From: Pierard, Kevin, NMENV <Kevin.Pierard@state.nm.us>
Sent: Wednesday, April 8, 2020 8:48 AM
To: Pamela T. Maestas
Cc: Dhawan, Neelam, NMENV; HOLTON, BRIAN, EMNRD; king.laurie@epa.gov; 'Raymond Martinez'; Catechis, Chris, NMENV; steve.yanicak@state.nm.us; Hai Shen; Arturo Duran; David Nickless; cheryl.rodriguez@em.doe.gov; Emily M. Day; Kim Lebak; Joseph A. Legare; Dana Lindsay; Frazer R. Lockhart; Elizabeth Lowes; Glenn Morgan; Bruce A. Robinson; Karly B. Rodriguez; Bradley Smith; Steve J. Veenis; Amanda B. White; Steve S. White; Regulatory Documentation; 'DINOC@santaclarapueblo.org'; rrcarpenter@santafenm.gov; arrand@santafenm.gov; Daria Cuthbertson; Christian T. Maupin; Audrey Krehlik; Jennifer Von Rohr
Subject: RE: Submittal to NMED on 4/8/2020 of 2020 LA-Pueblo Monitoring Plan

I acknowledge receipt of the 2020 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project (letter and enclosure)

From: Pamela T. Maestas <pamela.maestas@em-la.doe.gov>
Sent: Wednesday, April 8, 2020 7:40 AM
To: Pierard, Kevin, NMENV <Kevin.Pierard@state.nm.us>
Cc: Dhawan, Neelam, NMENV <neelam.dhawan@state.nm.us>; HOLTON, BRIAN, EMNRD <brian.holton@state.nm.us>; king.laurie@epa.gov; 'Raymond Martinez' <rmartinez@sanipueblo.org>; Catechis, Chris, NMENV <Chris.Catechis@state.nm.us>; Yanicak, Steve, NMENV <Steve.Yanicak@state.nm.us>; Hai Shen <hai.shen@em.doe.gov>; Arturo Duran <arturo.duran@em.doe.gov>; David Nickless <david.nickless@em.doe.gov>; cheryl.rodriguez@em.doe.gov; Emily M. Day <Emily.Day@em-la.doe.gov>; Kim Lebak <Kim.Lebak@EM-LA.DOE.GOV>; Joseph A. Legare <joseph.legare@em-la.doe.gov>; Dana Lindsay <dana.lindsay@em-la.doe.gov>; Frazer R. Lockhart <frazer.lockhart@em-la.doe.gov>; Elizabeth Lowes <elizabeth.lowes@em-la.doe.gov>; Glenn Morgan <glenn.morgan@em-la.doe.gov>; Bruce A. Robinson <bruce.robinson@em-la.doe.gov>; Karly B. Rodriguez <Karly.Rodriguez@EM-LA.DOE.GOV>; Bradley Smith <Bradley.Smith@EM-LA.DOE.GOV>; Steve J. Veenis <Steve.Veenis@em-la.doe.gov>; Amanda B. White <Amanda.White@em-la.doe.gov>; Steve S. White <steve.white@em-la.doe.gov>; Regulatory Documentation <RegDocs@EM-LA.DOE.GOV>; 'DINOC@santaclarapueblo.org' <DINOC@santaclarapueblo.org>; rrcarpenter@santafenm.gov; arrand@santafenm.gov; Daria Cuthbertson <Daria.Cuthbertson@em-la.doe.gov>; Christian T. Maupin <Christian.Maupin@em-la.doe.gov>; Audrey Krehlik <Audrey.Krehlik@EM-LA.DOE.GOV>; Jennifer Von Rohr <Jennifer.VonRohr@EM-LA.DOE.GOV>
Subject: [EXT] Submittal to NMED on 4/8/2020 of 2020 LA-Pueblo Monitoring Plan

Mr. Pierard,
Attached for submittal is a pdf of the following:

- Submittal of the 2020 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project (letter and enclosure)

Please acknowledge receipt of this submittal by responding to this email.
Let me know if you have any questions.
Thank you.

Pamela T. Maestas
Regulatory Documentation Manager
Newport News Nuclear BWXT-Los Alamos, LLC
c. 505-927-7882
regdocs@em-la.doe.gov

1200 Trinity Drive, Suite 150
Los Alamos, NM 87544

DEPARTMENT OF ENERGY
Environmental Management Los Alamos Field Office (EM-LA)
Los Alamos, New Mexico 87544

April 8, 2020

EMLA-2020-1291-02-001

Mr. Kevin Pierard
Bureau Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6313

Subject: Submittal of the 2020 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project

Dear Mr. Pierard:

Enclosed please find two hard copies with electronic files of the "2020 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project." The objective of this monitoring plan is to evaluate the effects of mitigation measures undertaken in the Los Alamos and Pueblo Canyons watershed under the New Mexico Environment Department– (NMED-) approved "Interim Work Plan to Mitigate Contaminated Sediment Transport in the Los Alamos and Pueblo Canyons." The "2019 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project" was approved by NMED on June 4, 2019.

Pursuant to Section XXIII.C of the Compliance Order on Consent, a pre-submission review meeting was held with the U.S. Department of Energy Environmental Management Los Alamos Field Office (EM-LA); Newport News Nuclear BWXT-Los Alamos, LLC (N3B); and NMED on December 17, 2019, to discuss changes in monitoring requirements for 2020.

If you have any questions, please contact Amanda White at (505) 309-1366 (amanda.white@em-la.doe.gov) or Cheryl Rodriguez at (505) 257-7941 (cheryl.rodriguez@em.doe.gov).

Sincerely,

For: Stephen C. Hoffman

Arturo Q. Duran
Compliance and Permitting Manager
Environmental Management
Los Alamos Field Office

Enclosures:

1. Two hard copies with electronic files – 2020 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project (EM2020-0018)

CC (letter with hard-copy enclosure[s]):
Steve Veenis, N3B
Cheryl Rodriguez, EM-LA

CC (letter with CD/DVD enclosure[s]):
Harry Burgess, Los Alamos County, Los Alamos, NM (2 copies)

CC (letter and enclosure[s] emailed):
Laurie King, EPA Region 6, Dallas, TX
Raymond Martinez, San Ildefonso Pueblo, NM
Dino Chavarria, Santa Clara Pueblo, NM
Rick Carpenter, City of Santa Fe, NM
Aaron Rand, City of Santa Fe, NM
Chris Catechis, NMED-DOE-OB
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William Alexander, N3B
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Public Reading Room (EPRR)
PRS Website

March 2020
EM2020-0018

2020 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project

Newport News Nuclear BWXT-Los Alamos, LLC (N3B), under the U.S. Department of Energy Office of Environmental Management Contract No. 89303318CEM000007 (the Los Alamos Legacy Cleanup Contract), has prepared this document pursuant to the Compliance Order on Consent, signed June 24, 2016. The Compliance Order on Consent contains requirements for the investigation and cleanup, including corrective action, of contamination at Los Alamos National Laboratory. The U.S. government has rights to use, reproduce, and distribute this document. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.

EM2020-0018

2020 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project

March 2020

Responsible program director:

Printed Name	Signature	Title	Organization	Date
Bruce Robinson		Program Director	Water Program	3/18/2020

Responsible N3B representative:

Printed Name	Signature	Title	Organization	Date
Bradley Smith		Acting Program Manager	N3B Environmental Remediation Program	3/19/20

Responsible DOE EM-LA representative:

Printed Name	Signature	Title	Organization	Date
Arturo Q. Duran	For:	Compliance and Permitting Manager	Office of Quality and Regulatory Compliance	3/19/2020

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1.0 INTRODUCTION

The objective of this monitoring plan is to describe methods and frequency of monitoring in the Los Alamos and Pueblo Canyons (LA/P) watershed. This monitoring plan has been developed to satisfy the requirements of the New Mexico Environment Department– (NMED-) approved “Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons” (LANL 2008, 101714), NMED’s “Approval with Modification, Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons” (NMED 2008, 103007), and in response to NMED’s comments on the annual “Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project” (Table 1.0-1). In accordance with these work plans, approvals, and annual monitoring plans, Los Alamos National Laboratory (LANL or the Laboratory) has undertaken several activities to reduce flood energy and associated sediment transport. Because contaminants migrate with sediment entrained in runoff, reduced sediment transport will thus reduce contaminant transport, which is the primary objective of the watershed mitigations.

Monitoring proposed within this plan is designed to satisfy four purposes:

1. Monitoring is described to evaluate the performance of the controls installed to mitigate sediment transport. Two types of monitoring that began in 2010 are designed to meet this objective:

    a. Monitoring geomorphic changes in the canyon bottom facilitates continued evaluation of sediment control mitigation measures; and

    b. Collecting and analyzing storm water runoff samples supports assessment of the performance of sediment control measures.

2. Monitoring is described to support the analyses requested by NMED to assess attainment of designated uses. Monitoring concentrations of dissolved metals and total recoverable metals and other pollutants, as requested by NMED in its approval of the 2010 monitoring plan (NMED 2010, 108444) and as adjusted via the annual monitoring plans, supports the determination of whether or not surface waters of the state are attaining designated uses.

3. Monitoring of contaminants in affected environmental media at U.S. Department of Energy (DOE) sites is required under DOE Order 458.1 Change 3, “Radiation Protection of the Public and the Environment” and reporting is required under DOE Order 231.1B, “Environment, Safety, and Health Reporting.”

4. Monitoring is described to satisfy requirements of the memorandum of understanding (MOU) between the DOE and the Buckman Direct Diversion Board (BDDB) regarding water-quality monitoring (hereafter, the DOE-BDDB MOU) (DOE and BDD Board 2017, 602995). Analysis of gross beta, isotopic uranium, radium-226, and radium-228 at gaging stations E050.1 and E060.1 is being performed to support the DOE-BDDB MOU.

Storm water and geomorphic monitoring conducted under this 2020 monitoring plan will evaluate the potential impacts of any changes that occur in the watershed and the efficacy of the mitigations over time. Figures 1.0-1 and 1.0-2 show storm water monitoring locations and sediment control features. Table 1.0-1 provides a summary of annual monitoring plans and approvals under which monitoring has been conducted since 2010.

Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided in this plan to NMED in accordance with DOE Order 458.1. Results from storm water events are systematically uploaded to the publically accessible environmental monitoring database, Intellus New Mexico, available at http://www.intellusnm.com/ (NMED 2016, 601563).

2.0 MONITORING GEOMORPHIC CHANGES

A field visit will be scheduled in conjunction with NMED at the end of the monitoring year to observe whether geomorphic changes have occurred and what level of monitoring needs to be conducted in order to quantify the change. If storm water peak discharge at any gaging station in the LA/P watershed is greater than 50 cubic feet per second (cfs), the upgradient reach will be visually inspected at the end of the monsoonal period to document qualitative geomorphic changes. Biannual and greater than 50 cfs inspections of the grade-control structures (GCSs) and detention basins will continue to be performed.

As of 2019, aerial-based light detection and ranging (LiDAR) surveys will be performed triennially to maintain a baseline and after large disturbance events. Previously, ground-based bank and thalweg surveys were performed annually along with a field visit with NMED at the end of the monitoring year. The field visits were conducted to observe whether geomorphic changes occurred and what level of monitoring needed to be conducted in order to quantify the change, potentially including a new LiDAR survey. LiDAR surveys began in 2014, repeat surveys were performed in 2015 and 2016, a new baseline was performed in 2018, and the next LiDAR survey is planned for 2021 unless a large disturbance event occurs, in which case the LiDAR survey would be performed that year. A large disturbance event has been defined for each canyon based on historical knowledge. Storm events where significant erosion or channel alterations occurred were examined, along with the associated discharge at the nearest gaging stations (Table 2.0-1). Based on this analysis, the discharge magnitude that has the potential to cause significant erosion was determined to be 300 cfs in Los Alamos Canyon, 250 cfs in Pueblo Canyon, and 350 cfs in DP Canyon. To simplify monitoring, a discharge of 200 cfs is proposed for all of the canyons. If discharge at one or more gaging station reaches this discharge value, it will be considered a large storm event that might warrant an aerial-based geomorphic and vegetation survey before the routine triennial survey. After a field visit is performed, if significant erosion or vegetation disturbance is observed, aerial surveys will be performed after/during the monsoon season (after for geomorphic surveys and during for vegetation surveys). The following details the plan to monitor quantitative geomorphic changes via LiDAR surveys if events warrant.

A baseline LiDAR aerial survey was performed in 2018 during which points were measured at a density at least equivalent to the 2016 LiDAR data set (18–24 points per m^2). The LiDAR surveys will provide a detailed digital elevation model (DEM) of the entire active channel within each monitoring area so a comparison with the previous survey's DEM can show areas of geomorphic change. If noteworthy features are identified in the LiDAR comparison, the features will be field-checked and additional ground-based survey methods may be implemented.

2.1 LiDAR Error Assessment

An estimate of the 95% confidence interval (2 standard deviations) of the root-mean-squared error (RMSE) for the DEM elevations will be obtained by comparing a subset of aerial LiDAR-derived point elevations with ground-surveyed global positioning system (GPS) point elevations (vertical accuracy for these GPS points is better than 0.1 ft). In general, error values for the DEM surface within areas vegetated with reed canary grass and willows tend to be higher than the unvegetated channel surfaces. A spatially variable error value will be generated for each sediment mitigation monitoring area (Figure 1.0-1). The RMSE error value of each pixel is subject to the area's individual "fuzzy inference system" model to compute the spatially variable error of the DEM surface. The lower limit of detection for each analysis area is defined by standard error propagation in addition/subtraction operations of the lowest error value.

The propagated error values provide the threshold above/below which any values in the DEM of difference (DoD) will be assumed to represent actual elevation change. The variable error surfaces will be calibrated to the 95% confidence interval RMSE values calculated for respective monsoonal period DEMs and propagated through the DoD calculations. Net changes for the study reach will then be calculated by summing the DoD over areas of erosion/deposition above or below the error threshold. As mentioned previously, DoD values above the threshold are assumed to represent geomorphic erosion or deposition. These identified elevation changes will be field verified using visual inspection methods to determine if geomorphic change occurred. Areas of confirmed or rejected geomorphic change will be identified and documented. Regardless of field verification confirmation, all DoD values will be used to calculate net volume changes. Topographic elevation changes will be classified as either channel erosion/deposition processes (e.g., aggradation or incision) or as other types of mass wasting, such as falls and slides/slumps. Because of the nature of rock/soil falls and slumps, large topographic changes may be evident (i.e., detected above the uncertainty threshold and confirmed in the field) that actually have small (if any) contribution to the net volume change within the channels. Therefore, these types of topographic elevation changes detected during DoD analyses may not yield results that can be thought of as volumetrically equivalent to within-channel geomorphic processes.

Using a spatially variable error in DoD calculations has made it possible to more accurately assess geomorphic processes on surfaces that have been traditionally difficult to model with LiDAR data. The incorporation of spatially variable error surfaces into the DoD calculations improves the analysis of steeply inclined surfaces (i.e., banks) and will allow for an accurate assesment of geomorphic activity on such features for the comparison between DEMs.

3.0 MONITORING VEGETATION CHANGES

A baseline vegetation survey was performed in 2019 and vegetation surveys will be conducted triennially, with the next survey to be conducted in 2022. Airborne hyperspectral and LiDAR sensors were used to classify vegetation species and determine vegetation density, stand height, and spatial extent. In addition, the normalized difference vegetation index, which is an indicator of photosynthetic activity using the red and near-infrared bands, was computed as a measure of the health of the Pueblo Canyon wetlands, including the historical upper and lower willow planting areas.

Vegetation features were surveyed using an AISA EAGLE II visible and near infrared (VNIR) hyperspectral imaging sensor system affixed to a Cessna 172 Skyhawk. A total of 128 spectral bands for the VNIR were collected, producing a ground sampling distance of 0.5 m. Location and altitude data were collected using an Oxford Technical Solutions, Ltd., 2+ second-generation GPS. Aerial surveys were then ground-truthed to classify wetland vegetation.

4.0 MONITORING STORM WATER RUNOFF

In 2020, storm water monitoring will be conducted at 13 gaging stations (Figure 1.0-1) and 2 ungaged stations (denoted as sampling locations in Figure 1.0-2) within the LA/P watershed. No changes to monitoring locations are planned from 2019 to 2020. Gaging stations are located in order to monitor sediment transport and performance of mitigations effectively throughout each watershed. Each gaging station automatically collects storm water runoff using ISCO samplers. Storm water analytical suites and the associated reports where data will be presented for each gaging station are presented in Table 4.0-1.

The goal of the sampling is to collect data that: (1) represent spatial and temporal variations in potential contaminant concentrations and suspended sediment concentrations (SSC) in storm water; (2) allow evaluation of short- and long-term trends in contaminant concentrations, SSC, and suspended sediment yield; (3) provide data to support the determination of whether or not surface waters of the state are attaining designated uses; and (4) meet requirements of the DOE-BDDB MOU. The monitoring strategy described below was developed to achieve these goals.

4.1 2020 Storm Water Monitoring Locations Inspection, Maintenance, and Sample Retrieval Plan

Storm water monitoring at all locations proposed for 2020 will occur using ISCO-type automated pump samplers. Two sampling locations, CO111041 and CO101038 in Figure 1.0-2, are not gaged and are proposed for monitoring at the detention basins below Solid Waste Management Unit (SWMU) 01-001(f). Monitoring requirements at these locations are listed in Table 4.0-1. These sampling locations will allow evaluation of how the sediment detention basins and associated vegetative buffer below the basins are performing. These monitoring locations will be inspected following a rain event exceeding 0.25 in. in a 30-min period as recorded at the rain gage at E055.5.

All other storm water monitoring will occur at gaging stations. Battery voltage, stage height, and sensor function at each gaging station will be remotely monitored daily. Flow-measurement devices and telemetry at gaging stations E050.1 and E060.1 will be inspected at least weekly and after each flow event throughout the year. Automated samplers, flow-measurement devices, and telemetry at other gaging stations will be inspected following a discharge event with peak discharge greater than the trip level and on a rolling 30-day schedule following the sampler trip discharge event from June 1 to October 31. The rolling 30-day schedule will ensure that gaging stations are inspected at least monthly and after sampler trip discharge storm events. Gaging station inspections will occur monthly from November 1 to May 31. Equipment found to be damaged or malfunctioning will be repaired within 5 business days after the problem is identified. If the time to repair monitoring equipment at E050.1 and E060.1 is expected to exceed 48-hr, DOE will notify BDDB per the DOE-BDDB MOU.

Automated samplers at gaging stations will be deployed and operational on or before June 1. All samples retrieved will be attempted within 1 business day after collection; however, this is not always feasible, such as with a site-wide storm event. If this is the case, sample retrieval will be performed using the following three-tiered priority order:

1. BDDB-related gaging stations E050.1 and E060.1;
2. Gaging stations bounding watershed mitigations at E038, E039.1, E042.1, E059.5, E059.8; and
3. Other gaging stations at E026, E030, E040, E055, E055.5, E056, CO101038, and CO111041.

Figure 4.1-1 illustrates this three-tiered approach to sample retrieval. Deviations from the planned inspection, maintenance, and sample collection objectives will be described in the “2020 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project.”

4.2 Storm Water Sampling and Analysis Plan

Evaluation of the performance of sediment controls will be supported by repeat analyses of SSC through each sampled storm at gaging stations above and below each watershed mitigation. Storm water runoff sampling at E050.1 and E060.1 will be triggered by discharges of approximately 5 cfs per the DOE-BDDB MOU. Storm water sampling at E026, E059.5, and E059.8 will be triggered by discharges of approximately 5 cfs as relatively few samples have been collected from these sites to date. Storm water runoff sampling at E038 will be triggered by discharges of approximately 100 cfs. Storm water runoff sampling at the remainder of the gaging stations (E030, E039.1, E040, E042.1, E055, E055.5, and E056) will be triggered by discharges of approximately 50 cfs. Table 4.2-1 shows the sampled storm distribution compared with the trip level. Figure 4.2-1 presents the distribution of peak discharges from sampled storm water events between 2010 and 2019. These histograms show that a majority of sampling has been performed on the lower end of the discharge scale at each of the gaging stations; thus, in 2020, the monitoring focus will be on the higher end of the discharge scale in order to fill data gaps and to collect samples from storms that have a greater potential to erode sediment and move contaminants.

Four storm water samples are planned at each of the following gaging stations: E026, E050.1, E059.5, E059.8, and E060.1. Two storm water samples are planned at each of the following gaging stations: E030, E038, E039.1, E040, E042.1, E055, E055.5, and E056. The LA/P watershed system has been shown to be stable over the past 10 yr unless there is a large disturbance event, in which case the number of samples to be collected will be reconsidered. Storm water runoff sampling for chemical and radiochemical analyses at all gaging stations will be triggered 10 min after the maximum discharge exceeding the triggering discharge. Sampling at the detention basins below SWMU 01-001(f) will be triggered by liquid-level actuators detecting the presence of water above each sampler's intake. The chemical and radiochemical analyses will be bounded by analysis of SSC to calculate an estimate of the sediment content of each chemical and radiochemical analysis.

Analytical requirements for storm water samples collected to satisfy the four monitoring purposes are presented in Table 4.2-2. Samples at gaging stations will be collected using automated storm water samplers that contain a carousel of twenty-four 1-L bottles and/or twelve 1-L bottles, as specified in Tables 4.2-3 through 4.2-8. Sample collection inlets will be placed a minimum of 0.33 ft above the bottom of natural stream channels and at 0.17 ft above the bottom of supercritical flumes. The sampling approach summarized above is intended to allow characterization of suspended sediment flux and contaminant concentrations from each portion of the hydrograph consisting of:

1. Rapidly rising limb
2. Short-duration peak
3. Rapidly receding limb following the peak, and
4. Longer-duration recessional limb following the peak.

To characterize water quality entering and leaving the sediment detention basins and adjoining vegetative buffer below the SWMU 01-001(f) drainage, automated pump samplers will collect storm water from one location immediately upstream of sediment basin 1 and one location at the terminus of the vegetative buffer up to four times annually when storm water discharge is occurring (Figure 1.0-2).

Analytical suites vary according to monitoring groups and are based on key indicator contaminants, NMED requests, and the DOE-BDDB MOU for portions of each watershed. Table 4.0-1 shows the monitoring groups, the analytical suite for each location, and the report associated with each monitoring suite. The results of SSC analyses will be used to calculate the total mass/activity transported during storm water runoff events at the gaging stations. Particle-size analyses conducted in conjunction with selected SSC analyses will support characterization of organic chemicals and radionuclides.

The list of analytical suites for each monitoring group presented in Table 4.0-1 is prioritized to guide what analyses will be conducted if the water volume collected from a storm event is not sufficient for all the planned suites. The analytical method, expected method detection limit (MDL), and minimal detectable activity (MDA) (for radionuclides) are presented in Table 4.2-2. The sampling sequence for CO101038 and CO111041 is presented in Table 4.2-3. The sampling sequence for E026, E030, E055, E055.5, and

E056 is presented in Table 4.2-4. Table 4.2-5 presents the sampling sequence at E038, E039.1, and E040. Table 4.2-6 presents the sampling sequence at E042.1. Table 4.2-7 presents the sampling sequence at E059.5 and E059.8. Table 4.2-8 presents the sampling sequence at E050.1 and E060.1. Additional samples beyond the required samples may potentially be submitted for chemical and radiochemical analyses at gaging stations E038, E059.5, E059.8, and E042.1 if samples are collected during an event at their paired downstream gaging stations (E039.1, E059.8, E060.1, and E050.1, respectively).

Total suspended sediment transport during a storm event is determined by sampling discharge periodically for SSC analysis throughout the hydrograph. Samples for SSC measurements will be collected at 2-min intervals for the first 30 min, then at 20-min intervals for the following 160 min if runoff is available. Repeat measurements will be taken above and below the DP Canyon GCS at E038 and E039.1, above and below the Los Alamos Canyon low-head weir at E042.1 and E050.1, and above and below the Pueblo Canyon drop structure and GCS at E059.5, E059.8, and E060.1 to better characterize the performance of the structures. At these stations, a second sampler is dedicated to collecting storm water for SSC analyses with the objective of representing most or all of the duration of runoff. Collecting SSC samples at 2-min intervals during the first 30 min allows characterization of the rapidly changing early part of the hydrograph.

4.3 Stage and Discharge Monitoring

Storm water runoff (in the form of stage and discharge) at each of the gaging stations listed in Table 4.0-1 and gaging station E099 will be monitored continuously throughout the year. Rating curves are used to convert stage to discharge. Rating curves for the gaging stations are updated following channel-forming flood events.

4.4 Inspections of Erosion and Sediment Control Structures

Erosion and sediment control structures and monitoring stations will be inspected after storm events exceeding 50 cfs, or other channel-forming flood events, within 3 business days. Repairs will be made as necessary to ensure such structures and other storm water mitigation features continue to function as intended.

4.5 Sediment Sampling and Analysis Plan

Sediment sampling is conducted annually within the LA/P watershed as part of voluntary monitoring conducted for the Annual Site Environmental Report (ASER). The results of the sediment sampling conducted in 2020 will be presented in the 2020 ASER.

4.6 Data Exceptions

Low bias of analytical results in high-sediment-content storm water has been observed in analyses performed by gamma spectroscopy, alpha spectroscopy, inductively coupled plasma (ICP) mass spectroscopy and ICP optical emission spectroscopy. This low bias can be avoided when the solid phase and liquid phase of each biphasic sample are analyzed separately and the results mathematically recombined.

5.0 RESPONSE TO NMED COMMENTS

5.1 Definition of Large Disturbance Events

In the approval of the 2019 monitoring plan (NMED 2019, 700461), NMED states:

> In the February 6, 2019 meeting, the DOE agreed to look at stream data from 2010-2018; and propose a definition of a large disturbance event in the 2019 Monitoring Plan. The DOE has included this information in Section 2.0 *Monitoring Geomorphic Changes* and in Figure 4.2-1, and have defined a large disturbance event as being greater than or equal to 300 cubic feet per second (cfs). The DOE states that this value is based on the median discharge of E030, E038, E039.1, E040, E042.1, E055, E055.5, and E056 from 2010-2018. NMED notes that the DOE has not included data from sampling location E026, E056, E050.1 and E060.1 for this time period when calculating the median for a large disturbance event; if this data was included, it may result in a different value for the median discharge.

The large disturbance event estimation from the "2019 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project" (N3B 2019, 700418) was not based on the "median discharge of E030, E038, E039.1, E040, E042.1, E055, E055.5, and E056 from 2010–2018." As discussed in section 2.0, the proposed large disturbance event discharge threshold of 300 cfs was based on reviewing historical storm events where significant erosion or channel alterations occurred along with the associated discharge at the nearest gaging station (see Table 2.0-1). NMED recommended that a threshold of 200 cfs be adopted to define a large disturbance event, thus the recommended 200 cfs threshold to define a large disturbance event was implemented during 2019 and will continue to be implemented during 2020.

5.2 Sampling 10 min after Peak Flow

The 24-bottle ISCOs begin collecting SSC samples as soon as they are triggered by flow in order to capture the full sedigraph. The 12-bottle ISCOs that collected samples for chemical and radiochemical analyses begin sampling 10 min after peak flow (Max+10). This protocol began in 2011 in order to minimize problems that commonly occur during the rising limb of the hydrograph such as instability, clogging, and missed samples. In the approval of the 2019 monitoring plan (NMED 2019, 700461), NMED commented that this delay in sample collection may not be representative. To address this question, we compared polychlorinated biphenyl (PCB) concentrations from before and after the switch to Max+10 sampling in 2011 (Figure 5.2-1). A Welch two-sample t-test was used to test for equality of the means between the two periods. An asterisk by a location name on the boxplots denotes a significant difference between means ($p < 0.05$). One site (E042.1) showed PCB concentrations to be significantly higher for pre-2011 samples than for post-2011 samples, and one site (E121) showed PCB concentrations to be significantly lower for pre-2011 samples than for post-2011 samples. The remainder showed no statistical difference. Thus, there is no evidence that Max+10 sampling is causing a low bias in PCB analyses.

A similar analysis was performed for SSC data (Figure 5.2-2). The majority of sites show higher SSC concentrations for post-2011 samples, indicating that the Max+10 sampling is not causing a low bias. Also, as seen from the length of the boxplots, variability is lower for the post-2011 data.

In the 2011 approval with modifications (NMED 2011, 203705), NMED made the following comment.

> NMED has evaluated 2010 hydrographs and determined that the time delay for collecting samples in the lower watershed should be extended from 10 minutes to approximately 30 minutes. This should improve the probability that samples submitted for laboratory analysis will be collected after the peak of the hydrograph. Either analyze past hydrographs to determine a site-specific delay time for each station or use a default delay of 30-minute to initiate sample collection.

This comment prompted an analysis of hydrographs and the switch to the Max+10 method, which acts as a site-specific delay.

5.3 PCB Results from NMED versus Newport News Nuclear BWXT-Los Alamos, LLC, Samples

NMED expressed concern during the pre-submission meeting on December 17, 2019, that PCB results are higher from the co-located NMED DOE-Oversight Bureau (NMED DOE-OB) samples than from Newport News Nuclear BWXT-Los Alamos, LLC (N3B) samples. To address this, a comparison was performed between NMED DOE-OB and N3B data for the same sites and storm events (Figure 5.3-1). When there were multiple samples for a storm event, the ones with the closest matching sample times were selected. NMED sample times were converted from Mountain Daylight Time to Mountain Standard Time for comparison with N3B sample times. A paired t-test was used to test for significant differences between NMED and N3B PCB results. Overall, PCB results are significantly higher in NMED data ($p = 0.0045$). For the three samples collected in 2012, NMED used the analytical laboratory TestAmerica and LANL used Cape Fear Analytical. When the 2012 data are excluded, the higher trend of NMED PCB concentrations approaches insignificance ($p = 0.037$). For all remaining years, both groups used Cape Fear Analytical for PCB analysis. For samples from 2017 on, there is no significant difference in PCB concentration between NMED and N3B ($p = 0.97$). We will continue to closely monitor PCB concentrations from co-located NMED samplers.

6.0 2020 MONITORING PLAN CHANGES

Changes from 2019 to 2020 monitoring are as follows:

- Adding total metals analysis: Total metals (unfiltered) will be added back to all sampling locations. Previously, the intent was to estimate total metals based on SSC concentrations. This prompted the need for a study comparing total metals in the sediment and water fractions with SSC. Sediment concentrations in samples have been too low to conduct this study. Therefore, the sampling plan will revert back to including total metals analysis.

7.0 REPORTING

All data collected as part of this 2020 monitoring plan will be presented in the “2020 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project,” to be submitted to NMED by April 30, 2021. The “2021 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project” will also be submitted to NMED by April 30, 2021. Monitoring conducted as part of this 2020 monitoring plan to determine whether or not waters of the state are attaining designated uses and to fulfill monitoring requirements in DOE Order 450.1A (superseded by 436.1) will be reported in the “2020 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project.” Monitoring conducted as part of this 2020 monitoring plan solely to fulfill requirements of the DOE-BDDB MOU will be made available publically in Intellus New Mexico, available at http://www.intellusnm.com/. All analytical data, stream discharge measurements, and DEM measurements collected as a result of this plan will be provided in the "2020 Monitoring Report for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project."

8.0 REFERENCES AND MAP DATA SOURCES

8.1 References

The following reference list includes documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ERID, ESHID, or EMID. This information is also included in text citations. ERIDs were assigned by the Laboratory's Associate Directorate for Environmental Management (IDs through 599999); ESHIDs were assigned by the Laboratory's Associate Directorate for Environment, Safety, and Health (IDs 600000 through 699999); and EMIDs are assigned by N3B (IDs 700000 and above). IDs are used to locate documents in N3B's Records Management System and in the Master Reference Set. The NMED Hazardous Waste Bureau and N3B maintain copies of the Master Reference Set. The set ensures that NMED has the references to review documents. The set is updated when new references are cited in documents.

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LANL (Los Alamos National Laboratory), May 2015. "2015 Monitoring Plan for Los Alamos/ Pueblo Watershed Sediment Transport Mitigation Project," Los Alamos National Laboratory document LA-UR-15-21412, Los Alamos, New Mexico. (LANL 2015, 600438)

LANL (Los Alamos National Laboratory), April 2016. "2016 Monitoring Plan for Los Alamos/ Pueblo Watershed Sediment Transport Mitigation Project," Los Alamos National Laboratory document LA-UR-16-22543, Los Alamos, New Mexico. (LANL 2016, 601434)

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NMED (New Mexico Environment Department), June 4, 2018. "Approval, 2018 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project," New Mexico Environment Department letter to D. Hintze (DOE-EM-LA) and J. Legare (N3B) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2018, 700007)

NMED (New Mexico Environment Department), June 4, 2019. "Approval, 2019 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project," New Mexico Environment Department letter to D. Hintze (EM-LA) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2019, 700461)

7.2 Map Data Sources

GageStation; Los Alamos National Laboratory, ER-ES, as published, project folder 15-0013; \\slip\gis\GIS\Projects\15-Projects\15-0013\zip\2015_E059.8_GageStation.shp; 2015.

Facility location; Los Alamos National Laboratory, ER-ES, as published, project folder 15-0013; \\slip\gis\GIS\Projects\15-Projects\15-0013\project_data.gdb;merge_sandia_features_AGAIN; 2015.

Erosion control structure; Los Alamos National Laboratory, ER-ES, as published, project folder 15-0013; \\slip\gis\GIS\Projects\15-Projects\15-0013\project_data.gdb;merge_sandia_features_AGAIN; 2015.

Sediment control structure; Los Alamos National Laboratory, ER-ES, as published, project folder 15-0013; \\slip\gis\GIS\Projects\15-Projects\15-0013\project_data.gdb;merge_sandia_features_AGAIN; 2015.

Willow planting area;Los Alamos National Laboratory, ER-ES, as published, project folder 14-0015; \\slip\gis\GIS\Projects\14-Projects\14-0015\shp\as_built_willow_banks.shp; 2015.

Structures; County of Los Alamos, Information Services; as published 29 October 2007.

Drainage; County of Los Alamos, Information Services; as published 16 May 2006.

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Road Centerlines for the County of Los Alamos; County of Los Alamos, Information Services; as published 04 March 2009.

Watersheds; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; EP2006-0942; 1:2,500 Scale Data; 27 October 2006.

Contour, 4-ft interval; Los Alamos National Laboratory, ER-ES, as published, project folder 15-0013; \\slip\gis\Data\HYP\LiDAR\2014\Bare_Earth\BareEarth_DEM_Mosaic.gdb; 2015.

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Sediment Geomorphology; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program, ER2002-0589; 1:1,200 Scale Data; 01 January 2002.

Monitoring area; Los Alamos National Laboratory, ER-ES, as published, project folder 15-0013; \\slip\gis\GIS\Projects\15-Projects\15-0013\zip\ZoomAreas.shp; 2015.

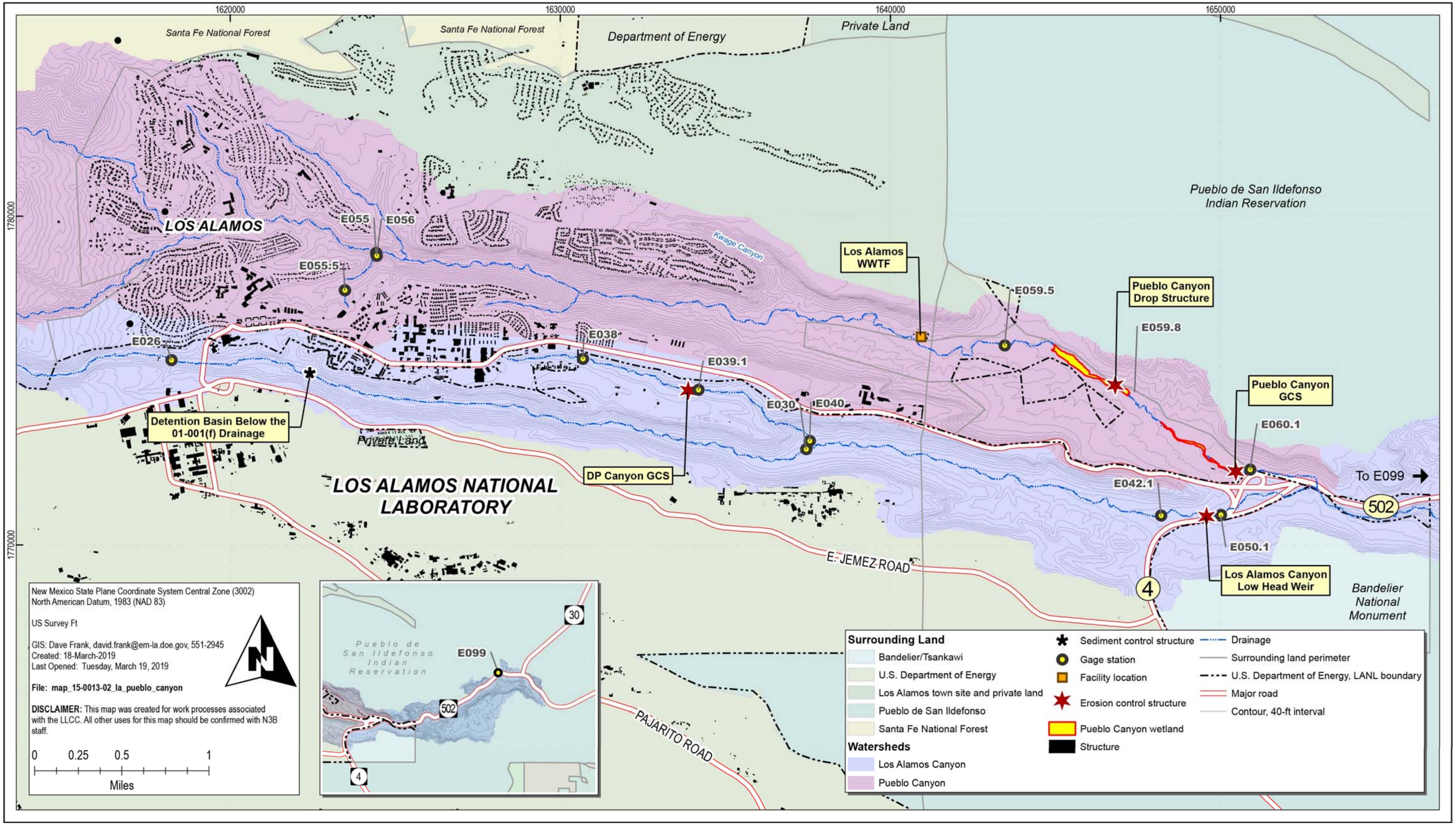


Figure 1.0-1 Monitoring locations and sediment trap mitigation sites in Los Alamos and Pueblo Canyons

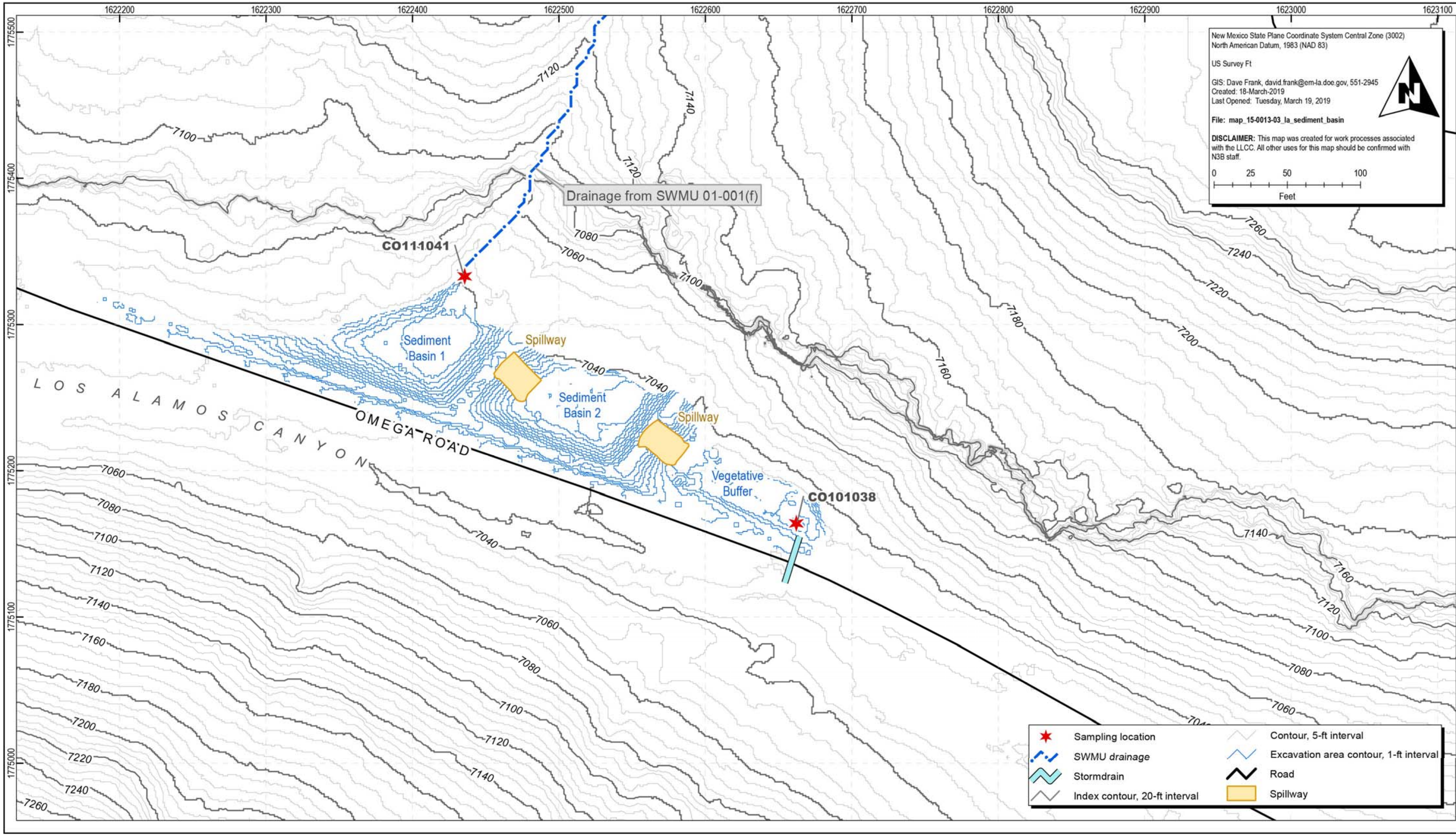


Figure 1.0-2 Detention basins and sampling locations below the SWMU 01-001(f) drainage

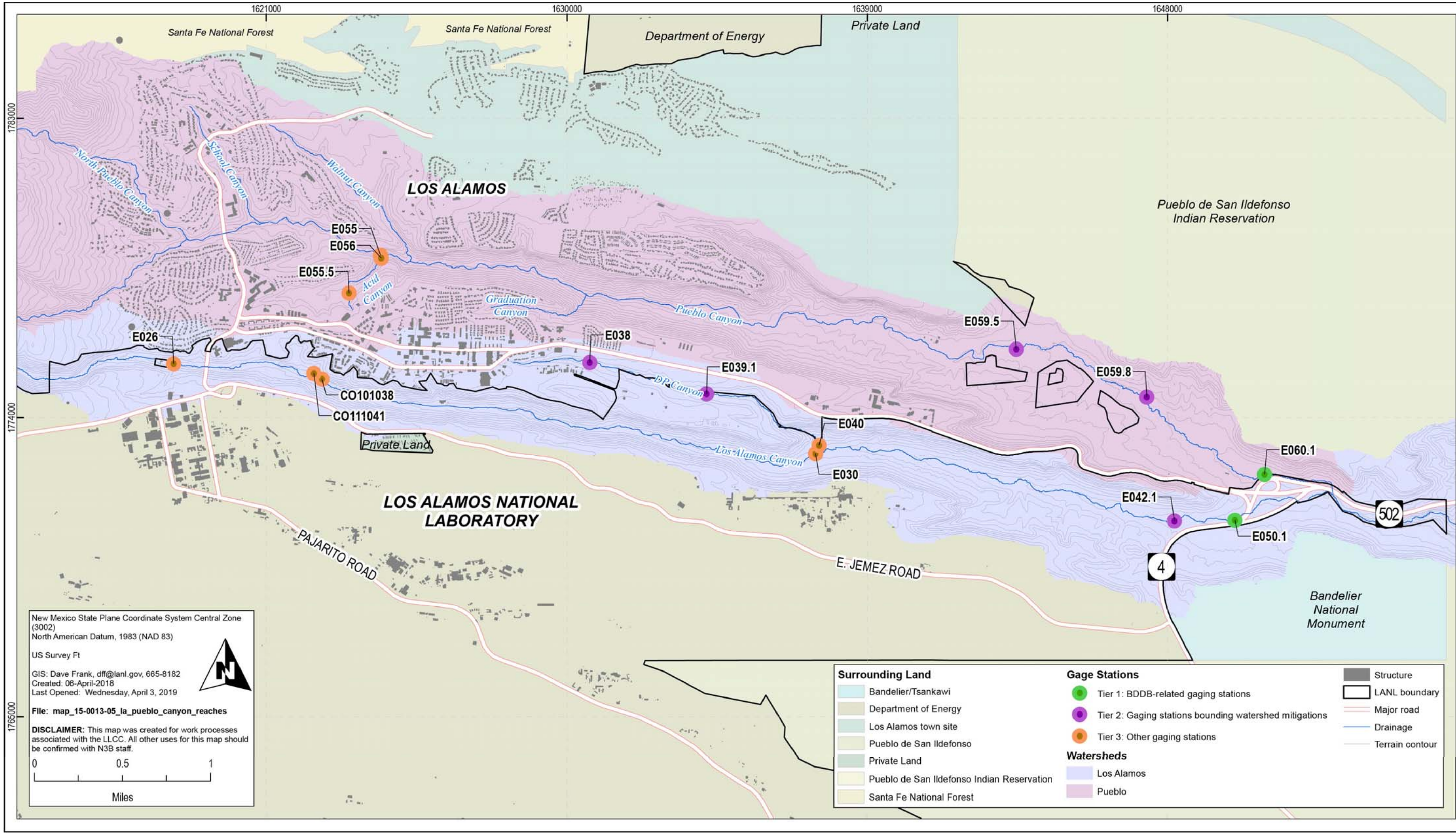


Figure 4.1-1 Three-tiered approach to sample retrieval when 1 business day collection is not feasible

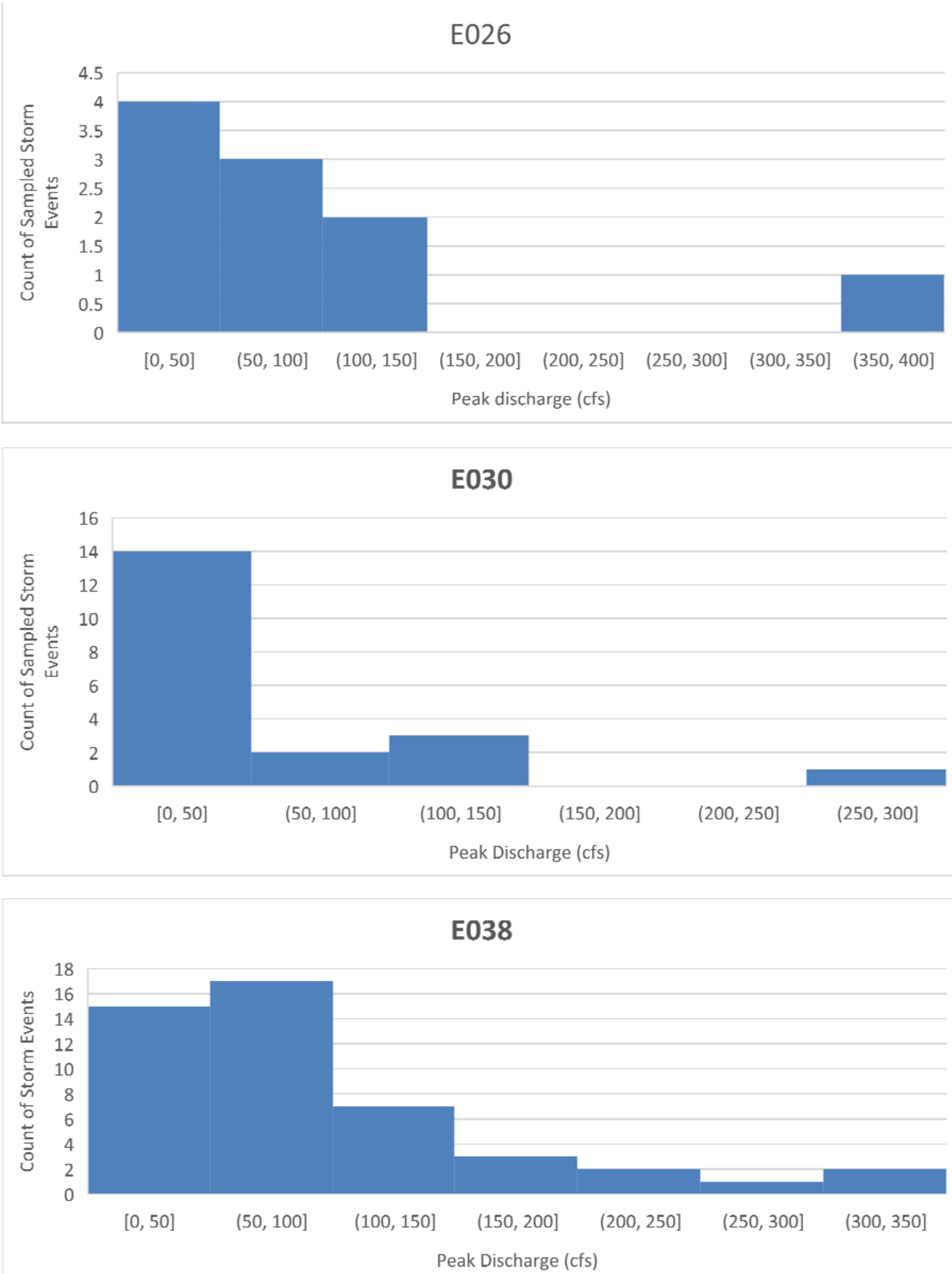
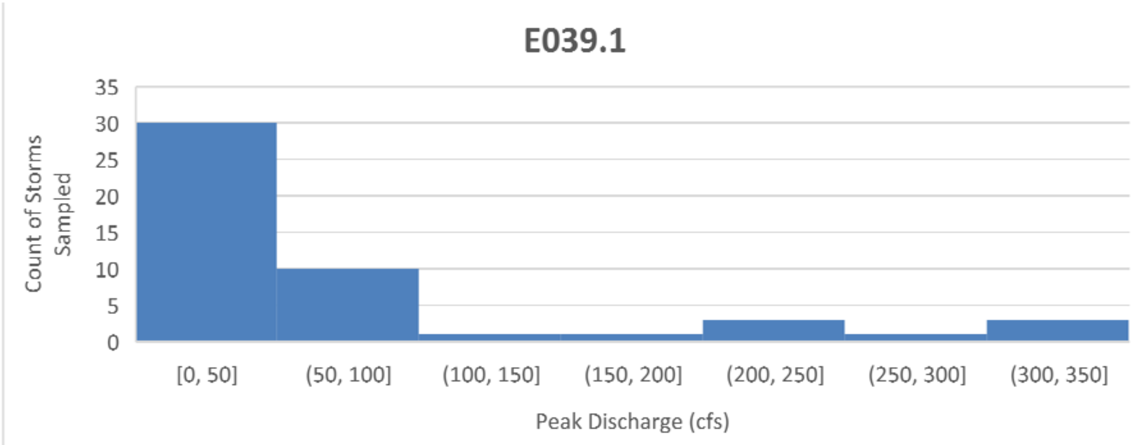
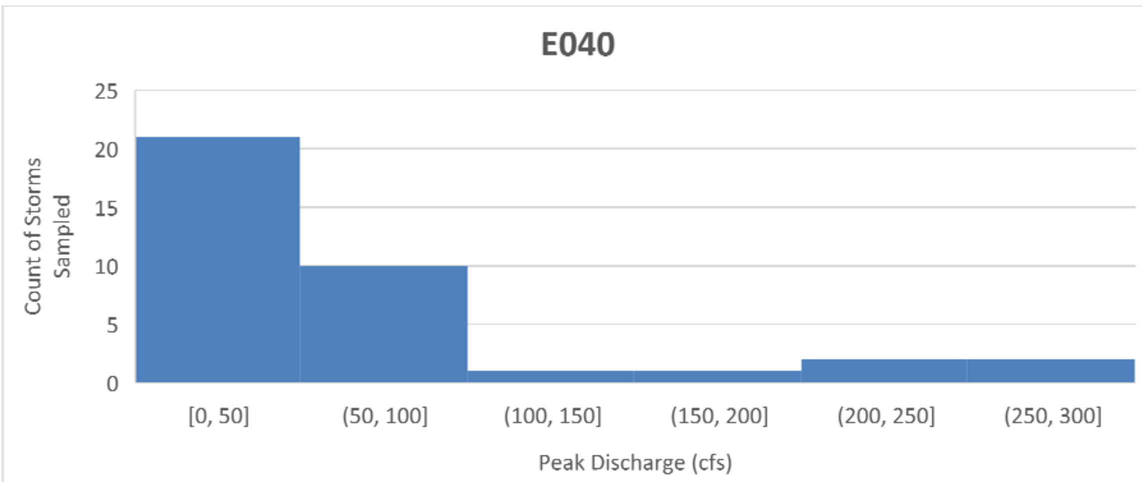


Figure 4.2-1 Sampled storm event peak discharge distribution 2010–2019





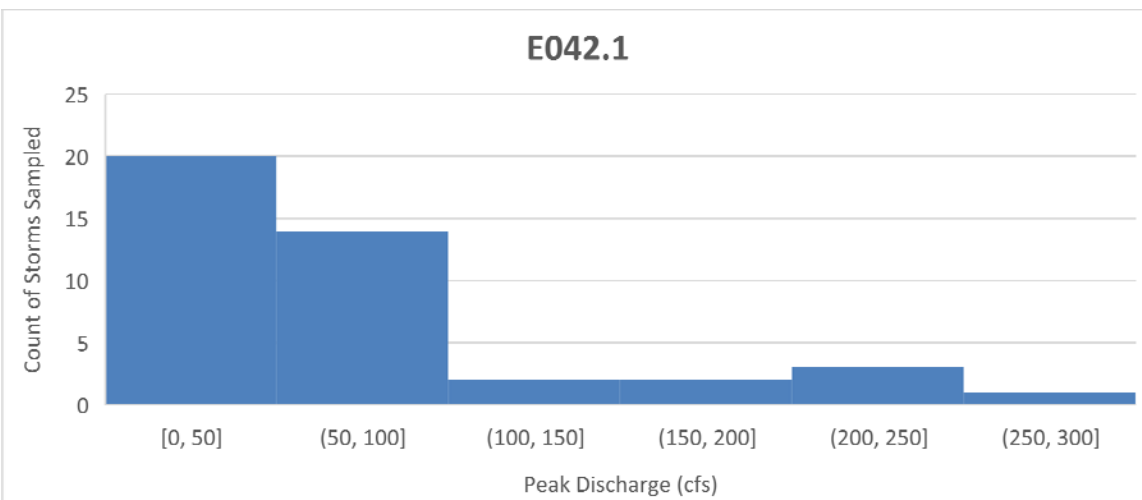


Figure 4.2-1 (continued) Sampled storm event peak discharge distribution 2010–2019

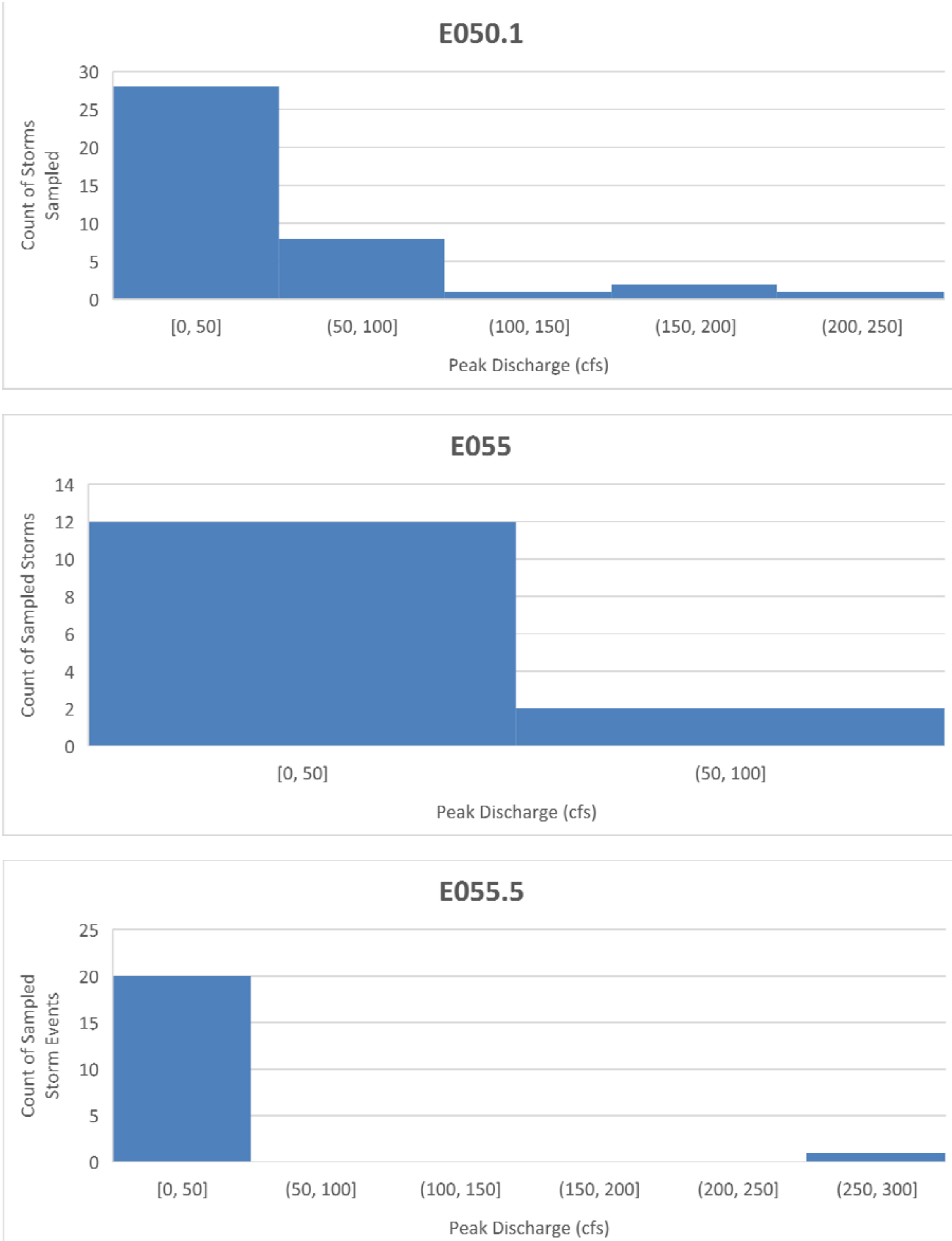


Figure 4.2-1 (continued) Sampled storm event peak discharge distribution 2010–2019

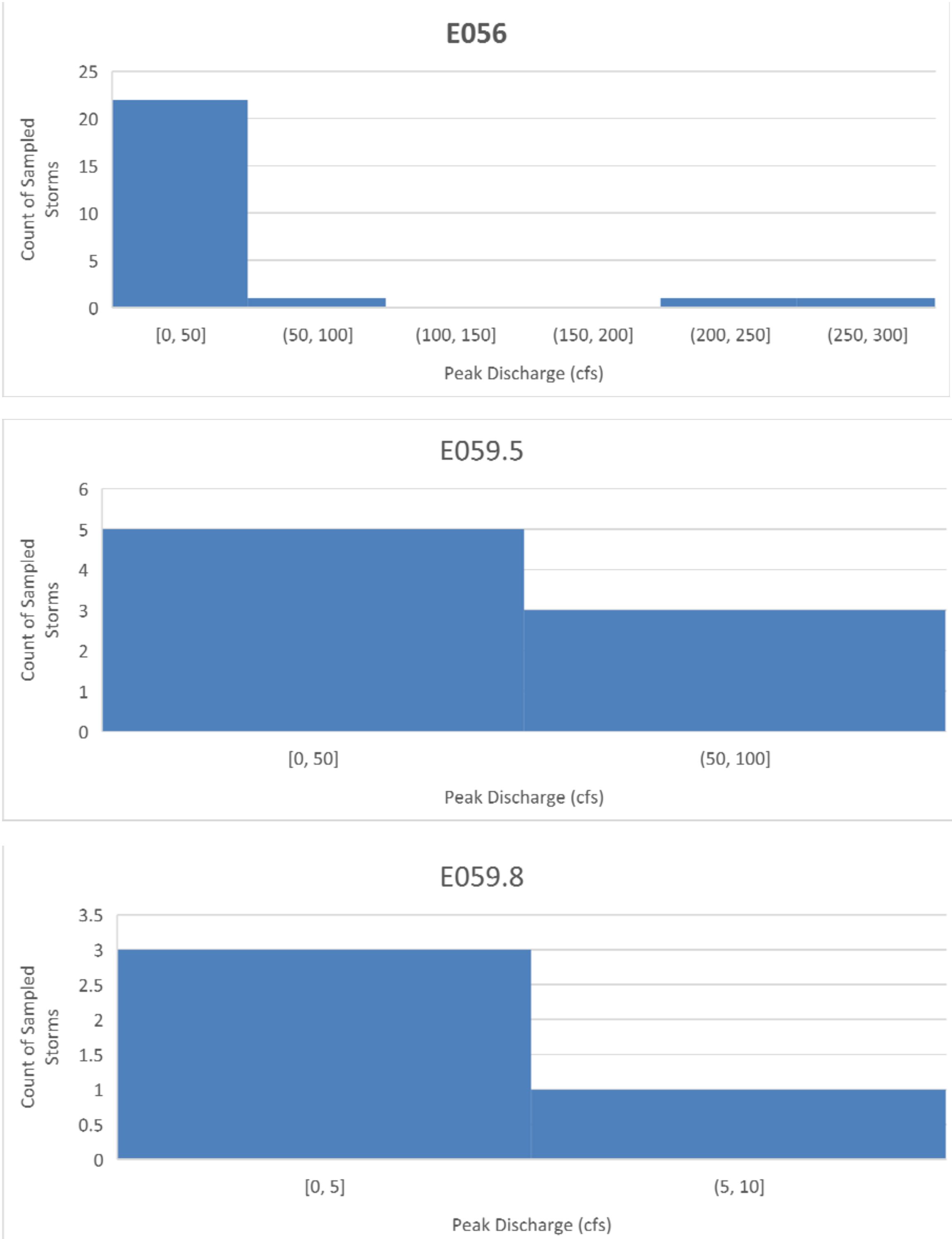


Figure 4.2-1 (continued) Sampled storm event peak discharge distribution 2010–2019

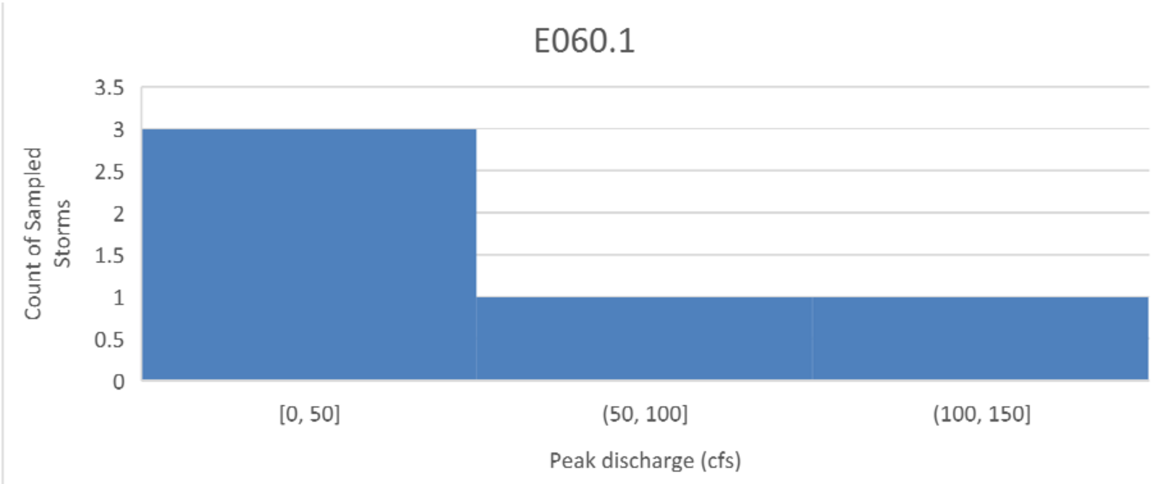
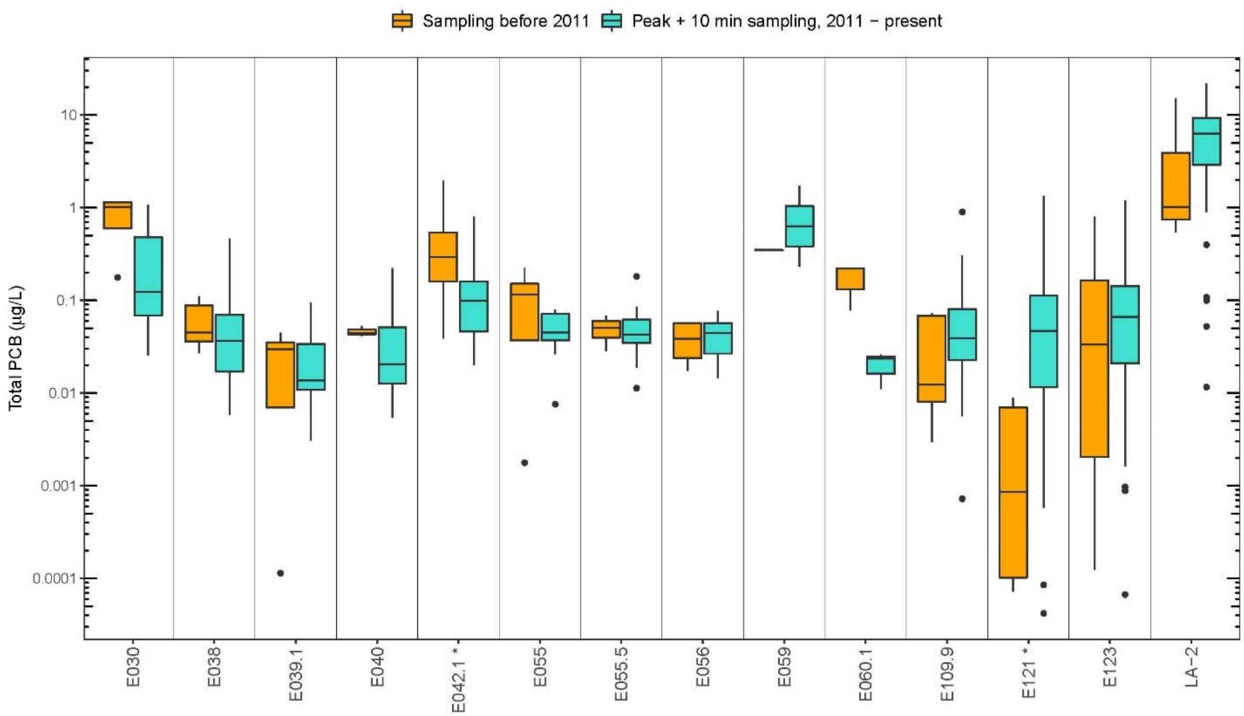
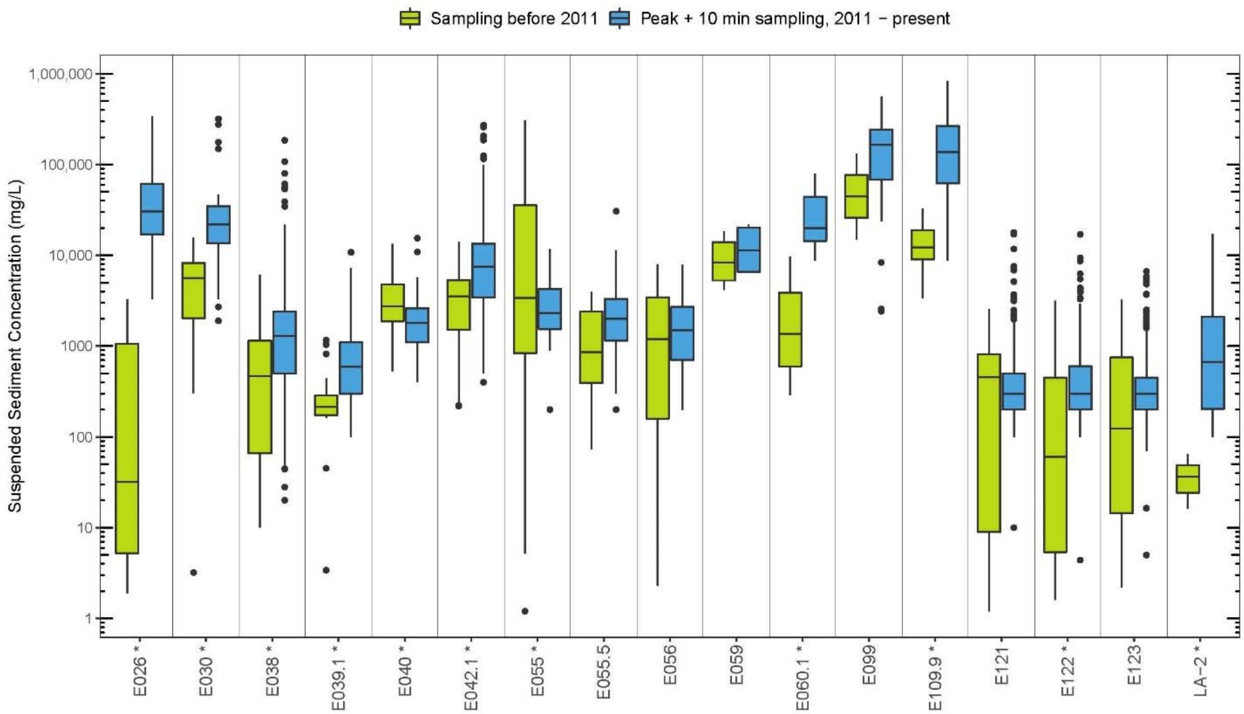


Figure 4.2-1 (continued) Sampled storm event peak discharge distribution 2010–2019



Note: An asterisk by the location name denotes a significant difference between means (p <0.05).

Figure 5.2-1 PCB concentrations before and after 2011



Note: An asterisk by the location name denotes a significant difference between means (p <0.05).

Figure 5.2-2 SSC concentrations before and after 2011

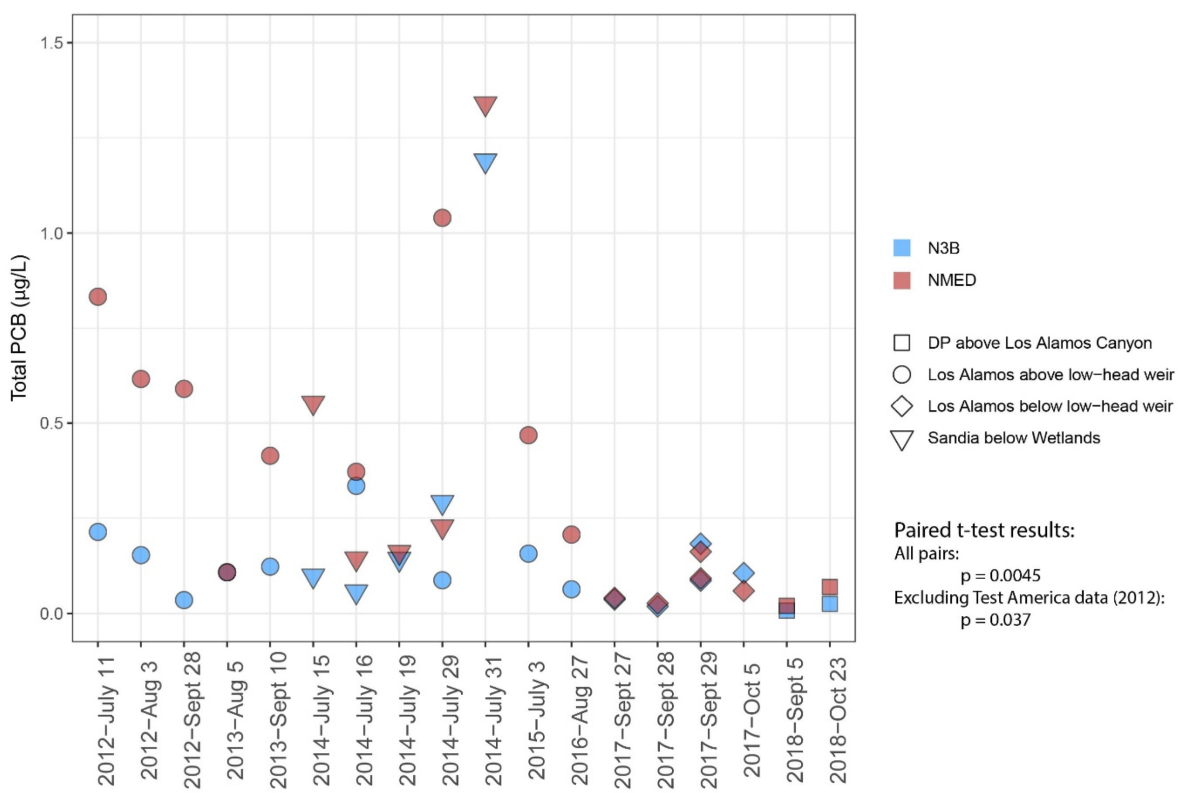


Figure 5.3-1 NMED DOE-OB and N3B PCB results for co-sampled storm events

Table 1.0-1
Monitoring Plans Submitted since 2010

Monitoring Year	Monitoring Plan Name	Reference and Date Submitted	Approval	NMED Approval and Approval Date
2010	Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	LANL 2009, 107457 10/15/2009	Approval with Modifications, Los Alamos and Pueblo Canyons Sediment Transport Monitoring Plan	NMED 2010, 108444 1/11/2010
2011	2011 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	LANL 2011, 201578 3/23/2011	Approval with Modifications [for the] 2011 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	NMED 2011, 203705 6/3/2011
2012	2012 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 2	LANL 2012, 222833 9/28/2012	Approval [for the] 2012 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 2	NMED 2013, 521854 1/23/2013
2013	2013 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 1	LANL 2013, 243432 6/21/2013	Approval [for the] 2013 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 1	NMED 2013, 523106 7/19/2013
2014	2014 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project	LANL 2014, 256575 5/15/2014	Neither approved nor denied	n/a*
2015	2015 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	LANL 2015, 600438 5/15/2015	Approval with Modifications [for the] 2015 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	NMED 2015, 600507 6/12/2015
2016	2016 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	LANL 2016, 601434 4/28/2016	[Approval for the] 2016 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	NMED 2016, 601563 6/16/2016
2017	2017 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	LANL 2017, 602342 4/27/2017	Approval with Modifications [for the] 2017 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	NMED 2017, 602504 7/11/2017
2018	2018 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	LANL 2018, 603015 4/24/2018	Approval [for the] 2018 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	(NMED 2018, 700007) 6/4/2018
2019	2019 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	N3B 2019, 700418 4/29/2019	Approval [for the] 2019 Monitoring Plan for Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project	NMED 2019, 700461 6/4/2019

*n/a = Not applicable.

Table 2.0-1
Significant Geomorphic Changes and Associated Peak Discharges

Date	Station	Peak Discharge (cfs)	Noted Erosion in Geomorphic Changes Section of the Corresponding Year's Annual Report
8/5/2010	E039.1	275	The DP Canyon GCS was not damaged during storms in 2010
8/5/2010	E056	243	Three Pueblo Canyon cross-vane structures were extensively damaged
8/16/2010	E039.1	306	The DP Canyon GCS was not damaged during storms in 2010
8/16/2010	E056	256	Three Pueblo Canyon cross-vane structures were extensively damaged
8/16/2010	E059	243	Three Pueblo Canyon cross-vane structures were extensively damaged
8/19/2011	E039.1	267	No noted major erosion/stream altering events
8/19/2011	E040	153	No noted major erosion/stream altering events
8/19/2011	E038	181	No noted major erosion/stream altering events
8/21/2011	E039.1	281	No noted major erosion/stream altering events
8/21/2011	E038	229	No noted major erosion/stream altering events
8/21/2011	E040	208	No noted major erosion/stream altering events
8/22/2011	E042.1	171	No noted major erosion/stream altering events
7/11/2012	E042.1	290	Net sediment deposition for 2012 in the DP Canyon GCS area is greater than that recorded in 2011, this sediment deposition includes both channel aggradation and overbank deposition
7/11/2012	E050.1	117	Net sediment deposition for 2012 in the DP Canyon GCS area is greater than that recorded in 2011, this sediment deposition includes both channel aggradation and overbank deposition
8/3/2012	E042.1	211	Net sediment deposition for 2012 in the DP Canyon GCS area is greater than that recorded in 2011, this sediment deposition includes both channel aggradation and overbank deposition
8/3/2012	E050.1	168	Net sediment deposition for 2012 in the DP Canyon GCS area is greater than that recorded in 2011, this sediment deposition includes both channel aggradation and overbank deposition
8/3/2012	E026	130	Net sediment deposition for 2012 in the DP Canyon GCS area is greater than that recorded in 2011, this sediment deposition includes both channel aggradation and overbank deposition
7/12/2013	E038	330	The engineered structures in Los Alamos and DP Canyons appear to have enhanced sediment deposition in these areas
7/12/2013	E039.1	330	The engineered structures in Los Alamos and DP Canyons appear to have enhanced sediment deposition in these areas
7/12/2013	E040	260	The engineered structures in Los Alamos and DP Canyons appear to have enhanced sediment deposition in these areas

Table 2.0-1 (continued)

Date	Station	Peak Discharge (cfs)	Noted Erosion in Geomorphic Changes Section of the Corresponding Year's Annual Report
9/12/2013	E026	400	Although the September 2013 flood event resulted in significant erosion in most surveyed areas in Pueblo Canyon, the magnitude of the erosion was likely reduced by the sediment mitigation structures and willow plantings
9/12/2013	E056	260	Although the September 2013 flood event resulted in significant erosion in most surveyed areas in Pueblo Canyon, the magnitude of the erosion was likely reduced by the sediment mitigation structures and willow plantings
7/15/2014	E038	270	The net deposition observed in Los Alamos and DP Canyons was likely enhanced by the sediment mitigation structures
7/31/2014	E039.1	250	The net deposition observed in Los Alamos and DP Canyons was likely enhanced by the sediment mitigation structures
7/31/2014	E040	240	The net deposition observed in Los Alamos and DP Canyons was likely enhanced by the sediment mitigation structures
7/15/2014	E040	270	The net deposition observed in Los Alamos and DP Canyons was likely enhanced by the sediment mitigation structures
7/31/2014	E042.1	210	The net deposition observed in Los Alamos and DP Canyons was likely enhanced by the sediment mitigation structures
7/31/2014	E050.1	201	The net deposition observed in Los Alamos and DP Canyons was likely enhanced by the sediment mitigation structures
7/31/2015	E040	240	Minor erosion noted
7/31/2015	E039.1	220	Minor erosion noted
7/8/2017	E038	205	The LA/P watershed underwent minor geomorphologic changes during the 2017 monsoon season
7/8/2017	E039.1	150	The LA/P watershed underwent minor geomorphologic changes during the 2017 monsoon season
7/8/2017	E040	101	The LA/P watershed underwent minor geomorphologic changes during the 2017 monsoon season

Note: There were no large storm events in 2016, 2018, and 2019.

Table 4.0-1
Locations, Analytical Suites, and Drivers for Storm Water Sampling

		Analytical Suites[a]		
Monitoring Group	Locations	Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project[b]	Investigative Studies	Supplemental BDDB Monitoring
Upper Los Alamos Canyon gaging stations	E026, E030	Dissolved/Total TAL metals[c] + boron + uranium, hardness, PCBs (by Method 1668C), gamma spectroscopy[d], dioxins and furans, strontium-90, isotopic plutonium, gross alpha, SSC, particle size	TOC[e], total recoverable aluminum, BLM suite[f]	n/a[g]
DP Canyon gaging stations	E038, E039.1, E040	Dissolved/Total TAL metals + boron + uranium, hardness, PCBs (by Method 1668C), gamma spectroscopy, isotopic plutonium, gross alpha, strontium-90, SSC, particle size	TOC, total recoverable aluminum, BLM suite	n/a
Upper Pueblo Canyon, and Acid Canyon gaging stations	E055, E055.5, E056	Dissolved/Total TAL metals + boron + uranium, hardness, PCBs (by Method 1668C), gamma spectroscopy, gross alpha, isotopic plutonium, americium-241 (by alpha spectroscopy), SSC, particle size	TOC, total recoverable aluminum, BLM suite	n/a
Lower Los Alamos Canyon gaging station	E042.1	Dissolved/Total TAL metals + boron + uranium, hardness, PCBs (by Method 1668C), gamma spectroscopy, isotopic plutonium, americium-241 (by alpha spectroscopy), dioxins and furans, gross alpha, strontium-90, SSC, particle size	TOC, total recoverable aluminum, BLM suite	n/a
Lower Los Alamos Canyon gaging station	E050.1	Dissolved/Total TAL metals + boron + uranium, hardness, PCBs (by Method 1668C), gamma spectroscopy, isotopic plutonium, americium-241 (by alpha spectroscopy), dioxins and furans, strontium-90, gross alpha, SSC, particle size	TOC, total recoverable aluminum, BLM suite	Gross beta, isotopic uranium, radium-226/radium-228

Table 4.0-1 (continued)

Monitoring Group	Locations	Analytical Suites[a]		
		Los Alamos/Pueblo Watershed Sediment Transport Mitigation Project[b]	Investigative Studies	Supplemental BDDB Monitoring
Lower Pueblo Canyon gaging stations	E059.5, E059.8	Dissolved/Total TAL metals + boron + uranium, hardness, PCBs (by Method 1668C), gamma spectroscopy, isotopic plutonium, americium-241 (by alpha spectroscopy), strontium-90, SSC, particle size, gross alpha	TOC, total recoverable aluminum, BLM suite	n/a
Lower Pueblo Canyon gaging station	E060.1	Dissolved/Total TAL metals + boron + uranium, hardness, PCBs (by Method 1668C), gamma spectroscopy, isotopic plutonium, americium-241 (by alpha spectroscopy), strontium-90, SSC, particle size, gross alpha, dioxins and furans	TOC, total recoverable aluminum, BLM suite	Gross beta, isotopic uranium, radium-226/radium-228
Detention basins and vegetative buffer below the SWMU 01-001(f) drainage	CO101038, CO111041	Dissolved/Total TAL metals + boron + uranium, hardness, PCBs (by Method 1668C), SSC, particle size, gross alpha	TOC, total recoverable aluminum, BLM suite	n/a

[a] Suites are listed in order of priority to guide analysis of limited water volume. SSC and particle size are independent of prioritization because they are derived from separate sample bottles.

[b] Radionuclides are collected and reported per DOE Order 436.1.

[c] Target analyte list (TAL) metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[d] Gamma spectroscopy = Actinium-228, beryllium-7, bismuth-212, bismuth-214, cesium-134, cesium-137, cobalt-60, gross gamma, iodine-131, lead-212, lead-214, potassium-40, protactinium-234, sodium-22, thallium-208, and thorium-234.

[e] TOC = Total organic carbon.

[f] BLM suite = Biotic ligand model suite, which includes dissolved organic carbon, chloride, sulfate, alkalinity, and pH.

[g] n/a = Not applicable.

Table 4.2-1
Sampled Storm Distribution in Relationship to Proposed Trip Level

Station	Proposed Trip Level (cfs)	Percent of Storms Sampled Less than or Equal to the Proposed Trip Level	Total Storms Samples (2010–2019)
E026	5	0%	10
E030	50	70%	20
E038	100	68%	47
E039.1	50	61%	49
E040	50	56%	37
E042.1	50	48%	42
E050.1	5	0%	39
E055	50	86%	14
E055.5	50	95%	21
E056	50	88%	25
E059.5	5	0%	8
E059.8	5	75%	4
E060.1	5	57%	7

Table 4.2-2
Analytical Requirements for Storm Water Samples

Analytical Suite	Method	Contract-Required Reporting Limit	Typical Detection Limit in Storm Water[a]	Upper Los Alamos Canyon (E026, E030)	Upper Pueblo Canyon and Acid Canyon (E055, E056, E055.5)	DP Canyon (E038, E039.1, E040)	Lower Los Alamos Canyon (E042.1, E050.1)	Lower Pueblo Canyon (E059.5, E059.8, E060.1)	Supplemental BDDB Monitoring (E050.1, E060.1)	Detention Basins below the SWMU 01-001(f) Drainage
PCBs	EPA:1668C	n/a[b]	25 pg/L	X[c]	X	X	X	X	—[d]	X
Isotopic plutonium	HASL-300	0.075 pCi/L	0.5 pCi/L	X	X	X	X	X	—	—
Gamma spectroscopy[e]	EPA:901.1	8 pCi/L (Cs-137)	10 pCi/L (Cs-137)	X	X	X	X	X	—	—
Isotopic uranium	HASL-300	0.1 pCi/L	0.5 pCi/L	—	—	—	—	—	X	—
Americium-241	HASL-300	0.075 pCi/L	0.5 pCi/L	—	X	—	X	X	—	—
Strontium-90	EPA:905.0	0.5 pCi/L	0.5 pCi/L	X	—	X	X	X	—	—
TAL metals[f] + B + U[g] (total and dissolved)	EPA:200.7/200.8/245.2	Variable	Variable	X	X	X	X	X	—	X
Total recoverable aluminum	EPA:200.8	100 µg/L	20 µg/L	X	X	X	X	X	—	X
Total organic carbon	EPA:415.1	1000 µg/L	330 µg/L	X	X	X	X	X	—	X
Dioxins and furans	EPA:1613B	10–50 ng/L	50 pg/L	X	—	—	X	X[h]	—	—
Gross alpha	EPA:900	3 pCi/L	10 pCi/L	X	X	X	X	X	—	X
Gross beta	EPA:900	3 pCi/L	10 pCi/L	—	—	—	—	—	X	—

Table 4.2-2 (continued)

Analytical Suite	Method	Contract-Required Reporting Limit	Typical Detection Limit in Storm Water[a]	Upper Los Alamos Canyon (E026, E030)	Upper Pueblo Canyon and Acid Canyon (E055, E056, E055.5)	DP Canyon (E038, E039.1, E040)	Lower Los Alamos Canyon (E042.1, E050.1)	Lower Pueblo Canyon (E059.5, E059.8, E060.1)	Supplemental BDDB Monitoring (E050.1, E060.1)	Detention Basins below the SWMU 01-001(f) Drainage
Radium-226/Radium-228	EPA:903.1/EPA:904	1 pCi/L	0.5/0.5 pCi/L	—	—	—	—	—	X	—
SSC	ASTM: D3977-97	3 mg/L	10 mg/L	X	X	X	X	X	—	X
Particle size	ASTM:C1070	n/a	0.01%	X	X	X	X	X	—	X
Alkalinity[i]	EPA:310	n/a	n/a	X	X	X	X	X	—	X
pH[i]	EPA:150.1	n/a	n/a	X	X	X	X	X	—	X
Chloride[i]	EPA:300	n/a	0.1 mg/L	X	X	X	X	X	—	X
Sulfate[i]	EPA:300	n/a	0.5 mg/L	X	X	X	X	X	—	X
Dissolved organic carbon	EPA:415.1	n/a	0.5 mg/L	X	X	X	X	X	—	X

[a] MDL or MDA for radionuclides.

[b] n/a = Not applicable.

[c] X = Monitoring planned.

[d] — = Monitoring not planned.

[e] Gamma spectroscopy = Actinium-228, beryllium-7, bismuth-212, bismuth-214, cesium-134, cesium-137, cobalt-60, gross gamma, iodine-131, lead-212, lead-214, potassium-40, protactinium-234, sodium-22, thallium-208, and thorium-234.

[f] Target analyte list (TAL) metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[g] + B + U = Plus boron plus uranium.

[h] Dioxins and furans are measured at E060.1 only.

[i] These analytical suites make up the biotic ligand model (BLM) analytical suite.

Table 4.2-3
Sampling Sequence for Collection of Storm Water Samples at the Detention Basins and Vegetative Buffer below the SWMU 01-001(f) Drainage

Sample Bottle (1 L)	CO101038, CO111041	
	Start Time (min) 12-Bottle ISCO	Analytical Suite
1	Trigger	SSC[a] particle size
2	Trigger +2	PCBs (UF[b]) Part 1[c]
3	Trigger +4	TOC[d] (UF), DOC[e] (F[f]), chloride + sulfate (F), alkalinity + pH (UF)
4	Trigger +6	PCBs (UF) Part 2
5	Trigger +8	TAL metals[g] + boron + uranium + hardness (F/UF), total recoverable aluminum (F10u[h])
6	Trigger +10	Gross alpha (UF)
7	Trigger +12	SSC
8	Trigger +14	Extra bottle
9	Trigger +16	Extra bottle
10	Trigger +18	Extra bottle
11	Trigger +20	Extra bottle
12	Trigger +22	Extra bottle

[a] SSC = Suspended sediment concentration.

[b] UF = Unfiltered.

[c] Bottles 2 and 4 are to be sent to the lab together for one PCB analysis.

[d] TOC = Total organic carbon.

[e] DOC = Dissolved organic carbon.

[f] F = Filtered through a 0.45-µm membrane.

[g] Target analyte list (TAL) metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[h] F10u = Filtered through a 10-µm membrane.

Table 4.2-4
Sampling Sequence for Collection of
Storm Water Samples at E026, E030, E055, E055.5, and E056

<table>
<tr><th rowspan="2">Sample Bottle (1 L)</th><th rowspan="2">Start Time (min) 12-Bottle ISCO</th><th>E026 and E030</th><th rowspan="2">Sample Bottle</th><th rowspan="2">Start Time (min) 12-Bottle ISCO</th><th>E055, E055.5, and E056</th></tr>
<tr><th>Analytical Suites</th><th>Analytical Suites</th></tr>
<tr><td>1</td><td>Max+10</td><td>SSC[a] particle size</td><td>1</td><td>Max+10</td><td>SSC; particle size</td></tr>
<tr><td>2</td><td>Max+12</td><td>PCBs (UF[b]) Part 1[c]</td><td>2</td><td>Max+12</td><td>PCBs (UF) Part 1</td></tr>
<tr><td>3</td><td>Max+14</td><td>TOC[d] (UF), DOC[e] (F[f]), chloride + sulfate (F), alkalinity + pH (UF)</td><td>3</td><td>Max+14</td><td>TOC (UF), DOC (F), chloride + sulfate (F), alkalinity + pH (UF)</td></tr>
<tr><td>4</td><td>Max+16</td><td>PCBs (UF) Part 2</td><td>4</td><td>Max+16</td><td>PCBs (UF) Part 2</td></tr>
<tr><td>5</td><td>Max+18</td><td>TAL metals[g] + boron + uranium + hardness (F/UF), total recoverable aluminum (F10u[h])</td><td>5</td><td>Max+18</td><td>TAL metals + boron + uranium + hardness (F/UF), total recoverable aluminum (F10u[h])</td></tr>
<tr><td>6</td><td>Max+20</td><td rowspan="2">Dioxins and furans (UF)</td><td>6</td><td>Max+20</td><td>Americium-241 (UF), isotopic plutonium (UF)</td></tr>
<tr><td>7</td><td>Max+22</td><td>7</td><td>Max+22</td><td rowspan="2">Gamma spectroscopy (UF), gross alpha (UF)</td></tr>
<tr><td>8</td><td>Max+24</td><td>Strontium-90 (UF)</td><td>8</td><td>Max+24</td></tr>
<tr><td>9</td><td>Max+26</td><td rowspan="2">Gamma spectroscopy[i] (UF), gross alpha (UF), isotopic plutonium (UF)</td><td>9</td><td>Max+26</td><td>SSC</td></tr>
<tr><td>10</td><td>Max+28</td><td>10</td><td>Max+28</td><td>Extra bottle</td></tr>
<tr><td>11</td><td>Max+30</td><td>SSC</td><td>11</td><td>Max+30</td><td>Extra bottle</td></tr>
<tr><td>12</td><td>Max+32</td><td>Extra bottle</td><td>12</td><td>Max+32</td><td>Extra bottle</td></tr>
</table>

[a] SSC = Suspended sediment concentration.

[b] UF = Unfiltered.

[c] Bottles 2 and 4 are to be sent to the lab together for one PCBs analysis.

[d] TOC = Total organic carbon.

[e] DOC = Dissolved organic carbon.

[f] F = Filtered through a 0.45-µm membrane.

[g] Target analyte list (TAL) metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[h] F10u = Filtered through a 10-µm membrane.

[i] Gamma spectroscopy = Actinium-228, beryllium-7, bismuth-212, bismuth-214, cesium-134, cesium-137, cobalt-60, gross gamma, iodine-131, lead-212, lead-214, potassium-40, protactinium-234, sodium-22, thallium-208, and thorium-234.

Table 4.2-5
Sampling Sequence for Collection of Storm Water Samples at E038, E039.1, and E040

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	E038, E039.1, and E040	E038 and E039.1	
		Analytical Suites	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
1	Max+10	SSC[a] particle size	Trigger	SSC
2	Max+12	PCBs (UF[b]) Part 1[c]	Trigger+2	SSC
3	Max+14	TOC[d] (UF), DOC[e] (F[f]), chloride + sulfate (F), alkalinity + pH (UF)	Trigger+4	SSC
4	Max+16	PCBs (UF) Part 2	Trigger+6	SSC
5	Max+18	TAL metals[g] + boron + uranium + hardness (F/UF), total recoverable aluminum (F10u[h])	Trigger+8	SSC
6	Max+20	Strontium-90 (UF)	Trigger+10	SSC
7	Max+22	Gamma spectroscopy[i] (UF), gross alpha (UF), isotopic plutonium (UF)	Trigger+12	SSC
8	Max+24		Trigger+14	SSC
9	Max+26	SSC	Trigger+16	SSC
10	Max+28	Extra bottle	Trigger+18	SSC
11	Max+30	Extra bottle	Trigger+20	SSC
12	Max+32	Extra bottle	Trigger+22	SSC
13	n/a[j]	n/a	Trigger+24	SSC
14	n/a	n/a	Trigger+26	SSC
15	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	Trigger+30	SSC
17	n/a	n/a	Trigger+50	SSC
18	n/a	n/a	Trigger+70	SSC
19	n/a	n/a	Trigger+90	SSC
20	n/a	n/a	Trigger+110	SSC
21	n/a	n/a	Trigger+130	SSC
22	n/a	n/a	Trigger+150	SSC
23	n/a	n/a	Trigger+170	SSC
24	n/a	n/a	Trigger+190	SSC

[a] SSC = Suspended sediment concentration.

[b] UF = Unfiltered.

[c] Bottles 2 and 4 are to be sent to the lab together for one PCBs analysis.

[d] TOC = Total organic carbon.

[e] DOC = Dissolved organic carbon.

[f] F = Filtered through a 0.45-µm membrane.

[g] Target analyte list (TAL) metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[h] F10u = Filtered through a 10-µm membrane.

[i] Gamma spectroscopy = Actinium-228, beryllium-7, bismuth-212, bismuth-214, cesium-134, cesium-137, cobalt-60, gross gamma, iodine-131, lead-212, lead-214, potassium-40, protactinium-234, sodium-22, thallium-208, and thorium-234.

[j] n/a = Not applicable.

Table 4.2-6
Sampling Sequence for Collection of Storm Water Samples at E042.1

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
1	Max+10	SSC[a] particle size	Trigger	SSC
2	Max+12	PCBs (UF[b]) Part 1[c]	Trigger+2	SSC
3	Max+14	TOC[d] (UF), DOC[e] (F[f]), chloride + sulfate (F), alkalinity + pH (UF)	Trigger+4	SSC
4	Max+16	PCBs (UF) Part 2	Trigger+6	SSC
5	Max+18	TAL metals[g] + boron + uranium + hardness (F/UF), total recoverable aluminum (F10u[h])	Trigger+8	SSC
6	Max+20	Dioxins and furans (UF)	Trigger+10	SSC
7	Max+22	Strontium-90 (UF)	Trigger+12	SSC
8	Max+24	Gamma spectroscopy[i] (UF), gross alpha (UF)	Trigger+14	SSC
9	Max+26		Trigger+16	SSC
10	Max+28	Americium-241 (UF), isotopic plutonium (UF)	Trigger+18	SSC
11	Max+60	SSC	Trigger+20	SSC
12	Max+62	Extra bottle	Trigger+22	SSC
13	n/a[j]	n/a	Trigger+24	SSC
14	n/a	n/a	Trigger+26	SSC
15	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	Trigger+30	SSC
17	n/a	n/a	Trigger+50	SSC
18	n/a	n/a	Trigger+70	SSC
19	n/a	n/a	Trigger+90	SSC
20	n/a	n/a	Trigger+110	SSC
21	n/a	n/a	Trigger+130	SSC
22	n/a	n/a	Trigger+150	SSC
23	n/a	n/a	Trigger+170	SSC
24	n/a	n/a	Trigger+190	SSC

[a] SSC = Suspended sediment concentration.

[b] UF = Unfiltered.

[c] Bottles 2 and 4 are to be sent to the lab together for one PCBs analysis.

[d] TOC = Total organic carbon.

[e] DOC = Dissolved organic carbon.

[f] F = Filtered through a 0.45-µm membrane.

[g] Target analyte list (TAL) metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[h] F10u = Filtered through a 10-µm membrane.

[i] Gamma spectroscopy = Actinium-228, beryllium-7, bismuth-212, bismuth-214, cesium-134, cesium-137, cobalt-60, gross gamma, iodine-131, lead-212, lead-214, potassium-40, protactinium-234, sodium-22, thallium-208, and thorium-234.

[j] n/a = Not applicable.

Table 4.2-7
Sampling Sequence for Collection of Storm Water Samples at E059.5 and E059.8

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
1	Max+10	SSC[a] particle size	Trigger	SSC
2	Max+12	PCBs (UF[b]) Part 1[c]	Trigger+2	SSC
3	Max+14	TOC[d] (UF), DOC[e] (F[f]), chloride + sulfate (F), alkalinity + pH (UF)	Trigger+4	SSC
4	Max+16	PCBs (UF) Part 2	Trigger+6	SSC
5	Max+18	TAL metals[g] + boron + uranium + hardness (F/UF), total recoverable aluminum (F10u[h])	Trigger+8	SSC
6	Max+20	Strontium-90 (UF)	Trigger+10	SSC
7	Max+22	Americium-241 (UF), isotopic plutonium (UF)	Trigger+12	SSC
8	Max+24	Gamma spectroscopy[i] (UF), gross alpha (UF)	Trigger+14	SSC
9	Max+26		Trigger+16	SSC
10	Max+28	SSC	Trigger+18	SSC
11	Max+60	Extra bottle	Trigger+20	SSC
12	Max+62	Extra bottle	Trigger+22	SSC
13	n/a[j]	n/a	Trigger+24	SSC
14	n/a	n/a	Trigger+26	SSC
15	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	Trigger+30	SSC
17	n/a	n/a	Trigger+50	SSC
18	n/a	n/a	Trigger+70	SSC
19	n/a	n/a	Trigger+90	SSC
20	n/a	n/a	Trigger+110	SSC
21	n/a	n/a	Trigger+130	SSC
22	n/a	n/a	Trigger+150	SSC
23	n/a	n/a	Trigger+170	SSC
24	n/a	n/a	Trigger+190	SSC

[a] SSC = Suspended sediment concentration.

[b] UF = Unfiltered.

[c] Bottles 2 and 4 are to be sent to the lab together for one PCBs analysis.

[d] TOC = Total organic carbon.

[e] DOC = Dissolved organic carbon.

[f] F = Filtered through a 0.45-µm membrane.

[g] Target analyte list (TAL) metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[h] F10u = Filtered through a 10-µm membrane.

[i] Gamma spectroscopy = Actinium-228, beryllium-7, bismuth-212, bismuth-214, cesium-134, cesium-137, cobalt-60, gross gamma, iodine-131, lead-212, lead-214, potassium-40, protactinium-234, sodium-22, thallium-208, and thorium-234.

[j] n/a = Not applicable.

Table 4.2-8
Sampling Sequence for Collection of Storm Water Samples at E050.1 and E060.1

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge
1	Max+10	SSC[a] particle size	Trigger	SSC
2	Max+12	PCBs (UF[b])	Trigger+2	SSC
3	Max+14	TOC[c] (UF), DOC[d] (F[e]), chloride + sulfate (F), alkalinity + pH (UF)	Trigger+4	SSC
4	Max+16	PCBs (UF)	Trigger+6	SSC
5	Max+18	TAL metals[f] + boron + uranium + hardness (F/UF), total recoverable aluminum (F10u[g])	Trigger+8	SSC
6	Max+20	Dioxins and furans (UF)	Trigger+12	SSC
7	Max+22		Trigger+14	SSC
8	Max+24	Strontium-90 (UF)	Trigger+16	Gross beta (UF)
9	Max+26	Gamma spectroscopy[h] (UF), gross alpha (UF)	Trigger+18	SSC
10	Max+28	Isotopic plutonium (UF), americium-241 (UF), isotopic uranium (UF)	Trigger+20	Radium-226/radium-228 (UF)
11	Max+60		Trigger+22	
12	Max+62	SSC	Trigger+24	SSC
13	n/a[i]	n/a	Trigger+26	Per this monitoring plan, section 3.6: TAL metals + boron + uranium + hardness (F/UF), solid phase TAL metals + boron + uranium, SSC
14	n/a	n/a	Trigger+28	
15	n/a	n/a	Trigger+30	SSC
16	n/a	n/a	Trigger+50	SSC
17	n/a	n/a	Trigger+70	SSC
18	n/a	n/a	Trigger+90	SSC
29	n/a	n/a	Trigger+110	SSC
20	n/a	n/a	Trigger+130	SSC
21	n/a	n/a	Trigger+150	SSC
21	n/a	n/a	Trigger+170	SSC
23	n/a	n/a	Trigger+190	SSC
24	n/a	n/a	Trigger+210	SSC

[a] SSC = Suspended sediment concentration.

[b] UF = Unfiltered.

[c] TOC = Total organic carbon.

[d] DOC = Dissolved organic carbon.

[e] F = Filtered through a 0.45-µm membrane.

[f] Target analyte list (TAL) metals are Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, and Zn; hardness is calculated from calcium and magnesium, components of the TAL list.

[g] F10u = Filtered through a 10-µm membrane.

[h] Gamma spectroscopy = Actinium-228, beryllium-7, bismuth-212, bismuth-214, cesium-134, cesium-137, cobalt-60, gross gamma, iodine-131, lead-212, lead-214, potassium-40, protactinium-234, sodium-22, thallium-208, and thorium-234.

i n/a = Not applicable.