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2013 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 1



Prepared by the Environmental Programs Directorate

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2013 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 1

June 2013

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1.0 INTRODUCTION

This monitoring plan is submitted pursuant to the New Mexico Environment Department's (NMED's) letter dated February 18, 2013, approving the extension request to submit the "2013 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project" (NMED 2013, 522065). The objective of this monitoring plan is to evaluate the effect of mitigation measures undertaken in the Los Alamos and Pueblo Canyons (LA/Pueblo) watershed under the NMED-approved "Interim Measure Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons" (LANL 2008, 101714) and the "Supplemental Interim Measures Work Plan to Mitigate Contaminated Sediment Transport in Los Alamos and Pueblo Canyons" (LANL 2008, 105716). In accordance with these work plans, Los Alamos National Laboratory (LANL or the Laboratory) has undertaken several activities to reduce flood energy and associated sediment transport. These activities include willow planting; construction of cross-vane structures (CVSs), a wing ditch, grade-control structures (GCSs), and sediment detention basins; and modification of basins above a low-head weir. Because contaminants migrate with sediment entrained in runoff, reduced sediment transport will thereby reduce contaminant transport, which is the primary objective of these activities.

Two types of monitoring that began in 2010, continued in 2011 and 2012, and will continue in the foreseeable future are designed to meet the following objectives: (1) monitor geomorphic changes in the canyon bottom that are measures of performance of various mitigations and (2) collect and analyze storm water runoff samples at gage and monitoring stations located throughout the watershed. Monitoring conducted during 2010 in the LA/Pueblo watershed was performed in accordance with the "Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project" (LANL 2009, 107457) and the "Approval with Modifications, Los Alamos and Pueblo Canyons Sediment Transport Monitoring Plan" (NMED 2010, 108444). Monitoring during 2011 in the LA/Pueblo watershed was performed in accordance with the "2011 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project" (LANL 2011, 201578) and the "Approval with Modifications [for the] 2011 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project" (NMED 2011, 203705). Monitoring conducted in 2012 in the LA/Pueblo watershed was performed in accordance with the "2012 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 2" (LANL 2012, 222833) and the "Approval [for the] 2012 Monitoring Plan for Los Alamos and Pueblo Canyons Sediment Transport Mitigation Project, Revision 2" (NMED 2013, 521854). Monitoring conducted in 2012 builds upon these previous documents.

Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with U.S. Department of Energy policy. Water quality results from storm water events are systematically uploaded to the publically accessible environmental monitoring database, Intellus New Mexico.

2.0 MONITORING GEOMORPHIC CHANGES

Monitoring of geomorphic changes (e.g., sediment deposition or erosion) associated with the mitigation measures has been conducted using three methods: (1) repeat cross-section surveys, (2) channel thalweg surveys, and (3) general area surveys. These surveys have been conducted at the locations described below. Surveys have been conducted annually in late fall, winter, or early spring to document geomorphic changes that may have occurred during the previous summer monsoon season. The optimal time is selected based on the weather, the presence or absence of ponded water in constructed basins, and the ability to work in wetlands after dense vegetation has senesced. Figure 2.0-1 shows the mitigation areas where surveys have been conducted and where repeat surveys were planned after the

2012 monsoon season, as described below. Channel sediments that experienced flow during the 2013 monsoon will be identified as locations for repeat surveys. Segments of channels that did not experience flow in 2013 will not be candidates for repeat surveys.

Evaluation of survey data from previous years (e.g., LANL 2011, 203661; LANL 2012, 218411) indicates the channel thalweg surveys are not the best method for evaluating changes in channel elevation in the survey areas. Specifically, because of changes in thalweg sinuosity and year-to-year variability in survey point spacing that affect the total cumulative length of the survey, thalweg profiles from 1 yr cannot be reliably overlain on profiles from a previous year to evaluate changes in channel elevation. Instead, potential channel elevation changes (aggradation or incision) can be more effectively monitored by directly comparing thalweg elevation at each surveyed cross-section in successive years.

2.1 Pueblo Canyon

Upper transition area—A total of 23 cross-sections were originally surveyed in September and October 2009 at 100-ft intervals, for a total of 1100 ft above and below a transition area separating a broad upcanyon wetland (reach P-3FE) from a narrower downcanyon wetland within incised geomorphic surfaces (reach P-4W) (LANL 2011, 203661). A longitudinal survey of the thalweg elevation through this area was also conducted that encompasses an area where willows were planted in spring 2009. Annual resurveys in these reaches are intended to monitor geomorphic changes in this portion of Pueblo Canyon, particularly those related to potential changes in the transition area.

Upper willow-planting area—A total of 18 cross-sections were originally surveyed in October 2009 in the area where willows were planted in spring 2008 and 2009 between the new County of Los Alamos wastewater treatment plant (WWTP) outfall and the wing ditch (Figure 2.0-1). These cross-sections were divided between the upper, middle, and lower thirds of this area. A total of six cross-sections were surveyed in each of these three areas at 100-ft intervals. A longitudinal channel thalweg profile was also surveyed in each of these areas. Annual resurveys at the upper willow-planting area are intended to document anticipated aggradation of floodplain surfaces where willows will slow flood water and trap sediment as well as monitor any changes to thalweg elevation in this area.

Pueblo Canyon GCS—A total of 15 cross-sections were originally surveyed in April 2010 at 100-ft intervals for a distance of 1500 ft above the Pueblo Canyon GCS (Figure 2.0-1). Three cross-sections were also surveyed below the GCS at 100-ft intervals to document any changes to the channel downcanyon of the structure. A longitudinal channel thalweg profile was also surveyed in this area. Annual resurveys in this area are intended to document expected sediment accumulation above the GCS and monitor potential changes in the upcanyon wetland.

CVSs—Two cross-sections were originally surveyed in April and May 2010 near each of the three CVSs (Figure 2.0-1): one 50 ft upcanyon and one 50 ft downcanyon of the apex rock of each structure. A longitudinal thalweg profile was also surveyed over these 100-ft intervals. Although the CVSs were damaged during floods in 2010 (LANL 2010, 111125) and have been abandoned, annual resurveys in this area serve to monitor potential geomorphic changes in Pueblo Canyon upstream from the WWTP outfall.

Wing ditch—Five cross-sections were originally surveyed in November 2009 downcanyon from the wing ditch (Figure 2.0-1) at 100-ft intervals, and a longitudinal channel thalweg profile was also surveyed over this distance. The wing ditch was designed to divert water from the main channel through the upper part of the lower Pueblo Canyon wetland into an abandoned channel to the south. However, the wing ditch is no longer needed for this purpose because new culverts installed during road reconstruction completed by the County of Los Alamos in 2011 immediately upstream from the wing ditch effectively divert water

into this formerly abandoned channel. Although no longer needed to perform monitoring, annual resurveys in this area serve to monitor potential geomorphic changes in this part of the wetland.

2.2 Los Alamos Canyon

DP Canyon GCS—A total of 11 cross-sections were originally surveyed in April and May 2010 above the DP Canyon GCS (Figure 2.0-1) at 100-ft intervals upcanyon of the structure. Two cross-sections were also surveyed below the GCS at 100-ft intervals to document any changes to the channel downcanyon of the structure. A longitudinal channel thalweg profile was also surveyed over this area. Annual resurveys in this area are intended to document expected sediment accumulation above the GCS.

Los Alamos Canyon low-head weir—After modifications were made in 2009 to the sediment detention basin above the Los Alamos Canyon low-head weir, including development of three separate basins, an initial topographic survey of this area was conducted in July 2009 (Figure 2.0-1). The basins were reexcavated in June 2011 to prepare for expected floods following the Las Conchas fire, and a new baseline survey was conducted in July 2011. Irregular topography associated with basalt mounds and constructed modifications above the weir warrant a more detailed survey than can be conducted with repeat cross-sections. Annual resurveys of this area in 2012 allowed annual measurements of sediment accumulation within the basins from monsoon-derived flow in the canyon.

Upper Los Alamos Canyon detention basins—A general topographic survey was originally conducted in March 2010 of sediment detention basins constructed below Solid Waste Management Unit (SWMU) 01-001(f). The basins were reexcavated in June 2011 to prepare for expected floods following the Las Conchas fire, and a new baseline survey was conducted in July 2011. Annual resurveys of this area in 2012 allowed measurements of sediment accumulation within the basins.

3.0 MONITORING STORM WATER RUNOFF

Storm water monitoring during 2013 will be conducted at the locations shown in Figure 2.0-1 and listed in Table 3.0-1. These locations are situated to compartmentalize monitoring for effective performance evaluation of the sediment transport mitigation sites within the watershed. Data will also be available to document baseline conditions upcanyon of these sites and to evaluate contaminant sources. The goals of the sampling are (1) to collect data that represent variations in contaminant concentrations and suspended sediment concentrations (SSC) within runoff events at each location and (2) to evaluate short-term and long-term trends in SSC, suspended sediment yield, and contaminant concentrations associated with the mitigation sites. The monitoring strategy described below is developed to achieve these goals. Data collected during implementation of the 2010, 2011, and 2012 monitoring plans were reviewed to develop recommendations regarding potential changes to analytical suites and/or sampling approaches.

Large parts of the upper watersheds of Los Alamos Canyon and a major tributary, Guaje Canyon, were affected by the Las Conchas fire in 2011. As documented after the Cerro Grande fire (Gallaher and Koch 2004, 088747), storm water chemistry can be strongly affected by incorporation of ash from burn areas. To help evaluate the influence of the Las Conchas fire on storm water quality in 2011, americium-241 and cyanide were added to the analytical suites at E026 and E030, and cyanide was added to the analytical suites at the other Los Alamos Canyon gages (E042.1, E050.1, and E109.9). Additionally, SSC measurements across the hydrograph were repeated at the upper boundary station at E026 to better characterize sediment flux from the burn area upstream from Laboratory sites. These modifications to the monitoring plan will continue in 2013.

Additionally, samples will be collected using automated pump samplers at the detention basins below SWMU 01-001(f) at locations CO111041 and CO101038, shown in Figure 3.0-1 and listed in Table 3.0-1. These samples will allow the performance of the sediment detention basins and associated wetland below the basins to be evaluated. As directed in the approval with modifications for the 2011 monitoring plan (NMED 2011, 203705), sampling was conducted in Graduation Canyon in 2011. The results of these analyses were reported in the March 2012 "Stormwater Performance Monitoring in the Los Alamos/Pueblo Watershed during 2011" (LANL 2012, 211396). Analytical results in 2011 and 2012 show total polychlorinated biphenyl (PCB) to be below the baseline PCB upper tolerance limit (UTL) of 0.098 µg/L for urban runoff, the primary source of storm water received by Graduation Canyon. Because results are consistently below the urban baseline UTL, the program is recommending not monitoring storm water at this location in 2013.

Gaging equipment at E050.1, E060.1, and E109.9 will be inspected weekly throughout the year; automated samplers and equipment at other gages will be inspected weekly from June 1 to October 31 and 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 discovered. Samples will be retrieved from the field within 1 business day of sample collection using the following priority order, if necessary:

- Los Alamos above the Rio Grande at E109.9;
- Lower watershed at E042.1, E050.1, E059, and E060.1;
- Upper watershed at E026, E030, E055, E055.5, E056, CO101038, and CO111041;
- DP Canyon at E038, E039.1, and E040.

Deviations from the planned inspection, maintenance, and sample retrieval objectives will be described in the annual monitoring report.

3.1 Discharge Gaging

Each of the stream gages listed in Table 3.0-1 will be monitored continuously throughout the year for stage, with the exception of E042 and E050, which will be decommissioned. Each gage has an established rating curve that will be reviewed annually or after large channel-altering floods to convert stage to discharge.

3.2 Sampling and Analysis

Storm water runoff sampling for SSC analyses at each of the monitoring locations, except at E038 and at the detention basins below SWMU 01-001(f), will be triggered by discharges of approximately 10 cubic feet per second (cfs). Sampling at E038 will be triggered by discharges of approximately 40 cfs. Sampling at the detention basins below SWMU 01-001(f) will be triggered by an actuator detecting the presence of water above the sampler intake. Storm water runoff sampling for chemical and radiochemical analyses will be triggered 10-min following the maximum discharge exceeding the triggering discharge. Analytical requirements for storm water samples are listed in Table 3.2-1. Samples at gages will be collected using automated storm water samplers that contain a carousel of 24 1-L bottles and/or 12 1-L bottles as specified in Tables 3.2-2, 3.2-3, 3.2-4, 3.2-5, 3.2-6, and 3.2-7. Sample collection inlets will be placed a minimum of 0.33 ft. above the bottom of natural stream channels and a minimum of 0.17 ft above the bottom of supercritical flumes. The sampling approach is intended to allow characterization of suspended sediment flux from the four portions of a typical hydrograph consisting of a rapidly rising limb, a short-duration peak, a rapidly receding limb following the peak, and a longer-duration recessional limb, and contaminant concentrations from the portions of each hydrograph following the peak.

The assignment of sample collection times for chemical and radionuclide analyses to segments of the hydrograph following the peak meets a requirement by NMED to not collect such samples before the peak (NMED 2011, 203705). However, evaluation of monitoring data from 2011 suggests this approach is not optimum for estimating chemical and radionuclide transport because the early parts of the hydrograph, where discharge and SSC are highest, are not sampled directly for contaminant concentrations, resulting in large uncertainties in chemical and radiochemical transport estimates through a hydrograph. Therefore, since one of the goals of the monitoring is to estimate chemical and radionuclide transport at specific stations, the Laboratory recommends that the sampling approach be modified to include sampling for targeted radionuclides earlier in each hydrograph. The results from 2012 confirmed this approach is valid.

The Laboratory proposes to add analyses of radionuclides before the peak of discharge to help improve estimates of radionuclide transport. One sample collected on the rising limb of the hydrograph near the peak of discharge will be selected for analyses of gamma spectroscopy radionuclides and isotopic plutonium, instead of SSC. The sample for additional radionuclide analyses will be selected based on a visual inspection of the hydrograph following sample collection and before shipment to the analytical laboratory.

To characterize water quality entering and leaving the detention basins and adjoining wetland below the SWMU 01-001(f) drainage, automated pump samplers will collect storm water from locations above and below the basins up to four times annually when storm water discharge is occurring (Figure 3.0-1). This configuration will remain intact in the 2013 monitoring effort

Analytical suites vary according to monitoring groups and are based on key indicator contaminants for a given portion of the watershed. Table 3.0-1 shows the monitoring groups and the analytical suite for each location. The analyses will allow determination of correlations between contaminant concentrations and SSCs. The SSC analyses will also allow calculations of the total mass transported during storm water runoff events at the gages. Particle-size analyses conducted in conjunction with selected SSC analyses will support characterization of chemicals and radionuclides.

Samples collected will be analyzed for the analytical suites described in Table 3.0-1. Samples will be submitted for chemical and radionuclide analyses at gage stations E059 and E042.1 if samples were collected during the event at their paired downstream gages (E060.1 and E050.1, respectively). The list of analyses for each monitoring group is prioritized to guide what analyses will be conducted if the collected water volume for a sample composite is insufficient to fulfill all planned suites. The priority is consistent with the order of the constituents listed in Table 3.0-1. The analytical method, expected method detection limit (MDL), and minimal detectable activity (MDA) (for radionuclides) are presented in Table 3.2-1. The sampling sequence for CO101038 and CO111041 is presented in Table 3.2-2. The sampling sequence for E030, E040, E055, E055.5, and E056 is presented in Table 3.2-3. Table 3.2-4 provides the sampling sequence at E026, E038, and E039.1. Table 3.2-5 provides the sampling sequence at E042.1 and E059. Table 3.2-6 provides the sampling sequence at E050.1 and E060.1. Table 3.2-7 provides the sampling sequence at E109.9.

Total suspended sediment transport during a runoff event at a station is determined most accurately when discharge is sampled periodically for SSC analysis through a hydrograph. In 2010, SSC was measured at 2- or 3-min intervals for the first 30 min, then at 20-min intervals throughout each runoff event only at lower watershed gages. In 2011, SSC measurements were added at 3-min intervals for the first 30 min, then at 20-min intervals throughout runoff events using a second automated sampler containing a carousel of 24 1-L bottles above and below the DP Canyon GCS at E038 and E039.1 to better characterize the performance of the GCS and upcanyon floodplains and in upper Los Alamos Canyon below the ice rink at E026 to help characterize the effects of the Las Conchas fire.

The second sampler was dedicated to collecting storm water for SSC analyses with the goal of representing most or all of the duration of runoff. This focus will be maintained during monitoring in 2013; however, all SSC samples will be collected at 2-min intervals during the first 30 min to better characterize the early part of the hydrograph and to provide bottles for the proposed additional radionuclide analyses.

If four runoff events have been sampled at a gaging station, subsequent events with discharge less than the largest discharge will be analyzed for SSC only. At upper watershed gages where a single sampler containing a carousel of 12 1-L bottles is installed, the first and last sample collected from these subsequent storms will be analyzed for SSC. At locations where a sampler containing a carousel of 24 1-L bottles is installed and dedicated to collection of samples throughout the entire hydrograph (i.e., upstream and downstream of watershed mitigations), all samples collected from this 24-bottle carousel from these subsequent storms will be analyzed for SSC. In this way, SSC analyses are obtained at many different times during the hydrograph, and suspended sediment transport for the entire runoff event can be characterized.

4.0 REPORTING

The repeat cross-section and general area surveys will be conducted in late fall to early spring, as described above. The survey data, plotted cross-sections, and discussion will be combined with the storm water performance monitoring in the Los Alamos/Pueblo watershed report submitted on March 31 of each year. The report includes discharge data from each gage, analytical results, and discussion. An update to the monitoring plan will be prepared annually and submitted by March 31 of every year.

5.0 REFERENCES

The following list includes all documents cited in this plan. Parenthetical information following each reference provides the author(s), publication date, and ER ID number. This information is also included in text citations. ER ID numbers are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Gallaher, B.M., and R.J. Koch, September 2004. "Cerro Grande Fire Impacts to Water Quality and Stream Flow near Los Alamos National Laboratory: Results of Four Years of Monitoring," Los Alamos National Laboratory report LA-14177, Los Alamos, New Mexico. (Gallaher and Koch 2004, 088747)

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LANL (Los Alamos National Laboratory), May 2012. "2011 Geomorphic Changes at Sediment Transport Mitigation Sites in the Los Alamos and Pueblo Canyon Watersheds," Los Alamos National Laboratory document LA-UR-12-21330, Los Alamos, New Mexico. (LANL 2012, 218411)

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NMED (New Mexico Environment Department), January 23, 2013. "Approval, 2012 Monitoring Plan for Los Alamos and Pueblo Canyons, Sediment Transport Mitigation Project, Revision 2," New Mexico Environment Department letter to P. Maggiore (DOE-LASO) and J. D. Mousseau (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2013, 521854)

NMED (New Mexico Environment Department), February 18, 2013. "Approval, Requests for Extensions to Submit the 2012 Storm Water Performance Monitoring Report and the Sediment Transport Mitigation Monitoring Plan and to Incorporate the Geomorphic Changes Survey Results into the Performance Monitoring Report for Los Alamos/Pueblo Canyons/Watersheds," New Mexico Environment Department letter to P. Maggiore (DOE-LASO) and J.D. Mousseau (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2013, 522065)

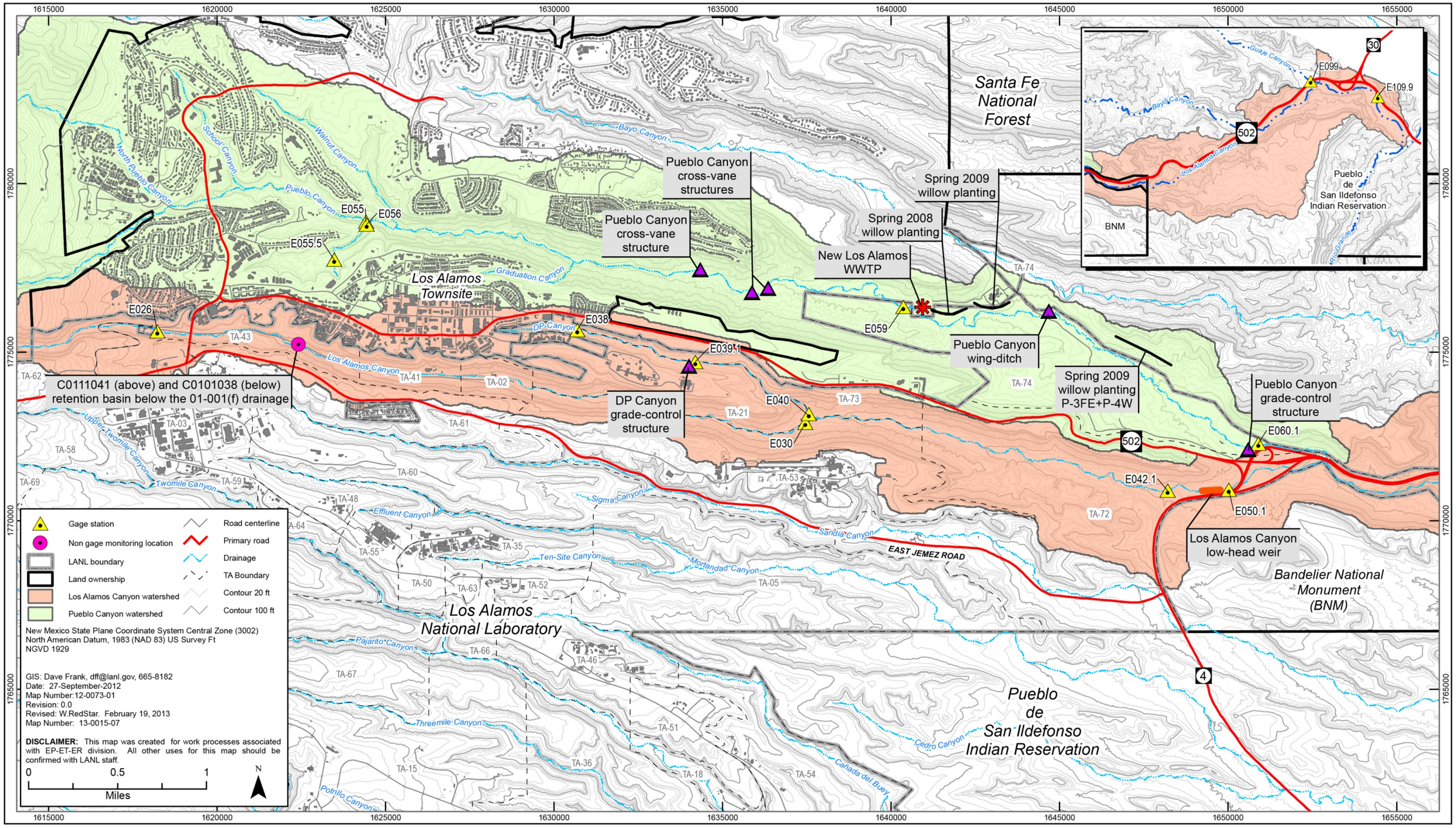


Figure 2.0-1 Los Alamos and Pueblo Canyons showing monitoring locations and sediment transport mitigation sites

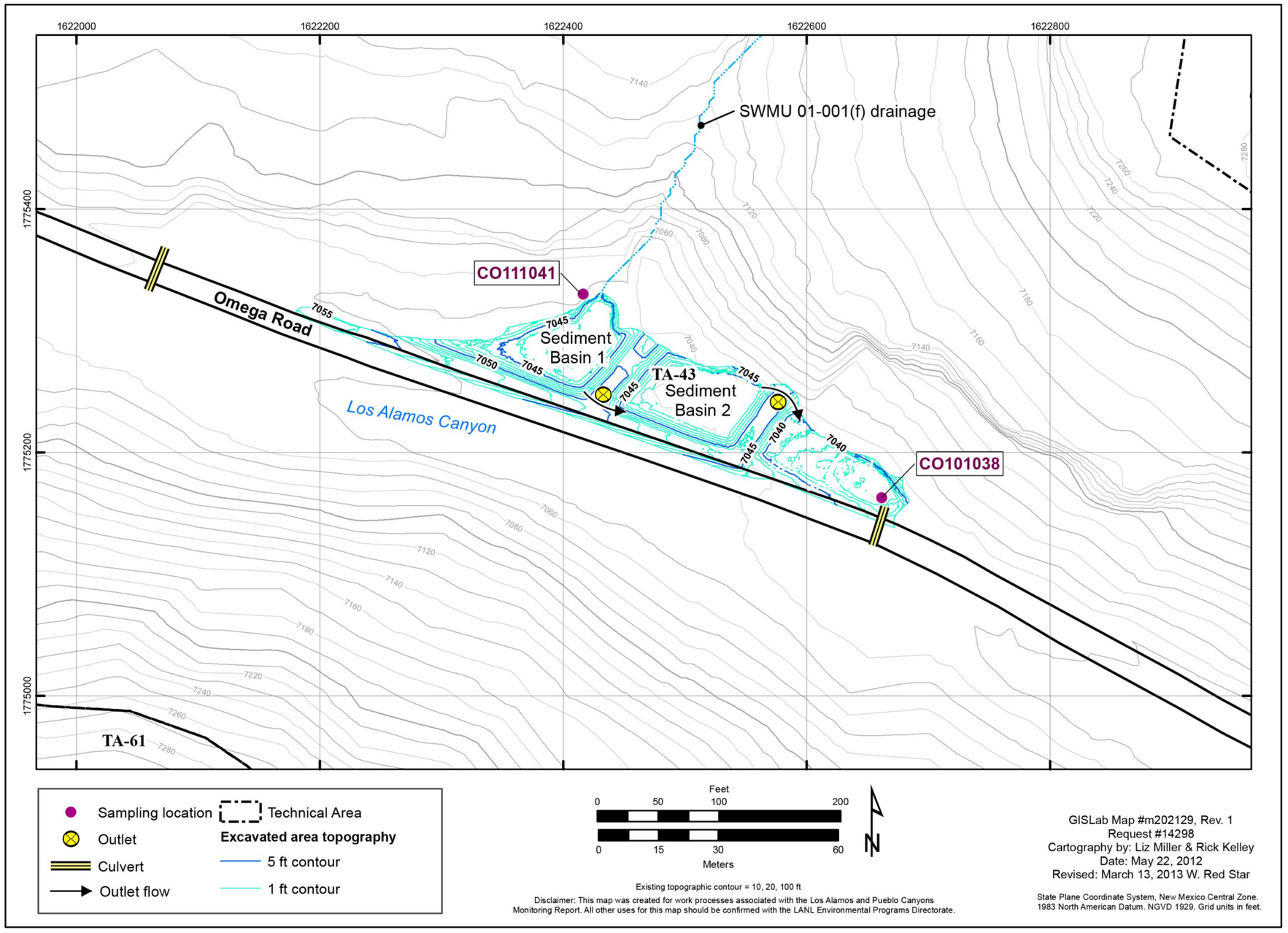


Figure 3.0-1 Detention basins and sampling locations below the SWMU 01-001(f) drainage

Table 3.0-1
Locations and Analytical Suites for Storm Water Samples

Monitoring Group	Locations	Analytical Suites[a,b]
Upper Los Alamos Canyon	E026, E030	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, isotopic uranium, americium-241 (by alpha spectroscopy), dioxin/furans, strontium-90, TAL[c] metals, hardness, cyanide, SSC, particle size
DP Canyon gages	E038, E039.1, E040	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, isotopic uranium, strontium-90, TAL metals, hardness, SSC, particle size
Upper Pueblo Canyon and Acid Canyon gages	E055, E055.5, E056	PCBs (by Method 1668A), isotopic plutonium, TAL Metals, hardness, SSC, particle size
Fire-affected lower watershed gages	E042.1, E050.1, E109.9	PCBs (by Method 1668A), isotopic plutonium, gamma spectroscopy radionuclides, isotopic uranium, americium-241 (by alpha spectroscopy), dioxin/furans, strontium-90, TAL metals, hardness, cyanide, SSC, particle size
Lower Pueblo Canyon gages	E059, E060.1	PCBs (by Method 1668A), isotopic plutonium, gamma spectroscopy radionuclides, isotopic uranium, americium-241 (by alpha spectroscopy), strontium-90, TAL metals, hardness, SSC, particle size
Detention basins and wetland below the SWMU 01-001(f) drainage	CO101038, CO111041	PCBs (by Method 1668A), TAL metals, hardness, isotopic uranium, total organic carbon, SSC
BDD[d]–Required Monitoring	E050.1, E060.1, E109.9	PCBs (by Method 1668A), gamma spectroscopy radionuclides, isotopic plutonium, isotopic uranium, americium-241 (by alpha spectroscopy), strontium-90, gross alpha, gross beta, radium-226/radium-228, TAL metals, Mercury, hardness, SSC

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

[b] Radionuclides will be analyzed in filtered and unfiltered samples at E109.9.

[c] TAL = Target analyte list; hardness is calculated from calcium and magnesium, components of the TAL list.

[d] BDD = Buckman Direct Diversion.

Table 3.2-1
Analytical Requirements for Storm Water Samples

Analytical Suite	Method	Detection Limit[a]	Upper Los Alamos Canyon	DP Canyon	Upper Pueblo Canyon and Acid Canyon	Fire Affected Lower Watershed	Lower Pueblo Canyon	BDD[b] Required Monitoring	Detention Basins below the SWMU 01-001(f) Drainage
PCBs	EPA:1668A	25 pg/L	√[c]	√	√	√	√	—[d]	√
Isotopic plutonium	HASL-300	0.5 pCi/L	√	√	√	√	√	—	—
Gamma spectroscopy	EPA:901.1	10 pCi/L (cesium-137)	√	√	—	√	√	—	—
Isotopic uranium	HASL-300	0.5 pCi/L	√	√	—	√	√	—	√
Americium-241	HASL-300	0.5 pCi/L	√	—	—	√	√	—	—
Strontium-90	EPA:905.0	0.5 pCi/L	√	√	—	√	√	—	—
TAL[e] metals	EPA:200.7/200.8/245.2	Variable	√	√	√	√	√	—	√
Cyanide	EPA:335.4	1.5 µg/L	√	—	—	√	—	—	—
Dioxins and furans	EPA:1613B	50 pg/L	√	—	—	√	—	—	—
Gross alpha	EPA:900	10 pCi/L	—	—	—	—	—	√	—
Gross beta	EPA:900	10 pCi/L	—	—	—	—	—	√	—
Radium-226/radium-228	EPA:903.1/EPA:904	0.5/0.5 pCi/L	—	—	—	—	—	√	—
SSC	EPA:160.2	10 mg/L	√	√	√	√	√	—	√
Total organic carbon	SW-846:9060	0.5 mg/L	—	—	—	—	—	—	√
Particle size	ASTM:C1070	0.01%	√	√	√	√	√	—	—

[a] MDL or MDA for radionuclides.

[b] BDD = Buckman Direct Diversion.

[c] √ = Monitoring planned.

[d] — = Monitoring not planned.

[e] TAL = Target analyte list; hardness is calculated from calcium and magnesium, components of the TAL list.

Table 3.2-2
Sampling Sequence for Collection of Storm Water Samples at the Detention Basins and Wetland below the SWMU 01-001(f) Drainage

Sample Bottle (1 L)	CO101038, CO111041	
	Start Time (min) 12-Bottle ISCO	Analytical Suite
1	Trigger	SSC
2	Trigger +1	PCB (UF[a])
3	Trigger +2	PCB (UF)
4	Trigger +3	TAL[b] metals (F[c]/UF)
5	Trigger +4	Isotopic uranium (UF)
6	Trigger +5	TOC[d] (UF)
7	Trigger +6	Extra bottle
8	Trigger +7	Extra bottle
9	Trigger +8	Extra bottle
10	Trigger +9	Extra bottle
11	Trigger +10	Extra bottle
12	Trigger +11	Extra bottle

[a] UF = Unfiltered.

[b] TAL = Target analyte list.

[c] F = Filtered.

[d] TOC = Total organic carbons.

Table 3.2-3
Sampling Sequence for Collection of Storm Water Samples at E030, E040, E055, E055.5, and E056

Sample Bottle (1 Liter)	Start Time (min) 12-Bottle ISCO	E055, E055.5, and E056	E030	E040
		Analytical Suites	Analytical Suites	Analytical Suites
1	Max+10	SSC (UF[a]); particle size	SSC, particle size	SSC, particle size
2	Max+11	PCB (UF)	PCB (UF)	PCB (UF)
3	Max+12	PCB (UF)	PCB (UF)	PCB (UF)
4	Max+13	Isotopic plutonium (UF)	Gamma spectroscopy(UF)	Gamma spectroscopy(UF)
5	Max+14	TAL[b] metals (F[c]/UF)	Americium-241; isotopic plutonium; isotopic uranium (UF)	Isotopic plutonium; isotopic uranium (UF)
6	Max+15	SSC	Americium-241; isotopic plutonium; isotopic uranium (UF)	Isotopic plutonium; isotopic uranium (UF)
7	Max+16	Extra bottle	Strontium-90 (UF)	Strontium-90 (UF)
8	Max+17	Extra bottle	Dioxins and furans (UF)	TAL metals (F/UF)
9	Max+18	Extra bottle	Dioxins and furans (UF)	SSC, particle size
10	Max+19	Extra bottle	TAL metals (F/UF)	Extra Bottle
11	Max+20	Extra bottle	Cyanide (UF)	Extra Bottle
12	Max+21	Extra bottle	SSC, particle size	Extra Bottle

[a] UF = Unfiltered.

[b] TAL = Target analyte list.

[c] F = Filtered.

Table 3.2-4
Sampling Sequence for Collection of Storm Water Samples at E026, E038, and E039.1

Sample Bottle (1 Liter)	Start Time (min) 12-Bottle ISCO	E026	E038 and E039.1	E026, E038, and E039.1	
		Analytical Suites	Analytical Suites	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge[a]
1	Max+10	PCB (UF[b])	PCB (UF)	Trigger	SSC
2	Max+11	PCB (UF)	PCB (UF)	Trigger+2	SSC
3	Max+12	Gamma spectroscopy(UF)	Gamma spectroscopy (UF)	Trigger+4	SSC
4	Max+13	Americium-241; isotopic plutonium; isotopic uranium (UF)	Isotopic uranium; isotopic plutonium (UF)	Trigger+6	SSC
5	Max+14	Americium-241; isotopic plutonium; isotopic uranium (UF)	Isotopic uranium; isotopic plutonium (UF)	Trigger+8	SSC
6	Max+15	Strontium-90 (UF)	Strontium-90 (UF)	Trigger+10	SSC
7	Max+16	Dioxins and furans (UF)	TAL metals (F/UF)	Trigger+12	SSC
8	Max+17	Dioxins and furans (UF)	Extra bottle	Trigger+14	SSC
9	Max+18	TAL[c] metals (F[d]/UF)	Extra Bottle	Trigger+16	SSC
10	Max+19	Cyanide (UF)	Extra Bottle	Trigger+18	SSC; particle size
11	Max+20	Extra bottle	Extra Bottle	Trigger+20	SSC
12	Max+21	Extra bottle	Extra Bottle	Trigger+22	SSC
13	n/a[e]	n/a	n/a	Trigger+24	SSC
14	n/a	n/a	n/a	Trigger+26	SSC
15	n/a	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	n/a	Trigger+30	SSC
17	n/a	n/a	n/a	Trigger+50	SSC
18	n/a	n/a	n/a	Trigger+70	SSC
19	n/a	n/a	n/a	Trigger+90	SSC
20	n/a	n/a	n/a	Trigger+110	SSC
21	n/a	n/a	n/a	Trigger+130	SSC
22	n/a	n/a	n/a	Trigger+150	SSC
23	n/a	n/a	n/a	Trigger+170	SSC
24	n/a	n/a	n/a	Trigger+190	SSC

[a] Two SSC analysis collected before the peak of discharge at E026 will be replaced by gamma spectroscopy and isotopic plutonium analyses.

[b] UF = Unfiltered.

[c] TAL = Target analyte list.

[d] F = Filtered.

[e] n/a = Not applicable.

Table 3.2-5
Sampling Sequence for Collection of Storm Water Samples at E042.1 and E059

Sample Bottle (1 L)	Start Time (min) 12-Bottle ISCO	E042.1	E059	E042.1 and E059	
		Analytical Suites 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge[a]
1	Max+10	PCB (UF[b])	PCB (UF)	Trigger	SSC
2	Max+11	Gamma spectroscopy (UF)	Gamma spectroscopy (UF)	Trigger+2	SSC
3	Max+12	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Trigger+4	SSC
4	Max+13	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Trigger+6	SSC
5	Max+14	Strontium-90 (UF)	Strontium-90 (UF)	Trigger+8	SSC
6	Max+16	TAL[c] metals (F[d]/UF)	TAL metals (F/UF)	Trigger+10	SSC
7	Max+17	Cyanide (UF)	Extra bottle	Trigger+12	SSC
8	Max+60	PCB (UF)	PCB (UF)	Trigger+14	SSC
9	Max+61	Isotopic plutonium (UF)	Isotopic plutonium (UF)	Trigger+16	SSC; particle size
10	Max+105	PCB (UF)	PCB (UF)	Trigger+18	SSC
11	Max+106	Isotopic plutonium (UF)	Isotopic plutonium (UF)	Trigger+20	SSC
12	n/a[e]	n/a	n/a	Trigger+22	SSC
13	n/a	n/a	n/a	Trigger+24	SSC
14	n/a	n/a	n/a	Trigger+26	SSC
15	n/a	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	n/a	Trigger+30	SSC
17	n/a	n/a	n/a	Trigger+50	SSC; particle size
18	n/a	n/a	n/a	Trigger+70	SSC
19	n/a	n/a	n/a	Trigger+90	SSC; particle size
20	n/a	n/a	n/a	Trigger+110	SSC
21	n/a	n/a	n/a	Trigger+130	SSC
22	n/a	n/a	n/a	Trigger+150	SSC
23	n/a	n/a	n/a	Trigger+170	SSC
24	n/a	n/a	n/a	Trigger+190	SSC

[a] Two SSC analysis collected before the peak of discharge will be replaced by gamma spectroscopy and isotopic plutonium analyses.

[b] UF = Unfiltered.

[c] TAL = Target analyte list.

[d] F = Filtered.

[e] n/a = Not applicable.

Table 3.2-6
Sampling Sequence for Collection of Storm Water Samples at E050.1 and E060.1

Sample Bottle (1 Liter)	Start Time (min) 12-Bottle ISCO	E050.1	E060.1	E050.1 and E060.1	
		Analytical Suites 12-Bottle ISCO	Analytical Suites 12-Bottle ISCO	Start Time (min) 24-Bottle ISCO	Analytical Suites 24-Bottle ISCO 1-L Poly Wedge[a]
1	Max+10	PCB (UF[b])	PCB (UF)	Trigger	SSC
2	Max+11	Gamma spectroscopy (UF)	Gamma spectroscopy (UF)	Trigger+2	SSC
3	Max+12	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Trigger+4	SSC
4	Max+13	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Trigger+6	SSC
5	Max+14	Strontium-90 (UF)	Strontium-90 (UF)	Trigger+8	Radium-226 (UF)
6	Max+16	TAL[c] metals (F[d]/UF)	TAL metals (F/UF)	trigger+12	Radium-228 (UF)
7	Max+17	Gross alpha/beta (UF) cyanide (UF)	Gross alpha/beta (UF)	Trigger+14	SSC
8	Max+60	PCB (UF)	PCB (UF)	Trigger+16	SSC
9	Max+61	Isotopic plutonium (UF)	Isotopic plutonium (UF)	Trigger+18	SSC; particle size
10	Max+105	PCB (UF)	PCB (UF)	Trigger+20	SSC
11	Max+106	Isotopic plutonium (UF)	Isotopic plutonium (UF)	Trigger+22	SSC
12	n/a[e]	n/a	n/a	Trigger+24	SSC
13	n/a	n/a	n/a	Trigger+26	SSC
14	n/a	n/a	n/a	Trigger+28	SSC
15	n/a	n/a	n/a	Trigger+30	SSC
16	n/a	n/a	n/a	Trigger+50	SSC
17	n/a	n/a	n/a	Trigger+70	SSC; particle size
18	n/a	n/a	n/a	Trigger+90	SSC
29	n/a	n/a	n/a	Trigger+110	SSC; particle size
20	n/a	n/a	n/a	Trigger+130	SSC
21	n/a	n/a	n/a	Trigger+150	SSC
21	n/a	n/a	n/a	Trigger+170	SSC
23	n/a	n/a	n/a	Trigger+190	SSC
24	n/a	n/a	n/a	Trigger+210	SSC

[a] Two SSC analysis collected before the peak of discharge will be replaced by gamma spectroscopy and isotopic plutonium analyses.

[b] UF = Unfiltered.

[c] TAL = Target analyte list.

[d] F = Filtered.

[e] n/a = Not applicable.

Table 3.2-7
Sampling Sequence for Collection of Storm Water Samples at E109.9

Sample Bottle (1 L)	E109.9			
	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[a]
1	Max+10	PCB (UF[b])	Trigger	SSC
2	Max+11	Gamma spectroscopy (UF)	Trigger+2	SSC
3	Max+12	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Trigger+4	SSC
4	Max+13	Isotopic plutonium, americium-241, and isotopic uranium (UF)	Trigger+6	SSC
5	Max+14	Strontium-90 (UF)	Trigger+8	SSC
6	Max+15	Dioxins and furans (UF)	Trigger+10	Gamma spectroscopy; isotopic plutonium, americium-241, and isotopic uranium (F)
7	Max+16	TAL[c] metals (F[d]/UF)	Trigger+12	SSC; particle size
8	Max+17	Gross alpha/beta (UF) cyanide (UF)	Trigger+14	Strontium-90 (F)
9	Max+60	PCB (UF)	Trigger+16	SSC
10	Max+61	Isotopic plutonium (UF)	Trigger+18	Radium-226 (UF)
11	Max+105	PCB (UF)	Trigger+20	SSC
12	Max+106	Isotopic plutonium (UF)	Trigger+22	Radium-228 (UF)
13	n/a[e]	n/a	Trigger+24	SSC
14	n/a	n/a	Trigger+26	Radium-226 (F)
15	n/a	n/a	Trigger+28	SSC
16	n/a	n/a	Trigger+30	Radium-228 (F)
17	n/a	n/a	Trigger+50	SSC
18	n/a	n/a	Trigger+70	SSC; particle size
19	n/a	n/a	Trigger+90	SSC
20	n/a	n/a	Trigger+110	SSC; particle size
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] Two SSC analysis collected before the peak of discharge will be replaced by gamma spectroscopy and isotopic plutonium analyses.

[b] UF = Unfiltered.

[c] TAL = Target analyte list.

[d] F = Filtered.

[e] n/a = Not applicable.