Sampling and Analysis Plan for Sediment Monitoring in the Pajarito Canyon Watershed

Introduction	This sediment sampling and analysis plan (SAP) presents the planned locations and analytical suites for sediment samples in the Pajarito watershed as required by the notice of disapproval for the "Pajarito Canyon Investigation Report" (LANL 2008, 104909). This SAP presents the Pajarito Canyon portion of an annual sediment monitoring program Los Alamos National Laboratory (the Laboratory) conducts to monitor sediment in affected watersheds, which are reported in the Laboratory's annual environmental surveillance report (e.g., LANL 2008, 105241). This SAP is based on results from previous sediment surveillance sampling data (e.g., LANL 2008, 105241), combined with results from other sediment investigations (e.g., LANL 2009, 106771). The nature and sources of contaminants in sediment in the Pajarito watershed are well-defined from previous studies (e.g., LANL 2008, 104909). Contaminants of concern that are or may be derived from Laboratory sites in the watershed include metals, dioxins and furans, explosive compounds, polychlorinated biphenyls, PCBs, and radionuclides (americium-241, plutonium isotopes, tritium, and uranium isotopes). The primary Laboratory sources of contaminants identified in sediment include Technical Area 08 (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 burn area and developed areas within various TAs and the White Rock townsite.
Approach	Sampling at most of the locations will occur once each year after the summer monsoon season to evaluate the cumulative effects of summer floods on contaminant concentrations. Other locations are identified as "contingency" locations to be sampled only if floods deposit new, fine-grained sediment of sufficient thickness (approximately 5 cm) to sample outside the active stream channels. Subsequent to the summer monsoon season, records from stream gages within the watershed will be reviewed to determine if flood events occurred that may have produced new fine-grained sediment deposits. Table 1 summarizes data of runoff events at select stream gages within the Pajarito watershed and serves as a preliminary guide to the recognition of flood events that may have deposited new sediment (the size of which varies between canyons) (e.g., Ortiz et al. 2008, 105250). Canyons that have runoff near or exceeding the approximate 5-yr discharge or stage will be visited in the field to determine if new, fine-grained sediment deposits are present and of sufficient thickness to be sampled.
Active Stream Channel Samples	Runoff has been recorded crossing the Laboratory boundary in Pajarito Canyon every year since stream gage E250 was established in 1995, and annual sampling of the active stream will be conducted to document potential changes in contaminant concentrations in the stream beds. Concentrations of contaminants have historically been very low in the primary active stream channels within the watershed (LANL 2008, 104909). Two locations along the main stream channel in Pajarito Canyon that have been historically routinely sampled will be maintained to define temporal trends in contaminant concentrations in the primary stream beds, particularly to evaluate potential trends in off-site transport. These locations are in the main Pajarito Canyon channel above New Mexico State Highway 4 (NM 4) and above the Rio Grande (Figure 1). In addition, sampling is planned at five additional locations along short tributary drainages to Pajarito Canyon below Material Disposal Area G at TA-54 that have been historically routinely sampled; their locations are shown in Figure 1. Planned sample locations and analytical suites are shown in Table 2. These suites are based on a review of historical data and include the key constituents present in each respective portion of the watershed.

Other Sediment Samples	In addition to active stream channels, other geomorphic settings in the Pajarito Canyon watershed will be sampled to evaluate trends in sediment contamination over time contingent on floods that deposit new sediment at these locations. These contingency locations include wetlands and the depositional area behind the flood retention structure (FRS) just below the Twomile Canyon confluence with Pajarito Canyon. These potential sample locations are shown in Figure 1. The wetlands in reach PA-3E (Pajarito Canyon below TA-18) and reach PA-4 (in Pajarito Canyon above NM 4) are planned for sampling after monsoon seasons in which 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. Sampling fine-grained deposits in PA-3E provides an integration of contaminants from all upcanyon locations, including the upper Pajarito Canyon, Twomile Canyon, and Threemile Canyon watersheds and TA-18. Sampling fine-grained deposits in PA-4 provides an integration of contaminants from these locations and TA-54 and also an indication of potential off-site transport past NM 4. Reach PA-3E was last sampled in August 2007 to evaluate sediment deposits from the record flood of August 25, 2006; reach PA-4 was not sampled then because new sediment deposits were too thin to sample (<5 cm thick) (LANL 2009, 106771). The Pajarito Canyon FRS was constructed in summer 2000 after the Cerro Grande fire to reduce the potential for flood impacts at TA-18. Water temporarily impounds behind the FRS during large floods, resulting in sediment deposition that extends upstream from the confluence in both canyons. Two samples of fine-grained sediment will be collected from reach PA-2W (Pajarito Canyon above the confluence) and reach TW-4E (Twomile Canyon above the confluence) after significant runoff events that impound water in these areas. Sampling fine-grained deposits in these two reaches provides an indication of the relative contributions of contaminants from the upper Pajarito Canyon and Twomile Canyon watersheds. These reaches were last sampled in August 2007 to evaluate sediment deposits from the record floods of August 24, 2005, and August 25, 2006 (LANL 2009, 106771).
Reporting	Analytical results from sediment samples collected as part of the Laboratory's Environmental Surveillance Program will be presented in the annual environmental surveillance report, which is published each year by the end of September.

REFERENCES

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs 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 New Mexico Environment Department 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.

LANL (Los Alamos National Laboratory), September 2008. "Pajarito Canyon Investigation Report," Los Alamos National Laboratory document LA-UR-08-5852, Los Alamos, New Mexico. (LANL 2008, 104909)

LANL (Los Alamos National Laboratory), September 2008. "Environmental Surveillance at Los Alamos During 2007," Los Alamos National Laboratory report LA-14369-ENV, Los Alamos, New Mexico. (LANL 2008, 105241)

LANL (Los Alamos National Laboratory), August 2009. "Pajarito Canyon Investigation Report, Revision 1," Los Alamos National Laboratory document LA-UR-09-4670, Los Alamos, New Mexico. (LANL 2009, 106771)

Ortiz, D., B. Cata, and G. Kuyumjian, October 2008. "Surface Water Data at Los Alamos National Laboratory: 2007 Water Year," Los Alamos National Laboratory report LA-14376, Los Alamos, New Mexico. (Ortiz et al. 2008, 105250)

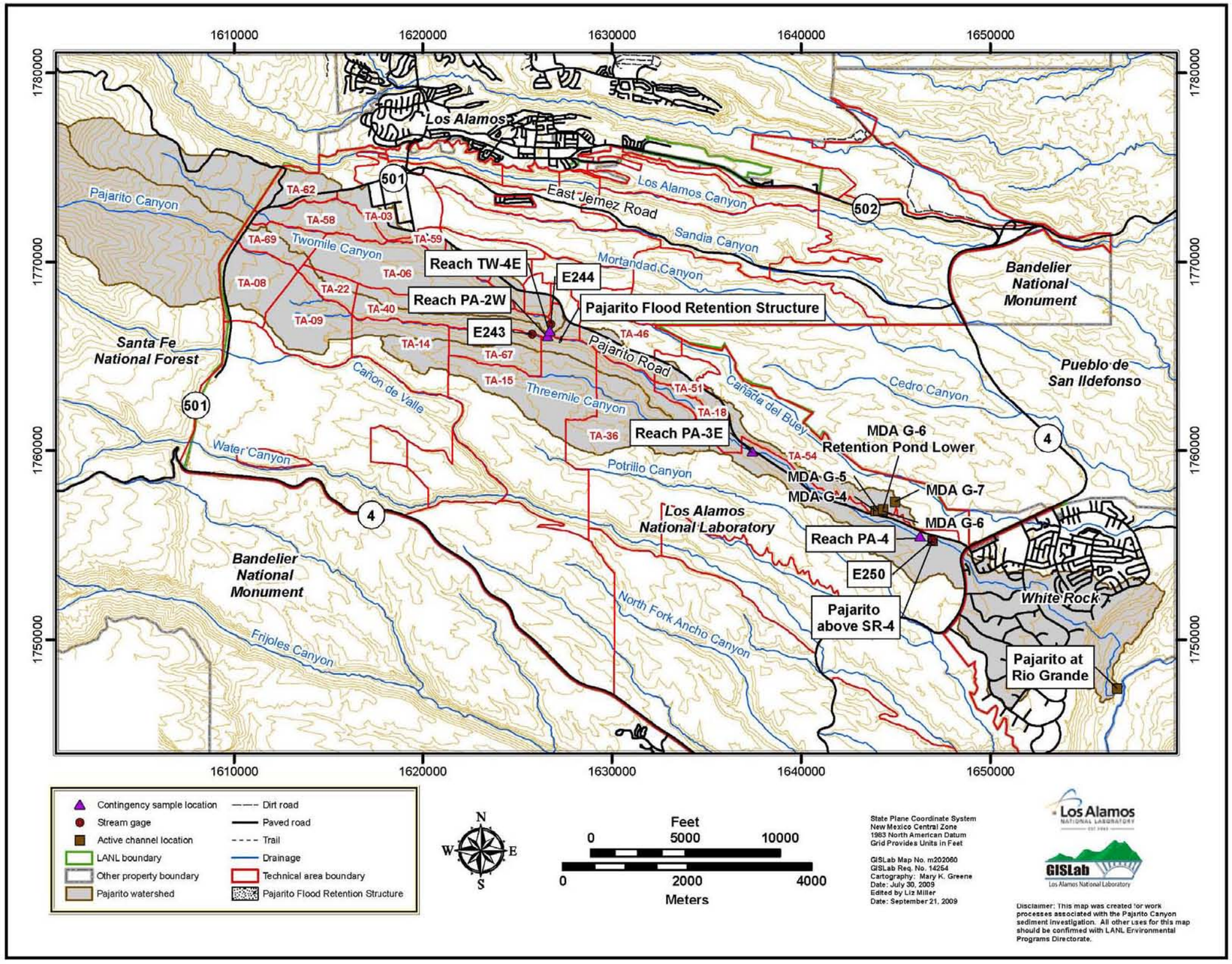

Figure 1 Sediment sample locations in the Pajarito watershed

Table 1
Summary of Runoff Events Recorded at
Select Stream Gages in the Pajarito Canyon Watershed

Gage	Gage Name	Period of Record	Maximum Recorded Discharge (cfs)	Year of Maximum	Approximate 5-Yr Discharge (cfs)*	% of Years with No Recorded Flow
E243	Pajarito above Twomile	2002–2008	272	2005	116	0%
E244	Two Mile above Pajarito	2002–2008	628	2006	517	14%
E250	Pajarito Canyon above SR 4	1995–2008	206	2006	26	0%

* Approximate 5-yr discharge is the value equaled or exceeded in 20% of the years of record, excluding 2000 and 2001, which are characterized by anomalous hydrologic conditions following the Cerro Grande fire.

Table 2
Planned and Contingency Sediment Sample Locations
and Analytic Suites for the Pajarito Canyon Watershed

Location Name	Target Analyte List Metals	Explosive Compounds	PCBs	Dioxins and Furans	Americium-241 (by alpha spectroscopy)	Isotopic Plutonium	Isotopic Uranium	Tritium	Particle Size
Active Stream Channels									
MDA G-4	1	—[a]	—	—	1	1	1	1	1
MDA G-5	1	—	1	—	1	1	1	1	1
MDA G-6	1	—	1	—	1	1	1	1	1
MDA G-6 Retention Pond Lower	1	—	1	—	1	1	1	1	1
MDA G-7	1	—	1	—	1	1	1	1	1
Pajarito above SR-4	1	1	1	—	1	1	1	1	1
Pajarito at Rio Grande	1	1	1	—	1	1	1	1	1
Total Planned #[b]	**7**	**2**	**6**	**0**	**7**	**7**	**7**	**7**	**7**
Contingency Locations for Fine-Grained Sediment (sampling dependent on occurrence of one or more large flood events)[c]									
Reach PA-2W	2	2	2	-	2	2	2	2	2
Reach PA-3E	2	2	2	2	2	2	2	2	2
Reach PA-4	2	2	2	2	2	2	2	2	2
Reach TW-4E	2	2	2	2	2	2	2	2	2
Total Contingency #	**8**	**8**	**8**	**6**	**8**	**8**	**8**	**8**	**8**

[a] — = No analyses planned.

[b] # = Number of planned analyses; does not include quality assurance duplicate locations, 10% of total, to be chosen with random number generator following finalization of samples table after annual monsoon season.

[c] Sample only if large floods occur before each annual sampling event (e.g., ≥5-yr event that produces fine-grained sediment deposits ≥5 cm thick).