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Los Alamos National Laboratory Environmental Surveillance Program Sampling and Analysis Plan for Sediment, 2012

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Prepared by the Environmental Programs Directorate

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1.0 INTRODUCTION

Monitoring of contaminants in affected environmental media at U.S. Department of Energy (DOE) sites is required under DOE Order 450.1A, Environmental Protection Program (DOE 2008). Annual monitoring of contaminants in sediments at selected locations at and near Los Alamos National Laboratory (LANL or the Laboratory) has occurred since 1969, and results are reported in the annual Environmental Report (e.g., LANL 2011a). This annual monitoring has been largely focused on active stream channel sediments, supplemented by sampling of other geomorphic settings such as sediment retention basins, floodplains, river banks and bars, and reservoirs to evaluate potential Laboratory impacts and to monitor trends in contamination over time. This monitoring is complemented by sediment sampling that occurs under other programs, including more detailed watershed-scale investigations that provide data on the nature and extent of contaminants in sediment deposits and that are used to evaluate potential human health and ecological risk (e.g., LANL 2004; LANL 2006; LANL 2009a; LANL 2009b; LANL 2009c; LANL 2009d; LANL 2011b; LANL 2011c; LANL 2011d). These latter investigations are currently conducted under the March 2005 Compliance Order on Consent with the New Mexico Environment Department (NMED). Additional monitoring of contaminants associated with sediment is provided through sampling of stormwater, which is also discussed in the annual Environmental Reports. In combination, the detailed watershed-scale sediment investigations and the stormwater sampling help to guide the annual surveillance sediment sampling by identifying key locations and analytical suites.

This sampling and analysis plan (SAP) presents the planned locations and analytical suites for Environmental Surveillance Program sediment sampling in calendar year 2012. This SAP is based on results from surveillance sediment sampling in previous years, combined with results from other sediment investigations and stormwater sampling. In addition to repeat samples from active stream channel locations, this SAP includes other samples intended to address specific questions concerning the potential environmental impacts from Laboratory activities. A primary focus of the sampling is to evaluate contaminants that cross or may cross the eastern, downstream Laboratory boundary and potentially reach the Rio Grande, including any impacts on the Rio Grande. A secondary focus is to evaluate temporal trends in contaminant concentrations closer to sources in watersheds that have been most impacted by Laboratory activities.

Work presented in this SAP follows the process specified in the Quality Assurance Project Plan for the Environmental Surveillance Program Sediment Sampling Project. Sampling will occur after the 2012 summer monsoon season to evaluate the combined effects of summer floods on contaminant concentrations. Many potential sampling locations are identified as contingency locations, that is, to be sampled contingent on the occurrence of runoff in the previous year for active stream channel samples or on the occurrence of large flood events resulting in new fine-grained sediment deposits in other settings. Subsequent to the 2012 summer monsoon season and before the samples table is finalized, stream gaging station records will be reviewed to identify which channels have experienced flow and which have experienced large flood events. As a preliminary guide to the recognition of large flood events (the size of which varies between canyons), Table 1 summarizes data on the size of runoff events at select gaging stations on the Pajarito Plateau (e.g., Ortiz and McCullough 2010). Canyons that have runoff near or exceeding the approximate 5-yr discharge or stage will be visited in the field to determine the presence or absence of new fine-grained sediment deposits of sufficient thickness to sample before the samples table is finalized.

In June and July 2011, the Las Conchas fire burned large areas in the headwaters of Los Alamos, Pajarito, and Water Canyons and their tributaries (LANL 2011e). Large floods occurred in these watersheds in 2011 that originated in the Las Conchas burn area, causing both erosion and sediment deposition. Additional large floods in these watersheds are possible in 2012. In 2011, the analytical suites in these watersheds were modified to include analytes that were identified as being elevated in ash-bearing sediment after the Cerro Grande fire (e.g., Katzman et al. 2001; Kraig et al. 2002; LANL 2004), to help evaluate the effects of the Las Conchas fire. Expanded analytical suites are also planned to be used in the 2012 sampling in these watersheds, contingent on the availability of funding. Table 2 presents planned and contingency sample locations and analytical suites for 2012, indicating analyses potentially added to evaluate effects of the Las Conchas fire. The number of sampling locations was also expanded in 2011 in fire-affected watersheds to both provide baseline data (sample locations above Laboratory sites and in non-Laboratory affected watersheds) and to evaluate the effects of post-fire floods on contaminant transport, particularly in the Water Canyon watershed where exceptionally large floods occurred in August 2011. Supplemental sample locations may also be added in 2012 contingent on the occurrence of large post-fire floods and the availability of funding.

2.0 LOS ALAMOS CANYON WATERSHED

The nature and sources of contaminants in sediment in the Los Alamos Canyon watershed are well defined from previous studies (e.g., LANL 2004; LANL 2009c). The primary Laboratory sources of contaminants are in upper Los Alamos Canyon (including its tributary DP Canyon) and Pueblo Canyon (including its tributary Acid Canyon). Additional sources for contaminants in sediment are the Los Alamos townsite and the Cerro Grande and Las Conchas burn areas. Los Alamos and Pueblo Canyons have both had known transport of Laboratory-derived contaminants to the Rio Grande, and monitoring of these canyons is important for understanding off-site transport. The Los Alamos Canyon watershed also includes Barrancas, Bayo, Guaje, and Rendija Canyons, but significant contamination from Laboratory activities has not been identified in sediment in these canyons (LANL 2009c); therefore, no sampling is planned in these canyons for the evaluation of potential Laboratory impacts. However, supplemental sampling in Guaje Canyon may be included as a baseline site in 2012 to help evaluate the effects of the Las Conchas fire.

2.1 Active Stream Channel Samples

Seven active channel locations that have been historically sampled in the Los Alamos Canyon watershed (shown in Figure 1) are considered to be sufficient to define spatial and temporal trends in contaminant concentrations in the stream beds. These include DP and Los Alamos Canyons above their confluence, Acid and Pueblo Canyons above their confluence, Los Alamos and Pueblo Canyons above the eastern Laboratory boundary (above NM 4 and NM 502, respectively), and Los Alamos Canyon above the Rio Grande (Los Alamos at Otowi). Note that the historical names for New Mexico state highways associated with sediment sampling locations are preceded by “SR” for “State Road,” and “SR” is interchangeable with “NM.” In 2010, the gaging station in Pueblo Canyon above NM 502 was moved downstream to a location below the newly constructed Pueblo Canyon grade-control structure (GCS), and the annual surveillance sampling location was also moved downstream to a location below the new gage (E060.1). Contaminants of concern that are, or may be, derived from Laboratory sites include metals, polychlorinated biphenyls (PCBs), and radionuclides. Planned sampling locations and analytical suites for 2012 are shown in Table 2.

2.2 Other Sediment Samples

In addition to active stream channels, other geomorphic settings in the Los Alamos Canyon watershed that are useful to evaluate trends in sediment contamination over time include floodplains, sediment retention structures, and GCSs. Potential sampling locations for these settings are shown in Figure 2.

Floodplains or other areas of fine-grained sediment deposition in reach LA-3E (in Los Alamos Canyon above NM 4), reach LA-5 (in Los Alamos Canyon above the Rio Grande), and reach P-4E (in Pueblo Canyon above NM 502) are planned for sampling in 2012 if significant floods occur that produce new overbank sediment deposits in these areas. Such floods are expected in the Los Alamos Canyon reaches, associated with runoff from the Las Conchas burn area. Supplemental sampling occurred in lower Guaje Canyon above NM 502 in 2011, as a baseline area, and additional sampling here in 2012 is possible. Two samples of fine-grained sediment would be collected in each reach for the analyte suite shown in Table 2. Reach P-4E was last sampled in September 2007 to evaluate sediment deposits resulting from large floods in August 2006 (Reneau and Koch 2008). Reaches LA-3E and LA-5 and lower Guaje Canyon were last sampled in December 2011 to evaluate sediment deposits from large floods in August 2011.

A sediment retention structure, the Los Alamos Canyon low-head weir, was constructed above NM 4 in summer 2000 after the Cerro Grande fire to reduce the off-site transport of contaminants associated with sediment in post-fire floods. This site was last sampled in November 2011 as part of the Environmental Surveillance Program, which included ash-rich sediment derived from the Las Conchas burn area. Up to four samples are planned to be collected at the weir in 2012 to document trends in contaminant concentrations at this location and, in combination with volume estimates obtained from repeat surveys, to estimate the amount or inventory of contaminants accumulated behind this structure. The analytical suite is shown in Table 2 and includes dioxins and furans because of increases in concentrations that occurred during summer 2008 runoff events.

GCSs were constructed in DP and Pueblo Canyons in late 2009 and early 2010 to mitigate the transport of contaminated sediment in these canyons (LANL 2010a; LANL 2010b). The area above the DP Canyon GCS was last sampled in November 2011, and the area above the Pueblo Canyon GCS was last sampled in December 2010. Up to four samples are planned to be collected above each of these structures in 2012 to document trends in contaminant concentrations at these locations and, in combination with volume estimates obtained from repeat surveys, to estimate the amount or inventory of contaminants accumulated behind these structures. The analytical suites are shown in Table 2.

Following excavation of PCB-contaminated sediment in late 2009 and early 2010, two sediment detention basins were constructed along the drainage below Solid Waste Management Unit (SWMU) 01-001(f) in upper Los Alamos Canyon (also known as the LA-SMA-2 drainage or Hillside 140) (LANL 2010c). The upper basin was last sampled in November 2011. The analytical suites are shown in Table 2.

3.0 SANDIA CANYON WATERSHED

The nature and sources of contaminants in sediment in the Sandia Canyon watershed are well defined from previous studies (e.g., LANL 2009b). The primary Laboratory sources of contaminants are near the headwaters of Sandia Canyon at Technical Area 03 (TA-03). Additional sources for contaminants in sediment also exist farther east, including at TA-53 and/or TA-72. Probable off-site transport of contaminants has occurred in Sandia Canyon, although there is no evidence of these contaminants having reached the Rio Grande.

3.1 Active Stream Channel Samples

Three active channel locations that have been historically sampled in Sandia Canyon (shown in Figure 1) are considered to be sufficient to define spatial and temporal trends in contaminant concentrations in the stream bed. These include locations below the wetland, above NM 4 and the eastern Laboratory boundary, and above the Rio Grande. Contaminants of concern that are, or may be, derived from

Laboratory sites include metals and PCBs. Planned sampling locations and analytical suites for 2012 are shown in Table 2. Because runoff does not extend beyond the Laboratory boundary every year (no flow was recorded at gaging station E125 above NM 4 in 38% of the years from 1995 to 2011), sampling of the active channel at the two eastern locations is contingent on runoff occurring in 2012 before the sampling event.

3.2 Other Sediment Samples

In addition to active stream channels, other geomorphic settings in the Sandia Canyon watershed that are useful to evaluate trends in sediment contamination over time include floodplains and low-lying abandoned channel surfaces that experience overbank flooding. Potential sampling locations for these settings are shown in Figure 2. Floodplains or other areas of fine-grained sediment deposition in reach S-5E (in Sandia Canyon above NM 4) are planned for sampling in 2012 if significant floods occur that produce new overbank sediment deposits in this reach. Two samples of fine-grained sediment would be collected in this reach for the analyte suite shown in Table 2. This area was last sampled in June 2007 (LANL 2009b).

4.0 MORTANDAD CANYON WATERSHED

The nature and sources of contaminants in sediment in Mortandad Canyon and its tributaries are well defined from previous studies (e.g., LANL 2006; LANL 2009a). The primary Laboratory source of contaminants in the watershed is the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) that discharges into Effluent Canyon. Additional sources for contaminants in sediment in Mortandad Canyon are TA-35, TA-48, and runoff from developed areas in TA-03 at the head of the canyon. Sources of contaminants in sediment in Cañada del Buey, a major tributary to Mortandad Canyon, include TA-46 and TA-54. Previous investigations have indicated no off-site transport of contaminants in Mortandad Canyon, although continued monitoring is appropriate.

4.1 Active Stream Channel Samples

Five locations along the main stream channel in Mortandad Canyon and one location in Cañada del Buey (shown in Figure 1) that have been historically sampled are considered to be sufficient to define spatial and temporal trends in contaminant concentrations in the primary stream beds. These include Mortandad Canyon above Effluent Canyon (Mortandad west of GS-1), below Effluent Canyon, at well MCO-8.5 (east of the sediment traps), at the Laboratory boundary, and at the Rio Grande, and Cañada del Buey below Material Disposal Area (MDA) G. Contaminants of concern that are, or may be, derived from Laboratory sites include metals, PCBs, and radionuclides. Planned sampling locations and analytical suites for 2012 are shown in Table 2. Because runoff does not extend beyond the Mortandad Canyon sediment traps in most years, sampling the active channel at well MCO-8.5 and at the Laboratory boundary are contingent on runoff occurring in 2012 before the sediment sampling event (flow is known to have passed MCO-8.5 only once in the last 20 yr, on August 25, 2006, never passing the Laboratory boundary since RLWTF discharges began in 1963; LANL 2006). Runoff has been recorded crossing the Laboratory boundary in Cañada del Buey every year since gaging station E230 was established in 1994, and therefore sampling at the Cañada del Buey station and downcanyon in Mortandad Canyon above the Rio Grande is planned in 2012.

In addition to sampling locations along the main stream channels, five locations along short tributary drainages to Cañada del Buey below MDA G at TA-54 have been historically sampled and are shown in Figure 3. Four of these locations, MDA G-10, MDA G-10.7, MDA G-10.8, and MDA G-13, have very small drainage areas and limited sediment deposits on bedrock and do not flow every year. Sampling will be contingent on flow occurring before the 2012 sampling event and producing sediment deposits of sufficient thickness to sample. Planned sampling locations and analytical suites for 2012 are shown in Table 2.

4.2 Other Sediment Samples

In addition to active stream channels, other geomorphic settings in the Mortandad Canyon watershed that are useful to evaluate trends in sediment contamination over time include floodplains and low-lying abandoned channel surfaces that experience overbank flooding and the Mortandad Canyon sediment traps. Potential sampling locations for these settings are shown in Figure 2.

Floodplains or other areas of fine-grained sediment deposition in reach CDB-3E (in Cañada del Buey below MDA G) are planned for sampling in 2012 if significant floods occur that produce new overbank sediment deposits in this reach. Two samples of fine-grained sediment would be collected in this reach for the analyte suite shown in Table 2. This reach was last sampled in September 2004 (LANL 2009a).

The Mortandad Canyon sediment traps impound water and accumulate sediment after runoff events, although only the largest events flow past trap #1 and into trap #2 or trap #3. Up to three samples of fine-grained sediment and one sample of coarse-grained sediment would be collected from the sediment traps following significant runoff events for the analyte suite shown in Table 2. Fine-grained sediment from all three sediment traps was sampled in September 2007 to evaluate sediment deposits resulting from a large flood in August 2006 that filled the traps to capacity (Reneau and Koch 2008).

5.0 PAJARITO CANYON WATERSHED

The nature and sources of contaminants in sediment in the Pajarito Canyon watershed are well defined from previous studies (e.g., LANL 2009d). The primary Laboratory sources of contaminants identified in sediment include TA-08 and TA-09 in the upper Pajarito Canyon watershed, TA-15 in the Threemile Canyon watershed, and TA-03 and TA-69 in the Twomile Canyon watershed. Additional sources for contaminants in sediment are the Cerro Grande and Las Conchas burn areas and developed areas within various TAs and the White Rock townsite. Pajarito Canyon has had probable transport of Laboratory-derived contaminants to the Rio Grande, and monitoring of this watershed is important for understanding off-site transport.

5.1 Active Stream Channel Samples

Two areas along the main stream channel in Pajarito Canyon that have been historically sampled (shown in Figure 1) are considered to be sufficient to define spatial and temporal trends in contaminant concentrations in the primary stream beds. These areas are Pajarito Canyon above SR-4 and above the Rio Grande. Because the Pajarito Canyon channel near the Rio Grande, below Pajarito Springs, is bouldery and contains little sediment that can be sampled, the sample location will be moved upstream to above Pajarito Springs, to within reach PA-5W below White Rock. Runoff has been recorded crossing the Laboratory boundary in Pajarito Canyon most years since gaging station E250 was established in 1995, and sampling at the two locations along the main Pajarito Canyon channel in 2012 will be contingent on runoff being recorded at E250 before the sampling event. In addition, sampling is planned at up to five locations along short tributary drainages to Pajarito Canyon below MDA G at TA-54 that have been historically sampled and are shown in Figure 3, contingent on the occurrence of runoff events and the existence of sufficient new sediment to sample. Contaminants of concern that are, or may be, derived from Laboratory sites include metals, dioxins and furans, explosive compounds, PCBs, semivolatile organic compounds (SVOCs), and radionuclides. Dioxins and furans and SVOCs were added to the analytical suite in this watershed beginning in 2010 at the request of NMED (NMED 2009). However, the Laboratory proposes to eliminate sampling for SVOCs in 2012 because they have been detected only at low concentrations in sediment samples collected in the Pajarito Canyon watershed, at concentrations below what is measured in areas receiving urban runoff, and are not useful for evaluating potential impacts from SWMUs. Planned sampling locations and analytical suites for 2012 are shown in Table 2.

5.2 Other Sediment Samples

In addition to active stream channels, other geomorphic settings in the Pajarito Canyon watershed that are useful to evaluate trends in sediment contamination over time include wetlands and an impoundment behind a flood-retention structure (FRS). Potential sampling locations for these settings are shown in Figure 2.

The wetlands in reach PA-3E (Pajarito Canyon below TA-18) and reach PA-4 (Pajarito Canyon above NM 4) are planned for sampling in 2012 if significant floods occur that produce new overbank sediment deposits in these reaches. Two samples of fine-grained sediment would be collected in each reach for the analyte suite shown in Table 2. Reaches PA-3E and PA-4 were last sampled in November 2011 following floods derived from the Las Conchas burn area.

The Pajarito Canyon FRS was constructed below the confluence of Pajarito and Twomile Canyons in summer 2000 after the Cerro Grande fire to reduce the potential for flooding at TA-18. Water impounds here during large floods, resulting in sediment deposition that extends upstream from the confluence in both canyons. Two samples of fine-grained sediment would be collected from reach PA-2W (Pajarito Canyon above the confluence) and reach TW-4E (Twomile Canyon above the confluence) following significant runoff events that impound water in these areas for the analyte suites shown in Table 2. These reaches were last sampled in November 2011 following floods derived from the Las Conchas burn area.

6.0 WATER CANYON WATERSHED

The nature and distribution of contaminants in sediment in the Water Canyon watershed, including its tributaries Cañon de Valle and Fence, Indio, and Potrillo Canyons, are partially known, in part because of the recent completion of investigations in Potrillo and Fence Canyons (LANL 2011c), Indio Canyon (LANL 2011b), and Water Canyon and Cañon de Valle (LANL 2011d). The primary Laboratory sources of contaminants identified in sediment are in TA-16 in the upper Cañon de Valle and Water Canyon watershed, with smaller sources in TA-36 in upper Potrillo Canyon and other Laboratory sites. Additional sources for contaminants in sediment are the Cerro Grande and Las Conchas burn areas. Water Canyon has had known transport of Laboratory-derived contaminants to the Rio Grande, and monitoring of this watershed is important for understanding off-site transport.

6.1 Active Stream Channel Samples

Five active channel locations that have been historically sampled in the Water Canyon watershed (shown in Figure 1) are considered to be sufficient to define spatial and temporal trends in contaminant concentrations in the stream bed. These include locations in Water Canyon below the confluence with Cañon de Valle (Water at Beta), in Fence, Potrillo, and Water Canyons above NM 4, and in Water Canyon above the Rio Grande. Indio Canyon has no known Laboratory contaminants, and therefore no monitoring is needed (LANL 2011b). Contaminants of concern that are, or may be, derived from

Laboratory sites include metals, explosive compounds, PCBs, and radionuclides. Planned sampling locations and analytical suites for 2012 are shown in Table 2. Because runoff does not extend beyond NM 4 every year in any of these canyons, sampling of the active channel at the locations near NM 4 or the Rio Grande is contingent on runoff occurring in 2012 before the sampling event.

6.2 Other Sediment Samples

In addition to active stream channels, other geomorphic settings in the Water Canyon watershed that are useful to evaluate trends in sediment contamination over time include floodplains and low-lying abandoned channel surfaces that experience overbank flooding. Potential sampling locations for these settings are shown in Figure 2. Floodplains or other areas of fine-grained sediment deposition in areas immediately above NM 4 are planned for sampling in 2012 if significant floods occur that produce new overbank sediment deposits in these areas. Reach PO-4 was last sampled in November 2011 following a flood in September 2011, and reach WA-4 was also last sampled in November 2011 following large floods in August 2011 that were derived from the Las Conchas burn area. Reach F-3 was last sampled in July 2010 as part of a more intensive investigation (LANL 2011c). Two samples of fine-grained sediment would be collected in each area for the analyte suites shown in Table 2. These analyte suites are based on the results of previous investigations in these canyons.

7.0 ANCHO CANYON WATERSHED

The nature and sources of contaminants in sediment in the Ancho Canyon watershed are well defined from previous studies (e.g., LANL 2011b). The primary Laboratory sources of contaminants identified in sediment are in the north fork of Ancho Canyon at TA-39, with minor sources also identified at TA-49. An additional source for contaminants in sediment is the burn area from the 1977 La Mesa fire. Previous investigations have indicated no off-site transport of contaminants in Ancho Canyon, although continued monitoring is appropriate.

7.1 Active Stream Channel Samples

Three active channel locations that have been historically sampled in the Ancho Canyon watershed (shown in Figure 1) are considered to be sufficient to define spatial and temporal trends in contaminant concentrations in the stream bed. These include locations in main Ancho Canyon and the north fork of Ancho Canyon above their confluence (below NM 4), and in Ancho Canyon near the Rio Grande. Contaminants of concern that are, or may be, derived from Laboratory sites include metals, explosive compounds, PCBs, and isotopic uranium. Planned sampling locations and analytical suites for 2012 are shown in Table 2, which includes contaminants identified in a detailed investigation of Ancho Canyon sediment deposits in 2010 (LANL 2011b). Because runoff does not extend beyond the confluence every year in these channels, sampling of the active channel at these locations is contingent on runoff occurring in 2012 before the sampling event.

7.2 Other Sediment Samples

In addition to active stream channels, other geomorphic settings in the Ancho Canyon watershed that are useful to evaluate trends in sediment contamination over time include floodplains and low-lying abandoned channel surfaces that experience overbank flooding. Potential sampling locations for these settings are shown in Figure 2. Floodplains or other areas of fine-grained sediment deposition in areas immediately above and below the confluence of main Ancho Canyon and the north fork are planned for sampling in 2012 if significant floods occur that produce new overbank sediment deposits in these areas.

Reaches A-3 and AN-4 were last sampled in July 2010 as part of a more intensive investigation (LANL 2011b), and Ancho Canyon above the north fork was last sampled in November 2008 following a record flood in August 2008 (Reneau and Kuyumjian 2009). Two samples of fine-grained sediment would be collected in each area for the analyte suite shown in Table 2, which includes contaminants identified in a detailed investigation of Ancho Canyon sediment deposits in 2010 (LANL 2011b).

8.0 CHAQUEHUI CANYON WATERSHED

The nature and sources of contaminants in sediment in the Chaquehui Canyon watershed are well defined from previous studies (e.g., LANL 2011b). All potential Laboratory sources of contaminants identified in sediment are at TA-33, which includes runoff from developed areas in addition to releases from SWMUs or areas of concern (AOCs). Chaquehui Canyon has had probable transport of Laboratory-derived contaminants to the Rio Grande, and monitoring of this watershed is important for understanding potential off-site transport.

8.1 Active Stream Channel Samples

One active channel location that has been previously sampled in the Chaquehui Canyon watershed (shown in Figure 1) is considered to be sufficient to define spatial and temporal trends in contaminant concentrations in the stream bed. This location is in main Chaquehui Canyon below the confluence with its north fork. Contaminants of concern that are, or may be, derived from Laboratory sites in this watershed include metals, cyanide, PCBs, and tritium. The planned analytical suite for 2012 is shown in Table 2 and includes contaminants identified in a detailed investigation of Chaquehui Canyon sediment deposits in 2010 (LANL 2011b). Because runoff does not extend beyond the confluence every year in these channels, sampling of the active channel at this location is contingent on runoff occurring in 2012 before the sampling event.

8.2 Other Sediment Samples

In addition to active stream channels, other geomorphic settings in the Chaquehui Canyon watershed that are useful to evaluate trends in sediment contamination over time include floodplains and low-lying abandoned channel surfaces that experience overbank flooding. Potential sampling locations for these settings are shown in Figure 2. Floodplains or other areas of fine-grained sediment deposition in areas below the confluence of main Chaquehui Canyon and the north fork are planned for sampling in 2012 if significant floods occur that produce new overbank sediment deposits in these areas. Reach CH-2 was last sampled in August 2010 as part of a more intensive investigation (LANL 2011b). Two samples of fine-grained sediment would be collected in this area for the analyte suite shown in Table 2, which includes contaminants identified in a detailed investigation of Chaquehui Canyon sediment deposits in 2010 (LANL 2011b).

9.0 RIO GRANDE

The nature and concentration of potential Laboratory-derived contaminants in sediment in the Rio Grande and at a downriver reservoir (Cochiti Reservoir) have been evaluated by comparing data from samples collected upriver and downriver from canyons that drain the Laboratory in combination with data from farther west on the Pajarito Plateau. Sampling in 2011 included five samples each from one area upriver of Los Alamos Canyon and all Laboratory sources, and two areas along the Rio Grande downriver from Los Alamos Canyon (above Buckman and below Water Canyon). The collection of five samples in each area allows examination of variations in analyte concentrations that result from particle size variations as well as sediment deposited in different geomorphic settings and probably during different runoff events (e.g., silt and clay in low-water areas in contrast to higher sand bars deposited during higher flow conditions). Sampling in these areas in 2012 is contingent on the occurrence of significant runoff events in canyons draining the Laboratory before the sampling event, and, depending on the specific locations of floods, other sampling areas may be added. The analytical suite will be dependent on which canyon or canyons flood. A preliminary analyte suite for these samples that assumes flooding in Los Alamos and Water Canyons is shown in Table 2. In Table 2, a subwatershed designation of “White Rock Canyon” indicates areas downriver of Los Alamos Canyon that are potentially impacted by the Laboratory, whereas a subwatershed designation of “Rio Grande” indicates areas upriver of Los Alamos Canyon (background or baseline areas).

Cochiti Reservoir was not sampled in 2011 because of logistical constraints following the Las Conchas fire, although sampling is provisionally planned for twice in 2012, once before the 2012 snowmelt runoff peak and once after the 2012 monsoon season, to document the effects of post-fire floods on Cochiti Reservoir sediment and potential Laboratory contributions.

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Security Fence; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Unknown; August 17, 2011.

Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating, and Mapping Section; Unknown; August 17, 2011.

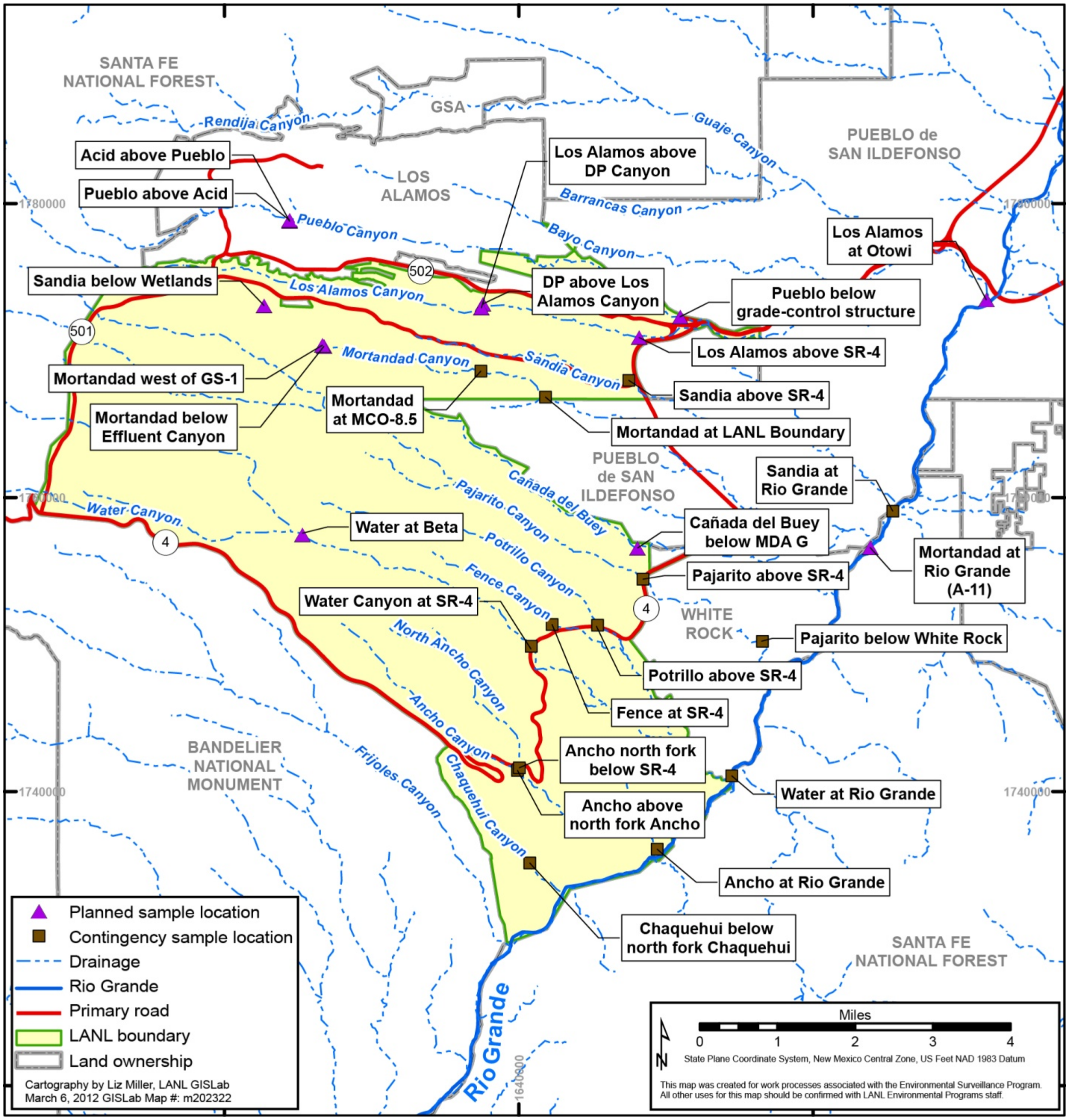

Figure 1 Active channel sampling locations in canyons downstream from Laboratory sites

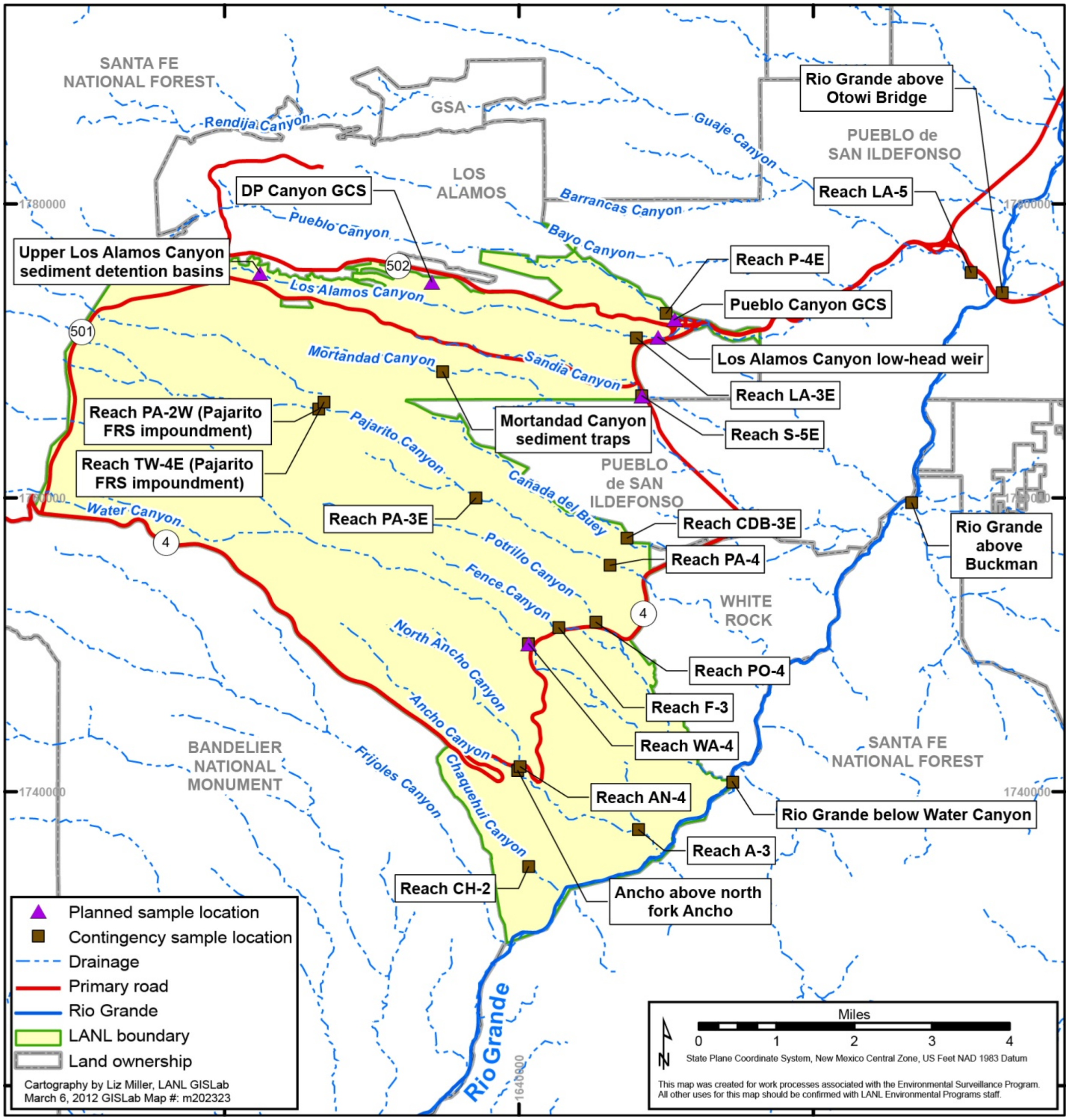

Figure 2 Sampling locations outside active channels in canyons downstream from Laboratory sites and along the Rio Grande

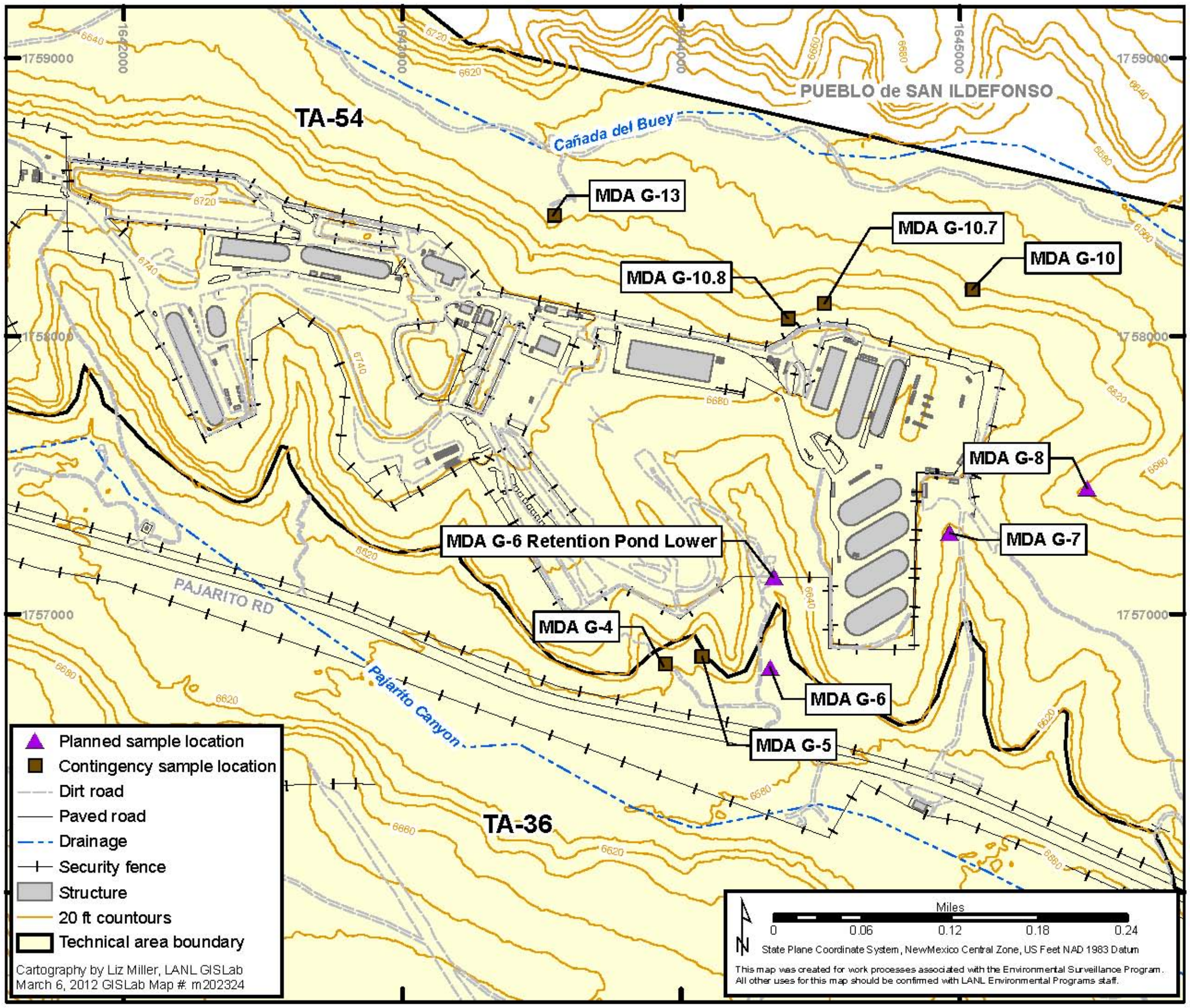

Figure 3 Sampling locations along drainages below MDA G at TA-54

Table 1
Summary of Runoff Events Recorded at
Select Stream Gages Downstream from SWMUs and AOCs

Gage	Gage Name	Period of Record	Maximum Recorded Discharge (cfs) or Stage (ft)	Year of Maximum Discharge	Approximate 5-yr Discharge (cfs[a]) or Stage (ft)[b]	Percent of Years with No Recorded Flow
E039.1[c]	DP below grade control structure	2000–2011	355 cfs	2006	290 cfs	0%
E042.1[b]	Los Alamos above low-head weir	1995–2011	240 cfs	2006	160 cfs	0%
E060.1[b]	Pueblo below grade control structure	1994–2011	1930 cfs	2006	504 cfs	0%
E109.9[b]	Los Alamos above the Rio Grande	2003–2011	5.8 ft[d]	2006	779 cfs	0%
E125	Sandia Canyon above SR 4	1995–2011	59 cfs	2006	13 cfs	38%
E202	Mortandad Canyon Above Sediment Traps	1997–2011	292 cfs	2006	6.4 cfs	33%
E203	Mortandad Canyon Below Sediment Traps	1997–2011	220 cfs	2006	0	87%
E204	Mortandad Canyon at LANL boundary	1994–2011	0	n/a[e]	0	100%
E227	MDA G-13	2007–2011	1.7 cfs	2007	1.7 cfs	20%
E230	Cañada del Buey above SR 4	1994–2010	210 cfs	1999	100 cfs	0%
E243	Pajarito above Twomile	2002–2010	272 cfs	2005	116 cfs	0%
E244	Two Mile above Pajarito	2002–2010	628 cfs	2006	517 cfs	22%
E248.5	MDA G-6u	2006–2011	5.4 cfs	2006	3.8 cfs	17%
E249.5	MDA G-7	2004–2010	5.7 cfs	2006	5.7 cfs	14%
E250	Pajarito Canyon above SR 4	1995–2011	206 cfs	2006	26 cfs	12%
E265	Water Canyon below SR 4	1995–2010	274 cfs	2000	69 cfs	25%
E267	Potrillo Canyon above SR 4	1995–2011	63 cfs	1995	20 cfs	6%
E274	North Fork Ancho	1999–2011	89 cfs, 2.8 ft	2008	1.6 ft	31%
E275	Ancho Canyon below SR 4	1995–2011	536 cfs	2008	414 cfs	6%
E338	Chaquehui Canyon	2000–2011	1.4 ft	2004	1.3 ft	33%
E340	North Fork Chaquehui Canyon	2001–2011	1.0 ft	2003 + 2006	0.8 ft	27%

[a] cfs = Cubic feet per second.

[b] Approximate 5-yr discharge or stage is the value equaled or exceeded in 20% of the years of record, excluding 2000 and 2001 in watersheds affected by the Cerro Grande fire and 2011 in watersheds affected by the Las Conchas fire (characterized by anomalous hydrologic conditions). (Stages have arbitrary datums and do not indicate flood depth.)

[c] Station constructed in 2010 as replacement for E039, E042, E060, or E110.

[d] Stage adjusted to approximate flow depth by subtracting median annual stage to reduce effects of bed elevation change.

[e] n/a = Not applicable.

Table 2
Planned and Contingency Sediment Sample Locations and Analytical Suites for 2012

Watershed	Subwatershed	Location Name or Area	Canyon-Based Sample Prefix	Target Analyte List Metals	Total Cyanide	Explosive Compounds (NMED List)	PCBs by Aroclor Method	PCB Congeners	Dioxins and Furans	Am-241 (by alpha spectrometry)	Gamma Spectrometry Radionuclides	Isotopic Pu	Isotopic U	Sr-90	Tritium	Particle Size (DRI[a])	Sample
Active Stream Channels, Pajarito Plateau																	
Los Alamos	Acid	Acid above Pueblo	CAPU	1	–[b]	–	1	–	–	1	–	1	–	–	–	1	1
Los Alamos	DP	DP above Los Alamos Canyon	CALA	1	–	–	1	–	–	1	1	1	–	1	–	1	1
Los Alamos	Los Alamos	Los Alamos above DP Canyon	CALA	1	–	–	1	–	–	1	1	1	–	1	–	1	1
Los Alamos	Los Alamos	Los Alamos above SR-4	CALA	1	–	–	1	–	–	1	1	1	–	1	–	1	1
Los Alamos	Los Alamos	Los Alamos at Otowi	CALA	1	–	–	1	–	–	1	1	1	–	1	–	1	1
Los Alamos	Pueblo	Pueblo above Acid	CAPU	1	–	–	1	–	–	–	–	–	–	–	–	1	1
Los Alamos	Pueblo	Pueblo below grade-control structure (PU-614903)	CAPU	1	–	–	1	–	–	1	–	1	–	–	–	1	1
Mortandad	Cañada del Buey	Cañada del Buey below MDA G (CB-603008)	CACB	1	–	–	1	–	–	1	–	1	–	–	–	1	1
Mortandad	Cañada del Buey	MDA G-8	CACB	1	–	–	–	–	–	1	–	1	–	–	–	1	1
Mortandad	Mortandad	Mortandad at Rio Grande (A-11)	CAMO	1	–	–	1	–	–	1	–	1	–	–	–	1	1
Mortandad	Mortandad	Mortandad below Effluent Canyon	CAMO	1	–	–	1	–	–	1	1	1	–	1	–	1	1
Mortandad	Mortandad	Mortandad west of GS-1	CAMO	1	–	–	1	–	–	–	–	–	–	–	–	1	1
Pajarito	Pajarito	MDA G-6	CAPA	1	–	–	1	–	1	1	–	1	–	–	–	1	1
Pajarito	Pajarito	MDA G-6 Retention Pond Lower	CAPA	1	–	–	1	–	1	1	–	1	–	–	–	1	1
Pajarito	Pajarito	MDA G-7	CAPA	1	–	–	1	–	1	1	–	1	–	–	–	1	1
Sandia	Sandia	Sandia below Wetlands	CASA	1	–	–	1	–	–	–	–	–	–	–	–	1	1
Water	Water	Water at Beta	CAWA	1	–	1	1	–	–	–	–	1	1	–	–	1	1
			Total	**17**	**0**	**1**	**16**	**0**	**3**	**13**	**5**	**14**	**1**	**5**	**0**	**17**	**17**
Contingency Locations along Active Stream Channels, Pajarito Plateau (For locations that do not flow every year, sample only if runoff event occurs in 2012 before sampling event and if new sediment is deposited.)																	
Ancho	Ancho	Ancho above north fork Ancho	CAAN	1	–	–	–	–	–	–	–	–	1	–	–	1	1
Ancho	Ancho	Ancho at Rio Grande	CAAN	1	–	1	1	–	–	–	–	–	1	–	–	1	1
Ancho	north fork Ancho	Ancho north fork below SR-4	CAAN	1	–	1	1	–	–	–	–	–	1	–	–	1	1
Chaquehui	Chaquehui	Chaquehui below north fork Chaquehui	CACH	1	1	–	1	–	–	–	–	–	–	–	1	1	1
Mortandad	Cañada del Buey	MDA G-10	CACB	1	–	–	–	–	–	1	–	1	–	–	–	1	1
Mortandad	Cañada del Buey	MDA G-10.7	CACB	1	–	–	–	–	–	1	–	1	–	–	–	1	1
Mortandad	Cañada del Buey	MDA G-10.8	CACB	1	–	–	–	–	–	1	–	1	–	–	–	1	1
Mortandad	Cañada del Buey	MDA G-13	CACB	1	–	–	–	–	–	1	–	1	–	–	–	1	1
Mortandad	Mortandad	Mortandad at LANL Boundary	CAMO	1	–	–	1	–	–	1	1	1	–	1	–	1	1
Mortandad	Mortandad	Mortandad at MCO-8.5	CAMO	1	–	–	1	–	–	1	1	1	–	1	–	1	1
Pajarito	Pajarito	MDA G-4	CAPA	1	–	–	–	–	1	1	–	1	–	–	–	1	1
Pajarito	Pajarito	MDA G-5	CAPA	1	–	–	1	–	1	1	–	1	–	–	–	1	1
Pajarito	Pajarito	Pajarito above NM 4 (PA-603937)	CAPA	1	–	1	1	–	1	1	–	1	1	–	–	1	1
Pajarito	Pajarito	Pajarito below White Rock (reach PA-5W)	CAPA	1	–	1	1	–	1	1	–	1	1	–	–	1	1
Sandia	Sandia	Sandia above SR-4	CASA	1	–	–	1	–	–	–	–	–	–	–	–	1	1
Sandia	Sandia	Sandia at Rio Grande	CASA	1	–	–	1	–	–	–	–	–	–	–	–	1	1

Table 2 (continued)

Watershed	Subwatershed	Location Name or Area	Canyon-Based Sample Prefix	Target Analyte List Metals	Total Cyanide	Explosive Compounds (NMED List)	PCBs by Aroclor Method	PCB Congeners	Dioxins and Furans	Am-241 (by alpha spectrometry)	Gamma Spectrometry Radionuclides	Isotopic Pu	Isotopic U	Sr-90	Tritium	Particle Size (DRI)	Sample
Water	Fence	Fence at SR-4	CAFÉ	1	–	1	1	–	–	–	–	–	–	–	–	1	1
Water	Potrillo	Potrillo above SR-4	CAPO	1	–	–	–	–	–	–	–	–	1	–	–	1	1
Water	Water	Water at Rio Grande	CAWA	1	–	1	1	–	–	–	–	1	1	–	–	1	1
Water	Water	Water Canyon at SR-4	CAWA	1	–	1	1	–	–	–	–	1	1	–	–	1	1
			Total	**20**	**1**	**7**	**13**	**0**	**4**	**10**	**2**	**12**	**8**	**2**	**1**	**20**	**20**
Contingency Locations on Floodplains and Miscellaneous Sites, Pajarito Plateau (Sample only in the case of a large flood event that results in new sediment layers that are thick enough to sample.)[c]																	
Ancho	Ancho	Ancho above north fork Ancho	CAAN	2	–	–	–	–	–	–	–	–	2	–	–	2	2
Ancho	Ancho	Reach A-3 (Ancho above Rio Grande)	CAAN	2	–	2	2	–	–	–	–	–	2	–	–	2	2
Ancho	north fork Ancho	Reach AN-4 (Ancho north fork below NM 4)	CAAN	2	–	2	2	–	–	–	–	–	2	–	–	2	2
Chaquehui	Chaquehui	Reach CH-2 (Chaquehui below north fork Chaquehui)	CACH	2	2	–	2	–	–	–	–	–	–	–	2	2	2
Los Alamos	DP	DP Canyon GCS	CALA	4	–	–	–	4	–	4	4	4	–	4	–	4	4
Los Alamos	Los Alamos	Upper Los Alamos Canyon sediment detention basins	CALA	–	4	–	4	–	–	–	4	–	4	–	–	4	4
Los Alamos	Los Alamos	Los Alamos Canyon low-head weir	CALA	4	4	–	–	4	4	4	4	4	–	4	–	4	4
Los Alamos	Los Alamos	Reach LA-3E (Los Alamos above NM 4)	CALA	2	2	–	–	2	2	2	2	2	–	2	–	2	2
Los Alamos	Los Alamos	Reach LA-5 (Los Alamos above Rio Grande)	CALA	2	2	–	–	2	2	2	2	2	–	2	–	2	2
Los Alamos	Pueblo	Pueblo Canyon GCS	CAPU	4	–	–	–	4	–	4	–	4	–	–	–	4	4
Los Alamos	Pueblo	Reach P-4E (Pueblo above NM 502)	CAPU	2	–	–	–	2	–	2	–	2	–	–	–	2	2
Mortandad	Cañada del Buey	Reach CDB-3E (Cañada del Buey below MDA G)	CACB	2	–	–	2	–	–	2	–	2	–	–	–	2	2
Mortandad	Mortandad	Mortandad Canyon sediment traps	CAMO	4	–	–	4	–	–	4	4	4	–	4	–	4	4
Pajarito	Pajarito	Reach PA-2W (Pajarito FRS impoundment)	CAPA	2	2	2	2	–	2	2	2	2	2	–	–	2	2
Pajarito	Pajarito	Reach PA-3E (Pajarito below TA-18)	CAPA	2	2	2	2	–	2	2	2	2	2	–	–	2	2
Pajarito	Pajarito	Reach PA-4 (Pajarito above NM 4)	CAPA	2	2	2	2	–	2	2	2	2	2	–	–	2	2
Pajarito	Twomile	Reach TW-4E (Pajarito FRS impoundment)	CATW	2	2	2	2	–	2	2	2	2	2	–	–	2	2
Sandia	Sandia	Reach S-5E (Sandia above NM 4)	CASA	2	–	–	2	–	–	–	–	–	–	–	–	2	2
Water	Fence	Reach F-3 (Fence above NM 4)	CAFÉ	2	–	2	2	–	–	–	–	–	–	–	–	2	2
Water	Potrillo	Reach PO-4 (Potrillo above NM 4)	CAPO	2	–	–	–	–	–	–	–	–	2	–	–	2	2
Water	Water	Reach WA-4 (Water above NM 4)	CAWA	2	2	2	2	–	2	–	2	2	2	–	–	2	2
			Total	**48**	**24**	**16**	**30**	**18**	**18**	**32**	**30**	**34**	**22**	**16**	**2**	**52**	**52**
Contingency Sediment Sample Locations and Suites along the Rio Grande (Sample only if significant runoff events occur in 2012 in Laboratory canyons.)																	
Rio Grande	Rio Grande	Rio Grande above Otowi Bridge	CABG	–	5	–	–	5	5	5	5	5	–	–	–	5	5
Rio Grande	White Rock Canyon	Cochiti Reservoir	CAWR	–	10	10	–	10	10	10	10	10	–	–	–	5	5
Rio Grande	White Rock Canyon	Rio Grande above Buckman	CAWR	–	5	–	–	5	5	5	5	5	–	–	–	5	5
Rio Grande	White Rock Canyon	Rio Grande below Water Canyon	CAWR	–	5	5	–	5	5	5	5	5	–	–	–	5	5
			Total	0	25	15	0	25	25	25	25	25	0	0	0	20	20

Note: Number of analyses planned for 2012; does not include quality assurance duplicate locations, 10% of total, to be chosen with random number generator following finalization of samples table after 2012 monsoon season.

[a] DRI = Desert Research Institute.

[b] – = No analyses planned for 2012.

[c] Sample only if large flood occurs in summer 2012 before sampling event (e.g., ≥5-yr event that produces fine-grained sediment deposits ≥5 cm thick); if analytical budget is insufficient to sample all locations, prioritize and defer some sampling until 2013. Values in red indicate analytes added to suite to evaluate effects of Las Conchas fire.