00	0.0171	0.400	0.0068	2.7
16	10:23	9.00	0.6	0.750	0.6	0.300	0.0020	1.00	0.0020	0.375	0.0007	0.3
17	10:24	9.50	0.6	0.800	0.6	0.320	-0.0157	1.00	-0.0157	0.400	-0.0063	-2.5
18	*10:25*	*10.00*	*0.6*	*0.800*	*0.6*	*0.320*	*-0.0276*	*1.00*	*-0.0276*	*0.400*	*-0.0110*	*-4.3*
19	*10:26*	*10.50*	*0.6*	*0.650*	*0.6*	*0.260*	*0.0000*	*1.00*	*0.0000*	*0.650*	*0.0000*	*0.0*
20	10:26	12.00	None	0.000	0.0	0.000	0.0000	1.00	0.0000	0.000	0.0000	0.0

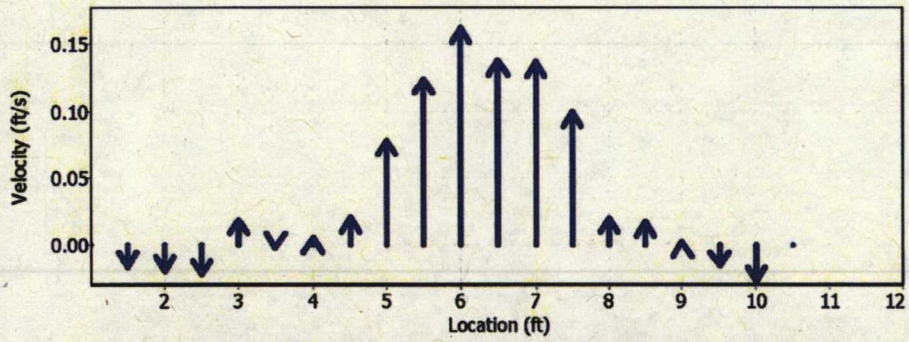
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

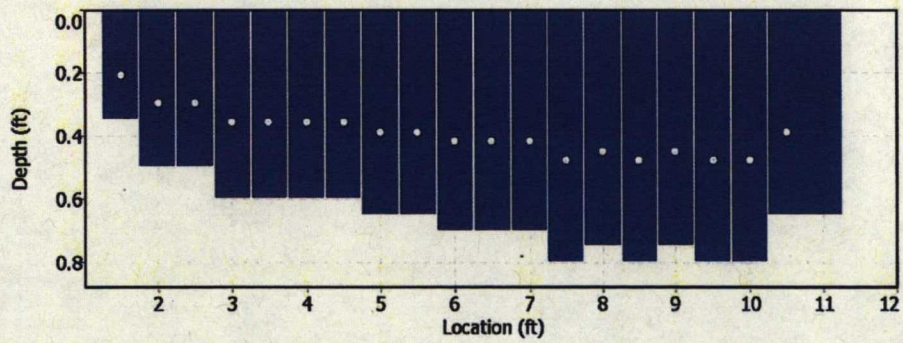
Discharge Measurement Summary

Date Generated: Mon Jul 8 2013

File Information		Site Details	
File Name	119.WAD	Site Name	
Start Date and Time	2013/03/20 10:10:32	Operator(s)	







Discharge Measurement Summary

Date Generated: Mon Jul 8 2013

File Information		Site Details	
File Name	119.WAD	Site Name	
Start Date and Time	2013/03/20 10:10:32	Operator(s)	

Quality Control

St	Loc	%Dep	Message
3	2.50	0.6	High angle: 131
13	7.50	0.6	High angle: 27
18	10.00	0.6	High angle: 177
19	10.50	0.6	High number of spikes: 2

Discharge Measurement Summary

Date Generated: Mon Jul 8 2013

File Information

File Name	136.136.WAD
Start Date and Time	2013/03/20 13:01:04

Site Details

Site Name	
Operator(s)	

System Information

Sensor Type	FlowTracker
Serial #	P161
CPU Firmware Version	2.3
Software Ver	2.30
Mounting Correction	0.0%

Units	(English Units)
Distance	ft
Velocity	ft/s
Area	ft^2
Discharge	cfs

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.6%	4.0%
Velocity	2.0%	12.7%
Width	0.2%	0.2%
Method	2.9%	-
# Stations	3.1%	-
Overall	**4.9%**	**13.3%**

Summary

Averaging Int.	15	# Stations	16
Start Edge	LEW	Total Width	7.700
Mean SNR	22.4 dB	Total Area	2.719
Mean Temp	51.85 °F	Mean Depth	0.353
Disch. Equation	Mid-Section	Mean Velocity	0.0620
		Total Discharge	**0.1687**

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD	Vel	CorrFact	MeanV	Area	Flow	%Q
0	13:01	2.20	None	0.000	0.0	0.000	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	*13:01*	*3.50*	*0.6*	*0.300*	*0.6*	*0.120*	*-0.0079*	*1.00*	*-0.0079*	*0.270*	*-0.0021*	*-1.3*
2	13:01	4.00	0.6	0.400	0.6	0.160	0.0417	1.00	0.0417	0.200	0.0083	4.9
3	13:03	4.50	0.6	0.600	0.6	0.240	0.0154	1.00	0.0154	0.300	0.0046	2.7
4	13:03	5.00	0.6	0.500	0.6	0.200	0.0069	1.00	0.0069	0.200	0.0014	0.8
5	13:05	5.30	0.6	0.500	0.6	0.200	0.0131	1.00	0.0131	0.150	0.0020	1.2
6	13:05	5.60	0.6	0.500	0.6	0.200	0.0358	1.00	0.0358	0.175	0.0063	3.7
7	*13:06*	*6.00*	*0.6*	*0.500*	*0.6*	*0.200*	*0.0351*	*1.00*	*0.0351*	*0.175*	*0.0061*	*3.6*
8	*13:07*	*6.30*	*0.6*	*0.450*	*0.6*	*0.180*	*0.1171*	*1.00*	*0.1171*	*0.135*	*0.0158*	*9.4*
9	13:08	6.60	0.6	0.500	0.6	0.200	0.1870	1.00	0.1870	0.175	0.0327	19.4
10	13:09	7.00	0.6	0.500	0.6	0.200	0.1204	1.00	0.1204	0.225	0.0271	16.1
11	13:10	7.50	0.6	0.500	0.6	0.200	0.1447	1.00	0.1447	0.250	0.0362	21.4
12	13:10	8.00	0.6	0.350	0.6	0.140	0.1509	1.00	0.1509	0.175	0.0264	15.6
13	13:11	8.50	0.6	0.300	0.6	0.120	0.0453	1.00	0.0453	0.150	0.0068	4.0
14	*13:12*	*9.00*	*0.6*	*0.200*	*0.6*	*0.080*	*-0.0207*	*1.00*	*-0.0207*	*0.140*	*-0.0029*	*-1.7*
15	13:12	9.90	None	0.000	0.0	0.000	0.0000	1.00	0.0000	0.000	0.0000	0.0

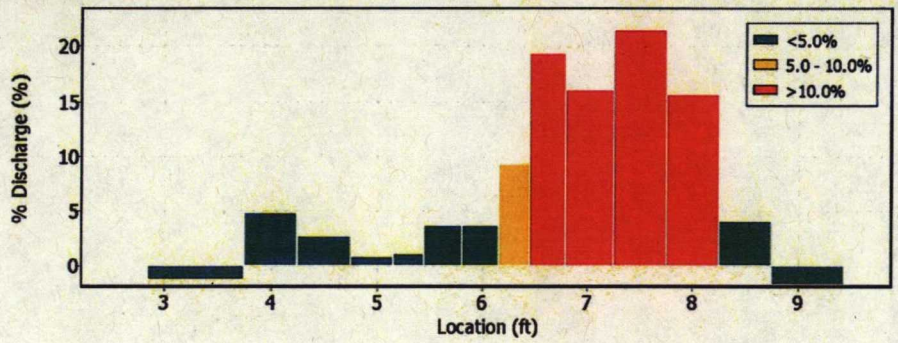
Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

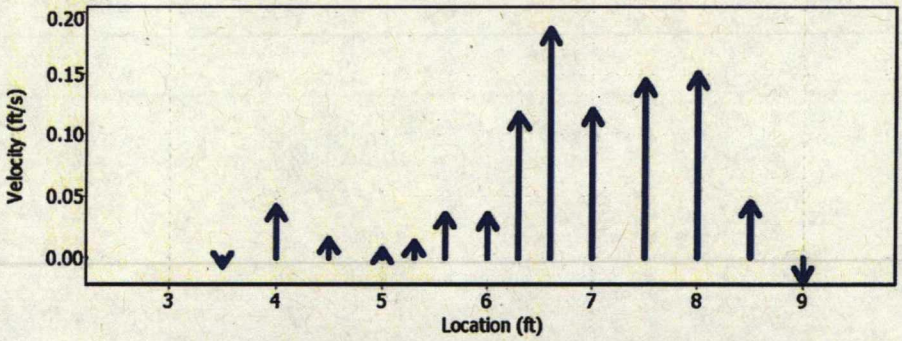
Discharge Measurement Summary

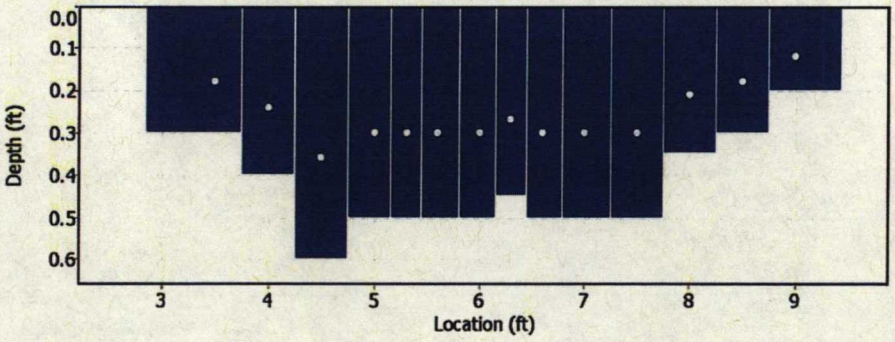
Date Generated: Mon Jul 8 2013

File Information	
File Name	136.136.WAD
Start Date and Time	2013/03/20 13:01:04

Site Details	
Site Name	
Operator(s)	







Discharge Measurement Summary

Date Generated: Mon Jul 8 2013

File Information		Site Details	
File Name	136.136.WAD	Site Name	
Start Date and Time	2013/03/20 13:01:04	Operator(s)	

Quality Control

St	Loc	%Dep	Message
1	3.50	0.6	SNR (34.2) is different from typical SNR (22.4)
7	6.00	0.6	High angle: -71
		0.6	Boundary QC is Fair; possible boundary interference
8	6.30	0.6	High angle: -30
14	9.00	0.6	High angle: 165
		0.6	SNR (11.8) is different from typical SNR (22.4)
		0.6	Boundary QC is Fair; possible boundary interference

Additional Flow Measurements

4/23/2013

Station	Flow (cfs)	Mean Velocity (fps)	Total Area (ft2)
BH118 US	0.022	0.01	2.2
BH118	0.04	0.006	6.67
BH118 DS	0.038	0.04	3.5
BH119 US	0.151	0.02	9.72
BH119 DS	0.048	0.01	7
BH136 US	0.033	0	7.6
BH136	0.017	0.01	2.2
BH136 DS	0.03	0	5.9

4/30/2013

Station	Flow (cfs)	Mean Velocity (fps)	Total Area (ft2)
BH118	5.125	1.6	6.6

5/8/2013

Station	Flow (cfs)	Mean Velocity (fps)	Total Area (ft2)
BH118	0.108	0.05	2.1
BH119	0.104	.02	4.6

Appendix B: Survey Data

BH118	3/20/2013			Bearing = 269 degrees North				GPS: N 33°52.636 W082°17.696 ± 28 ft.	
Cross-Section (XS) Survey of Unnamed Tributary, Barite Hill 118, Project #13-0262									
Station	Northing (N)	Easting (E)	Elevation (Z)	Remarks	V	HR	SD (ft.)	Rod Ht.= 6.47 ft.	
BS	33.105	-0.03	1001.96	Backsight to set up instrument for FC-120	83°32'20"	359°56'50"	33.315	Instrument Ht.=4.68 ft.	
100	-20.47	2.04	1000.66	Upper Right Bank of Cross-Section (XS)				Occupied Point=	N = 0.0
101	-7.61	2.95	1000.225	Upper Right Bank					E= 0.0
102	5.515	4.71	999.56	Upper Right Bank					Z = 1000.0
103	7.89	4.81	998.01	Mid -Right Bank				Begin XS @ 1030	
104	8.77	3.225	995.67	REW				End XS @ 1120	
105	12.19	3.865	995.495	Thalweg				Begin LP @ 1125	
106	15.49	4.565	995.83	Left Streambed Bottom				End LP @ 1145	
107	19.39	4.52	996.015	LEW				SD = surface distance from Total Station (TS) in feet	
108	21.48	6.635	998.33	Left Bank Ridge				V= vertical angle	
109	25.455	8.34	999.85	Left Bank near small Beech Tree				HR = horizontal return angle	
110	27.955	9.695	1001.87	Left Bank Top of Bank	277°02'50"	18°55'35"	29.72	MCF=TS	
Longitudinal Profile (LP) of Unnamed Tributary, Barite Hill 118, Project #13-0262								HNJ=Prism	
111	20.195	-47.91	995.77	Upstream Thalweg Longitudinal Profile (LP)	267°18'45"	292°51'25"	52.055		
112	24.995	-46.52	996.26	LEW Upstream Longitudinal Profile	267°53'15"	298°14'50"	52.845		
113	18.71	-40.75	995.78	Upstream Thalweg Longitudinal Profile	266°53'55"	294°39'45"	44.905		
114	22.255	-40.1	996.25	LEW Upstream Longitudinal Profile	267°33'15"	294°01'45"	45.9		
115	12.885	-1.925	995.595	Upstream Thalweg Longitudinal Profile	258°39'15"	351°30'15"	13.29		
116	20.4	-1.19	996.1	LEW Upstream Longitudinal Profile	264°06'40"	356°39'20"	20.545		
117	4.805	61.16	994.545	Downstream Thalweg Longitudinal Profile	266°34'50"	85°30'25"	61.46		
118	6.525	69.66	995.225	LEW Downstream Longitudinal Profile	263°33'20"	84°39'00"	70.03		

BH119	3/20/2013			Bearing = 153 degrees North				GPS: N 33°52.547 W082°17.871 ± 33 ft.	
Cross-Section (XS) Survey of Unnamed Tributary, Barite Hill 119, Project #13-0262									
Station	Northing (N)	Easting (E)	Elevation (Z)	Remarks	V	HR	SD (ft.)	Rod Ht.= 6.47 ft.	
BS	-28.595	17.62	1001.115	Backsight to set up instrument for FC-120	86°05'35"	148°21'30"	33.665	Instrument Ht.=5.29 ft.	
100	-45.36	-0.41	1001.89	Upper Right Bank of Cross-Section (XS)/shelf	273°52'15"	180°31'05"	45.465	Occupied Point=	N = 0.0
101	-22.805	1.055	1000.94	Upper Right Bank					E= 0.0
102	-14.68	0.79	1000.285	Upper Right Bank/Floodplain					Z = 1000.0
103	-6.88	0.18	1000.25	Edge of Right Bank				Begin XS @ 1200	
104	5.25	0.235	998.94	Edge of Right Bank				End XS @ 1250	
105	6.57	0.15	997.25	REW				Begin LP @ 1255	
106	6.575	0.19	996.555	Right Streambed Bottom				End LP @ 1315	
107	8.675	0.13	996.505	Right Streambed Bottom				SD = surface distance from Total Station (TS) in feet	
108	10.89	0.34	996.545	Thalweg				V= vertical angle	
109	13.625	0.16	996.285	Left Streambed Bottom				HR = horizontal return angle	
110	16.89	0.305	997.015	Left Streambed Edge				MCF/DML/HNJ=TS	
111	16.91	0.275	997.25	LEW				HNJ/SHB = Prism	
112	19.12	0.82	999.955	Left Top of Bank					
113	29.895	1.715	1001.685	Left Floodplain					
114	39.88	1.43	1003.22	Left Floodplain	276°17'30"	002°03'05"	= 40.0		
Longitudinal Profile of Unnamed Tributary, Barite Hill 119, Project #13-0262									
115	19.585	-72.6	997.25	Upstream LEW Longitudinal Profile (LP)	268°48'10"	285°05'45"	75.21		
116	11.455	-69.815	996.93	Thalweg Upstream Longitudinal Profile	268°28'10"	279°19'10"	70.775		
117	16.94	-51.265	997.21	Upstream LEW Longitudinal Profile	268°17'35"	288°17'05"	54.015		
118	14.925	-51.45	996.025	Thalweg Upstream Longitudinal Profile	267°00'45"	286°10'45"	53.645		
119	6.175	64.31	997.23	Downstream LEW Longitudinal Profile	268°35'20"	84°30'55"	64.625		
120	1.44	56.96	996.22	Thalweg Downstream Longitudinal Profile	267°23'15"	88°33'10"	57.035		

BH136	3/20/2013			Bearing = 108 degrees North				GPS: N 33°52.001 W082°18.206 ± 40 ft.
Cross-Section (XS) Survey of Unnamed Tributary, Barite Hill 136, Project #13-0262								
Station	Northing (N)	Easting (E)	Elevation (Z)	Remarks	V	HR	SD (ft.)	Rod Ht.= 6.55 ft.
BS	-5.65	15.12	1003.28	Backsight to set up instrument for FC-120, LB Top	74°25'25"	110°29'20"	16.755	Instrument Ht.=5.33 ft.
100	-16.86	-0.42	1003.265	Top Left Bank				Occupied Point= N = 0.0
101	-8.865	-0.16	1003.27	Left Bank Edge				E= 0.0
102	-6.005	0.255	1002.29	Left Bank, Break in Slope				Z = 1000.0
103	0.82	3.815	999.695	LEW				Begin XS @ 1400
104	4.565	3.435	999.42	Left Streambed Bottom				End XS @ 1435
105	6.425	3.455	999.12	Left Streambed Bottom				Begin LP @ 1435
106	7.33	3.53	999.01	Thalweg				End LP @ 1455
107	9.03	3.435	999.145	Right Streambed Bottom				SD = surface distance from Total Station (TS) in feet
108	11.305	3.855	999.67	Right Channel Bottom Edge				V= vertical angle
109	11.37	3.66	999.71	REW				HR = horizontal return angle
110	12.075	3.695	1001.005	Right Top of Channel (Lower)				MCF/DML/HNJ=TS
111	14.74	3.105	1001.98	Right Top of Channel (Upper)				HNJ/DML = Prism
112	18.6	2.96	1003.145	Right Top of Channel (Upper)				
113	24.86	1.765	1003.05	Right Top of Channel (Upper)				
114	32.97	3.36	1003.845	Right Top of Channel (Upper)	278°41'25"	005°49'20"	33.525	
Longitudinal Profile of Unnamed Tributary, Barite Hill 136, Project #13-0262								
115	16.71	48.655	1000.085	Upstream REW Longitudinal Profile (LP)	271°27'10"	71°02'40"	51.465	
116	12.635	48.38	999.685	Thalweg Upstream Longitudinal Profile	271°02'20"	75°21'50"	50.01	
117	14.055	26.22	999.685	Upstream REW Longitudinal Profile	271°44'30"	61°48'25"	29.76	
118	10.94	21.525	998.945	Thalweg Upstream Longitudinal Profile	270°23'15"	63°03'45"	24.145	
119	9.115	-60.345	998.555	Downstream REW Longitudinal Profile	269°47'15"	278°35'30"	61.03	
120	9.455	-57.33	998.315	Thalweg Downstream Longitudinal Profile	269°32'25"	279°19'45"	58.11	

Appendix C: Rating Curve Data

BH118

Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)
0.1	0.01	2	10.33	3.85	40.52	5.65	78.29	7.6	211.92
0.15	0.02	2.05	10.80	3.9	41.76	5.7	80.28	7.65	217.01
0.175	0.03	2.1	11.28	3.95	43.01	5.75	82.34	7.7	222.19
0.2	0.04	2.15	11.76	4	44.29	5.8	84.47	7.75	227.47
0.25	0.08	2.2	12.26	4.065	45.97	5.85	86.67	7.8	232.84
0.3	0.12	2.25	12.77	4.1	46.10	5.9	88.94	7.85	238.30
0.335	0.16	2.3	13.28	4.15	46.36	5.95	91.29	7.9	243.86
0.35	0.20	2.35	13.80	4.2	46.71	6	93.70	7.95	249.51
0.4	0.33	2.4	14.33	4.25	47.15	6.05	96.19	8	255.26
0.45	0.49	2.45	14.88	4.3	47.66	6.1	98.75	8.05	261.11
0.52	0.76	2.5	15.42	4.35	48.24	6.15	101.38	8.1	267.06
0.6	1.04	2.515	15.59	4.355	48.30	6.2	104.08	8.15	273.10
0.65	1.23	2.55	16.00	4.4	48.86	6.25	106.86	8.2	279.24
0.7	1.43	2.6	16.59	4.45	49.54	6.3	109.71	8.25	285.48
0.75	1.64	2.65	17.19	4.5	50.28	6.35	112.64	8.3	291.82
0.8	1.87	2.7	17.80	4.55	51.08	6.4	115.64	8.35	298.27
0.85	2.11	2.75	18.42	4.6	51.94	6.45	118.72	8.4	304.81
0.9	2.35	2.8	19.05	4.65	52.85	6.5	121.87		
0.95	2.61	2.835	19.24	4.7	53.82	6.55	125.11		
1	2.88	2.85	19.50	4.73	54.42	6.6	128.41		
1.05	3.16	2.9	20.38	4.75	54.66	6.65	131.80		
1.1	3.45	2.95	21.29	4.8	55.31	6.7	135.27		
1.15	3.75	3	22.21	4.85	56.06	6.75	138.82		
1.2	4.06	3.05	23.15	4.9	56.89	6.8	142.44		
1.25	4.38	3.1	24.10	4.95	57.80	6.85	146.15		
1.3	4.71	3.15	25.07	5	58.79	6.9	149.94		
1.35	5.05	3.2	26.06	5.05	59.85	6.95	153.81		
1.4	5.40	3.25	27.07	5.1	60.99	7	157.77		
1.45	5.76	3.3	28.09	5.15	62.21	7.05	161.80		
1.5	6.13	3.35	29.14	5.165	62.59	7.1	165.92		
1.55	6.51	3.4	30.19	5.2	63.50	7.15	170.13		
1.6	6.90	3.45	31.27	5.25	64.86	7.2	174.42		
1.65	7.29	3.5	32.37	5.3	66.30	7.25	178.80		
1.7	7.70	3.55	33.48	5.35	67.80	7.3	183.27		
1.75	8.12	3.6	34.61	5.4	69.37	7.35	187.82		
1.8	8.54	3.65	35.76	5.45	71.02	7.4	192.46		
1.85	8.97	3.7	36.92	5.5	72.73	7.45	197.19		
1.9	9.42	3.75	38.10	5.55	74.51	7.5	202.01		
1.95	9.87	3.8	39.30	5.6	76.37	7.55	206.92		

BH119

Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)
0	0.000	1.75	1.20	3.75	5.44	5.75	20.12
0.05	0.000	1.8	1.28	3.8	5.59	5.8	20.77
0.1	0.001	1.85	1.36	3.85	5.74	5.85	21.43
0.15	0.003	1.9	1.45	3.9	5.91	5.9	22.11
0.2	0.006	1.95	1.53	3.98	6.20	5.95	22.81
0.22	0.013	2	1.62	4	6.33	6	23.52
0.25	0.000	2.05	1.71	4.05	6.57	6.05	24.26
0.26	0.000	2.15	1.89	4.1	6.81	6.1	25.01
0.27	0.000	2.2	1.98	4.15	7.07	6.15	25.78
0.3	0.000	2.25	2.08	4.2	7.33	6.2	26.58
0.35	0.003	2.3	2.18	4.25	7.60	6.25	27.39
0.4	0.010	2.35	2.28	4.3	7.89	6.3	28.22
0.45	0.020	2.4	2.38	4.35	8.18	6.35	29.07
0.5	0.032	2.45	2.48	4.4	8.48	6.4	29.94
0.55	0.047	2.5	2.59	4.45	8.79	6.45	30.83
0.6	0.064	2.55	2.70	4.5	9.12	6.5	31.74
0.65	0.08	2.6	2.81	4.55	9.45	6.55	32.68
0.7	0.10	2.7	2.99	4.6	9.79	6.6	33.63
0.73	0.12	2.75	3.06	4.7	10.44	6.65	34.61
0.75	0.13	2.8	3.13	4.75	10.75	6.7	35.60
0.8	0.15	2.85	3.21	4.8	11.07	6.75	36.62
0.85	0.18	2.9	3.30	4.85	11.40	6.8	37.66
0.9	0.21	2.95	3.39	4.9	11.75	6.85	38.72
0.95	0.25	3	3.48	4.95	12.12	6.9	39.80
1	0.28	3.05	3.58	5	12.50	7	42.03
1.05	0.33	3.1	3.68	5.05	12.89	7.5	54.57
1.1	0.38	3.15	3.79	5.1	13.31	8	69.54
1.15	0.43	3.2	3.91	5.15	13.73	8.5	87.13
1.2	0.48	3.25	4.03	5.2	14.18	9	107.51
1.25	0.53	3.3	4.15	5.25	14.64	9.5	130.86
1.3	0.59	3.35	4.28	5.3	15.11	10	157.33
1.35	0.65	3.4	4.41	5.35	15.60	10.5	187.09
1.4	0.71	3.45	4.55	5.4	16.11	11	220.31
1.45	0.78	3.5	4.69	5.45	16.63	11.5	257.12
1.5	0.84	3.55	4.84	5.5	17.17	12	297.70
1.55	0.91	3.6	5.00	5.55	17.73	12.5	342.17
1.6	0.98	3.65	5.16	5.6	18.30	13	390.70
1.65	1.05	3.67	5.22	5.65	18.89	13.5	443.41
1.7	1.13	3.7	5.30	5.7	19.50	14	500.46

BH136

Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)	Depth (ft)	Q (cfs)
0.05	0.000	1.85	1.93	3.8	8.90	5.7	22.79	7.65	56.64	9.6	115.38	11.55	204.53
0.1	0.001	1.9	2.05	3.85	9.16	5.75	23.39	7.7	57.81	9.65	117.26	11.6	207.26
0.11	0.002	1.95	2.16	3.9	9.44	5.8	24.01	7.75	59.00	9.7	119.17	11.65	210.02
0.135	0.003	2	2.28	3.95	9.71	5.85	24.64	7.8	60.20	9.75	121.09	11.7	212.79
0.15	0.004	2.05	2.40	4	10.00	5.9	25.29	7.85	61.42	9.8	123.03	11.75	215.60
0.2	0.009	2.1	2.51	4.04	10.23	5.95	25.94	7.9	62.66	9.85	125.00	11.8	218.42
0.25	0.015	2.15	2.64	4.1	10.58	6	26.61	7.95	63.91	9.9	126.98	11.85	221.27
0.3	0.023	2.2	2.76	4.15	10.55	6.05	27.29	8	65.18	9.95	128.99	11.9	224.15
0.35	0.033	2.25	2.89	4.2	9.94	6.1	27.99	8.05	66.47	10	131.01	11.95	227.04
0.4	0.046	2.3	3.02	4.25	10.22	6.15	28.70	8.1	67.78	10.05	133.06	12	229.97
0.41	0.048	2.35	3.16	4.26	10.33	6.2	29.42	8.15	69.10	10.1	135.13	12.05	232.91
0.45	0.059	2.4	3.30	4.3	10.50	6.25	30.16	8.2	70.44	10.15	137.22	12.1	235.88
0.5	0.075	2.45	3.44	4.35	10.80	6.3	30.91	8.25	71.80	10.2	139.33	12.15	238.87
0.55	0.094	2.5	3.59	4.4	11.10	6.35	31.67	8.3	73.17	10.25	141.46	12.2	241.89
0.6	0.12	2.55	3.74	4.45	11.42	6.4	32.45	8.35	74.56	10.3	143.61	12.25	244.94
0.66	0.15	2.6	3.90	4.5	11.74	6.45	33.24	8.4	75.97	10.35	145.78	12.3	248.00
0.7	0.17	2.65	4.06	4.55	12.08	6.5	34.04	8.45	77.40	10.4	147.98	12.35	251.09
0.75	0.22	2.7	4.22	4.6	12.43	6.55	34.86	8.5	78.85	10.45	150.19	12.4	254.21
0.8	0.26	2.75	4.39	4.65	12.78	6.6	35.69	8.55	80.31	10.5	152.43	12.45	257.35
0.85	0.31	2.8	4.56	4.7	13.15	6.65	36.54	8.6	81.79	10.55	154.69	12.5	260.52
0.9	0.36	2.85	4.74	4.75	13.52	6.7	37.40	8.65	83.29	10.6	156.97	12.55	263.71
0.95	0.41	2.9	4.92	4.8	13.91	6.75	38.28	8.7	84.81	10.65	159.27	12.6	266.93
1	0.47	2.95	5.10	4.85	14.31	6.8	39.17	8.75	86.35	10.7	161.59	12.65	270.17
1.05	0.53	3	5.29	4.9	14.72	6.85	40.07	8.8	87.90	10.75	163.94	12.7	273.43
1.1	0.60	3.05	5.48	4.95	15.14	6.9	40.99	8.85	89.48	10.8	166.31	12.75	276.72
1.15	0.67	3.1	5.68	5	15.57	6.95	41.93	8.9	91.07	10.85	168.70	12.8	280.04
1.2	0.74	3.15	5.87	5.05	16.01	7	42.88	8.95	92.68	10.9	171.11	12.85	283.38
1.25	0.81	3.2	6.08	5.1	16.46	7.05	43.84	9	94.31	10.95	173.55	12.9	286.75
1.3	0.89	3.25	6.29	5.15	16.92	7.1	44.82	9.05	95.96	11	176.00	12.95	290.14
1.35	0.97	3.3	6.50	5.2	17.40	7.15	45.82	9.1	97.63	11.05	178.48	13	293.56
1.4	1.05	3.35	6.72	5.25	17.88	7.2	46.83	9.15	99.32	11.1	180.98	13.05	297.01
1.45	1.14	3.4	6.94	5.3	18.38	7.25	47.86	9.2	101.02	11.15	183.51	13.1	300.48
1.5	1.23	3.45	7.17	5.35	18.89	7.3	48.90	9.25	102.75	11.2	186.06	13.15	303.97
1.55	1.32	3.5	7.40	5.4	19.41	7.35	49.96	9.3	104.49	11.25	188.63	13.2	307.49
1.6	1.41	3.55	7.64	5.45	19.94	7.4	51.03	9.35	106.26	11.3	191.22	13.25	311.04
1.65	1.51	3.6	7.88	5.5	20.49	7.45	52.12	9.4	108.04	11.35	193.83	13.3	314.61
1.7	1.61	3.65	8.12	5.55	21.05	7.5	53.23	9.45	109.85	11.4	196.47	13.35	318.21
1.75	1.72	3.7	8.38	5.6	21.61	7.55	54.35	9.5	111.67	11.45	199.14	13.4	321.84
1.8	1.82	3.75	8.63	5.65	22.20	7.6	55.49	9.55	113.51	11.5	201.82	13.45	325.49

Appendix D: Stage Data from BH119

Date	stage (ft)	Date	stage (ft)	Date	stage (ft)	Date	stage (ft)
5/4/2013 0:16	1.153	5/4/2013 19:10	1.268	5/5/2013 18:10	2.199	5/6/2013 21:10	1.986
5/4/2013 0:32	1.151	5/4/2013 20:10	1.312	5/5/2013 18:11	2.199	5/6/2013 22:06	1.99
5/4/2013 1:16	1.151	5/4/2013 20:10	1.313	5/5/2013 19:10	2.17	5/6/2013 22:29	1.99
5/4/2013 2:01	1.151	5/4/2013 21:10	1.4	5/5/2013 20:09	2.147	5/6/2013 22:58	1.991
5/4/2013 2:58	1.152	5/4/2013 21:10	1.402	5/5/2013 21:09	2.128	5/6/2013 23:14	1.991
5/4/2013 3:00	1.151	5/4/2013 22:10	1.551	5/5/2013 22:09	2.114	5/6/2013 23:36	1.99
5/4/2013 3:10	1.151	5/4/2013 22:10	1.554	5/5/2013 23:10	2.102	5/7/2013 0:18	1.99
5/4/2013 3:44	1.151	5/4/2013 22:10	1.554	5/6/2013 0:08	2.092	5/7/2013 0:42	1.989
5/4/2013 4:22	1.151	5/4/2013 23:10	1.712	5/6/2013 1:08	2.084	5/7/2013 1:11	1.99
5/4/2013 4:50	1.153	5/4/2013 23:10	1.712	5/6/2013 2:10	2.076	5/7/2013 1:27	1.988
5/4/2013 5:11	1.153	5/4/2013 23:10	1.715	5/6/2013 3:10	2.071	5/7/2013 2:42	1.988
5/4/2013 6:07	1.152	5/5/2013 0:10	1.938	5/6/2013 4:10	2.063	5/7/2013 2:53	1.985
5/4/2013 6:10	1.153	5/5/2013 1:10	2.061	5/6/2013 5:00	2.057	5/7/2013 3:10	1.985
5/4/2013 6:38	1.151	5/5/2013 2:10	2.405	5/6/2013 6:08	2.052	5/7/2013 4:05	1.983
5/4/2013 7:10	1.151	5/5/2013 3:10	2.471	5/6/2013 6:59	2.048	5/7/2013 4:21	1.984
5/4/2013 7:21	1.152	5/5/2013 3:45	2.596	5/6/2013 7:10	2.048	5/7/2013 4:53	1.981
5/4/2013 8:11	1.151	5/5/2013 3:54	2.466	5/6/2013 8:09	2.04	5/7/2013 5:18	1.981
5/4/2013 9:06	1.152	5/5/2013 4:11	2.485	5/6/2013 9:10	2.036	5/7/2013 6:09	1.979
5/4/2013 9:10	1.151	5/5/2013 4:41	2.502	5/6/2013 10:08	2.028	5/7/2013 6:14	1.979
5/4/2013 10:05	1.152	5/5/2013 5:10	2.486	5/6/2013 10:34	2.028	5/7/2013 6:20	1.98
5/4/2013 10:18	1.152	5/5/2013 6:10	2.359	5/6/2013 11:10	2.021	5/7/2013 7:33	1.979
5/4/2013 11:00	1.151	5/5/2013 7:10	2.226	5/6/2013 12:05	2.012	5/7/2013 8:07	1.978
5/4/2013 11:13	1.151	5/5/2013 8:09	2.155	5/6/2013 12:20	2.014	5/7/2013 8:35	1.976
5/4/2013 12:03	1.151	5/5/2013 8:23	2.15	5/6/2013 13:07	2.006	5/7/2013 9:12	1.976
5/4/2013 12:11	1.151	5/5/2013 9:10	2.285	5/6/2013 13:19	2.008	5/7/2013 10:07	1.971
5/4/2013 12:48	1.15	5/5/2013 9:10	2.29	5/6/2013 14:04	2.001	5/7/2013 11:10	1.933
5/4/2013 13:10	1.151	5/5/2013 10:10	2.551	5/6/2013 15:10	1.995	5/7/2013 12:05	1.916
5/4/2013 14:06	1.168	5/5/2013 10:30	2.594	5/6/2013 15:34	1.991	5/7/2013 13:10	1.91
5/4/2013 14:10	1.168	5/5/2013 11:10	2.501	5/6/2013 16:11	1.991	5/7/2013 14:03	1.901
5/4/2013 15:08	1.178	5/5/2013 11:39	2.503	5/6/2013 17:07	1.945	5/7/2013 14:57	1.891
5/4/2013 15:10	1.178	5/5/2013 12:10	2.449	5/6/2013 17:11	1.945	5/7/2013 15:14	1.891
5/4/2013 16:10	1.199	5/5/2013 12:20	2.439	5/6/2013 18:02	1.941	5/7/2013 16:10	1.71
5/4/2013 16:10	1.199	5/5/2013 12:59	2.464	5/6/2013 18:10	1.941	5/7/2013 17:10	1.556
5/4/2013 17:05	1.219	5/5/2013 13:10	2.46	5/6/2013 19:02	1.938	5/7/2013 18:10	1.481
5/4/2013 17:10	1.22	5/5/2013 14:10	2.404	5/6/2013 19:11	1.938	5/7/2013 19:10	1.436
5/4/2013 18:10	1.241	5/5/2013 15:10	2.337	5/6/2013 20:00	1.934	5/7/2013 20:10	1.41
5/4/2013 18:10	1.241	5/5/2013 16:10	2.281	5/6/2013 20:11	1.935	5/7/2013 21:08	1.395
5/4/2013 19:09	1.268	5/5/2013 17:10	2.236	5/6/2013 21:08	1.986		

END OF REPORT