SURFACE WATER MONITORING PROGRAM

TRIANNUAL REPORT 2015-2017

BUCKMAN DIRECT DIVERSION BOARD &

DOE - LOS ALAMOS NATIONAL LABORATORY

MEMORANDUM OF UNDERSTANDING (MOU)

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Buckman Direct Diversion

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River, take me along
In your sunshine,
Sing me your song
Ever moving and winding and free
You rolling old river,
You changing old river,
Let's you and me river
Run down to the sea.
Bill Staines, *River* (Song)

Executive Summary

The stormwater monitoring effort of the Rio Grande at Buckman Direct Diversion (BDD) was conceived as a part of the five years Memorandum of Understanding (MOU) between the Buckman Direct Diversion Board and the US Department of Energy, Los Alamos National Laboratory (DOE LANL) signed by the parties in 2010. A four years report was produced by BDD and summarized the results from that MOU. In 2015 a revised MOU between the parties were signed and this annual report presents the results from all three years of monitoring under the 2015 MOU. This report was produced as part of the reporting requirement of the Federal Grant by DOE.

The BDD is the source of raw water for the Buckman Regional Water Treatment Plant which treats river water for drinking water purposes. The treated water is then used by the City and County of Santa Fe to supply drinking water to their customers. The objective of the 2015 MOU surface water monitoring program was to sample potential flows from the Los Alamos and Pueblo Canyons (LA/PC) watershed and from the Rio Grande (RG) watershed, and the results were to be used to evaluate the stormwater quality of the Rio Grande at BDD.

The Los Alamos and Pueblo Canyons are located on the Pajarito Plateau where for decades Los Alamos National Laboratory had discharged contaminated waste and wastewater as part of the "Manhattan Project" and later LANL's nuclear weapons program. The confluence of these canyons with the Rio Grande is located nearby Otowi Bridge, 3.5 miles upstream from BDD. Another goal of the 2015 MOU was to find an operational parameter or parameters of the Diversion which will help with identifying more specific events when diversion should be halted and when diversion does not need to be halted due to the discharges from the Canyons. Thus, a more efficient and economical monitoring could be applied.

The LA/P Canyons are ephemeral streams and when they flow, their run off may carry contaminants from the canyons, discharge them into the Rio Grande near Otowi Bridge and transport them downstream to BDD. The contaminants of greatest concern that could potentially be transported from LA/PCW to BDD via the Rio Grande are radionuclides used and discharged throughout the years of LANL operations, specifically, Plutonium 239/240, Plutonium 238, Americium 241, Strontium 90, Cesium 137, and Uranium isotopes. All 23 metals are also monitored at BDD as a part of the sampling effort. Most radionuclides and metals preferentially transport by suspended sediments, thus storm events would result in stormwater samples with higher concentrations of these contaminants than under base flows conditions of the river.

During this monitoring period, BDD sampled total of 14 storm events, and total of 14 of baseflow events. This report summarizes the monitoring data collected during the summer seasons from 2015 through 2017 at the BDD. It also compares found contaminant concentrations to the BDD-calculated Rio Grande sediment background concentrations and NMWQCC surface water standards (20.6.4 NMAC) to investigate exceedances from screening values or regulatory limits. During the 2015-2017 seasons, the following radionuclides were detected in stormwater and base flow samples, Plutonium-

238, Plutonium-239/240, Neptunium-237, Strontium-90, Radium-226, Radium-228, Uranium-234, Uranium-235, and Uranium-238. All detected radionuclides had exceedances from the Rio Grande background levels. The sum of Ra 226 and Ra 228 and gross alpha concentrations exceeded the NM WQCC surface water standards.

The concentrations of 16 metals exceeded the Rio Grande background levels. Those were Al, Sb, Be, B, Cr, Co, Cu, Pb, Fe, Hg, Ni, Se, Ag, Tl, U, and Zn. The concentrations of 6 metals exceeded the NM WQCC standards for dissolved metals: Al, Cd, Cu, Ag, Tl, and Zn.

Many detected values of total PCBs and Dioxins/Furans exceeded the NM WQCC standards, but the concentrations of perchlorate were within the limits observed in groundwater wells as previously measured and established by NMED (UTL concentration of 0.4 ppb.)

BDD continues to monitor the stormwater at the Diversion under the 2018 MOU. For more information on this program contact BDD at 505-955-4504 (BDD Regulatory Compliance Officer.)

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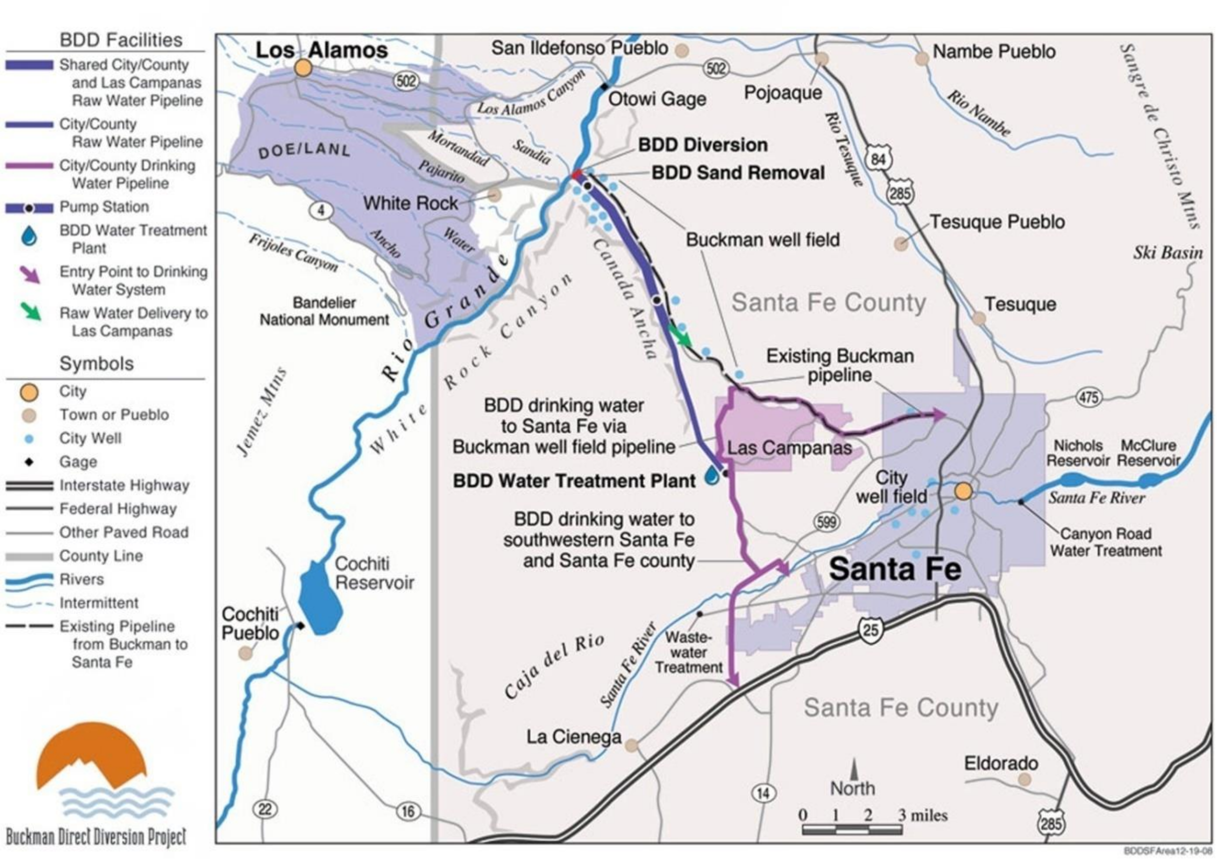
Acronyms and Abbreviations

BDD	Buckman Direct Diversion
BDDB	Buckman Direct Diversion Board
Cfs	cubic feet per second
D/F	Dioxins and Furans
DOE	Department of Energy
DOE OB	New Mexico Environment Department/Department of Energy Oversight Bureau
F	Filtered
GCS	Grade Control Structure
Hrs	hours
HWB	New Mexico Environment Department/Hazardous Waste Bureau
LA	Los Alamos
LA/P	Los Alamos and Pueblo
LACW	Los Alamos Canyon Watershed
LANL	Los Alamos National Laboratory
MOU	Memorandum of Understanding
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
PCBs	Polychlorinated Biphenyls
PCi/g	Picocuries per gram
PCi/l	Picocuries per liter
Rads	Radionuclides
RG	Rio Grande
SCADA	Supervisory Control and Data Acquisition
TREAT	The
UF	Unfiltered
USGS	United States Geological Survey

I. BACKGROUND

The Buckman Direct Diversion (BDD) Project was designed to divert surface water from the Rio Grande, treat it, and provide drinking water to the City and County of Santa Fe. The design of the Project began in September 2008 and construction was completed in early 2011. The point of diversion (BDD Intake) is on the east bank of the Rio Grande, about 3.5 miles downstream from where New Mexico Route 502 crosses the river at Otowi Bridge. See Figure 1. At approximately the same location, near the Otowi Bridge, the Los Alamos/Pueblo (LA/P) canyons watershed flows into the Rio Grande. These canyons and their tributaries have been impacted by contamination originating from Los Alamos National Laboratory (LANL) operations, when LANL discharged radioactive liquid wastes into the canyons on the Pajarito Plateau that drain into the Rio Grande. LANL occupies about 36 square miles on the Pajarito Plateau, on the western side of the river, and has operated (under various names) since 1943.

Figure 1. BDD area setting.



I.1 2015 Memorandum of Understanding (2015 MOU)

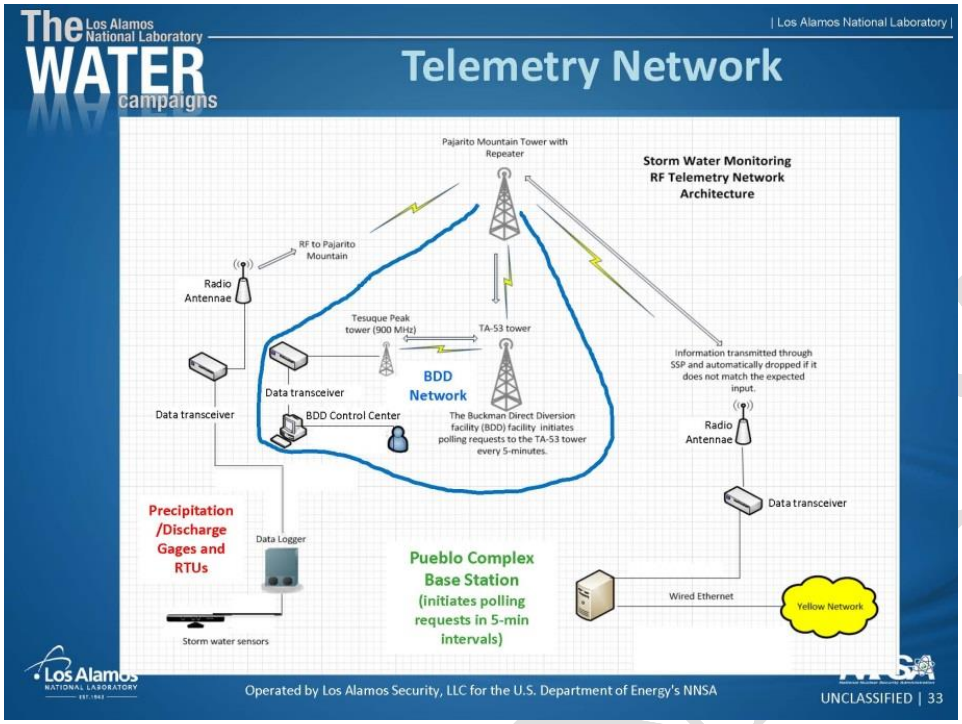
In 2010, prior to coming online, BDD entered into a Memorandum of Understanding (MOU), a non-binding agreement, with DOE/LANL to monitor and sample surface water from Los Alamos and Pueblo Canyons in order to determine the stormwater quality at the BDD (BDD and DOE, 2015). The report of the analytical results and conclusions of this program were published in (Bowman, 2011-2014). Under the MOU which was renewed in 2015, the following programs have been maintained. A copy of the 2015 MOU is provided in Attachment 4 to this report. This report presents the analytical results from all three years under the revised 2015 MOU.

- Early notification system (ENS), a preventive program with the following objectives:
  Two or three gaging stations relay real-time stage height data in 5-minute intervals to the BDD Control Room through SCADA, and another video station relays images only. The participating LANL stations are described in the 2015 renewed MOU: (1) LANL gaging station E050.1 in Los Alamos Canyon above the Pueblo Canyon confluence, (2) LANL gaging station E060 in Pueblo Canyon above the Los Alamos confluence, (3) video station E062 in the Los Alamos Canyon below the confluence of Los Alamos and Pueblo Canyons, and (4) LANL gaging station E099, the farthest downgradient from LANL gaging station within the ENS, located in Guaje Canyon above the confluence of Guaje Canyon and Los Alamos Canyon. The previously participating gaging station E109.9 was located in the lower Los Alamos Canyon, 0.7 miles from the Rio Grande. That station was buried by sediment carried by strong storm flow in September 2013.
  When storm flows exceed 5 cubic feet per second (cfs) at the LANL gages, BDD is notified. The trigger flow of 5 cfs was selected by LANL (under the Los Alamos/Pueblo Canyons Stormwater Monitoring Plans) as a flow with the potential to reach the Rio Grande. When such storm flows are streaming in Los Alamos Canyon, the diversion will close for 10 to 12 hours or until the storm has subsided.
- Surface water sampling program of stormwater and baseflow of the Rio Grande at BDD.
  When storm run offs of 5 cfs or greater flow in the Los Alamos and Guaje Canyons as measured by the LANL gages, water quality sampling will be triggered at BDD. Costs for sampling, equipment, and maintenance are shared between the BDD Board and DOE/LANL. Samples collected from this program are tested for the following constituents: suspended sediment concentration, total and dissolved metals (23) plus mercury, gross alpha, gross beta, strontium-90, americium-241, radionuclides by gamma spectroscopy (including cesium-137), plutonium (isotopic), uranium (isotopic), neptunium-237, dioxin/furans, PCBs, radium-226 and -228, and perchlorate.
  Pursuant to the 2015 MOU, DOE funds costs up to a certain dollar amount for BDD sampling at the intake, after which BDD funds the costs.
- The Removal Efficiency and Assessment of Treatments (TREAT) Study in 2015 MOU replaced the Contaminant Fate Analysis (CFA) Program. TREAT Study is entirely funded by the BDD Board.

II. Early Notification System

The purpose of the early notification system (ENS) was to provide real time stream flow data to the BDD from the following LA/PC watershed locations. A schematic of the BDD network incorporated in the LANL telemetry is provided on Figure 2 (LA-UR-14-25041, 2014).

Figure 2. ENS telemetry network.



The stations participating in the monitoring program under the 2015 MOU were:

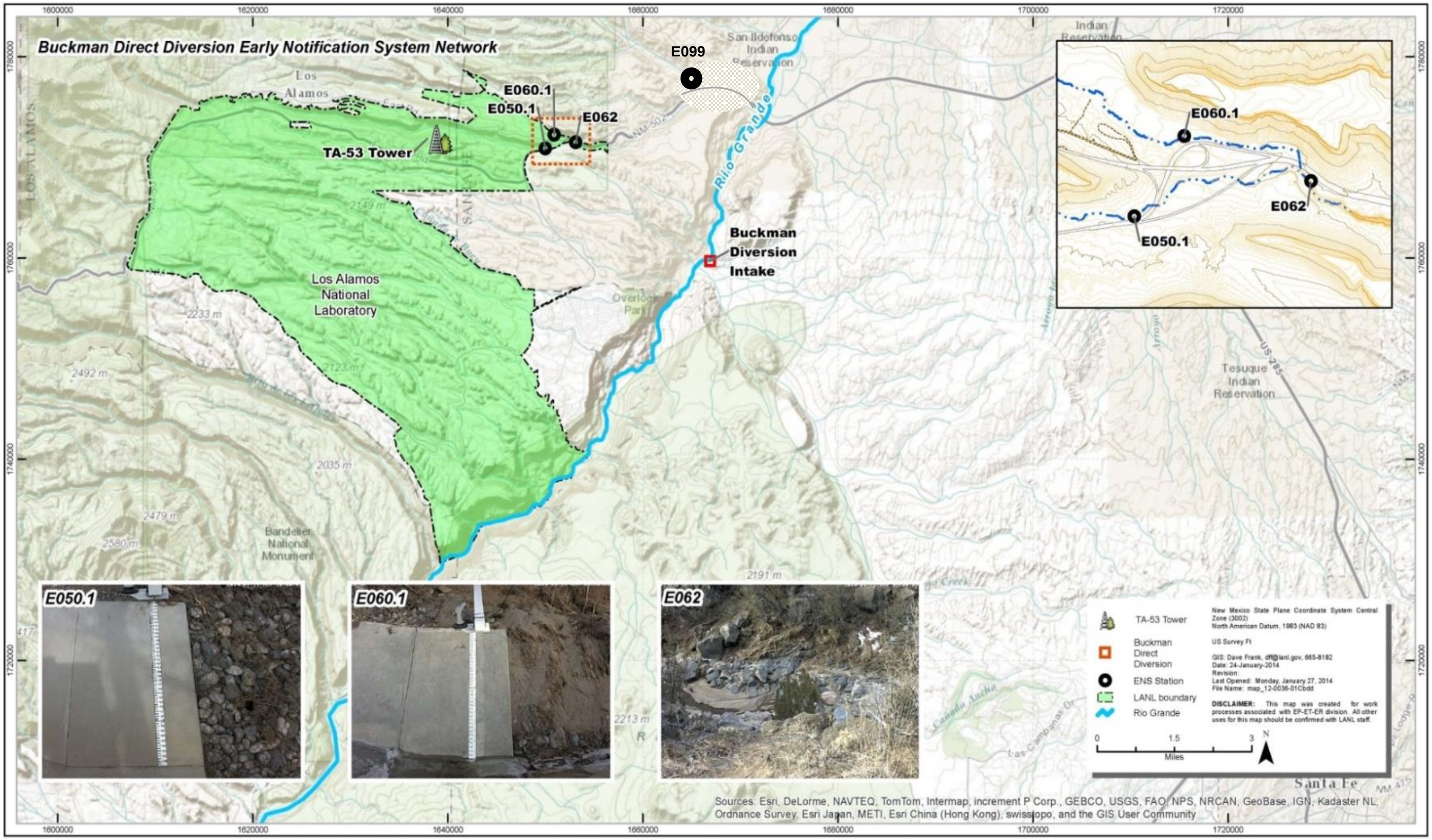
- Gage station E060.1 in Pueblo Canyon above the Los Alamos Canyon confluence and below the grade-control structure;
- Gage station E050.1 in Los Alamos Canyon above the Pueblo Canyon confluence and below the low-head weir;
- Camera station E062.1 in Los Alamos Canyon below its confluence with Pueblo Canyon; and
- Gage station E099 in Guaje Canyon, a major tributary to the Los Alamos Canyon.

Gage stations E050.1 and E060.1 monitor stage height at 5-minute intervals. Sutron 8210 and 9210 data loggers store each recorded stage-height measurement as it is made. Discharge is computed for each 5-minute stage measurement using rating curves for each individual gage. Shaft-encoder float sensors installed in stilling wells were used to measure water levels. Self-contained bubbler pressure sensors (Sutron Accubar) were used to provide backup sensing at E050.1 and E060.1 (LA-UR-11-5459, 2010). An ultrasonic probe sensor (Siemens Miltronics "The Probe") and cameras serve as back up for verification of flow. The cameras collect images every 5 minutes and are available for viewing on a special web site. Discharge data from the gage stations is transmitted to the BDD Control Room through SCADA (see Figure 3).

Gage station E099 does not have a trapezoid flume for measuring the discharge, thus discharges below 50 cfs are only estimates of the actual flows. However, for season 2015 and 2016, LANL did not release real-time discharge data for this gage, and thus BDD could not use it as a trigger to the ENS as originally intended. The 2011-2014 BDD report on the ENS indicated that E099 flows about 70% of the time when lower LAC flows, and therefore, it was the best indicator of LAC flow that might discharge to the Rio Grande.

The purpose of the ENS was to signal when there is a discharge in the Los Alamos Canyon in order for BDD to initiate closure of the intake of raw water. When discharge at the LANL gage stations was measured to be greater than 5 cfs combined, the BDD was closed and no river water was pumped for 10-12 hours, or until the storm event at Los Alamos region has subsided.

Figure 3. 2015-2017 ENS stations setting.



III. Surface Water Quality Monitoring Program

III.1 LANL Stations, Set up, Capabilities, Triggers

LANL stations monitoring stormwater pursuant to the 2015 MOU were gage stations E050.1, E060.1, and E099. Gage stations E050.1 and E060.1 were equipped with concrete, trapezoidal, super-critical flow flume, see Figure 4 (LA-UR-14-25041, 2014), while station E099 did not have a special flume. The gages were equipped with measuring equipment of the stage height in order to calculate an accurate discharge through the gages during storm events. Gages E050.1 and E060.1 were equipped with automated samplers. Station E062 is only equipped with a camera and provides verification of flow or no flow through the LA Canyon after the Pueblo Canyon confluence. LANL maintains a website that hosts real-time images from the cameras to verify flow.

Figure 4. Typical LANL well-equipped gage station.

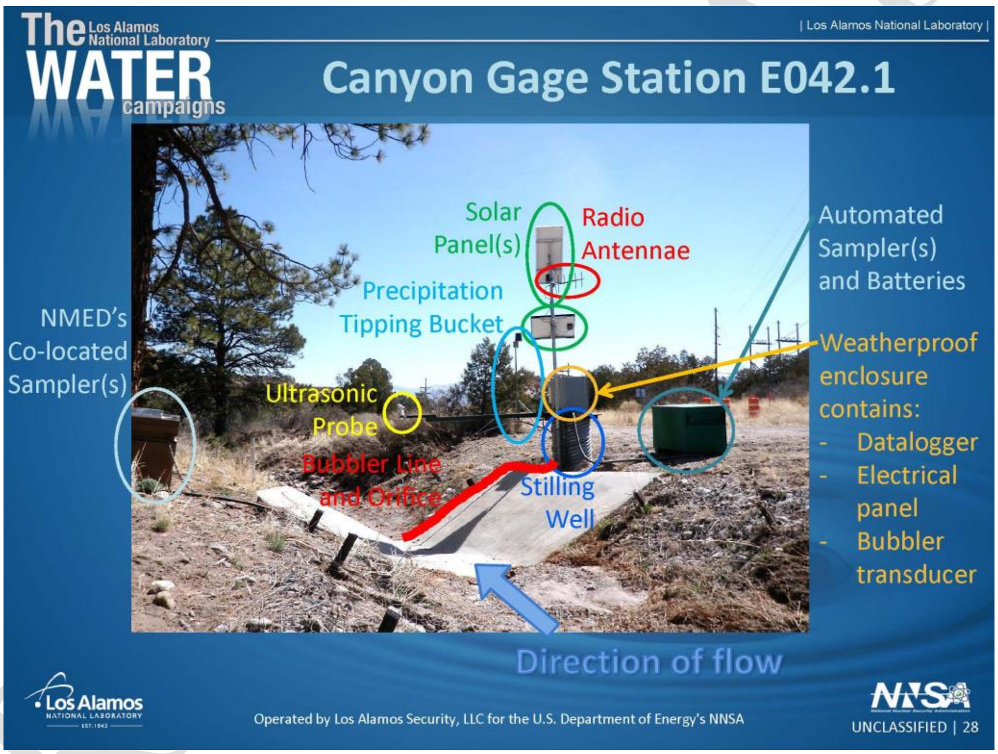
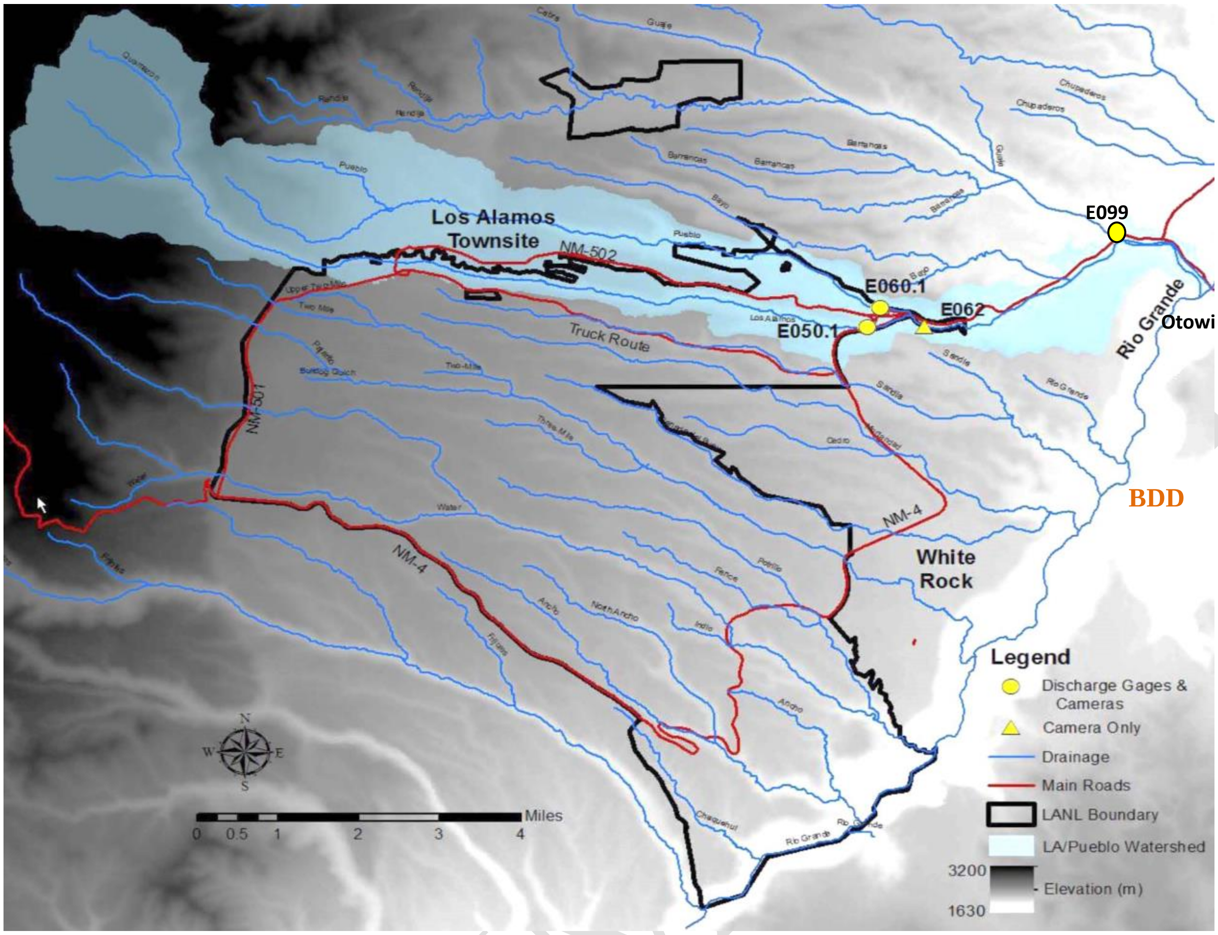


Table 1. LANL gage stations description.

Gage Station	Location ID/Sampling Dates	Latitude (decimal degree)	Longitude (decimal degree)
E050.1	Los Alamos below low-head weir (2011-2017)	35.867182	-106.217583
E060/E060.1	Pueblo below GCS (2010-2017)	35.870942	-106.214606
E062	Los Alamos below Pueblo (no sampling)	35.868828	-106.207102
E099	Guaje at SR-502 (2000-2013)	35.884540	-106.162000

Figure 5. LANL gages and sampling stations.



As part of the 2015 MOU, the stations were maintained and inspected by LANL staff. LANL committed to maintain the event sampling system as necessary to support the purpose and performance standards described above. The samplers were inspected no less than weekly from June to October of each year, and after each flow event and/or 72 hours between flow events to collect samples. General maintenance was performed in accordance with LANL SOPs, and included ensuring sampler is powered up and operational, load testing of battery and replacement of battery, inspection of sampler pump tubing, line, and intake to ensure no air leaks, cracks or plugs, and test sample collection cycle to ensure correct programming, tripping and volumes are correct.

III.2 BDD Intake Station: Set up, Capabilities, Triggers

III.2.a. BDD Equipment

The samplers installed at the BDD intake are ISCO Model 3700. Three of the samplers contain 24 1L polyethylene wedge-shaped containers and one contains 6 1L glass and 6 1L polyethylene containers (Figure 6). Thus, the total number of plastic 1-L containers is 77 and the number of 1-L glass containers is 7. The BDD staff maintains the equipment of these samplers.

The samplers can communicate remotely with the BDD Treatment Plant. The samplers can be started or stopped at any time during sampling events, and can be programmed to sample at any frequency and order. Sample collection timing and bottle fill sequence for each sampler can be programmed as well.

Figure 6. BDD intake station set up.

III.2.b. BDD Sampling Strategy

The early warning for BDD to stop diverting and start sampling is a 5 cfs flow in the LA/P canyon system, either canyon (middle Los Alamos Canyon, Pueblo Canyon or Guaje Canyon) or combined flow. When such flow is detected, the "storm event" procedure: stop diversion, start sampling is triggered within 10 min of the event. In addition, a baseflow sampling was conducted once a month. The sampling sequence for each season is described in the charts below.

Figure 7. 2015 Sampling sequence.

Three 24-carousel ISCO 3700 containing 24 1-L poly wedges and one 12-carousel ISCO containing 7 1-L amber glass and 5 1-L poly containers									
	24-Samples Carousel No.: 3 ,4, 5							12-Samples Carousel No.: 2	
SUITE	SSC Every 30 min	Iso Rads/GS Every 30 min	Sr-90 Every 30 min	Ra-226/228 Every 30 min	GROSS A/B Every 30 min	Metals Every 30 min	Perchlorate Selected times	DIOX/FUR Every 1 hr	PCB Congener Every 1 hr
LAB	BDD	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS
ANALYTICAL METHOD	ASTM:Method D3977:97C	EPA:901.1 HASL-300	ASTM 5811	EPA:903.1 EPA:904	EPA 900.0	EPA:200.7 EPA:200.8 EPA:245.2	EPA:314.0	EPA:1613B	EPA 1668A
ORDER CODE	SSC	GS+IsoU/Pu/	Sr 90	Ra226/	GAB	Metals	ClO4	D/F	PCBs
FIELD PREP CODE	UF	UF	UF	UF	UF	UF/F	UF	UF	UF
PRESERVATION	ice	HNO3	HNO3	HNO3	HNO3	HNO3	ice	ice	ice
HOLDING TIME (DAYS)	7	180	180	180	180	180	28	365	365
ISCO Type	24	24	24	24	24	24	24	12	12
VOL REQUIRED (L)	1	4	1	1	0.5	2x0.25	0.1	1	1
SHIPPING CONTAINER	poly	poly	poly	poly	poly	poly	poly	glass	glass
Rio Grande at BDD 3	Bottle 1, 9, 17	Bottle 2-5, 10-13,	Bottle 6, 14, 22	Bottle 7, 15, 23	Bottle 8, 16, 24			Selected bottles	Selected bottles
Rio Grande at BDD 4	Bottle 1, 9, 17	Bottle 2-5, 10-13,	Bottle 6, 14, 22	Bottle 7, 15, 23	Bottle 8, 16, 24				
Rio Grande at BDD 5	Bottle 1, 9, 17	Bottle 2-5, 10-13, 18-21	Bottle 6, 14, 22	Bottle 7, 15, 23	Bottle 8, 16, 24				

Timing		BDD 2 bottles	BDD 3 bottles	BDD 4 bottles	BDD 5 bottles
Start	0 hr	sampling 1-2	sampling 1-8	waiting	waiting
Start + 30min		waiting	sampling 9-16	waiting	waiting
Start + 60min	1 hr	sampling 3-4	sampling 17-24	waiting	waiting
Start + 90min		waiting	finished	sampling 1-8	waiting
Start + 120min	2 hrs	sampling 5-6	finished	sampling 9-16	waiting
Start + 150min		waiting	finished	sampling 17-24	waiting
Start + 180min	3 hrs	sampling 7-8	finished	finished	sampling 1-8
Start + 210min		waiting	finished	finished	sampling 9-16
Start + 240min	4 hrs	sampling 9-10	finished	finished	sampling 17-24
Start + 270min		waiting	finished	finished	finished
Start + 210min	5 hrs	sampling 11-12	finished	finished	finished

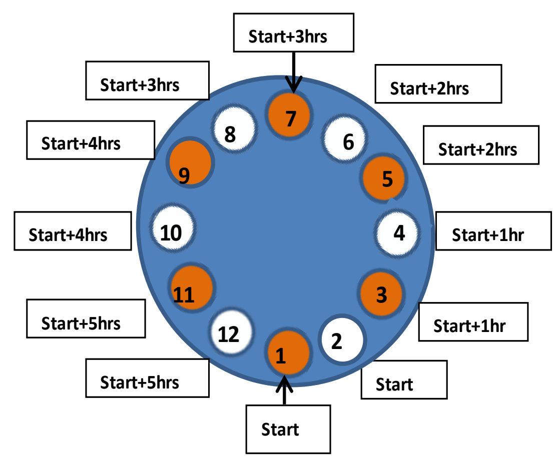
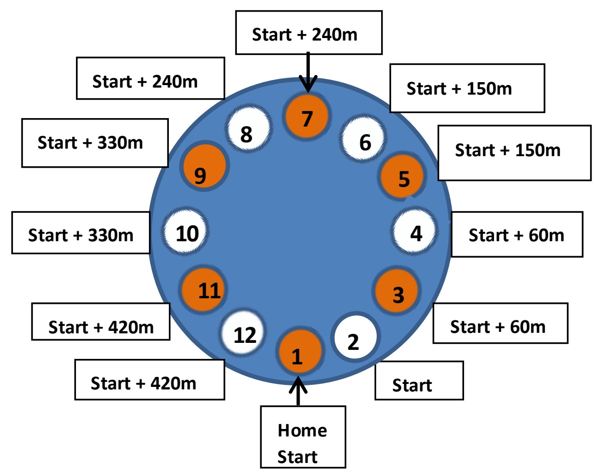


Figure 8. 2016 and 2017 Sampling sequence.

Three 24-carousel ISCO 3700 containing 24 1-L poly wedges and one 12-carousel ISCO containing 7 1-L amber glass and 5 1-L poly containers									
	24-Samples Carousel No.: 3 ,4, 5							12-Samples Carousel No.: 2	
SUITE	SSC Every 30 min	Iso Rads/GS Every 30 min	Sr-90 Every 30 min	Ra-226/228 Every 30 min	GROSS A/B Every 30 min	Metals Every 30 min	Perchlorate Selected times	DIOX/FUR Every 1 hr	PCB Congener Every 1 hr
LAB	BDD	ALS	ALS	ALS	ALS	ALS	ALS	ALS	ALS
ANALYTICAL METHOD	ASTM:Method D3977:97C	EPA:901.1 HASL-300	ASTM 5811	EPA:903.1 EPA:904	EPA 900.0	EPA:200.7 EPA:200.8 EPA:245.2	EPA:314.0	EPA:1613B	EPA 1668A
ORDER CODE	SSC	GS+IsoU/Pu/ Am241/Np237	Sr 90	Ra226/ Ra228	GAB	Metals	ClO4	D/F	PCBs
FIELD PREP CODE	UF	UF	UF	UF	UF	UF/F	UF	UF	UF
PRESERVATION	ice	HNO3	HNO3	HNO3	HNO3	HNO3	ice	ice	ice
HOLDING TIME (DAYS)	7	180	180	180	180	180	28	365	365
ISCO Type	24	24	24	24	24	24	24	12	12
VOL REQUIRED (L)	1	4	1	1	0.5	2x0.25	0.1	1	1
SHIPPING CONTAINER	poly	poly	poly	poly	poly	poly	poly	glass	glass
Rio Grande at BDD 3	Bottle 1, 9, 17	Bottle 2-5, 10-13,	Bottle 6, 14, 22	Bottle 7, 15, 23	Bottle 8, 16, 24			Selected bottles	Selected bottles
Rio Grande at BDD 4	Bottle 1, 9, 17	Bottle 2-5, 10-13,	Bottle 6, 14, 22	Bottle 7, 15, 23	Bottle 8, 16, 24				
Rio Grande at BDD 5	Bottle 1, 9, 17	Bottle 2-5, 10-13, 18-21	Bottle 6, 14, 22	Bottle 7, 15, 23	Bottle 8, 16, 24				

Timing		BDD 2	BDD 3	BDD 4	BDD 5
Start	0 hr	1-2	1-8	wait	wait
Start + 30min		wait	9-16	wait	wait
Start + 60min	1 hr	3-4	17-24	wait	wait
Start + 105min		wait	finished	1-8	wait
Start + 150min	2.5 hrs	5-6	finished	9-16	wait
Start + 195min		wait	finished	17-24	wait
Start + 240min	4 hrs	7-8	finished	finished	1-8
Start + 285min		wait	finished	finished	9-16
Start + 330min	5.5 hrs	9-10	finished	finished	17-24
Start + 375min		wait	finished	finished	finished
Start + 420min	7 hrs	11-12	finished	finished	finished



III.2.c. Analytes and Methods

Samples collected during stormwater sampling were screened at BDD in order to determine the best representatives of before, during, and after the event. Then, the samples were sent to a contract outside laboratory and analyzed for the following analytes using the methods listed in Table 2. The laboratory conducting the analyses for the entire sampling period was ALS Environmental.

Table 2. Analytes sampled at BDD.

Analytes	Method	Detection Limit*	Field Prep Code
Gross alpha	EPA:900	3 pCi/L	UF
Gross beta	EPA:900	3 pCi/L	UF
Sr-90	ASTM 5811	0.5 pCi/L	UF
Am-241	HASL-300:AM-241	0.05 pCi/L	UF
Ac-228	EPA:901.1	NA	UF
Bi-212	EPA:901.1	NA	UF
Bi-214	EPA:901.1	NA	UF
Cs-137	EPA:901.1	5 pCi/L	UF
Cs-134	EPA:901.1	NA	UF
Co-60	EPA:901.1	5 pCi/L	UF
Na-22	EPA:901.1	10 pCi/L	UF
Np-237	HASL-300: NP-237	10 pCi/L	UF
K-40	EPA:901.1	10 pCi/L	UF
Pa-234m	EPA:901.1	NA	UF
Pb-212	EPA:901.1	NA	UF
Pb-214	EPA:901.1	NA	UF
Th-234	EPA:901.1	NA	UF
Tl-208	EPA:901.1	NA	UF
Pu (isotopic)	HASL-300:ISOPU	0.05 pCi/L	UF
U (isotopic)	HASL-300:ISOU	0.05 pCi/L	UF
Ra-226, -228	903.1, 904	1 pCi/L	UF
TAL metals (23), plus Hg	EPA:200.7, EPA: 200.8, EPA:245.2	0.2 – 300 mg/L	UF, F
SSC	ASTMD3977:97C	3 mg/L	UF
Dioxin-Furans	EPA1613B	0.2 – 0.5 pg/L	UF
PCBs	EPA 1668A	20 – 150 pg/L	UF
Perchlorate	SW846 6850 Modified	0.2 mg/L	UF

III.3 Summary of 2015-2017 Storm Events

III.3.a. Los Alamos/Pueblo Canyons Watershed Storm Events.

The storm events occurring in the entire Los Alamos and Pueblo Canyon documented by LANL are listed in the tables below.

Table 3. LA/P Canyons 2015 storm events documented by LANL, (LA-UR-16-22705, 2016).

Table 2.3-1
Maximum Daily Discharge and Storm Water Sampling in the LA/P Watershed during 2015

Date	Los Alamos Canyon Discharge (cfs)[a]							Pueblo and Acid Canyon Discharge (cfs)[a]					
	DP Canyon			Los Alamos Canyon				Acid Canyon		Pueblo Canyon			
	E038	E039.1	E040	E026	E030	E042.1	E050.1	E055.5	E056	E055	E059.5	E059.8	E060.1
21 to 22-May-15	30 BT[b]	24 S[c]	23 S	0 BT	0 BT	6.2 BT	0 BT	<1 IA[d]	4.2 IA	5.3 IA	6.2 BT	—[e]	<1 BT
26-Jun-15	160 S	66 S	41 S	8.4 BT	2.3 BT	0 BT	0 BT	7.1 BT	2.7 BT	1 BT	0 BT	—	0 BT
02-Jul-15	17 BT	5.2 BT	0 BT	<1 BT	0 BT	0 BT	<1 BT	1.9 BT	3.2 BT	12 NS[f]	1.4 BT	—	12 S
03-Jul-15	150 S	51 S	39 S	2.8 BT	5.3 BT	10 S	0 BT	47 NS	31 S	53 S	50 S	—	8.7 NS
07-Jul-15	37 BT	46 S	66 S	18 NS	15 S	53 S	40 S	17 NS	16 NS	12 NS	63 NS	—	3.8 BT
20-Jul-15	78 S	99 S	72 S	4 BT	7.1 BT	56 S	34 S	40 NS	15 S	5.7 BT	5 BT	—	6.7 S
29 to 30-Jul-15	78 S	49 S	28 S	17 NS	6.3 BT	12 NS	22 S	13 NS	9 S	10 NS	<1 NS	—	0 BT
31-Jul-15	110 S	220 S	240 S	25 NS	6.1 BT	74 S	43 S	7.8 BT	2.2 BT	<1 BT	73 S	—	4.2 BT
01-Aug-15	21 BT	25 NS	23 NS	21 NS	4.3 BT	12 NS	15 NS	<1 BT	3.1 BT	4.4 BT	1 BT	—	<1 BT
02-Aug-15	2 BT	1.8 BT	0 BT	66 S	6.7 BT	12 NS	18 NS	<1 BT	1.9 BT	1.3 BT	1.1 BT	—	0 BT
03-Aug-15	8.6 BT	7.5 BT	<1 BT	26 NS	7.1 BT	15 NS	24 NS	<1 BT	3.8 BT	3.5 BT	1.4 BT	—	0 BT
08-Aug-15	52 S	46 S	18 NS	6.8 BT	2.5 BT	6.7 BT	11 S	18 NS	3.2 BT	<1 BT	1.1 BT	—	0 BT
20-Oct-15	10 BT	<1 BT	0 BT	0 BT	0 BT	0 BT	0 BT	2.8 BT	10 NS	0 BT	<1 BT	<1 BT	0 BT
21-Oct-15	16 BT	28 S	37 S	<1 BT	5 BT	17 S	18 S	3.7 BT	25 S	13 NS	5.6 BT	10 S	0 BT
23-Oct-15	5.3 BT	1.1 BT	0 BT	21 NS	9.2 BT	8.1 NS	5.4 S	1.3 BT	14 NS	<1 BT	<1 BT	<1 BT	0 BT
29-Oct-15	9.4 BT	7 BT	<1 BT	1.9 BT	<1 BT	0 BT	0 BT	2.4 BT	11 NS	10 NS	<1 BT	<1 BT	0 BT

[a] Maximum discharge values reported have an accuracy of ± 50 cfs.
[b] BT = Below triggering threshold, no sample collected.
[c] S = Sample was collected, cell is highlighted in yellow.
[d] IA = Sampler was inactive.
[e] — = E059.8 was built in 2015. Sampling equipment was installed, and the sampler was activated on September 28, 2015.
[f] NS = No sample was collected, cell is highlighted in blue.

Table 4. LA/P Canyons 2016 storm events documented by LANL, (LA-UR-17-23308, April 2017).

Table 2.3-1
Maximum Daily Discharge and Storm Water Sampling in the LA/P Watershed during 2016

Date	Los Alamos Canyon Discharge (cfs)							Pueblo and Acid Canyon Discharge (cfs)					
	DP Canyon			Los Alamos Canyon				Acid Canyon		Pueblo Canyon			
	E038	E039.1	E040	E026	E030	E042.1	E050.1	E055.5	E056	E055	E059.5	E059.8	E060.1
7/19/2016	1.5 BT[a]	0 BT	0 BT	11 CT[b]	0 BT	0 BT	0 BT	0.3 BT	0 BT	0 BT	0 BT	0 BT	0 BT
8/3/2016	34 BT	26 S[c]	11 S	56 S	4 BT	0 BT	0 BT	5.8 BT	0.1 BT	9 BT	4.2 BT	0.1 BT	0 BT
8/7/2016	0.03 BT	0.1 BT	0 BT	0.4 BT	0 BT	0 BT	0 BT	0.2 BT	0.1 BT	17 S	4.0 BT	0 BT	0 BT
8/19/2016	80 S	EF[d] NS[e]	38 S	0.1 BT	1.4 BT	3.6 BT	0 BT	24 S	0.1 BT	0.1 BT	29 NS	0.5 BT	0.6 BT
8/24/2016	130 S	EF NS	75 S	0 BT	1.6 BT	9.6 BT	0 BT	10 S	0.1 BT	0 BT	7.9 BT	1.0 BT	0.3 BT
8/27/2016	100 S	EF NS	69 S	2 BT	9.8 BT	63 S	25 S	26 S	0.1 BT	6.7 BT	45 S	6.9 BT	3.6 BT
9/3/2016	0.03 BT	EF	0 BT	0.3 BT	0 BT	0 BT	0 BT	15 S	0.1 BT	18 S	4.1 BT	0.1 BT	0 BT
9/6/2016	24 BT	42 S	5 S	0.8 BT	3.6 BT	0 BT	0 BT	35 NS	0.1 BT	4.5 BT	15 NS	0.6 BT	3.8 BT
11/5/2016	16 BT	25 S	15 S	0 BT	0 BT	0 BT	0 BT	8.5 BT	17 S	8.3 BT	0.1 BT	0.01 BT	0.6 BT
11/5-11/6/2016	14 BT	40 CT	9.6 BT	0 BT	0 BT	12 S	0 BT	3.7 BT	8 BT	5.6 BT	0.4 BT	0.3 BT	0.1 BT

[a] BT = Below gage station triggering threshold, no sample collected.
[b] CT = Close to gage station trip level, no sample collected. Stage measurement sensors can have inaccuracies +/- 2 cfs.
[c] S = Sample was collected. These discharge levels are highlighted in yellow to emphasize those events for which discharge exceeded the trip level and samples were collected.
[d] EF = Equipment failure. Equipment did not provide a discharge measurement.
[e] NS = No sample was collected, but discharge was above gaging station trip level. These discharge levels are shaded in blue to highlight those events where discharge was above trip level, but no sample was collected.

Table 5. LA/P Canyons 2017 storm events documented by LANL, (LA-UR-18-23237, April 2018)

Table 2.3-1
Maximum Daily Discharge and Storm Water Sampling in the LA/P Watershed during 2017

Date	Los Alamos Canyon Discharge (cfs)							Pueblo and Acid Canyon Discharge (cfs)					
	DP Canyon			Los Alamos Canyon				Acid Canyon		Pueblo Canyon			
	E038	E039.1	E040	E026	E030	E042.1	E050.1	E055.5[a]	E056	E055	E059.5	E059.8	E060.1
7/8/2017	110 S[b]	60 S	27 S	0.14 BT[c]	0 BT	0 BT	0 BT	1.55 NS[d]	2.6 S	0 BT	0 BT	0 BT	0 BT
7/26/2017	205 S	150 S	101 S	0.29 BT	6.5 BT	30 S	0 BT	2.31 S	24 S	0.75 BT	0.03 BT	0 BT	0.25 BT
7/27/2017	2 BT	0.93 BT	1.04 BT	0 BT	0 BT	0 BT	0 BT	0.89 S	0.16 BT	0 BT	0.3 BT	0 BT	0 BT
7/29/2017	45 S	45 S	39 NS	0.09 BT	0 BT	5.9 BT	0 BT	1.50 S	4.4 S	16 NS	0.43 BT	0 BT	0 BT
8/7/2017	76 S	18 S	5.9 BT	0.04 BT	0 BT	0 BT	0 BT	0 BT	0.67 BT	0.25 BT	0.47 BT	0 BT	0.15 BT
8/23/2017	21 BT	4.9 BT	0 BT	0.07 BT	0 BT	0 BT	0 BT	0 BT	4.7 S	16 NS	0.4 BT	0 BT	0 BT
9/26/2017	24 BT	15 BG[e]	2.6 BT	0.04 BT	0 BT	0 BT	0 BT	0 BT	2.3 BT	0 BT	0.33 BT	0 BT	0 BT
9/27/2017	36 BT	35 BG	51 S	0.44 BT	8.5 CT[f]	25 S	32 S	0 BT	4.7 BT	33 S	21 NS	0 BT	0 BT
9/28–9/29/2017	110 BG	9 BT	50 S	1.9 BT	12 S	51 S	56 S	0 BT	12 BG	22 S	61 S	1.9 S	0 BT
9/30/2017	10 BT	0 BT	0.14 BT	1 BT	0 BT	0 BT	0.42 BT	0 BT	3.5 BT	15 NS	0.17 BT	0.02 BT	0 BT
10/4–10/5/2017	84 BG	18 BG	51 BG	3.4 CT	10 S	40 S	35 S	0 BT	4.6 BT	14 NS	26 NS	1.6 S	0 BT

[a] Log check dams installed downstream of E055.5 caused the channel bed to fluctuate significantly throughout 2017; therefore, the water depth (ft) is presented for E055.5 instead of discharge. The location of the stage sensor was moved upstream to a more stable location in March 2018.

[b] S = Sample was collected. These discharge levels are highlighted in yellow to emphasize those events for which discharge exceeded the trip level and samples were collected.

[c] BT = Below gage station triggering threshold, no sample collected.

[d] NS = No sample was collected, but discharge was above gaging station trip level. These discharge levels are shaded in blue to highlight those events where discharge was above trip level, but no sample was collected.

[e] BG = Below greatest discharge; that is, if four samples have been collected, only storms with a peak discharge greater than the peak discharge of the storms already collected will be sampled.

[f] CT = Close to gage station trip level, no sample collected. Stage measurement sensors can have inaccuracies +/- 2 cfs.

III.3.b. BDD Intake Storm Events.

Table 6 through Table 8 list the sampled storm events at the Diversion and the most important parameters associated with each event. The documented events were triggered by discharges at E050.1, E060.1, or E099 LANL gages. BDD also sampled 14 baseflow dates: 6/19/2015, 7/9/2015, 9/1/2015, 9/23/2015, 6/3/2016, 6/8/2016, 7/6/2016, 7/28/2016, 8/3/2016, 10/11/2016, 5/9/2017, 7/5/2017, 8/30/2017, and 10/31/2017, not represented in these tables.

Table 6. BDD documented 2015 storm events.

Date	Crossover Date	PeakFlow E099	PeakTime E099	PeakFlow E050.1	PeakTime E050.1	PeakFlow E060.1	PeakTime E60.1	Sampled?	Max Otowi Flow (cfs)	Comments on Rio Grande Conditions
7/2/15		80	1705	0.5	1545	11.3	1605	Y	1,350	Small river event at 1730.
7/3/15		500	1605	0	na	1.5	1205	N	1,770	Small river event at 1730.
7/7/15	AM & PM 7/8	97	1745	53	0722	16/19	0615/1025	Y	3,190	River events of 3,080 cfs and 3,190 cfs at 0600 and 0830. Another river event of 3,600 cfs on 7/8 at 0300.
7/9/15	7/10	5.3	2200	0	na	3.6	0015 7/10	N	2,150	No river event.
7/20/15		4.3	1940	34.2	2150	6.7	1945	Y	1,100	No river event. Small river event of 1,580 cfs at 2245 on 7/19.
7/21/15		2.6	0250	26.5	0210	0.1	all day	N	1,250	Small river event at 730.
7/30/15	7/29	3	0800	23.6	0020	<1		Y	no record	River event at approximately 0000.
7/31/15		31.5	1450	43	1550	4.2	1745	Y	1,760	Small river event at 1530.
8/1/15		23	1755	15.1	1650	0.4	all day	N	1,950	River event at 0715.
8/2/15		28	1840	16.3 18	1855 2345	0	na	N	1,200	No river event.
8/3/15	8/4, 8/5, 8/6, 8/7	10	0425	24	0435	0	na	N	1,290	Negligible rise in discharge at 1214 (8/3). Discharge subsides further on 8/4. Similar low levels from 8/4 through 8/7.
8/8/15		2.0	2050	10.6	2155	0	na	N	2,670	River event at 2015.
8/17/15		10	1435	0	na	0	na	N	1,130	No river event.
10/21/15		17.5	1720	24.3	1915	0	na	Y	2,540	River event at 19:30.
10/24/15	10/23	0	na	5.4	0005	0	na	Y	660	No river event.

Table 7. BDD documented 2016 storm events.

Date	Crossover Date	PeakFlow E099	PeakTime E109.9	PeakFlow E050.1	PeakTime E050.1	PeakFlow E060.1	PeakTime E60.1	Sampled?	Max Otowi Flow (cfs)	Comments on Rio Grande Conditions
8/7/16		24.3	1730	0	na	0		N	1,020	No river event.
8/16/16		43.2	1550	0	na	0.5	1440	N	824	No river event.
8/19/16		19.4	1815	0	na	0.6	all day	N	802	No river event.
8/21/16	8/20 8/22	8.7	1040	0	na	0.5	2015 (8/20)	N	1,700	Small river event at 1830 (8/21). Larger river event on 8/22 of 2790 cfs at 2015.
8/23/16		100	1245	0	na	0.1	all day	N	1,640	Small river event at 2345.
8/24/16		50.3	1420	0	na	0.15	all day	N	792	No river event.
8/27/16	8/28	25.8	2205	25.4	1335	3.6	1155	Y	874	No river event.
8/30/16		5.3	630	0	na	0	na	N	830	No river event.
9/3/16		10.9	1735	0	na	0	na	N	852	No river event.
9/5/16		5.3	1720	0	na	0	na	N	786	No river event.
9/6/16		5.3	1845	0	na	3.8	1740	N	921	Negligible rise in discharge.
LANL did not release the flow data for gage E099 for this season until March 2017.										

Table 8. BDD documented 2017 storm events.

Date	Crossover Date	PeakFlow E099	PeakTime E099	PeakFlow E050.1	PeakTime E050.1	PeakFlow E060.1	PeakTime E60.1	Sampled?	Max Otowi Flow (cfs)	Comments on Rio Grande Conditions
5/29/17		6	1515	0	na	0.6	1705	Y	5,230	No river event.
7/27/17	7/26	27.7	0240	0	na	<1	na	Y	1,430	Small river event at 0400.
8/8/17	8/7	136.5	1522	<1	na	<1	na	Y	1,700	River event at 1330.
9/28/17	9/27	<1	na	40.5	0121	<1	na	Y	1,580	Small river event on 9/27 at 2245.
9/29/17		7.4	0204	62	0348	<1	na	Y	2,050	River event at 0130.
10/4/17	10/5	95	2400	37	0155 10/5	<1	na	Y	2,650	River event at 1900. Another river event of 2,840 cfs at 0045 on 10/5.

A complete inventory of all samples collected for each sampling season is provided in Attachment 1.

III.3.c. LA/P Canyons Daily Discharges

From the flow data of the LANL gages the daily discharge table was compiled. If any flow at E050.1, E060.1, or E099 was 5 cfs or greater, that date was included in the table along with the discharges of the remaining gages. Then the percent of all days when the flows were greater than 5 at each gage in comparison to the flows in the entire watershed was calculated. The percent gives the opportunity to evaluate the efficiency of each gage as a trigger for the ENS and the surface water sampling program.

Table 9. Maximum daily discharges for gages in LA/P Canyons watershed.

Date	E050.1	E060.1	E099	BDD Sampled
7/2/2015	0.1	11.3 S	79.8	Y
7/3/2015	0	1.4	499.9	N
7/7/2015	40.4 S	3.8	96.6	Y
7/9/2015	3.6	0.0	5.3	Y
7/20/2015	34.2 S	6.7 S	4.3	Y
7/21/2015	26.5	0.1	2.6	N
7/29/2015	22.0 S	0	0.1	Y
7/30/2015	18.0	0	0	N
7/31/2015	43.0 S	4.2	31.5	Y
8/1/2015	15.1	0.4	23.0	N
8/2/2015	18.4	0	28.0	N
8/3/2015	24.0	0	10.0	N
8/4/2015	15.9	0	4.8	N
8/5/2015	10.3	0	2.9	N
8/6/2015	7.0	0	0.7	N
8/8/2015	10.6 S	0	1.5	N
8/17/2015	0	0	10.0	N
10/21/2015	18.4 S	0	17.5	Y
10/23/2015	5.4 S	0	0	Y
Total Days	79%	11%	53%	
08/07/2016	0	0	24.3	N
08/16/2016	0	0.5	43.2	N
08/19/2016	0	0.6	19.4	N
08/21/2016	0	0.5	8.7	N
08/22/2016	0	0	5.3	N
08/23/2016	0	0.3	100.0	N
08/24/2016	0	0.3	50.3	N
08/27/2016	25 S	3.6	25.8	Y
08/28/2016	<0.1	2.9	8.9	N
08/30/2016	0	0	5.3	N
09/03/2016	0	0	10.9	N
09/05/2016	0	0	5.3	N
09/06/2016	0	3.8	5.3	N
Total Days	8%	0%	100%	
05/29/2017	0	0.6	6.0	Y
07/27/2017	0	<1	27.7	Y
08/08/2017	0	<1	136.5	Y
09/27/2017	17 S	<1	0.3	N
09/28/2017	40.5 S	<1	<1	Y
09/29/2017	62 S	<1	7.5	Y
10/04/2017	2.8	<1	95	Y
10/05/2017	37 S	<1	90	Y
10/06/2017	7	<1	0.4	N
Total Days	56%	0%	67%	

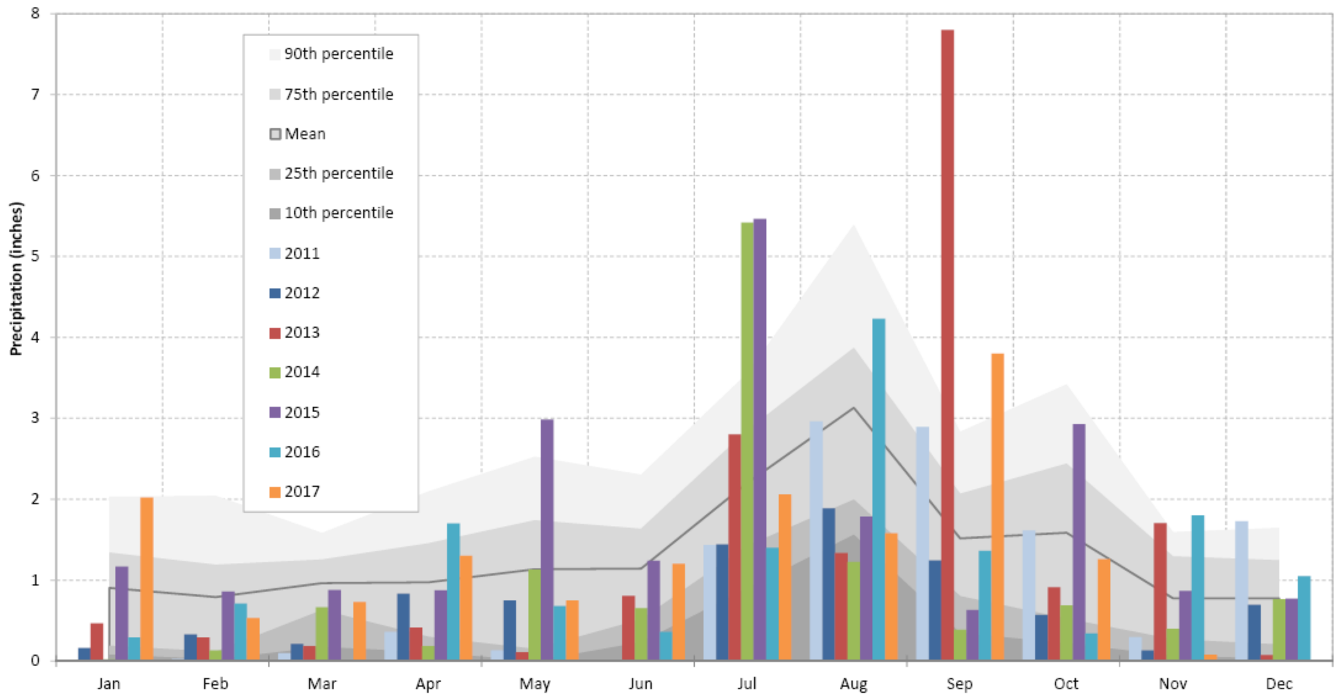
S means this event was sampled by LANL

IV. Storm Events

IV.1 Annual Precipitation 2011-2017

The monthly precipitation for the region of Los Alamos is pictured on Figure 9, (LA-UR-18-23237, April 2018).

Figure 9. Los Alamos monthly precipitation 2011-2017.



IV.2 2015-2017 Rio Grande Discharge

The graph below pictures the Rio Grande discharge as measured at the Otowi Gage station for each summer season in this monitoring period. Superimposed on the graph are storm events that occurred in the LA/PCW. The graph also marks which of those events were sampled by BDD (red markings) and which events were not successfully sampled by BDD (black markings). The green triangles mark events that were sampled by NMED DOE OB at the BDD intake.

Figure 10. Rio Grande hydrograph at Otowi Gage, 6/1/2015 - 10/31/2015.

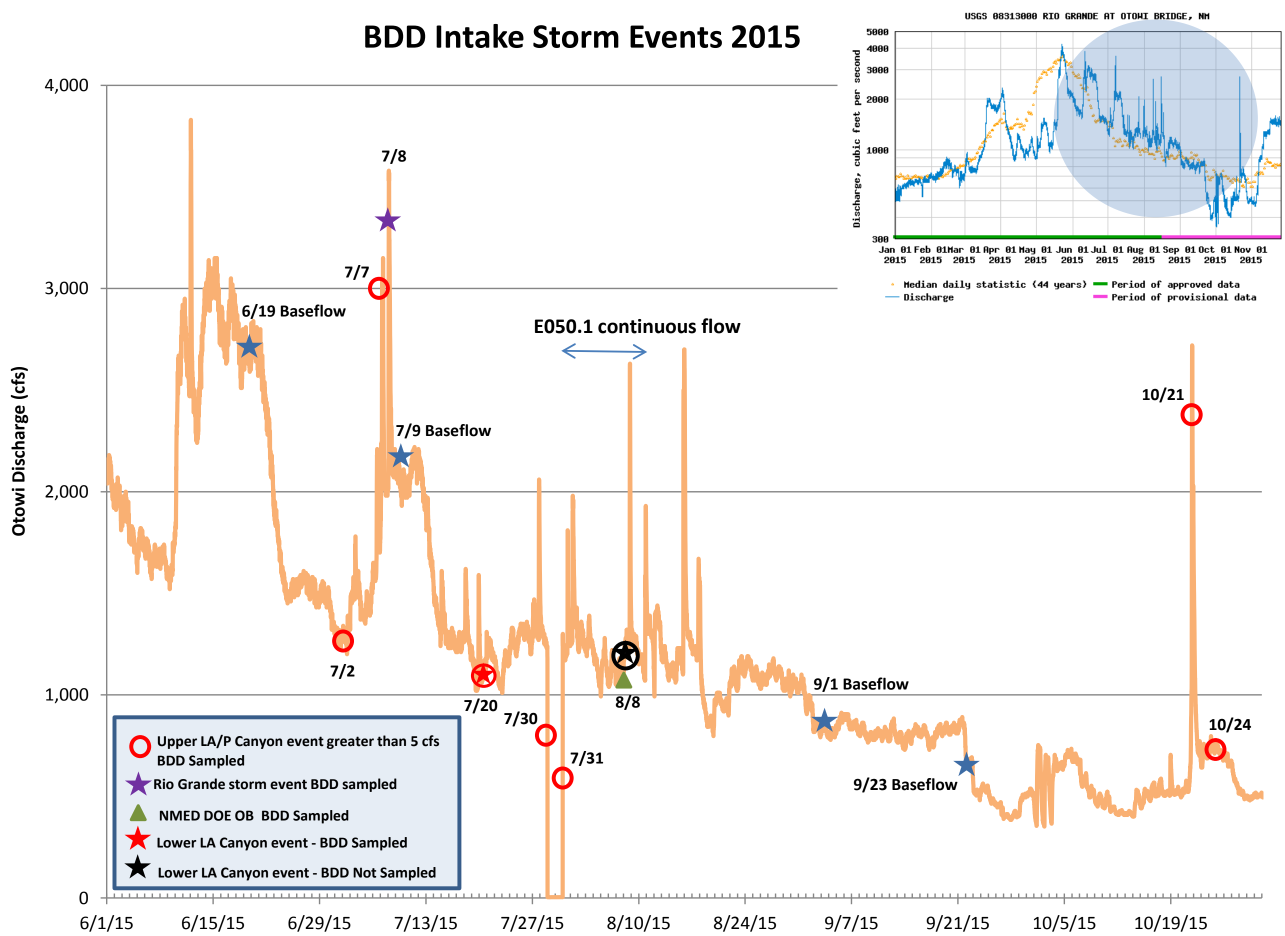


Figure 11. Rio Grande hydrograph at Otowi Gage, 6/1/2016 - 10/31/2016.

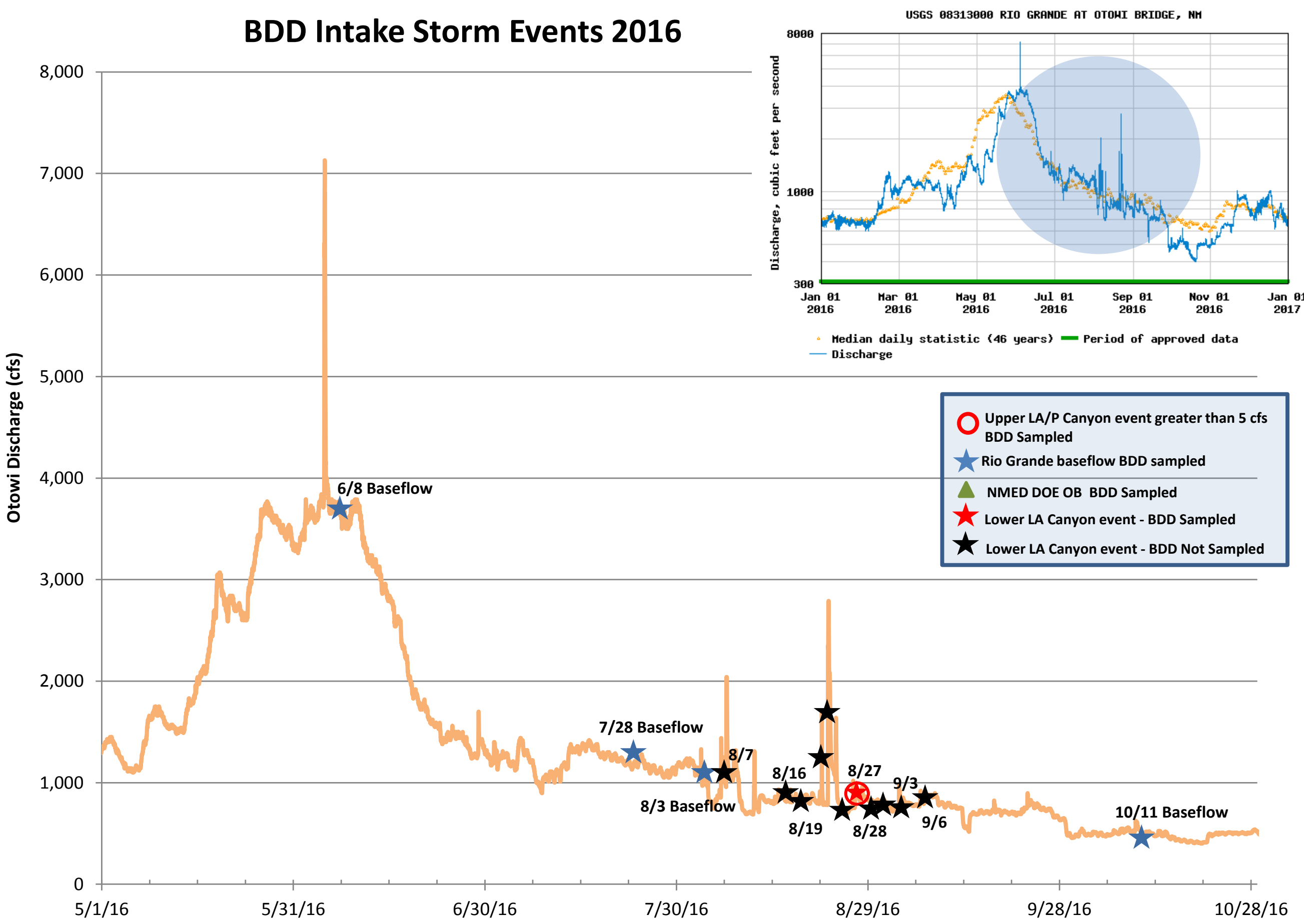
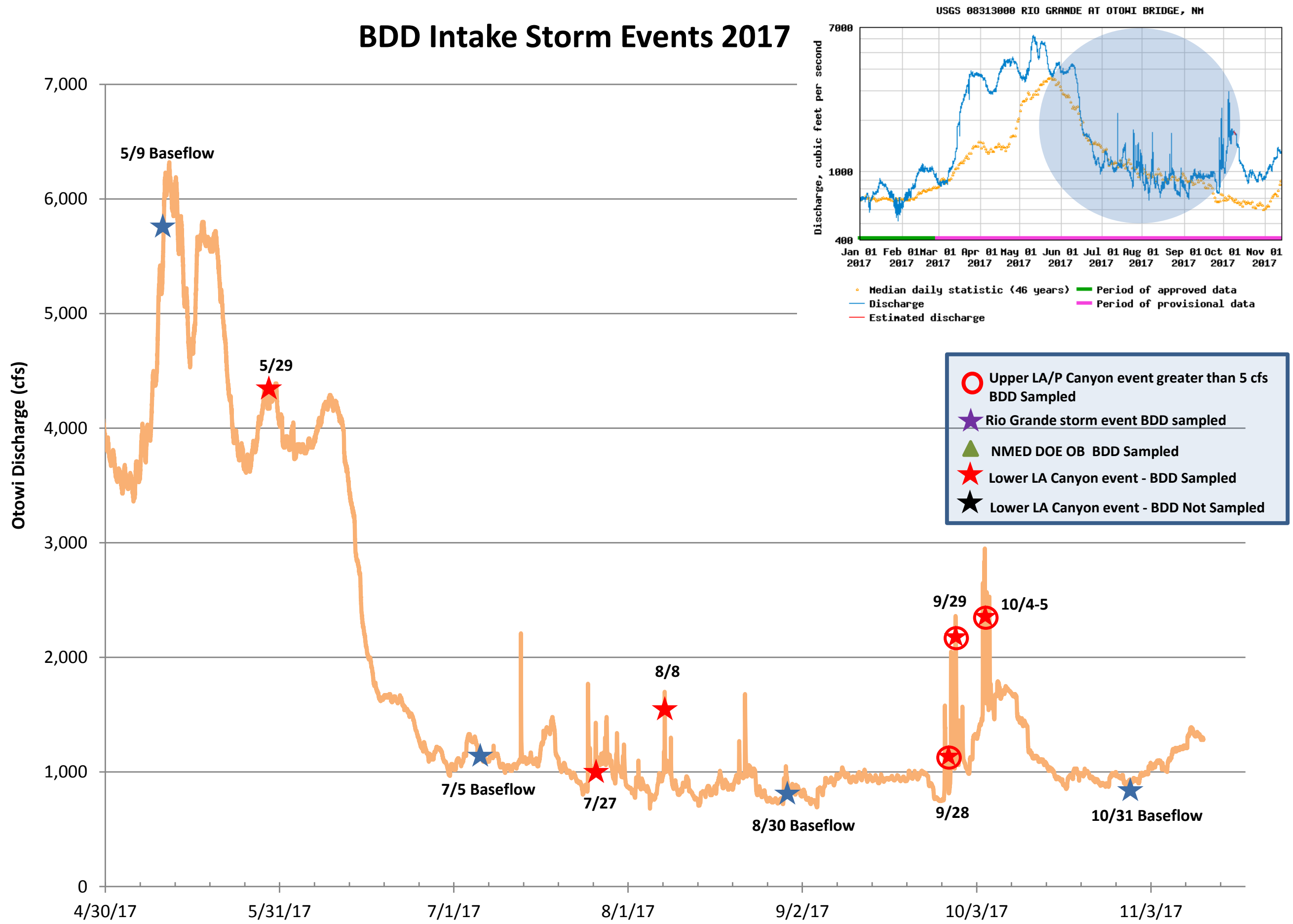


Figure 12. Rio Grande hydrograph at Otowi Gage, 5/1/2017 - 10/31/2017.



V. Comparison Values

The occurrences of radionuclides and metals during the 2015-2017 storm seasons were compared to the Rio Grande sediment background values (RG UTL) previously calculated in the BDD 2011-2014 report. Those are provided in Table 10. Table 11 lists the NM WQCC standards and screening values for surface water.

Table 10. RG background values.

pCi/g	Pu 239/240	Pu 238	Am 241	Sr 90	Cs 137	U 238	U 234	U 235
RG UTL av	**0.014**	**0.008**	**0.018**	**0.76**	**0.50**	**1.28**	**1.43**	**0.083**
PP UTL[1]	0.068	0.006	0.040	1.04	0.90	2.29	2.59	0.200
pCi/g	**Ra 226**	**Ra 228**	**K 40**	**Gross α**	**Gross β**	**Gross γ**		
RG UTL av	**1.32**	**1.67**	**28.47**	**18.64**	**31.5**	**11.78**		
PP UTL[1]	2.59	2.33	36.80					

[1] Pajarito Plateau UTLs: Values were reported in (R. T. Ryti, 1998)

mg/kg	Al	As	Ba	Be	B	Cd	Cr	Co	Cu	Fe	Pb
RG UTL av	**9,067**	**4.80**	**284**	**0.603**	**8.54**	**0.833**	**11.87**	**8.04**	**11.71**	**16,189**	**9.74**
PP UTL[1]	15,400	3.98	127	1.310	-	0.400	10.50	4.73	11.20	13,800	19.70
mg/kg	**Hg**	**Mo**	**Ni**	**Se**	**Ag**	**Sr**	**Tl**	**Sb**	**U**	**V**	**Zn**
RG UTL av	**0.0284**	**2.35**	**9.80**	**0.87**	**0.52**	**100.6**	**0.114**	**NA**	**3.70**	**35.2**	**56.2**
PP UTL[1]	0.1000	-	9.38	0.30	1.00	-	0.730	0.83	2.22/6.99	19.7	60.2

Table 11. NM WQCC standards and screening values.

NMWQCC Surface Water Standards								
Analytical Suite	Analyte Code	Analyte Name	Field Prep	Acute Aquatic	Human Health Persistent	Lifestock Watering	Wildlife Habitat	Screening Criteria
METALS	Al	Aluminum	F	658	n/a	n/a	n/a	
METALS	Sb	Antimony	F	n/a	640	n/a	n/a	
METALS	As	Arsenic	F	340	9	200	n/a	
METALS	B	Boron	F	n/a	n/a	5,000	n/a	
METALS	Cd	Cadmium	F	0.59	n/a	50	n/a	
METALS	Cr	Chromium	F	n/a	n/a	1,000	n/a	
METALS	Cr(III)	Chromium(III)	F	210	n/a	n/a	n/a	
METALS	Co	Cobalt	F	n/a	n/a	1,000	n/a	
METALS	Cu	Copper	F	4	n/a	500	n/a	
METALS	Pb	Lead	F	17	n/a	100	n/a	
METALS	Mn	Manganese	F	1,999	n/a	n/a	n/a	
METALS	Hg	Mercury	F	1.4	n/a	n/a	n/a	
METALS	Hg	Mercury	UF	n/a	n/a	10	0.77	
METALS	Ni	Nickel	F	170	4,600	n/a	n/a	
METALS	Se	Selenium	F	n/a	4,200	50	n/a	
METALS	Se	Selenium	UF	20	n/a	n/a	5	
METALS	Ag	Silver	F	0.4	n/a	n/a	n/a	
METALS	Tl	Thallium	F	n/a	0.47	n/a	n/a	
METALS	V	Vanadium	F	n/a	n/a	100	n/a	
METALS	Zn	Zinc	F	54	26,000	25,000	n/a	
WET_CHEM	CN(TOTAL)	Cyanide(Total)	UF	22	140	n/a	5.2	
PCB_CONG	1336-36-3	Total PCBs	UF	n/a	0.00064	n/a	0.014	
DIOX/FUR	n/a	Dioxin (TEQ)	UF	n/a	0.000000051	n/a	n/a	
RAD	GROSSA	Gross alpha	UF	n/a	n/a	15	n/a	
RAD	Ra-226+228	Radium-226 & 228	UF	n/a	n/a	30	n/a	
RAD	Am-241	Americium-241	UF					1.9
RAD	Cs-137	Cesium-137	UF					6.4
RAD	Pu-238	Plutonium-238	UF					1.5
RAD	Pu-239/240	Plutonium-239/240	UF					1.5
RAD	Sr-90	Strontium-90	UF					3.5
RAD	H-3	Tritium	UF					4,000
All units are ug/L except for RAD, which are pCi/L								
F=filtered and UF=unfiltered								

VI. Analytical Results for 2015-2017 Sampling Period

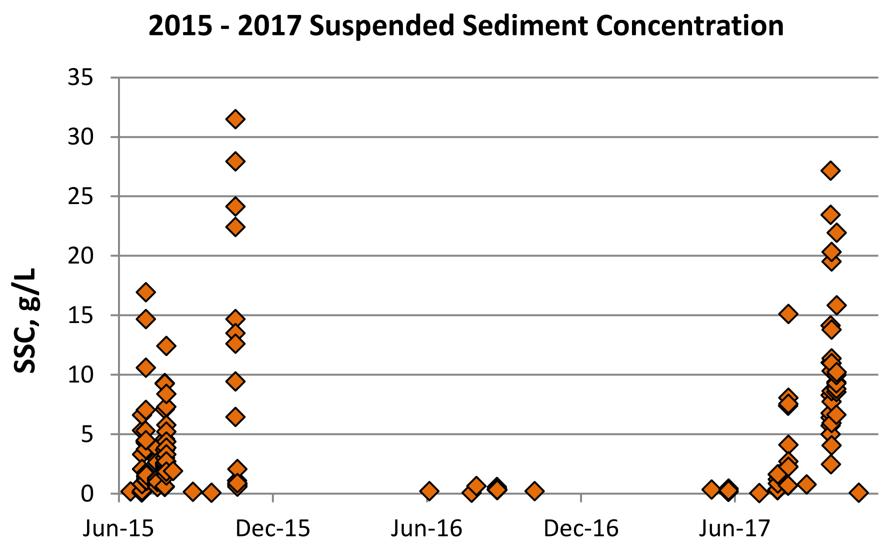
VI.1 Sediment Transport at BDD

BDD sampled storm and base flow throughout the 2015-2017 summer seasons and the descriptive statistics of the results are listed below. A graphical representation of the results is offered on Figure 13.

Table 12. Descriptive statistics of SSC results.

SSC mg/L						
Num Obs	**Min**	**Max**	**Mean**	**SD**	**Median**	**95%ile**
149	0.0372	31.4834	5.2461	6.4471	2.4600	19.9956

Figure 13. SSC at BDD for 2015-2017 seasons.



VI.2 Analytical Results for Radionuclides

Attachment 2 lists the descriptive statistics for all radionuclides monitored under this program. In this section the results for radionuclides were presented in graphical form, such as chronological plots for stormwater and sediment, and stormwater concentrations vs. SSC. In the plot of stormwater concentrations vs SSC, if any results were above the "black" line, it indicates an exceedance of the RG background values (RG UTL), and, therefore an indicator of contaminants transported from Los Alamos and Pueblo Canyons.

The graphical presentation of the data led to the following conclusions. There were exceedances of the RG background levels for Pu-238,-239/240, Sr-90, Ra-226, Ra-228, U-234, U-238, and U-235. All radionuclides concentrations vs. SSC, exhibited a low coefficient of determination which is indicative of anthropological sources of contamination.

VI.2.a. Plutonium-238.

Figure 14. Chronological results for Pu-238 in stormwater, 2008-2017.

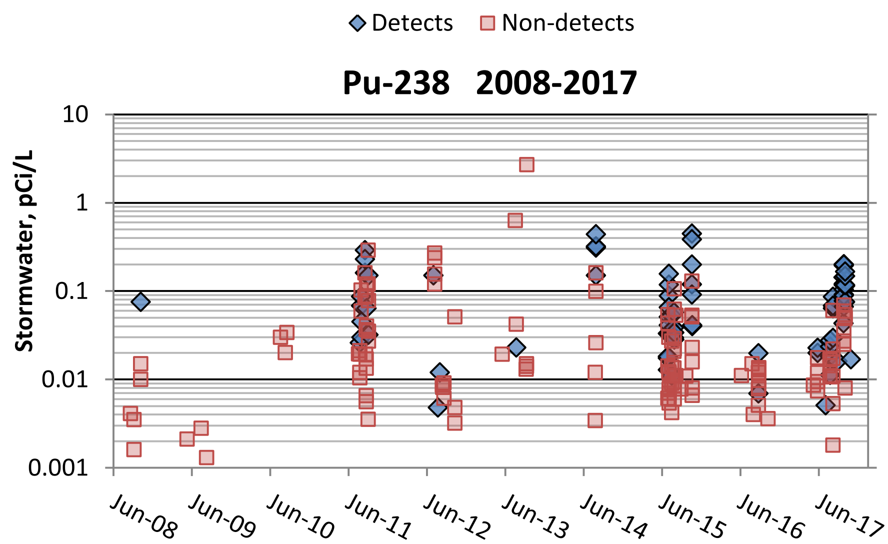


Figure 15. Chronological results for Pu-238 in sediment & SSC, 2008-2017.

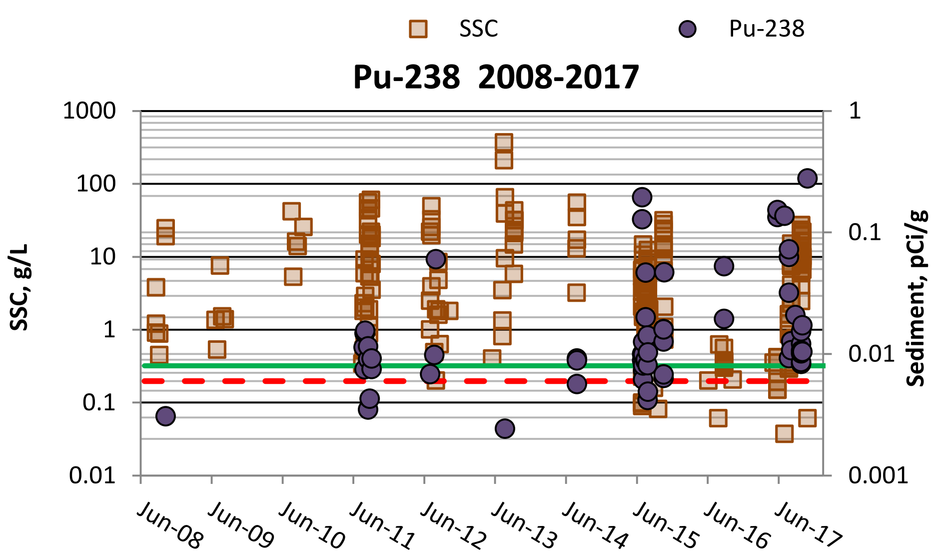
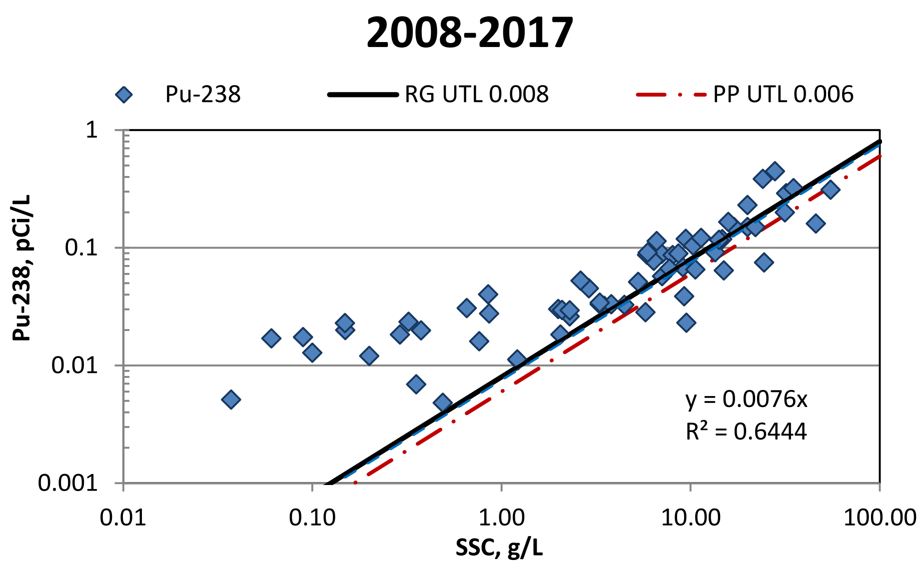


Figure 16. Pu-238 stormwater concentrations vs. SSC, 2008-2017.



VI.2.b. Plutonium-239/240

Figure 17. Chronological results for Pu-239/240 in stormwater, 2008-2017.

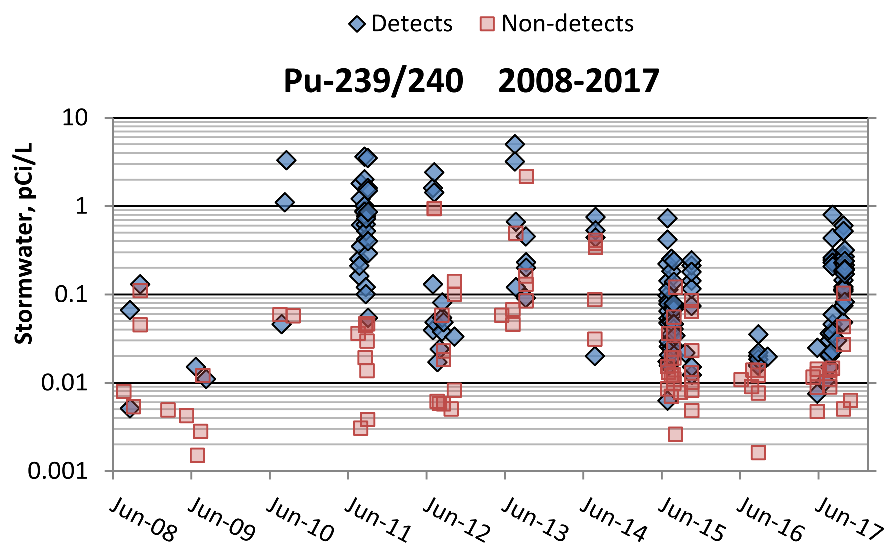


Figure 18. Chronological results for Pu-239/240 in sediment & SSC, 2008-2017.

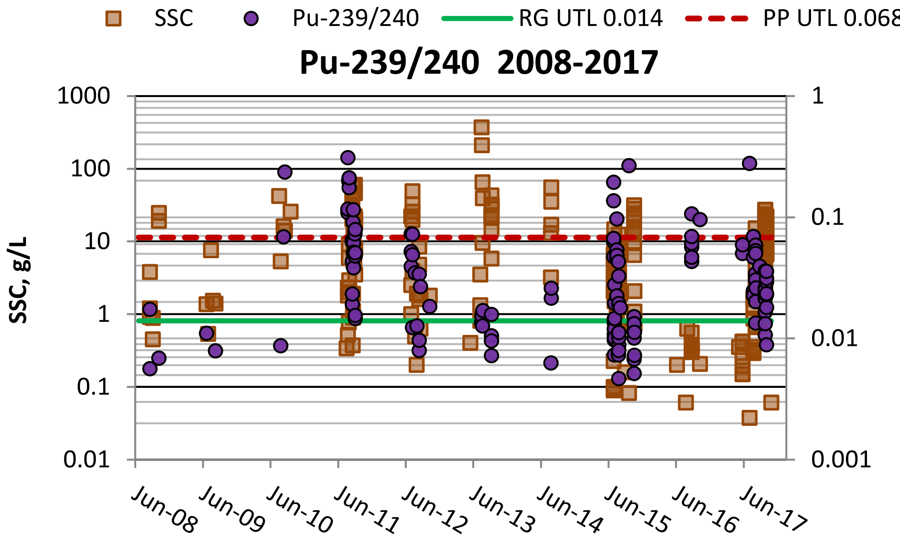
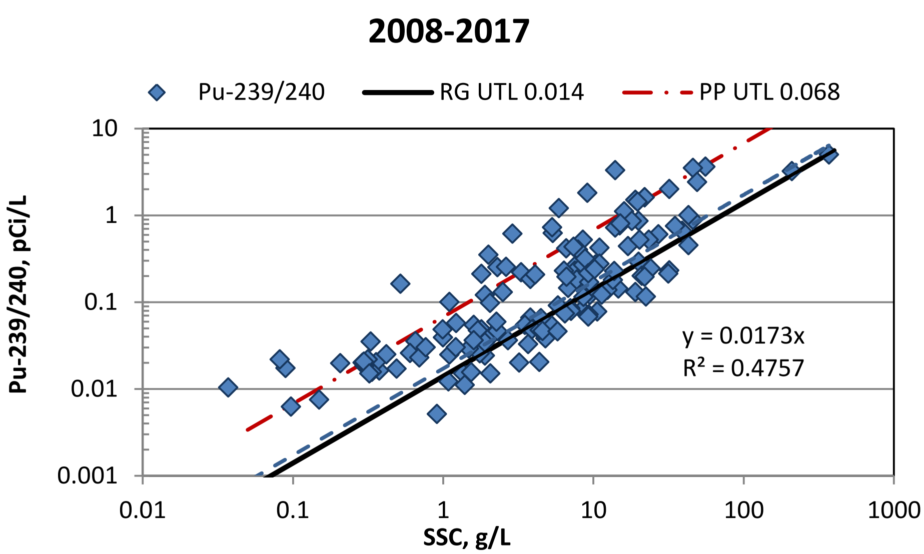


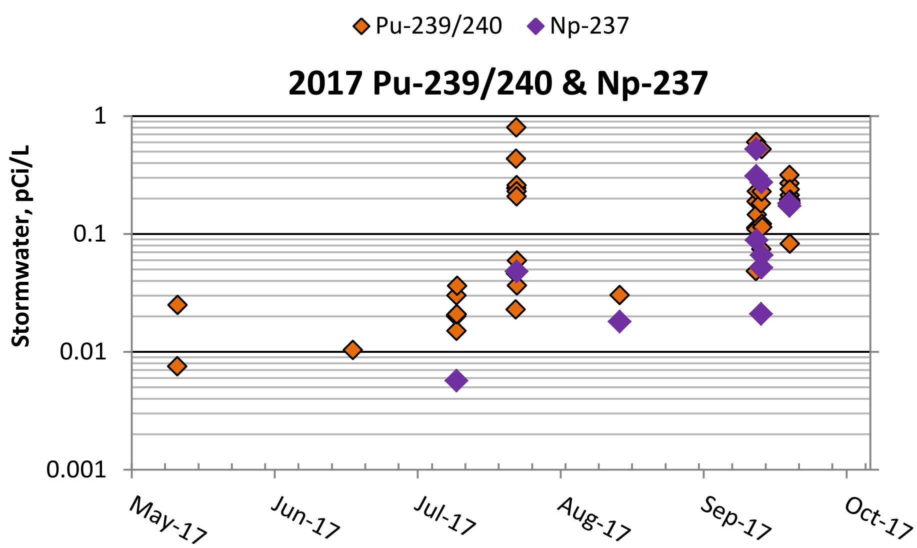
Figure 19. Pu-239/240 stormwater concentrations vs. SSC, 2008-2017.



VI.2.c. Neptunium-237

Neptunium-237 was detected only in 2017. Those results are presented together with Pu-239/240 in the figure below.

Figure 20. 2017 Stormwater results for Np-237 & Pu-239/240.



VI.2.a. Strontium-90

Figure 21. Chronological results for Sr-90 in stormwater, 2008-2017.

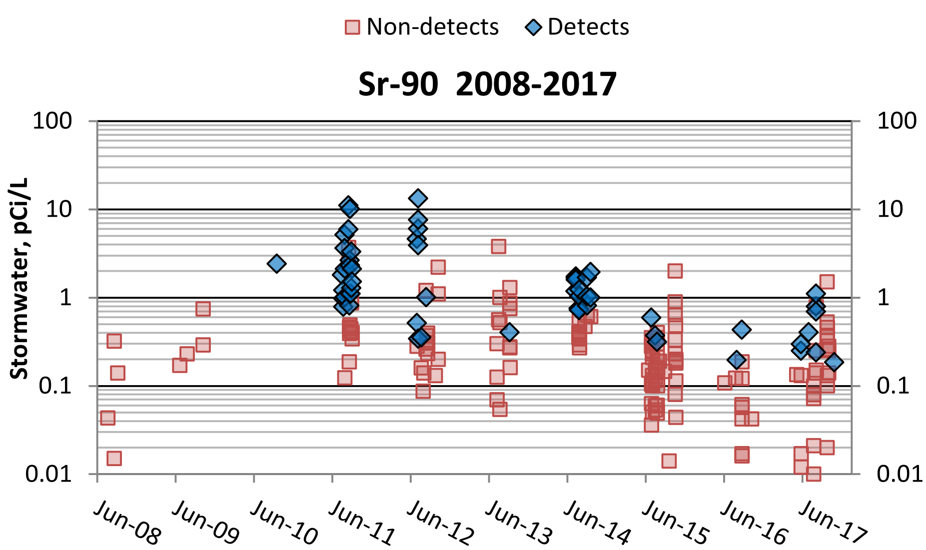


Figure 22. Chronological results for Sr-90 in sediment & SSC, 2008-2017.

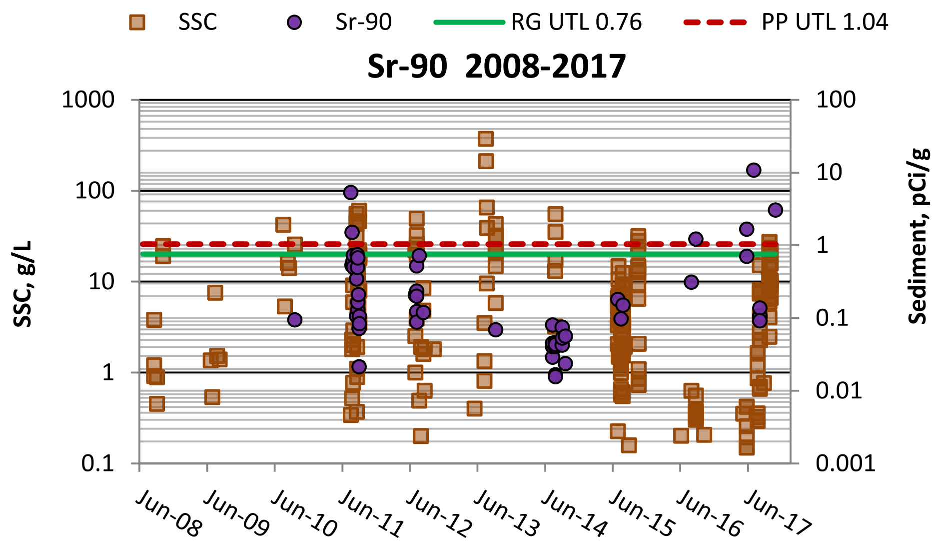
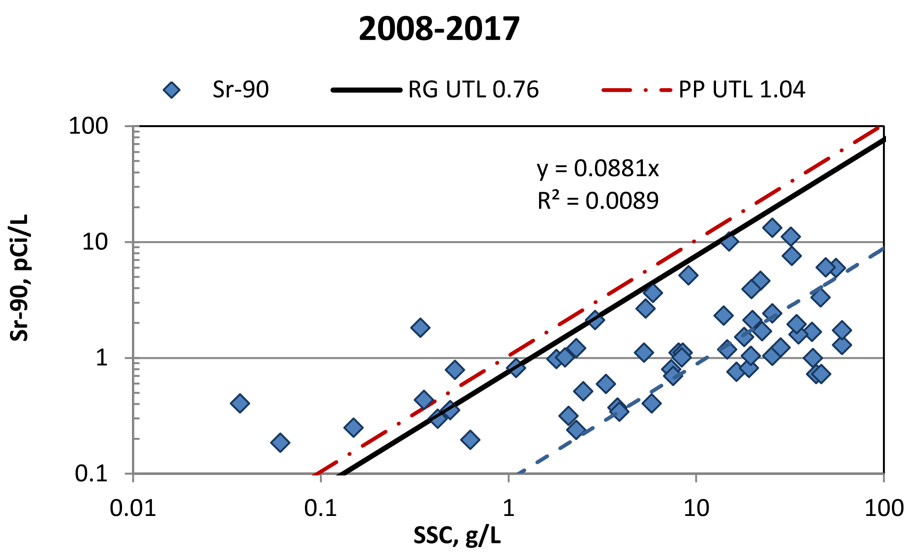


Figure 23. Sr-90 stormwater concentrations vs. SSC, 2008-2017.



VI.2.b. Radium-226

Figure 24. Chronological results for Ra-226 in stormwater, 2008-2017.

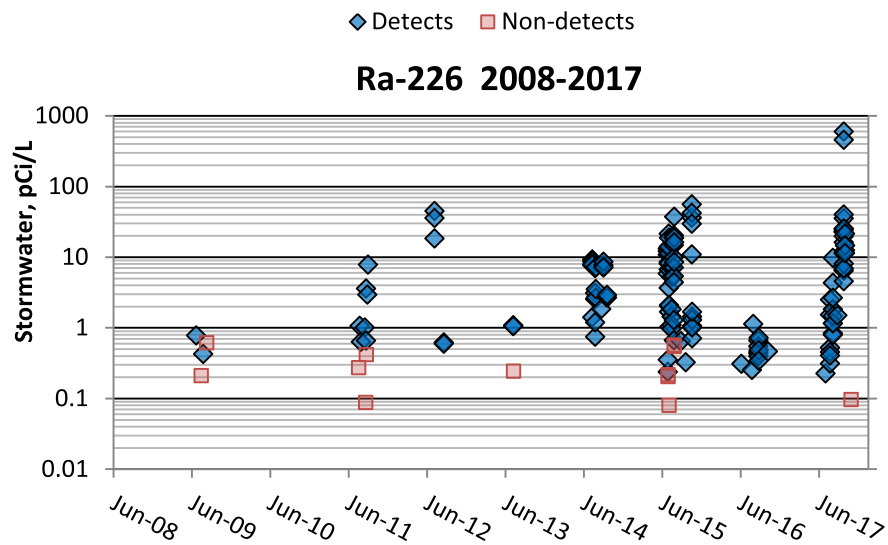


Figure 25. Chronological results for Ra-226 in sediment & SSC, 2008-2017.

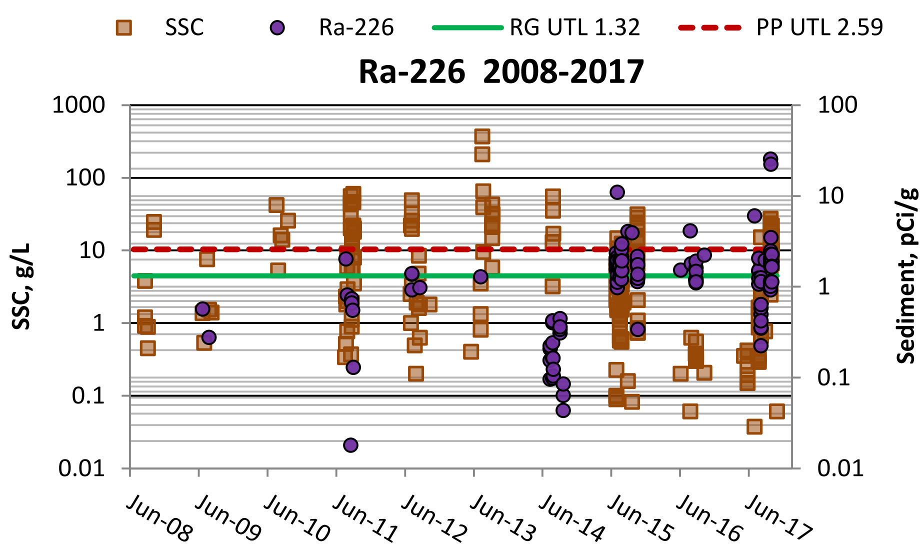
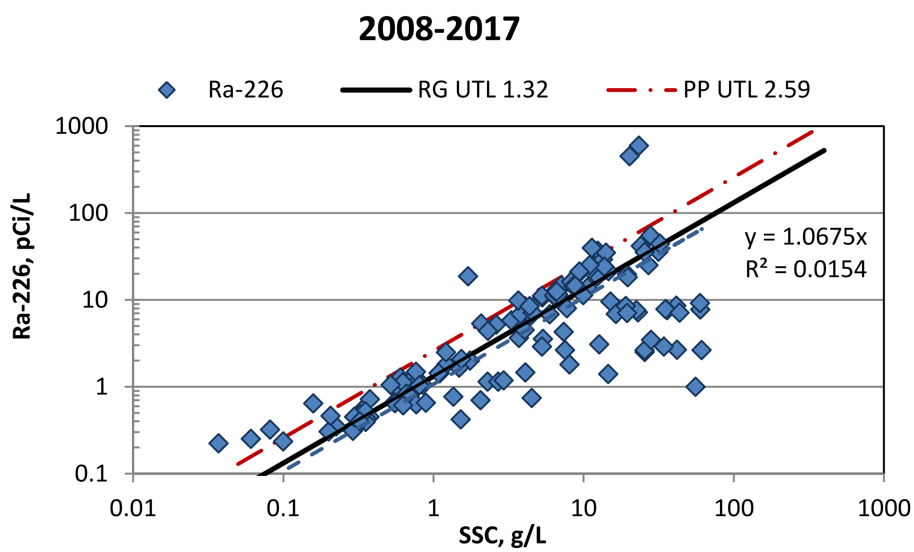


Figure 26. Ra-226 stormwater concentrations vs. SSC.



VI.2.a. Radium-228

Figure 27. Chronological results for Ra-228 in stormwater, 2008-2017.

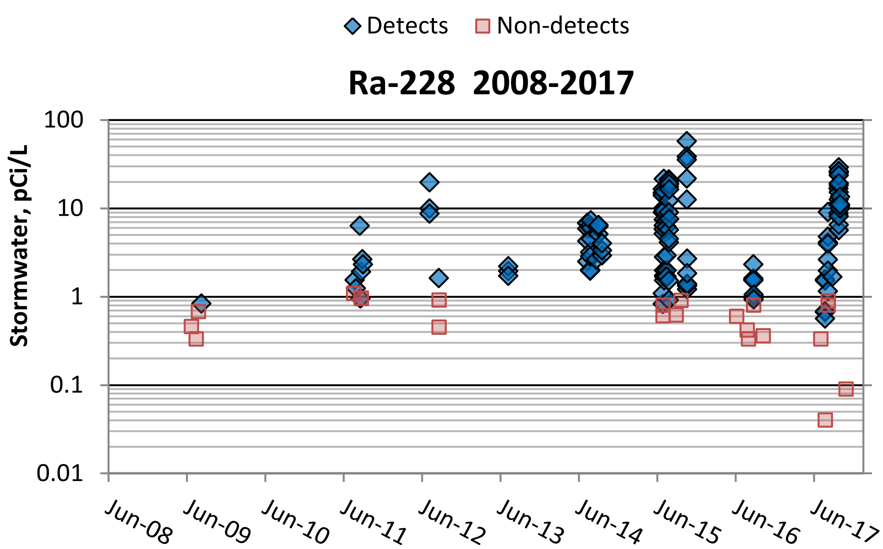


Figure 28. Chronological results for Ra-228 in sediment & SSC, 2008-2017.

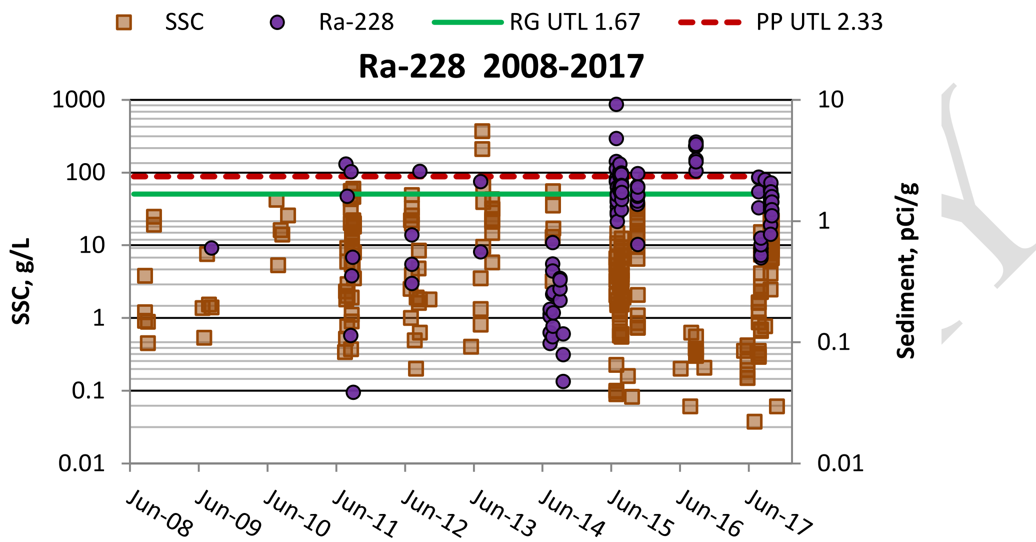
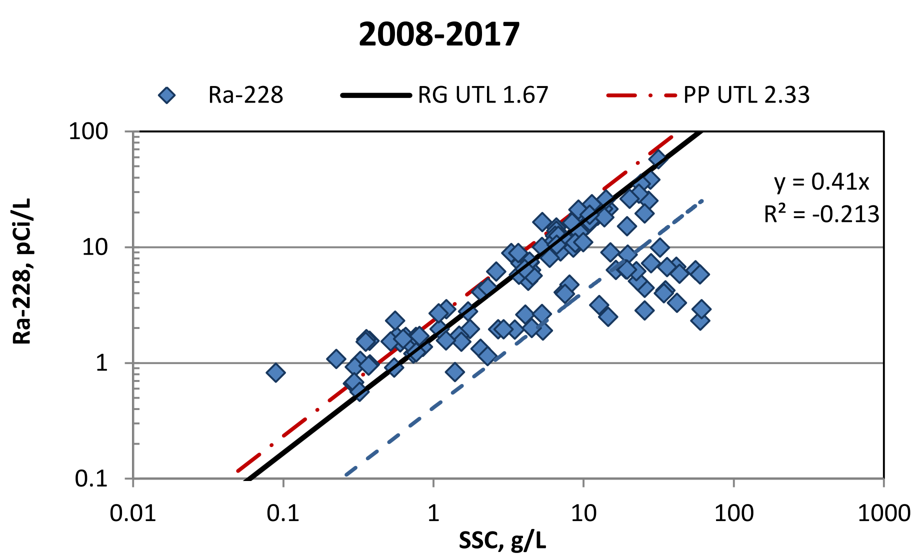


Figure 29. Ra-228 stormwater concentrations vs. SSC.



VI.2.a. Uranium-234

Figure 30. Chronological results for U-234 in stormwater, 2008-2017.

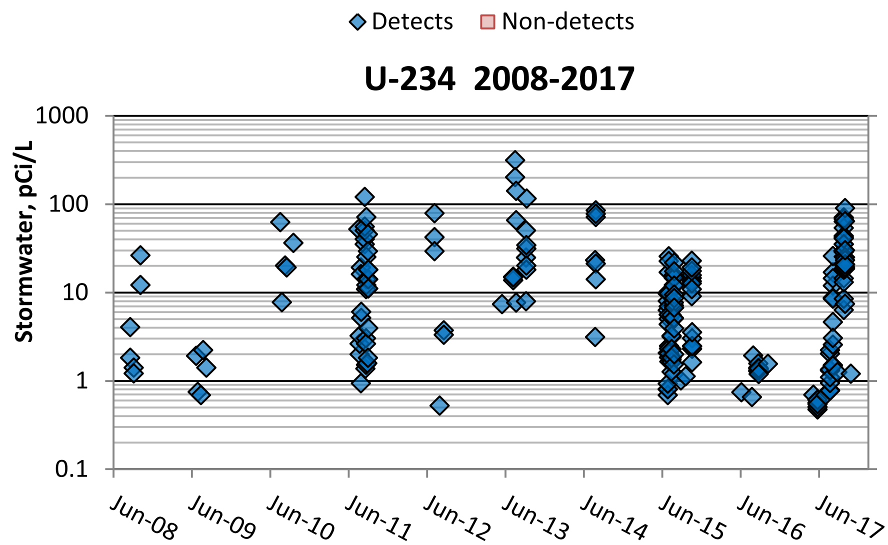


Figure 31. Chronological results for U-234 in sediment & SSC, 2008-2017.

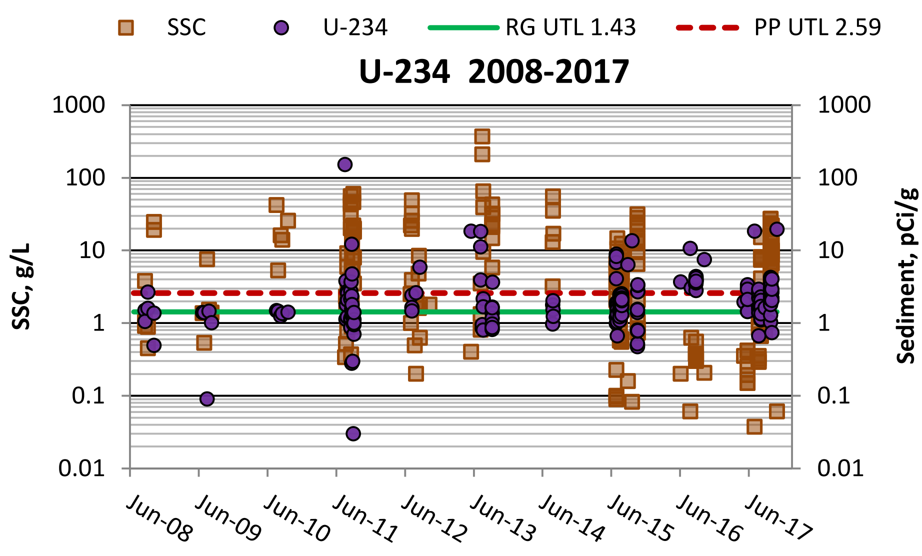
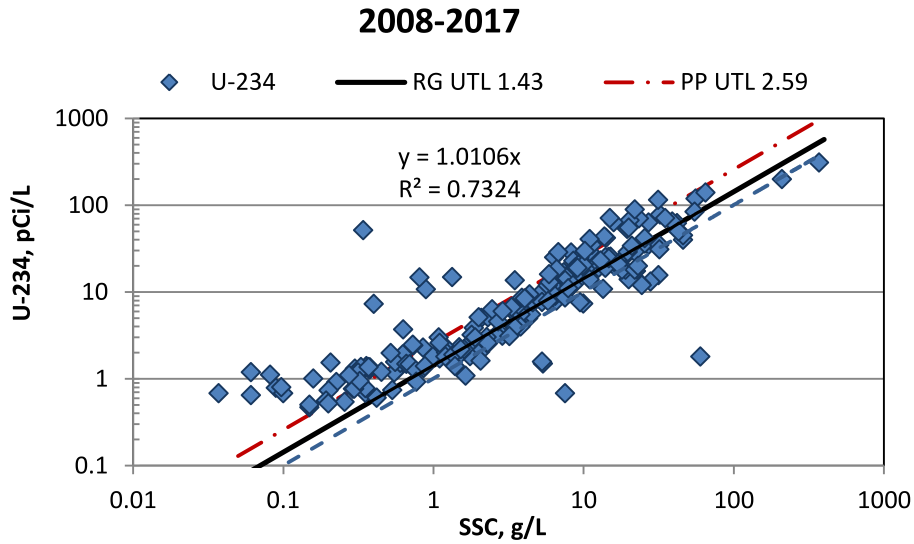


Figure 32. U-234 stormwater concentrations vs. SSC.



VI.2.a. Uranium-235

Figure 33. Chronological results for U-235 in stormwater, 2008-2017.

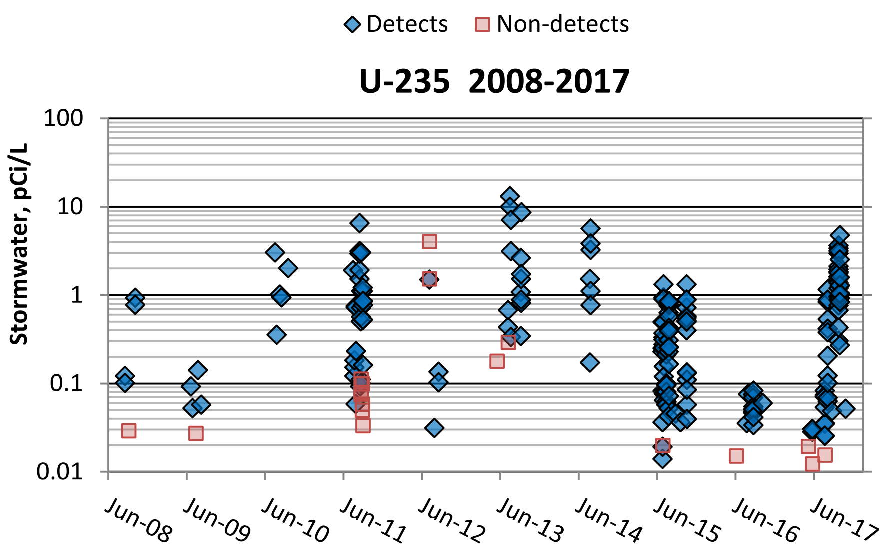


Figure 34. Chronological results for U-235 in sediment & SSC, 2008-2017.

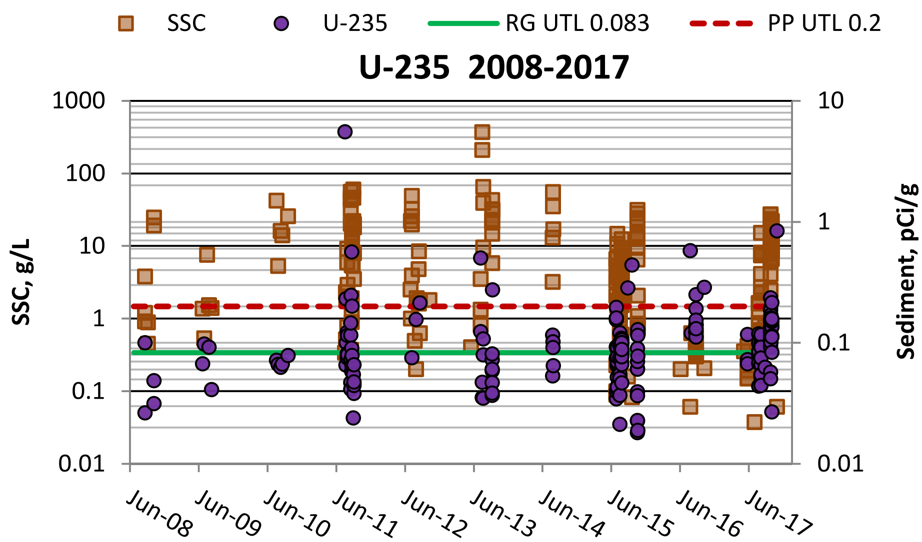
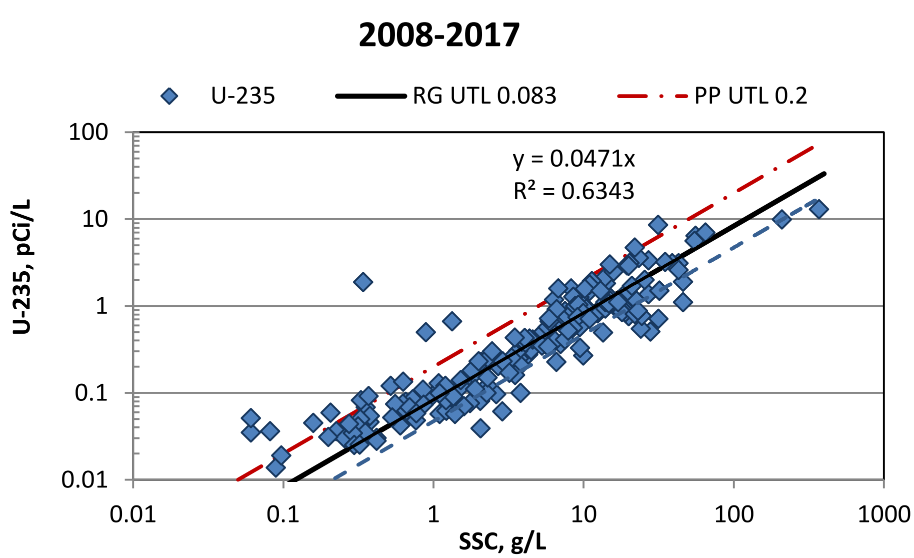


Figure 35. U-235 stormwater concentrations vs. SSC.



VI.2.a. Uranium-238

Figure 36. Chronological results for U-238 in stormwater, 2008-2017.

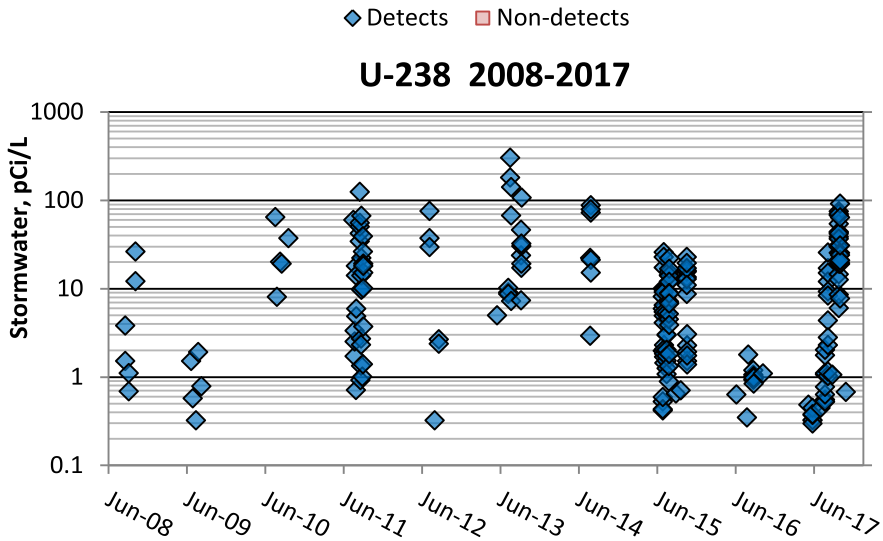


Figure 37. Chronological results for U-238 in sediment & SSC, 2008-2017.

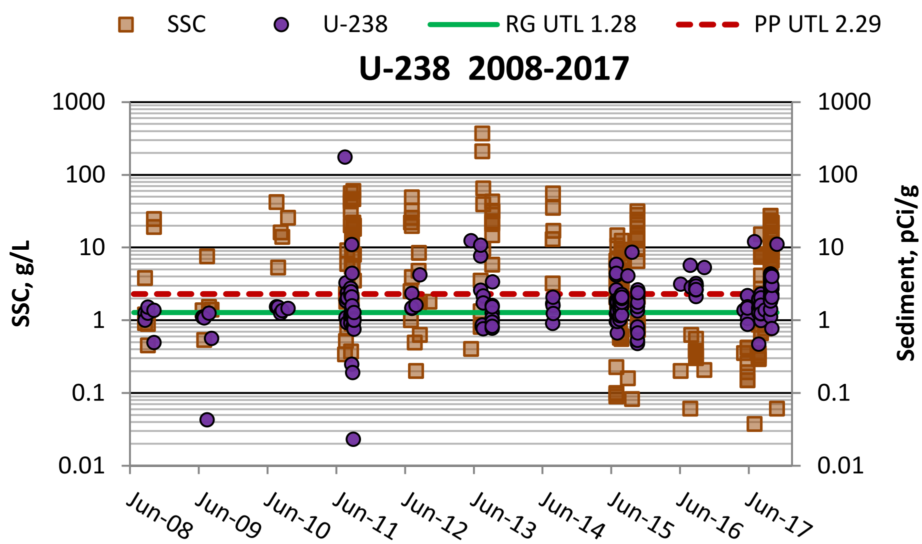
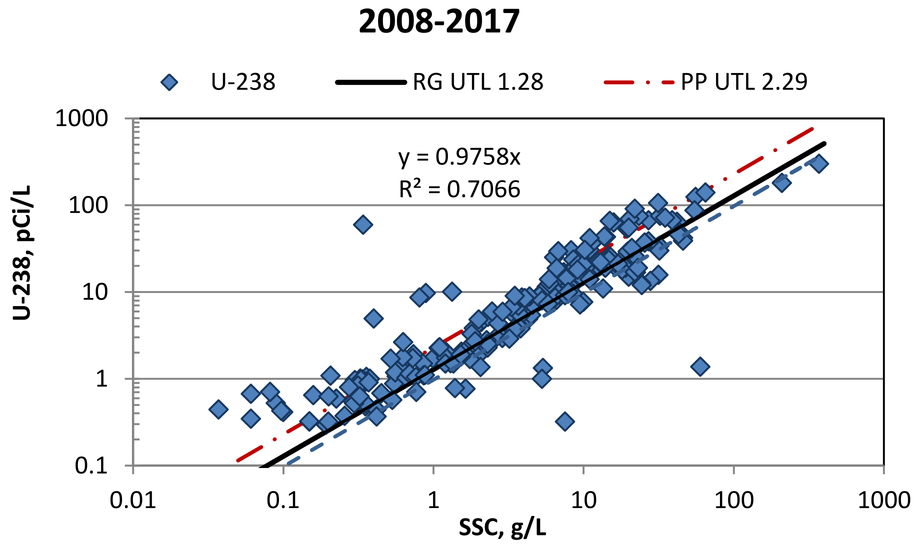


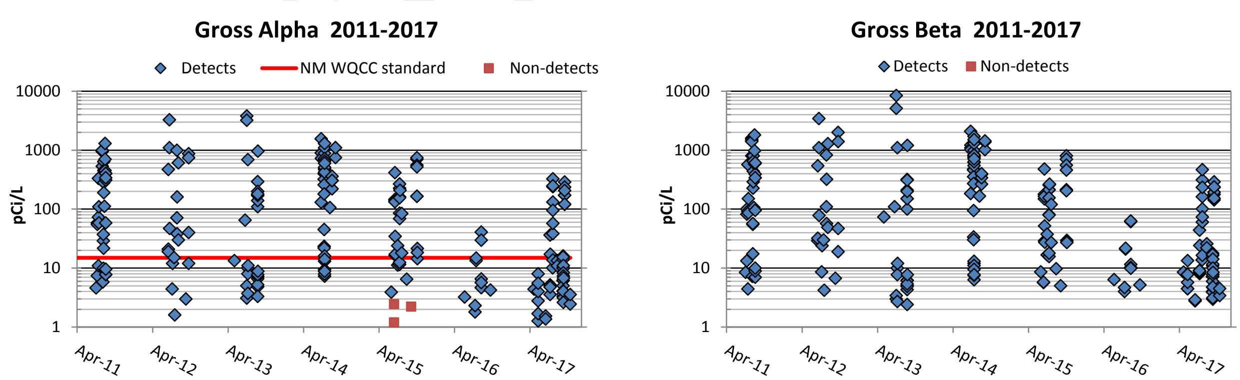
Figure 38. U-238 stormwater concentrations vs. SSC.



VI.2.b. Gross Alpha and Gross Beta

The following figures depict the results of the 2011 through 2017 sampling for gross alpha and beta radionuclides. The pattern of the values appears similar implying that the same source(s) may be responsible for the concentrations. There were regular exceedances of the surface water standard for gross alpha during this monitoring period.

Figure 39. Gross alpha and gross beta stormwater results, 2011-2017.



VI.3 Analytical Results for Metals

A statistical summary of all metal results, unfiltered and filtered, is presented in Attachment 3.

VI.3.a. Aluminum (Al)

Figure 40. Al stormwater concentrations vs. SSC

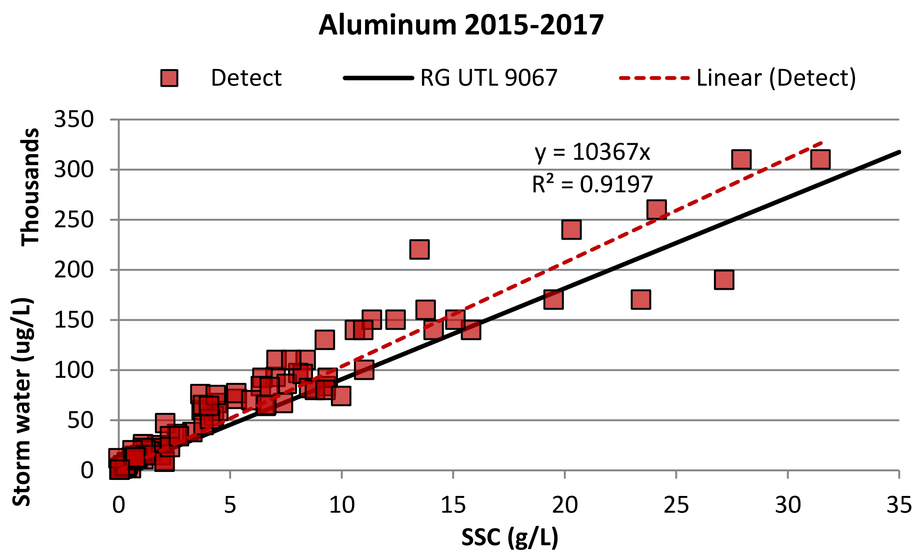
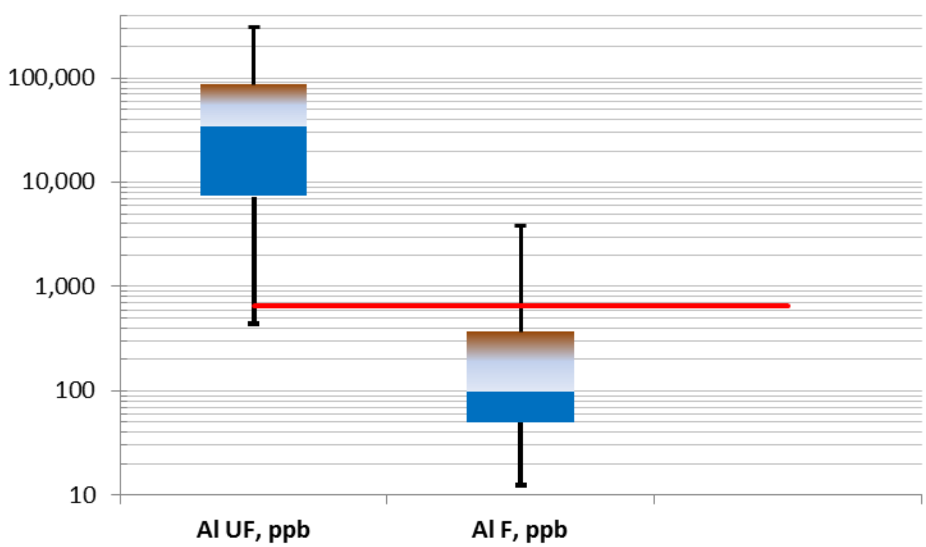


Figure 41. Unfiltered and filtered results for Al.



Max	310,000	n=116	3,800	n=87
75th	85,500		370	
Median	34,000		99	
25th	7,310		50	
Min	440		13	

The concentrations of unfiltered samples exceeded the RG background, and a few filtered samples exceeded the NM WQCC standards. The Al concentrations for unfiltered and filtered samples differ with two orders of magnitude and imply high affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results indicate naturally occurring source(s) along the RG.

VI.3.b. Arsenic (As)

Figure 42. As stormwater concentrations vs. SSC

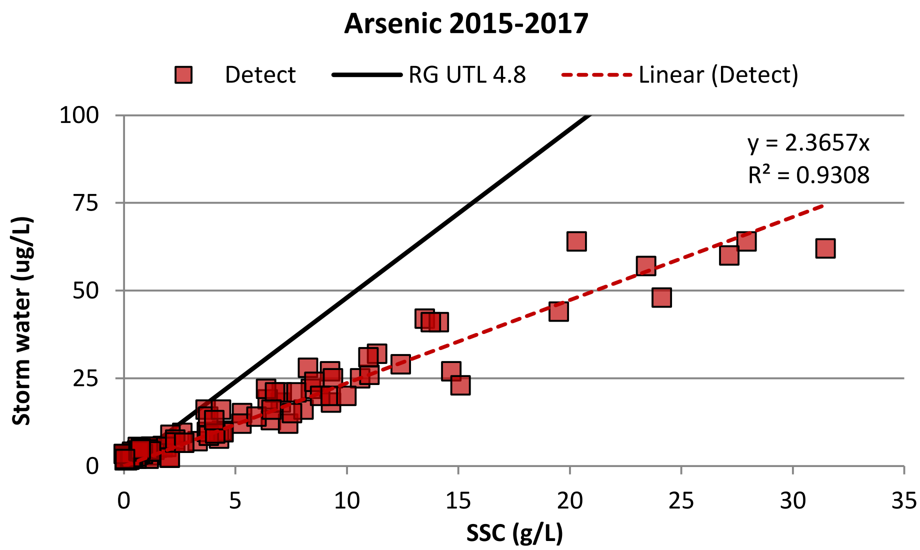
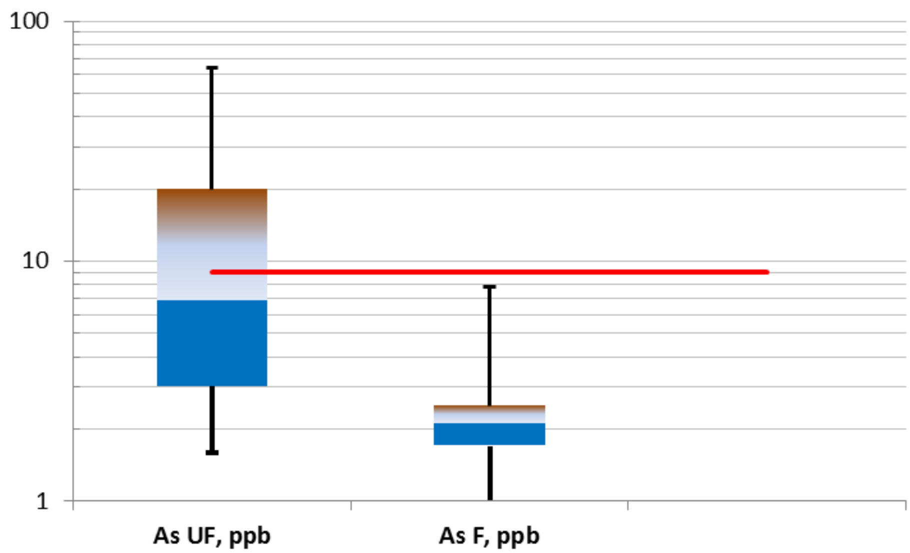


Figure 43. Unfiltered and filtered results for As.



Max	64	n=116	7.8	n=87
75th	20		2.5	
Median	6.85		2.1	
25th	3		1.7	
Min	1.6		0.92	

There were no substantial exceedances of RG background values and the NM WQCC standards. The As concentrations for unfiltered and filtered samples differ with less than an order of magnitude and imply some solubility in water and somewhat sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results indicate naturally occurring source(s) along the RG.

VI.3.c. Antimony (Sb)

Figure 44. Sb stormwater concentrations vs. SSC.

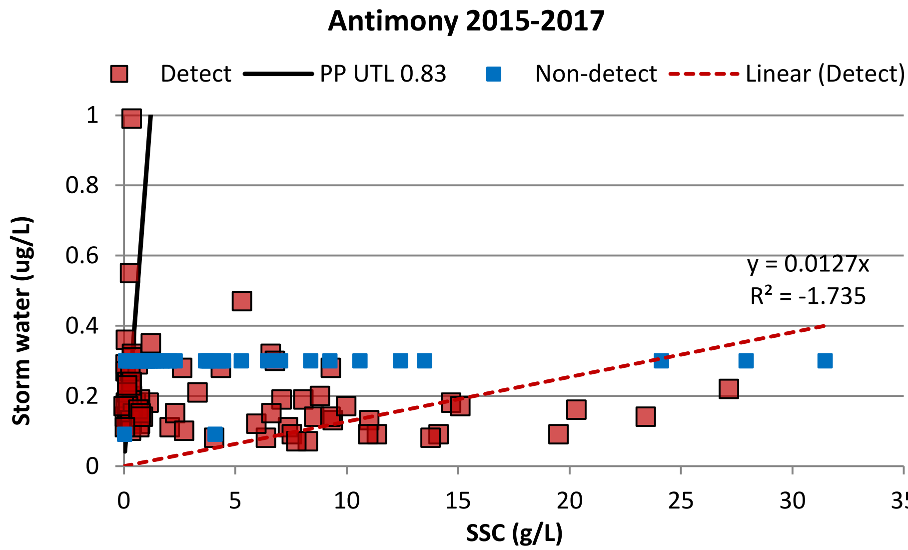
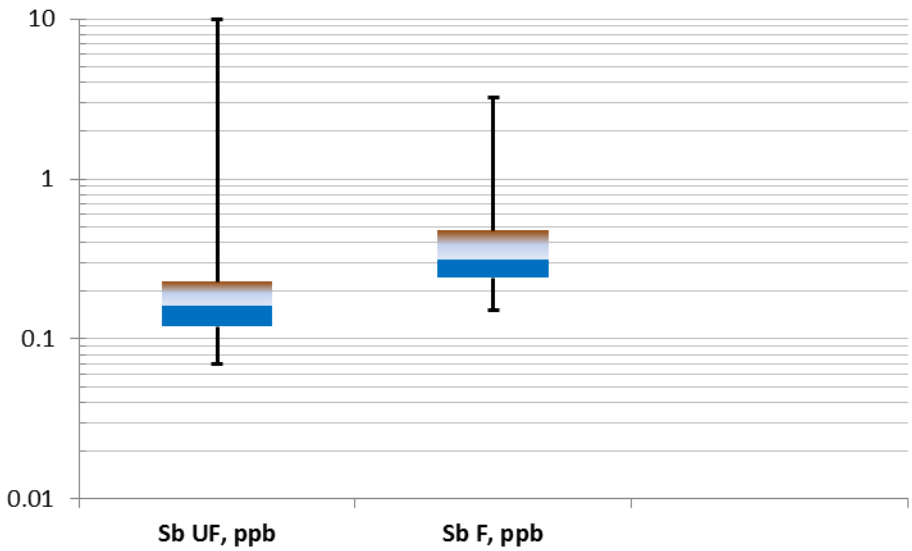


Figure 45. Unfiltered and filtered results for Sb.



Max	10.00	n=84	3.20	n=94
75th	0.23		0.47	
Median	0.16		0.31	
25th	0.12		0.24	
Min	0.07		0.15	

There were a few concentrations of unfiltered samples that exceeded the RG background, and none of the filtered samples exceeded the NM WQCC standards. The Sb concentrations for unfiltered and filtered samples were very compatible in magnitude, indicating that the soluble form of antimony is prevalent in the river. The poor coefficient of determination in the stormwater concentration vs SSC results suggests anthropogenic source(s).

VI.3.d. Barium (Ba)

Figure 46. Ba stormwater concentrations vs. SSC.

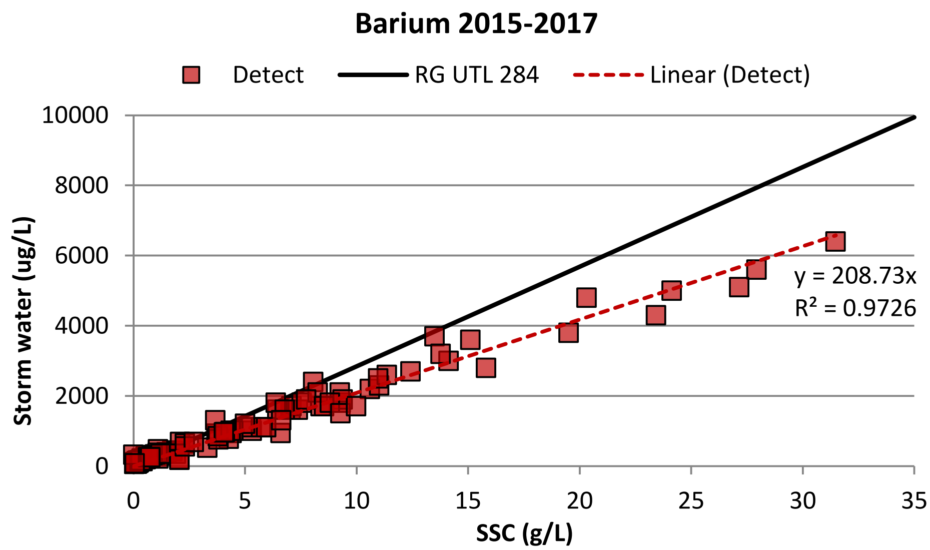
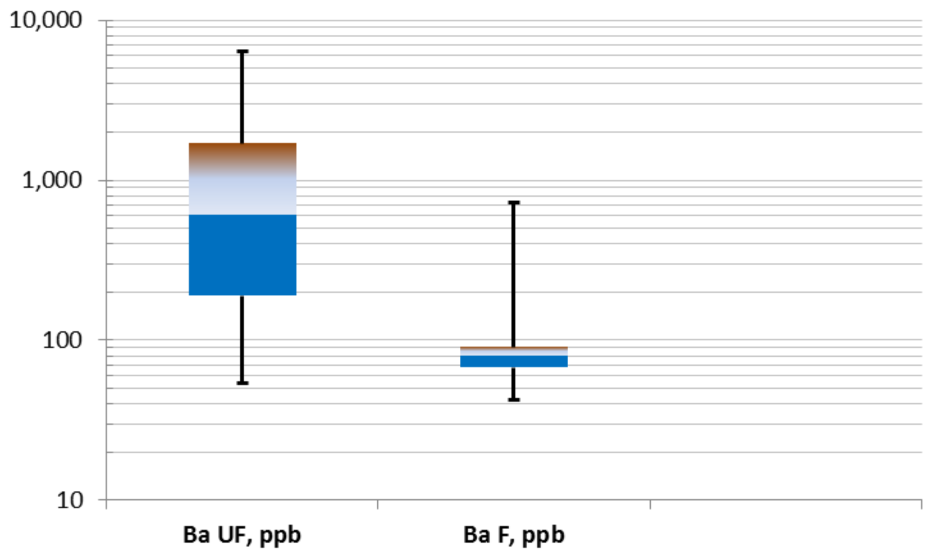


Figure 47. Unfiltered and filtered results for Ba.



Max	6,400	n=116	719.0	n=88
75th	1,700		89.7	
Median	600		79.0	
25th	189		67.8	
Min	54		42.0	

Only a few concentrations of unfiltered samples exceeded the RG background. The Ba concentrations for unfiltered and filtered samples differ with one order of magnitude and imply affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Ba along the RG.

VI.3.e. Beryllium (Be)

Figure 48. Be stormwater concentrations vs. SSC.

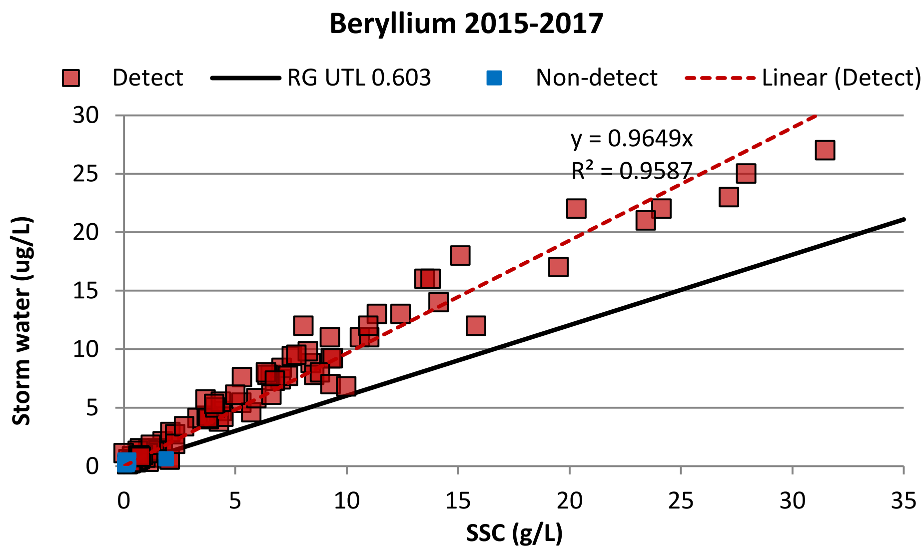
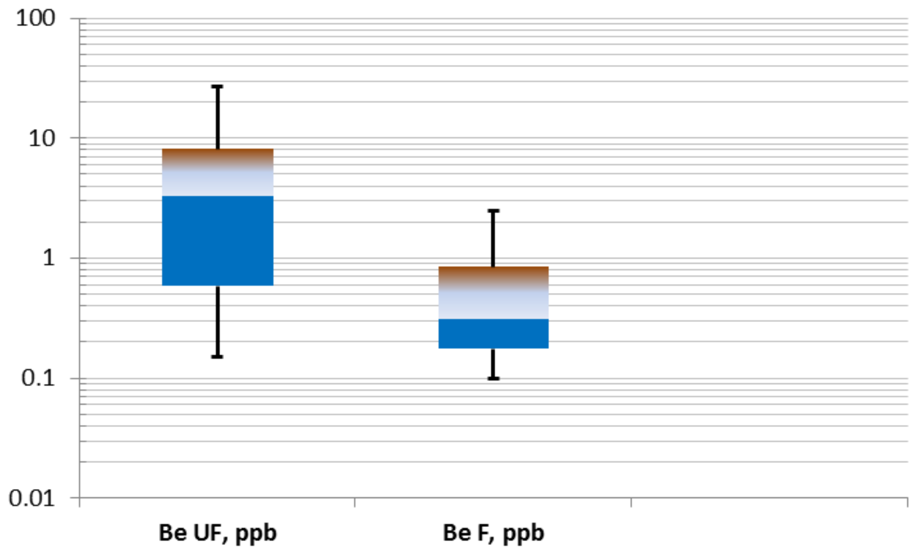


Figure 49. Unfiltered and filtered results for Be.



Max	27.0	n=114	2.48	n=10
75th	8.1		0.85	
Median	3.3		0.31	
25th	0.6		0.18	
Min	0.2		0.10	

Most concentrations of unfiltered samples exceeded the RG background. There were only a few detects for filtered samples implying affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Be along the RG.

VI.3.f. Boron (B)

Figure 50. B stormwater concentrations vs SSC.

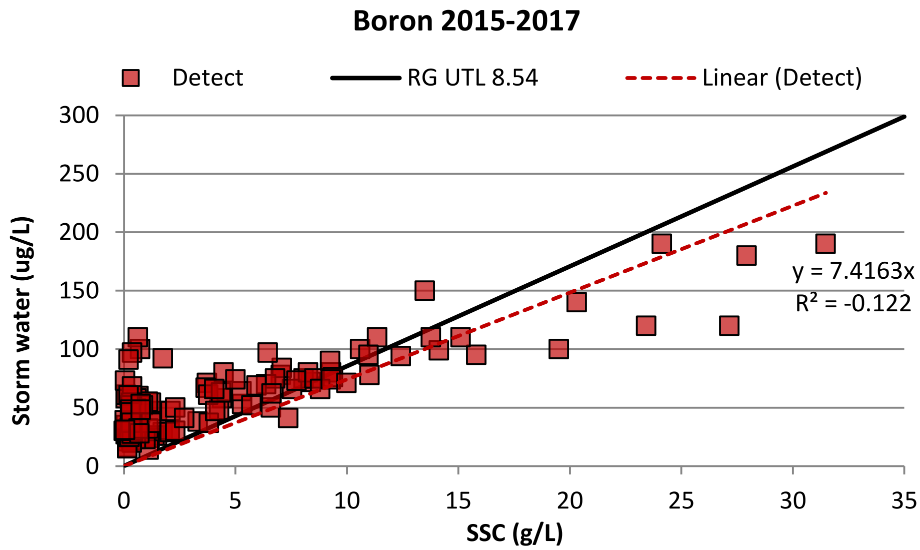
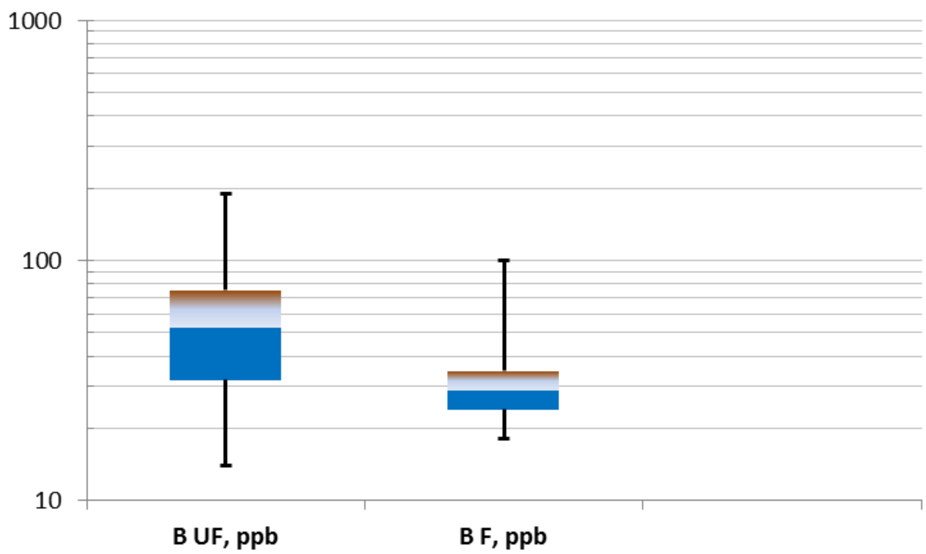


Figure 51. Unfiltered and filtered results for B.



	B UF, ppb		B F, ppb	
Max	190	n=127	100	n=104
75th	75		35	
Median	53		29	
25th	32		24	
Min	14		18	

Most concentrations of unfiltered samples exceeded the RG background, but there were no exceedances of the NM WQCC standard for filtered samples. The B concentrations of filtered samples were less in magnitude than unfiltered but clearly showed higher water solubility than other metals. The low coefficient of determination in the stormwater concentration vs SSC results suggests anthropogenic source(s).

VI.3.g. Cadmium (Cd)

Figure 52. Cd stormwater concentrations vs SSC.

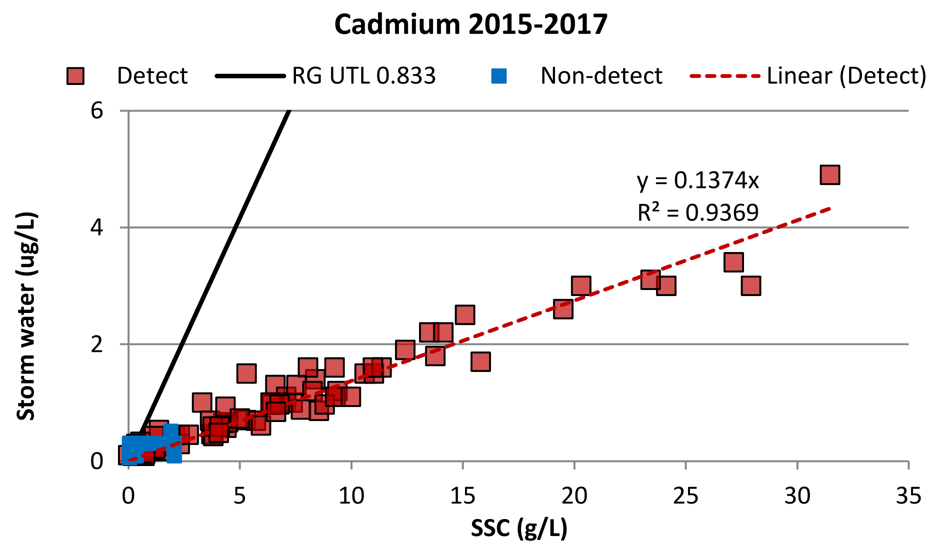
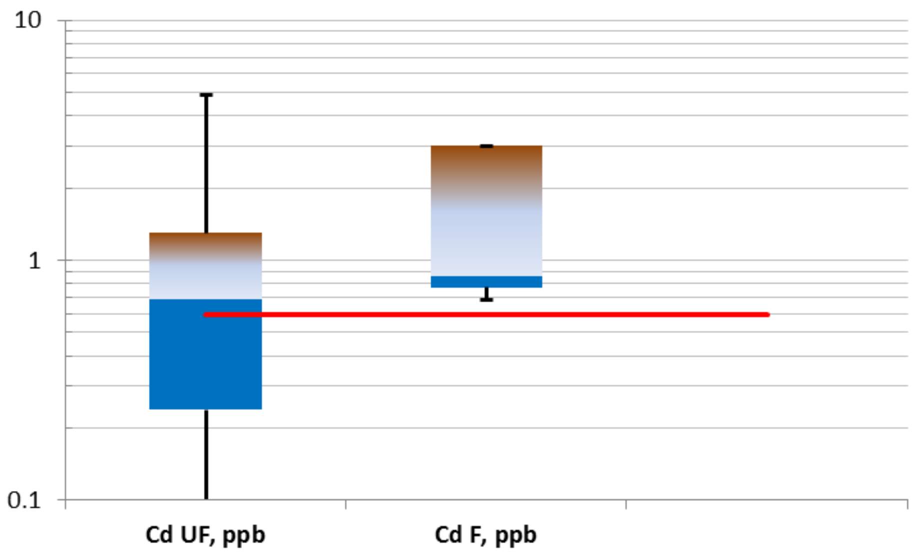


Figure 53. Unfiltered and filtered results for Cd.



Max	4.90	n=92	3.00	n=3
75th	1.30		3.00	
Median	0.69		0.86	
25th	0.24		0.77	
Min	0.09		0.68	

Most concentrations of unfiltered samples did not exceed the RG background, and all filtered samples exceeded the NM WQCC standards. There were only a few detects for filtered samples implying affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Cd along the RG.

VI.3.h. Calcium (Ca)

Figure 54. Ca stormwater concentrations vs. SSC

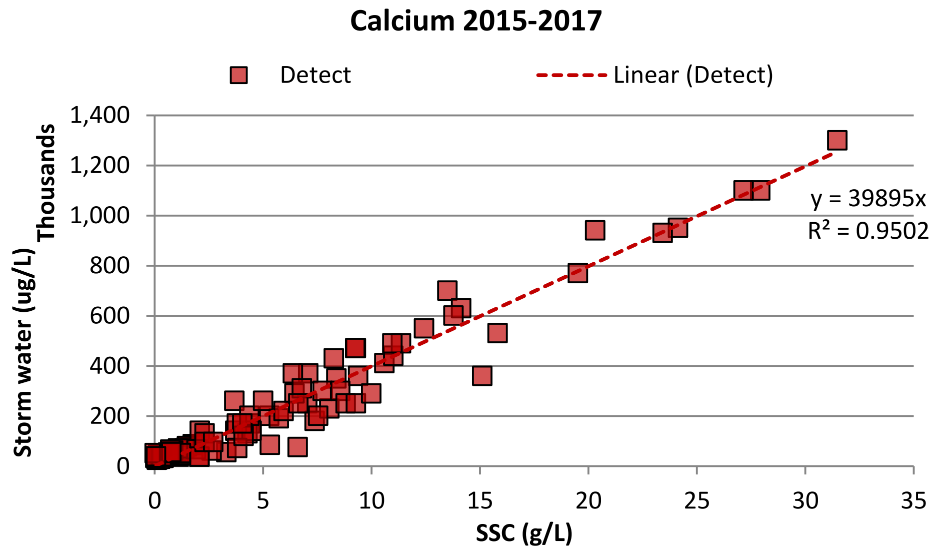
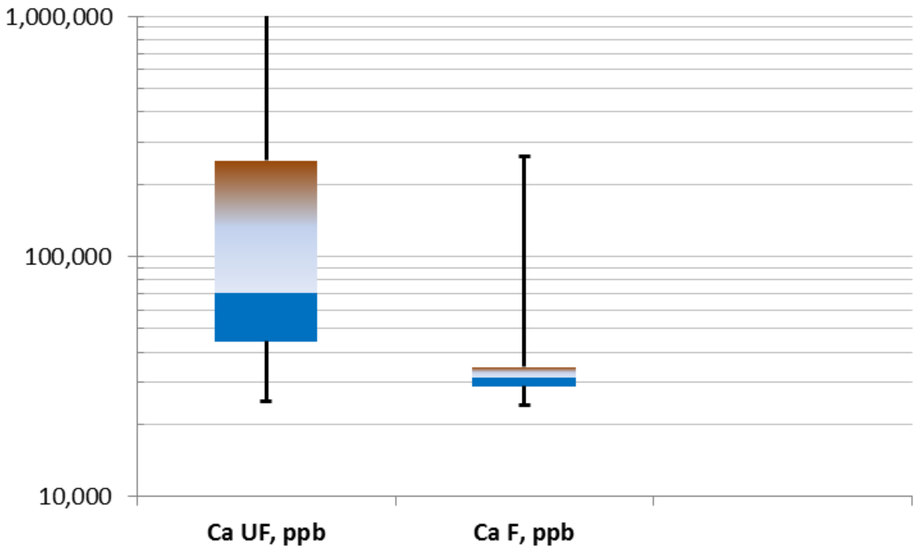


Figure 55. Unfiltered and filtered results for Ca.



Max	1,300,000		260,000	
75th	252,500		34,750	
Median	71,000	n=130	31,350	n=108
25th	44,250		29,000	
Min	25,000		24,000	

The concentrations of filtered samples were reduced in comparison to unfiltered indicating somewhat sediment transport for this constituent. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Ca along the RG.

VI.3.i. Chromium (Cr)

Figure 56. Cr stormwater concentrations vs SSC.

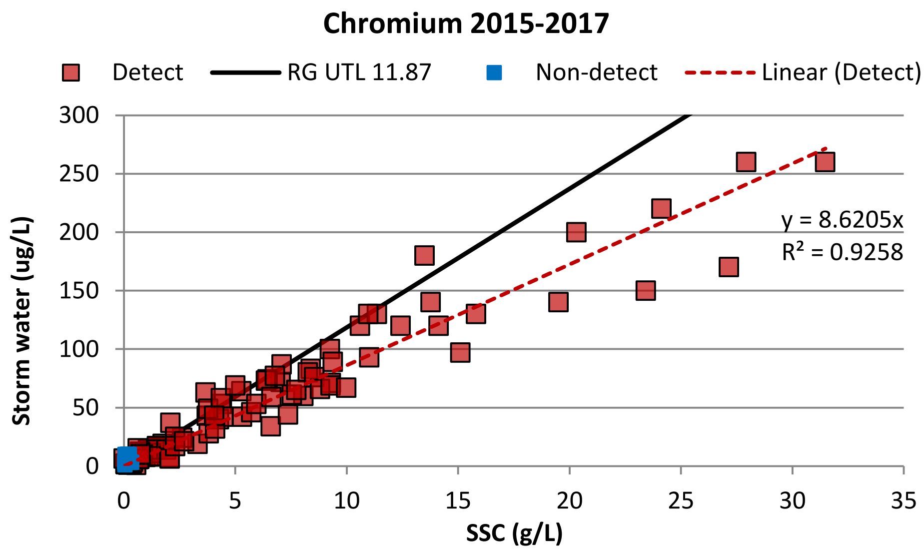
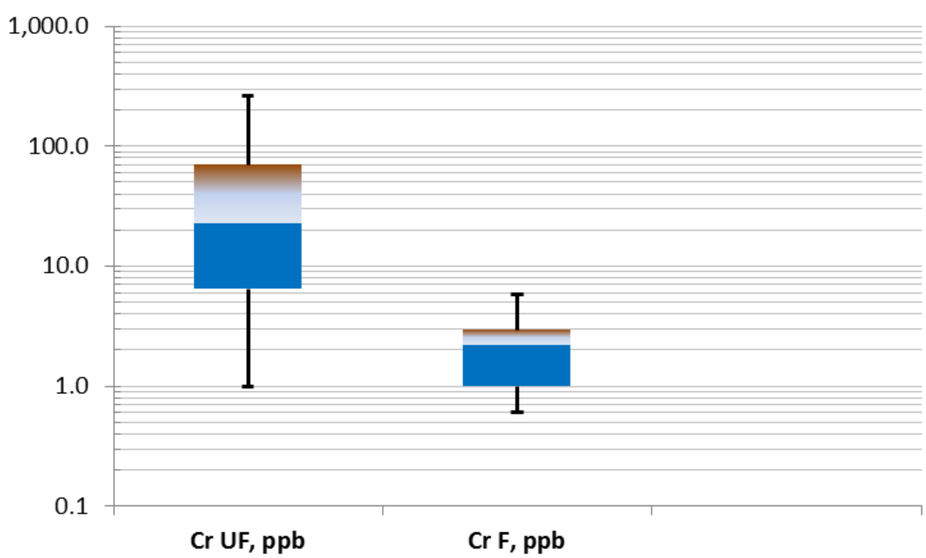


Figure 57. Unfiltered and filtered results for Cr.



Max	260.0	n=116	5.80	n=45
75th	70.5		2.95	
Median	22.5		2.16	
25th	6.5		1.00	
Min	1.0		0.60	

A few concentrations of unfiltered samples exceeded the RG background, but no filtered samples exceeded the NM WQCC standards. The Cr concentrations for unfiltered and filtered samples differ with one order of magnitude and imply high affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Cr along the RG.

VI.3.j. Cobalt (Co)

Figure 58. Co stormwater concentrations vs. SSC.

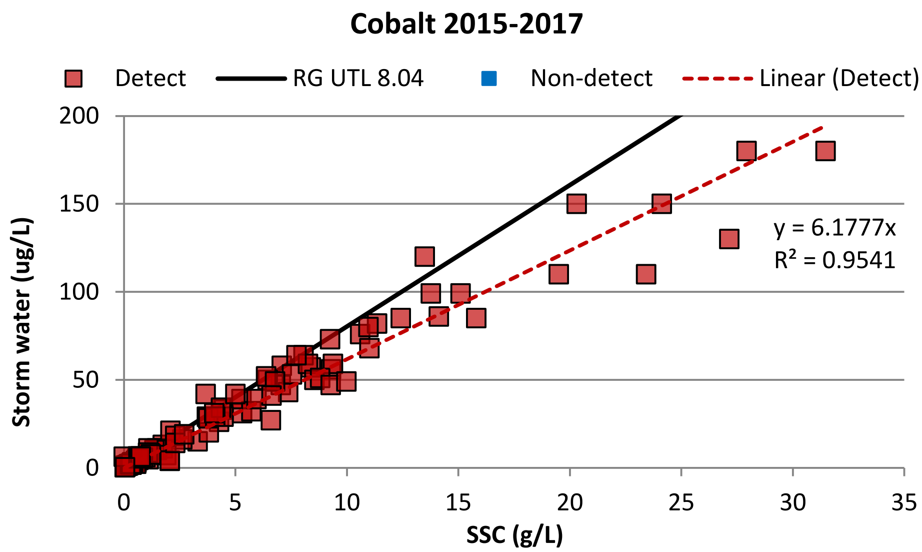
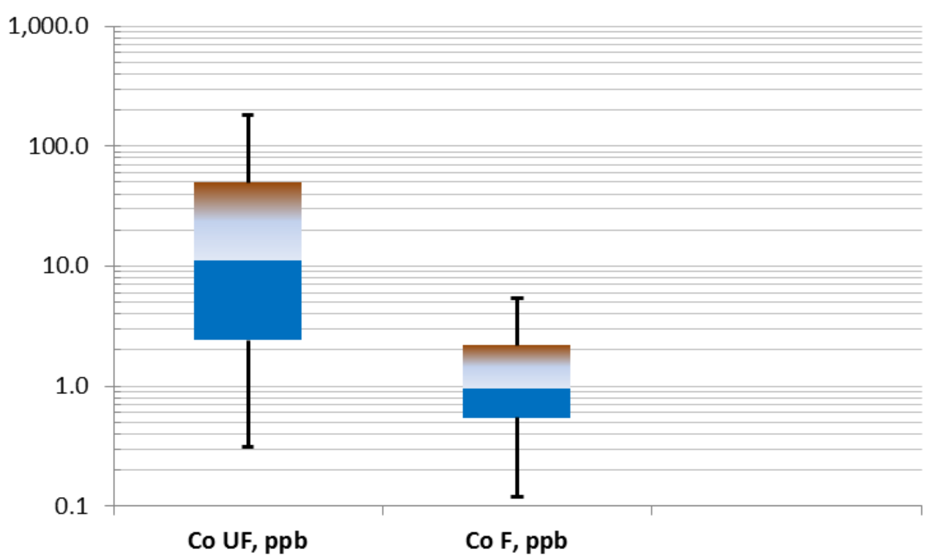


Figure 59. Unfiltered and filtered results for Co.



Max	180.0	n=130	5.40	n=103
75th	49.3		2.20	
Median	11.0		0.95	
25th	2.4		0.55	
Min	0.3		0.12	

A few concentrations of unfiltered samples exceeded the RG background, and no filtered samples exceeded the NM WQCC standards. The Co concentrations for unfiltered and filtered samples differ with one order of magnitude and imply affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Co along the RG.

VI.3.k. Copper (Cu)

Figure 60. Cu stormwater concentrations vs. SSC.

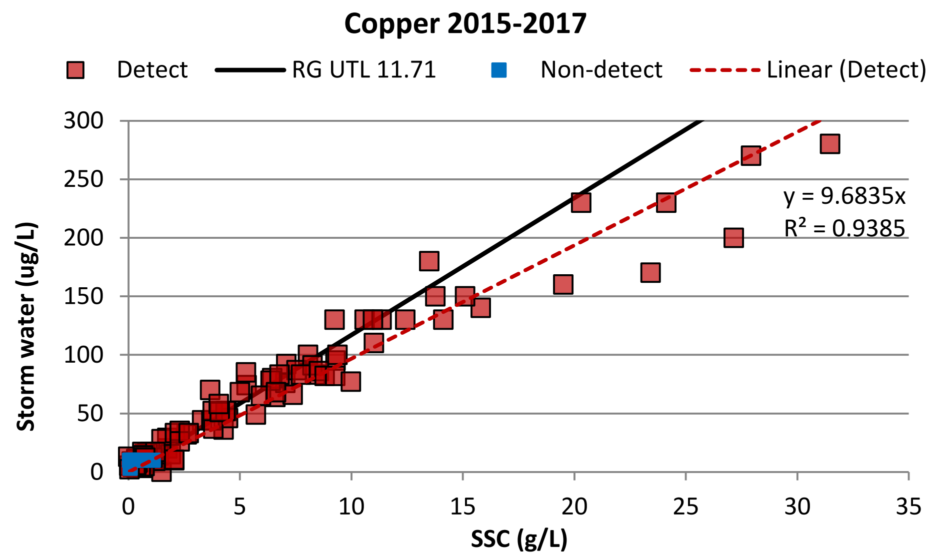
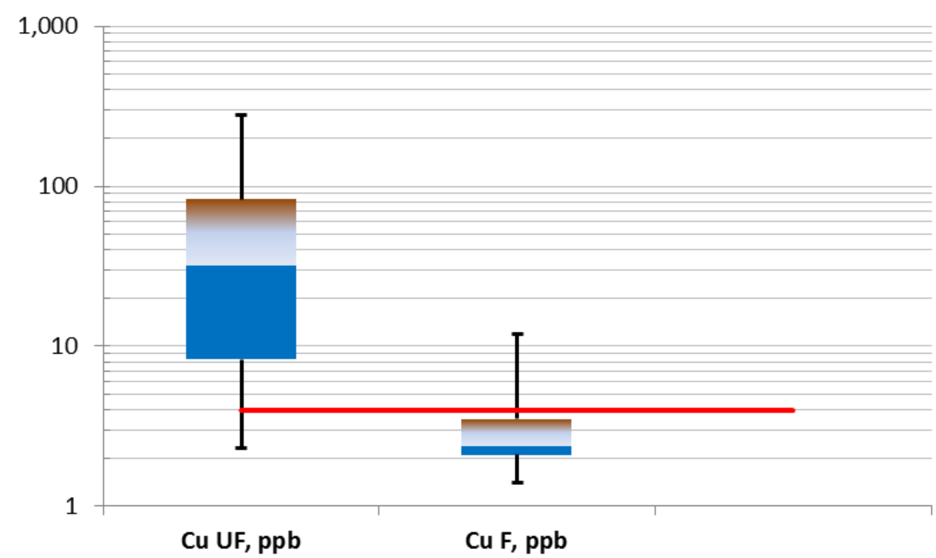


Figure 61. Unfiltered and filtered results for Cu.



Max	280.0		12.0	
75th	83.0		3.5	
Median	32.0	n=119	2.4	n=27
25th	8.3		2.1	
Min	2.3		1.4	

There were concentrations of unfiltered samples that exceeded the RG background, and a few detects of the filtered samples exceeded the NM WQCC standards. The Co concentrations for unfiltered and filtered samples differ with one order of magnitude implying high affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Cu along the RG.

VI.3.l. Iron (Fe)

Figure 62. Fe stormwater concentrations vs. SSC.

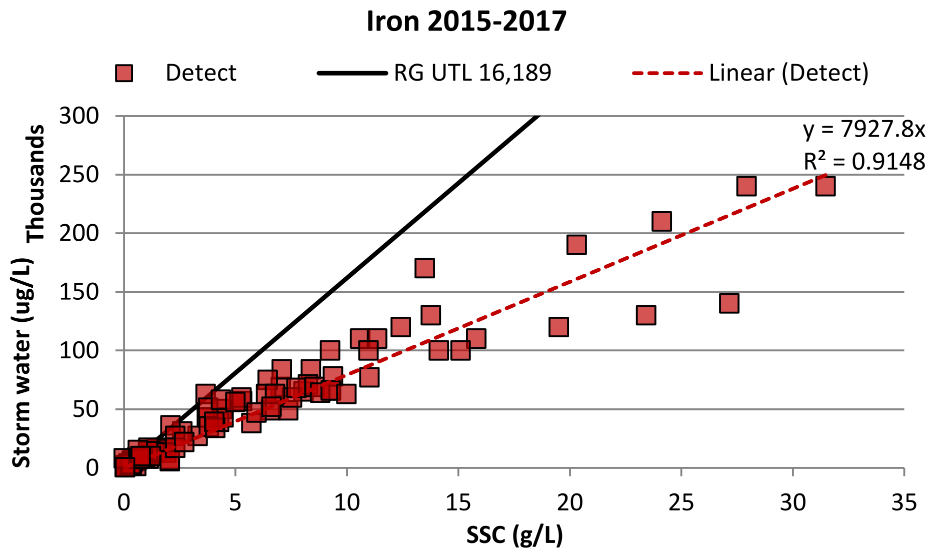
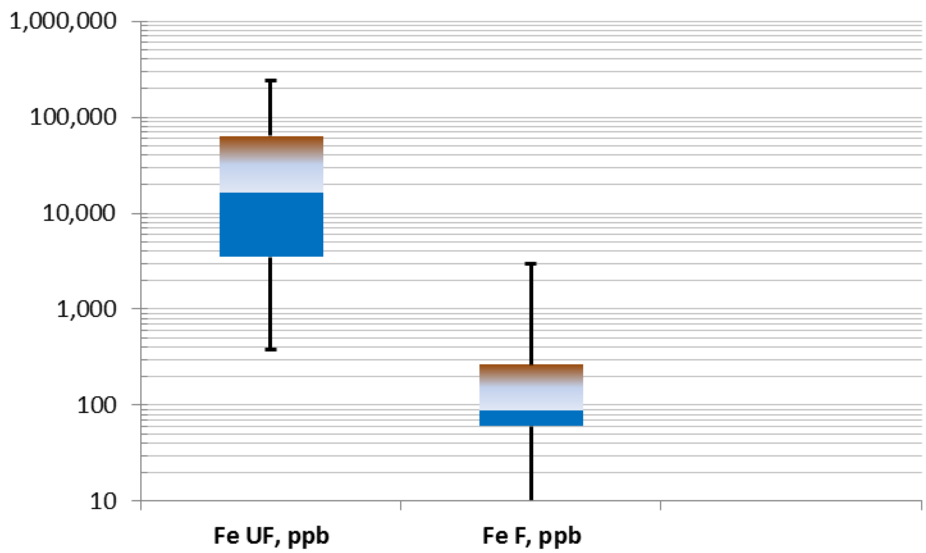


Figure 63. Unfiltered and filtered results for Fe.



Max	240,000	n=130	3,000	n=89
75th	63,250		265	
Median	16,000		88	
25th	3,475		60	
Min	380		10	

A few concentrations of unfiltered samples exceeded the RG background. The Fe concentrations for unfiltered and filtered samples differ with two orders of magnitude and imply high affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Fe along the RG.

VI.3.m. Lead (Pb)

Figure 64. Pb stormwater concentrations vs. SSC.

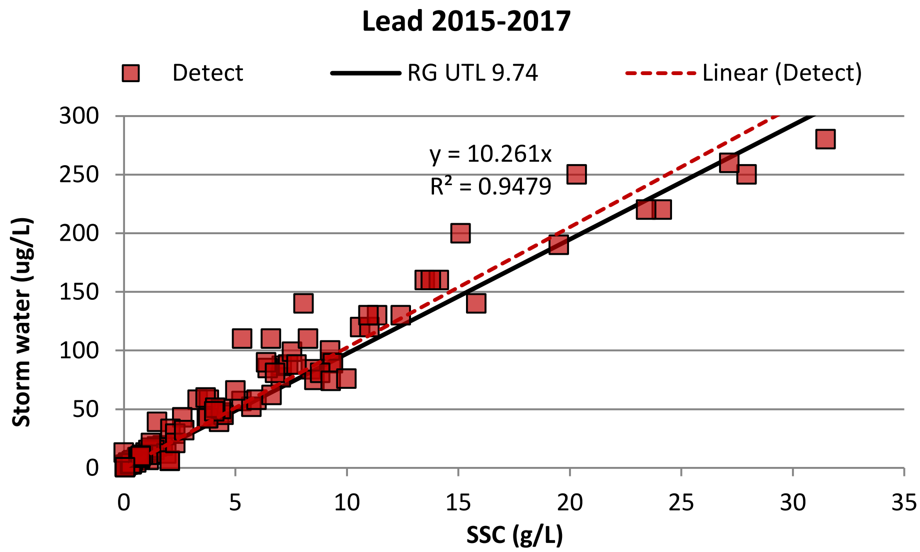
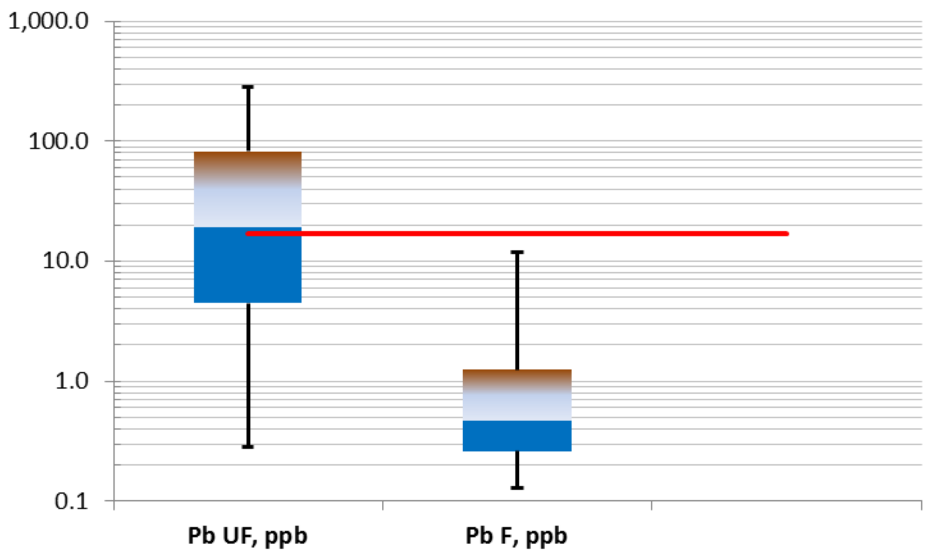


Figure 65. Unfiltered and filtered results for Pb.



Max	280.0	n=130	12.00	n=37
75th	81.8		1.25	
Median	19.0		0.46	
25th	4.4		0.26	
Min	0.3		0.13	

Some concentrations of unfiltered samples exceeded the RG background, and no filtered samples exceeded the NM WQCC standards. The concentrations of filtered samples were one order of magnitude less than unfiltered samples implying affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Pb along the RG.

VI.3.n. Magnesium (Mg)

Figure 66. Mg stormwater concentrations vs. SSC.

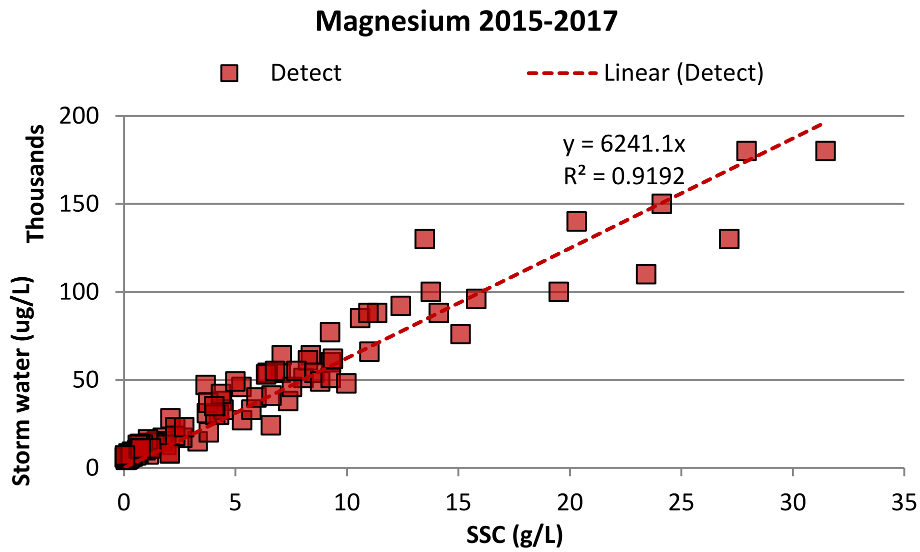
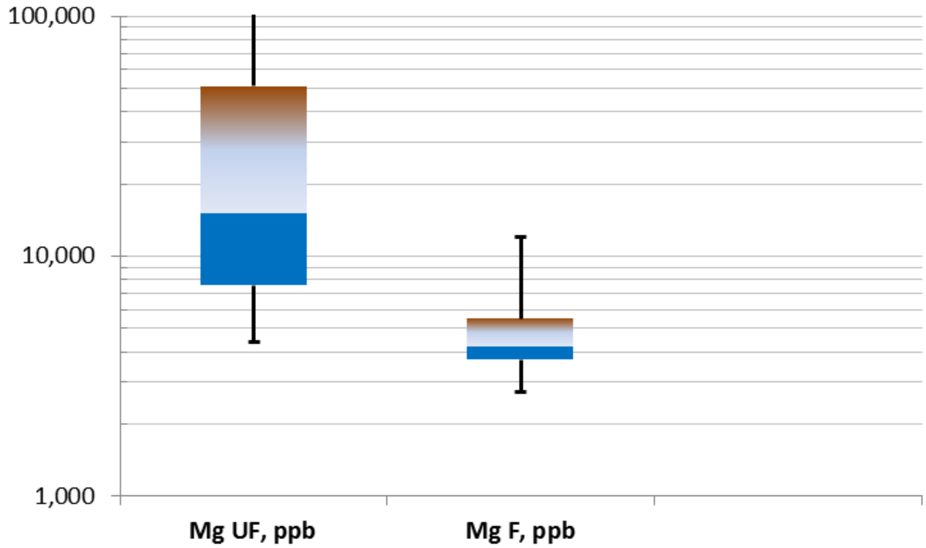


Figure 67. Unfiltered and filtered results for Mg.



Max	180,000	n=130	12,000	n=107
75th	51,000		5,500	
Median	15,000		4,200	
25th	7,525		3,695	
Min	4,400		2,700	

The concentrations of filtered samples were reduced in comparison to unfiltered indicating somewhat sediment transport for this constituent. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Mg along the RG.

VI.3.o. Manganese (Mn)

Figure 68. Mn stormwater concentrations vs. SSC.

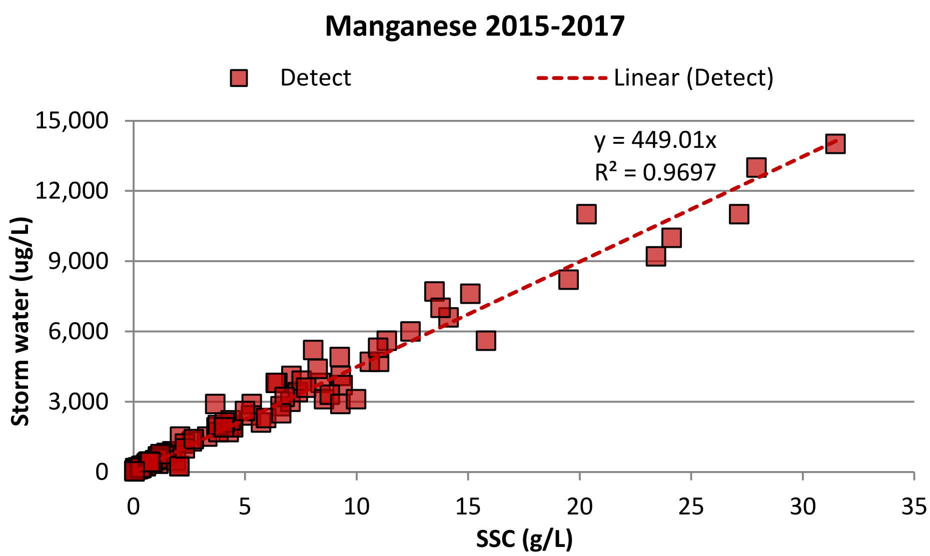
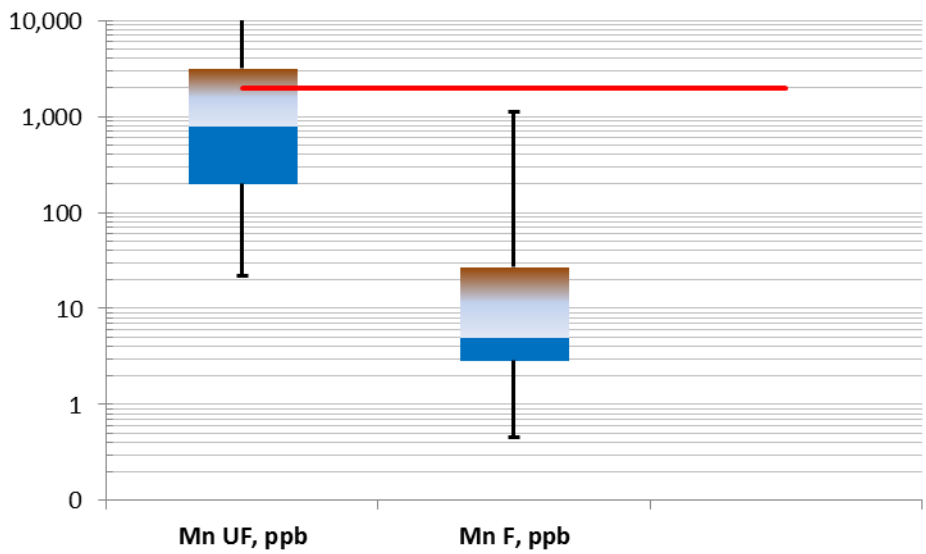


Figure 69. Unfiltered and filtered results for Mn.



Max	14,000	n=130	1,100.0	n=104
75th	3,125		26.8	
Median	790		5.0	
25th	197		2.9	
Min	22		0.5	

All concentrations of filtered samples were below the NM WQCC standards. The concentrations of filtered samples were reduced in comparison to unfiltered two orders of magnitude indicating preferential sediment transport for this constituent. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Mn along the RG.

VI.3.p. Mercury (Hg)

Figure 70. Hg stormwater concentrations vs. SSC

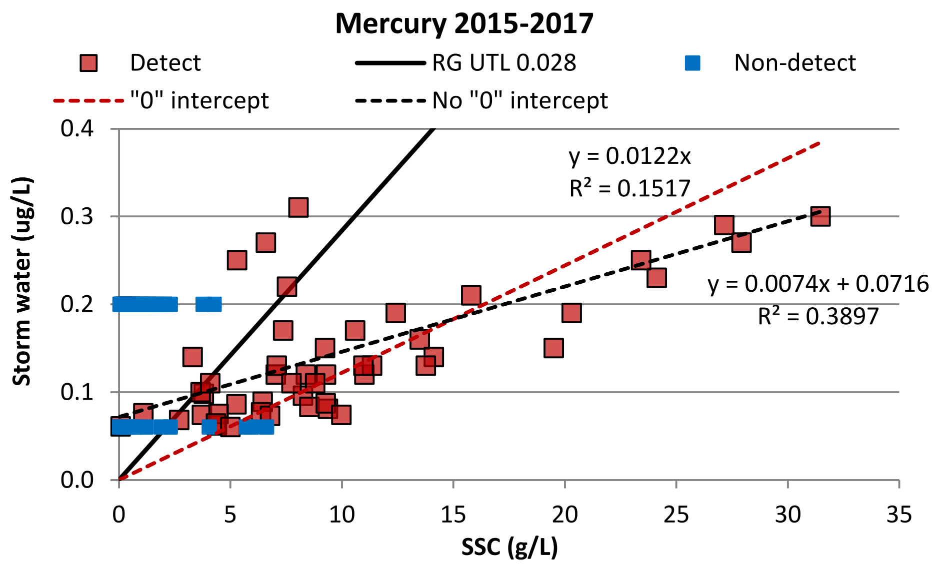
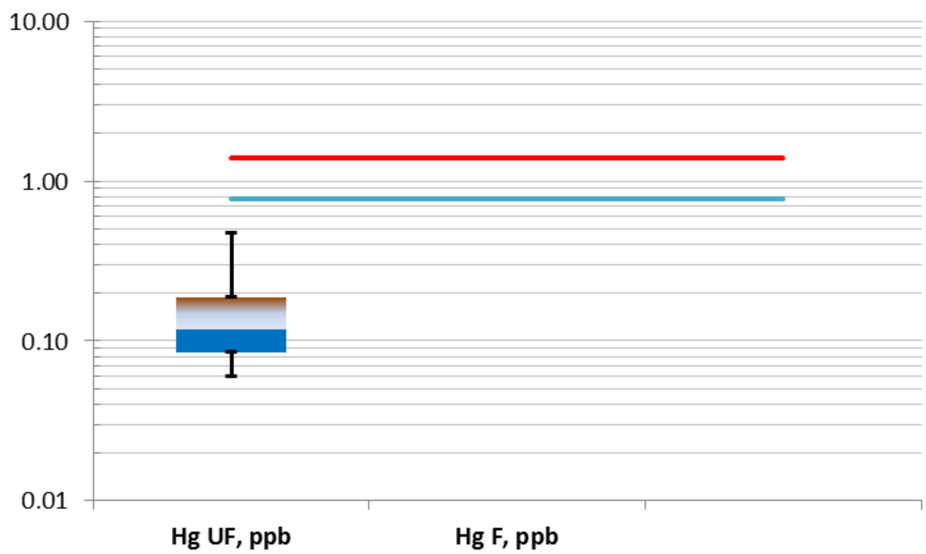


Figure 71. Unfiltered and filtered results for Hg.



Max	0.470	n=53	ND	n=0
75th	0.190		ND	
Median	0.120		ND	
25th	0.086		ND	
Min	0.060		ND	

A few concentrations of unfiltered samples exceeded the RG background, but none exceeded the NM WQCC standard. There were no detects of the filtered samples implying affinity to solid particles and preferential sediment transport. The low coefficient of determination in the stormwater concentration vs SSC results suggests anthropogenic source(s).

VI.3.q. Nickel (Ni)

Figure 72. Ni stormwater concentrations vs. SSC.

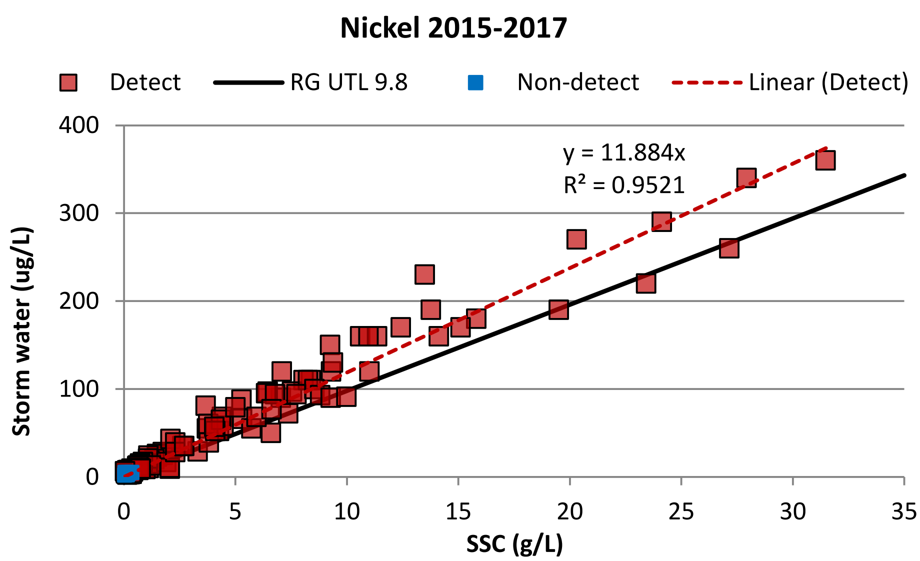
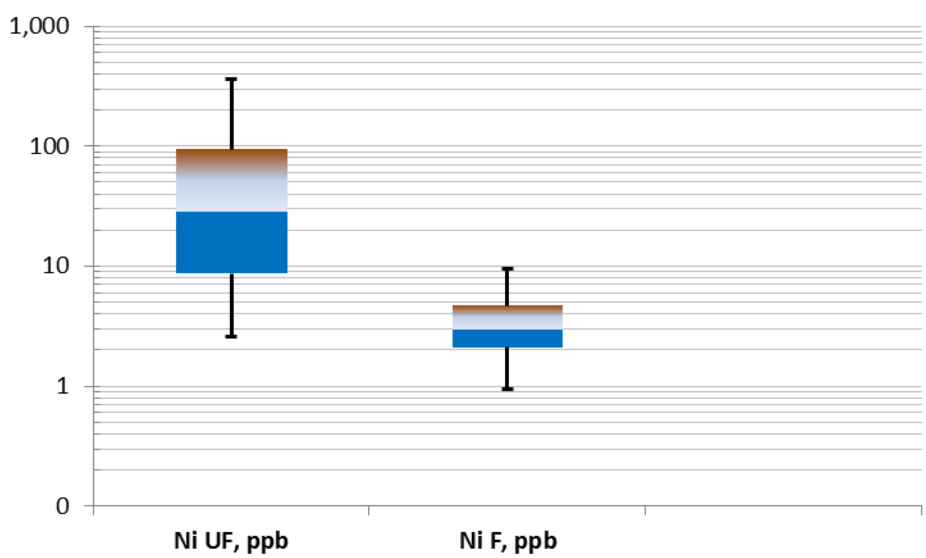


Figure 73. Unfiltered and filtered results for Ni.



	Ni UF, ppb		Ni F, ppb	
Max	360.0	n=121	9.6	n=52
75th	94.5		4.6	
Median	28.0		2.9	
25th	8.7		2.1	
Min	2.6		0.9	

Most concentrations of unfiltered samples exceeded the RG background. The concentrations of filtered samples were one order of magnitude less than unfiltered samples implying affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Ni along the RG.

VI.3.r. Potassium (K)

Figure 74. K stormwater concentrations vs. SSC.

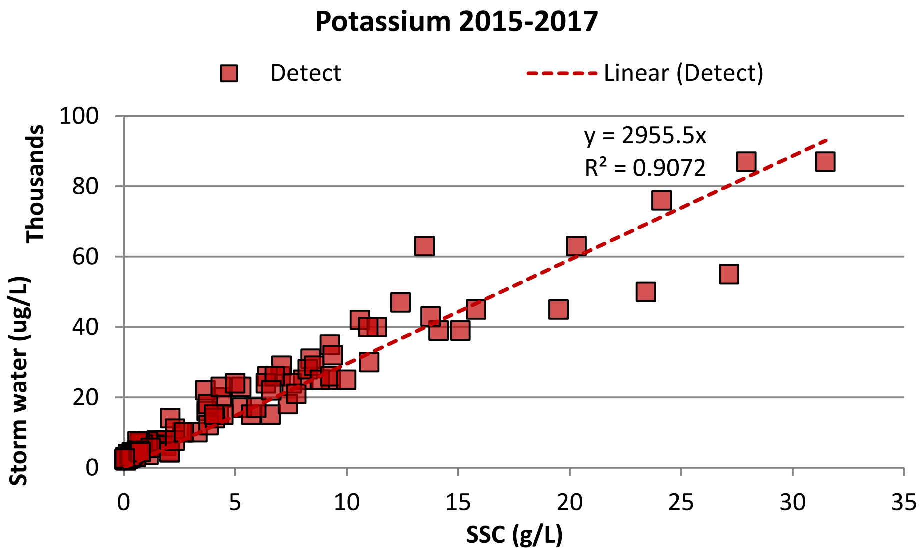
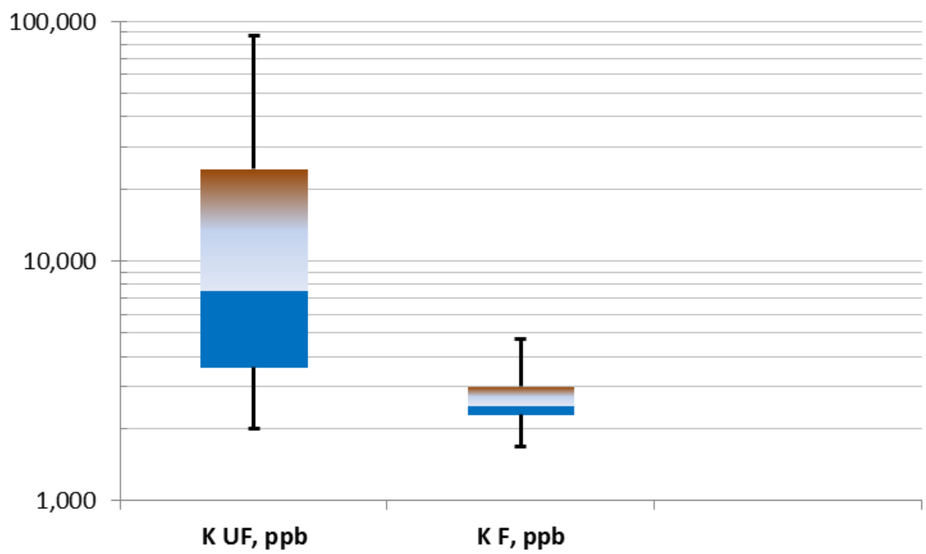


Figure 75. Unfiltered and filtered results for K.



Max	87,000	n=130	4,700	n=107
75th	24,250		3,010	
Median	7,500		2,500	
25th	3,600		2,300	
Min	2,000		1,690	

The concentrations of filtered samples were reduced in comparison to unfiltered indicating somewhat sediment transport for this constituent. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of K along the RG.

VI.3.s. Selenium (Se)

Figure 76. Se stormwater concentrations vs. SSC.

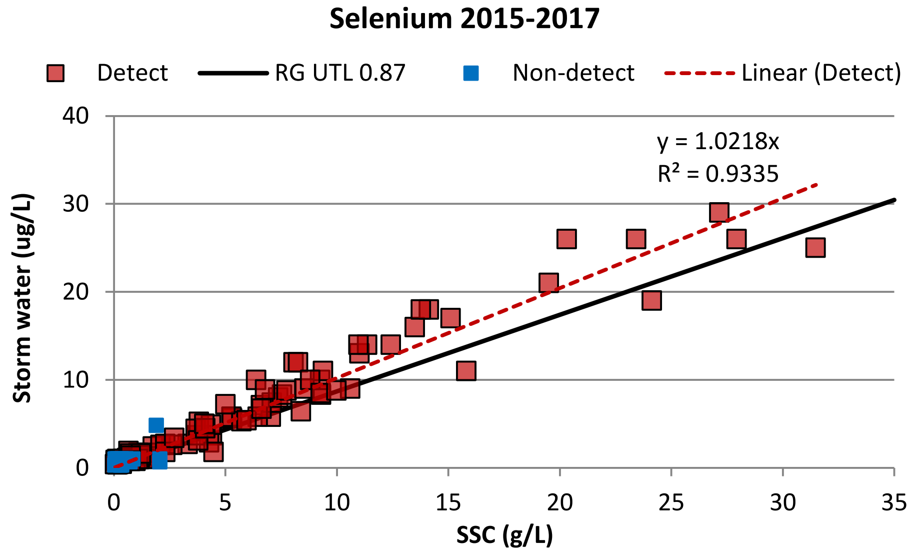
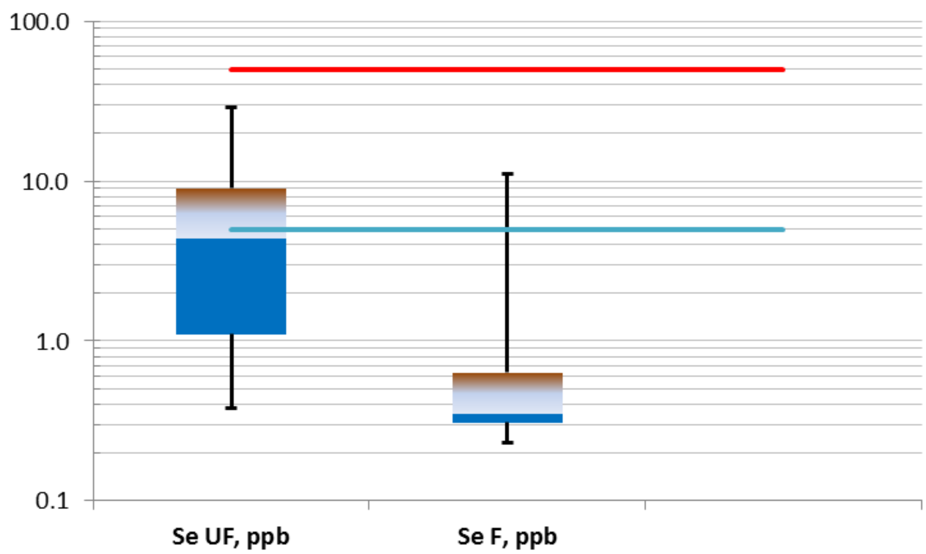


Figure 77. Unfiltered and filtered results for Se.



Max	29.00	n=95	11.00	n=41
75th	9.00		0.64	
Median	4.40		0.35	
25th	1.10		0.31	
Min	0.38		0.23	

A large number of the concentrations of unfiltered samples exceeded the RG background and a few exceeded the NM WQCC standard (blue line), and no filtered samples exceeded the NM WQCC standards (red line). The concentrations of filtered samples were less in magnitude than unfiltered samples implying some sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Se along the RG.

VI.3.t. Silver (Ag)

Figure 78. Ag stormwater concentrations vs. SSC.

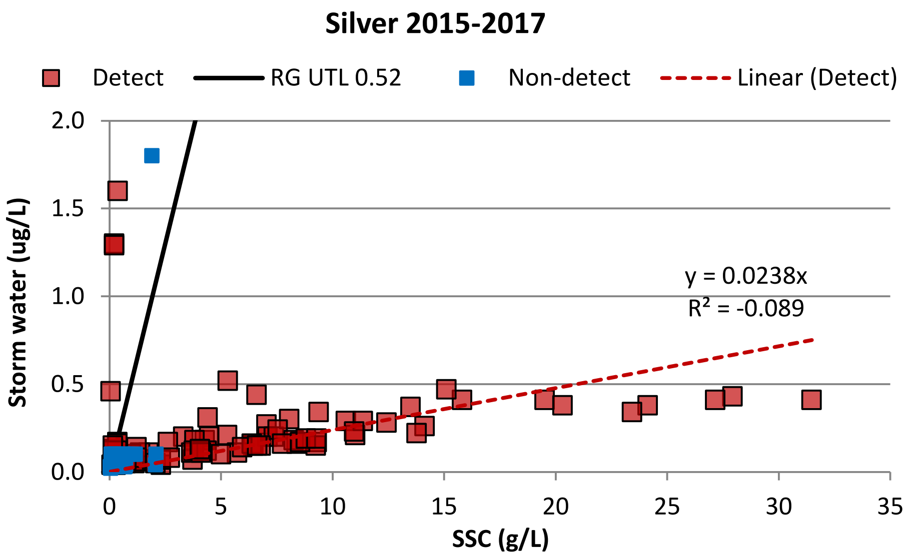
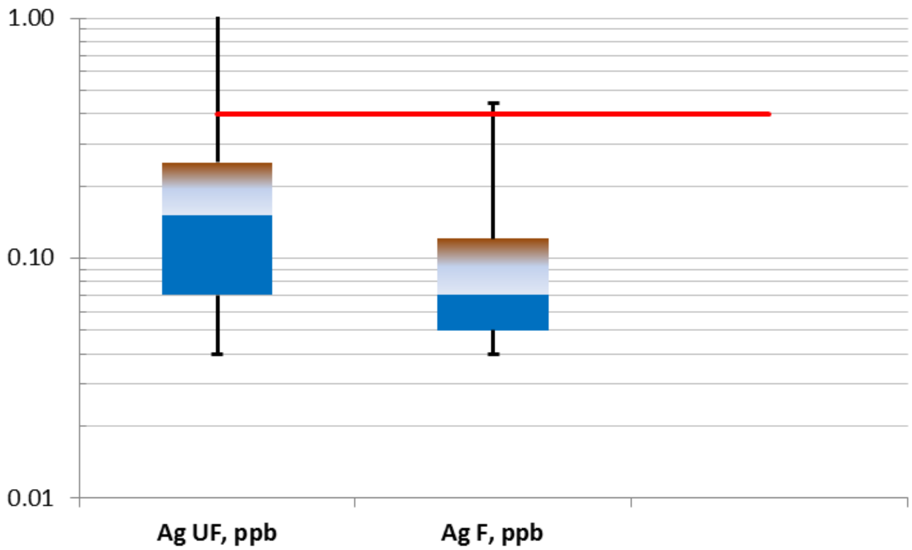


Figure 79. Unfiltered and filtered results for Ag.



Max	2.90	n=101	0.44	n=11
75th	0.25		0.12	
Median	0.15		0.07	
25th	0.07		0.05	
Min	0.04		0.04	

Only a few concentrations of unfiltered samples exceeded the RG background, and only one filtered sample exceeded the NM WQCC standards. The concentrations of filtered samples were less in magnitude than unfiltered samples implying some preferential sediment transport. The low coefficient of determination in the stormwater concentration vs SSC results suggests anthropogenic source(s).

VI.3.u. Sodium (Na)

Figure 80. Na stormwater concentrations vs. SSC.

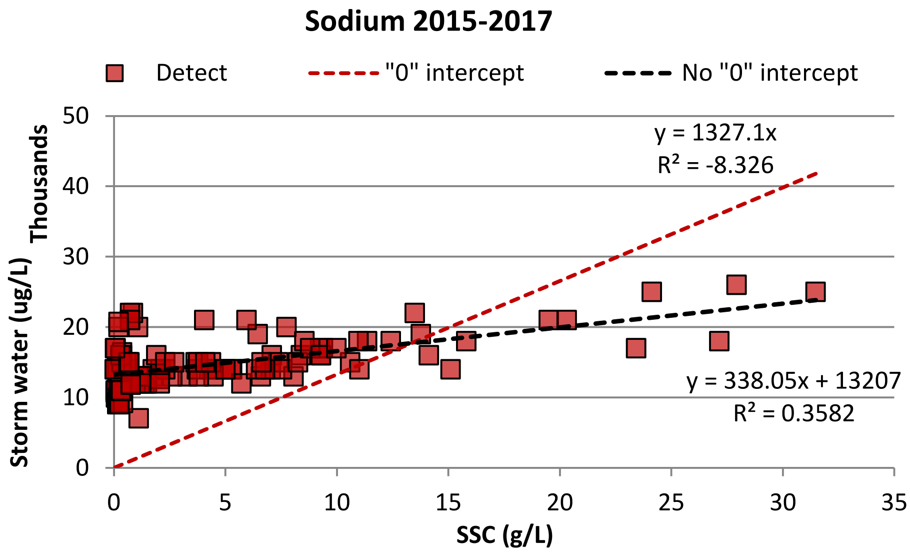
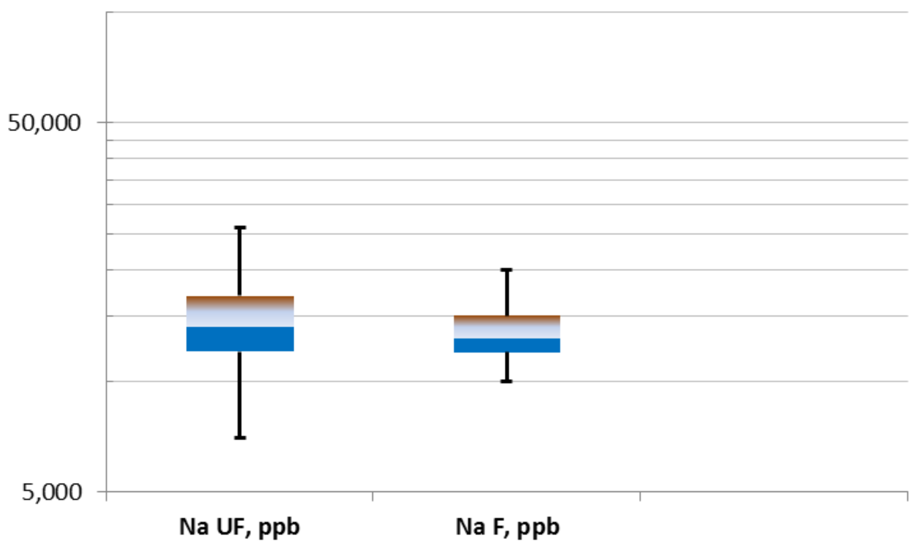


Figure 81. Unfiltered and filtered results for Na.



Max	26,000	n=130	20,000	n=107
75th	17,000		15,000	
Median	14,000		13,000	
25th	12,000		11,950	
Min	7,000		10,000	

The concentrations of unfiltered and filtered samples were within the same range suggestive of very high water solubility for Na. That explains the low coefficient of determination on the stormwater concentrations vs SSC plot.

VI.3.v. Thallium (Tl)

Figure 82. Tl stormwater concentrations vs. SSC.

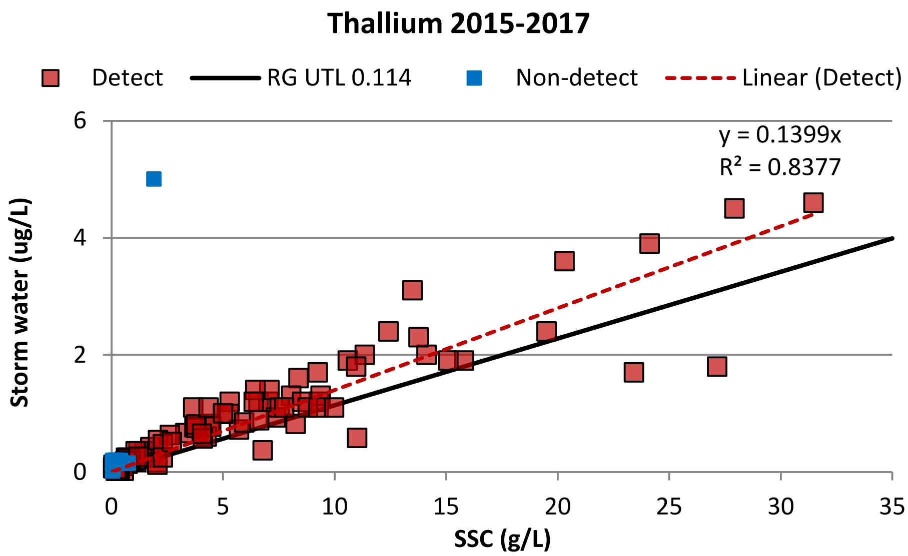
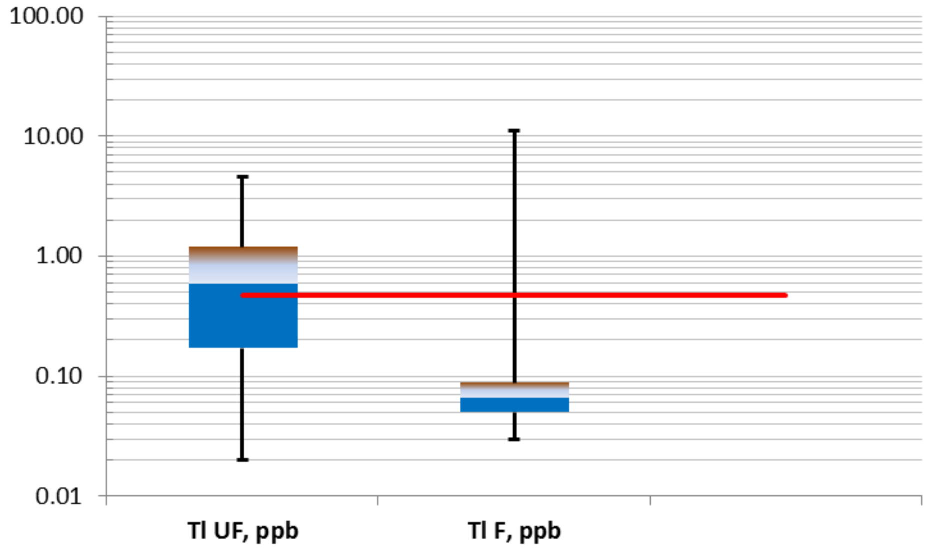


Figure 83. Unfiltered and filtered results for Tl.



Max	4.60	n=104	11.00	n=16
75th	1.20		0.09	
Median	0.59		0.07	
25th	0.17		0.05	
Min	0.02		0.03	

Most concentrations of unfiltered samples exceeded the RG background, and some filtered samples exceeded the NM WQCC standards. The concentrations of filtered samples were less in magnitude than unfiltered samples implying some preferential sediment transport. The value of the coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring and anthropogenic source(s) of Tl along the RG.

VI.3.w. Uranium (U)

Figure 84. U stormwater concentrations vs. SSC.

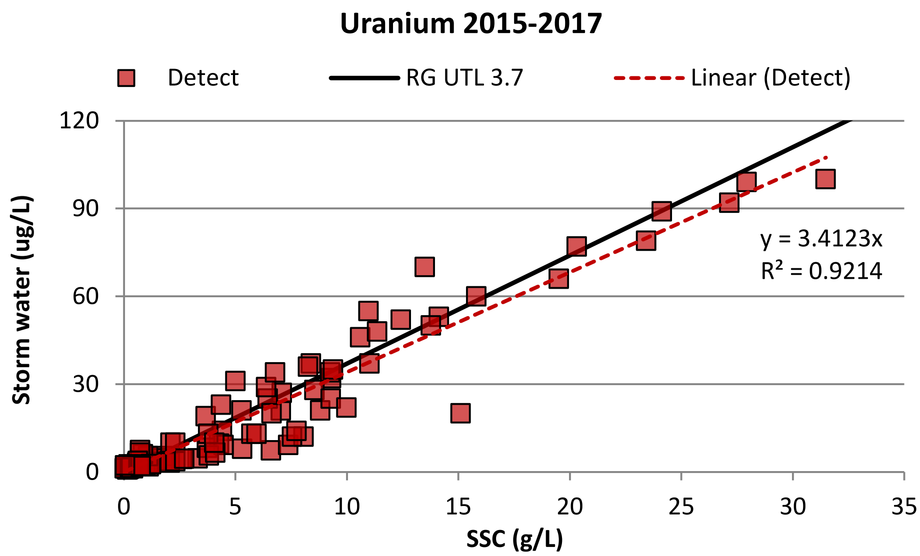
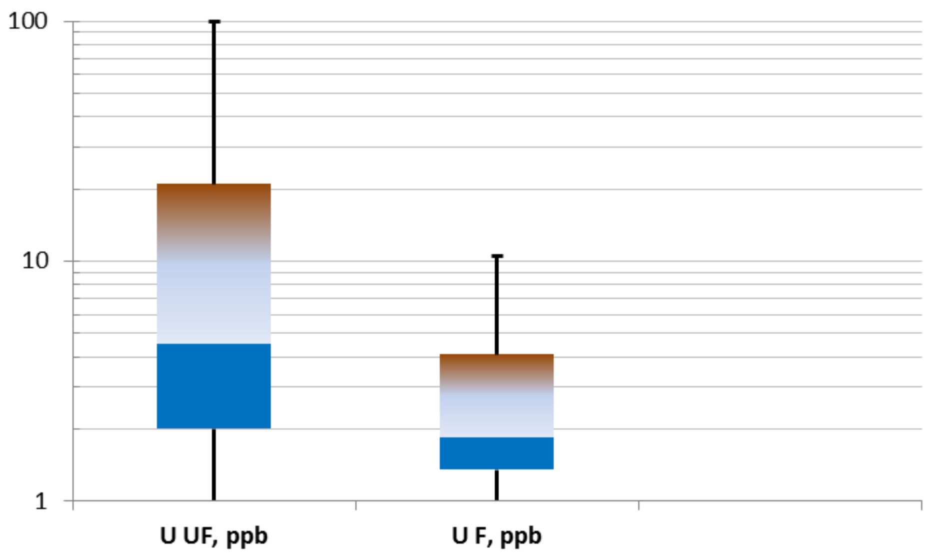


Figure 85. Unfiltered and filtered results for U.



Max	100.0	n=127	10.5	n=104
75th	21.0		4.1	
Median	4.5		1.8	
25th	2.0		1.3	
Min	0.9		1.0	

Some concentrations of unfiltered samples exceeded the RG background. The concentrations of filtered samples were less in magnitude than unfiltered samples implying some affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of U along the RG.

VI.3.x. Vanadium (V)

Figure 86. V stormwater concentrations vs. SSC.

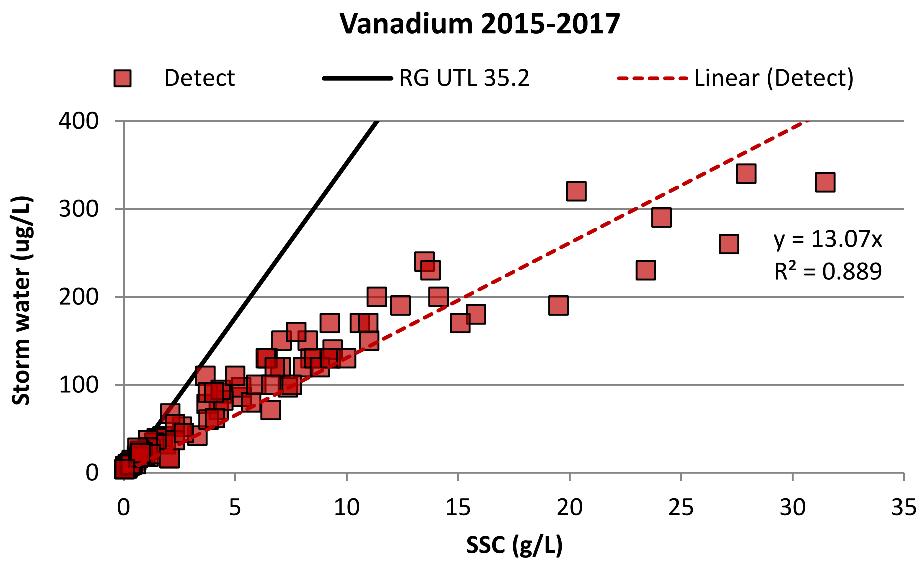
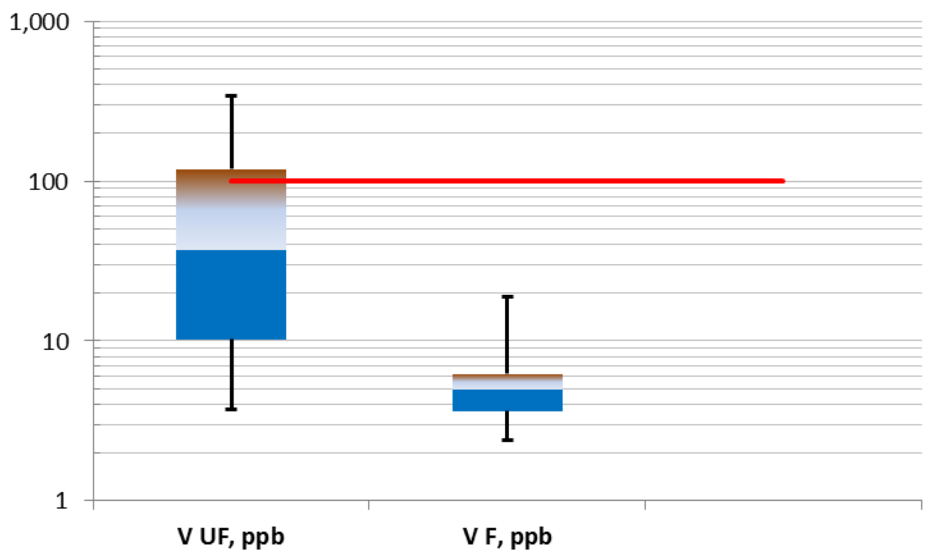


Figure 87. Unfiltered and filtered results for V.



Max	340.0	n=130	19.0	n=107
75th	120.0		6.3	
Median	37.0		5.0	
25th	10.3		3.7	
Min	3.7		2.4	

Most concentrations of unfiltered samples did not exceed the RG background, and no filtered samples exceeded the NM WQCC standards. The concentrations of filtered samples were approximately one order of magnitude less than unfiltered samples implying affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of V along the RG.

VI.3.y. Zinc (Zn)

Figure 88. Zn stormwater concentrations vs. SSC.

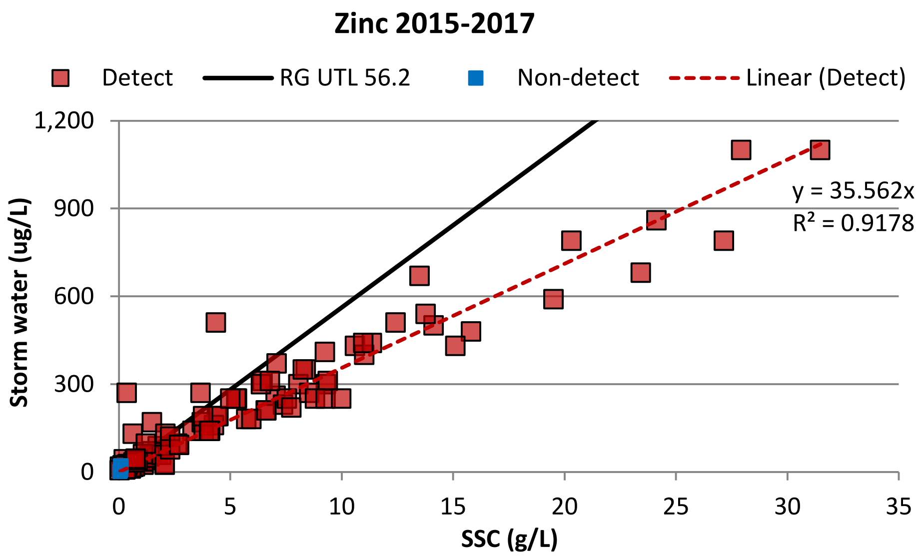
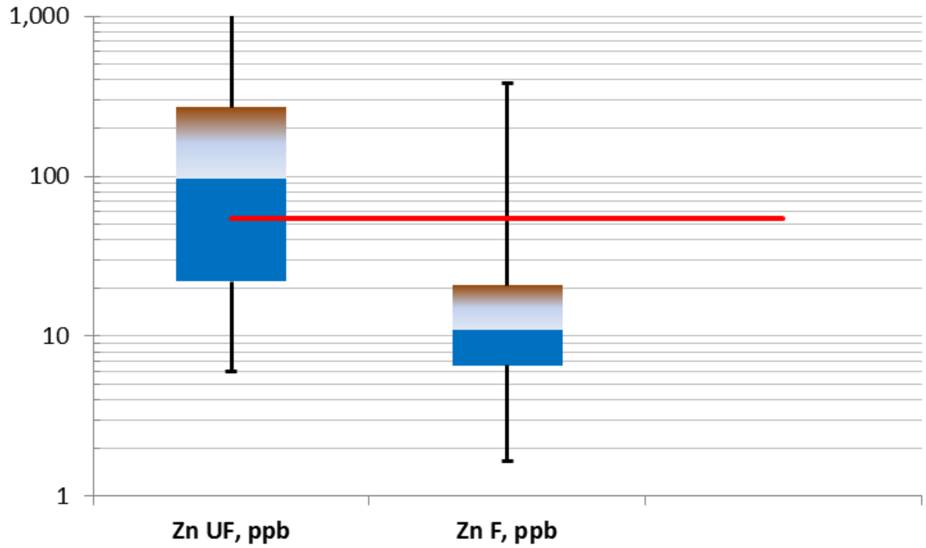


Figure 89. Unfiltered and filtered results for Zn.



Max	1,100.0	n=124	380.0	n=19
75th	270.0		20.7	
Median	96.0		11.0	
25th	22.0		6.6	
Min	6.0		1.6	

A few concentrations of unfiltered samples exceeded the RG background, and a few filtered samples exceeded the NM WQCC standards. The concentrations of filtered samples were one order of magnitude less than unfiltered samples implying affinity to solid particles and preferential sediment transport. The high coefficient of determination in the stormwater concentration vs SSC results suggests naturally occurring source(s) of Zn along the RG.

VI.4 Results for PCBs, Dioxins and Furans, and Perchlorate

The table below summarizes the results for Total PCBs, Dioxins/Furans (D/F), and Perchlorate.

Table 13. 2015-2017 total PCBs, D/F TEQ, and Perchlorate results.

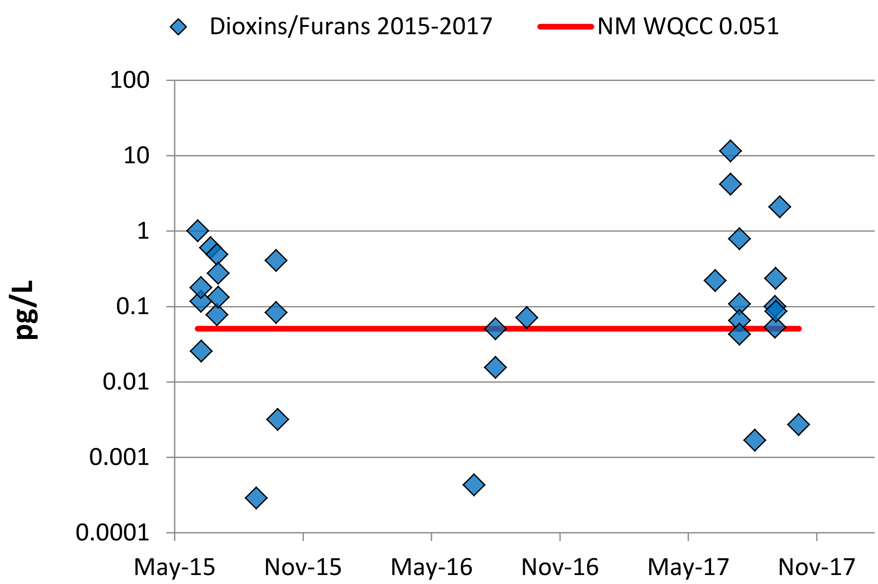
Date & Time	Total PCBs ng/L	D/F TEQ pg/L	ClO^{4-} ug/L	Method Blank Concentrations	
7/2/15 17:41	0.0092 B1	ND B2		B1=0.069	B2=0.0014
7/2/15 18:41	27.1 B1	1.0084 B2		B1=0.069	B2=0.0014
7/7/15 7:09	0.15 B1	0.1173 B2		B1=0.069	B2=0.0014
7/7/15 8:09	0.73 B1	0.1773 B2		B1=0.069	B2=0.0014
7/7/15 22:29	0.16 B1	0.0255 B2		B1=0.340	B2=0.0014
7/20/15 21:48	5.5 B1	0.5995 B2		B1=0.340	B2=0.0014
7/20/15 22:48	0.95 B1			B1=0.340	B2=0.0014
7/30/15 2:22	1.1 B1	0.4882 B2		B1=0.069	B2=0.0014
7/30/15 3:22	0.7 B1	0.0779 B2		B1=0.069	B2=0.0014
7/31/15 17:53	2.63 B1	0.2753 B2		B1=0.069	B2=0.0014
7/31/15 18:52	0.4 B1	0.1334 B2		B1=0.069	B2=0.0014
9/23/15 13:34	0.0068 B1	0.0003 B3		B1=0.069	B2=0.0014
10/21/15 18:42	16 B1		0.310	B1=0.340	B2=0.0014
10/21/15 20:12			0.340		B2=0.0014
10/21/15 20:42		0.4057 B2			B2=0.0014
10/21/15 22:42	0.97 B1	0.0833 B2		B1=0.340	B2=0.0014
10/24/15 0:11	0.22 B1		0.061 J	B1=0.340	B2=0.0014
10/24/15 1:11		0.0032 B2	<0.06		B2=0.0014
10/24/15 4:11	0.11 B1		<0.06	B1=0.340	B2=0.0014
6/3/16 9:10		ND			
6/8/16 8:54	0.322 B1		0.16 J	B1=0.0853	
7/6/16 8:40			0.088 J		
7/28/16 8:15	0.186 B1	0.00043	0.17 J	B1=0.0853	
8/3/16 8:38	0.212 B1	ND	0.15 J	B1=0.390	
8/27/16 16:28	0.232 B1		<0.06	B1=0.248	
8/27/16 17:28		0.0505 B2	<0.06		B2=0.1958
8/27/16 18:28	0.163 B1		<0.06	B1=0.248	
8/27/16 19:28		0.0156 B2	<0.06		B2=0.1958
10/11/16 8:14	0.113 B1	0.0711 B2	<0.06	B1=0.083	B2=0.0005
7/5/17 9:45	18.4 B1	0.22 B2	0.18 J	B1=0.658	B2=0.37
7/27/17 1:29	3.29 B1	11.6 B2	<0.06	B1=0.658	B2=0.3
7/27/17 4:00	3.22 B1	4.2 B2	<0.06	B1=0.658	B2=0.3
8/8/17 13:59	2.27 B1	0.108 B2	<0.06	B1=1.26	B2=5.931
8/8/17 16:30	1.32 B1	0.793 B2	0.14 J	B1=1.26	B2=5.931
8/9/17 17:15			0.23		
8/8/17 17:57	1.38 B1	0.065 B2		B1=1.26	B2=5.931
8/8/17 19:27	2.08 B1	0.043 B2	0.07 J	B1=1.26	B2=5.931
8/9/17 21:03			0.1 J		
8/30/17 10:00	0.145 B1	0.00169 B2	<0.06	B1=0.123	B2=0.0016
9/28/17 0:12	101/123 B1		<0.06	B1= 0.970	
9/28/17 1:12		0.0530 B2			B2=0.0431
9/28/17 2:42	0.564 B1		<0.06	B1= 0.970	
9/28/17 4:12		0.1003 B2			B2=0.0431
9/28/17 5:42	0.557 B1		<0.06	B1= 0.970	
9/29/17 1:08	7.51 B1		<0.06	B1= 0.204	
9/29/17 2:08		0.236 B2			B2=0.0431
9/29/17 3:38	0.89 B1		<0.06	B1= 0.970	

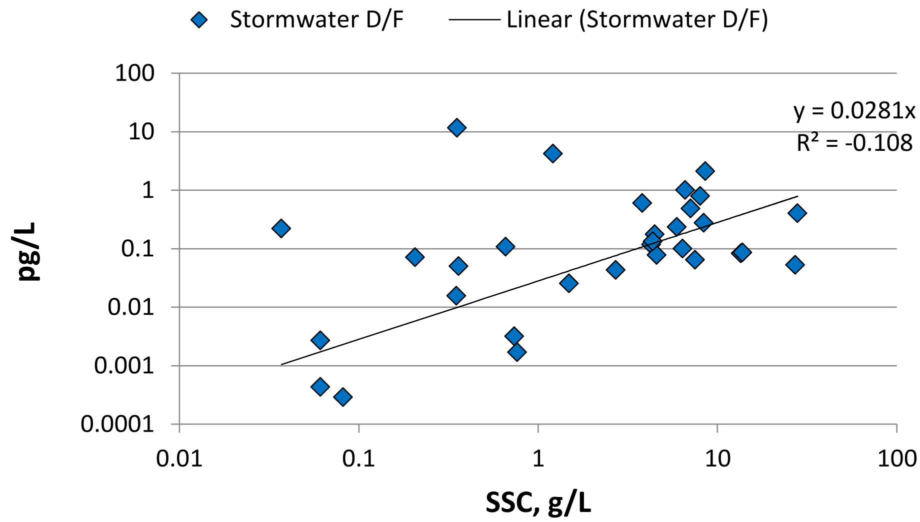
Date & Time	Total PCBs ng/L	D/F TEQ pg/L	ClO^{4-} ug/L	Method Blank Concentrations
9/29/17 5:08		0.0863 B2		B2=0.0431
9/29/17 6:38	1.71 B1		<0.06	B1= 0.970
10/4/17 22:58	0.437 B1		<0.06	B1=0.970
10/4/17 23:58		2.1061 B2	<0.06	B2=0.0925
10/5/17 1:28	1.300 B1		<0.06	B1=0.970
10/31/17 14:23	4.61 B1	0.0027 B2	0.11 J	B1=0.139 B2=0.0245
Comparison Values	NM WQCC 0.64 ng/L	NM WQCC 0.051 pg/L	NMED UTL 0.4 ug/L	

Notes:	
(yellow)	Results are above the comparison values
J	Results are estimated
ND	Non-detect
B	Constituent found in the method blank
NM WQCC	New Mexico Water Quality Control Commission standard
NMED UTL	New Mexico Environment Department Upper Tolerance Limit

Many concentrations of D/F exceeded the NM WQCC standard throughout the monitoring period as shown below, and these constituents did not have any suspended sediment transport properties.

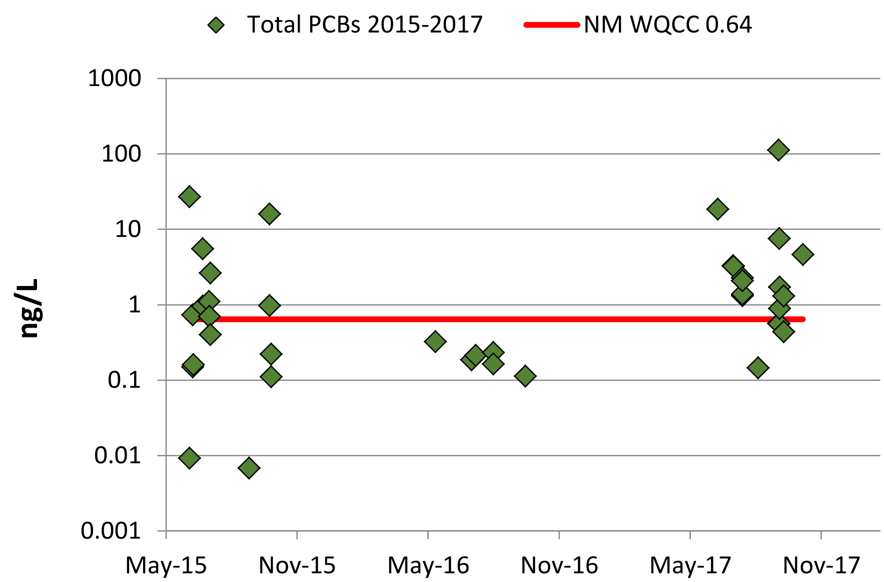
Figure 90. Stormwater concentration plots for Dioxins/Furans.





Similarly, to D/F, concentrations of total PCBs exceeded the NM WQCC standard on a regular basis and their transport was not influenced by the suspended sediment flow.

Figure 91. Stormwater concentration plots for total PCBs.



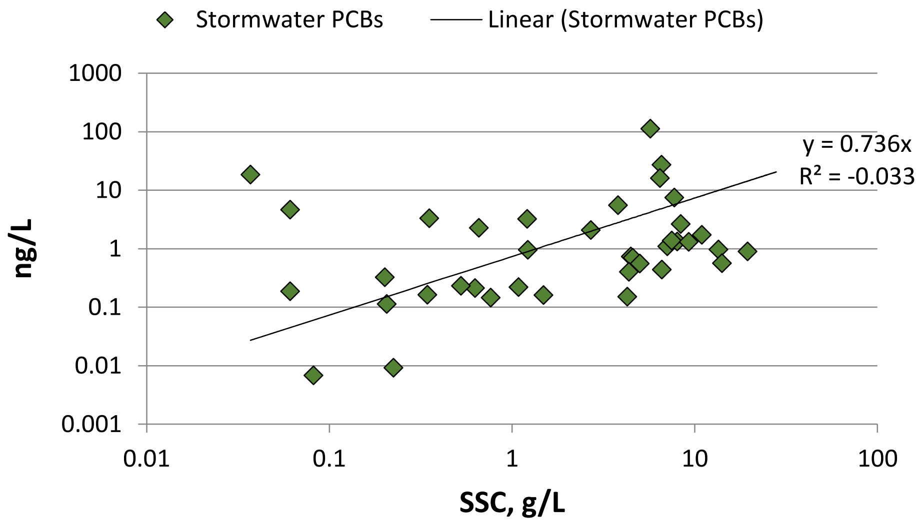
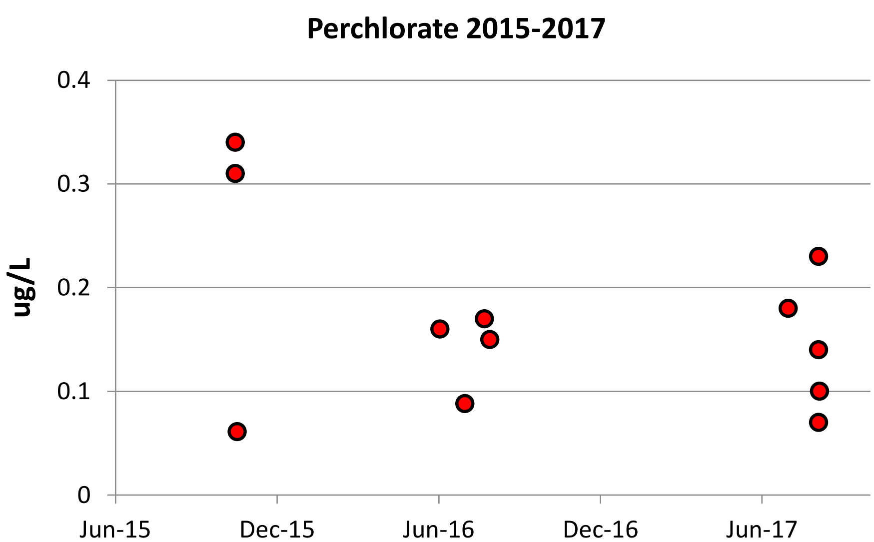


Figure 92. 2015-2017 Results for Perchlorate Detects.



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ATTACHMENT 1

Date	Time	SSC Result, ppm	Analysis	U/Pu/Np/Am/gamma (4 L)	Sr-90 (1 L)	Ra226/228 (1 L)	alpha/beta	metals U (500mL)	metals F (500mL)	PCBs 1 L (glass)	Dioxins 1 L (glass)	ClO4 (125mL)
7/2/15	1541	89	BDD-SWSF-070215-A	1	1	1	1	1	1	0	0	0
7/2/15	1611	100	BDD-SWSF-070215-B	1	1	1	1	1	1	0	0	0
7/2/15	1641	97	BDD-SWSF-070215-C	1	1	1	0	1	1	0	0	0
7/2/15	1741	225	BDD-SWSF-070215-D	1	1	1	0	1	1	1	1	0
7/2/15	1811	5,309	BDD-SWSF-070215-E	1	1	1	0	1	1	0	0	0
7/2/15	1841	6,600	BDD-SWSF-070215-F	1	1	1	0	1	1	1	1	0
7/2/15	1910	3,289	BDD-SWSF-070215-G	1	1	1	0	1	1	0	0	0
7/2/15	1940	2,054	BDD-SWSF-070215-H	1	0	0	0	0	0	0	0	0
7/2/15	2040	806	BDD-SWSF-070215-I	0	0	0	0	0	0	0	0	0
7/7/15	0609	5,279	BDD-SWSF-070715-A	1	1	1	1	1	1	0	0	0
7/7/15	0639	4,396	BDD-SWSF-070715-B	1	1	1	0	1	1	0	0	0
7/7/15	0709	4,276	BDD-SWSF-070715-C	1	1	1	0	1	1	1	1	0
7/7/15	0739	3,723	BDD-SWSF-070715-D	1	1	1	0	1	1	0	0	0
7/7/15	0809	4,473	BDD-SWSF-070715-E	1	1	1	0	1	1	1	1	0
7/7/15	0839	NA	BDD-SWSF-070715-F	1	1	1	0	1	1	0	0	0
7/7/15	0908	7,038	BDD-SWSF-070715-G	1	1	1	1	1	1	0	0	0
7/7/15	0938	10,595	BDD-SWSF-070715-H	1	1	1	0	1	1	0	0	0
7/7/15	1008	14,685	BDD-SWSF-070715-I	1	1	1	1	1	1	0	0	0
7/7/15	1109	NO	BDD-SWSF-070715-J	1	0	0	0	0	0	0	0	0
7/7/15	2229	see 2230 below	BDD-SWBF-070715-K	0	0	0	0	0	0	1	0	0
7/7/15	2230	1,703	BDD-SWBF-070715-L	1	1	1	1	1	1	0	0	0
7/7/15	2300	1,751	BDD-SWBF-070715-M	1	1	1	1	2	0	0	0	0
7/7/15	2330	1,488	BDD-SWBF-070715-N	1	1	1	1	2	0	0	1	0
7/8/15	0000	1,378	BDD-SWBF-070815-O	0	0	0	0	1	0	0	0	0
7/8/15	0030	1,240	BDD-SWBF-070815-P	0	0	0	0	0	0	0	0	0
7/8/15	0100	1,156	BDD-SWBF-070815-Q	0	0	0	0	1	0	0	0	0
7/8/15	0129	1,077	BDD-SWBF-070815-R	0	0	0	0	0	0	0	0	0
7/8/15	0159	1,113	BDD-SWBF-070815-S	0	0	0	0	1	0	0	0	0
7/8/15	0229	1,540	BDD-SWBF-070815-T	1	1	1	1	0	0	0	0	0
7/9/15	1300	976	BDD-SWBF-070915-A	1	1	1	1	1	0	0	0	0
7/20/15	2118	1,102	BDD-SWSF-072015-A	1	1	1	0	1	1	0	0	0
7/20/15	2148	3,813	BDD-SWSF-072015-B	1	1	1	0	1	1	1	1	0
7/20/15	2218	2,626	BDD-SWSF-072015-C	1	1	1	0	1	1	0	0	0
7/20/15	2248	1,222	BDD-SWSF-072015-D	1	1	1	1	1	1	1	0	0
7/20/15	2318	656	BDD-SWSF-072015-E	1	1	1	0	1	1	0	0	0
7/20/15	2348	570	BDD-SWSF-072015-F	1	1	1	1	1	1	0	0	0
7/21/15	0048	993	BDD-SWSF-072115-G	1	0	0	0	0	0	0	0	0
7/20/15	1948	1,299	BDD-SWSF-072015-H	1	0	0	0	0	0	0	0	0
7/20/15	2048	2,886	BDD-SWSF-072015-I	1	0	0	0	0	0	0	0	0
7/30/15	0022	549	BDD-SWSF-073015-A	1	1	1	1	1	0	0	0	0
7/30/15	0052	603	BDD-SWSF-073015-B	1	1	1	1	1	0	0	0	0
7/30/15	0122	9,224	BDD-SWSF-073015-C	1	1	1	1	1	0	0	0	0
7/30/15	0152	9,250	BDD-SWSF-073015-D	1	1	1	1	1	0	0	0	0
7/30/15	0222	7,086	BDD-SWSF-073015-E	1	1	1	1	1	1	1	1	0
7/30/15	0252	3,676	BDD-SWSF-073015-F	1	1	1	1	1	0	0	0	0
7/30/15	0322	4,586	BDD-SWSF-073015-G	1	1	1	0	1	1	1	1	0
7/30/15	0352	2,088	BDD-SWSF-073015-H	1	1	1	1	1	0	0	0	0
7/30/15	0422	2,305	BDD-SWSF-073015-I	1	1	1	1	1	0	0	0	0
7/30/15	0522	2,566	BDD-SWSF-073015-J	0	0	0	0	0	0	0	0	0
7/31/15	1553	1,531	BDD-SWSF-073115-A	1	0	0	0	0	0	0	0	0
7/31/15	1653	7,299	BDD-SWSF-073115-B	1	0	0	0	0	0	0	0	0
7/31/15	1723	12,419	BDD-SWSF-073115-C	1	1	1	0	1	1	0	0	0

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7/31/15	1753	8,384	BDD-SWSF-073115-D	1	1	1	1	1	0	1	1	0
7/31/15	1823	5,773	BDD-SWSF-073115-E	1	1	0	0	0	0	0	0	0
7/31/15	1852	4,364	BDD-SWSF-073115-F	1	1	1	0	1	1	1	1	0
7/31/15	1922	3,876	BDD-SWSF-073115-G	1	0	0	0	0	0	0	0	0
7/31/15	1953	3,313	BDD-SWSF-073115-H	1	0	0	0	0	0	0	0	0
7/31/15	2053	1,859	BDD-SWSF-073115-I	1	0	0	0	0	0	0	0	0
9/1/15	1228-124	243	BDD-SWBF-090115-A	1	1	1	1	1	0	0	0	0
9/23/15	1334	82	BDD-SWBF-092315-A	1	1	1	1	0	1	1	1	0
10/21/15	1842	6,456	BDD-SWSF-102115-A	1	1	1	1	1	1	1	0	1
10/21/15	1912	9,429	BDD-SWSF-102115-B	1	1	0	0	0	0	0	0	0
10/21/15	1941	14,675	BDD-SWSF-102115-C	1	0	0	0	0	0	0	0	0
10/21/15	2012	31,483	BDD-SWSF-102115-D	1	1	1	1	1	0	0	0	1
10/21/15	2042	27,933	BDD-SWSF-102115-E	1	1	1	1	1	1	0	1	0
10/21/15	2112	24,134	BDD-SWSF-102115-F	1	1	1	1	0	1	0	0	0
10/21/15	2142	22,429	BDD-SWSF-102115-G	1	0	0	0	0	0	0	0	0
10/21/15	2242	13,502	BDD-SWSF-102115-H	1	1	1	1	1	0	1	1	0
10/21/15	2341	12,615	BDD-SWSF-102115-I	1	0	0	0	0	0	0	0	0
10/24/15	0011	1,086	BDD-SWSF-102415-A	1	1	1	1	1	1	1	0	1
10/24/15	0041	852	BDD-SWSF-102415-B	1	1	1	0	1	0	0	0	0
10/24/15	0111	735	BDD-SWSF-102415-C	1	1	1	1	1	1	0	1	1
10/24/15	0141	2,065	BDD-SWSF-102415-D	1	1	1	0	1	0	0	0	0
10/24/15	0211	NO	BDD-SWSF-102415-E	0	0	0	0	0	0	0	0	0
10/24/15	0241	NO	BDD-SWSF-102415-F	0	0	0	0	0	0	0	0	0
10/24/15	0311	730	BDD-SWSF-102415-G	1	1	1	0	1	0	0	0	0
10/24/15	0341	582	BDD-SWSF-102415-H	0	0	0	0	0	0	0	0	0
10/24/15	0411	NO	BDD-SWSF-102415-I	1	1	1	1	1	1	1	0	1
10/24/15	0511	873	BDD-SWSF-102415-J	0	0	0	0	0	0	0	0	0
6/3/16	09:10	211	BDD-SWBF-060316-A	0	0	0	0	0	0	0	1	0
6/8/16	08:54	201	BDD-SWBF-060816-A	1	1	1	1	1	0	1	0	1
7/6/16	08:40	Not sampled	BDD-SWBF-070616-A	0	0	0	0	0	0	0	0	1
7/28/16	08:15	61	BDD-SWBF-072816-A	1	1	1	1	1	1	1	1	1
8/3/16	08:38	628	BDD-SWBF-080316-A	1	1	1	1	1	1	1	1	1
8/27/16	14:36	691		0	0	0	0	0	0	0	0	0
8/27/16	15:06	376	BDD-SWBF-082716-A	1	1	1	0	1	1	0	0	1
8/27/16	15:36	358	BDD-SWBF-082716-B	1	1	1	0	1	1	0	0	0
8/27/16	16:20	557	BDD-SWBF-082716-C	1	1	1	0	1	1	0	0	1
8/27/16	16:28	525	BDD-SWBF-082716-D	0	0	0	1	0	0	1	0	0
8/27/16	17:05	355	BDD-SWBF-082716-E	1	1	1	0	1	1	0	0	1
8/27/16	17:28	360	BDD-SWBF-082716-F	0	0	0	1	0	0	0	1	0
8/27/16	17:50	335	BDD-SWBF-082716-G	1	1	1	0	1	1	0	0	0
8/27/16	18:28	345	BDD-SWBF-082716-H	0	0	0	1	0	0	1	0	0
8/27/16	18:35	377	BDD-SWBF-082716-I	1	1	1	0	1	1	0	0	1
8/27/16	19:20	325	BDD-SWBF-082716-J	1	1	1	0	1	1	0	0	0
8/27/16	19:28	350	BDD-SWBF-082716-K	0	0	0	1	0	0	0	1	0
8/27/16	20:05	301	BDD-SWBF-082716-L	1	1	1	0	1	1	0	0	0
8/27/16	20:28	330	BDD-SWBF-082716-M	1	0	0	0	0	0	0	0	0
8/27/16	21:28	315	BDD-SWBF-082716-N	1	0	0	0	0	0	0	0	0
10/11/16	08:14	206	BDD-SWBF-103116-A	1	1	1	1	1	1	1	1	1
5/9/17	15:45	352	BDD-SWBF-050917-A	1 (w/o Np)	1	0	1	1	0	0	0	0
5/29/17	14:11-	149	BDD-SWSF-052917-A	1 (w/o Np)	1	0	1	1	0	0	0	0
5/29/17	14:42	149	BDD-SWSF-052917-B	1 (w/o Np)	1	0	1	1	0	0	0	0
5/29/17	14:56-	193	BDD-SWSF-052917-C	1 (w/o Np)	1	0	1	1	0	0	0	0
5/29/17	15:12	419	BDD-SWSF-052917-D	1 (w/o Np)	1	0	1	1	0	0	0	0

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5/29/17	15:41-	256	BDD-SWSF-052917-E	1 (w/o Np)	1	0	1	1	0	0	0	0
7/5/17	09:45	37	BDD-SWBF-070517-A	1	1	1	1	1	1	1	1	1
7/27/17	01:29	353	BDD-SWSF-072717-A	1	1	1	1	1	1	1	1	1
7/27/17	01:59	291	BDD-SWSF-072717-B	1	1	1	1	1	1	0	0	1
7/27/17	02:29	297	BDD-SWSF-072717-C	1	1	1	1	1	1	0	0	1
7/27/17	03:15	323	BDD-SWSF-072717-D	1	1	1	1	1	1	0	0	1
7/27/17	04:00	1,212	BDD-SWSF-072717-E	1	1	1	1	1	1	1	1	1
7/27/17	04:45	not available	BDD-SWSF-072717-F	1	1	1	1	1	1	0	0	1
7/27/17	05:33	862	BDD-SWSF-072717-G	1	0	0	0	0	0	0	0	0
7/27/17	07:03	1,600	BDD-SWSF-072717-H	1	0	0	0	0	0	0	0	0
7/27/17	08:33	1,636	BDD-SWSF-072717-I	1	0	0	0	0	0	0	0	0
8/8/17	13:59	660	BDD-SWSF-080817-A	1	1	1	1	1	1	1	1	1
8/8/17	14:29	695	BDD-SWSF-080817-B	1	1	1	1	1	1	0	0	1
8/8/17	14:59	2,298	BDD-SWSF-080817-C	1	1	1	1	1	1	0	0	1
8/8/17	15:45	7,346	BDD-SWSF-080817-D	1	1	1	1	1	1	0	0	1
8/8/17	16:30	8,017	BDD-SWSF-080817-E	1	1	1	1	1	1	1	1	1
8/8/17	17:15	14,973	BDD-SWSF-080817-F	1	1	1	1	1	1	0	0	1
8/8/17	17:57	7,512	BDD-SWSF-080817-G	1	1	1	1	1	1	1	1	1
8/8/17	18:42	4,098	BDD-SWSF-080817-H	1	1	1	1	1	1	0	0	1
8/8/17	19:27	2,704	BDD-SWSF-080817-I	1	1	1	1	1	1	1	1	1
8/8/17	21:03	2,259	BDD-SWSF-080817-J	1 (w/o Np, gamma)	0	0	0	0	0	0	0	1
8/30/17	10:00	765	BDD-SWBF-083017-A	1	1	1	1	1	1	1	1	1
9/28/17	00:12	5,726	BDD-SWSF-092817-A	1	1	1	1	1	1	1	0	1
9/28/17	00:38	11,010	BDD-SWSF-092817-B	1	1	1	1	1	1	0	0	0
9/28/17	01:12	27,155	BDD-SWSF-092817-C	1	1	1	1	1	1	0	2	0
9/28/17	01:54	23,431	BDD-SWSF-092817-D	1	1	1	1	1	1	0	0	0
9/28/17	02:42	14,127	BDD-SWSF-092817-E	1	1	1	1	1	1	1	0	1
9/28/17	03:24	8,263	BDD-SWSF-092817-F	1	1	1	1	1	1	0	0	0
9/28/17	04:12	6,381	BDD-SWSF-092817-G	1	1	1	1	1	1	0	1	0
9/28/17	04:51	6,781	BDD-SWSF-092817-H	1	1	1	1	1	1	0	0	0
9/28/17	05:42	5,001	BDD-SWSF-092817-I	1	1	1	1	1	1	1	0	1
9/28/17	07:12	2,460	BDD-SWSF-092817-J	1 (Pu/U/Am only)	0	0	0	0	0	0	0	0
9/29/17	01:08	7,747	BDD-SWSF-092917-A	1	1	1	1	1	1	1	0	1
9/29/17	01:37	4,051	BDD-SWSF-092917-B	1	1	1	1	1	1	0	0	0
9/29/17	02:08	5,947	BDD-SWSF-092917-C	1	1	1	1	1	1	0	1	0
9/29/17	02:50	10,322	BDD-SWSF-092917-D	1 (Pu/U/Am only)	0	0	0	0	0	0	0	0
9/29/17	03:38	19,518	BDD-SWSF-092917-E	1	1	1	1	1	1	1	0	1
9/29/17	04:20	20,314	BDD-SWSF-092917-F	1	1	1	1	1	1	0	0	0
9/29/17	05:08	13,779	BDD-SWSF-092917-G	1	1	1	1	1	1	0	1	0
9/29/17	05:53	11,358	BDD-SWSF-092917-H	1	1	1	1	1	1	0	0	0
9/29/17	06:38	10,970	BDD-SWSF-092917-I	1	1	1	1	1	1	1	0	1
9/29/17	08:08	8,617	BDD-SWSF-092917-J	1 (Pu/U/Am only)	0	0	0	0	0	0	0	0
10/4/17	22:58	6,627	BDD-SWSF-100417-A	1	1	1	1	1	1	1	0	1
10/4/17	23:27	9,387	BDD-SWSF-100417-B	1	1	1	1	1	1	0	0	0
10/4/17	23:58	8,555	BDD-SWSF-100417-C	1	1	1	1	1	1	0	1	1
10/5/17	00:40	8,806	BDD-SWSF-100417-D	1	1	1	1	1	1	0	0	0
10/5/17	01:28	9,274	BDD-SWSF-100417-E	1	1	1	1	1	1	1	0	1
10/5/17	02:10	9,982	BDD-SWSF-100417-F	1	1	1	1	1	1	0	0	0
10/5/17	02:58	10,201	BDD-SWSF-100417-G	1 (Pu/U/Am only)	0	0	0	0	0	0	0	0
10/5/17	04:28	21,935	BDD-SWSF-100417-H	1 (Pu/U/Am only)	0	0	0	0	0	0	0	0

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10/5/17	05:58	15,843	BDD-SWSF-100417-J	1 (Pu/U/Am only)	0	0	0	0	0	0	0	0
10/31/17	14:23	61	BDD-SWBF-103117-A	1	1	1	1	1	1	1	1	1

ATTACHMENT 2

2015-2017 Report

Plutonium-239/240 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects Min	Non-Detects Max	Detects Min	Detects Max	Detects Mean	Detects Standard Deviation	Detects 95th Percentile
2015	24	45	0.0026	0.12	0.0062	0.725	0.10337	0.12749	0.25099
2016	7	7	0.0016	0.0138	0.0156	0.035	0.02096	0.00657	0.03104
2017	14	45	0.0047	0.103	0.0075	0.7974	0.18065	0.17199	0.51918
2008-2017	96	156	-0.00504	2.15	0.0051	5	0.38211	0.74270	1.65000

Plutonium-239/240 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects Min	Non-Detects Max	Detects Min	Detects Max	Detects Mean	Detects Standard Deviation	Detects 95th Percentile
2015		44			0.00464	0.26505	0.03548	0.05114	0.13052
2016		7			0.04312	0.10622	0.06822	0.02400	0.10287
2017		38			0.00884	0.27691	0.03786	0.04269	0.06853
2008-2017		147			0.00464	0.30962	0.04623	0.05503	0.18783

Plutonium-238 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects Min	Non-Detects Max	Detects Min	Detects Max	Detects Mean	Detects Standard Deviation	Detects 95th Percentile
2015	41	26	-0.0053	0.129	0.0110	0.4460	0.08404	0.10586	0.32873
2016	12	2	0.0036	0.015	0.0069	0.0198	0.01335	0.00912	0.01916
2017	26	32	0	0.069	0.0051	0.2010	0.08382	0.05814	0.19625
2008-2017	179	81	-0.15	2.69	0.0048	0.4460	0.09438	0.09618	0.31000

Plutonium-238 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects Min	Non-Detects Max	Detects Min	Detects Max	Detects Mean	Detects Standard Deviation	Detects 95th Percentile
2015		25			0.00416	0.19444	0.02502	0.04347	0.11186
2016		2			0.01943	0.05270	0.03606	0.02353	0.05104
2017		20			0.00827	0.27802	0.05124	0.07143	0.15907
2008-2017		66			0.00242	0.27802	0.02935	0.04992	0.13615

Np-237 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects Min	Non-Detects Max	Detects Min	Detects Max	Detects Mean	Detects Standard Deviation	Detects 95th Percentile
2015	54	0	-0.058	0.062	na	na	na	na	na
2016	12	0	-0.0061	0.0093	na	na	na	na	na
2017	30	12	-0.1	0.076	0.0057	0.5243	0.14694	0.15625	0.40660
2008-2017	96	12	-0.1	0.076	0.0057	0.5243	0.14694	0.15625	0.40660

Np-237 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects Min	Non-Detects Max	Detects Min	Detects Max	Detects Mean	Detects Standard Deviation	Detects 95th Percentile
2015		0			na	na	na	na	na
2016		0			na	na	na	na	na
2017		13			0.00470	0.02770	0.01577	0.00632	0.02520
2008-2017		13			0.00470	0.02770	0.01577	0.00632	0.02520

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Sr-90 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	55	3	-0.57	1.99	0.3130	0.5900	0.42433	0.14627	0.56800
2016	12	2	-0.099	0.186	0.195	0.43	0.31250	0.16617	0.41825
2017	40	8	-0.79	1.5	0.184	1.1000	0.49313	0.33047	0.99150
2008-2017	182	58	-3.8	3.8	0.184	13.2000	2.11545	2.71134	7.91750

Sr-90 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015		3			0.09704	0.17847	0.14180	0.04131	0.17561
2016		2			0.31066	1.21059	0.76062	0.63634	1.16559
2017		8			0.09145	10.80747	2.07879	3.67760	8.08428
2008-2017		58			0.01548	10.80747	0.60572	1.59172	1.86017

Ra-226 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	5	50	0.08	0.57	0.235	55.2	9.9063	11.9788	36.3500
2016	0	12	na	na	0.25	1.12	0.5113	0.2342	0.9000
2017	1	39	0.096	0.096	0.223	593	36.1926	116.1203	80.7500
2008-2017	12	138	0.08	0.61	0.223	593	15.4750	63.1694	35.9500

Ra-226 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015		48			0.339	10.921	2.0018	1.4661	3.5856
2016		12			1.104	4.105	1.7025	0.8355	3.0743
2017		36			0.223	25.308	2.7649	5.2838	10.0590
2008-2017		130			0.018	25.308	1.7847	3.0360	3.7214

Ra-228 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	4	51	0.61	0.91	0.82	57.3	10.0055	10.9881	28.3500
2016	5	7	0.33	0.8	0.92	2.31	1.4157	0.4913	2.0970
2017	5	35	0.04	0.89	0.56	28.9	10.3697	8.2701	25.9200
2008-2017	22	129	0.04	1.09	0.56	57.3	8.0858	8.8171	24.4200

Ra-228 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015		48			0.639	9.163	2.0352	1.2407	3.0401
2016		7			2.570	4.471	3.6931	0.7354	4.4131
2017		32			0.496	2.289	1.3251	0.5318	2.2222
2008-2017		121			0.038	9.163	1.5365	1.2290	3.1970

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U-234 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	0	66	na	na	0.682	25.370	7.350	6.538	20.950
2016	0	14	na	na	0.648	1.91	1.301	0.313	1.683
2017	0	59	na	na	0.469	89.504	18.194	21.155	64.052
2008-2017	0	218	na	na	0.469	310	18.292	32.512	70.439

U-234 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015		64			0.474	13.558	2.248	2.149	6.752
2016		14			2.800	10.640	4.457	2.085	8.579
2017		60			0.666	19.576	2.870	3.130	4.088
2008-2017		214			0.030	151.176	3.311	10.558	7.742

U-235 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	1	65	0.0198	0.0198	0.0138	1.31	0.3415	0.3245	0.8880
2016	1	13	0.015	0.015	0.0334	0.082	0.0550	0.0156	0.0778
2017	6	53	-0.0027	0.0192	0.0251	4.708	0.9896	1.0716	3.2064
2008-2017	23	200	-0.0027	4.01	0.0138	13	0.9323	1.6347	3.2068

U-235 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015		63			0.018	0.440	0.0862	0.0626	0.1593
2016		13			0.111	0.575	0.1918	0.1264	0.4016
2017		54			0.027	0.839	0.1237	0.1087	0.2003
2008-2017		196			0.018	5.529	0.1356	0.3988	0.2473

U-238 Stormwater, pCi/L

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	0	66	na	na	0.413	25.699	7.167	6.680	21.275
2016	0	14	na	na	0.346	1.77	0.981	0.308	1.387
2017	0	59	na	na	0.295	91.104	18.572	21.912	67.455
2008-2017	0	218	na	na	0.295	300	17.940	31.779	69.877

U-238 Sediment, pCi/g

Year	Non-detects/	Detects	Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015		64			0.480	8.574	1.846	1.253	4.125
2016		14			2.118	5.681	3.192	1.013	5.424
2017		60			0.467	11.937	2.463	1.916	4.163
2008-2017		214			0.023	174.706	2.955	11.938	4.715

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Gross Alpha Stormwater, pCi/L									
			Non-Detects		Detects				
Year	Non-detects/	Detects	Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	3	31	1.2	2.44	3.91	740	166.01	207.27	629.00
2016	0	11	na	na	1.8	40.6	11.54	12.65	35.20
2017	0	53	na	na	1.27	325	51.70	86.10	242.80
2008-2017	3	218	1.2	2.44	1.27	3800	261.70	496.08	1,006.50

Gross Beta Stormwater, pCi/L									
			Non-Detects		Detects				
Year	Non-detects/	Detects	Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	0	34	na	na	4.99	799	165.39	205.96	604.10
2016	0	11	na	na	4.01	62.8	19.85	21.66	61.95
2017	0	53	na	na	2.78	467	61.16	101.16	258.80
2008-2017	0	221	na	na	2.4	8400	355.79	797.54	1,430.00

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ALUMINUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	1600	310000	60,495.47	73,253.79	228,500.00
2016	12	12	na	na	1100	20000	5,021.33	4,535.97	11,390.00
2017	47	47	na	na	440	240000	62,584.71	61,280.94	170,000.00
All	117	117	na	na	440	310000	54,914.23	66,382.43	181,000.00

ALUMINUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	34	43	43	15	2640	538.88	730.16	1,995.00
2016	11	10	50	50	15	51.5	25.53	14.01	49.58
2017	41	41	na	na	11	3800	324.30	657.16	1,495.00
All	88	85	43	50	11	3800	376.48	666.42	1,900.00

ARSENIC Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	1.9	64	12.24	13.76	41.10
2016	12	12	na	na	1.9	5.4	3.06	0.87	4.44
2017	47	47	na	na	1.56	64	15.99	16.13	50.50
All	117	117	na	na	1.56	64	12.65	14.44	43.10

ARSENIC Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	33	3.8	3.8	0.92	8.57	2.408	1.407	4.950
2016	11	11	na	na	1.7	2.3	2.017	0.157	2.240
2017	41	41	na	na	1.4	7.8	2.318	0.919	3.200
All	88	85	3.8	3.8	0.92	8.57	2.316	1.090	3.825

ANTIMONY Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	20	0.3	7.4	0.11	10	0.675	2.085	0.465
2016	12	10	0.3	0.3	0.12	0.32	0.201	0.074	0.314
2017	47	45	0.09	0.09	0.07	0.99	0.168	0.145	0.330
All	117	75	0.09	7.4	0.07	10	0.306	1.078	0.359

ANTIMONY Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	23	0.179	7.4	0.18	0.44	0.296	0.078	0.435
2016	11	11	na	na	0.16	0.28	0.222	0.036	0.274
2017	41	41	na	na	0.15	3.2	0.511	0.434	0.821
All	88	75	0.179	7.4	0.15	3.2	0.400	0.341	0.737

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BARIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	67	6400	1,030.2	1,306.0	3,565.0
2016	12	12	na	na	82	220	160.1	40.4	213.0
2017	47	47	na	na	54	5100	1,339.4	1,342.8	4,050.0
All	117	117	na	na	54	6400	1,051.1	1,287.4	3,755.0

BARIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	36	na	na	42	720	102.0	138.1	128.5
2016	11	11	na	na	61	91	84.7	9.4	91.0
2017	41	41	na	na	47	190	83.1	21.4	112.8
All	88	88	na	na	42	720	91.2	90.1	120.0

BERYLLIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	51	0.131	0.62	0.17	27	5.446	6.174	17.800
2016	12	10	0.266	0.5	0.29	1.3	0.523	0.290	1.036
2017	47	44	0.084	0.5	0.15	23	6.746	6.460	20.100
All	117	105	0.084	0.62	0.15	27	5.464	6.204	19.050

BERYLLIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	1	0.131	0.62	2.3	2.48	2.390	0.127	2.471
2016	11	2	0.266	0.5	0.3	0.34	0.320	0.028	0.338
2017	41	6	0.0837	0.15	0.1	0.36	0.220	0.106	0.350
All	88	9	0.0837	0.62	0.1	2.48	0.674	0.910	2.399

BORON Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	55	55	na	na	14	190	61.27	38.94	150.00
2016	12	12	na	na	21.2	110	56.13	28.23	100.90
2017	47	47	na	na	15	140	59.70	31.03	115.00
All	114	114	na	na	14	190	60.03	34.57	117.00

BORON Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	33	33	na	na	19.1	63	29.57	8.56	42.30
2016	11	11	na	na	18	100	51.18	28.06	98.20
2017	41	41	na	na	19	62	29.08	7.37	38.55
All	85	85	na	na	18	100	32.03	14.11	60.20

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CADMIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	57	38	0.088	0.51	0.09	4.9	1.022	0.933	2.960
2016	12	8	0.088	0.3	0.09	0.29	0.152	0.069	0.270
2017	47	40	0.056	0.3	0.09	3.4	1.042	0.898	3.000
All	116	86	0.056	0.51	0.09	4.9	0.946	0.904	3.000

CADMIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	1	0.177	0.51	0.68	0.86	0.770	na	na
2016	11	0	0.088	0.3	na	na	na	na	na
2017	41	1	0.056	0.09	3	3	3.000	na	na
All	88	2	0.056	0.51	0.68	3	1.513	1.291	2.786

CALCIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	25000	1300000	190,834.4	256,593.7	677,500.0
2016	12	12	na	na	30100	54000	44,440.0	7,058.7	51,200.0
2017	47	47	na	na	27000	1100000	244,084.3	262,524.7	850,000.0
All	117	117	na	na	25000	1300000	194,833.1	249,939.6	738,500.0

CALCIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	36	na	na	24000	260000	41,395.5	47,569.0	53,700.0
2016	11	11	na	na	33000	40000	37,307.7	2,007.3	39,400.0
2017	41	41	na	na	27000	89000	33,004.0	8,440.4	37,865.0
All	88	88	na	na	24000	260000	36,977.6	31,094.7	41,400.0

CHROMIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	1.4	260	45.82	59.28	172.50
2016	12	11	10	10	1	15	3.16	3.58	8.31
2017	47	37	0.92	10	3.6	200	68.19	50.88	153.00
All	117	106	0.92	10	1	260	48.00	56.05	155.00

CHROMIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	14	0.6	10	0.6	2.1	1.031	0.470	2.020
2016	11	0	0.878	10	na	na	na	na	na
2017	41	23	0.916	3	1.1	5.8	2.816	1.011	4.620
All	88	37	0.6	10	0.6	5.8	2.142	1.214	4.080

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COBALT Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	0.81	180	31.318	41.183	117.000
2016	12	12	na	na	0.51	6.4	2.183	1.304	4.020
2017	47	47	na	na	0.31	150	38.507	38.983	110.000
All	117	117	na	na	0.31	180	30.776	39.196	110.000

COBALT Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	32	1	1.2	0.27	5.4	2.829	1.359	4.720
2016	11	11	na	na	0.12	2.2	0.435	0.681	1.900
2017	41	41	na	na	0.24	3.5	0.825	0.548	1.800
All	88	84	1	1.2	0.12	5.4	1.554	1.401	4.200

COPPER Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	50	3.05	10	3.3	280	60.14	64.94	197.50
2016	12	11	10	10	3.9	17	6.39	3.22	10.70
2017	47	47	na	na	2.3	230	62.20	58.33	165.00
All	117	108	3.05	10	2.3	280	54.70	60.43	171.00

COPPER Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	1	3.05	10	11	12	11.50	na	na
2016	11	6	1.15	10	1.4	2.5	1.98	0.49	2.49
2017	41	15	1.7	3	1.8	8.8	3.23	1.75	5.74
All	88	22	1.15	10	1.4	12	3.52	2.77	10.34

IRON Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	1400	240000	45,200.3	55,688.6	164,000.0
2016	12	12	na	na	980	15000	3,860.0	3,409.3	8,840.0
2017	47	47	na	na	380	190000	46,533.9	46,071.6	130,000.0
All	117	117	na	na	380	240000	40,953.5	50,197.3	130,000.0

IRON Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	26	24.7	100	25	1600	417.91	485.01	1,500.00
2016	11	11	na	na	9.8	297	66.35	97.36	280.80
2017	41	36	9.37	44	43	3000	246.61	521.00	1,114.50
All	88	73	9.37	100	9.8	3000	280.33	480.36	1,365.00

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LEAD Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	1.3	280	50.881	60.962	157.000
2016	12	12	na	na	1.3	9	4.015	1.691	6.291
2017	47	47	na	na	0.28	260	67.109	70.587	210.000
All	117	117	na	na	0.28	280	51.840	64.071	195.500

LEAD Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	11	0.13	2.9	0.16	12	2.539	4.080	11.870
2016	11	6	0.171	0.5	0.27	1.6	0.600	0.456	1.303
2017	41	13	0.128	0.16	0.13	3.3	0.769	0.900	2.625
All	88	30	0.128	2.9	0.13	12	1.407	2.681	5.240

MAGNESIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	4400	180000	35,623.6	40,649.1	124,900.0
2016	12	12	na	na	5200	13000	7,616.7	1,860.4	10,158.0
2017	47	47	na	na	4600	140000	39,922.4	35,925.1	105,000.0
All	117	117	na	na	4400	180000	34,078.5	37,465.7	105,500.0

MAGNESIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	36	na	na	2900	12000	4,785.2	1,722.0	7,270.0
2016	11	11	na	na	4900	6200	5,686.2	294.0	6,020.0
2017	41	41	na	na	2700	6700	4,243.4	1,056.4	5,965.0
All	88	88	na	na	2700	12000	4,641.5	1,394.9	6,685.0

MANGANESE Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	90	14000	2,157.0	2,863.2	7,445.0
2016	12	12	na	na	56	370	181.6	68.4	279.0
2017	47	47	na	na	22	11000	2,763.3	2,949.6	8,700.0
All	117	117	na	na	22	14000	2,166.9	2,824.0	7,975.0

MANGANESE Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	34	0.84	0.84	1.5	1100	83.41	230.85	236.00
2016	11	10	2	2	0.45	4.4	1.28	1.15	3.52
2017	41	41	na	na	1.2	210	26.02	46.14	136.60
All	88	85	0.84	2	0.45	1100	46.34	152.39	167.65

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NICKEL Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	56	2.44	5	2.6	360	66.45	81.39	230.00
2016	12	8	3.95	5	5.4	13	8.00	2.22	11.29
2017	47	46	1.9	1.9	2.6	270	72.94	73.03	206.50
All	117	110	1.9	5	2.6	360	64.30	76.08	220.00
NICKEL Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	11	1.8	5	2.8	6.9	4.40	1.41	6.27
2016	11	3	3.95	5	4.7	9.5	7.67	2.59	9.43
2017	41	27	0.89	1.9	0.94	9.6	2.77	1.61	5.21
All	88	41	0.89	5	0.94	9.6	3.53	2.03	7.75
POTASSIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	2000	87000	17,428.4	19,631.4	60,600.0
2016	12	12	na	na	2100	7500	3,572.0	1,248.4	5,281.0
2017	47	47	na	na	2400	63000	18,513.5	16,276.2	47,500.0
All	117	117	na	na	2000	87000	16,255.3	17,676.8	48,650.0
POTASSIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	36	na	na	1690	4700	2,542.7	665.0	3,870.0
2016	11	11	na	na	1700	2910	2,357.7	285.8	2,844.0
2017	41	41	na	na	2000	4600	2,949.2	605.8	4,050.5
All	88	88	na	na	1690	4700	2,710.2	642.0	3,963.0
SELENIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	44	0.663	4.8	0.78	26	5.322	5.967	18.100
2016	12	2	0.663	1	0.68	1.1	0.837	0.229	1.063
2017	47	42	0.3	1	0.38	29	8.052	7.641	25.000
All	117	88	0.3	4.8	0.38	29	6.473	6.901	22.200
SELENIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	5	0.675	4.8	0.8	1.4	1.044	0.246	1.400
2016	11	0	0.663	1	na	na	na	na	na
2017	41	25	0.22	0.3	0.23	11	0.679	1.855	0.620
All	88	30	0.22	4.8	0.23	11	0.750	1.669	1.400

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SILVER Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	43	0.0379	1.8	0.04	0.52	0.173	0.130	0.425
2016	12	11	0.0407	0.1	0.05	1.6	0.428	0.567	1.420
2017	47	39	0.02	0.1	0.04	2.9	0.242	0.435	0.410
All	117	93	0.02	1.8	0.04	2.9	0.234	0.361	0.470

SILVER Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	3	0.0379	1.8	0.04	0.08	0.055	0.016	0.078
2016	11	4	0.0407	0.1	0.05	0.44	0.210	0.170	0.420
2017	41	0	0.02	0.03	na	na	na	na	na
All	88	7	0.02	1.8	0.04	0.44	0.125	0.135	0.390

SODIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	7000	26000	15,117.2	3,860.7	22,000.0
2016	12	12	na	na	9720	20700	15,181.3	2,901.3	20,210.0
2017	47	47	na	na	9000	21000	14,392.9	3,473.2	21,000.0
All	117	117	na	na	7000	26000	14,840.5	3,605.4	21,000.0

SODIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	36	na	na	10000	20000	13,200.0	2,729.0	19,000.0
2016	11	11	na	na	14000	20000	15,530.8	1,499.7	17,600.0
2017	41	41	na	na	10000	20000	13,634.0	2,348.7	17,550.0
All	88	88	na	na	10000	20000	13,686.0	2,518.4	19,000.0

THALLIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	53	0.0402	5	0.05	4.6	0.864	1.042	3.220
2016	12	11	0.2	0.2	0.02	0.18	0.050	0.041	0.109
2017	47	32	0.015	0.2	0.17	3.6	1.205	0.741	2.345
All	117	96	0.015	5	0.02	4.6	0.859	0.944	2.400

THALLIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	11	0.0402	5	0.05	5.1	0.455	1.396	2.100
2016	11	0	0.0175	0.2	na	na	na	na	na
2017	41	3	0.0146	0.15	0.03	11	3.697	6.325	9.906
All	88	14	0.0146	5	0.03	11	1.063	2.933	6.575

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URANIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	1.1	100	15.13	23.22	68.00
2016	14	14	na	na	0.85	2.5	1.81	0.63	2.50
2017	42	42	na	na	1.1	92	21.83	23.98	74.80
All	114	114	na	na	0.85	100	15.72	22.68	68.80

URANIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	35	35	na	na	0.99	10.5	2.83	2.62	8.87
2016	9	9	na	na	1.6	2.3	1.76	0.20	2.09
2017	41	41	na	na	1.1	7.9	3.43	2.10	7.52
All	85	85	na	na	0.99	10.5	3.01	2.27	7.70

VANADIUM Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	58	na	na	4.8	340	77.33	81.86	274.00
2016	12	12	na	na	4.2	28	10.70	5.40	18.34
2017	47	47	na	na	3.7	320	88.29	81.22	230.00
All	117	117	na	na	3.7	340	73.95	79.91	235.50

VANADIUM Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	36	na	na	2.39	19	5.81	3.49	9.67
2016	11	11	na	na	2.5	4.29	3.53	0.44	4.12
2017	41	41	na	na	3	11	5.43	1.55	7.87
All	88	88	na	na	2.39	19	5.35	2.56	8.91

ZINC Unfiltered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	58	54	6.21	20	9.72	1100	206.71	246.48	689.00
2016	12	12	na	na	12	130	25.23	29.14	54.40
2017	47	46	1.5	1.5	6	790	218.04	211.48	639.50
All	117	112	1.5	20	6	1100	189.33	224.33	658.00

ZINC Filtered, ug/L									
Year	Total/ Detects		Non-Detects		Detects				
			Min	Max	Min	Max	Mean	Standard Deviation	95th Percentile
2015	36	3	0.17	20	8.6	160	41.74	66.23	131.80
2016	11	0	9.77	20	na	na	na	na	na
2017	41	10	1.47	6	1.64	380	41.42	102.70	183.20
All	88	13	0.17	20	1.64	380	40.42	89.61	182.00

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MERCURY Unfiltered, ug/L									
Year	**Total/ Detects**		Non-Detects		Detects				
			Min	**Max**	**Min**	**Max**	**Mean**	**Standard Deviation**	**95th Percentile**
2015	60	27	0.06	0.2	0.061	0.3	0.15	0.07	0.27
2016	11	0	0.06	0.2	na	na	na	na	na
2017	46	25	0.06	0.2	0.06	0.47	0.15	0.10	0.31
All	117	52	0.06	0.2	0.06	0.47	0.15	0.08	0.29

MERCURY Filtered, ug/L									
Year	**Total/ Detects**		Non-Detects		Detects				
			Min	**Max**	**Min**	**Max**	**Mean**	**Standard Deviation**	**95th Percentile**
2015	35	0	0.06	0.2	na	na	na	na	na
2016	11	0	0.06	0.2	na	na	na	na	na
2017	41	0	0.06	0.06	na	na	na	na	na
All	87	0	0.06	0.2	na	na	na	na	na

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ATTACHMENT 4

DEPARTMENT OF ENERGY
National Nuclear Security Administration
Los Alamos Field Office
Los Alamos, New Mexico 87544

FEB 24 2015

Joe Maestas
Board Chair
Buckman Direct Diversion Board
341 Caja Del Rio Rd.
Santa Fe, New Mexico 87506

Dear Mr. Maestas:

Subject: Return of Countersigned "Memorandum of Understanding between the U.S. Department of Energy and the Buckman Direct Diversion Board Regarding Water Quality Monitoring," dated January 12, 2015

On behalf of the Department of Energy/National Nuclear Security Administration, Los Alamos Field Office, the executed original of the "Memorandum of Understanding between the U.S. Department of Energy and the Buckman Direct Diversion Board Regarding Water Quality Monitoring," dated January 12, 2015, is enclosed. This agreement establishes roles and responsibilities for each of the signatories regarding coordination of water quality monitoring activities that address Los Alamos National Laboratory origin water quality concerns in Los Alamos and Pueblo Canyons.

If you have any questions regarding the water quality monitoring activities in relation to the Buckman Direct Diversion Project, please contact Federal Project Director Cheryl Rodriguez at (505) 665-5330 or David Rhodes at (505) 665-5325.

Thank you for the opportunity to work collaboratively on this important opportunity. We look forward to continuing to strengthen our relationship.

Peter Maggiore
Assistant Manager
Environmental Projects Office

Enclosure

cc w/out enclosure:
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C. Rodriguez, EPO, NA-LA
K. Armijo, EPO, NA-LA
S. DeRoma, SC, NA-LA

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Records Center, NA-LA
Official Contract File, NA-LA

EPO-32CR-731- 613761

MEMORANDUM OF UNDERSTANDING BETWEEN THE U.S. DEPARTMENT OF ENERGY AND THE BUCKMAN DIRECT DIVERSION BOARD REGARDING WATER QUALITY MONITORING

A. Parties

The Parties to this MOU are the Buckman Direct Diversion Board (BDD Board) and the U.S. Department of Energy (DOE).

B. Background

The Buckman Direct Diversion (BDD) is designed to divert water from the Rio Grande for use by the City and County of Santa Fe water utilities in the Santa Fe area and to provide a source for the water supply systems of Santa Fe County, the City of Santa Fe, Las Campanas Club, and Las Campanas Cooperative. The water to be diverted is San Juan-Chama Project water (a U.S. Bureau of reclamation interbasin water transfer project) and native New Mexico state waters regulated by the State of New Mexico.

The point of diversion for the BDD is on the east bank of the Rio Grande in northern New Mexico, near the historic Buckman townsite. The point of diversion is approximately 15 miles northwest of the City of Santa Fe and is located about three miles downstream from the confluence of the Rio Grande and Los Alamos Canyon (where Route 502 crosses the Rio Grande at Otowi Bridge).

LANL is located on the Pajarito Plateau above the Los Alamos/Pueblo Canyon watershed. The Los Alamos/Pueblo Canyon system intermittently and infrequently flows to the Rio Grande just below the Otowi Bridge and upstream of the BDD Project point of diversion. The Los Alamos/Pueblo Canyon watershed contains sediments with LANL-origin contamination from historic releases from LANL. Rain events may cause the transport of sediments, and these sediments have in the past and may in the future be transported to the Rio Grande and then to the BDD intake. The Los Alamos/Pueblo system has been investigated under the Compliance Order on Consent between LANL and the State of New Mexico Environment Department, and measures (including infrastructure) to reduce the transport of contaminated sediment have been implemented.

The New Mexico legislature encouraged the BDD Board and DOE to memorialize their agreement to certain activities relating to the mitigation and monitoring of LANL-origin water quality contaminants. The BDD Board requested a written agreement with LANL and DOE in 2007 and the New Mexico legislature passed resolutions in 2009 and 2010 that ultimately resulted in the Memorandum of Understanding that was executed on May 13, 2010 (the 2010 MOU). The 2010 MOU represented an agreement between the Parties that water quality management and monitoring are mutual priorities and that the activities described were consistent with, and would be carried out subject to, the policies, regulations, and applicable laws that pertain to the Parties.

This MOU will be utilized by the public and the BDD Board to inform the operations of the BDD Project, and will provide information that will guide the future water quality policies and priorities of the Parties.

Upon the execution of this MOU, the 2010 MOU will be terminated in accordance with Section G.3 of that 2010 MOU and this MOU shall evidence the consent of the Parties to the termination.

C. Objective

This MOU establishes roles and responsibilities with regard to coordination of monitoring activities by the Los Alamos National Laboratory (LANL) and the Department of Energy (DOE) in Los Alamos and Pueblo Canyons in relation to operation of the BDD Project. The primary objectives of this MOU include the following:

1. To continue the relationship developed between DOE and the BDD, and
2. To determine whether LANL legacy contaminants from Los Alamos and Pueblo Canyons into the Rio Grande warrants operational constraints for diversion at the BDD intake. This determination will be made relative to regional storm water events and/or to base flow in the Rio Grande, with the goal of reducing the long-term need for the Early Notification System (ENS).

D. Authorities

The Parties represent that they have the authority to enter into this MOU and are able to meet the respective commitments herein to the extent permitted by law.

1. Department of Energy. The U.S. Department of Energy is authorized to enter into this MOU pursuant to the Atomic Energy Act, as amended (Title 42 U.S.C. 2011, et seq.).
2. BDD Board. The BDD Board is authorized to enter into this MOU pursuant to the March 7, 2005, Joint Powers Agreement between Santa Fe County and the City of Santa Fe and associated state, county, and municipal laws related thereto.

E. Agreement Principles

E.1 Memorandum of Agreement and Protocols between DOE and the Pueblo de San Ildefonso

The Parties recognize that DOE must comply with the requirements of the 2014 Memorandum of Agreement between DOE and the Pueblo, and the associated *Protocols for Access to Pueblo Lands and for Protecting Confidential Pueblo Information* pertaining to activities on, and information gathered by, DOE on Pueblo de San Ildefonso property. DOE will consult with the Pueblo as necessary regarding the use of information gathered pursuant to this MOU.

E.2 Los Alamos / Pueblo Canyons Early Notification System

The Early Notification System is to provide real time stream flow data to the BDD at the following locations to enable the BDD staff to make decisions regarding facility operations, including temporarily ceasing diversion of water from the Rio Grande. The system includes the following parts:

- LANL Gage Station E050.1 in Los Alamos Canyon above the Pueblo Canyon confluence,
- LANL Gage Station E060.1 in Pueblo Canyon above the Los Alamos Canyon confluence,
- Station E062.1 in the narrow canyon below the confluence of Los Alamos and Pueblo Canyons, and
- Station E099 in Guaje Canyon.

LANL ENS stations E050.1 and E060.1 will be equipped with gaging (flow measurement) capabilities, real-time conveyance of stream-flow data (telemetry), camera capability to act as a backup for the gaging capabilities, and automated storm water samplers. Flows at the LANL gaging stations E060.1 and E050.1 shall be measured within a trapezoidal supercritical-flow flume design as reported in "Techniques of Water-resources Investigations of the United States Geological Survey, Chapter A14, Use of Flumes in Measuring Discharge" (F.A. Kilpatrick and V.R. Snyder, 1983), and between approximately 1 and 350 cubic feet per second (cfs). The system shall be capable of a low flow trigger stage of 5 cfs (adjustable).

Flow indication at all stations will consist of either a visual (camera) or transducer signal as confirmation of storm water flows at the locations to provide for better time studies on storm water flow travel from gage stations to the Rio Grande and to the point of diversion at the BDD. Maintenance of the flow indication equipment shall be the responsibility of DOE.

The BDD Board will, at its discretion, consult with the Pueblo de San Ildefonso regarding the installation of a real-time flow indicator(s) at the lower Los Alamos Canyon and the Rio Grande.

E.3 Los Alamos / Pueblo Canyons Storm Water Quality Sampling System

The sample collection system will provide water quality contaminant sampling data from storm water flow events at the LANL ENS gage stations to characterize and quantify the relationship of LANL contaminants in Los Alamos/Pueblo Canyon storm water flows into the Rio Grande in relation to the base flows and regional storm water flows. Gage stations E050.1 and E060.1 shall be equipped with automated samplers that will be triggered by the occurrence of runoff at these stations. DOE funds all sampling activities for this water quality system as part of monitoring pursuant to Section VII of the Compliance Order on Consent to evaluate contaminant transport mitigation measures within the LA/P watershed.

The samplers shall be capable of collecting samples from flow events greater than 5 cfs such that samples can be correlated with samples collected at the BDD intake through hydrograph comparison. The analyte list for these samplers is contained in Appendix A of this MOU and is generally consistent with, but contains negotiated changes to, the NMED-approved Los Alamos and Pueblo Canyon Sediment Transport Monitoring Plan for storm water monitoring in Los Alamos and Pueblo Canyons. Sampling shall be conducted from June through October of each year.

The Parties will review the available data, the analyte list, and the sampling protocols (e.g., trigger stage, sample collection process, etc.) during the Biannual Review. DOE will notify the BDD Board of any changes in the NMED-approved workplan. The collection and processing of samples will be in accordance with the LANL standard operating procedures (SOP) listed in Appendix A. The analytical methods are listed in Appendix A and will follow EPA guidelines and methods.

DOE shall maintain the sampling system as necessary, with samplers to be inspected weekly from June through October and after each flow event, in accordance with LANL SOPs listed in Appendix A. Samples will be collected after each flow event or within 72 hours of the event. In the event any station is not functioning, DOE shall notify the BDD and repair the station so the time period of inoperability is as short as possible. Inspection and repair schedules will be contingent on safe working conditions. If the period of operability is expected to exceed 48 hours, the DOE will communicate as quickly as practicable with the BDD staff via telephone call and/or email.

The Parties acknowledge that the inoperability of any ENS station during subsequent flow events and the inability to collect another set of samples is not an invalidation of the sampling program. Every event is not necessary to be sampled to contribute to the contaminant fate analysis and the evaluation of LANL contaminant contributions to the samples collected at the BDD intake location.

E.4 Rio Grande at BDD Project Location Sampling Program

The purpose is to provide both base-flow and event-based sampling of the Rio Grande when triggered by notification of flows in Los Alamos and/or Pueblo Canyons or as determined by the BDD Board for the purpose of water quality sampling at the Rio Grande at BDD in the search for operational criteria for ceasing diversion.

The sampling system includes a dedicated sampling station equipped with automated samplers that can be triggered by notification of Los Alamos and Pueblo Canyons' flows from the ENS gage stations, or by the BDD staff. The BDD Board shall retain title to the sampling equipment and shall own and operate the equipment at the BDD intake.

DOE shall pay up to $96,000 in sampling and analytical costs per year for each of the three (3) years under this MOU (2015, 2016, and 2017). The BDD Board shall be responsible for any additional sampling costs, and the BDD Board is responsible for all maintenance, inspection and repair of the sampling station located at the BDD intake. DOE will seek funding via a grant to the BDD Board for the sampling and analytical costs. If such a grant is not available by March 31, 2015, DOE will be directly responsible for all sampling and analytical costs until an alternative funding mechanism is implemented.

The analyte list for these samplers is contained in Appendix A of this MOU. Sampling shall be conducted from June through October of each year. The Parties will review the available data, the analyte list, and the sampling protocols (e.g., trigger stage, sample collection process, etc.) during the Biannual Review. The collection and processing of samples will be in accordance with BDD sampling procedures listed in Appendix A of this MOU and that are consistent with the LANL standard operating procedures (SOP) listed in Appendix A. The analytical methods are listed in Appendix A and will follow EPA guidelines and methods.

The BDD Board shall fund the maintenance, inspection, and repair of the BDD intake sampling system as necessary effective July 1, 2015. Samplers shall be inspected weekly from June through October and after each flow event. Samples will be collected after each flow event or within 72 hours of the event. In the event the station is not functioning, BDD staff shall notify DOE and repair the station so the time period of inoperability is as short as possible. Inspection and repair schedules will be contingent on safe working conditions. If the period of operability is expected to exceed 48 hours, BDD staff will communicate as quickly as practicable with the DOE via telephone call and/or email.

The Parties acknowledge that the inoperability of the BDD intake station during subsequent flow events and the inability to collect another set of samples is not an invalidation of the sampling program. It is not necessary that every event be sampled to contribute to the contaminant fate analysis and the evaluation of LANL contaminant contributions to the samples collected at the BDD Project location.

E.5 TREAT Study

BDD Board will fund a continuation of the Contaminant Fate Analysis that was started under the 2010 MOU under "The Removal Efficiency and Assessment of Treatments" (TREAT) Study. The TREAT Study will examine the treatment efficiency of the conventional and advanced treatments at the BDD with respect to contaminants in order to help determine the BDD operational criteria for diversion from the Rio Grande. The TREAT Study will focus on the capabilities of the BDD with respect to removal of contaminants as they are found to occur in the Rio Grande at BDD intake.

E.6 Analysis

The BDD Board will fund and BDD staff will be the lead on an annual report on the analysis of the data collected under this MOU. DOE will provide input and comments to the BDD report. Each annual report will be updated with the data from the latest monitoring period. The objective of the report is to summarize and present the collected data in the search for BDD operational criteria that determines the operational criteria for diversions from the Rio Grande. The report shall be reviewed and comments provided by DOE by May 31 of each year with the goal of revising the Appendix A sampling plan before the next storm season.

The BDD Board will conduct an evaluation of the water quality monitoring results and TREAT data and make a determination on operational parameters or criteria on whether or when to cease diverting from the Rio Grande. DOE will provide technical input on the report and shall be afforded an opportunity to review and comment on the report.

F. BDD Project Data Sharing

DOE shall be responsible for the costs associated with the sampling and analyses from the primary ENS components listed in Section E.2 in Los Alamos and Pueblo Canyons. Analytical results from E060.1 and E050.1 sampling will be made available to the BDD staff via the Intellus database within 30-60 calendar days after DOE receives sampling results from the analytical laboratory. Paper copies of the results will not be provided. Flow results from the secondary locations listed in Section E.1 shall be transmitted to the BDD staff no later than concurrently with the primary sample results.

DOE will, on at least an annual basis, update the transit time for storm water flows (from meteorological tower reports, the E050.1 and E060.1 gage stations, E062.1, and E099 flow indicators) between Lower Los Alamos Canyon at Rio Grande flow indication location and the BDD intake to determine transit time for various storm intensities and flows. BDD staff will provide technical input on the report and shall be afforded an opportunity to review and comment on the information.

Analytical results from the BDD intake will be made available to both the BDD Board and DOE via the Intellus database as soon as they are available.

The BDD Board will make records available to the DOE consistent with this MOU and that are generally available to the public, and this information shall be used in the Biannual Review process.

G. Coordination

DOE and the BDD Board will coordinate as necessary with the Pueblo de San Ildefonso and the New Mexico Environment Department on any issues related to the implementation of this MOU, and will engage in any consultation required to accomplish the purposes of this MOU.

Coordination between the Parties shall be to the mutual benefit of both parties and shall include data sharing (as above), technical assistance, and data and analysis reviews. Both parties should allow at least one week for response when requesting technical assistance or data and for analysis reviews, and should strive for more time to meet needs.

H. Biannual Review

The Parties shall meet twice annually to discuss issues related to this MOU. The meeting target months shall be October and April each year.

I. Contacts

All notices, correspondence, and communications arising under this MOU shall be provided to the representatives listed below, and any notice, demand, request, or information authorized of related to this MOU shall be deemed to have been given if mailed (return receipt requested), hand-delivered, or faxed (with confirmation of transmission) as follows:

- **DOE**

  Peter Maggiore
  Assistant Manager, Environmental Projects Office
  Los Alamos Field Office / NNSA / DOE
  3747 West Jemez Road, MS-A316

Los Alamos, NM 87544
Phone: 505-665-05925
Cell: 505-695-5109
Email: Peter.Maggiore@nnsa.doe.gov

With copy to:
DOE Counsel
Silas Deroma
Phone: 505-667-4668
Email: Silas.Deroma@nnsa.doe.gov

- **BDD Board**

Charles Vokes
BDD Facility Manager
Buckman Direct Diversion
341 Caja De Rio Road
Santa Fe, NM 87506
Phone: 505-955-4507
Email: cmvokes@ci.santa-fe.nm.us

With copy to:
BDD Board Counsel
Nancy Long
Long and Komer
2200 Brothers Road
P.O. Box 5098
Santa Fe, NM 87502
Cell: 505-470-2158
Email: nlong@nm.net

J. Period of Agreement, Modification, or Termination

This MOU is effective upon the signature of the BDD Board and DOE as shown below. This agreement is intended to address 2015, 2016 and 2017 and shall expire on December 1, 2017, UNLESS both Parties agree to extend this MOU for an optional three (3) year period. This optional extension may be executed by a re-signed copy of the signature page by the respective authorized parties to this MOU.

The Parties may modify this MOU by written amendment and in the same manner as this MOU was executed. Either Party may unilaterally terminate this MOU before the date of expiration, provided the party seeking termination provides written notice to the other party's representative 90 days before the intended termination date.

K. Dispute Resolution

If the Parties disagree over how to interpret this MOU, representatives of the Parties shall present their differences in writing to the Points of Contact for the other Party. If the Parties fail to resolve their differences within 30 days, the BDD Project Facility Manager and the Los Alamos Field Office Environmental Projects Office Assistant Manager shall prepare a written description of the dispute and the BDD Board Chair and the DOE Los Alamos Field Office Manager shall meet to reconcile the dispute. These representatives shall use efforts such as negotiation, facilitation, and mediation to resolve the dispute.

L. Other Provisions

Nothing in this MOU is intended to conflict with requirements of the Parties or applicable laws. Any such conflicting terms shall be invalid, but the remainder of this MOU shall remain in effect. If a term is deemed invalid, the Parties shall take appropriate action, including amendment or termination. The activities described in this MOU are consistent with, and will be carried out subject to, all known policies, regulations, and applicable laws that pertain to the parties.

This MOU in no way restricts the Parties from participating in any activity with other public or private agencies, organizations, or individuals.

Activities described in this MOU are subject to the availability of appropriated fund. Both the BDD Board and Los Alamos Field Office Environmental Projects Office Assistant Manager shall make the appropriations of funds for the activities described in this MOU a priority when seeking regular or project specific funding requests.

This MOU describes the basis on which the parties will cooperate on the topics described herein. This MOU is NOT a financial obligation that serves as a basis for expenditures, and any financial obligations necessary to carry out the activities described herein shall be addressed in other documents internal to each party. Expenditure of funds, human resources, equipment, supplies, facilities, training, public information, and technical expertise will be provided by each party as necessary to fulfill its obligations under this MOU.

This MOU is neither a fiscal nor a funds obligation document. Nothing in this MOU authorizes or is intended to obligate the parties to expend, exchange, or reimburse funds, services, or supplies, or transfer or receive anything of value. Any requirement for the payment or obligation of funds by DOE established by the terms of this MOU shall be subject to availability of funds and Secretarial discretion, and no provision herein shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. §1341.

This MOU is not legally enforceable and shall not be construed to create any legal obligation n the part of either party. This MOU shall not be construed to provide a private right, or cause of action, for or by any person or entity.

M. Signatures

NOW, each of the BDD Board and DOE has caused this MOU to be executed and delivered by its duly authorized representatives as of the last date shown below,

BDD Board

________________________ 1-8-15
Joseph Maestas, BDD Board Chair Date

DOE

________________________ 1/12/15
Kimberly Davis Lebak, Manager, Los Alamos Field Office Date

This Memorandum of Understanding is valid for three years from the date of the last signature.

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Appendix A
Sampling and Analysis Plan

The tables that follow the text below contain the analytes for the water quality sampling in accordance with this Memorandum.

Regarding LA/Pueblo Canyon Telemetry:

1. Telemetry used to communicate flow data from the gaging stations to the BDD shall provide a received signal level at each receiver with a fade margin of no less than 25 dBm above the equipment receiver threshold. Telemetry equipment shall include battery backup sized to provide a minimum 12 hour operation after failure of primary power. Battery run time shall be calculated in a mode of operation consistent with frequent data transmission during a slow event.

2. The amount of time between a station trigger and when notification is available to the BDD will be as short as is practical, with a goal not to exceed 1minute.

Regarding LA/Pueblo Canyon Water Quality Sampling:

1. The goals of the sampling strategy are to collect data that represent variations in contaminant concentrations and suspended sediment concentration (SSC) within runoff events across a typical hydrograph for each location (Monitoring Plan for LA/P Canyon Sediment Transport Mitigation Project (LA-UR-09-6563)).

2. Each of the gages will be monitored continuously for stage. Samples at E050 and E060 will be triggered by 5-cfs flows to ensure sampling at flows that may extend to the Rio Grande (Monitoring Plan for LA/P Canyon Sediment Transport Mitigation Project (LA-UR-09-6563)).

3. Prioritization of analytes if water volume is insufficient to fulfill suite is unfiltered, then filtered, and by constituents: SSC, Isotopic Plutonium, Am-241 (HASL-300), Sr-90, Isotopic Uranium, Radium-226/228, Gross alpha/beta, radionuclides by gamma spec, target analyte list metals, PCBs, dioxin/furans, perchlorates, cyanide, TOC.

4. All events exceeding 5cfs at E050.1 and E060.1 will be analyzed for the parameters in Table 2.

Regarding Detection Limits in the Analyte Tables:

Method reporting limits for sample analyses for each medium shall be established at the lowest level practicable for the method and analyte concentrations and shall not exceed soil, groundwater, surface water, or vapor emissions background levels, cleanup standards, and screening levels. The preferred method detection limits are a maximum of 20 percent of the background, screening, or cleanup levels. Detection limits that exceed established soil, groundwater, surface water, or air emissions cleanup standards, screening levels, or background levels and are reported as "not detected" shall be considered data quality exceptions and an explanation for the exceedance and its acceptability for use shall be provided. (Section IX.C.3.c Method Reporting Limits from the Consent Order).

Regarding BDD Intake Water Quality Sampling:

The sampler set up at the BDD intake contains 4 autosamplers. The samplers installed at the BDD intake are ISCO Model 3700. The BDD staff maintains the equipment of these samplers.

The samplers can communicate remotely with the BDD Treatment Plant. The samplers can be started or stopped at any time during storm events, and can be programmed to sample at any frequency and order. Sample collection timing and bottle fill sequence for each sampler can be programmed as well.

Sampling Strategy at BDD Intake

The early notification for BDD to stop diverting and start sampling is a 5 cfs flow in the LA/P canyon system. Consequently, the time for this flow's arrival at the BDD is programmed into the software program or estimated the BDD operators, and at that time the "storm event" procedure is triggered: stop diversion, start sampling. The sampling sequence may be triggered by change in stage of the Rio Grande as well.

Automated Storm Event Sample Collection at BDD Intake

When a flow greater than 5 cfs is detected by a sensor at E050.1 and/or E060.1, a signal is automatically transmitted electronically to the BDD's Supervisory Control and Data Acquisition system (SCADA). Usually, 75 minutes (or as determined by the BDD operator) after the transmission of the signal from either E050.1 or E060.1, SCADA will automatically transmit a start signal to autosamplers located near the BDD's diversion structure, and it would fill out the pre-loaded collection containers at programmed intervals Signals are automatically transmitted electronically to the BDD's Supervisory Control and Data Acquisition system (SCADA). When a flow greater than 5 cfs is detected by the SCADA at E050.1 and/or E060.1 or a combined flow of the two stations is greater than 5 cfs, the ENS sequencing will begin. After time calculated delays have expired (or as determined by the BDD operator), SCADA will automatically transmit a start signal to autosamplers located near the BDD's diversion structure, and it would fill out the pre-loaded collection containers at programmed intervals

Deviations from Pre-Programmed Sample Collection

The LANL gauging stations are equipped with cameras which may help in estimating the LA/P canyon flow arrival or whether to determine if any false alarm is triggered. The BDD operators do not rely exclusively on the early 5cfs notification. After the notification is received at the BDD, the storm event is verified by the video cameras at the gauging stations, or evaluated from weather point of view and/or timing in the season, in order to correct the flow arrival in determining the best time to stop diversion and start sampling. The BDD operator may correct or change the pre-programmed trigger times listed earlier. Sometimes, equipment may be malfunctioning, or in case of very strong flash floods, sensors may be out of service. At such times the cameras become the sole tool for estimating flow arrival, or verification of a storm event.

Notification to Partners

Storm events and sampling during events is communicated to the BDD partners via email.

Analytes and Methods

Samples collected during stormwater sampling will be screened at BDD in order to determine the best representatives of before, during, and after the event. Then, the samples will be sent to a lab and analyzed for the following analytes using the methods listed in Table 3.

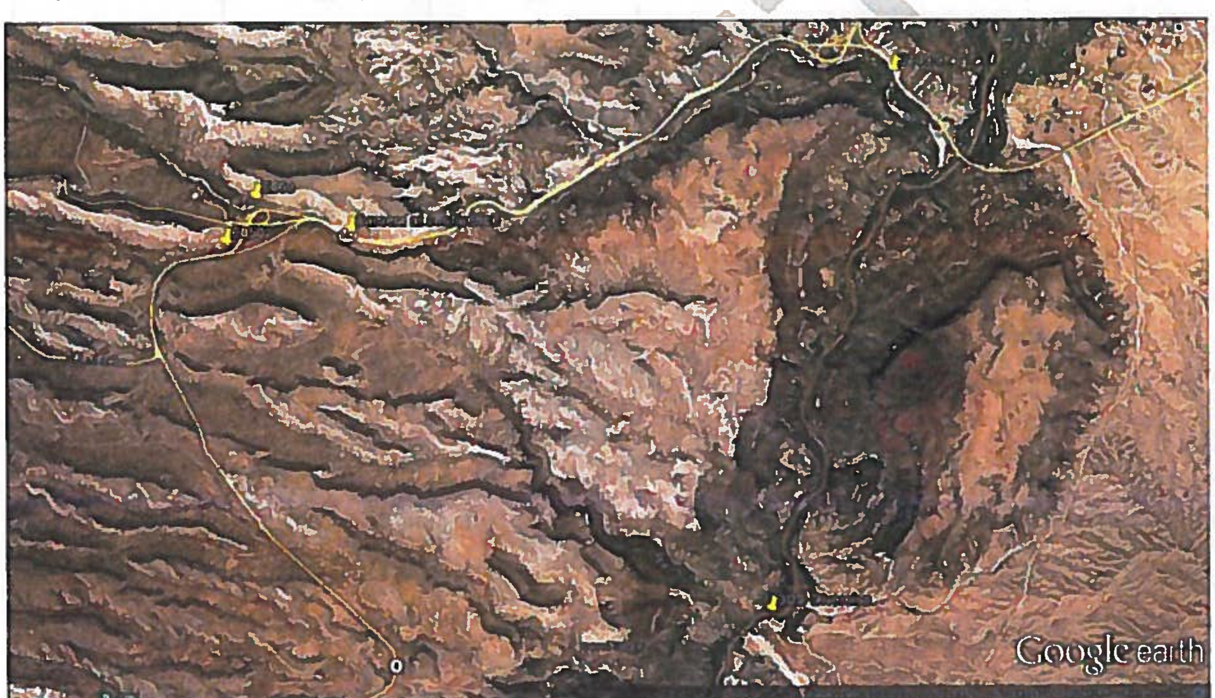

Table 1: Standard Operating Procedures

SOP Number/Title	Application			
LANL Procedures	**Stream Gage/Sampler Maintenance**	**LA/P Canyon Storm Water Quality Data**	**Rio Grande above Otowi Location**	**Rio Grande at BDD Diversion Location**
SOP-5213 Collecting Storm Water Runoff Samples and Inspecting Samplers	X	X	X	
SOP-5214 Installation, Setup and Maintenance of ISCO Samplers		X	X	
SOP-5215 Processing Storm Water Samples		X	X	
EP-ERSS-SOP-5057 Handling, Packaging and Transporting Field Samples		X	X	
SOP-5255 Shipping of Environmental Samples by the WES Sample Management Office (SMO)		X	X	
ENV-WQH-SOP-009.3 Operation and Maintenance of Stream Gaging Stations	X	X	X	
BDD Procedures				
BDD SOP				X

Table 2: Los Alamos/Pueblo Canyon Storm Water Quality Sampling

Analytes	Method	Detection Limit	Field Prep Code
Suspended Sediment Concentration	ASTM:D3977-97	3 mg/L	UF
TAL metals (23) plus Hg	EPA:200.7, EPA: 200.8, EPA:245.2	0.2-300 mg/L	UF
Hardness	SM:A2340B	2 mg/l	UF
Gross alpha	EPA:900	3 pCi/L	F, UF
Gross beta	EPA:900	3 pCi/L	F, UF
Strontium-90	EPA:905.0	0.5 pCi/L	UF
Americium-241	HASL-300:AM-241	0.05 pCi/L	UF
Gross gamma	EPA:901.1	15 pCi/L	UF
Cesium-137	EPA:901.1	5 pCi/L	UF
Cobalt-60	EPA:901.1	5 pCi/L	UF
Sodium-22	EPA:901.1	10 pCi/L	UF
Neptunium-237	EPA:901.1	40 pCi/L	UF
Potasium-40	EPA:901.1	75 pCi/L	UF
Radionuclides by gamma spec	EPA:901.1	varies	UF
Plutonium (isotopic)	HASL-300:ISOPU	0.05 pCi/L	UF
Uranium (isotopic)	HASL-300:ISOU	0.05 pCi/L	UF
Dioxin/Furans	SW-846:8290	0.2-0.5 pCi/L	UF
PCBs	EPA 1668A	20-150 pCi/L	UF
Radium-226 & 228	EPA:903.1 & EPA:904.4	1 pCi/L	UF

Table 3: Rio Grande at BDD Diversion Sampling Program

Analytes	Method	Detection Limit	Field Prep Code
Suspended Sediment Concentration	ASTM:D3977-97	3 mg/L	UF
TAL metal (23) plus Hg	EPA:200.7, EPA: 200.8, EPA:245.2	0.2-300 mg/L	F, UF
Hardness	SM:A2340B	2 mg/l	UF
Gross alpha	EPA:900	3 pCi/L	F, UF
Gross beta	EPA:900	3 pCi/L	F, UF
Strontium-90	EPA:905.0	0.5 pCi/L	F, UF
Americium-241	HASL-300:AM-241	0.05 pCi/L	F, UF
Gross gamma	EPA:901.1	15 pCi/L	UF
Cesium-137	EPA:901.1	5 pCi/L	F, UF
Cobalt-60	EPA:901.1	5 pCi/L	F, UF
Sodium-22	EPA:901.1	10 pCi/L	F, UF
Neptunium-237	EPA:901.1	40 pCi/L	F, UF
Potasium-40	EPA:901.1	75 pCi/L	F, UF
Radionuclides by gamma spec	EPA:901.1	varies	UF
Plutonium (isotopic)	HASL-300:ISOPU	0.05 pCi/L	F, UF
Uranium (isotopic)	HASL-300:ISOU	0.05 pCi/L	F, UF
Dioxin/Furans	SW-846:8290	0.2-0.5 pCi/L	UF
PCBs	EPA 1668A	20-150 pCi/L	UF
Radium-226 & 228	EPA:903.1 & EPA:904.4	1 pCi/L	F, UF
TDS	EPA:160.1	10 pCi/L	F
TOC	SW-846:9060	1 mg/L	UF
PADS-particle size analysis	ASTM C-1070-01	0.1 %	UF
Perchlorate	SW846 6850 Modified	0.02 mg/l	UF