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Investigation Report for Ancho, Chaquehui, and Indio Canyons, Revision 1

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EXECUTIVE SUMMARY

This investigation report for Ancho, Chaquehui, and Indio Canyons presents the results of sediment studies Los Alamos National Laboratory (the Laboratory) conducted largely in 2010 and the results of other investigations of surface water, including springs and potential shallow groundwater. The investigations reported herein address sediment and surface water potentially impacted by solid waste management units (SWMUs) and areas of concern (AOCs) located within the Ancho and Chaquehui watersheds. Investigations occurred along 20 km (13 mi) of canyon bottom downcanyon of SWMUs or AOCs. Investigations also occurred in Indio Canyon, which is undeveloped, because of the possible airborne transport of contaminants from firing sites in the north fork of Ancho Canyon at Technical Area 39 (TA-39). The objectives of the investigations included defining the nature and extent of chemicals of potential concern (COPCs) in sediment and assessing the potential risks to human health and the environment from these COPCs. Analytical data from surface-water samples were also evaluated. The investigations address the sources, fate, and transport of COPCs in Ancho, Chaquehui, and Indio Canyons and evaluate the need for additional characterization or remedial actions.

Sediment investigations included geomorphic mapping, associated geomorphic characterization, and sediment sampling in 10 investigation reaches in Ancho and Chaquehui Canyons located downcanyon from SWMUs or AOCs in TA-33, TA-39, and TA-49, and 1 additional reach in Indio Canyon. Surface-water investigations included evaluating analytical data from one location of perennial spring-fed surface water in lower Ancho Canyon near the Rio Grande, two springs in lower Chaquehui Canyon near the Rio Grande, and stormwater samples collected from four upcanyon stream gages in Ancho and Chaquehui Canyons.

Sediment COPCs in Ancho, Chaquehui, and Indio Canyons include 15 inorganic chemicals, 36 organic chemicals, and 7 radionuclides. These COPCs are derived from a variety of sources, including Laboratory SWMUs and AOCs, ash from the 1977 La Mesa fire, and natural sources such as noncontaminated soil, sediment, and bedrock. Assessments in this report focus on the subset of sediment COPCs considered most important for evaluating potential ecological or human health risk and for understanding contaminant transport. The relative importance of the sediment COPCs was partially determined by comparing COPC concentrations with human health residential screening action levels and soil screening levels and with ecological screening levels.

No persistent surface water occurs in Ancho, Chaquehui, or Indio Canyons, other than surface water due to emergence of regional groundwater at springs near the Rio Grande. No analytes in surface water near the Rio Grande were identified as potentially important for evaluating ecological risk. Stormwater comparison values were exceeded by four inorganic chemicals, two organic chemicals, and by gross-alpha radiation in samples from Ancho and Chaquehui Canyons, although these results do not present potential acute risks. Comparison with sediment data indicates that these results are partially related to transport from firing sites at TA-39, although the absence of these analytes as COPCs in sediment close to the Rio Grande indicates little transport to the river in Ancho Canyon. The presence of tritium above background levels in Chaquehui Canyon sediment close to the Rio Grande, downcanyon from a former tritium facility at TA-33, does indicate some transport of tritium to the river, at low concentrations.

Sediment data from Indio Canyon indicate that there has been little or no transport of contaminants into Indio Canyon associated with airborne dispersion from firing sites in the north fork of Ancho Canyon at TA-39. Therefore, further investigation or monitoring of Indio Canyon is not needed.

The results of this investigation indicate potential human health risks in Ancho, Chaquehui, and Indio Canyons are within acceptable limits for current and reasonably foreseeable future land uses. The site-specific human health risk assessment using residential screening values and a recreational

exposure scenario indicates no unacceptable risks from carcinogens (incremental cancer target risk of 1×10^{-5}), noncarcinogens (hazard index of 1.0), or radionuclides (target dose limit of 15 mrem/yr) from COPCs in sediment or surface water.

Chemicals of potential ecological concern (COPECs) identified in the ecological risk screening assessment were evaluated using multiple lines of evidence. The main lines of evidence that led to concluding that COPECs did not pose a risk to biota in Ancho, Chaquehui, and Indio Canyons were (1) frequency of detection greater than sediment and soil background and (2) population area use adjustments to hazard quotients. In addition, concentrations measured in Ancho, Chaquehui, and Indio Canyons were compared with results from other watersheds where more detailed biota investigations have been conducted. These comparisons also indicated concentrations of COPECs in Ancho, Chaquehui, and Indio Canyons derived from Laboratory SWMUs or AOCs are not likely to produce adverse ecological impacts, and no additional biota investigations, mitigation, or monitoring is required.

The conceptual model indicates the conditions for sediments are likely to stay the same or improve because of decreases in contaminant concentrations after peak releases; therefore, no further monitoring of sediment is necessary. However, several firing sites in the watershed remain active, and additional future releases are possible. Potential contaminant transport from these sites will be characterized in aggregate area investigations and monitored under the requirements of the National Pollutant Discharge Elimination System Individual Permit for Stormwater Discharges from certain SWMUs and AOCs at Los Alamos National Laboratory.

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1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) is a multidisciplinary research facility under the U.S. Department of Energy (DOE) that is managed by Los Alamos National Security, LLC. The Laboratory is located in north-central New Mexico, approximately 90 km (60 mi) northeast of Albuquerque and 30 km (20 mi) northwest of Santa Fe. The Laboratory comprises an area of 103 km^2 (40 mi^2), mostly on the Pajarito Plateau, which consists of a series of mesas separated by eastward-draining canyons. It also includes part of White Rock Canyon along the Rio Grande to the east. The Laboratory is currently investigating sites potentially contaminated by past operations, both inside and outside the current Laboratory boundary, to ensure contaminants do not threaten human health or the environment. The sites under investigation are designated as solid waste management units (SWMUs) or areas of concern (AOCs). In addition to investigations at SWMUs and AOCs, contamination in canyon bottoms and in groundwater is being investigated on a watershed basis between the potential sources and the Rio Grande, the master drainage in the region.

1.1 Purpose and Scope

This investigation report presents the results of sediment studies conducted largely in 2010 and includes a compilation of surface-water data collected from 1967 to 2010 in Ancho, Chaquehui, and Indio Canyons and their tributaries. The watershed areas for these canyons are shown in Figure 1.1-1. The investigations reported herein address sediment and surface water potentially impacted by SWMUs and AOCs located within these watersheds. These media are collectively referred to as canyons media in this report. Results from regional groundwater monitoring wells in the Ancho watershed will be included in a subsequent investigation report on Water Canyon and Cañon de Valle. The Water Canyon and Cañon de Valle (Water-Valle) watershed contains the main potential sources for groundwater contamination in the southern part of the Laboratory, and an evaluation of regional groundwater in this area needs to consider data from the upgradient wells in the Water-Valle watershed.

The investigations were conducted to fulfill the requirements of several documents. The “South Canyons Investigation Work Plan” (hereafter, the work plan) (LANL 2006, 093713) describes the Laboratory’s work scope and the regulatory requirements for characterizing the Ancho, Chaquehui, and Indio watersheds. A companion document, the “South Canyons Historical Investigation Report” (the HIR) (LANL 2006, 093714) contains a review of SWMUs and AOCs in these watersheds, the history of releases, and contaminant data collected before the work plan was prepared. The New Mexico Environment Department (NMED) approved the work plan in 2007 following the Laboratory’s responses to a notice of disapproval (NOD) (LANL 2007, 095405; NMED 2007, 095025; NMED 2007, 095490). The requirement to prepare and implement the work plan was also included by reference in Section IV.B.6.b.i of the Compliance Order on Consent (the Consent Order).

The investigations conducted under the work plan also followed the technical strategy presented in the “Core Document for Canyons Investigations” (hereafter, the canyons core document) (LANL 1997, 055622). The canyons core document was prepared after a pilot study in Los Alamos and Pueblo Canyons was implemented in 1996, with the goal of standardizing the technical strategy for work in canyons at the Laboratory. In 1998, NMED approved the core document following the Laboratory’s response to a request for supplemental information (LANL 1998, 057666; NMED 1998, 058638).

Data collected during the investigations included in this report are used to (1) define the nature and extent of contamination within canyon bottoms in the Ancho, Chaquehui, and Indio watersheds; (2) update the conceptual model for contaminant distribution and transport within these canyons; (3) assess potential current human health and ecological risk from contaminants within these canyons; (4) determine and recommend potential remedial actions, if needed, that may be appropriate to achieve or maintain site conditions at an acceptable risk level; and (5) provide support for decisions at SWMUs and AOCs. The assessments in this report are conducted using sediment data mostly collected in 2010, supplemented by some earlier data (2008 and 2009), and surface-water data collected from 2003 to 2010 to evaluate current environmental conditions. Data from environmental surveillance sediment sampling are compared with current concentrations and help to identify any temporal trends in contamination.

This report addresses characterization and risk assessment within Ancho, Chaquehui, and Indio Canyons, encompassing approximately 20.4 km (12.7 mi) of canyon bottom downcanyon of SWMUs and AOCs at Technical Area 33 (TA-33), TA-39, and TA-49. The characterization and assessment approach used in this investigation provides an integrating perspective on historical and current contaminant releases to the canyon bottoms and subsequent contaminant redistribution resulting from various transport processes. This approach facilitates the development of conceptual models that describe expected spatial and temporal trends in contaminant concentrations, thus supporting recommendations for long-term monitoring. The results also support the Laboratory's watershed approach by providing information on the extent of contamination associated with SWMUs and AOCs and SWMU and AOC aggregates in the Ancho and Chaquehui watersheds and by helping to identify and prioritize remedial activities within these watersheds.

1.2 Organization of Investigation Report

This investigation report includes the following sections, following the outline used in the NMED-approved "Mortandad Canyon Investigation Report" (LANL 2006, 094161; NMED 2007, 095109) and subsequent canyons investigation reports. Section 1 is an introduction to the report and to the Ancho, Chaquehui, and Indio watersheds. Section 2 provides background information on the sources and history of contaminant releases, previous investigations of canyons media, and remediation activities that have occurred in these watersheds. Section 3 describes the scope of activities in this investigation. Section 4 introduces the field investigations. Section 5 describes the regulatory context of this investigation. Section 6 presents screening level (SL) assessments that identify chemicals of potential concern (COPCs) and that help focus subsequent sections on the subset of the most important COPCs for evaluating potential human health risk. Section 7 presents a physical system conceptual model, including discussions of the nature, sources, extent, fate, and transport of select COPCs that are most relevant for evaluating potential human health and ecological risk and contaminant transport. Section 8 presents ecological screening assessments and human health risk assessments and results. Section 9 presents conclusions and recommendations. Acknowledgements of those who contributed to this report are listed in section 10. Section 11 presents references cited in this report and the map data sources.

This report has the following appendixes. Appendix A presents a list of acronyms and abbreviations, a table showing conversion of metric units to U.S. customary units, and data qualifier definitions. Appendix B presents field investigation methods and results. Appendix C presents analytical results from sediment and water samples and summarizes data quality. Data packages are included as Attachment C-1 on DVD. Analytical data from the Sample Management Database (SMDB) and Water Quality Database (WQDB) used in this report are on DVD in Attachment C-2. Appendix D presents supporting information on spatial contaminant trends. Appendix E presents supporting information on risk and statistics. Supplemental tables for Appendixes B, C, and E are provided on CD in Attachment 1.

1.3 Watershed Description

The Ancho watershed heads on the Pajarito Plateau in TA-49 and has a maximum elevation of approximately 2220 m (7280 ft) above sea level (asl). Ancho Canyon extends approximately 11.9 km

(7.4 mi) to the Rio Grande at an elevation of approximately 1640 m (5380 ft) asl (Figure 1.1-1). The north fork of Ancho Canyon is a major tributary that also heads in TA-49 and extends approximately 7.0 km (4.3 mi), through TA-39, to its confluence with main Ancho Canyon at an elevation of approximately 1900 m (6240 ft) asl, 4.0 km (2.5 mi) above the Rio Grande. The Ancho watershed has a total drainage area of approximately 17.5 km^2 (6.8 mi^2), which is entirely located on Laboratory land. Approximately 32% of the Ancho watershed (5.6 km^2) is drained by the north fork, and approximately 33% (5.8 km^2) is drained by main Ancho Canyon above the confluence with the north fork.

The Chaquehui watershed heads on the Pajarito Plateau near the Bandelier National Monument entrance station and has a maximum elevation of approximately 2100 m (6900 ft) asl. Chaquehui Canyon extends approximately 5.4 km (3.3 mi) to the Rio Grande at an elevation of approximately 1635 m (5370 ft) asl (Figure 1.1-1). The north fork of Chaquehui Canyon is a major tributary that heads in TA-33 and extends approximately 2.0 km (1.2 mi) to its confluence with main Chaquehui Canyon at an elevation of approximately 1830 m (6010 ft) asl, 1.0 km (0.6 mi) above the Rio Grande. The Chaquehui watershed has a total drainage area of approximately 4.1 km^2 (1.6 mi^2), of which 85% is on Laboratory land and 15% is on Bandelier National Monument land.

Indio Canyon is a tributary to Water Canyon that heads on the Pajarito Plateau in TA-39. Its watershed has a maximum elevation of approximately 2090 m (6860 ft) asl and extends approximately 2.7 km (1.7 mi) to Water Canyon at an elevation of approximately 1935 m (6350 ft) asl, approximately 5.4 km (3.3 mi) above the Rio Grande. The Indio watershed has a total drainage area of approximately 1.3 km^2 (0.5 mi^2), which is entirely located on Laboratory land.

Bedrock geologic units exposed within the Ancho, Chaquehui, and Indio watersheds include the Tshirege and Otowi Members of the Bandelier Tuff, the Cerro Toledo interval, basaltic rocks of the Cerros del Rio volcanic field, and sedimentary rocks of the Puye Formation and Santa Fe Group (Griggs and Hem 1964, 092516; Smith et al. 1970, 009752; Dethier 1997, 049843). The biological setting of the Ancho, Chaquehui, and Indio watersheds is discussed in section 2.2.3 of the investigation work plan (LANL 2006, 093713). Details about the hydrology of the watersheds are provided in section 7 and Appendix B of this report.

1.4 Current Land Use

The Ancho and Indio watersheds, and the portion of the Chaquehui watershed downcanyon from SWMUs and AOCs, are located entirely on DOE land. Laboratory activities in the canyon bottoms, outside the active floodplain, include active firing areas, office buildings, and other support buildings in the north fork of Ancho Canyon in TA-39. There is no public access to the watersheds near SWMUs and AOCs, although there is public access for hiking in the lower parts of Ancho and Chaquehui Canyons near the Rio Grande.

2.0 BACKGROUND

Releases from SWMUs and AOCs within the Ancho and Chaquehui watersheds have occurred as a result of dispersal from firing sites, discharges from outfalls, and other activities in TA-33, TA-39, and TA-49 (LANL 2006, 093714). SWMUs and AOCs in these watersheds are shown in Figure 2.0-1. These canyons also receive stormwater runoff from roads, parking lots, and other developed areas in these TAs, and have been affected by wildfire. Part of the Ancho watershed is also within TA-70, which is an undeveloped technical area where no Laboratory operations have been conducted. The Indio watershed is completely undeveloped, and the only potential contaminant source is airborne dispersion from firing sites in the north fork of Ancho Canyon at TA-39. Previous sampling results from within these canyons indicated contamination from inorganic chemicals, organic chemicals, and radionuclides (LANL 2006, 093714). Additional sampling has been proposed and/or conducted to further define nature and extent of contamination at some SWMUs and AOCs located in the Chaquehui Canyon Aggregate Area (LANL 2010, 111298.9), the North Ancho Canyon Aggregate Area (LANL 2007, 101894; LANL 2010, 108500.11; LANL 2010, 111505), and at TA-49 (LANL 2010, 110654.16; LANL 2010, 110656.17). A work plan for investigation of TA-33 SWMUs and AOCs within the South Ancho Canyon Aggregate Area is planned for submission to NMED in 2013. The following sections summarize the sources and history of contaminant releases as well as investigations that have addressed contaminant distribution and concentration in canyons media. Remediation activities implemented to reduce contamination in source areas are also discussed.

2.1 Sources and History of Contaminant Releases and Remediation

2.1.1 TA-33

TA-33, also known as Hot Point Site, was used originally as a firing area beginning in 1947 and later for tritium operations from 1955 to 1990 (LANL 1992, 007671). A high-pressure tritium handling facility located here has been decommissioned and removed. Presently, TA-33 houses an intelligence technology group and the National Radio Astronomy Observatory's (NRAO) Very Large Baseline Array Telescope. Most facilities at TA-33 are within the Chaquehui watershed, including the TA-33 Main Site, Area 6, South Site, and NRAO Site. SWMUs, AOCs, and consolidated units at these sites include Material Disposal Area (MDA) E [Consolidated Unit 33-001(a)-99], MDA K [Consolidated Unit 33-002(a)-99], former outfalls, septic systems, former firing sites, and surface disposal sites. Two former National Pollution Discharge Elimination System- (NPDES-) permitted outfalls also historically discharged treated and noncontact cooling water to Chaquehui Canyon; no active NPDES-permitted outfalls currently discharge from TA-33. The TA-33 East Site is partly within the Ancho watershed; SWMUs, AOCs, and consolidated units at this site include MDA D [Consolidated Unit 33-003(a)-99], a septic system, a firing site, and surface disposal sites. Remediation activities conducted at TA-33 include a general cleanup of Consolidated Unit 33-006(b)-00 in 1984 (LANL 1995, 051903) and voluntary corrective actions at SWMUs 33-010(a,d,g) and 33-011(b) in 1996 (LANL 1996, 054755) and at SWMUs 33-002(a-c) in 2005 (LANL 2010, 110352). In addition, an accelerated corrective action was conducted at SWMU 33-013 in 2005 (LANL 2006, 092080) and NMED issued a certificate of completion for this site (NMED 2006, 093526).

2.1.2 TA-39

TA-39 (Ancho Canyon Site) has been used primarily as a high explosives test-firing site since 1953. The behavior of nonnuclear weapons is studied at TA-39, primarily by photographic techniques. Various phenomenological aspects of explosives, interactions of explosives, explosions involving other material, shock wave physics, equation state measurements, and pulsed-power systems design are also investigated. SWMUs, AOCs, and consolidated units at TA-39 are located within the north fork of Ancho Canyon and consist of active and inactive firing sites, high-explosive storage areas, septic systems, areas of soil contamination, and landfills. In 2009, landfill trenches at MDA Y, SWMU 39-001(b), were excavated and the contents were removed for off-site disposal (LANL 2010, 108500.11). Excavation, confirmatory sampling, and backfilling with clean material at another landfill, SWMU 39-001(a), and the inactive septic system at SWMU 39-006(a) were also completed in 2009 (LANL 2010, 108500.11). MDA Y, SWMU 39-005, and five AOCs received certificates of completion from NMED (2010, 110430). Preliminary characterization of the active firing sites and the extended drainages from these sites was recently completed and indicated that current activities are not contributing to off-site migration of contaminants (LANL 2010, 108500.11). The Phase II Work Plan for the North Ancho

Aggregate Area recommended that further investigation of the active sites be delayed until operations at these sites cease (LANL 2010, 111505).

2.1.3 TA-49

TA-49 (Frijoles Mesa Site) includes the headwaters of Ancho Canyon and the north fork of Ancho Canyon. Subsurface hydronuclear experiments involving special nuclear materials were conducted in underground shafts drilled into the mesa from 1959 to 1961 (LANL 1992, 007670; LANL 1997, 056594). Areas 1, 2, 2A, 2B, 3, and 4 each contain subsurface test shafts used for underground hydronuclear safety, tracer, and containment experiments. Areas 2, 2A and 2B are referred to as MDA AB. From 1962 to 1977, TA-49 was used sporadically for experiments involving firing assemblies, atmospheric phenomena observations, pulsed-gas laser and shock tube experiments, and a seismic study, all of which appear to have involved no significant amounts of hazardous or radioactive materials (LANL 1992, 007670, p. 3-9). TA-49 is divided into 10 operational areas, all of which are mesa-top sites. In addition to Areas 1 through 4, other areas are Area 5 (control area); Area 6 (landfill, burn site, and trenches); Area 7 (security station); Area 10 (experimental chamber); Area 11 (radiochemistry and small-scale shot area); and Area 12 (Bottle House area). TA-49 is currently being used as a buffer zone for activities at firing sites in TA-15 and TA-39 and as the location for the Hazardous Devices Team Training Facility. SWMUs located at TA-49 include underground shafts, MDA AB, a central control area, an underground calibration chamber, a radiochemistry and small-scale shot area, and firing sites.

Surface and subsurface field sampling at the 10 operational areas discussed above were conducted at TA-49 in 2009 and 2010, and results were reported in two investigation reports (LANL 2010, 110654.16; LANL 2010, 110656.17). The nature and extent of contamination for organic chemicals and most inorganic chemicals and radionuclides were defined for the SWMUs and AOCs; extent was found to be localized around the sites. However, at most sites, the extent of contamination for a few inorganic chemicals and/or radionuclides was not defined, and further sampling was recommended. In addition, characterization of background values (BVs) for inorganic chemicals in Bandelier Tuff unit Qbt 4 was proposed to better evaluate background exceedances in Qbt 4. Sediment sampling in Ancho Canyon indicated that the canyon was not impacted by organic or inorganic chemicals released at TA-49 but may have been impacted by plutonium-239/240 released at TA-49 (LANL 2010, 110656.17).

2.1.4 La Mesa Fire

In June 1977, the La Mesa fire burned the upper part of the Ancho watershed at TA-49. Approximately 3.5 km^2 (1.4 mi^2) of the watershed was within the burn perimeter (Foxx 1984, 006292), comprising 20% of the Ancho watershed. The area within the burn perimeter was classified into areas of varying foliar damage, as shown in Figure 2.1-1. Within the burn perimeter, 18.8% of the area had all needles consumed, 31.4% of the area had all needles singed, 43.3% of the area had 1% to 99% of the needles singed, and the remainder was not burned. The area where all needles were consumed is equivalent to high-severity burn using current burn severity ratings, the area where all needles were singed is equivalent to moderate severity burn, and the area with 1% to 99% of the needles singed is equivalent to either low or moderate severity burn. No part of the Chaquehui or Indio watersheds burned in the La Mesa fire.

Various naturally occurring inorganic chemicals (e.g., barium, cobalt, and manganese) and anthropogenically created fallout radionuclides (e.g., cesium-137, plutonium-239/240, and strontium-90) were concentrated in ash from the May 2000 Cerro Grande fire at levels exceeding that of background sediments before the fire, and the transport of ash resulted in elevated levels of these analytes in postfire sediment deposits in some canyons (Katzman et al. 2001, 072660; Kraig et al. 2002, 085536; LANL

2004, 087390). Elevated levels of inorganic chemicals and radionuclides that can be attributed to the transport of Cerro Grande ash have also been found in stormwater samples in some canyons (Gallaher and Koch 2004, 088747). Ash from the La Mesa fire is expected to have similar elevated concentrations of inorganic chemicals and fallout radionuclides to those found in Cerro Grande ash.

2.2 Potential Contamination in Canyons Media

Potential contamination in sediment and surface water in the Ancho, Chaquehui, and Indio watersheds has been evaluated in several previous studies dating back to 1969. Some key studies, summarized below, provide background and supplemental data for the investigations presented in this report. Relevant information from these studies is also included in subsequent sections of this report.

2.2.1 Environmental Surveillance Program

The Laboratory's Environmental Surveillance Program has conducted investigations of sediment and surface water in the Ancho, Chaquehui, and Indio watersheds since 1969 (e.g., Purtymun 1971, 004795). Sediment investigations have included the sampling of the active stream channels in Ancho, Chaquehui, and Indio Canyons. Surface-water investigations have included sampling of stormwater at five stream gages within Ancho, Chaquehui, and Indio Canyons; springs in lower Ancho and Chaquehui Canyons; and spring-fed perennial surface water in lower Ancho Canyon. Sediment and surface-water analyses are reported in the annual environmental surveillance reports (e.g., LANL 2010, 111232), and summaries of results from active channel sediment and surface-water sampling in Ancho, Chaquehui, and Indio Canyons through 2005 are presented in the HIR (LANL 2006, 093714). Additionally, flow measurements are made at stream gages in Ancho Canyon and reported in annual surface-water data reports (e.g., Ortiz and McCullough 2010, 109826). This work supports the evaluation of long-term trends in contamination in different media and an understanding of the role of stormwater transport.

2.2.2 Resource Conservation and Recovery Act Permit and Consent Order Investigations

Since 1993, studies of canyons media in the Ancho and Chaquehui watersheds have been conducted by the Laboratory as part of Resource Conservation and Recovery Act permit and Consent Order investigations. Results of these investigations have been presented in several reports (LANL 1997, 055633; LANL 2006, 093714; LANL 2010, 110656.17). The work presented in this investigation report builds on these previous studies.

3.0 SCOPE OF ACTIVITIES

The scope of activities in this report includes investigations of sediment in the Ancho, Chaquehui, and Indio watersheds, as presented in the work plan and subsequent documents (LANL 2006, 093713; LANL 2007, 095405; NMED 2007, 095025; NMED 2007, 095490). This report also presents surface-water data and observations of potential shallow groundwater in the watershed obtained as part of other investigations. These investigations are discussed below.

3.1 Sediment Investigations

The sediment investigations presented in this report focused on characterizing the nature, extent, and concentrations of COPCs in post-1942 sediment deposits in a series of reaches in the Ancho, Chaquehui, and Indio watersheds. Data from these reaches were used to evaluate potential human health and ecological risks and to identify spatial trends of COPCs at watershed scales, including variations in COPC concentrations at increasing distances from SWMUs and AOCs. The investigation methods are discussed in section 4 and Appendix B, section B-1.0, of this report; in the investigation work plan (LANL 2006, 093713); and in the canyons core document (LANL 1997, 055622; LANL 1998, 057666).

The scope of this investigation included characterization of 11 reaches identified in the work plan (LANL 2006, 093713, p. 47). Table 3.1-1 lists the sediment investigation reaches, providing the approximate length and distance of each reach from the Rio Grande as well as additional information on the reaches. Locations of reaches are shown in Figure 3.1-1.

3.2 Surface-Water and Potential Shallow Groundwater Investigations

The surface-water investigations discussed in this report include the presentation and screening of analytical data from springs in lower Ancho and Chaquehui Canyons, perennial spring-fed base flow in lower Ancho Canyon, and stormwater from several gaging stations in Ancho and Chaquehui Canyons. Analytical data from three springs—Ancho Spring, Doe Spring and Spring 9A (Figure 3.2-1)—are included in the surface-water data set in this report. Ancho Spring is considered to be a background location (LANL 2010, 110535) and is also the source of perennial flow that extends to the Rio Grande. In the Ancho watershed, the available gages are E273 (Ancho above north fork Ancho), E274 (Ancho north fork below SR-4), E275 (Ancho below SR-4), and E300 (Ancho Canyon spring tributary below SR-4). In the Chaquehui watershed, the gages are E338 (Chaquehui at TA-33), and E340 (Chaquehui tributary at TA-33). Locations of gaging stations are shown in Figure 3.2-1.

No stormwater samples are available for the 2003 to 2010 period from gages E273 and E300. Gage E300 is not downgradient of any SWMUs or AOCs, and stormwater data gathered at that location in 2001 may provide useful information on stormwater composition from a background location.

Data on flow measurements obtained at gages E264 (Indio Canyon at SR-4), E274, and E275 are also summarized in this report and are used to assess runoff frequency and amplitude in Ancho and Indio Canyons. Limited measurements of runoff events have also been made at two gages in the Chaquehui watershed, E338 and E340, although no rating curves have been developed for these gages and consequently no discharge estimates are available.

No new shallow boreholes were drilled as part of this investigation. However, the investigations of potential shallow groundwater summarized in this report include observations from several boreholes and wells drilled in Ancho Canyon and the north fork of Ancho Canyon for other investigations. Observations at these locations are discussed in section 7.2. No investigation boreholes have been drilled in Chaquehui or Indio Canyons. Locations of wells and boreholes in the Ancho watershed are shown in Figure 3.2-1.

3.3 Deviations from Planned Activities

The Consent Order Section IV.B.6.b.ii specified installation of one alluvial monitoring well downgradient of MDA Y, SWMU 39-001(b), in the north fork of Ancho Canyon at TA-39; therefore, a new well designated ACA-1 was proposed in the work plan (LANL 2006, 093713). Rather than installing this well, remediation of MDA Y was recommended in 2007 and conducted in 2009 (LANL 2007, 101894; LANL 2010, 108500.11). All buried waste was removed from MDA Y, and the site received a certificate of completion from NMED in 2010 (NMED 2010, 110430). In addition, an existing alluvial monitoring well, 39-DM-6, located immediately downgradient of MDA Y, has been historically dry and was recommended for abandonment (Koch and Schmeer 2010, 108926; LANL 2010, 111505). The intent of well ACA-1 was to monitor potential alluvial water downgradient of MDA Y. Because the buried contaminant source has been removed, and alluvial groundwater is not observed at 39-DM-6, well ACA-1 is not needed to characterize potential contaminant migration in groundwater downgradient of MDA Y.

In its response to NMED's NOD on the work plan, the Laboratory specified that after the Phase 1 sediment investigation was completed, a Phase 1 summary report would be prepared to present the results and propose a Phase 2 investigation, if appropriate (LANL 2007, 095405). Because of time constraints, a Phase 1 summary report was not prepared and no Phase 2 investigation was conducted. All information that would have been contained in the summary report is presented in this investigation report, and any recommendations for additional work are proposed in section 9 of this investigation report.

4.0 FIELD INVESTIGATIONS

Field investigations in the Ancho, Chaquehui, and Indio watersheds included investigations of sediment in 11 investigation reaches. No surface-water or groundwater investigations were conducted as part of the implementation of the work plan (LANL 2006, 093713), although surface-water data and observations from monitoring wells and other holes obtained from other investigations were compiled and summarized. The approaches and methods of these investigations are discussed briefly in the following sections. A more detailed discussion of the methods and of the field investigation results is presented in Appendix B.

4.1 Sediment

Sediment investigations in the Ancho, Chaquehui, and Indio watersheds included detailed geomorphic characterization and sediment sampling in a series of discrete reaches, following the general process described in the NMED-approved work plan and canyons core document (LANL 1997, 055622; LANL 2006, 093713). The geomorphic characterization in these reaches included preparing a detailed geomorphic map delineating the horizontal extent of geomorphic units with varying physical characteristics and/or age. The geomorphic characterization also included measuring the thickness of potentially contaminated post-1942 sediment deposits to estimate the volume of potentially contaminated sediment in each reach. Several methods were used to identify the bottom of post-1942 sediment deposits, including determining the depth of buried trees and associated buried soils and noting the presence or absence of materials imported to the watersheds after 1942 (e.g., quartzite gravel, metal fragments, and plastic).

Plates 1, 2, and 3 present geomorphic maps of the sediment investigation reaches in the Ancho, Chaquehui, and Indio watersheds, including sample locations and stratigraphic description locations within these reaches. The horizontal extent of contaminated or potentially contaminated sediment deposits in each reach is delineated by the extent of the channel ("c") and floodplain ("f") units in these maps. Section B-1.0 of Appendix B includes more detailed discussion and presentation of the field investigation methods and results, including sediment thickness measurements. Field data on the volume of sediment in the different geomorphic units in a reach were used to help allocate samples for analysis at off-site laboratories. All analytical results of the sediment sampling incorporated in this investigation report are presented in Attachment C-2 in Appendix C (on DVD).

4.2 Surface-Water and Potential Shallow Groundwater Investigations

The surface-water and potential shallow groundwater field investigations in Ancho and Chaquehui Canyons were designed to monitor potential contamination in spring-fed surface water and stormwater and the potential presence of shallow groundwater and associated contamination. Analytical results for surface-water sampling are discussed in section 7.2.2, and the data are provided in Attachment C-2 in Appendix C. Water-quality field parameters, including pH, specific conductance, temperature, and turbidity, were measured for each surface-water sample collected. Flow measurements from gaging stations in Ancho and Indio Canyons are summarized in section 7.2.2. No shallow groundwater has been observed in shallow observation wells in Ancho Canyon, and no shallow groundwater samples have been collected from the Ancho, Chaquehui, or Indio watersheds.

5.0 REGULATORY CRITERIA

This section provides information on the regulatory context, human health SLs, ecological screening levels (ESLs), applicable water-quality standards, and other SLs for the Ancho, Chaquehui, and Indio Canyons investigation.

5.1 Regulatory Context

Requirements governing canyons investigations are discussed in Section IV.B of the Consent Order. As described in Section IV.B, the canyons investigations primarily focus on fate and transport of contaminants from the point of origin to each canyon watershed drainage system and, if necessary, to the regional aquifer and/or to the Rio Grande.

The canyon bottoms addressed in this investigation report are potentially contaminated with both hazardous and radioactive components. NMED, pursuant to the New Mexico Hazardous Waste Act, regulates cleanup of hazardous wastes and hazardous constituents. DOE regulates cleanup of radioactive contamination, pursuant to DOE Order 5400.5, “Radiation Protection of the Public and the Environment,” and DOE Order 435.1, “Radioactive Waste Management.” Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with DOE policy.

The regulatory requirements for conducting canyons investigations under the Consent Order are implemented through work plans approved by NMED. The approved work plan for Ancho, Chaquehui, and Indio Canyons is the “South Canyons Investigation Work Plan” (LANL 2006, 093173; LANL 2007, 095405; NMED 2007, 095490).

There are two types of surface-water samples evaluated. Stormwater is transient and exists for some period directly in response to precipitation events. All other surface-water samples are referred to as nonstorm-related surface water. Some of the locations included in the nonstorm-related surface water data are springs. Because springs are emergent groundwater, sample results from springs are compared with standards applicable to groundwater and surface water. Except for comparing spring water concentrations with groundwater standards, all other evaluations of groundwater associated with Ancho, Chaquehui, and Indio Canyons are deferred to the Investigation Report for Water Canyon and Cañon de Valle.

Surface-water discharges are subject to a permit under Section 402 of the federal Clean Water Act (CWA), including stormwater discharges. Stormwater discharges from certain SWMUs and AOCs are regulated by an Individual Permit (IP) issued by Region 6 of the U.S. Environmental Protection Agency (EPA), pursuant to the NPDES permit program (Authorization to Discharge under the National Pollutant Discharge Elimination System, NPDES Permit No. NM0030759, effective November 1, 2010). This permit covers stormwater runoff from sites with significant industrial activity [see 40 Code of Federal Regulations 122.26(b)(14)].

The assessments in this report are primarily risk based for all media and contaminants. Concentrations of chemicals and radionuclides in sediment are compared with various risk-based SLs, which are described in sections 5.2 and 5.3. Surface-water and groundwater standards are used to support the assessment of nature and extent of contamination. Applicable water-quality standards are discussed in section 5.4. Stormwater comparison values are discussed in section 5.5.

5.2 Human Health SLs

Human health SLs for sediment are the soil screening levels (SSLs) for inorganic and organic chemicals and the screening action levels (SALs) for radionuclides. These are media-specific concentrations derived for residential exposure. If environmental concentrations of contaminants are below SALs or SSLs, then the potential for adverse human health effects is highly unlikely. For sediment COPCs with carcinogen or noncarcinogen endpoints, SSLs from NMED guidance (NMED 2009, 108070) were used, if available. If values were not available from NMED, then the residential screening value from the EPA regional screening tables, available at http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm, was used as the SSL (adjusted to 10^{-5} risk to conform with NMED SSLs). The SSLs for noncarcinogens are based on a hazard quotient (HQ) of 1. The SSLs for carcinogens are based on a cancer risk level of 10^{-5}. For nonradionuclide COPCs without SSLs, surrogate chemicals were used in some cases (NMED 2003, 081172), where applicable. SALs for radionuclides were obtained from Laboratory guidance (LANL 2005, 088493; LANL 2009, 107655). The radionuclide SALs have a target dose limit of 15 mrem/yr, which is consistent with DOE guidance (DOE 2000, 067489).

Human health SLs for nonstorm-related surface water are NMED tap water screening values for chemicals (NMED 2009, 108070). If values were not available from NMED, then the EPA regional tap water screening levels were used (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm). The DOE Derived Concentration Guides (DCGs) were used for radionuclides (DOE Order 5400.5, "Radiation Protection of the Public and the Environment"). The SLs for chemicals in water are based on the same HQ and cancer risk levels as the SSLs. The DCGs for nonstorm-related surface water are based on a target dose limit of 4 mrem/yr, which is the radiation dose limit for a public drinking water supply in DOE Order 5400.5, "Radiation Protection of the Public and the Environment."

The initial screening comparisons of sediment and water data to residential SSLs and SALs are provided in section 6. Additional information regarding the potential for human health risks from COPCs in affected media in Ancho, Chaquehui, and Indio Canyons is provided in section 8.2.

5.3 Ecological Screening Levels

ESLs are used to determine chemicals of potential ecological concern (COPECs) for sediment and water. The document "Screening Level Ecological Risk Assessment Methods, Revision 2" (LANL 2004, 087630), contains information about how ESLs are derived. ESLs are developed for a suite of receptors designed to represent individual feeding guilds. Receptors such as the robin and kestrel are modeled with multiple diets to represent multiple feeding guilds. Concentrations of each COPC in sediment and nonstorm-related surface water were compared with ESLs from the ECORISK Database Version 2.5 (LANL 2010, 110846); these comparisons are discussed in section 6. Additional information regarding the potential for ecological risks from COPCs in affected media in Ancho, Chaquehui, and Indio Canyons is provided in section 8.1.

5.4 Water-Quality Standards and Comparison Values

COPCs in water are identified by comparing concentrations with applicable water-quality standards and other comparison values. The New Mexico Water Quality Control Commission (NMWQCC) establishes surface-water standards in the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 New Mexico Administrative Code [NMAC]). Standards with an effective date of January 14, 2011, were used in this report. Certain watercourses may be “classified” and have segment-specific designated uses. A designated use may be an attainable or an existing use (e.g., livestock watering) for surface water. Nonclassified surface waters are described as ephemeral, intermittent, or perennial, each of which also has corresponding designated uses described in 20.6.4.97-99 NMAC. The designated uses for surface water are associated with use-specific water-quality criteria (WQC), including numeric criteria.

Stream channels in Ancho, Chaquehui, and Indio Canyons are classified as ephemeral and intermittent (20.6.4.128 NMAC), with designated uses of livestock watering, wildlife habitat, limited aquatic life, and secondary contact. Thus, the numeric WQC for livestock watering (20.6.4.900[F] and 20.6.4.900[J] NMAC); wildlife habitat (20.6.4.900[G] and 20.6.4.900[J] NMAC); acute aquatic life (20.6.4.900[H], 20.6.4.900[I], and 20.6.4.900[J] NMAC); and secondary contact (20.6.4.900[E] NMAC) apply to nonstorm-related surface water for all of the watercourse classifications. For classified ephemeral or intermittent segments, the WQC for acute total ammonia (20.6.4.900[K] NMAC) also applies. The New Mexico Environment Improvement Board (NMEIB) Standards for Protection Against Radiation (20.3.4.461 [D], 20.3.4.461 [E] NMAC) are applicable to nonstorm-related surface water.

Concentrations of radionuclides in nonstorm-related surface water were compared with the lowest of the following values to identify COPCs:

- NMEIB Standards for Protection Against Radiation (20.3.4.461 [D], 20.3.4.461 [E] NMAC)
- DOE generic or Laboratory-specific Biota Concentration Guides (BCGs) for protection of ecological receptors (DOE 2002, 085637; McNaughton et al. 2008, 106501)

If none of the above standards exists for an analyte, the following comparison values were used to identify nonstorm-related surface water COPCs:

- DCGs based on 4 mrem/yr

To identify COPCs in groundwater based on sample results from springs, comparisons with the lowest of the following standards were performed:

- human health (20.6.2.3103[A] NMAC: Human Health Standards)
- other standards for domestic water (20.6.2.3103[B] NMAC: Other Standards for Domestic Water Supply)
- EPA maximum contaminant levels (MCLs)
- NMEIB Standards for Protection Against Radiation (20.3.4.461 [D], 20.3.4.461 [E] NMAC)

If none of the above standards exists for an analyte, the following comparison values were used to identify groundwater COPCs:

- DOE DCGs based on 4 mrem/yr
- EPA regional tap water SLs

Comparisons of spring concentrations to applicable standards and available comparison values are summarized in section 6. The NMED tap water screening values (NMED 2009, 108070) for carcinogens and noncarcinogens are also provided in section 6 as an additional point of comparison for water concentrations.

5.5 Stormwater Comparison Values

Stormwater discharges are regulated under the CWA, and no applicable standards for stormwater are available. The IP contains target action levels for specific contaminants in stormwater, but these action levels apply only at the monitoring locations specified in the permit. For purposes of assessing the relative quality of stormwater discharges, stormwater monitoring data obtained from Ancho and Chaquehui Canyons downgradient of SWMUs and AOCs are compared with the following values from the State of New Mexico Standards for Interstate and Intrastate Surface Waters (Section 20.6.4 NMAC):

- livestock watering (20.6.4.900[F] and 20.6.4.900[J] NMAC)
- wildlife habitat (20.6.4.900[G] and 20.6.4.900[J] NMAC)
- acute aquatic life (20.6.4.900[H], 20.6.4.900[I], and 20.6.4.900[J] NMAC)
- human health (persistent) (20.6.4.11[G] NMAC)

Stormwater concentrations are compared with these values in section 6.

6.0 CANYONS CONTAMINATION

This section describes the methodology and results of screening assessments conducted to identify COPCs in sediment and nonstorm-related surface-water samples collected in Ancho, Chaquehui, and Indio Canyons. The screening process for stormwater data is also described. Identifying COPCs forms the basis for evaluating contamination in canyons media. COPCs identified in this section are used in the ecological risk assessment in section 8.1 and are evaluated in the human health risk assessment in section 8.2. A subset of these COPCs is discussed as part of the conceptual model development in section 7. Section 6.1 briefly describes how the data were prepared for the screening processes. Section 6.2 presents the screen for sediment, and section 6.3 presents the screens for nonstorm-related surface water and groundwater. Section 6.4 presents the screen for stormwater. The term “sediment” includes all post-1942 sediment deposits in the canyon bottoms, including deposits in abandoned channels and floodplains as well as in active stream channels; therefore, sediment includes alluvial soil as defined in some other studies.

6.1 Data Preparation

Data packages for the analytical data for all media are presented in Attachment C-1 in Appendix C. The data used in the assessments were obtained from the SMDB and the WQDB and are presented in Attachment C-2 in Appendix C. The samples collected, analytical methods, and data-quality issues are summarized in Appendix C, and data qualifiers are defined in Appendix A.

Certain analytical results were not evaluated in the screens and subsequent risk assessments for the following reasons.

- Duplicate sample results for analytes analyzed by a less sensitive method—For example, semivolatile organic compound (SVOC) results from samples that were also analyzed by a volatile organic compound, polycyclic aromatic hydrocarbon, or explosive compounds analytical method. The duplicate results from the SVOC method are excluded from the screen because the other analytical methods provide lower detection limits.
- Field duplicate results—Results are from samples obtained for quality assurance/quality control (QA/QC) purposes and not as characterization data.
- Results from surface-water samples collected before 2003—Results from samples collected in 2003 and later are used in the screens because these data are most representative of current site conditions.
- Results from Ancho Spring, which is included as a location in the groundwater background data set (LANL 2010, 110535), are not included in the COPC screens or risk evaluations.

Two of the surface-water samples collected from Ancho and Chaquehui Canyons after 2002 that were assigned a media code other than “stormwater” (WT) were from a short-duration, rain-on-snow event in January 2008. This event was more similar to typical stormwater events than snowmelt runoff that provides persistent flow in other canyons, and this sample is included as part of the stormwater screen in section 6.4.

6.2 Sediment COPCs

This section presents the process for screening analytical results obtained from sediment samples collected in Ancho, Chaquehui, and Indio Canyons. Samples collected and analyses performed by the analytical laboratories are presented in Table 6.2-1. The analytes included for each of these analytical suites are listed in Appendix C, Table C-2.0-4. Sampling locations are shown on Plates 1, 2, and 3. Analytical results were screened to develop a list of COPCs, as presented in section 6.2.1.

6.2.1 Identification of Sediment COPCs

Inorganic and radionuclide COPCs in sediment are identified by a screening process that includes comparing the maximum concentrations by reach with Laboratory-specific sediment BVs (LANL 1998, 059730). Analytes are retained as COPCs using rules specific to the class of analyte. This process is discussed below.

For inorganic chemicals, an analyte is retained as a COPC in a reach if

- the analyte has a BV, and a detected or nondetected result in the reach exceeds the BV, or
- the analyte does not have a BV but has at least one detected result in the reach.

For radionuclides, an analyte is retained as a COPC in a reach if

- the analyte has a BV and a detected or nondetected result in the reach exceeds the BV, or
- the analyte does not have a BV but has at least one detected result in the reach.

There are no BVs for organic chemicals, and retaining an organic chemical as a COPC is based on detection status. For organic chemicals, an analyte is retained as a COPC in a reach if at least one result is detected in the reach.

A total of 15 inorganic chemicals, 36 organic chemicals, and 7 radionuclides were retained as COPCs in sediment in Ancho, Chaquehui, and Indio Canyons. Table 6.2-2 presents sample results greater than BVs for inorganic chemicals; Table 6.2-3 presents sample results for all detected organic chemicals; and Table 6.2-4 presents sample results greater than BVs for radionuclides. Summaries of maximum sample results in each reach for these COPCs (which include detection limits for some inorganic chemicals) are presented in Tables 6.2-5, 6.2-6, and 6.2-7 for inorganic chemicals, organic chemicals, and radionuclides, respectively. ESLs and residential SSLs and SALs are included in the tables for comparison purposes. The assessment of the potential for adverse ecological risks, including the screen against ESLs, is presented in section 8.1. The assessment of the potential for adverse effects on human health, including the screen against residential SSLs and SALs, is presented in section 8.2.

6.2.2 Comparison of Sediment COPC Concentrations to Residential SSLs and SALs

Maximum concentrations of sediment COPCs (including detection limits for inorganic chemicals) in each reach were compared with residential SSLs for inorganic and organic chemicals or residential SALs for radionuclides to identify which COPCs are most important for understanding potential human health risk. One inorganic COPC, arsenic, has a maximum concentration exceeding the residential SSL in reach AN-4 and is shaded in gray in Table 6.2-5. No radionuclide or organic COPCs have maximum concentrations exceeding residential SALs or SSLs in Ancho, Chaquehui, and Indio Canyons.

6.3 Surface-Water and Groundwater COPCs

This section presents the process for screening nonstorm-related surface-water and groundwater (spring) sample results from Ancho and Chaquehui Canyons. Nonstorm-related surface-water and groundwater (spring) samples collected and analyses performed by the analytical laboratories are presented in Table 6.3-1. The analytes included for each of these suites are listed in Appendix C, Table C-2.0-5. Sample locations are presented in Figure 3.2-1. Analytical results from nonstorm-related surface-water and spring samples were screened to develop a list of COPCs, as presented in section 6.3.1. Spring samples were screened both as nonstorm-related surface water and as groundwater.

6.3.1 Identification of Surface-Water and Spring COPCs

There are no BVs for surface water, and retaining an analyte as a COPC is based on detection status. This process is performed for groups of data defined by field preparation (filtered or nonfiltered samples) and analyte type (inorganic chemicals, organic chemicals, and radionuclides). An analyte is retained as a COPC for a location if there is at least one detected result at that location.

For springs, COPCs are also identified by a screening process that includes comparing the maximum concentrations with BVs from the Laboratory Groundwater Background Investigation Report, revision 4 (LANL 2010, 110535).

For inorganic chemicals and radionuclides, an analyte is retained as a COPC for a location if

- the analyte has a BV, and a detected result at that location exceeds the BV, or
- the analyte does not have a BV but has at least one detected result at that location.

There are no groundwater BVs for organic chemicals, and retaining an organic chemical as a COPC is based on detection status. For organic chemicals, an analyte is retained as a COPC for a location if there is at least one detected result at that location.

A total of 34 inorganic chemicals, 5 organic chemicals, and 7 radionuclides were retained as COPCs in water in Ancho and Chaquehui Canyons. Maximum sample results for nonstorm-related surface water and springs are presented in Tables 6.3-2 to 6.3-11.

6.3.2 Comparison of Water COPC Concentrations with Standards

Maximum detected concentrations of water COPCs were compared with applicable water-quality standards, as discussed in section 5, to identify which are most important from a regulatory perspective. A single COPC, thallium, in Ancho and Chaquehui Canyons has detected concentrations greater than a water-quality standard.

6.4 Stormwater

This section presents the process for screening analytical results obtained from stormwater samples collected in Ancho and Chaquehui Canyons. Stormwater samples collected and analyses performed by the analytical laboratories are presented in Table 6.4-1. The analytes included for each of these suites are listed in Appendix C, Table C-2.0-5.

6.4.1 Stormwater Screen against Comparison Values

The first step in the stormwater screen is an evaluation of detected concentrations in filtered and nonfiltered stormwater samples against the lowest comparison value applicable for that field preparation from the State of New Mexico Standards for Interstate and Intrastate Surface Waters (Section 20.6.4 NMAC), as described in section 5.4. The stormwater comparison values are presented in Table 6.4-2 and include values for livestock watering, wildlife habitat, human health persistent, and acute aquatic life. Table 6.4-3 presents the results of the stormwater screen for analytes with concentrations exceeding a comparison value grouped by location, field preparation, and analyte type. Table 6.4-3 also summarizes the number of stormwater results by analyte exceeding the lowest comparison value and the basis for the comparison value. These analytes are discussed further in section 7.2.2.

Four gaging stations in Ancho and Chaquehui Canyons for which stormwater samples are available are gage E275, Ancho below SR-4, above reach A-3; gage E274, Ancho north fork below SR-4, in reach AN-4; gage E338, Chaquehui at TA-33, below reach CH-1; and gage E340, Chaquehui tributary at TA-33, in reach CHN-1.

The stormwater comparison values were exceeded by two inorganic chemicals (aluminum and copper) in filtered samples. The stormwater comparison values for mercury, selenium, and gross-alpha radiation were also exceeded in nonfiltered samples. For organic chemicals, the stormwater comparison values for total polychlorinated biphenyls (PCBs) and the dioxin congener 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) were exceeded in nonfiltered samples. Both aluminum and gross-alpha radiation commonly exceed the comparison values in background locations on the Pajarito Plateau (e.g., LANL 2010, 111232).

6.4.2 Comparison of Stormwater Concentrations with Acute Exposure Benchmarks

Analytes with concentrations greater than comparison values were further evaluated relative to the potential for acute exposure to human health or ecological receptors. The acute exposure benchmarks for the protection of ecological receptors are a subset of the comparison values discussed in section 6.4.1. Specifically, the comparison values associated with acute aquatic life address the protection of ecological receptors to acute exposures; these benchmark comparisons are discussed in section 6.4.2.1. Total PCBs and dioxins exceeded persistent human health comparison values, so these analytes are evaluated further for human health exposures. Both livestock watering and wildlife habitat values are protective of the potential for adverse effects based on chronic exposures and therefore do not pertain to effects associated with acute exposures. The analytes exceeding only these chronic comparison values (mercury, selenium, gross-alpha radiation) are not evaluated further because chronic exposures from stormwater are not realistic. However, aluminum and copper concentrations are greater than acute ecological comparison values, and these analytes are discussed further below.

6.4.2.1 Acute Ecological Comparisons

The maximum detected concentrations of two analytes (aluminum and copper) exceeded stormwater comparison values based on acute aquatic life criteria. Because the stormwater comparison values are based on an acute exposure, the acute aquatic life standards are also used as the benchmarks for acute ecological exposures. Table 6.4-4 summarizes the maximum detected concentrations exceeding the acute benchmarks, and these exceedances are discussed in section 8.1.

6.4.2.2 Acute Human Health Comparisons

The maximum detected concentration of two analytes (total PCBs and dioxins) exceeded stormwater comparison values based on persistent human health criteria used as comparison values. There are no acute human health comparison values for any analytes. The potential for acute health effects associated with exposure to stormwater is qualitatively discussed in section 8.2.

6.5 Summary

Table 6.5-1 presents a summary of the COPCs in sediment, nonstorm-related surface water, and springs, and detected analytes in stormwater in Ancho, Chaquehui, and Indio Canyons. Table 6.5-1 indicates which COPCs have maximum results that exceed (1) residential SSLs or SALs for sediment and (2) water-quality standards for nonstorm-related surface water and groundwater. Table 6.5-1 also indicates which stormwater analytes have maximum detected concentrations that exceed acute exposure comparison values.

7.0 PHYSICAL SYSTEM CONCEPTUAL MODEL

This section discusses aspects of the physical system conceptual model relevant for understanding the nature, sources, extent, fate, and transport of contaminants in the Ancho, Chaquehui, and Indio watersheds, particularly in sediment and surface water. The discussion includes COPCs included in evaluations of potential human health risk in section 8.2 and COPCs identified as relevant for evaluating potential current ecological risk in section 8.1. Additional COPCs are discussed to provide insights into potential releases from SWMUs or AOCs and the downcanyon extent of contaminants. As used in this section, “contaminant” refers to COPCs known to represent releases from Laboratory SWMUs or AOCs or other anthropogenic sources, whereas "COPC" is a more general term that also includes analytes identified in section 6 that may or may not represent such releases.

The following discussion is divided into two sections. Section 7.1 uses spatial variations in COPC concentration in sediment to identify sources and describe the distribution and transport of contaminants. Section 7.2 describes the hydrology of the watershed, including surface water, and discusses key surface-water COPCs.

7.1 COPCs in Sediment

The following sections first use spatial variations in concentrations of sediment COPCs in Ancho, Chaquehui, and Indio Canyons to identify sources, in part distinguishing COPCs that are present because of releases from SWMUs or AOCs from COPCs derived from other sources, such as natural background variations and ash from the La Mesa fire. Because of mixing of sediment from various sources during transport, contaminant concentrations are generally highest near the point of release and decrease downcanyon (e.g., Marcus 1987, 082301; Graf 1996, 055537; LANL 2004, 087390; Reneau et al. 2004, 093174; LANL 2006, 094161; LANL 2009, 106939; LANL 2009, 107453; LANL 2009, 107497; LANL 2010, 111507). Therefore, the spatial distribution of contaminants can directly indicate their source or sources. Indio Canyon contains no Laboratory sites, and the only possible source of Laboratory-derived contaminants is airborne dispersion from firing activities in the north fork of Ancho Canyon at TA-39. To evaluate this possible pathway, data from COPCs in Indio Canyon are compared with data from the north fork of Ancho Canyon, close to the firing sites. Figures D-1.1-1, D-1.1-2, and D-1.1-3 in Appendix D show all sample results for all COPCs plotted against distance from the Rio Grande, which help to identify sources and possible outliers in the data set. COPCs associated with natural background variations also commonly have concentrations that vary with particle size, and comparisons of their concentrations and particle size distribution with those in background sediment samples can be useful in evaluating the presence of contamination. Figures 7.1-1 to 7.1-4 illustrate the geomorphic context of some key COPCs discussed in this section, including their relation to different geomorphic units and sediment facies and to post−La Mesa fire sediment deposits.

7.1.1 Inorganic Chemicals in Sediment

This section focuses on spatial variations of select inorganic chemicals in Ancho, Chaquehui, and Indio Canyons. One inorganic COPC in Ancho Canyon sediment, arsenic, has maximum detected concentrations greater than residential SSLs, and only arsenic is included in the human health risk assessment discussed in section 8.2. Six inorganic chemicals in sediment samples are important for assessing potential ecological risk, as discussed in section 8.1: antimony, chromium, cyanide, mercury, selenium, and vanadium. Several additional inorganic chemicals have spatial distributions that indicate releases from SWMUs or AOCs, including copper. One additional COPC, perchlorate, was detected in Indio Canyon sediment and is relevant for evaluating possible contamination there. Another COPC, iron, is relevant for understanding the distribution of several other metals. The spatial distribution of these inorganic chemicals (discussed below) indicates they are derived from a variety of sources, including SWMUs or AOCs and naturally occurring soils and bedrock. Once in the canyon bottoms, most of these inorganic chemicals adsorb to sediment particles and organic matter (Salomons and Forstner 1984, 082304) and can be remobilized by floods that scour the stream bed or erode banks, being transported varying distances downcanyon.

Supporting information on spatial variations in inorganic chemicals in Ancho, Chaquehui, and Indio Canyons is included in Appendix D. Table D-1.2-1 presents average concentrations in each reach for inorganic chemicals discussed in this section, substituting one-half of the detection limit for nondetected sample results. Table D-1.2-1 presents the upper and lower bounds on these averages using either the detection limit or zero for nondetects, respectively, which indicate uncertainties in the average values. This table shows that average concentrations of these inorganic chemicals are generally lower in coarse facies sediment than in fine facies sediment, as found in other canyons (LANL 2004, 087390; LANL 2006, 094161; LANL 2009, 107416; LANL 2009, 106939; LANL 2009, 107453; LANL 2009, 107497; LANL 2010, 111507). Figure 7.1-5 and the discussions in the following sections focus on data from fine facies sediment. Figure 7.1-5 and Table D-1.2-1 also show the uncertainty in the average concentration of some inorganic chemicals that exists in some reaches because of elevated detection limits and/or detected concentrations close to detection limits.

The plots in Figure 7.1-5 include both the sediment BV for each inorganic chemical, which is an estimate of the upper level of background concentrations, and the average value from the background sediment data set, where available (averages from McDonald et al. 2003, 076084, Table 10, pp. 49−50). The background averages are included to be consistent with the presentation of averages from potentially contaminated samples, although averages for fine facies sediment are expected to be higher than the entire background data set, which also includes coarse facies samples. For reaches where an inorganic chemical is not a COPC, the average background concentration is plotted in Figure 7.1-5.

Antimony is an important COPC for evaluating ecological risk in Ancho Canyon. Antimony has a low detection frequency, 4%, and is a COPC only because of detection limits above the sediment BV of 0.83 mg/kg in each reach. Average concentrations of antimony in both fine-grained and coarse-grained sediment are poorly constrained because of the high frequency of nondetected results (Table D-1.2-1). Because no detected antimony results are above the BV, antimony concentrations are inferred to represent naturally occurring background.

Arsenic is an important COPC for evaluating potential human health risk in Ancho Canyon and has detected concentrations exceeding the sediment BV of 3.98 mg/kg and the residential SSL of 3.9 mg/kg in two samples from reach AN-4 (4.79 and 4.84 mg/kg). Both samples were collected from thin (4−10 cm thick), fine-grained sediment layers deposited by a record flood in August 2008 (Figure 7.1-3) (LANL 2009, 108621). The spatial distribution of arsenic and other inorganic COPCs in AN-4 is shown in Figure 7.1-6. Average concentrations of arsenic in both fine-grained and coarse-grained sediment from AN-4 are below the BV (Figure 7.1-5 and Table D-1.2-1). Because arsenic was not identified as a COPC in upcanyon reaches or at TA-39 SWMUs (LANL 2010, 108500.11) and because these results were not replicated in the 2010 sampling, these results are inferred to represent outliers in the background distribution.

Chromium is an important COPC for evaluating potential ecological risk in Chaquehui Canyon and is above the BV of 10.5 mg/kg in a single sample from reach CH-1, at 13.8 mg/kg. Average concentrations of chromium in both fine-grained and coarse-grained sediment from CH-1 are below the BV (Figure 7.1-5 and Table D-1.2-1). This sample also has the highest concentrations of iron, manganese, vanadium, and zinc in this data set. Black magnetite-rich sands on the Pajarito Plateau are elevated in chromium, iron, manganese, vanadium, zinc, and other metals (Reneau et al. 1998, 062050), and the composition of this CH-1 sample indicates the presence of black sands.

Copper has a distribution that indicates releases from firing sites within the north fork of Ancho Canyon at TA-39, which is consistent with known releases of copper from these sites (LANL 2006, 093714; LANL 2010, 108500.11). Copper has results above the BV of 11.2 mg/kg in two fine-grained samples from reach AN-2, close to firing sites, which are also elevated in uranium isotopes and other COPCs. Data from stormwater samples have also indicated the transport of copper from firing sites at the Laboratory (LANL 2009, 108621, p. 223). Average concentrations of copper in both fine-grained and coarse-grained sediment from AN-2 are below the BV (Figure 7.1-5 and Table D-1.2-1). The maximum result, 18.5 mg/kg, is less than twice the BV, and the absence of copper above the BV in downcanyon reaches indicates that releases were relatively small, and that there has been limited downcanyon transport. This conclusion is supported by recent investigations in the North Ancho Canyon Aggregate Area that indicated decreasing copper concentrations downcanyon from the firing sites (LANL 2010, 108500.11).

Cyanide is an important COPC for evaluating potential ecological risk in Chaquehui Canyon and has maximum detected concentrations exceeding the sediment BV of 0.82 mg/kg in three reaches (A-1, AN-4, and CH-1). The highest cyanide concentrations were measured in CH-1, with a maximum concentration of 4.68 mg/kg from a fine-grained sediment sample (CACH-10-25597) (Figure 7.1-4, top). CH-1 also has the highest frequency of results above the BV, 30%, and average concentrations in both fine-grained and coarse-grained sediment are above the BV (Figure 7.1-5 and Table D-1.2-1). These results indicate releases of cyanide from one or more sites at TA-33. Because cyanide has not been measured above the BV in reach CH-2, closest to the Rio Grande, the downcanyon extent of cyanide above the BV is somewhere between CH-1 and CH-2, 2.1 to 1.0 km above the Rio Grande. The next highest concentrations of cyanide, up to 1.13 mg/kg, were measured in A-1 in upper Ancho Canyon, and 20% of the A-1 samples had detected cyanide above the BV. These results were both from fine-grained post−La Mesa fire sediment (e.g., Figure 7.1-1, top), and these results are consistent with the presence and concentrations of cyanide in post−Cerro Grande sediment (LANL 2009, 106939; LANL 2009, 107416; LANL 2009, 107497). Therefore, the A-1 results do not indicate releases from Laboratory sites at TA-49. In AN-4, a single subsurface sample had cyanide detected at approximately 15% above the BV, at 0.95 mg/kg. This result indicates either minor releases from TA-39, a background outlier, or possibly some cyanide derived from La Mesa fire ash. The presence of cyanide as a COPC in TA-39 soil and sediment supports a possible source at TA-39 SWMUs (LANL 2010, 108500.11).

Iron is a mineralogically important COPC that is relevant for understanding the distribution of several other metals. Iron has maximum detected concentrations exceeding the sediment BV of 13,800 mg/kg in single samples from each of four reaches (AN-1, CH-1, CH-2, and CHN-1). The maximum result for iron, 25,600 mg/kg, was from a sample from CH-1 that also has the highest concentrations of manganese, vanadium, and zinc in this data set. Black magnetite-rich sands on the Pajarito Plateau are elevated in iron, manganese, vanadium, zinc, and other metals (Reneau et al. 1998, 062050), and the composition of this CH-1 sample indicates the presence of black sands. The AN-1, CH-2, and CHN-1 samples with iron above the BV also have the highest concentrations of vanadium in each reach. Average iron concentrations are below the BV in all reaches, and the spatial pattern of iron does not indicate significant releases from Laboratory sites (Figure 7.1-5 and Table D-1.2-1).

Mercury is an important COPC for evaluating potential ecological risk in the north fork of Ancho Canyon at TA-39. Mercury has maximum detected concentrations above the BV of 0.1 mg/kg in three reaches (AN-2, AN-3, and AN-4), with the highest concentrations in fine-grained sediment in reach AN-2 that are also elevated in copper and uranium isotopes. Average concentrations are also highest in fine-grained sediment in these three reaches, above or close to the BV (Figure 7.1-5 and Table D-1.2-1). The distribution of mercury and its association with copper and uranium indicate a source at TA-39 firing sites, which is consistent with known releases of mercury from these sites (LANL 2006, 093714; LANL 2010, 108500.11). Because mercury has not been measured above the BV in reach A-3 close to the Rio Grande, the downcanyon extent of mercury above the BV is somewhere between AN-4 and A-3, 4.0 to 1.0 km above the Rio Grande.

Perchlorate is the only inorganic COPC detected in reach I-1 and was also detected in all Ancho and Chaquehui Canyon reaches. Perchlorate has no BV and is considered a COPC based solely on detection status. As shown in Figure 7.1-5 and Table D-1.2-1, estimated average concentrations in all reaches are similar, and in most reaches are affected by a high frequency of nondetects. Although the detection frequency in I-1 is relatively high (70%), the average detected concentration in I-1 (0.00095 mg/kg) is less than the average detection limit for nondetects in this data set (0.00213 mg/kg). The only possible source of Laboratory-derived perchlorate in Indio Canyon would be firing activities in the north fork of Ancho Canyon at TA-39, but perchlorate is not elevated in the TA-39 reach closest to the firing sites (AN-2). Therefore, these data indicate that the perchlorate is naturally occurring. Data from other canyons at the Laboratory have also indicated similar concentrations of naturally occurring perchlorate (e.g., LANL 2009, 106939; LANL 2009, 107497).

Selenium is an important COPC for evaluating ecological risk in Ancho Canyon. Selenium was detected in no samples and is a COPC only because of detection limits above the sediment BV of 0.3 mg/kg in each reach. Average concentrations of selenium in both fine-grained and coarse-grained sediment are poorly constrained because of the high frequency of nondetected results (Table D-1.2-1). Because no selenium was detected, selenium concentrations are inferred to represent naturally occurring background.

Vanadium is an important COPC for evaluating potential ecological risk in Chaquehui Canyon and has maximum detected concentrations exceeding the sediment BV of 19.7 mg/kg in 12 samples from 5 investigation reaches (A-1, AN-1, CH-1, CH-2, and CHN-1). The maximum vanadium concentration, 48.8 mg/kg, is from a sediment sample from CH-1 that also has the highest iron, manganese, and zinc concentrations in this data set (sample CACH-10-25595). The samples with the second and third highest vanadium concentrations also have iron above the BV (samples CACH-10-25621 and CACH-10-4838, 31.8 and 27.9 mg/kg, reaches CHN-1 and CH-2, respectively). Black magnetite-rich sands on the Pajarito Plateau are elevated in iron, vanadium, zinc, and other metals (Reneau et al. 1998, 062050), and the composition of these samples indicates the presence of black sands. However, elevated vanadium concentrations in other samples suggest releases from Laboratory sites. Reach CHN-1 has the highest frequency of vanadium results above the BV, 50%, and also has average vanadium concentrations in fine-grained sediment above the BV (Figure 7.1-5 and Table D-1.2-1). Two of the CHN-1 samples with elevated vanadium also have the highest concentrations of Aroclor-1260 and tritium in this data set, suggesting contemporaneous releases.

Figure 7.1-7 presents relations of concentrations of vanadium with silt and clay content in Ancho, Chaquehui, and Indio Canyon sediment samples and background samples (background data from McDonald et al. 2003, 076084). This plot shows the relatively high vanadium in single coarse-grained samples from AN-1, CH-1, CH-2, and CHN-1. Most other samples share a positive correlation between vanadium concentration and silt and clay content that indicates naturally occurring vanadium, with the exception of several CHN-1 samples. The elevated vanadium in these CHN-1 samples relative to their silt and clay content also indicates some releases of vanadium into the north fork of Chaquehui Canyon from TA-33.

7.1.2 Organic Chemicals in Sediment

This section focuses on spatial variations of select organic chemicals in Ancho, Chaquehui, and Indio Canyons. No organic chemicals in Ancho, Chaquehui, or Indio Canyon sediment have maximum detected concentrations greater than residential SSLs, and none are included in the human health risk assessment in section 8.2. In addition, no organic chemicals are important for assessing potential ecological risk. One explosive compound, triaminotrinitrobenzene (TATB), was detected in Ancho Canyon sediment and has a spatial distribution that indicates releases from Laboratory sites. The PCBs Aroclor-1248, Aroclor-1254, and Aroclor-1260 were detected in Ancho and Chaquehui Canyon sediment and are of interest because of potential impacts on surface-water quality (e.g., LANL 2010, 111232). Two organic chemicals, the SVOC di-n-butylphthalate and the pesticide heptachlor, were detected in Indio Canyon and are relevant for understanding potential contamination in this canyon. The spatial distribution of these organic chemicals is discussed in this section. Table D-1.2-2 presents average concentrations for these organic chemicals in coarse and fine facies samples in Ancho, Chaquehui, and Indio Canyons, substituting one-half of the detection limit for nondetected sample results. This table also presents the upper and lower bounds on these averages, using either the detection limit or zero for nondetects, respectively.

The SVOC di-n-butylphthalate was detected in sediment samples from two reaches, in one sample each from AN-2 and I-1, at 0.107 and 0.0899 mg/kg, respectively. Both detected results were much less than the detection limits for all other samples (0.334 to 0.487 mg/kg). Because the detected results were less than the detection limits for most samples, no conclusions can be made about sources or distribution of di-n-butylphthalate. However, the absence of other AN-2 COPCs in I-1 indicates it is unlikely that the I-1 detect resulted from airborne dispersion from firing sites in the north fork of Ancho Canyon.

The pesticide heptachlor was detected in four sediment samples from three reaches, AN-3, AN-4, and I-1. The maximum detected result, 0.001 mg/kg, was from I-1, and the source of this heptachlor is unknown. Although the AN-3 and AN-4 detects suggest releases at TA-39, such as associated with pest control, the detected concentrations (0.000319 to 0.000474 mg/kg) are less than the detection limits for the other samples in this data set (0.142 to 0.000669 mg/kg), and the sources and distribution of heptachlor are uncertain.

The explosive compound TATB was detected in two sediment samples from one reach, AN-2, at 0.373 and 1.58 mg/kg, downcanyon from firing sites in the north fork of Ancho Canyon at TA-39. This is consistent with known usage of TATB at TA-39 firing sites (LANL 2006, 093714; LANL 2010, 108500.11). The absence of detected TATB in downcanyon reaches indicates small releases and limited transport.

PCBs were detected in five reaches in Ancho and Chaquehui Canyons (AN-2, AN-3, AN-4, CH-1, and CHN-1), at concentrations well below residential SSLs (maximum of 0.0079 mg/kg for Aroclor-1260 in CHN-1 versus the SSL of 2.22 mg/kg). PCBs have low solubilities and a strong affinity for organic material and sediment particles (Chou and Griffin 1986, 083419). PCBs were widely used in electric transformers and other industrial applications (Walker et al. 1999, 082308, pp. 364−365), and their widespread use is consistent with their occurrence in Ancho and Chaquehui Canyon sediment. The sediment data indicate PCBs were derived from multiple sources in these watersheds, as discussed below. Average PCB concentrations in coarse and fine facies samples in these Ancho and Chaquehui Canyon reaches are presented in Table D-1.2-2, and the averages for Aroclor-1254 and Aroclor-1260 in fine facies sediment are shown in Figure 7.1-8. The estimated average concentrations have considerable uncertainty because of high frequencies of nondetects and because most detected results (63%) are below the average detection limit for other samples from these reaches (0.0034 mg/kg).

Aroclor-1248 was detected in only one sample, from reach AN-2, at 0.0025 mg/kg. Aroclor-1254 was detected in 10 samples, with the highest concentration (0.0073 mg/kg) and the highest frequency of detects (50%) measured in reach CH-1. The highest concentration of Aroclor-1254 was measured in the sample with the highest concentration of cyanide (Figure 7.1-4, top), suggesting contemporaneous releases. SWMU 33-009, where there was recorded disposal of electrical capacitors (LANL 2009, 107348), is one possible source for these PCBs. Aroclor-1260 was detected in eight samples, with the highest concentration (0.0079 mg/kg) and the highest frequency of detects (50%) measured in reach CHN-1 (Figure 7.1-4, bottom). In contrast, reaches AN-2 and AN-4 had PCBs detected in only 10% of their samples, and reach AN-3 in 30% of the samples. These data indicate at least two sources for PCBs in TA-33, and probably at least two sources in TA-39. Investigations at TA-39 also indicate multiple sources for PCBs, including SWMUs 39-001(a), 39-004(c), and 39-007(a) (LANL 2010, 108500.11). No PCBs were detected in the reaches closest to the Rio Grande (A-3 and CH-2), indicating little transport to the river.

7.1.3 Radionuclides in Sediment

Seven radionuclides are identified as COPCs in sediment in Ancho, Chaquehui, and Indio Canyons in section 6: cesium-137, plutonium-238, plutonium-239/240, tritium, uranium-234, uranium-235/236, and uranium-238. None of these radionuclides are identified as important for evaluating potential ecological risk in section 8.1 or potential human health risk in section 8.2. These COPCs are discussed below to evaluate sources, distribution, and potential off-site transport. Average concentrations of each radionuclide COPC in coarse and fine facies sediment in each reach are presented in Table D-1.2-3 in Appendix D.

Cesium-137 and plutonium-239/240 are fallout radionuclides that are identified as COPCs only in reaches that were burned during the La Mesa fire, specifically reaches A-1, A-2, and AN-1. They were detected above BVs only in postfire sediment samples, and their concentrations are within the range found in post−Cerro Grande sediment samples that contain reworked ash from the Cerro Grande burn area (e.g., LANL 2004, 087630). The maximum concentrations of cesium-137 and plutonium-239/240 (3.52 and 0.128 pCi/g, respectively) were measured in the same sediment sample from A-1, fine-grained sediment that included a 4-cm-thick “muck” (reworked ash) layer at the base (sample CAAN-10-24774) (Figure 7.1-1, top). For comparison, the maximum concentrations of cesium-137 and plutonium-239/240 measured in post−Cerro Grande sediment samples collected from background areas were 8.26 and 0.343 pCi/g, respectively, in a muck sample from Pueblo Canyon above Diamond Drive (sample CABG-00-0081, LANL 2004, 087390). The BVs for cesium-137 and plutonium-239/240 are 0.9 and 0.068 pCi/g, respectively. In addition, although there were known releases of plutonium-239/240 at MDA AB in TA-49 (e.g., LANL 2006, 093713), the maximum concentration in sediment, in A-1, is upgradient from MDA AB. This sample also has the highest cyanide concentration in Ancho Canyon, and cyanide is another COPC that is elevated in Cero Grande ash, as discussed in section 7.1.1. These data therefore indicate that the elevated cesium-137 and plutonium-239/240 measured in sediment in the Ancho watershed is derived from atmospheric fallout and was concentrated in ash from the La Mesa fire.

Plutonium-238 is a fallout radionuclide that was detected above the BV of 0.006 pCi/g in only a single sediment sample, at 0.0191 pCi/g from reach I-1 in Indio Canyon (sample CAIN-10-25632). Because plutonium-238 was not identified as a COPC in the north fork of Ancho Canyon at TA-39 (LANL 2010, 108500.11), which is the only possible Laboratory source of contaminants for Indio Canyon, this result does not indicate releases from the Laboratory but instead a background (i.e., atmospheric fallout) outlier.

Tritium is identified as a COPC in three reaches: AN-4, CH-2, and CHN-1. The highest tritium concentration (0.383 pCi/g vs the BV of 0.093 pCi/g) was measured in a fine-grained sample from reach CHN-1 (sample CACH-10-25617) (Figure 7.1-4, bottom), downcanyon from MDA K and a former tritium facility [Consolidated Unit 33-0002(a)-99]. The average tritium concentration in fine-grained samples from CHN-1, 0.121 pCi/g (Figure 7.1-8 and Table D-1.2-3), is also above the BV, and these data are consistent with known releases from the tritium facility (e.g., LANL 2006, 093713). The maximum tritium concentration downcanyon in reach CH-2, 0.116 pCi/g, is 25% higher than the BV and indicates some transport into lower Chaquehui Canyon. Only a single detected tritium result from AN-4 was above the BV, in a fine-grained sample collected in 2008 (0.098 pCi/g in sample CAAN-08-16461). This result is less than 10% above the BV, and because tritium was not identified as a COPC in upcanyon reaches and was not identified as a COPC in the 2010 samples from AN-4, this tritium result probably indicates a background outlier and not Laboratory releases.

Uranium isotopes were detected above the sediment BVs in four reaches in the Ancho watershed: A-1, AN-2, AN-3, and AN-4. The highest concentrations of uranium-234, uranium-235/236, and uranium-238 were each measured in a coarse-grained active channel sample from AN-2 (sample CAAN-10-24814) (Figure 7.1-2, top), below open-air firing sites in the north fork of Ancho Canyon at TA-39. These isotopes are also above BVs in fine-grained sediment in AN-2, although average concentrations for all three isotopes are higher in the coarse facies sediment (Table D-1.2-3). Downcanyon in reaches AN-3 and AN-4, only uranium-238 is above the BV, and it is only above the BV in fine-grained sediment. These differences indicate that the uranium partially occurs as relatively large particles in the stream channel close to the source (coarse sand size or larger), but that downcanyon transport is largely associated with smaller particle sizes (fine to very fine sand and silt). Isotopic uranium analyses of active channel sediment from the north fork of Ancho Canyon below NM 4, within reach AN-4, collected from 2000 to 2009 by the Laboratory's surveillance program also do not show uranium isotopes above BVs (e.g., LANL 2010, 111232), also indicating little downcanyon transport in the stream bed as bed load particles. Decreasing concentrations of uranium isotopes downcanyon from active firing sites at TA-39 are also shown by recent investigations in the North Ancho Canyon Aggregate Area (LANL 2010, 108500.11).

The highest concentration of uranium-238 measured in AN-4 near NM 4 was in a sample of sediment deposited by a record flood on August 4, 2008 (LANL 2009, 108621, p. 245) (Figure 7.1-3), indicating active transport of uranium down the north fork into main Ancho Canyon in suspended sediment. However, uranium-238 has not been measured above the BV farther downcanyon, including in reach A-3 close to the Rio Grande. The downcanyon extent of uranium-238 above the BV is therefore somewhere between AN-4 and A-3, 4.0 to 1.0 km above the Rio Grande. The absence of uranium isotopes above BVs in reach I-1 indicates that the testing activities in the north fork of Ancho Canyon at TA-39 have not resulted in recognizable contamination in Indio Canyon sediment.

In reach A-1, uranium-234 and uranium-238 were detected above the BVs in fine-grained post−La Mesa fire samples. Because these isotopes were not detected above BVs in post−Cerro Grande fire samples (e.g., LANL 2004, 087390), these data indicate releases of uranium into the upper Ancho watershed at TA-49, upcanyon from MDA AB, and transport in postfire runoff events. The absence of uranium isotopes above BVs in reaches A-2 and AN-1 indicate that MDA AB is not a recognizable source for uranium in sediment in the Ancho watershed.

Figure 7.1-9 shows the spatial variations in average concentrations of uranium-238 in fine facies sediment in Ancho, Chaquehui, and Indio Canyons, showing the elevated concentrations in reaches A-1, AN-2, AN-3, and AN-4, and background levels in the other reaches. Figure 7.1-10 shows the concentrations of uranium-238 plotted against silt and clay content, illustrating that near the source, in AN-2, the highest concentration occurs in a sample with low silt and clay content (3.5%) but that samples with higher silt and clay content (23−42%) are also elevated. In the other reaches, uranium-238 is above the BV only in samples with at least 27% silt and clay. Comparison of uranium-238 and uranium-235/236 concentrations in samples from the Ancho watershed indicates that samples with uranium-238 concentration above 5 pCi/g consist of depleted uranium, with uranium-238/235 ratios greater than 21.72 (Figure 7.1-11). This finding is consistent with historical information that indicates use of depleted uranium at TA-39 (LANL 2006, 093714, pp. 22−23).

7.1.4 Summary of Sources and Distribution of Key Sediment COPCs

The data discussed in the previous sections indicate sediment COPCs in Ancho, Chaquehui, and Indio Canyons have a variety of sources, including Laboratory TAs and associated SWMUs or AOCs, ash from the La Mesa fire, and natural background. Table 7.1-1 summarizes the inferred primary sources of the sediment COPCs discussed above and also the inferred downcanyon extent of COPCs that are or that may be derived from Laboratory sources. These inferences are made based on their concentrations, spatial distribution, relation to other COPCs, and other information, as discussed in the previous sections. Sources and downcanyon extent for these COPCs are discussed further below.

7.1.4.1 La Mesa Fire

The 1977 La Mesa fire burned the upper part of the Ancho watershed with a severity comparable to areas burned in the 2000 Cerro Grande fire in the eastern Jemez Mountains and the Pajarito Plateau (Foxx 1984, 006292). Sediment deposits in reaches burned by the La Mesa fire (A-1, A-2, and AN-1) have similar stratigraphy to that observed in post−Cerro Grande deposits, with dark, ash-rich sediment ("muck") overlying older, lighter-colored sediment. Fallout radionuclides are elevated in post−Cerro Grande sediment deposits (Katzman et al. 2001, 072660; Kraig et al. 2002, 085536; LANL 2004, 087390), and the fallout radionuclides cesium-137 and plutonium-239/240 have concentrations in post−La Mesa fire sediment in reaches A-1, A-2, and AN-1 within the range measured in post−Cerro Grande sediment. Cesium-137 and plutonium-239/240 are also collocated in post−La Mesa fire sediment, with the highest concentrations occurring in the same samples. Although MDA AB at TA-49 is also a known source of plutonium-239/240, the highest concentration of plutonium-239/240 was measured in upper Ancho Canyon upcanyon from MDA AB, in reach A-1. These relations indicate that ash from the La Mesa fire is the primary source of cesium-137 and plutonium-239/240 in sediment in the Ancho watershed.

7.1.4.2 Natural Background Variability

Sediment data from different canyons indicate that natural background concentrations for many inorganic chemicals and radionuclides are more variable than those found in the original sediment background data set used to develop BVs for the Laboratory (LANL 1998, 059730; McDonald et al. 2003, 076084). As a result, sediment concentrations can be elevated above BVs even where no Laboratory releases have occurred (e.g., LANL 2006, 094161; LANL 2009, 106939; LANL 2009, 107416; LANL 2009, 107453; LANL 2009, 107497; LANL 2010, 111507). In the Ancho, Chaquehui, and Indio Canyons sediment data set, the spatial distribution of some inorganic COPCs, including arsenic, chromium, and iron, indicates they are dominantly or entirely derived from naturally occurring materials, representing locally elevated background concentrations (Table 7.1-1). For some inorganic COPCs, including vanadium, these data indicate the concentrations are predominantly naturally derived, with inferred minor releases from Laboratory TAs. The elevated concentrations of several metals in some samples, including chromium, iron, manganese, vanadium, and zinc, indicate the presence of naturally occurring black magnetite-rich sands common in Pajarito Plateau stream channels (Reneau et al. 1998, 062050).

7.1.4.3 TA-33

The spatial distribution of COPCs indicates that the former tritium facility in TA-33 is one source of contaminants in Chaquehui Canyon sediment. The radionuclide tritium has its highest concentrations in reach CHN-1, in the north fork of Chaquehui Canyon a short distance downcanyon from the tritium facility, which is consistent with known releases from this site (LANL 2006, 093714, p. 25). Because tritium is also elevated above the BV in reach CH-2, 0.8 km from the Rio Grande, its distribution indicates possible transport to the river. The sediment data also indicate minor releases of vanadium into the north fork of Chaquehui Canyon. Data from reach CH-1 indicates that cyanide was released from one or more sites at TA-33, although the specific source has not been identified. The absence of cyanide above the BV in CH-2 indicates that its downcanyon extent above the BV is between 2.1 and 1.0 km above the Rio Grande. PCBs were also released into both main Chaquehui Canyon above CH-1, possibly from SWMU 33-009 (LANL 2009, 107348), and the north fork of Chaquehui Canyon above CHN-1, although PCBs have not been detected farther downcanyon in CH-2. Notably, although there were known releases of uranium at TA-33 (LANL 2006, 093714, pp. 25−26), no uranium isotopes have been identified as COPCs in Chaquehui Canyon sediment, indicating that there has been little downcanyon transport of uranium away from sources at TA-33.

7.1.4.4 TA-39

The spatial distribution of COPCs indicates that one or more firing sites in the north fork of Ancho Canyon in TA-39 constitute the most important source or sources of contaminants in Ancho Canyon. The radionuclides uranium-234, uranium-235/236, and uranium-238, the metals copper and mercury, and the explosive compound TATB have their highest concentrations in Ancho Canyon in reach AN-2, downcanyon from firing points 57 and 88. Recent investigations in the North Ancho Canyon Aggregate Area also indicate that TA-39 firing sites are the main source for these COPCs in the north fork of Ancho Canyon (LANL 2010, 108500.11). The downcanyon extent of mercury and uranium-238 above BVs is somewhere between reaches AN-4 and A-3, approximately 4.0 to 1.0 km above the Rio Grande. Copper, uranium-234, and uranium-235/236 are elevated above BVs only in the reach closest to the firing sites, AN-2, and their downcanyon extent above BVs is between AN-2 and AN-3, approximately 7.1 to 5.7 km above the Rio Grande. TATB was detected only in AN-2 and also apparently has limited distribution. PCBs were detected in reaches AN-2, AN-3, and AN-4 and indicate releases from sites within TA-39, consistent with other investigations (e.g., LANL 2010, 108500.11), although PCBs from these sources have not been detected farther downcanyon in main Ancho Canyon. Cyanide was identified as a COPC in AN-4, and because cyanide is also a COPC upcanyon at TA-39 SWMUs (LANL 2010, 108500.11), this suggests a source at TA-39 and some downcanyon transport.

7.1.4.5 TA-49

The spatial distribution of COPCs indicates small releases of uranium-234 and uranium-238 from TA-49 into upper Ancho Canyon above MDA AB. The specific source or sources of this uranium has not been identified, although there was known usage of uranium at TA-49 (LANL 2006, 093714, p. 21). The downcanyon extent of this uranium is somewhere between reaches A-1 and A-2, approximately 10.7 to 9.9 km above the Rio Grande. A previous investigation indicated that plutonium-239/240 derived from TA-49 was present in Ancho Canyon sediment (LANL 2010, 110656.17). However, the concentrations of plutonium-239/240, along with cesium-137, and their occurrence in ash-bearing post−La Mesa fire sediment indicates that fallout radionuclides concentrated in La Mesa fire ash are the primary source of these COPCs in Ancho Canyon sediment.

7.1.5 Temporal Trends in Contaminant Concentration and the Role of Infrequent Events

Data on sediment contamination in other canyons at the Laboratory indicate concentrations were highest at the time of peak releases and subsequently decreased over time as contaminated and noncontaminated sediment mixed (e.g., Malmon 2002, 076038; LANL 2004, 087390; Reneau et al. 2004, 093174; LANL 2006, 094161). These same temporal trends have also been documented in other regions (e.g., Lewin et al. 1977, 082306; Rowan et al. 1995, 082303). Although no direct data on temporal trends in sediment contamination from Ancho or Chaquehui Canyons are available, contaminant concentrations in these canyons are expected to follow the same trends found elsewhere and decrease over time because of decreases in the release of contaminants where releases were directly into stream channels, such as outfalls below the former tritium facility at TA-33 into the north fork of Chaquehui Canyon. However, temporal variations may be less regular where contaminants have been more widely dispersed by open-air testing at firing sites. In particular, the relatively high concentration of uranium-238 measured in reach AN-4 in a deposit from the record flood of August 4, 2008 (LANL 2009, 108621, p. 245) indicates remobilization of uranium in this event, such as from runoff from hillsides near the TA-39 firing sites. Such infrequent events may result in temporary increases in transport from source areas and short-lived increases in contaminant concentrations in downcanyon sediment.

7.2 Conceptual Model for Hydrology and Contaminant Transport in Water

The conceptual model for hydrology and contaminant transport in water focuses on pathways originating in the Ancho and Chaquehui watersheds where Laboratory operations have been conducted and includes Indio Canyon, which could be potentially impacted by open-air testing activities in the north fork of Ancho Canyon. This discussion focuses on surface-water hydrology and evaluations of potential shallow groundwater. Figure 7.2-1 shows a conceptual hydrogeologic cross-section originating in the north fork of Ancho Canyon and continuing in Ancho Canyon to the Rio Grande. Locations discussed in this section are shown in Figure 3.2-1.

7.2.1 Hydrology of Surface Water and Potential Shallow Groundwater

Ancho Canyon above its confluence with the north fork, the north fork of Ancho Canyon, Chaquehui Canyon, and Indio Canyon are classified as dry canyons, as described by Birdsell et al. (2005, 092048). Dry canyons generally head on the Pajarito Plateau, have relatively small catchment areas (less than 13 km^2), experience infrequent surface flows, and have limited or no saturated alluvial systems. The hydrologic conditions yield little downcanyon near-surface contaminant migration and are characterized by very slow unsaturated water flow from the surface to the regional aquifer. Because surface-water flow is infrequent and shallow alluvial groundwater is not common, contaminants largely remain near their original sources, including in sediment. Net infiltration beneath dry canyons is low, with rates generally believed to be less than tens of millimeters per year and commonly on the order of 1 mm/yr or less. Finally, transport times to the regional aquifer beneath dry canyons are expected to exceed hundreds of years (Birdsell et al. 2005, 092048).

7.2.1.1 Surface Water

The conceptual hydrogeologic cross-section shown in Figure 7.2-1 illustrates many of the features of the dry canyon conceptual model. Both main Ancho Canyon and the north fork of Ancho Canyon head on the Pajarito Plateau in the south-central part of the Laboratory. Approximately 5.6 km^2 is drained by the north fork of Ancho Canyon and, above the confluence with the north fork, approximately 5.8 km^2 is drained by main Ancho Canyon (see section 1.3). Surface-water flow is ephemeral and occurs as runoff, primarily following infrequent, intense thunderstorms or during snowmelt. Its source is direct precipitation and runoff from surrounding mesa tops. Chaquehui and Indio Canyons also have small drainage areas of 4.1 km^2 and 1.3 km^2, respectively, and surface-water flow is ephemeral. No active outfalls exist in the three watersheds.

Runoff (surface-water flow) records are published for gages E274 (Ancho north fork below SR-4), E275 (Ancho below SR-4), and E264 (Indio Canyon at SR-4) (Figure 3.2-1) (e.g., Ortiz and McCullough, 2010, 109826), as summarized in Table B-2.0-1. Gage E275 has the longest record, 1995 through 2009, and data from this gage indicate an average of five to six runoff events per year. Surface-water flows at this gage have exceeded 300 ft^3/s (cfs) during six of these years. Only 2 yr of data are available for gage E274, 2008 and 2009, and these indicate two to three runoff events per year with maximum discharge of 89 cfs. Finally, data for gage E264 are available from 2007 through 2009 and indicate an average of four to five runoff events per year and a maximum annual discharge of only 0.03 cfs in Indio Canyon. Numbers of runoff events are summarized in Table B-2.0-1 for gage E340 along the north fork of Chaquehui Canyon. No rating curve has been developed for this gage, and consequently no discharge estimates are available. However, between 2006 and 2010, an average of four to five runoff events per year occurred. Years with no runoff are not uncommon in these canyons. Data from these gages indicate that the main channel of Ancho Canyon has the highest volume and frequency of runoff events of the three watersheds considered in this report. Infrequent and low-volume runoff events in the north fork of

Ancho Canyon may supply insufficient surface water to transport water-phase contaminants beneath the canyon floor in TA-39.

Springs near the Rio Grande in Ancho and Chaquehui Canyons are perennial and are discharge points of the regional aquifer. Flows from Ancho Spring in Ancho Canyon regularly reach the Rio Grande (Figure 7.2.1). Water pressures in regional well R-31 show higher heads in the lowest two screens (Koch and Schmeer 2009, 105181), suggesting that Ancho Spring likely emerges from the Totavi Lentil because of confined or semiconfined conditions below the Cerros del Rio basalt. This deep source is likely responsible for the background water chemistry observed at this spring. Flow from Doe Spring and Spring 9A in Chaquehui Canyon, which emerge from maar deposits of the Cerros del Rio volcanic field, support short perennial stretches of surface water. Indio Canyon has no springs or perennial reaches.

7.2.1.2 Potential Shallow Groundwater

Available observations indicate that there are not significant alluvial or perched shallow groundwater zones beneath Ancho Canyon or the north fork of Ancho Canyon, as discussed below. Infrequent surface water runoff infiltrating canyon-bottom alluvium is probably insufficient to create shallow perched zones, and, therefore, focused infiltration and contaminant transport in canyon bottoms is unlikely and subsurface migration is likely to be minimal. Conditions observed during drilling and any subsequent observations at shallow boreholes are provided in Table B-2.0-2. No borehole data are available for Chaquehui or Indio Canyons, but shallow groundwater is even less likely in these canyons because of their smaller watersheds and lower frequency of runoff. There are no direct moisture data (other than drillers' observations) available for any shallow boreholes in the canyon floors for the three watersheds.

At TA-49, in the headwaters of the main and north forks of Ancho Canyon, several deep mesa-top boreholes and wells have been drilled to intermediate depths of 300 to 700 ft below ground surface (bgs) (49-CH-1 through 49-CH-4, 49-2-700) and to the regional aquifer (DT-5A, DT-10, DT-9, R-29, and R-30) (Figure 3.2-1). No perched-intermediate groundwater zones were encountered when these wells were drilled (LANL 2006, 093714; LANL 2010, 110478; LANL 2010, 110518). A moisture profile for the 700-ft-deep mesa-top borehole 49-2-700-1 (Figure B-2.0-1) shows low moisture content (<17% by weight) throughout the profile; the profile is similar to those beneath other dry mesas and indicates that infiltration along neighboring canyons does not impact moisture beneath the mesa at TA-49. In addition, 49-Gamma was drilled to 54 ft bgs in upper Ancho Canyon, and wells 49-9M-2 through 49-9M-4 were drilled in the drainage of the upper north fork of Ancho Canyon; these boreholes were dry when drilled. These observations show a lack of shallow groundwater in the upper portions of the Ancho watershed.

In the lower part of the north fork of Ancho Canyon, investigation boreholes were drilled at SWMUs 39-001(a) and 39-001(b) [MDA Y] in 1994. At SWMU 39-001(a), three shallow wells (39-DMB-1, 39-DM-2, and 39-DM-4) and four angled boreholes (ASC-0 through ASC-4) were installed (Figure 3.2-1). At MDA Y, two shallow wells (39-UM-3 and 39-DM-6) and nine angled boreholes (ASC-11 through ASC-19) were installed (Figure 3.2-1). The wells were drilled to encounter the alluvium/tuff interface, although 39-DMB-1 was extended into basalt. Angled boreholes had lengths of 80 ft (depths of 56.5 ft bgs) and were extended under the waste sites. Unsaturated conditions were encountered at all of these locations, although small lenses of saturation were observed in core from angled holes ASC-15, ASC-16, and ASC-18 (LANL 2010, 108592); the drillers logs do not indicate that standing water was encountered in any of these holes. Core samples from these boreholes did not indicate contaminant transport beneath the SWMUs (LANL 1997, 055633). Periodic sampling of alluvial wells 39-UM-3, located upgradient of MDA Y, and 39-DM-6, located downgradient of MDA Y, was attempted 16 times from 2006 through 2009, but conditions at these wells were dry each time (Table B-2.0-3). Because these two wells have been dry since installation, they were removed from the Interim Facility-Wide Groundwater Monitoring Plan in 2009

(LANL 2009, 106115). During the 2009 excavation of MDA Y, the alluvium beneath the site was observed to be dry (LANL 2010, 108500.11). These observations indicate the lack of perched groundwater in the alluvium (only small lenses of saturation were encountered during drilling) and little driver for deep transport into the underlying unsaturated zone. Regional well R-31 is also located in this segment of the north fork of Ancho Canyon. During drilling of R-31, the initial depth of saturation was unclear (Vaniman et al. 2002, 072615). When the well was constructed, the upper screen was placed at 439 ft bgs in order to capture any perched water that may have existed. The screen has been dry since construction, indicating a lack of perched-intermediate groundwater in the area (Koch and Schmeer 2010, 108926).

Five shallow wells and 12 angled boreholes discussed above were recommended for plugging and abandonment (P&A) in the Phase II Work Plan for the North Ancho Canyon Aggregate Area (LANL 2010, 111505). Water levels were measured in the shallow wells and angled boreholes following 2009 remediation activities, and measureable water was observed in several of the angled boreholes but none of the wells. It is believed that the angled boreholes were installed for neutron moisture-logging probe access beneath the disposal sites, and details of the construction of these boreholes are unknown, as is the source of the water in the boreholes. These wells and boreholes are not being used for monitoring activities because local sources were remediated, and the wells may represent conduits for surface-water infiltration or condensation of pore water. The Phase II work plan recommends purging any standing water and checking for recovery before P&A (LANL 2010, 111505).

7.2.2 Surface-Water COPCs

As discussed in section 6.4, seven analytes in stormwater samples from one or more gaging stations in Ancho and Chaquehui Canyons exceeded comparison values: aluminum, copper, mercury, selenium, gross-alpha radiation, total PCBs, and dioxins. In addition, arsenic was greater than a screening level and thallium was greater than a standard in nonstorm-related surface water. These results are discussed in this section to evaluate sources and possible off-site transport of Laboratory-derived contaminants.

Aluminum exceeded the stormwater comparison value of 750 µg/L at all four stations with samples (gages E274, E275, E338, and E340), with results of 503 to 2660 µg/L, although it was not identified as a COPC in sediment in Ancho or Chaquehui Canyons. Aluminum also commonly exceeds its comparison value at background locations on the Pajarito Plateau (e.g., LANL 2010, 111232; LANL 2010, 111507). Therefore, the aluminum detected probably represents background conditions and not Laboratory-derived contamination.

Arsenic exceeded the NMED tap water screening value of 0.448 µg/L in single filtered samples from Doe Spring and Spring 9A in lower Chaquehui Canyon, at 2.9 and 1.88 µg/L, respectively. These results are below the groundwater BV of 3.72 µg/L (LANL 2010, 110535) and are also below detected results from both filtered and nonfiltered samples from Ancho Spring collected in 2007 and 2009, 3.3 to 4.4 µg/L. Ancho Spring is considered a background location (LANL 2010, 110535), and these results indicate that the arsenic is likely naturally occurring.

Copper exceeded the stormwater comparison value of 4.3 µg/L in one sample from the north fork of Ancho Canyon (gage E274), at 8.1 µg/L. Copper is a COPC in sediment in the north fork of Ancho Canyon, derived from firing sites at TA-39 (section 7.1), and this stormwater result probably indicates some transport of copper from TA-39 past E274 into main Ancho Canyon.

Mercury exceeded the stormwater comparison value of 0.77 µg/L in one sample from Ancho Canyon below NM 4 (gage E275), at 0.83 µg/L. Mercury is a COPC in sediment in the north fork of Ancho Canyon, derived from firing sites at TA-39 (section 7.1), and these stormwater results probably indicate some transport of mercury from TA-39 past E275.

Selenium exceeded the stormwater comparison value of 5 µg/L in one sample from Ancho Canyon below NM 4 (gage E275), at 5.78 µg/L. Selenium was not detected in sediment in any reach but is a COPC in all reaches because of detection limits that are higher than the BV. The source of this selenium is uncertain but is inferred to represent natural background.

Thallium exceeded the NMWQCC human health standard of 0.47 µg/L in two filtered base-flow samples from Ancho Canyon above the Rio Grande, at 0.48 and 0.91 µg/L in 2004 and 2006, and in one filtered sample from Doe Spring in Chaquehui Canyon, at 0.48 µg/L in 2005. At both locations, thallium has relatively low frequencies of detection above the standard in samples collected from 2003 to 2010, 25% in Ancho Canyon and 20% at Doe Spring. Thallium was not detected in six other filtered samples collected from Ancho Canyon above the Rio Grande from 2003 through 2010, with detection limits of 0.138 to 1 µg/L (half of these below the standard). Similarly, thallium was not detected in four other samples from Doe Spring collected from 2003 through 2007, with detection limits of 0.02 to 0.4 µg/L (all below the standard). Thallium is not a COPC in sediment in either Ancho or Chaquehui Canyon, and there are no known Laboratory releases of thallium in these watersheds. Therefore, the detected thallium is inferred to be naturally occurring.

Gross-alpha radiation exceeded the stormwater comparison value of 15 pCi/L in five samples from two stations: four from Ancho Canyon below NM 4 (gage E275) and one from Chaquehui Canyon (gage E338). The maximum result, 889 pCi/L, was from E275. Gross-alpha radiation commonly exceeds 15 pCi/L at background locations on the Pajarito Plateau, including a result of 513 pCi/L from the Santa Fe Forest north of Los Alamos in 2009 (LANL 2010, 111232), and the results from Ancho and Chaquehui Canyons may largely represent background conditions. However, as uranium isotopes are COPCs in the north fork of Ancho Canyon at TA-39, some of this gross-alpha radiation may be related to the transport of uranium from TA-39.

Two organic chemicals, total PCBs and dioxins, were measured at concentrations greater than stormwater comparison values. Total PCBs (calculated as the sum of PCB congeners) were measured at 0.0746 µg/L in Ancho Canyon below NM 4 (gage E275), compared with the persistent human health comparison value of 0.00064 µg/L. Dioxins (calculated as the sum of 2,3,7,8-TCDD equivalents) were measured at concentrations of 8×10^{-6} to 3×10^{-5} µg/L at E275 and in Chaquehui Canyon (gage E338), compared with the persistent human health comparison value of 5.1×10^{-8} µg/L. As discussed in section 7.1, PCBs have known sources at TA-39, upcanyon from E275, and dioxins have also been previously identified as COPCs at TA-39, although at very low concentrations that did not require further investigation (LANL 2010, 108500.11, pp. 86−87). The PCB concentrations measured at E275 are within the range measured in urban runoff from the Los Alamos townsite (LANL 2010, 111232).

In summary, two inorganic chemicals in stormwater samples that exceed comparison values, copper and mercury, have inferred sources at firing sites in the north fork of Ancho Canyon at TA-39, and these results indicate active transport into main Ancho Canyon. Elevated gross-alpha radiation in stormwater may also be partly caused by transport of uranium isotopes from TA-39. However, the absence of copper, mercury, or uranium isotopes above BVs downcanyon in reach A-3, near the Rio Grande, indicates that this transport is limited. Dioxins and PCBs measured at low concentrations in stormwater may also have sources at Laboratory sites. The other analytes exceeding comparison values may be entirely related to naturally occurring background materials.

8.0 RISK ASSESSMENTS

8.1 Screening Level Ecological Risk Assessment

Steps 1 and 2 of the eight-step EPA Ecological Risk Assessment Guidance for Superfund (ERAGS) (EPA 1997, 059370) are the screening level ecological risk assessment (SLERA) (LANL 2004, 087630), which identifies COPECs and ecological receptors potentially at risk. This section presents ecological risk screening results based on the comparison of ESLs with available sediment and surface-water data. Additional information on the screening methodology and development of ESLs is provided in the SLERA methods document (LANL 2004, 087630). The ESLs used for screening soil, sediment, and surface-water data in this report are from ECORISK Database, Version 2.5 (LANL 2010, 110846). Where DOE and Laboratory-specific BCGs for radionuclides are more conservative than radiological ESLs, maximum radionuclide concentrations in each reach are compared with the DOE and Laboratory-specific BCGs (DOE 2002, 085637; DOE 2004, 085639). Comparison of sediment and surface-water data with lowest effect ecological screening levels (L-ESLs) is also provided as part of the screening level risk characterization. The ESL and L-ESL comparisons identify COPECs for further evaluation in the weight of evidence evaluation. The conclusion of the screening assessment is a recommendation on whether to proceed to the baseline ecological risk assessment (ERAGS Steps 3 to 8).

8.1.1 Problem Formulation for Ecological Screening

An in-depth generic problem formulation is given in section 3.0 of the SLERA document along with a detailed development of assessment endpoints from which screening receptors were selected (LANL 2004, 087630). A summary, as applied to the canyon bottoms in the Ancho, Chaquehui, and Indio watersheds, is presented below.

Historical contaminant releases into the Ancho and Chaquehui watersheds have occurred from multiple SWMUs and/or AOCs, as discussed in section 2.1 and indicated by sediment data (section 7.1). Mechanisms of contaminant release to the Ancho and Chaquehui watersheds include releases to soil from open-detonation firing sites and contaminants mobilized by stormwater runoff. Potential Laboratory contaminant sources are in TA-33, TA-39, and TA-49. Although airborne transport of contaminants from firing sites in the Ancho watershed into the Indio watershed is possible, such transport has not been identified in the sediment data, as discussed in section 7.1. For ecological receptors, the primary impacted media in the canyons are sediment deposits (soils) and nonstorm-related surface water in the canyon bottom. Sediment in the canyon bottom in most investigation reaches (except in the c1 unit in reach A-3) is not exposed to persistent water; therefore, the sediment in all geomorphic units (active and abandoned channels and floodplains) is evaluated as soil by comparing COPC concentrations with the soil ESLs. For the Ancho, Chaquehui, and Indio watersheds, assuming that active channel sediment has aquatic community pathways and receptors is a protective assumption because water is ephemeral in most stream channels in these watersheds. Sediment in other geomorphic units, such as abandoned channels and floodplains (e.g., c2, c3, f1, and f2 units), is not exposed to persistent water. Sediment in geomorphic units other than c1 (abandoned channels and floodplains) is evaluated as soil by comparing concentrations with the soil ESLs. The active channel sediment in the Ancho, Chaquehui, and Indio watersheds was also evaluated as soil in the terrestrial ecological screening, as all sediment in the investigation reaches are dry for most of the year, except for the active channel in reach A-3, and accessible to terrestrial receptors. For A-3, the margins of the active channel are locally above water and accessible to terrestrial receptors, and screening of active channel sediment as soil is also appropriate. Contaminants present in persistent nonstorm-related surface water may also interact with receptors in the aquatic food web. Therefore, contaminant concentrations in persistent surface water and spring water (collectively referred to as nonstorm-related surface water) were also evaluated by comparing detected concentrations with surface-water ESLs.

Many of the reaches within Ancho, Chaquehui, and Indio Canyons have ponderosa pine as the dominant overstory vegetation, although some reaches also contain piñon, juniper, and/or cottonwood trees, depending on elevation and microclimate. These reaches include narrow high-walled areas, wider areas with grass beneath the tree cover, and some wide open areas with shrubs and large forbs but little tree cover. Parts of the upper Ancho watershed were also burned during the 1977 La Mesa fire; shrubby vegetation dominates in these areas. Abundant wildlife, including deer, elk, small mammals, and birds, have been seen within many of the canyon reaches. It is possible that the Mexican spotted owl, a threatened and endangered (T&E) species, could nest, roost, and forage at varying levels in some of the reaches in the Ancho, Chaquehui, and Indio watersheds (Nisengard 2010, 111141), although the owl has not been observed in these watersheds.

All sediment results are screened against the minimum soil ESLs and minimum soil L-ESLs for terrestrial receptors for a particular chemical or radionuclide. The ESLs for soil developed for each of the receptors consider both direct exposure and (except for plants and earthworms) uptake through food. The toxicity reference values (TRVs) used to develop the ESLs are based on no observed adverse effect levels (NOAELs) for survival, growth, or reproduction. These are conservative estimates of concentrations of a chemical or radionuclide that have shown no effect on individuals in scientific studies presented in the literature. The TRVs used to develop the L-ESLs are based on lowest observed adverse effect levels (LOAELs) or lowest observed effect concentrations (LOECs) for survival, growth, or reproduction. The development of TRVs and the values for TRVs and ESLs are documented in the ECORISK Database, Version 2.5 (LANL 2010, 110846).

Aquatic habitat and receptors are present in reach A-3 in lower Ancho Canyon near the Rio Grande, associated with perennial spring-fed surface water. Ancho Spring, upstream from A-3, is one source of this water, and additional springs are present in the reach (Plate 1). A shorter perennial stretch of spring-fed surface water occurs in lower Chaquehui Canyon, downcanyon from reach CH-2, fed in part by Doe Spring and Spring 9A.

Persistent surface-water data are available from 2003 to present at four locations in Ancho and Chaquehui Canyons, although one of these locations, Ancho Spring, is included in the groundwater background data set and is not evaluated for risk. Persistent surface water is present below reach A-3 at the location “Ancho at Rio Grande” and at two springs below CH-2 (Doe Spring and Spring 9A). The other reaches only have ephemeral flow and therefore have no potential for chronic exposure to water. To ensure that contaminants in water have not been overlooked relative to acute exposures, the results of the screening of stormwater samples versus comparison values from the State of New Mexico standards for acute aquatic life (20.6.4.900[H], 20.6.4.900[I], and 20.6.4.900[J] NMAC) are considered in this report.

The ESLs for sediment from the ECORISK Database, Version 2.5 (LANL 2010, 110846) were used to screen sediment in areas of the canyons that could potentially contain water. The sediment ESLs are developed based on potential toxicity to aquatic community organisms and two species of aerial insectivores (the little brown myotis bat and the violet-green swallow) that may be exposed to sediment contamination through ingestion of sediment-dwelling insects. Because persistent surface water exists in some parts of Ancho and Chaquehui Canyons, nonstorm-related surface-water data were screened against the limiting water ESLs from the ECORISK Database, Version 2.5, which are protective of both aquatic community organisms and drinking of water by wildlife receptors (LANL 2008, 110846). Sample results are also compared with L-ESLs for sediment and water. Stormwater, a transient medium, was not screened using surface-water ESLs; however, stormwater COPEC concentrations were compared with NMWQCC standards for acute aquatic life as a relative measurement of potential acute effects.

8.1.2 Ecological Screening Approach for the Ancho, Chaquehui, and Indio Canyons

Sediment has been sampled extensively within Ancho, Chaquehui, and Indio Canyons. To evaluate whether the concentrations of chemicals and radionuclides represent a potential risk to ecological receptors in these canyons, the maximum detected concentration of each COPC in each reach was evaluated. If detection limits for inorganic chemicals were greater than sediment BVs, then these nondetected results were also evaluated in the ecological screening tables.

Screening risk characterization is based on the HQ. Initially, the HQ is calculated by dividing the maximum concentration of a chemical or radionuclide COPC by the minimum ESL applicable to that medium. Any COPC with an HQ greater than1 is identified as a COPEC for that medium. The next step is to calculate the HQ based on the maximum concentration divided by the L-ESL for that COPEC and medium. Calculating HQs with ESLs and L-ESLs provides bounds on the potential for ecological risks, and those COPECs with L-ESL-based HQs greater than 1 warrant further evaluation in the weight of evidence evaluation.

Maximum COPC concentrations in soil (as defined in section 8.1.1) were compared with the minimum soil ESLs and L-ESLs for terrestrial receptors presented in section 8.1.3. The active channel sediments (c1 geomorphic unit) were also evaluated as “sediment” and screened against the minimum sediment ESLs and L-ESLs presented in section 8.1.4.

The DOE soil BCGs for cesium-137 and strontium-90 are more restrictive than soil ESLs for these radionuclides. As documented in “Site-Representative Biota Concentration Guides at Los Alamos” (McNaughton et al. 2008, 106501), the Laboratory has developed site-specific BCGs for both cesium-137 and strontium-90 following guidance stated in DOE Standard 1153-2002 (DOE 2002, 085637). The Laboratory site-specific soil BCG published for cesium-137 (2000 pCi/g) is less restrictive than the soil ESL of 680 pCi/g. Strontium-90, which has a Laboratory site-specific BCG of 300 pCi/g, was not detected in Ancho, Chaquehui, and Indio Canyons. Because the DOE and Laboratory site-specific soil BCGs are less restrictive than soil ESLs for radionuclides, a BCG evaluation to supplement the ESL screen was not necessary for Ancho, Chaquehui, and Indio Canyons.

Surface water occurs within Ancho, Chaquehui, and Indio Canyons as the result of runoff from rainfall and snowmelt in some reaches, combined with discharge from springs. Also, after runoff events, persistent pools of water can be locally present for some time. Surface-water sampling stations from which nonstorm-related surface-water samples have been collected are shown in Figure 3.2-1. Stations from which stormwater has been collected are also shown in Figure 3.2-1. Water-sampling results from all nonstorm-related surface-water locations in Ancho and Chaquehui Canyons are compared with the minimum water ESLs and L-ESLs that are protective of both aquatic receptors and drinking water by terrestrial wildlife. The HQs associated with these surface-water COPCs and COPECs are presented in section 8.1.5. The COPCs for ecologically relevant nonstorm-related surface water are identified in Tables 6.3-2 through 6.3-11.

Stormwater represents a transient exposure that is not well suited for comparison with water ESLs. Filtered and nonfiltered stormwater samples collected in these watersheds were screened using the surface-water comparison values (see section 6.4 for more information). The results of stormwater screening versus NMAC water-quality standards are used to ensure that the potential for acute effects has been adequately addressed with the ESL water screening for chronic effects.

8.1.3 Risk Characterization for Soil

The data evaluation in section 6 determined which chemicals and radionuclides were retained as COPCs. As discussed in section 6.2, a total of 15 inorganic chemicals, 36 organic chemicals, and 7 radionuclides were retained as COPCs in sediment in Ancho, Chaquehui, and Indio Canyons. Maximum sample results for these COPCs in each reach are presented in Tables 6.2-5, 6.2-6, and 6.2-7 for inorganic chemicals, organic chemicals, and radionuclides, respectively. All COPCs are compared with minimum soil ESLs as the initial step to identify COPECs, as presented below.

The criterion for retaining a COPC as a COPEC is an HQ greater than 1. This HQ is calculated based on dividing the maximum concentration of a chemical or radionuclide COPC by the minimum ESL applicable to that medium. The COPECs identified by the minimum ESL comparisons are refined for further evaluation based on the HQ calculated using the minimum L-ESL. If the concentrations for the COPEC are bounded between the minimum ESL and minimum L-ESL, then further evaluation is not warranted because adverse effects are unlikely. COPECs with HQs greater than 1 calculated from the minimum L-ESL are further evaluated in the uncertainty analysis and weight of evidence evaluation.

Tables 8.1-1, 8.1-2, and 8.1-3 provide the HQ for the maximum concentration of each inorganic COPC, radionuclide COPC, and organic COPC in soil respectively. The HQs in these three tables are based on the maximum concentration divided by the minimum soil ESLs, which are designed for the protection of terrestrial receptors and aerial herbivores, insectivores, omnivores, and carnivores (robin and kestrel). Eleven inorganic COPECs (antimony, cadmium, chromium, copper, cyanide [total], lead, manganese, mercury, selenium, vanadium, and zinc) and three organic COPECs (di-n-butylphthalate, endrin, and endrin ketone) are shaded in Tables 8.1-1 and 8.1-3. No detected radionuclide concentrations exceeded an HQ of 1 (Table 8.1-2).

Surrogate ESLs are used for endosulfan I and endosulfan II (based on the ESL for endosulfan); endosulfan sulfate, endrin aldehyde, and endrin ketone (based on the ESL for endrin); and heptachlor epoxide (based on the ESL for heptachlor). COPECs for which no ESLs are available include perchlorate and TATB; these COPECs are evaluated in section 8.1.7.

For the 14 soil COPECs listed above, the minimum L-ESLs were compiled (Table 8.1-4). Table 8.1-5 provides the HQ for soil COPECs based on maximum concentration divided by the minimum L-ESL. Six soil COPECs (antimony, chromium, cyanide [total], mercury, selenium, and vanadium) are shaded in Table 8.1-5. These soil COPECs are retained for the weight of evidence evaluation.

8.1.4 Risk Characterization for Sediment (Active Channel)

Tables 8.1-6 and 8.1-7 present the HQ results for the maximum concentrations seen in geomorphic unit c1 sediment (active channel sediment). The HQs in these two tables are based on the maximum concentration divided by the minimum sediment ESLs. During the process of researching sediment effect levels for this report, the sediment iron ESL from the ECORISK Database, Version 2.5 (LANL 2010, 110846) was determined to be in error. The value was reported as 20 mg/kg based on a no effect level of 2% iron by weight, but 2% iron should be 20,000 mg/kg. Therefore, the minimum sediment ESL used in this report is 20,000 mg/kg. Three inorganic chemical COPECs (antimony, cadmium, and selenium) and one organic chemical COPEC (di-n-butylphthalate) were shaded in Table 8.1-6. No maximum detected radionuclide concentrations exceeded an HQ of 1 (Table 8.1-7).

For the four sediment COPECs listed in the previous paragraph, the minimum L-ESLs were compiled (Table 8.1-4). Table 8.1-8 provides the HQ for sediment COPECs based on maximum concentration divided by the minimum L-ESL. No sediment COPECs are retained for the weight of evidence evaluation.

8.1.5 Risk Characterization for Surface Water

The data evaluation in section 6.3.1 (see Tables 6.3-2 through 6.3-11) determined which nonstorm-related surface-water chemicals and radionuclides were retained as COPCs. All COPCs are compared with minimum surface-water ESLs to identify COPECs, as presented below.

Filtered and nonfiltered stormwater samples were also screened using NMAC surface-water comparison values in section 6.4 to assess the potential for adverse, acute effects from stormwater in Ancho and Chaquehui Canyons. Stormwater concentrations are not compared with ESLs.

Tables 8.1-9 to 8.1-11 present the HQ results for the maximum concentrations seen in nonstorm-related surface water. The HQs in these two tables are based on the maximum concentration divided by the minimum water ESLs. Nonstorm-related surface water COPECs without ESLs (chloromethane and dichlorobenzene[1,3-]) are discussed in section 8.1.7.

HQs based on maximum concentrations of three inorganic COPCs (aluminum, barium, and selenium) exceeded an HQ of 1 in nonstorm-related surface water at sample locations in Ancho and Chaquehui Canyons. Two radionuclides (radium-226 and thorium-232) exceeded an HQ of 1 in nonstorm-related surface water in Ancho and Chaquehui Canyons. No maximum detected concentrations of organic chemicals resulted in HQs greater than 1 in nonstorm-related surface water.

As discussed in section 6.4, Ancho and Chaquehui Canyon stormwater was evaluated against comparison values from the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC). Maximum detected concentrations for five stormwater COPCs exceeded the acute aquatic life values (20.6.4.900[H], 20.6.4.900[I], and 20.6.4.900[J] NMAC) (see section 6.4 and Table 6.4-4). The results of stormwater screening versus acute exposure comparison values are used to assess the potential for acute effects from nonstorm-related surface-water COPECs that may or may not have been identified as COPECs with the water ESL screening for chronic effects. Both of the stormwater COPCs that exceeded acute aquatic life criteria (aluminum and copper) were also identified as aquatic community chronic exposure COPECs for nonstorm-related surface water.

For the five nonstorm-related surface-water COPECs (aluminum, barium, selenium, radium-226, and thorium-232), the minimum L-ESLs were compiled (Table 8.1-4). Table 8.1-12 provides the HQ for nonstorm-related surface-water COPECs based on maximum concentration divided by the minimum L-ESL. No nonstorm-related surface-water COPECs are retained for the weight of evidence evaluation.

8.1.6 Ecological Risk Assessment Weight of Evidence

Ecological risk characterization identified six soil COPECs that had maximum detected concentrations or detection limits greater than L-ESLs (Table 8.1-13). All other soil COPCs with ESLs were either bounded between the minimum ESL and L-ESL or were less than the ESL. All sediment or water COPCs with ESLs were either bounded between the minimum ESL and L-ESL or were less than the ESL. COPCs without ESLs are discussed in section 8.1.7. The receptors associated with the minimum L-ESL are identified in Table 8.1-13 and are either plants or wildlife. The weight of evidence evaluations for plants and wildlife are discussed below.

Three of the soil COPECs in Table 8.1-13 have plant as the receptor associated with the minimum L-ESL. Antimony, chromium, and vanadium were evaluated in order to understand their distribution among and within reaches, to compare with sediment and soil background, and to compare with studies conducted in previous canyons biota investigations. Contaminant concentrations, risk measures, and results that are less than results from previous studies (or "bounded by" previous studies) can be evaluated against analogous COPEC and media measurements in Ancho, Chaquehui, and Indio Canyons as a line of evidence to evaluate the potential for ecological risks. Relevant COPEC exposure data for assessment endpoints were assembled from the Los Alamos and Pueblo Canyons, Mortandad Canyon, Pajarito Canyon, and Sandia Canyon investigation reports (LANL 2004, 087390; LANL 2006, 094161; LANL 2009, 106939; LANL 2009, 107453). Samples with biota-relevant exposure data from the previous canyons investigations are tabulated in Attachment 1, Tables E-1.0-1 to E-1.0-3 (on CD). A qualitative evaluation applicable to each of these plant COPECs is that the vegetation in Ancho, Chaquehui, and Indio Canyons is diverse and can provide suitable habitat for T&E species (the Mexican spotted owl, as noted in section 8.1.1).

Table 8.1-14 shows the maximum concentrations of plant COPECs in Ancho, Chaquehui, and Indio Canyons and compares these concentrations with sediment and soil BVs and the maximum detected concentrations in reaches where plant toxicity tests were conducted in the Los Alamos and Pueblo, Mortandad, Pajarito, and Sandia watersheds. Observations for antimony, chromium, and vanadium are summarized below.

Antimony: Antimony was detected in 5 of 115 sediment samples from three reaches (AN-1, CH-1, and CHN-1), and all of these concentrations were less than the sediment and soil BVs. The range of detection limits was from 0.88 mg/kg to 4.96 mg/kg, and without the two largest nondetections, the maximum was 1.77 mg/kg. The two largest nondetections were 4.96 mg/kg and 4.73 mg/kg from reaches A-3 and AN-4, respectively. Given the lack of antimony detections in the watershed above the BV, the sources and distribution of antimony are uncertain, although antimony is inferred to be naturally occurring (section 7.1.1). Given the low frequency of antimony detections, it is also not possible to use statistically robust methods to estimate the concentrations of antimony. Although the “detection limit divided by 2 method” is not recommended for calculating upper confidence limits (UCLs), it is informative that all but three of the nondetections are less than 2 times the BV. Based on the information available for antimony, the practical “no effect” level would be the sediment BV of 0.83 mg/kg.

Chromium: One sediment sample result is greater than the minimum L-ESL. The maximum result was from reach CH-1 and is greater than the sediment BV but less than the soil BV. Therefore, adverse effects would not be expected from this level of chromium in soil. In addition, the maximum concentration of chromium in Ancho, Chaquehui, and Indio Canyons is less than the highest chromium concentrations evaluated with phytotoxicity testing in Los Alamos/Pueblo, Mortandad, Pajarito, or Sandia Canyons (Table 8.1-14). The chromium in the CH-1 sample is probably naturally occurring, associated with black, magnetite-rich sands (section 7.1.1).

Vanadium: The maximum concentration (48.8 mg/kg from reach CH-1) is greater than the sediment and soil BVs; otherwise, concentrations are bounded by the soil BV. In addition, the maximum concentration of vanadium in Ancho, Chaquehui, and Indio Canyons was less than the highest vanadium concentrations evaluated with phytotoxicity testing in Sandia Canyon (Table 8.1-14). The vanadium in the CH-1 sample is probably naturally occurring, associated with black, magnetite-rich sands (section 7.1.1). Therefore, adverse effects would not be expected from this level of vanadium.

Three of the soil COPECs in Table 8.1-13 have wildlife (robin or shrew) as the receptor associated with the minimum L-ESL. Cyanide [total], mercury, and selenium were evaluated in order to understand their distribution among and within reaches, to compare with sediment and soil background, and to determine HQs adjusted by home range (area use factor ([AUF)]) or population AUF (PAUF). Table 8.1-15 presents the home range and population area for the robin and shrew. This information is used to make the AUF and PAUF adjustments to HQs presented for the robin and shrew in Table 8.1-16 for cyanide [total], mercury, and selenium. Observations for cyanide [total], mercury, and selenium are summarized below.

Cyanide [total]: Cyanide was detected above the sediment BV in six samples from three reaches (A-1, AN-4, and CH-1). The three largest concentrations (4.68, 3.81, and 2.97 mg/kg) were from reach CH-1. Table 8.1-16 shows that population scale effects are unlikely for these reaches in Ancho and Chaquehui Canyons. In addition, the maximum concentration of cyanide [total] in Ancho and Chaquehui Canyons was less than the highest concentrations evaluated with bird studies in Sandia Canyon (Table 8.1-17). Therefore, adverse effects of cyanide [total] on birds are unlikely.

Mercury: Mercury was detected above the sediment BV in eight samples from three reaches (AN-2, AN-3, and AN-4). The three largest detects (0.807 and 0.468 mg/kg) were from reach AN-2. Table 8.1-16 shows that population scale effects are unlikely for these reaches in Ancho Canyon. In addition, the maximum concentration of mercury in Ancho Canyon was less than the highest concentrations evaluated with bird studies in Pajarito and Sandia Canyons (Table 8.1-17). Therefore, adverse effects of mercury on birds are unlikely.

Selenium: Selenium was detected in 0 of 115 sediment samples. The range of nondetected sample results was from 0.88 mg/kg to 1.35 mg/kg; all of these results were greater than the sediment BV but less than the soil BV. Therefore, adverse effects would not be expected from this level of selenium in soil. In addition, Table 8.1-16 shows that population scale effects are unlikely for reaches in Ancho, Chaquehui, and Indio Canyons based on the maximum detection limit reported for each reach, and the selenium is inferred to be naturally occurring (section 7.1.1).

The weight of evidence information for the six soil COPECs is summarized in Table 8.1-18. With the exception of antimony, sample results for these COPECs are either bounded by soil background or PAUF adjustments, indicating that there are no adverse effects of these COPECs on populations. However, there is diverse and extensive vegetative cover in these reaches, and adverse effects of COPECs on plants is not indicated by this observation. Thus, risks from antimony on plants are unlikely given the information available.

8.1.7 Ecological Risk Assessment Uncertainties

There are several ecological risk assessment uncertainties related to Ancho, Chaquehui, and Indio Canyons. Uncertainties associated with established ESLs fall into two main categories. The first group is associated with COPECs, including toxicity and bioavailability (or transfer factors between soil and food). The second group relates to receptors, including feeding rates, the amount of incidental soil ingestion, and diets. These uncertainties are addressed by selecting inputs to the soil ESL calculations that are conservative. For some detected COPCs, no ESLs were available for ecological screening, and it is therefore not possible to evaluate potential ecological impacts from these COPCs. Sediment COPCs detected in Ancho, Chaquehui, and Indio Canyons but that have no ESLs include one inorganic chemical (perchlorate) and three organic chemicals (TATB, chloromethane, and dichlorobenzene[1,3-]). These COPECs are discussed further below.

Perchlorate was detected in 42 of 110 sediment samples, and its maximum detected concentration (0.00207 mg/kg) was less than the maximum detection limit (0.00292 mg/kg). The NMED residential SSL for perchlorate is 54.8 mg/kg, indicating the potential toxicity is low relative to the detected concentrations. Because of the potentially low toxicity, perchlorate is not retained as a COPEC.

TATB was detected in 2 of 115 sediment samples, and the maximum detected concentration (1.58 mg/kg) was less than two times the maximum detection limit (1 mg/kg). The minimum ESL for 1,3,5-trinitrobenzene (6.6 mg/kg for the deer mouse) is used to screen TATB and results in a maximum HQ of 0.2. Therefore, TATB is not retained as a COPEC.

Chloromethane was detected in 1 of 21 water samples, and the maximum detected concentration (0.375 µg/L) was less than the maximum detection limit (1 µg/L). The NMED tap water screening level for chloromethane is 17.8 µg/L, indicating the potential toxicity is low relative to the detected concentration. Because of the potentially low toxicity and infrequent detection, chloromethane is not retained as a COPEC.

Dichlorobenzene[1,3-] was detected in 1 of 21 water samples, and the maximum detected concentration (0.513 µg/L) was less than the maximum detection limit (1 µg/L). The NMED tap water screening level for dichlorobenzene[1,4-] is 4.27 µg/L, and using this chemical as a surrogate indicates the potential toxicity is low relative to the detected concentration. In addition, the NMED tap water screening level for 1,3-dichlorobenzene (18.3 µg/L) (NMED 2009, 108070) indicates the potential toxicity is low relative to the detected concentration. Because of the potentially low toxicity and infrequent detection, dichlorobenzene[1,3-] is not retained as a COPEC.

In addition to uncertainties associated with ESLs, there are uncertainties associated with exposure. The assessment has been conservative by use of the maximum concentration in each reach. Realistic exposures to wildlife would assess contamination through the UCL of the mean. Another aspect of exposure is the difference of COPEC concentrations from background. This assessment has used comparisons of maximum concentrations to sediment or soil BVs. Such comparisons are likely protective in this case, as the magnitude of concentrations greater than sediment BVs was small for some COPCs. More definitive background comparisons would utilize statistical tests that evaluate the entire distribution of reach and background concentrations.

Two of the six soil COPECs were identified because detection limits were greater than the minimum L-ESLs. Antimony had 5 detections out of 115 samples, and all of these detections were less than the sediment BV. Therefore based on these detections, there is no evidence for elevated antimony in the watershed. In contrast all 110 of the antimony nondetections were greater than the sediment BV, but all but 3 of the nondetections were less than 2 times the sediment BV. Therefore, the antimony nondetections are generally consistent with background and do not provide evidence for a release. There were no detections for selenium, but all of the nondetections were greater than the sediment BV and many were greater than the L-ESL. However, the selenium detection limits were less than soil BV, suggesting that adverse effects are unlikely.

8.1.8 Summary of the SLERA

COPECs were identified for Ancho, Chaquehui, and Indio Canyons based on the comparison of maximum detected concentrations with applicable soil, sediment, and water ESLs. Where COPEC concentrations in Ancho, Chaquehui, and Indio Canyons samples resulted in an HQ greater than 1, they were compared with L-ESLs to further refine COPECs. The comparison to L-ESLs identified six soil COPECs that were further evaluated with multiple lines of evidence. COPEC concentrations in Ancho, Chaquehui, and Indio Canyons were compared with soil BVs because soil is relevant as an exposure medium for these canyon-bottom sediments with associated terrestrial receptors and exposure pathways. The PAUF adjustments to the HQ were another evaluation for wildlife. If the HQs adjusted for population area were less than 1, then adverse effects on populations were not indicated. Lastly, concentrations reported for Ancho, Chaquehui, and Indio Canyons were compared with previous canyons biota studies Based on these multiple lines of evidence, the conclusion is that the none of the COPECs are retained, and there is risk to biota in Ancho, Chaquehui, and Indio Canyons.

8.2 Human Health Risk Assessment

The human health risk assessment evaluates the potential risk to human health in Ancho, Chaquehui, and Indio Canyons from COPCs identified in section 6. The risk assessment approach used in this report follows NMED guidance (NMED 2009, 108070). The approach utilizes media- and scenario-specific SLs to evaluate the potential human health risks from sediment and surface water in Ancho, Chaquehui, and Indio Canyons. Section 8.2.1 provides the basis for selecting the exposure scenarios for the human health risk assessment. In section 8.2.2, the data collection and evaluation processes described in previous sections of the report are summarized, focusing on aspects of data analysis that are pertinent to the risk assessment. Section 8.2.2 also lays out the logic for selecting COPCs for the human health risk assessment. Section 8.2.3 describes the calculation of exposure point concentrations. The exposure scenarios are described in section 8.2.4. Risk characterization (section 8.2.5) is based on the sum of fractions (SOFs) method for evaluating the potential for additive effects with COPCs that are classified as noncarcinogens, carcinogens, or radionuclides. Uncertainty related to the various assumptions and inputs used in the risk assessment is evaluated in section 8.2.6 to support interpretation of the risk characterization. A summary of the risk assessment is provided in section 8.2.7.

8.2.1 Problem Formulation

The risk assessment uses information pertaining to current and reasonably foreseeable future land use in Ancho, Chaquehui, and Indio Canyons to assess potential impacts under reasonable maximum exposure (RME) conditions. The canyon bottoms in Ancho, Chaquehui, and Indio Canyons are entirely on Laboratory land. There are active sites in the watershed, but none are located within the 100-yr floodplain. Most parts of these canyons are closed to public access, except for the lower parts of Ancho and Chaquehui Canyons near the Rio Grande, as discussed in section 1.4.

The assessment employs the recreational scenario, which combines extended backyard exposure for a child and an adult trail user, to represent potential exposure to contaminated sediment and surface water in Ancho, Chaquehui, and Indio Canyons. This is a conservative assessment because access to the canyon bottom is restricted to workers on official business in the only part of the watershed requiring a human health risk assessment (reach AN-4). Such official business is limited to environmental work associated with collecting samples or related activities. The extended backyard scenario describes an older child (age 6–11 yr) living in a home sufficiently close to the canyon that he or she may use the canyon as an extension of the play areas immediately surrounding the home. The trail user scenario describes an adult individual who contacts contaminated sediment while hiking or jogging in the canyons. The Ancho, Chaquehui, and Indio Canyon reaches were also evaluated under the residential scenario as a supplemental scenario for comparison purposes.

8.2.2 Data Collection and Evaluation

The approach to sampling design, data collection, and characterization is described in sections 3 and 4 and in Appendix B. Sampling methods, sample analyses, and data quality are presented in Appendix C. Section 6 describes how sediment data within reaches were combined for comparison with BVs. Water data were evaluated at each surface-water sampling location.

8.2.2.1 Identifying COPCs for the Human Health Risk Assessment

The COPCs for the human health risk assessment are identified based on SL comparisons and calculations using residential soil SSLs and SALs and surface-water SLs. This approach is similar to that described and used in previous canyons investigation reports (LANL 2004, 087390; LANL 2006, 094161;

LANL 2009, 106939; LANL 2009, 107416; LANL 2009 107453; LANL 2009, 107497; LANL 2010, 111507). This process includes calculating a ratio, which is the maximum detected concentration of a COPC in a reach divided by the SL. Ratios based on maximum detected concentrations for all COPCs within a reach are summed to calculate the SOF for the risk type. An SOF is the sum of these ratios for each risk type (i.e., carcinogens [SOFca], noncarcinogens [SOFnc], and radionuclides [SOFrad]. If a reach has an SOF greater than 1.0 for a risk type, all COPCs in the reach for that risk type with a ratio greater than 0.1 are evaluated in the site-specific risk assessment. The COPCs with a ratio less than or equal to 0.1 are excluded because they are not likely to substantially contribute substantially to risk. If the ratio for an individual COPC was greater than 0.1 but the SOF for the reach and risk type was less than 1, none of the COPCs were evaluated further.

8.2.2.2 Sediment COPCs

The human health SLs for nonradionuclides in sediment are the NMED residential SSLs (NMED 2009, 108070). For chemicals for which NMED does not provide a SSL, the residential screening value from the current EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm) was used as the SL (carcinogens are adjusted to a 10^{-5} risk level to be consistent with the NMED target risk level). Surrogate compounds were used for some COPCs that lack NMED or EPA SLs (NMED 2003, 081172). Residential SALs were used for radionuclides based on 15 mrem/yr and derived using RESRAD Version 6.5 (LANL 2009, 107655).

Tables 8.2-1 to 8.2-3 present the residential SSLs and SALs used to calculate the ratios based on the maximum detected concentrations for each COPC. These tables also provide the SOFs for each reach for each risk type for all sediment COPCs. The COPCs and reaches shaded gray are those retained for further evaluation. Table 8.2-1 provides the results for noncarcinogens and indicates no COPCs or reaches are retained for further evaluation. Table 8.2-2 provides the results for carcinogens and indicates one COPC (arsenic) in one reach (AN-4) is retained for further evaluation. Table 8.2-3 provides the results for radionuclides and indicates no COPCs or reaches are retained for further evaluation.

8.2.2.3 Surface-Water COPCs

The SLs for surface water for organic and inorganic COPCs are the tap water screening values from NMED (NMED 2009, 108070). For chemicals for which NMED does not provide a value, the tap water screening value from the current EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm) was used as the SL (carcinogens are adjusted to a 10^{-5} risk level to be consistent with the NMED target risk level). These tap water screening values were supplemented by EPA drinking water standards (MCLs) issued under the Safe Drinking Water Act (http://www.epa.gov/safewater/contaminants/index.html) or 20.6.4 NMAC Standards for Interstate and Intrastate Surface Waters. Radionuclide SLs are based on a dose of 4 mrem/yr and are from the DOE DCGs (DOE Order 5400.5, "Radiation Protection of the Public and the Environment").

Stormwater represents a transient exposure that is not well suited for comparison with water SLs. Filtered and nonfiltered stormwater samples collected in these watersheds were screened using the surface-water comparison values (see section 6.4 for more information). The results of stormwater screening versus NMAC water-quality standards are used to ensure that the potential for acute effects has been adequately addressed with the SL water screening for chronic effects.

Thus, in evaluating surface water associated with sediment reaches in Ancho and Chaquehui Canyons, only data for nonstorm-related surface-water samples were evaluated (i.e., springs and perennial surface water). For many of the surface-water samples, chemical analysis was performed on both the nonfiltered and filtered samples. Both filtered and nonfiltered sample results were used for the surface-water COPC evaluation.

Tables 8.2-4 to 8.2-6 present the human health water SLs used to calculate the ratios; these tables also provide the SOFs for each risk class for all surface-water COPCs. Table 8.2-4 provides the results for noncarcinogens; Table 8.2-5 provides the results for carcinogens; and Table 8.2-6 provides the results for radionuclides. Table 8.2-5 indicates one COPC (arsenic) in one reach (CH-2) is retained for further evaluation.

As discussed in section 6.4, Ancho and Chaquehui Canyon stormwater was evaluated against comparison values from the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC). Two organic chemicals (total PCBs and dioxins) were identified with concentrations greater than human health persistent chronic comparison values. There are no acute comparison values for human health risk for these chemicals. PCBs (as Aroclor mixtures) were not detected in nonstorm-related surface water, which indicates that PCBs are not likely to pose a chronic health risk. There are no analyses for dioxins in nonstorm-related surface water from these canyons, and they are not evaluated further in this assessment.

8.2.2.4 COPC Summary

Table 8.2-7 summarizes the analyte class (carcinogen in sediment and surface water) and reaches (AN-4 and CH-2) retained for further evaluation.

8.2.3 Calculating Exposure Point Concentrations

According to the EPA (1989, 008021), the measure of exposure appropriate for a risk assessment is the average concentration of a contaminant throughout an exposure unit or a geographic area to which humans are exposed. This premise is based on the assumption that over a period of time, a receptor would contact all parts of the exposure unit. A receptor is not likely to be exposed to only the maximum or any other particular detected concentration of a chemical for the full period of exposure. A conservative estimate of the average concentration of a chemical across an exposure unit (the exposure point concentration [EPC]) is the UCL (typically a 95% UCL) of the mean. Different methods are available to estimate the 95% UCL, depending upon the underlying distribution of the data set.

Sediment. The investigation approach for sediment resulted in representative samples associated with different geomorphic units and sediment facies within each reach. These data are combined to estimate means and UCLs of the means for COPCs retained for the human health risk assessment in each reach. The EPA software ProUCL Version 4.00.05 (EPA 2010, 109944) was used to calculate the sediment UCLs. If the recommended calculated UCL was less than the maximum concentration for a COPC within a reach, then the UCL recommended by ProUCL was used as the EPC. Further details on the calculation of the UCLs used in this risk assessment are provided in Appendix E, section E-2, and in the ProUCL technical guidance (EPA 2009, 110368). The input and output files for the ProUCL calculations are provided in Attachment 1.

Surface Water. Surface-water COPC concentrations are evaluated for the reach most closely associated with the sampling locations. Because of limited numbers of samples and detections, the surface-water EPC is based on the maximum detected concentration. The surface-water EPC for the recreational user scenario is presented in Table 8.2-14.

8.2.4 Exposure Scenarios

Table 8.2-8 summarizes the exposure pathways evaluated for the recreational and residential scenarios.

8.2.4.1 Recreational Scenario

The human health risk assessment focuses on potential risks resulting from direct exposure to contaminants in sediment through ingestion, inhalation, and external irradiation. The water pathways for the recreational user consist of ingestion and dermal contact (chemicals only) using persistent surface-water data. Assessment of cumulative risks resulting from the exposures to sediments and persistent surface water were not applicable, as the sediment and water COPCs were not collocated at the same reach. Stormwater data were compared with comparison values in section 6.

Stormwater is not included as part of the quantitative human health risk assessment because stormwater is transient and does not occur frequently enough to sustain chronic exposures. Exposure to groundwater is not evaluated because no groundwater in Ancho, Chaquehui, or Indio Canyons is available for human use under current or reasonably foreseeable future conditions for the recreational scenario. Exposures to the recreational receptor are evaluated at the scale of sediment investigation reaches or water location. This local-scale evaluation is protective compared with an assessment based on a larger scale encompassing numerous reaches and areas between reaches because it includes areas closest to contaminant sources where contaminant concentrations are highest.

Exposure parameters were selected to provide an RME estimate of potential exposures. As discussed in EPA guidance (1989, 008021), the RME estimate is generally the principal basis for evaluating potential health impacts. In general, an RME estimate of risk is at the high end of a risk distribution (i.e., 90th to 99.9th percentiles) (EPA 2001, 085534). An RME assesses risk to individuals whose behavioral characteristics may result in much higher potential exposure than seen in the average individual.

The recreational scenario addresses limited site use for outdoor activities, such as hiking, playing, and jogging. The receptor for this scenario is anticipated to be an adult hiker and/or a child playing in the canyon over an extended period. Therefore, receptors for the recreational scenario are defined as adults and older children (6–11 yr). A complete description of the sediment-associated parameter values and associated rationale is provided in Laboratory guidance (LANL 2010, 108613). Parameters for water exposures can be found in previous canyons investigation reports (LANL 2004, 087390, p. 8-37). Exposure parameters for the recreational scenario are provided in Appendix E, section E-2. Recreational SSLs are from Laboratory guidance (LANL 2010, 108613). Table 8.2-9 presents the sediment and surface-water SLs for the COPC (arsenic) evaluated for the recreational scenario.

8.2.4.2 Residential Scenario

Risk estimates for the residential scenario are provided as a supplemental scenario in Appendix E, section E-2. Residential SSLs are from NMED guidance (NMED 2009, 108070). Exposure parameters and results for the residential scenario are provided in Appendix E, section E-2.

8.2.5 Risk Characterization

Potential human health effects were assessed using the ratios of EPCs to SLs for each COPC retained in this assessment for each of the scenarios evaluated. These ratios were summed (SOFs) for an investigation reach within the COPC class. A SOF less than 1 indicates exposure is not likely to result in an unacceptable risk. The SOF values are then multiplied by the target effect level (i.e., risk = 1×10^{-5}) to provide risk estimates.

Table 8.2-10 presents the summary of recreational risk estimates for reaches AN-4 and CH-2. Table 8.2-11 presents the COPC and sediment risk estimates for reach AN-4 for the recreational scenario. Table 8.2-12 presents the COPC and surface-water risk estimates for reach CH-2 for the recreational scenario. The sediment EPC used in the sediment calculations for Table 8.2-11 is presented in Table 8.2-13. The water EPC used in the surface-water calculations for Table 8.2-12 is presented in Table 8.2-14. Results for the supplemental exposure scenario (residential) are provided in Appendix E, section E-2.

Potential risks due to carcinogens in sediment or surface water were evaluated for arsenic in reaches AN-4 and CH-2 (Table 8.2-10). The total incremental excess cancer risk for arsenic in both reaches was less than 1×10^{-6}, indicating that risk due to carcinogens in sediment or surface water in Ancho, Chaquehui, and Indio Canyons is not a concern for the recreational scenario.

8.2.6 Uncertainty Analysis

The uncertainty analysis uses qualitative and semiquantitative information to evaluate the uncertainty associated with the dose estimates presented. The uncertainty analysis is organized according to the major aspects of the human health risk assessment: data collection and evaluation (section 8.2.6.1), exposure assessment (section 8.2.6.2), and toxicity assessment (section 8.2.6.3).

8.2.6.1 Data Collection and Evaluation

The COPCs identified in section 6 were retained for evaluation in the human health risk assessment. COPCs retained for calculation of EPCs were those with ratios greater than 0.1 for endpoints with SOF values greater than 1 for the residential screen. Thus, the COPCs retained represent an inclusive list of potential human health risk drivers.

The only COPC retained for sediment in the human health risk assessments, arsenic in reach AN-4, has its likely source in naturally occurring material (see section 7.1, Table 7.1-1). The assessment is protective by including this COPC in the evaluation of the potential human health effects.

No BVs are available for surface water. The inability to distinguish COPCs in surface water based on comparisons with background concentrations is a substantial source of uncertainty in the results of the human health risk assessment for this media. Therefore, concentrations of arsenic (which contribute to carcinogenic risk) in surface water could be associated with local background and not with releases from Laboratory SWMUs or AOCs.

The possibility of underestimating EPCs for investigation reaches is another potential source of uncertainty. Three approaches were used to minimize that possibility. First, the emphasis of the geomorphic characterization and sediment sampling was to identify and sample post-1942 sediment deposits, which focuses sampling on potentially contaminated material, excluding areas not impacted by dispersion of contaminants by post-1942 floods. The process of characterizing reaches and focusing on sampling is discussed further in section 4.1 and in section B-1.0 of Appendix B. Second, UCLs on the average sediment concentrations were used as EPCs to minimize the chance of underestimating concentrations in a reach. Third, sampling was biased to fine facies sediment deposits where concentrations are generally highest, as discussed in section 7.1, with fewer samples collected from coarse facies sediment deposits where concentrations are generally lower.

Uncertainty also exists for estimating EPCs for water-sampling locations. COPC concentrations often change with hydrologic conditions, particularly suspended sediment concentrations. The data evaluated in this assessment represent a snapshot of the current hydrological conditions and generally reflect a range of hydrologic conditions at each sampling location. As discussed in section 7.2.1 and Appendix B, section B-2.0, sampling occurred during a range of water-level conditions and field parameters, so the EPCs calculated from these data represent the range of COPC concentrations at the sampling locations. Using the maximum detected concentration for the human health risk assessment minimizes the chance of underestimating the exposure and hence the risk for a sampling location when there are only a limited number of sample results available.

8.2.6.2 Exposure Assessment

Uncertainty pertaining to exposure parameters was addressed in the human health risk assessment by using RME estimates for several exposure parameters (Appendix E, section E-2). The use of RME assumptions, coupled with upper-bound estimates of the average concentration of COPCs in sediment, is intended to produce a protective bias in the risk calculations. The results of the risk assessment, discussed in section 8.2.5, include the key COPCs and exposure pathways associated with potential health impacts. This evaluation of uncertainty is focused on these COPCs and pathways.

Key exposure pathways for contaminated sediment for the recreational scenario include incidental soil ingestion, inhalation, and external irradiation. A common source of protective bias in the exposure assessment for these pathways is that the entire 1-h daily exposure time defined for the recreational scenario is spent on contaminated sediment deposits within a reach. To the extent that time may be spent in other canyon areas, such as uncontaminated stream terraces, colluvial slopes, or bedrock areas during recreational activities, exposure to contaminated sediment deposits is overestimated.

Each scenario is evaluated at the scale of an investigation reach. The risk assessment does not attempt to integrate exposure across multiple reaches. By assessing each reach separately, the impacts of local variability in COPC concentrations upon the results are preserved. The assessment is protective and thus likely overestimates risks and doses by assuming that all exposures occur within a sediment investigation reach (roughly 200 m long), including areas closest to SWMUs and AOCs where contaminant concentrations would be highest. Risks and doses for more realistic exposures from multiple reaches within Ancho, Chaquehui, and Indio Canyons are expected to be lower. Because each reach is treated equally from an exposure perspective, no consideration is made regarding ease of access or land area available for recreation. In addition, it is implicitly assumed that all exposure for a single individual takes place in one investigation reach rather than some random combination of some or all of the investigation reaches and intervening areas.

For carcinogens, to evaluate effects only of possible Laboratory-derived COPCs, the exposure assessment should evaluate incremental exposures that are greater than background. However, the EPCs calculated in this report also include background concentrations. Background exposures are not negligible because risks are based on concentrations of arsenic that have a background component in all reaches. Thus, the risk was overestimated for arsenic, which has an EPC less than the sediment BV (2.66 mg/kg versus 3.98 mg/kg). Incidental ingestion has a second exposure characteristic in addition to time spent on-site that was biased in a protective manner. Adult soil ingestion was assumed to be 100 mg/d, which is twice the EPA-recommended value for adults (EPA 1997, 066596).

An important aspect of uncertainty in exposure to COPCs in surface water relates to exposure intensity. Dermal contact and surface-water ingestion were assumed to occur 20 times per yr for 30 yr (recreational user). This assumption was developed to bound a high-end exposure condition. Potential contact by adults with surface water in Ancho and Chaquehui Canyons is highly intermittent at some locations based on the limited availability of water.

8.2.6.3 Toxicity Assessment

The primary uncertainty associated with the screening values is related to the derivation of toxicity values used in their calculation. Toxicity values (slope factors [SFs] and reference doses [RfDs]) were used to derive the screening values used in this screening evaluation (NMED 2009, 108070). Uncertainties were identified in five areas with respect to the toxicity values: (1) extrapolation from other animals to humans, (2) interindividual variability in the human population, (3) the derivation of RfDs and SFs, (4) the chemical form of the COPC, and (5) the use of surrogate chemicals.

Extrapolation from Animals to Humans: The SFs and RfDs are often determined by extrapolation from animal data to humans, which may result in uncertainties in toxicity values because differences exist between other animals and humans in chemical absorption, metabolism, excretion, and toxic response. Differences in body weight, surface area, and pharmacokinetic relationships between animals and humans are taken into account to address these uncertainties in the dose-response relationship. However, conservatism is usually incorporated into each of these steps, resulting in the overestimation of potential risk.

Individual Variability in the Human Population: For noncarcinogenic effects, the degree of human variability in physical characteristics is important in determining the risks that can be expected at low exposures and in determining the NOAEL. The NOAEL uncertainty factor approach incorporates a factor of 10 to reflect the possible interindividual variability in the human population that can contribute to uncertainty in the risk evaluation. This factor of 10 is generally considered to result in a conservative estimate of risk to noncarcinogenic COPCs.

Derivation of RfDs and SFs: The RfDs and SFs for different chemicals are derived from experiments conducted by different laboratories that may have different accuracy and precision that could lead to an over- or underestimation of the risk.

The uncertainty associated with the toxicity factors for noncarcinogens is measured by the uncertainty factor, the modifying factor, and the confidence level. For carcinogens, the weight of evidence classification indicates the likelihood that a contaminant is a human carcinogen. Toxicity values with high uncertainties may change as new information is evaluated.

Chemical Form of the COPC: COPCs may be bound to the environmental matrix and not available for absorption into the human body. However, the exposure scenarios default to the assumption that the COPCs are bioavailable. This assumption can lead to an overestimation of the total risk.

Use of Surrogate Chemicals: The use of surrogates for chemicals that do not have EPA-approved or provisional toxicity values also contributes to uncertainty in risk assessment. Surrogates were used to establish toxicity values for endosulfan I, endosulfan II, endrin aldehyde, endrin ketone, and endosulfan sulfate based on structural similarity (NMED 2003, 081172). The overall impact of surrogates on the risk-screening assessment is minimal because the COPCs were detected at low concentrations, had HQs less than 0.1, and were not retained for further evaluation.

Additive Approach: For noncarcinogens, the effects of exposure to multiple chemicals are generally not known, and possible interactions could be synergistic or antagonistic, resulting in either an over- or underestimation of the potential risk. Additionally, RfDs used in the risk calculations typically are not based on the same endpoints with respect to severity, effects, or target organs. Therefore, the potential for noncarcinogenic effects may be overestimated for individual COPCs that act by different mechanisms and on different target organs but are addressed additively.

8.2.7 Summary of the Human Health Risk Assessment

The potential human health impacts associated with COPCs in Ancho, Chaquehui, and Indio Canyons were assessed relative to a radiological dose criterion of 15 mrem/yr for sediment, a chemical cancer risk criterion of 1×10^{-5}, and a chemical hazard criterion of 1 for noncarcinogens. No radionuclides or noncarcinogenic COPCs were retained for risk evaluations, and thus no adverse effects from these COPCs are inferred. For the two reaches (AN-4 and CH-2) evaluated for a single carcinogenic COPC (arsenic), the risk for the recreational scenario was less than 1×10^{-6}.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The results of this investigation indicate the nature and extent of contamination in canyons media in Ancho, Chaquehui, and Indio Canyons are defined, and human health risks are acceptable for current and reasonably foreseeable future land uses. In addition, ecological screening of sediment and surface-water data indicates little to no potential for adverse ecological effects to terrestrial or aquatic systems. Therefore, corrective actions are not needed to mitigate unacceptable risks in Ancho, Chaquehui, and Indio Canyons. Potential corrective actions at SWMUs or AOCs within the Ancho and Chaquehui watersheds are addressed separately as part of aggregate area investigations.

Investigations of sediment in Ancho, Chaquehui, and Indio Canyons indicate inorganic, organic, and radionuclide COPCs are present. These COPCs are derived from several sources, including Laboratory SWMUs and AOCs, ash from the 1977 La Mesa fire, and natural sources, such as noncontaminated soil, sediment, and bedrock. Only one COPC, arsenic, has results above human health SLs in one reach, AN-4. These arsenic results were from samples collected in 2008, which were not replicated in sampling in 2010, and the detected arsenic is probably derived from natural sources. The risk assessments and screening assessments show potential human health risks are within acceptable regulatory limits, and no adverse ecological effects exist under current conditions. The conceptual model indicates these conditions for sediment are likely to stay the same or improve because of decreases in contaminant concentrations after peak releases; therefore, no further monitoring of sediment in Ancho, Chaquehui, and Indio Canyons is necessary. However, several firing sites at TA-39 in the Ancho watershed remain active and additional releases are possible. These sites are monitored under the requirements of the IP, and potential contamination at these sites will be characterized further after they have been deactivated. Monitoring of possible stormwater transport of contaminants from SWMUs and AOCs at TA-33 and TA-49 will also continue under the requirements of the IP.

The spatial distribution of sediment COPCs in Ancho and Chaquehui Canyons indicates contaminants have been released and transported downcanyon from TA-33, TA-39, and TA-49. The primary contaminant sources in the Ancho Canyon watershed are firing sites in the north fork of Ancho Canyon at TA-39, and the highest concentrations of uranium isotopes, copper, mercury, and other analytes are found in the closest downcanyon reach, AN-2. Contaminant sources in the Chaquehui Canyon watershed include a former tritium facility that discharged water into the north fork of Chaquehui Canyon, and the highest concentrations of tritium and other COPCs are found in the closest downcanyon reach, CHN-1. Additional COPCs, including cyanide, were released from other sites at TA-33 into main Chaquehui Canyon above reach CH-1. Concentrations decrease downcanyon, and no Laboratory-derived COPCs have been identified in the farthest downcanyon reach in Ancho Canyon, A-3. However, tritium has been measured above the BV in the farthest downcanyon reach in Chaquehui Canyon, CH-2, indicating probable transport of low levels of tritium to the Rio Grande.

Indio Canyon is undeveloped, and the only possible source of contaminants there is airborne dispersion from firing sites in the north fork of Ancho Canyon at TA-39. However, the absence of uranium isotopes above BVs or other COPCs that can be traced to TA-39 firing sites indicates that there has been little or no transport of contaminants into Indio Canyon, and further investigation or monitoring of Indio Canyon is not needed.

No persistent surface water or shallow groundwater has been identified in the Ancho, Chaquehui, or Indio watersheds, other than surface water due to emergence of regional groundwater at springs near the Rio Grande. Comparison of results from stormwater in Ancho Canyon with sediment results indicates two analytes that are above comparison values, copper and mercury, have probable sources at TA-39 firing sites. Gross-alpha radiation may also be elevated in Ancho Canyon in part because of the transport of uranium. In addition, dioxins and PCBs measured at low concentrations in stormwater may also have sources at Laboratory sites. However, the absence of copper, mercury, and isotopic uranium results in sediment above BVs in reach A-3, close to the Rio Grande, and the absence of detected PCBs, indicates little or no transport to the river. Other analytes identified in surface water above comparison values or standards have probable sources in naturally occurring background materials, including aluminum, arsenic, selenium, and thallium. Stormwater in the Ancho and Chaquehui watersheds will continue to be monitored under the requirements of the IP.

The site-specific human health risk assessment uses residential screening values and a recreational exposure scenario to conservatively represent the current and reasonably foreseeable future land use in Ancho, Chaquehui, and Indio Canyons. The assessment of potential chronic exposure includes COPCs in sediment and persistent surface water that occur in Ancho and Chaquehui Canyons. The assessment results indicate no unacceptable risks from carcinogens (incremental cancer risk criterion of 1×10^{-5}), noncarcinogens (hazard index of 1), or radionuclides (target dose limit of 15 mrem/yr) from COPCs in sediment or water.

COPECs identified in the initial ecological screening were evaluated using multiple lines of evidence. Frequency of detection greater than sediment and soil background and PAUF adjustments to HQs were the main lines of evidence that led to the conclusion that COPECs did not pose a risk to biota in Ancho, Chaquehui, and Indio Canyons. In addition, concentrations measured in Ancho, Chaquehui, and Indio Canyons were compared with results from other watersheds where more detailed biota investigations have been conducted. These comparisons also indicate the concentrations of COPECs in Ancho, Chaquehui, and Indio Canyons derived from Laboratory SWMUs or AOCs are not likely to produce adverse ecological impacts. Therefore, no additional biota investigations, mitigation, or monitoring is required.

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- Project Leader: Steven Reneau
- Contaminant Sources: Kay Birdsell and Steven Reneau
- Sediment Investigations: Steven Reneau

- Surface Water Hydrology: Kay Birdsell and Elaine Jacobs
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- Surface Water COPCs: Steven Reneau and Randall Ryti
- Risk Assessments: Randall Ryti
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11.0 REFERENCES AND MAP DATA SOURCES

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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.

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11.2 Map Data Sources

The following list provides data sources for maps included in the main body of this report.

Title; Owner; Intended Scale; Publication Date.

Active Firing Sites; Digitized from a map of Firing Sites and Access Control of Los Alamos National Laboratory; Los Alamos National Laboratory, Earth and Environmental Sciences GISLab; Unknown; January 2011.

Drainage; Los Alamos National Laboratory, Environment and Remediation Support Services; 1:24,000; August 20, 2008.

Gaging stations; Los Alamos National Laboratory, Water Quality and Hydrology Group; Unknown; June 13, 2005.

Geomorphology (Reaches); Los Alamos National Laboratory, Environment and Remediation Support Services; 1:200; Work in progress.

2000 LIDAR Hypsography; Los Alamos National Laboratory, Earth and Environmental Sciences GISLab; 1:1,200; Draft.

Monitoring wells; Los Alamos National Laboratory, Waste and Environmental Sciences Division; 1:2,500; December 20, 2010.

Other holes; Los Alamos National Laboratory, Waste and Environmental Sciences Division; 1:2,500; December 20, 2010.

Other surface water sample; Los Alamos National Laboratory, Waste and Environmental Services Division; 1:2,500; December 20, 2010.

Material disposal areas; Los Alamos National Laboratory, Environment and Remediation Support Services; 1:2,500; April 23, 2004.

Property boundaries (including LANL boundary); SSMO Site Planning and Project Initiation Group; Unknown; August 16, 2010.

Roads, Surfaced; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; Unknown; September 10, 2007.

Springs; Los Alamos National Laboratory, Waste and Environmental Services Division, in cooperation with New Mexico Environment Department, DOE Oversight Bureau; 1:2,500; December 16, 2010.

SWMUs and AOCs; Los Alamos National Laboratory, ESH&Q WES Environmental Data and Analysis Group; 1:2,500; December 9, 2010.

Technical area boundaries; Los Alamos National Laboratory, SSMO Site Planning and Project Initiation Group; Unknown; September 19, 2007.

Watershed; Los Alamos National Laboratory, Environment and Remediation Support Services; 1:2,500; October 27, 2006.

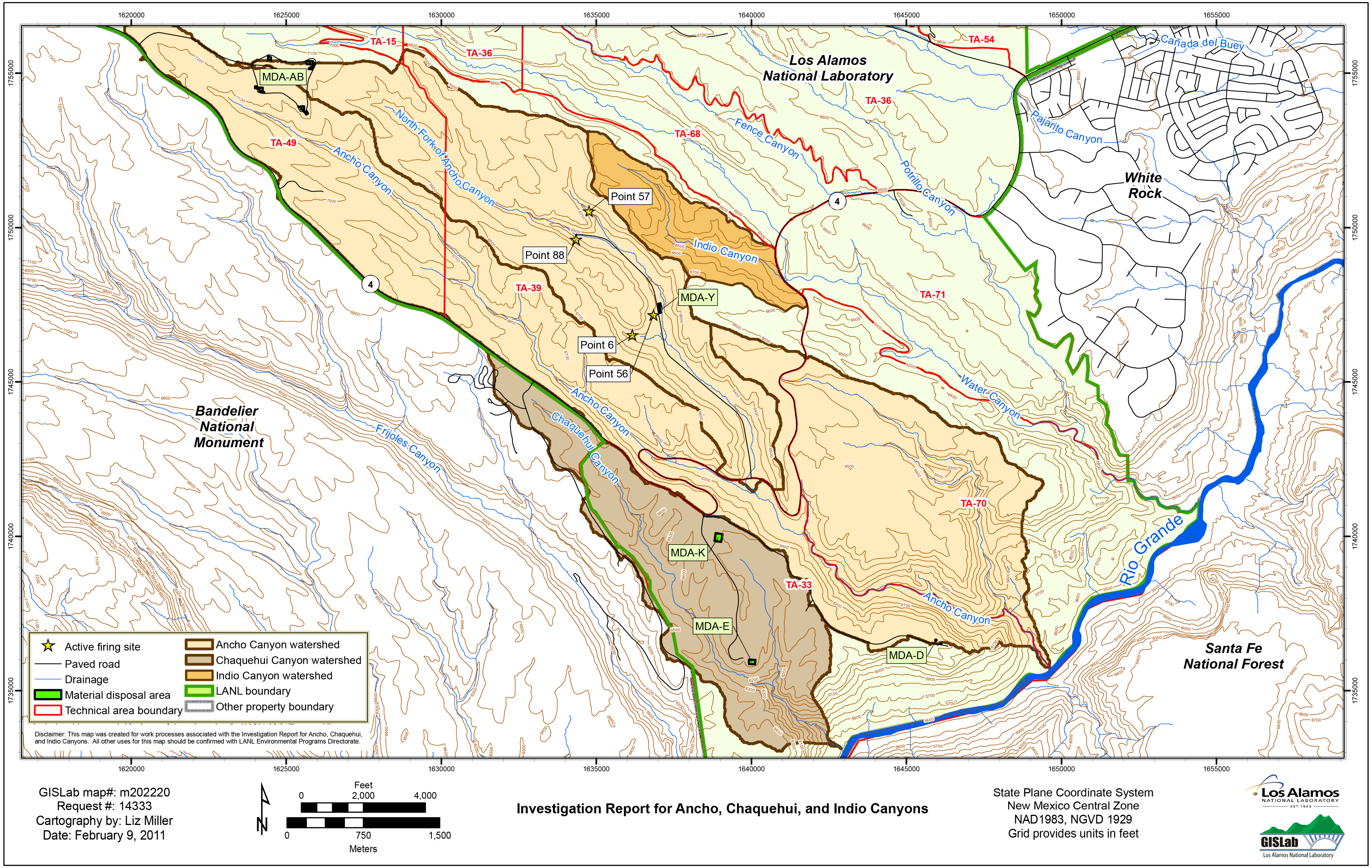


Figure 1.1-1 Ancho, Chaquehui, and Indio watersheds showing TA boundaries, MDAs, and firing sites

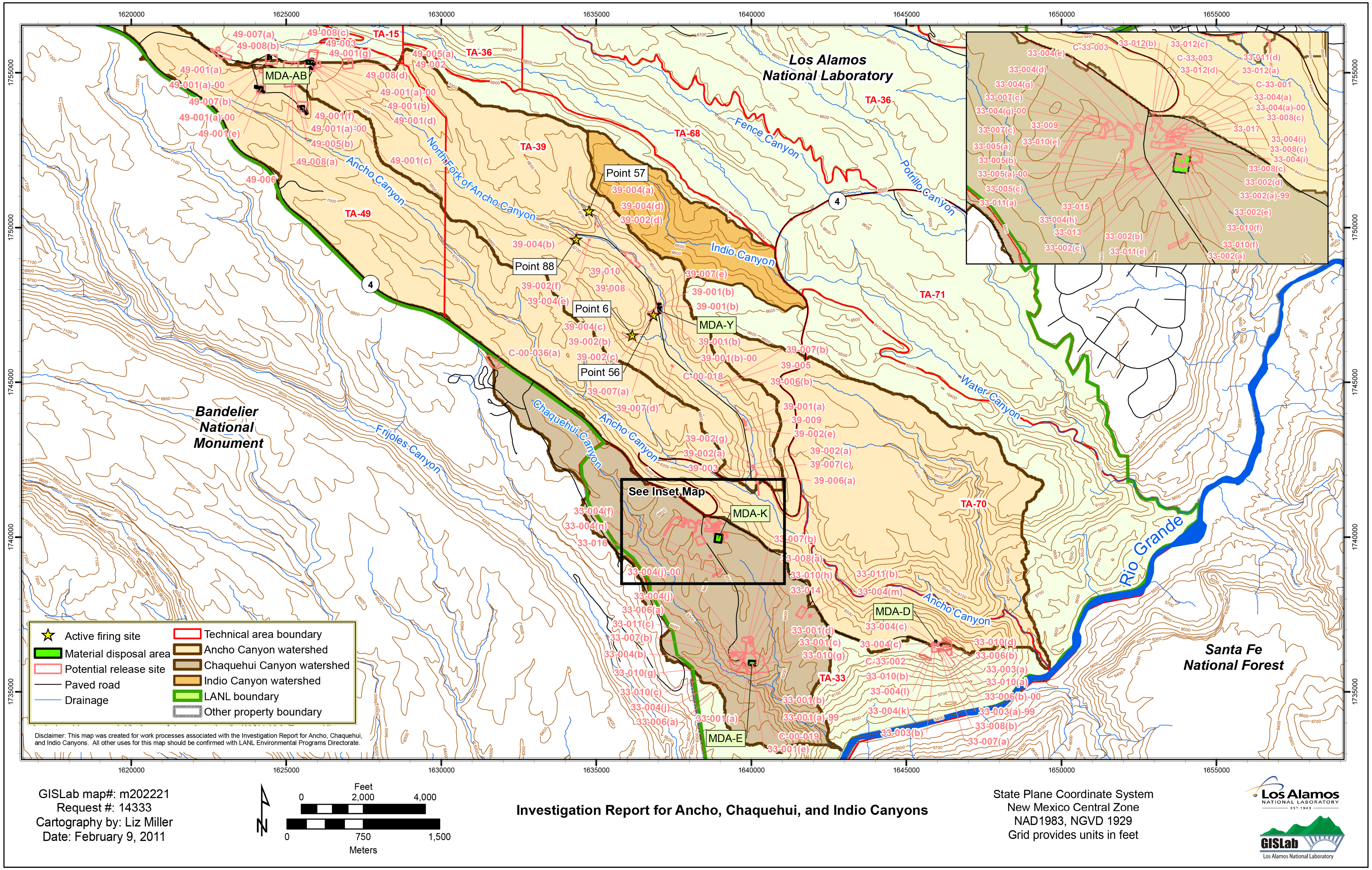


Figure 2.0-1 Ancho, Chaquehui, and Indio watersheds showing SWMUs and AOCs, TA boundaries, MDAs, and firing sites

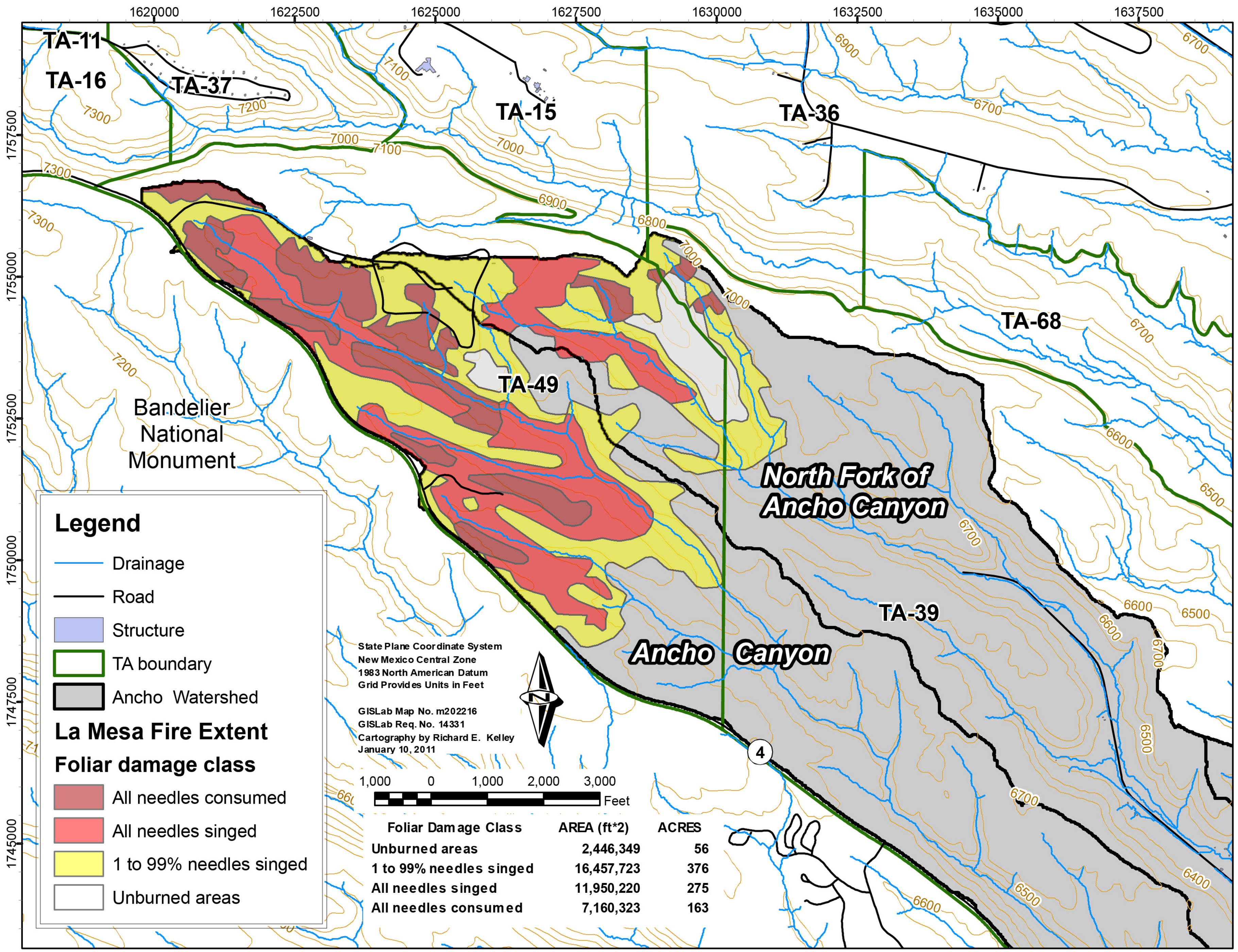


Figure 2.1-1 Extent of burn and foliar damage classes in the Ancho watershed from the 1977 La Mesa fire

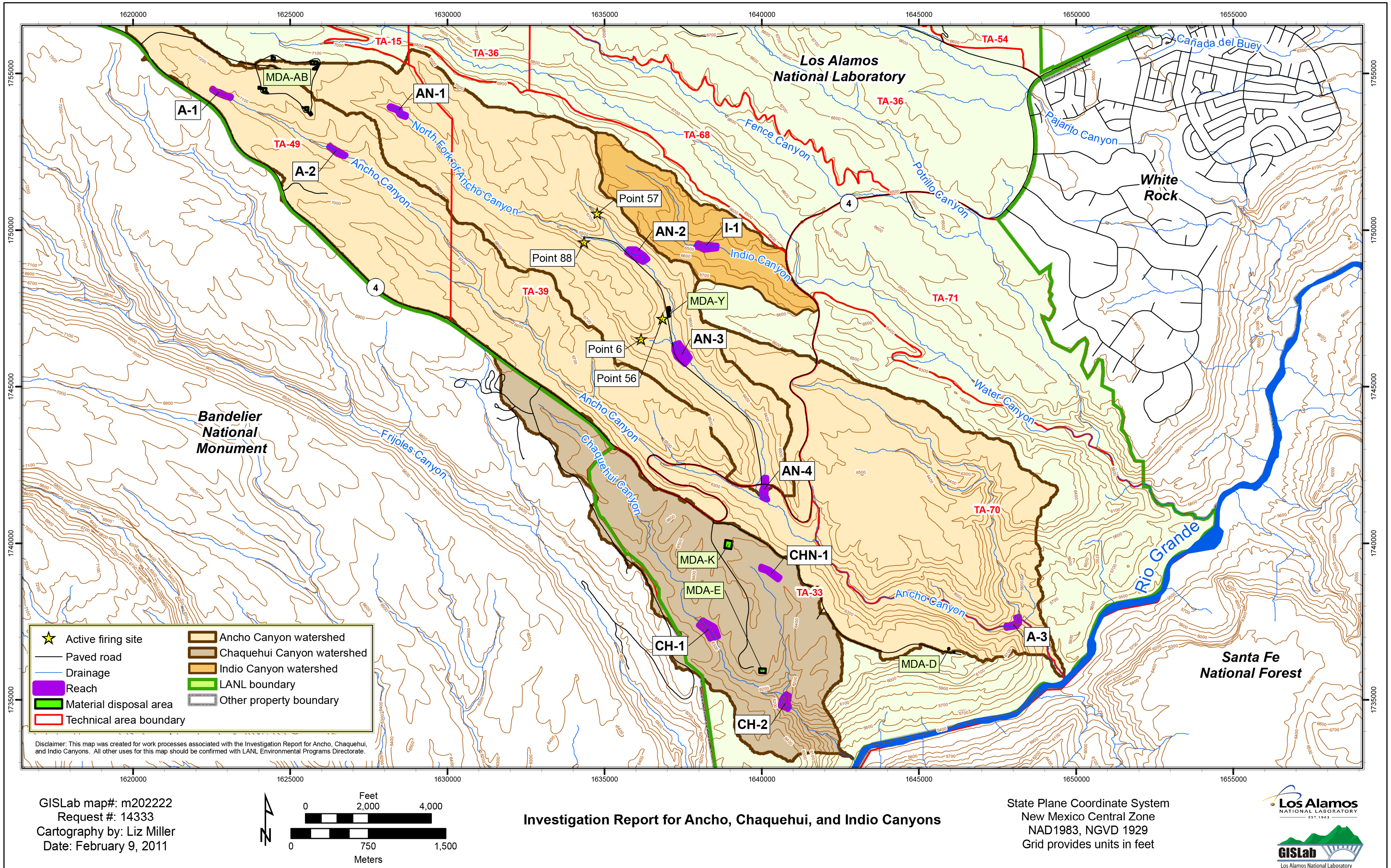


Figure 3.1-1 Ancho, Chaquehui, and Indio watersheds showing reach boundaries, TA boundaries, MDAs, and firing sites

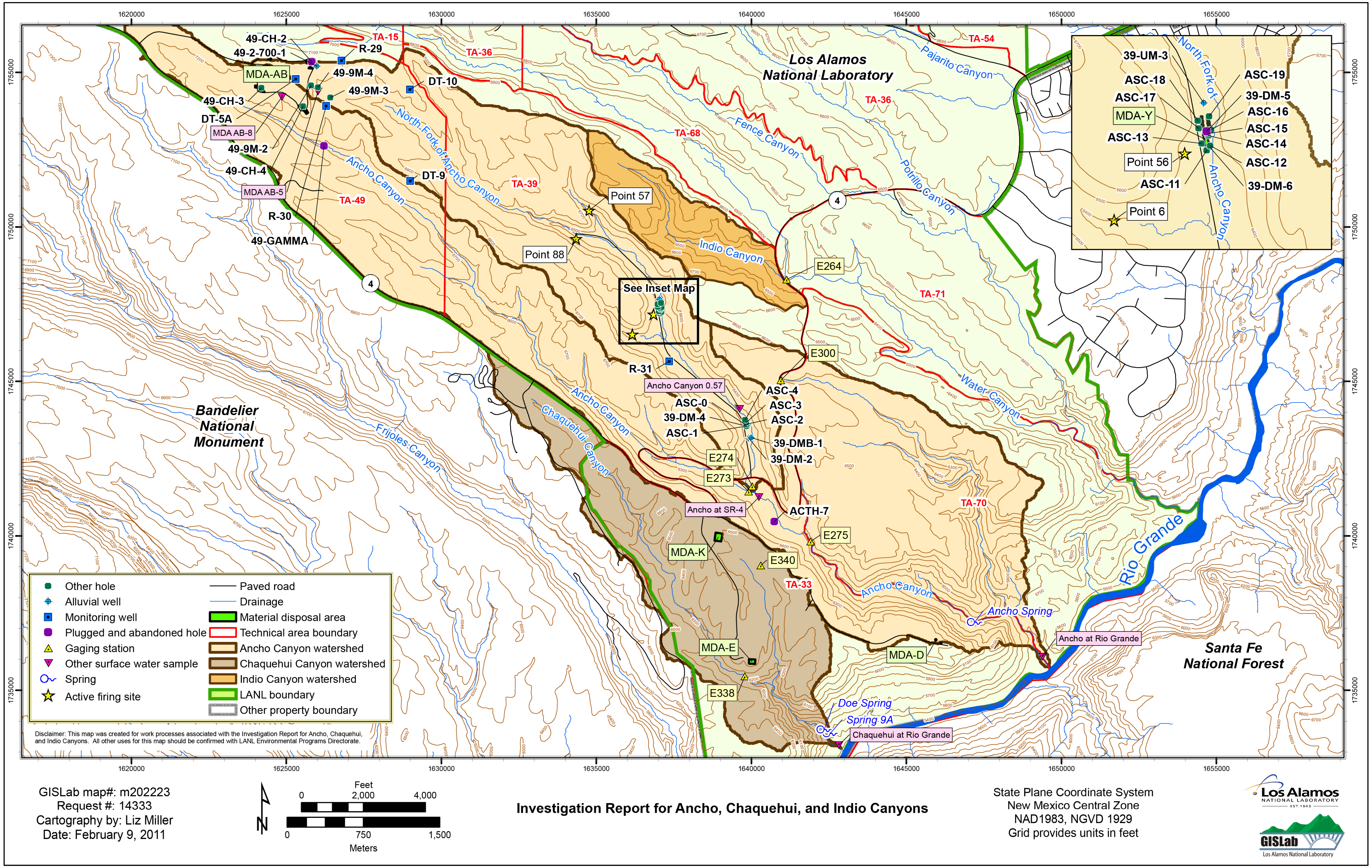


Figure 3.2-1 Ancho, Chaquehui, and Indio watersheds showing gages, wells and other holes, springs, TA boundaries, MDAs, and firing sites

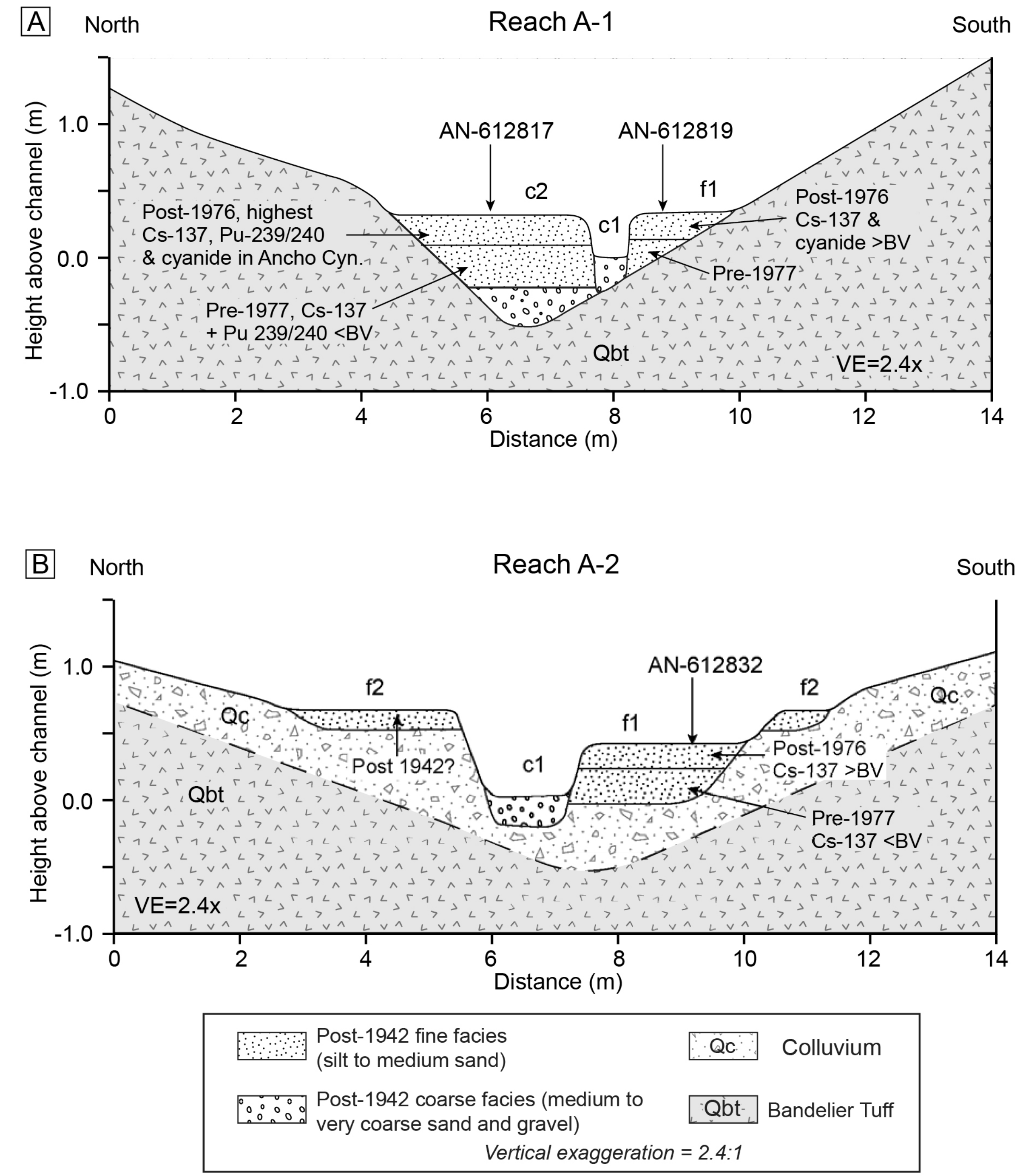


Figure 7.1-1 Schematic cross-sections showing post-1942 coarse facies and fine facies sediment deposits and pre– and post–La Mesa fire (pre-1977 and post-1976) deposits in reaches (a) A-1 and (b) A-2 in upper Ancho Canyon

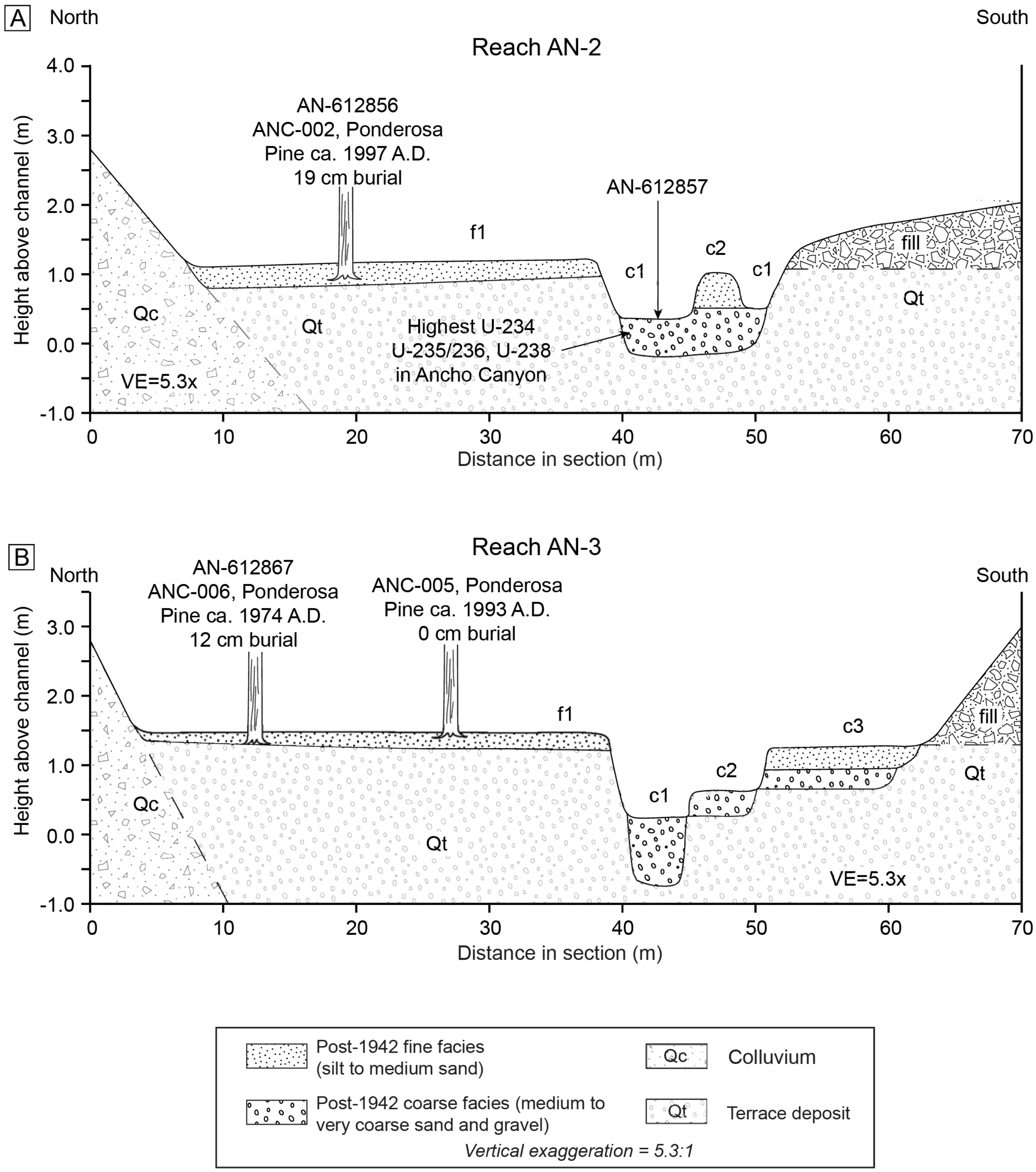


Figure 7.1-2 Schematic cross-sections showing post-1942 coarse facies and fine facies sediment deposits in reaches (a) AN-2 and (b) AN-3 in the north fork of Ancho Canyon

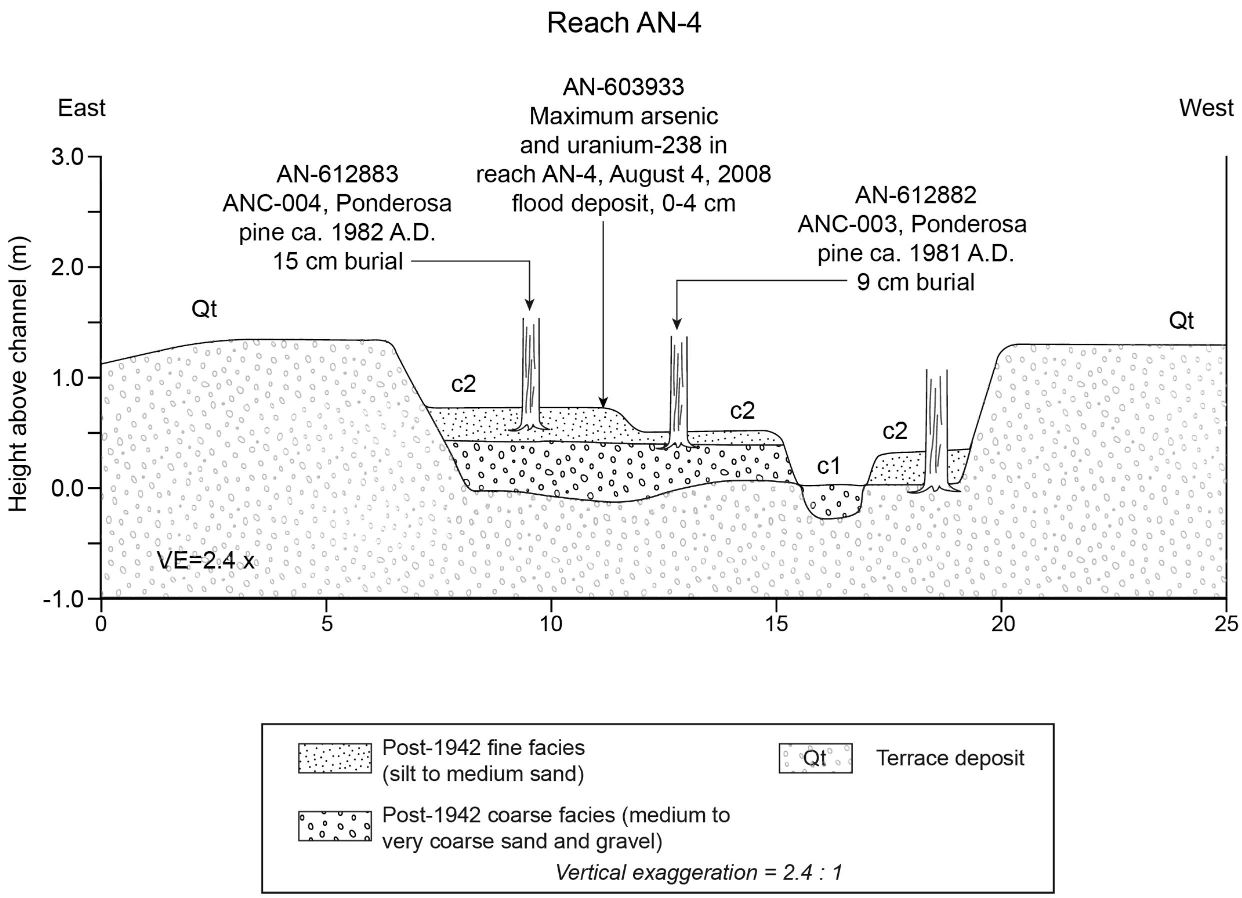


Figure 7.1-3 Schematic cross-section showing post-1942 coarse facies and fine facies sediment deposits in reach AN-4 in the north fork of Ancho Canyon

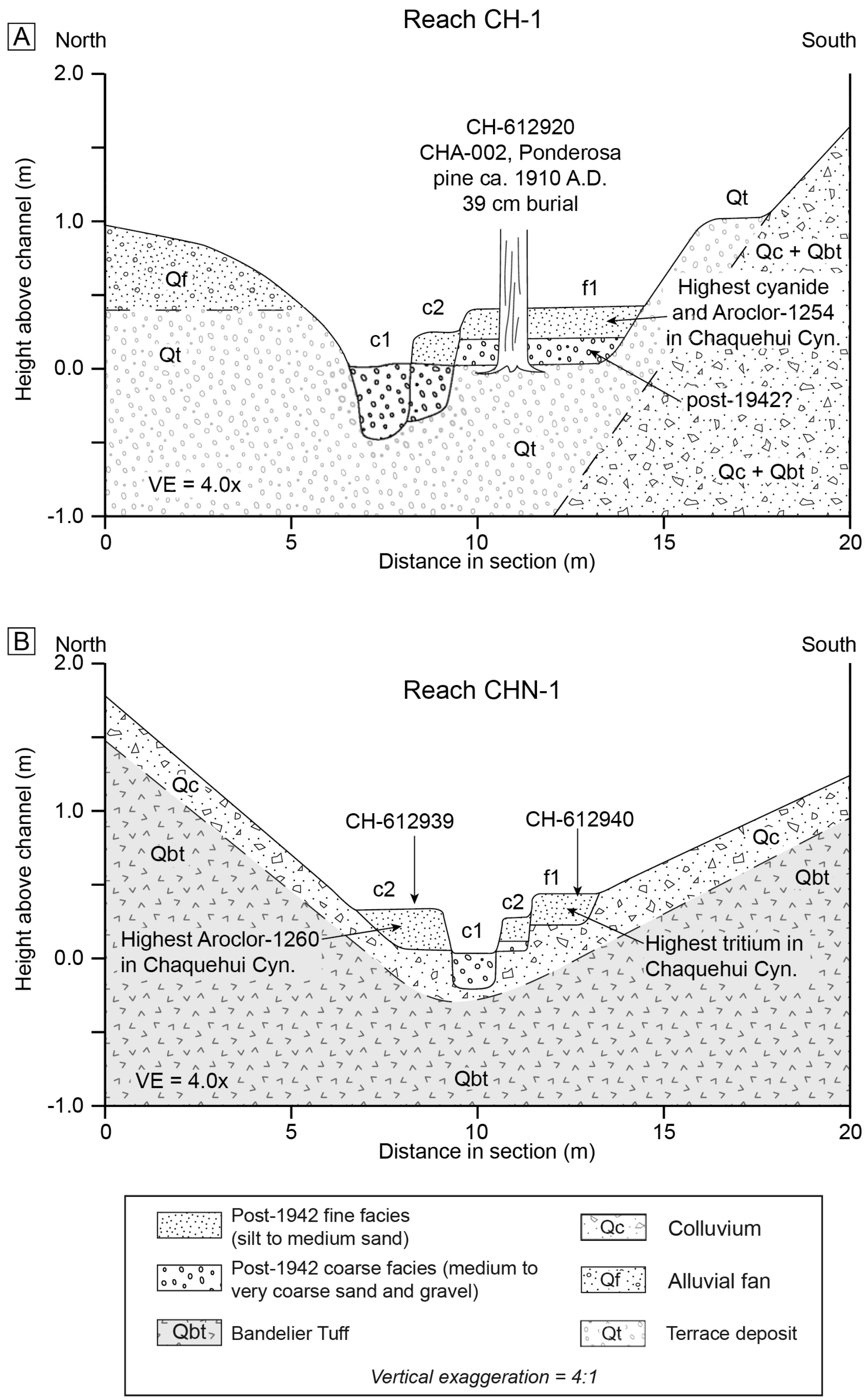
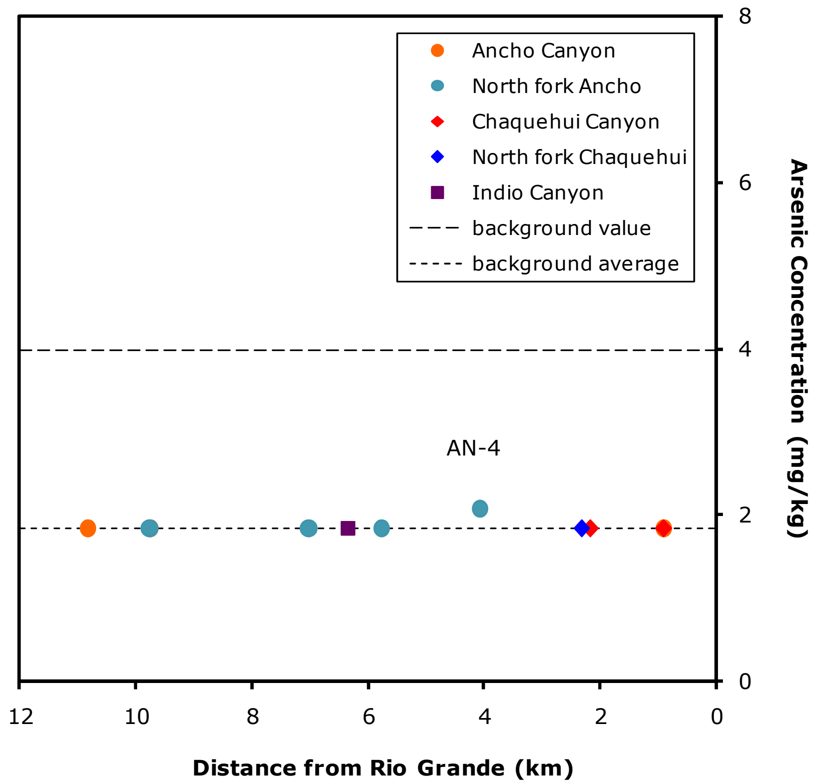
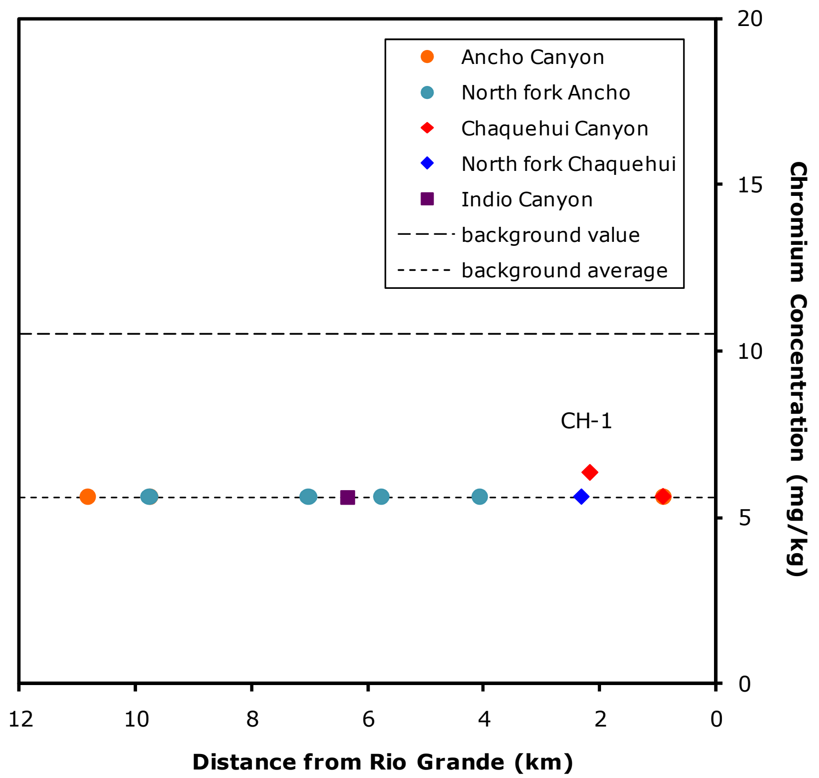


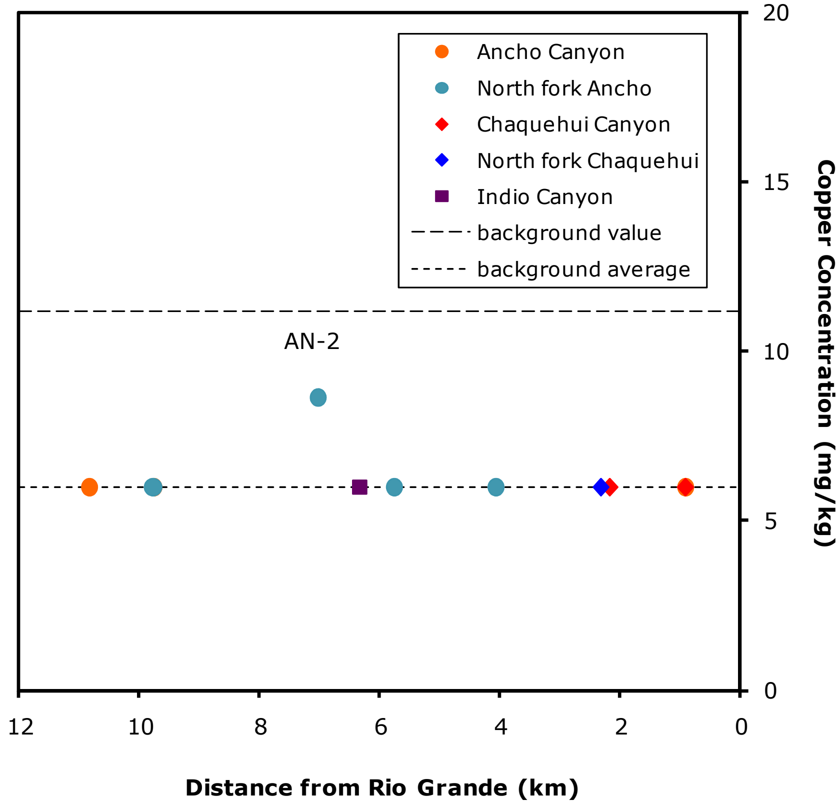
Figure 7.1-4 Schematic cross-sections showing post-1942 coarse facies and fine facies sediment deposits in reaches (a) CH-1 and (b) CHN-1 in Chaquehui Canyon and the north fork of Chaquehui Canyon

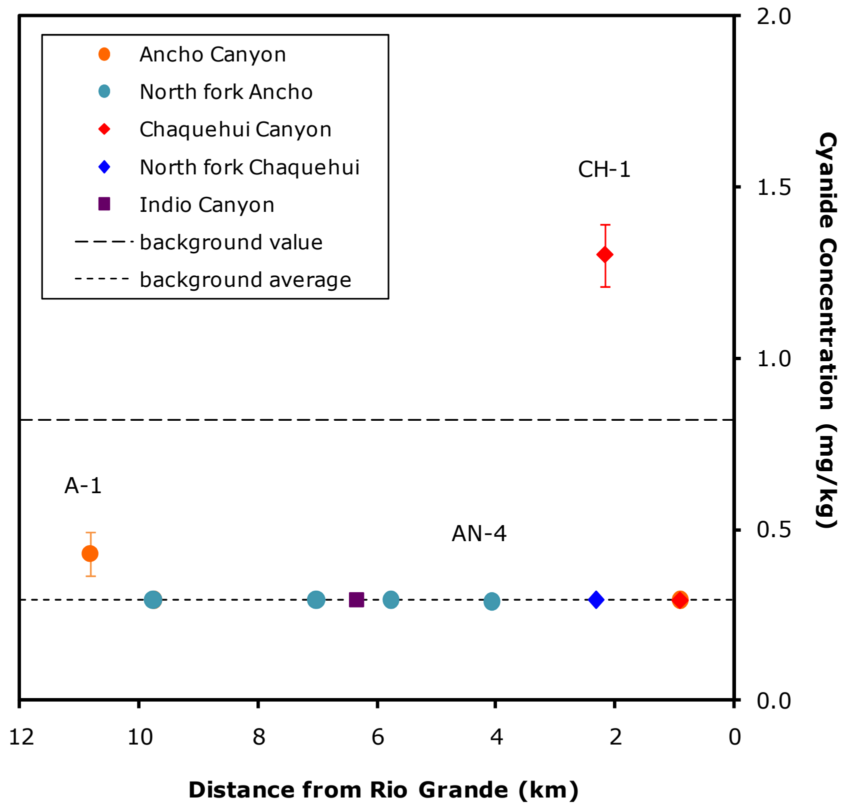




a.

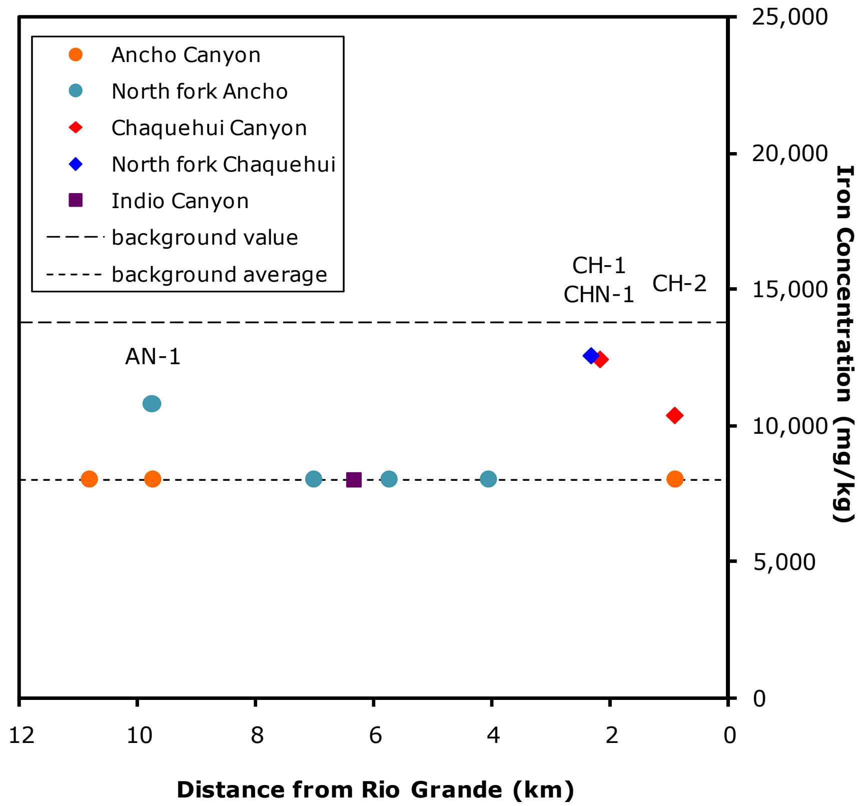
Figure 7.1-5 Estimated average concentrations of select inorganic chemicals in fine facies sediment in Ancho, Chaquehui, and Indio Canyons

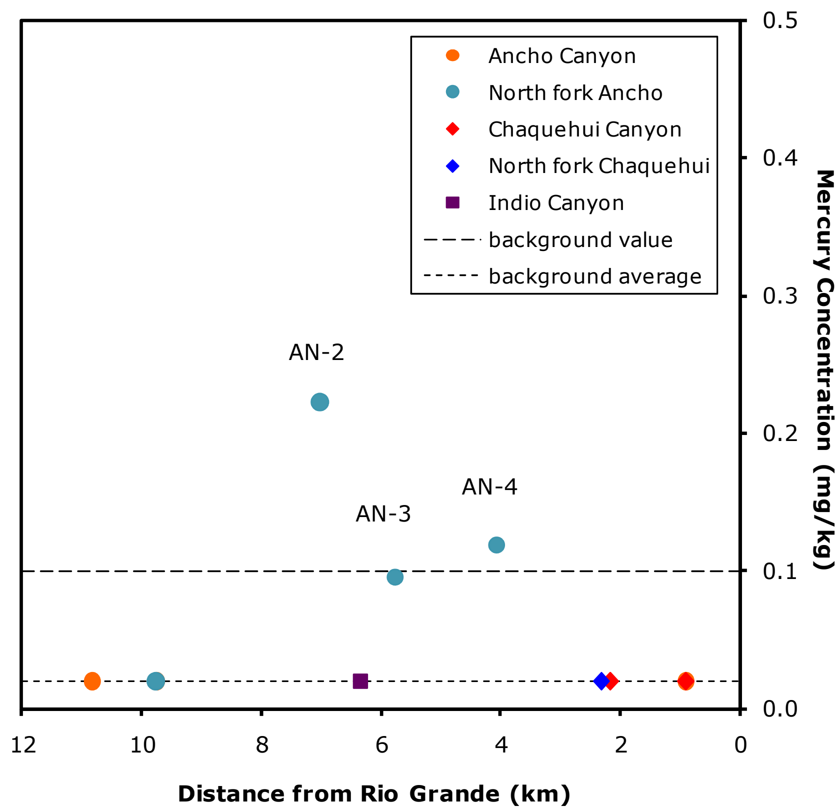




b.

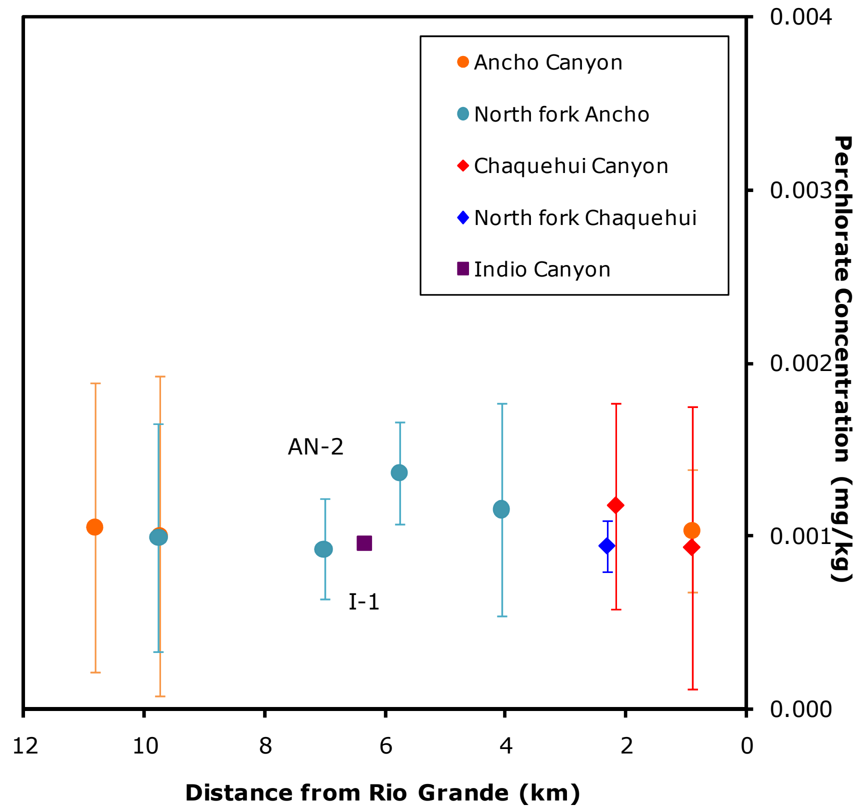
Figure 7.1-5 (continued) Estimated average concentrations of select inorganic chemicals in fine facies sediment in Ancho, Chaquehui, and Indio Canyons

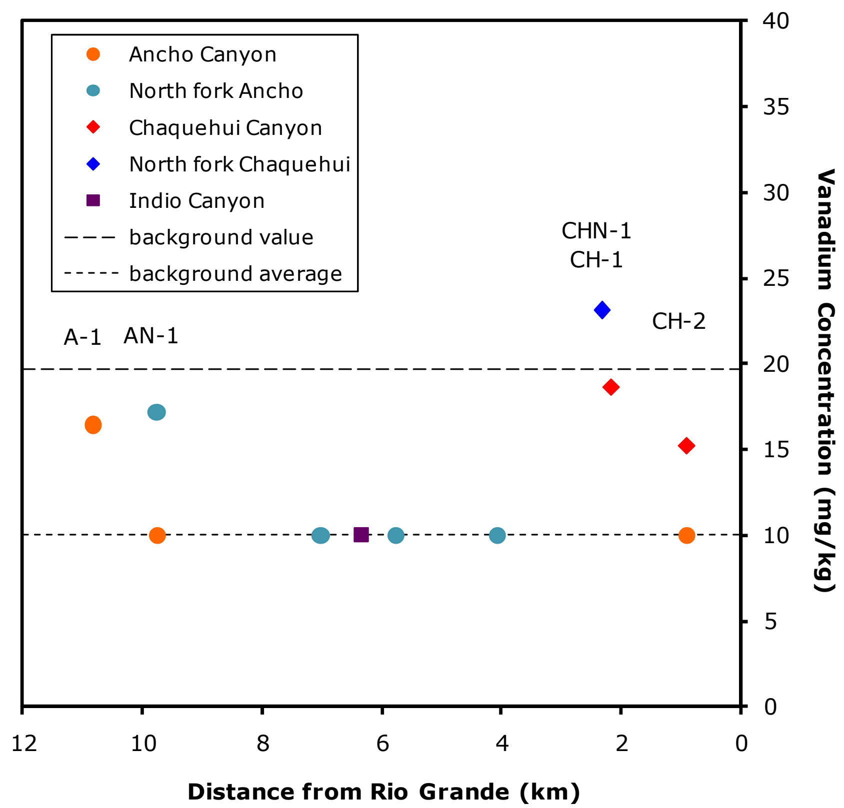




c.

Figure 7.1-5 (continued) **Estimated average concentrations of select inorganic chemicals in fine facies sediment in Ancho, Chaquehui, and Indio Canyons**





d.

Figure 7.1-5 (continued) Estimated average concentrations of select inorganic chemicals in fine facies sediment in Ancho, Chaquehui, and Indio Canyons

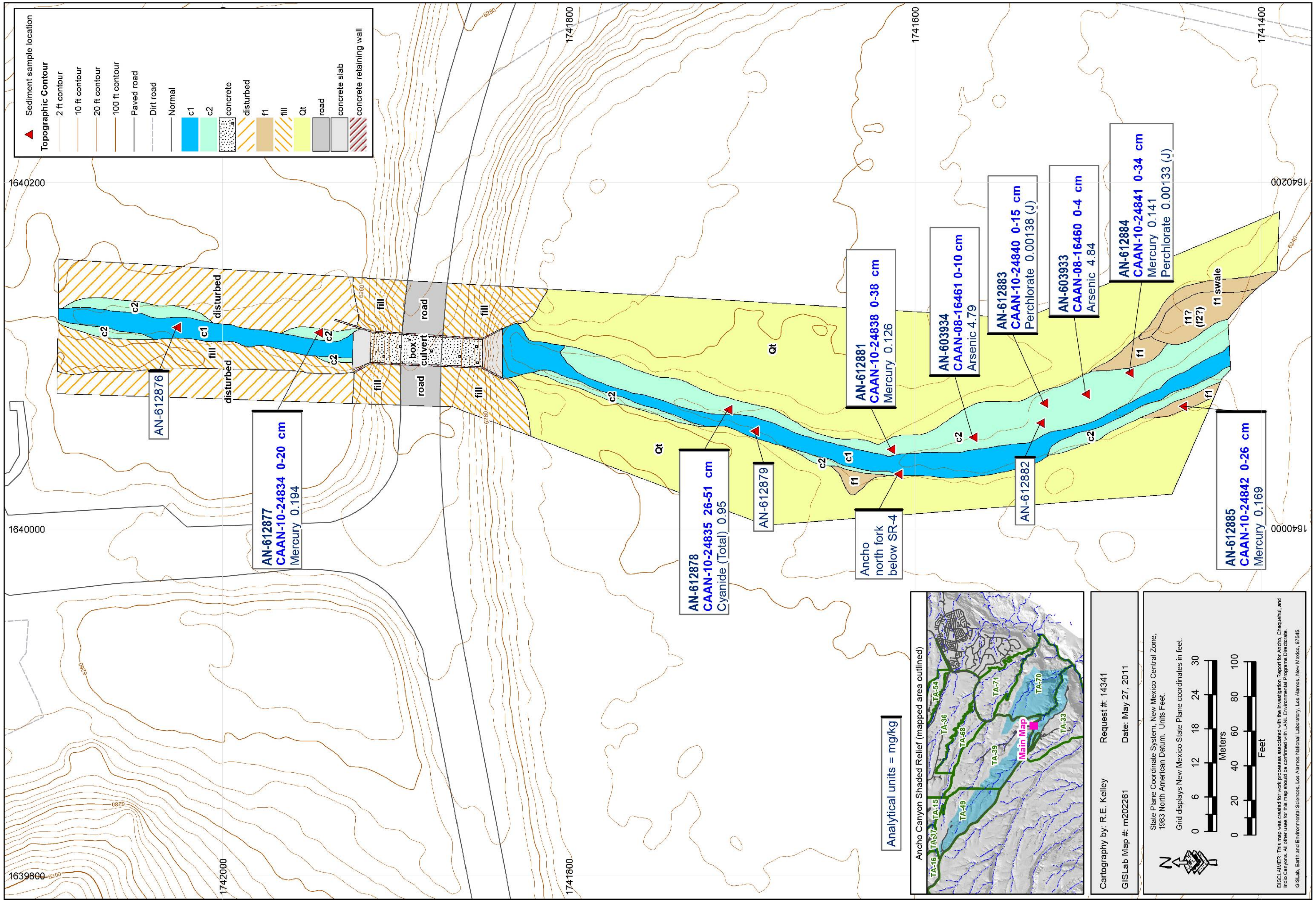


Figure 7.1-6 Results for detected inorganic COPCs in reach AN-4

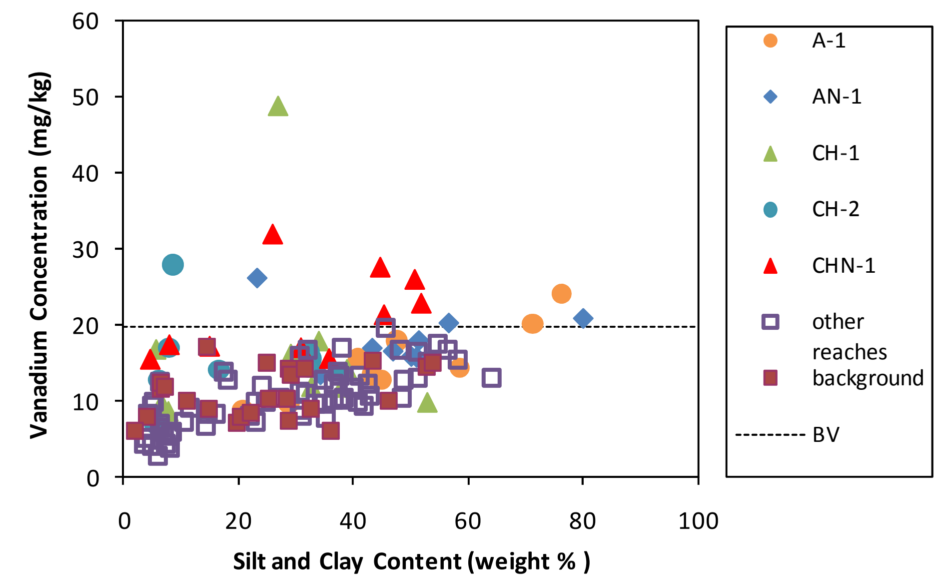
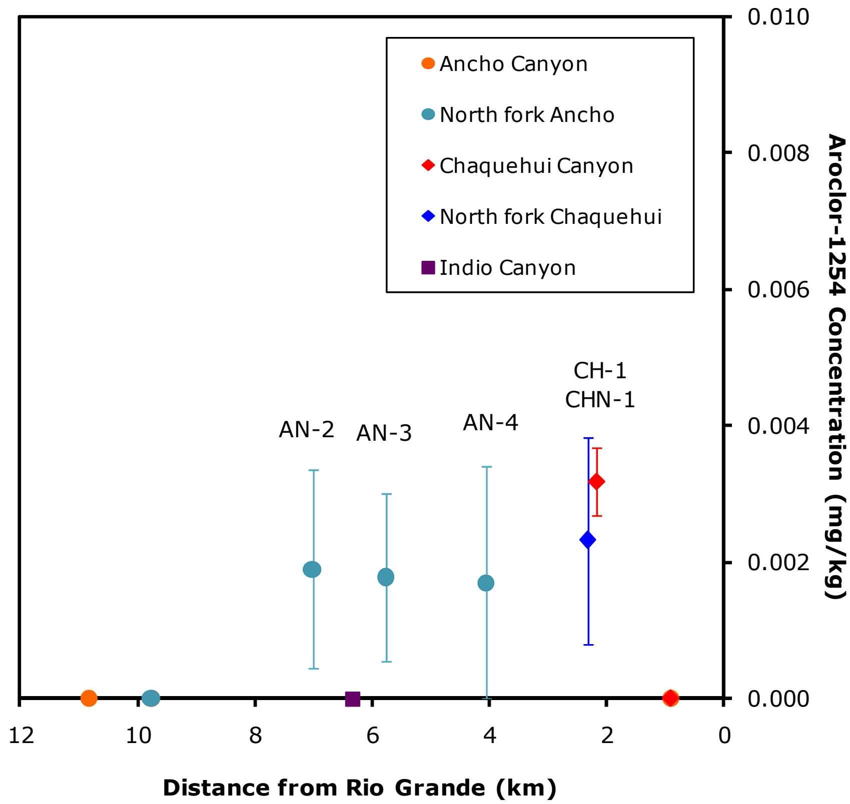


Figure 7.1-7 Vanadium concentrations in Ancho, Chaquehui, and Indio Canyons and background sediment samples versus silt and clay content



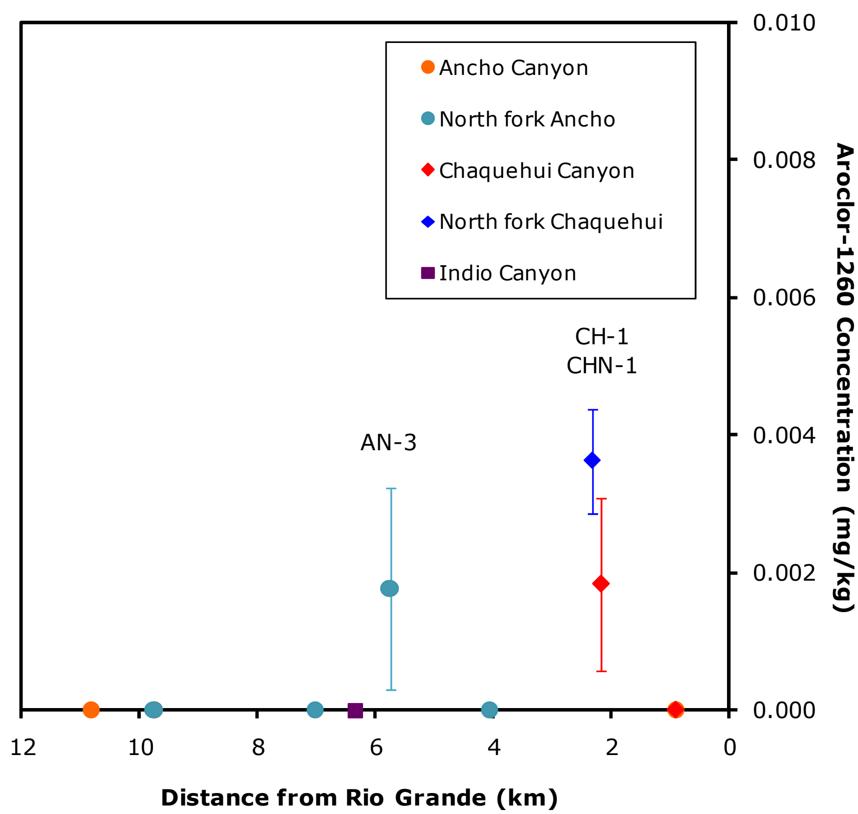


Figure 7.1-8 Estimated average concentrations of Aroclor-1254 and Arolcor-1260 in fine facies sediment in Ancho, Chaquehui, and Indio Canyons

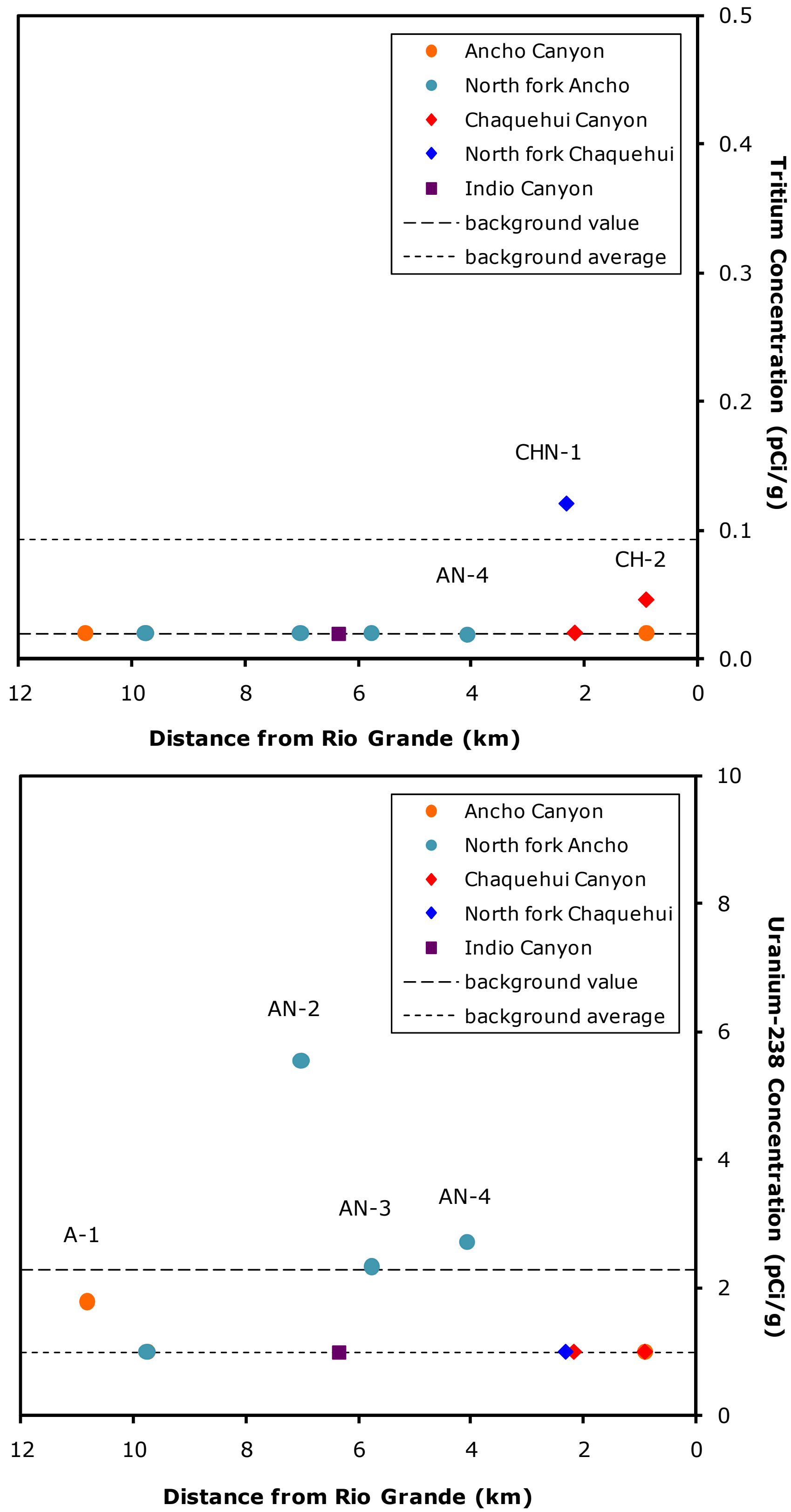


Figure 7.1-9 Estimated average concentrations of tritium and uranium-238 in fine facies sediment in Ancho, Chaquehui, and Indio Canyons

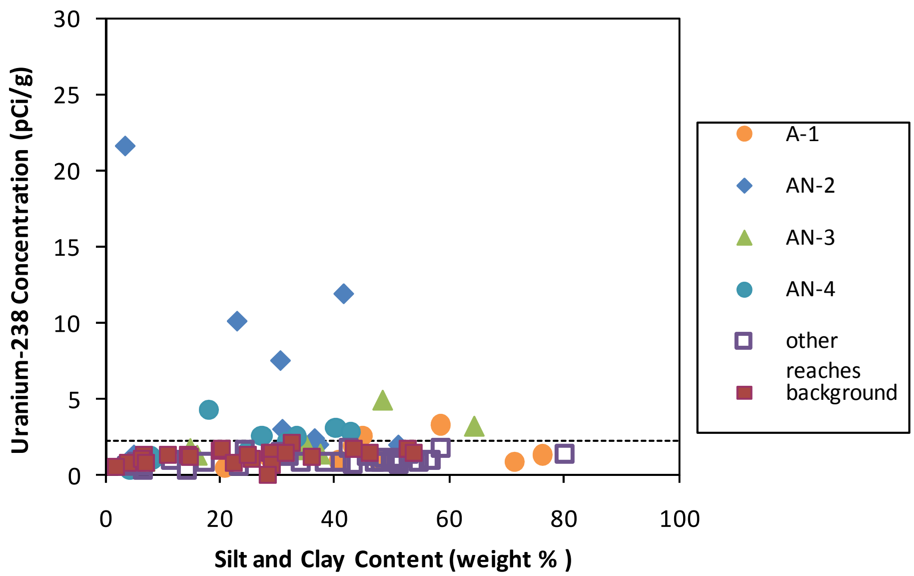
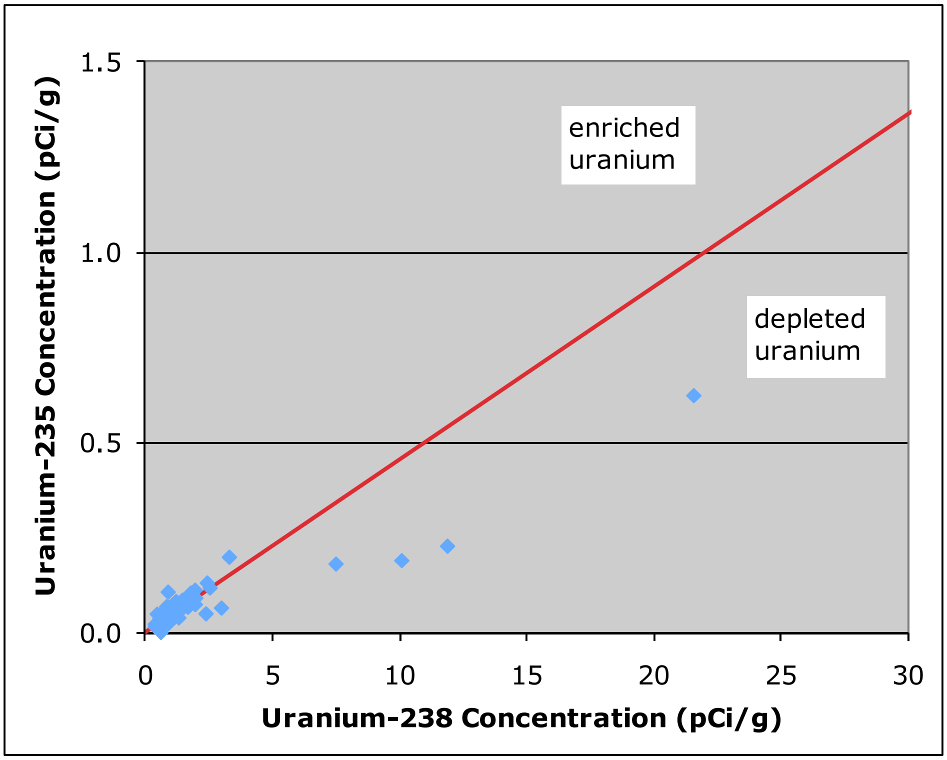
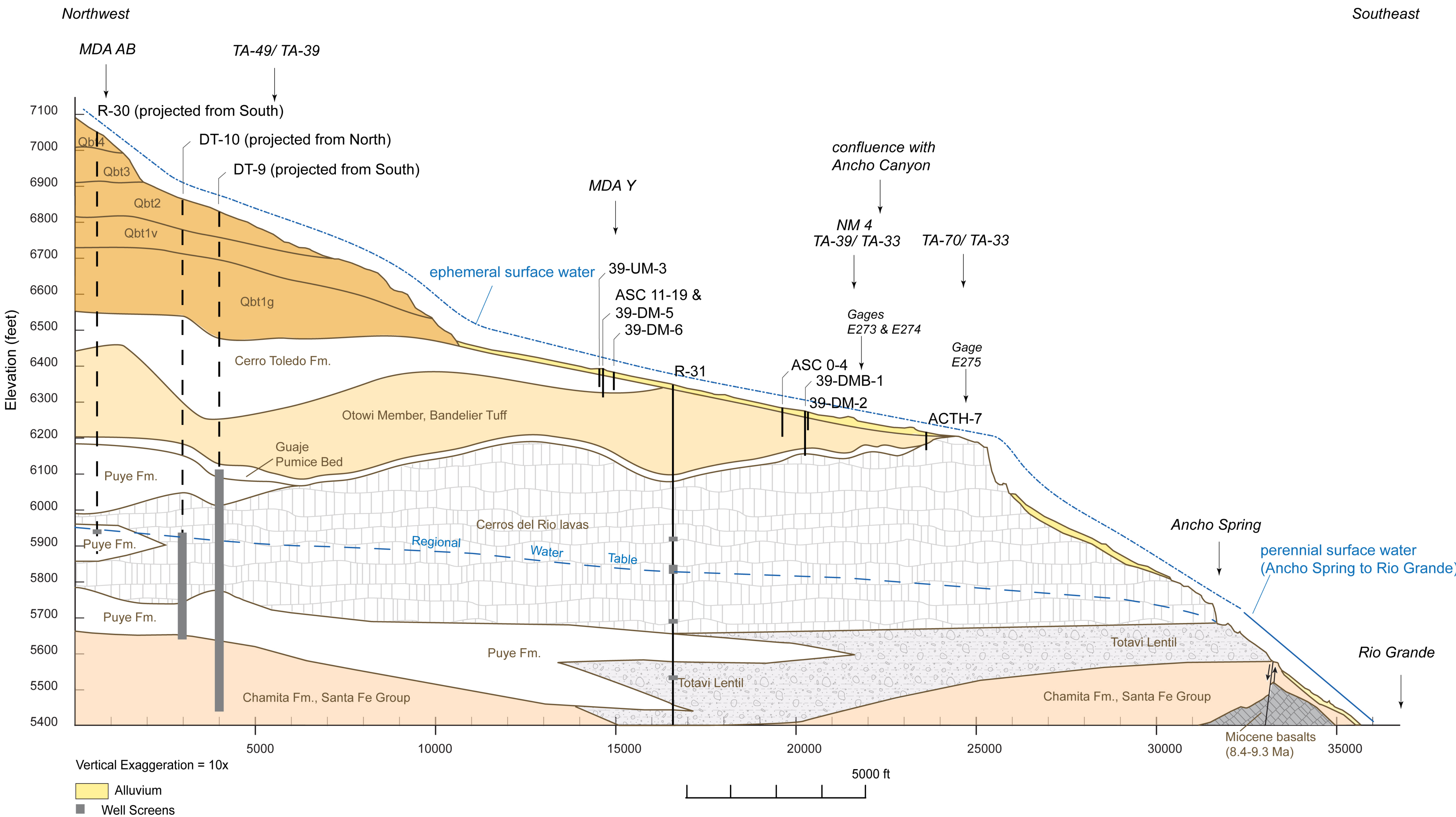


Figure 7.1-10 Concentrations of uranium-238 in Ancho Canyon and background sediment samples versus silt and clay content



Note: The red line indicates values expected in natural uranium, and values plotting below the line indicate depleted uranium.

Figure 7.1-11 Plot of uranium-238 versus uranium-235/236 concentrations in Ancho Canyon sediment samples



Note: Bedrock geology is modified from the 2009 geologic framework model (Cole et al. 2009, 106101) and the geology of the White Rock Quadrangle (Dethier and Koning 2007, 111612 and Dethier 1997, 049843).

Figure 7.2-1 Conceptual hydrogeologic cross-section for the North Ancho tributary and Ancho Canyon

Table 3.1-1
Sediment Investigation Reaches in Ancho, Chaquehui, and Indio Canyons

Sub-watershed	Investigation Reach	Approximate Distance from Rio Grande to Midpoint of Reach (km)	Reach Length (km)*	Notes
Ancho Canyon	A-1	10.83	0.20	Upcanyon from MDA AB at TA-49
	A-2	9.76	0.20	Downcanyon from MDA AB at TA-49
	A-3	0.90	0.20	Downcanyon from MDA D at TA-33
North fork of Ancho Canyon	AN-1	9.77	0.20	Downcanyon from MDA AB at TA-49
	AN-2	7.02	0.21	Downcanyon from Point 57 and Point 88 firing sites at TA-39
	AN-3	5.76	0.20	Downcanyon from Point 6 and Point 56 firing sites and MDA Y at TA-39
	AN-4	4.06	0.21	Upcanyon from confluence with main Ancho Canyon
Chaquehui Canyon	CH-1	2.17	0.20	Downcanyon from westernmost TA-33 SWMUs and AOCs
	CH-2	0.91	0.20	Downcanyon from confluence with north fork of Chaquehui Canyon
North fork of Chaquehui Canyon	CHN-1	2.32	0.21	Downcanyon from MDA K and former tritium facility at TA-33
Indio Canyon	I-1	6.34	0.20	Undeveloped watershed, potentially receiving contaminants from TA-39 firing sites

*Length refers to area mapped and characterized.

Table 6.2-1
Samples Collected and Analyses Performed for Sediment from Ancho, Chaquehui, and Indio Canyons

Reach	Location ID	Top Depth (cm)	Bottom Depth (cm)	Sample ID	Field QC Type	Collection Date	Americium-241	Gamma Spectroscopy Radionuclides	Tritium	Explosive Compounds	Isotopic Plutonium	Isotopic Thorium	Isotopic Uranium	Target Analyte List Metals	Polycyclic Aromatic Hydrocarbons	Perchlorate	Pesticides and Polychlorinated Biphenyls	Strontium-90	Semivolatile Organic Compounds	Volatile Organic Compounds	Cyanide (Total)
A-1	AN-612816	0	16	CAAN-10-24773	n/a[a]	08/24/10	X[b]	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612817	0	26	CAAN-10-24774	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612817	26	56	CAAN-10-24775	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612819	0	19	CAAN-10-24776	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612820	4	28	CAAN-10-24777	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612821	0	16	CAAN-10-24778	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612821	16	44	CAAN-10-24779	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612823	11	40	CAAN-10-24780	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612824	0	18	CAAN-10-24781	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612825	0	31	CAAN-10-24782	n/a	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-1	AN-612825	0	31	CAAN-10-24843	Field Duplicate	08/24/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612826	0	46	CAAN-10-24783	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612826	0	46	CAAN-10-24844	Field Duplicate	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612827	0	14	CAAN-10-24784	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612828	0	44	CAAN-10-24785	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612829	0	16	CAAN-10-24786	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612830	0	18	CAAN-10-24787	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612831	15	35	CAAN-10-24788	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612832	0	17	CAAN-10-24789	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612832	17	46	CAAN-10-24790	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612834	0	29	CAAN-10-24791	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-2	AN-612834	29	49	CAAN-10-24792	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612836	0	15	CAAN-10-24793	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612837	0	17	CAAN-10-24794	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612838	0	11	CAAN-10-24795	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612838	11	52	CAAN-10-24796	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612840	0	16	CAAN-10-24797	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612841	0	20	CAAN-10-24798	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612842	0	10	CAAN-10-24799	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612843	0	37	CAAN-10-24800	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612844	0	35	CAAN-10-24801	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A-3	AN-612844	0	35	CAAN-10-24845	Field Duplicate	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 6.2-1 (continued)

Reach	Location ID	Top Depth (cm)	Bottom Depth (cm)	Sample ID	Field QC Type	Collection Date	Americium-241	Gamma Spectroscopy Radionuclides	Tritium	Explosive Compounds	Isotopic Plutonium	Isotopic Thorium	Isotopic Uranium	Target Analyte List Metals	Polycyclic Aromatic Hydrocarbons	Perchlorate	Pesticides and Polychlorinated Biphenyls	Strontium-90	Semivolatile Organic Compounds	Volatile Organic Compounds	Cyanide (Total)
A-3	AN-612845	0	19	CAAN-10-24802	n/a	09/10/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612846	0	26	CAAN-10-24803	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612846	0	26	CAAN-10-24846	Field Duplicate	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612846	26	44	CAAN-10-24804	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612848	0	17	CAAN-10-24805	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612849	0	13	CAAN-10-24806	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612849	13	49	CAAN-10-24807	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612851	0	26	CAAN-10-24808	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612852	0	27	CAAN-10-24809	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612853	0	19	CAAN-10-24810	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612854	32	59	CAAN-10-24811	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-1	AN-612855	8	31	CAAN-10-24812	n/a	08/31/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612856	0	19	CAAN-10-24813	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612857	0	51	CAAN-10-24814	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612857	0	51	CAAN-10-24847	Field Duplicate	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612858	0	22	CAAN-10-24815	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612859	0	19	CAAN-10-24816	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612860	0	29	CAAN-10-24817	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612860	38	79	CAAN-10-24818	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612862	0	67	CAAN-10-24819	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612863	0	30	CAAN-10-24820	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612864	0	34	CAAN-10-24821	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-2	AN-612865	0	28	CAAN-10-24822	n/a	09/07/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612866	0	39	CAAN-10-24823	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612867	0	17	CAAN-10-24824	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612868	0	24	CAAN-10-24825	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612868	0	24	CAAN-10-24848	Field Duplicate	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612869	0	23	CAAN-10-24826	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612870	0	93	CAAN-10-24827	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612871	0	58	CAAN-10-24828	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612872	0	17	CAAN-10-24829	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612873	0	9	CAAN-10-24830	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-3	AN-612874	0	29	CAAN-10-24831	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 6.2-1 (continued)

Reach	Location ID	Top Depth (cm)	Bottom Depth (cm)	Sample ID	Field QC Type	Collection Date	Americium-241	Gamma Spectroscopy Radionuclides	Tritium	Explosive Compounds	Isotopic Plutonium	Isotopic Thorium	Isotopic Uranium	Target Analyte List Metals	Polycyclic Aromatic Hydrocarbons	Perchlorate	Pesticides and Polychlorinated Biphenyls	Strontium-90	Semivolatile Organic Compounds	Volatile Organic Compounds	Cyanide (Total)
AN-3	AN-612875	0	30	CAAN-10-24832	n/a	09/08/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-603933	0	4	CAAN-08-16460	n/a	11/18/08	—[c]	—	X	X	X	—	X	X	—	—	—	—	—	—	X
AN-4	AN-603934	0	10	CAAN-08-16461	n/a	11/18/08	—	—	X	X	X	—	X	X	—	—	—	—	—	—	X
AN-4	AN-612876	0	32	CAAN-10-24833	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612877	0	20	CAAN-10-24834	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612877	0	20	CAAN-10-24849	Field Duplicate	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612878	26	51	CAAN-10-24835	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612879	0	24	CAAN-10-24836	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612879	24	80	CAAN-10-24837	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612881	0	38	CAAN-10-24838	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612882	9	48	CAAN-10-24839	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612883	0	15	CAAN-10-24840	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612884	0	34	CAAN-10-24841	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	AN-612885	0	26	CAAN-10-24842	n/a	09/13/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AN-4	Ancho north fork below SR-4	0	2	CAAN-08-16457	n/a	11/18/08	—	—	X	X	—	—	X	X	—	—	—	—	—	—	X
AN-4	Ancho north fork below SR-4	0	2	CAAN-10-4836	n/a	11/06/09	—	—	X	X	—	—	X	X	—	—	—	—	—	—	—
CH-1	CH-612916	0	23	CACH-10-25593	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612917	0	15	CACH-10-25594	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612918	0	28	CACH-10-25595	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612918	28	53	CACH-10-25596	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612920	0	21	CACH-10-25597	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612921	0	20	CACH-10-25598	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612921	0	20	CACH-10-25623	Field Duplicate	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612922	0	31	CACH-10-25599	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612923	0	20	CACH-10-25600	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612924	0	42	CACH-10-25601	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-1	CH-612924	42	70	CACH-10-25602	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-609842	0	16	CACH-10-4838	n/a	11/16/09	—	—	X	X	—	—	X	X	—	—	—	—	—	—	—
CH-2	CH-612926	18	38	CACH-10-25603	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612926	18	38	CACH-10-25624	Field Duplicate	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612927	21	44	CACH-10-25604	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612927	44	71	CACH-10-25605	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612929	54	86	CACH-10-25606	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 6.2-1 (continued)

Reach	Location ID	Top Depth (cm)	Bottom Depth (cm)	Sample ID	Field QC Type	Collection Date	Americium-241	Gamma Spectroscopy Radionuclides	Tritium	Explosive Compounds	Isotopic Plutonium	Isotopic Thorium	Isotopic Uranium	Target Analyte List Metals	Polycyclic Aromatic Hydrocarbons	Perchlorate	Pesticides and Polychlorinated Biphenyls	Strontium-90	Semivolatile Organic Compounds	Volatile Organic Compounds	Cyanide (Total)
CH-2	CH-612930	0	37	CACH-10-25607	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612931	0	73	CACH-10-25608	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612932	22	56	CACH-10-25609	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612932	56	96	CACH-10-25610	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612934	8	46	CACH-10-25611	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CH-2	CH-612935	0	28	CACH-10-25612	n/a	08/26/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612936	0	20	CACH-10-25613	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612936	0	20	CACH-10-25625	Field Duplicate	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612937	0	15	CACH-10-25614	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612937	15	46	CACH-10-25615	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612939	0	30	CACH-10-25616	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612940	0	19	CACH-10-25617	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612941	0	19	CACH-10-25618	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612942	0	16	CACH-10-25619	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612943	0	14	CACH-10-25620	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612944	0	19	CACH-10-25621	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CHN-1	CH-612945	0	23	CACH-10-25622	n/a	08/23/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612966	1	29	CAIN-10-25632	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612967	0	18	CAIN-10-25633	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612968	0	21	CAIN-10-25634	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612969	7	58	CAIN-10-25635	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612970	0	22	CAIN-10-25636	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612971	0	22	CAIN-10-25637	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612972	0	26	CAIN-10-25638	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612973	0	28	CAIN-10-25639	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612974	0	32	CAIN-10-25640	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612975	0	30	CAIN-10-25641	n/a	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
I-1	IN-612975	0	30	CAIN-10-25642	Field Duplicate	09/01/10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

[a] n/a = Not applicable (not a field QC sample).
[b] X = Analysis was performed.
[c] — = Analysis was not performed.

Table 6.2-2
Inorganic Chemicals above BVs in Ancho, Chaquehui, and Indio Canyon Sediment Samples

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Cyanide (Total)	Iron	Lead	Manganese	Mercury	Perchlorate	Selenium	Vanadium	Zinc
Sediment BV					**0.83**	**3.98**	**0.4**	**10.5**	**4.73**	**11.2**	**0.82**	**13,800**	**19.7**	**543**	**0.1**	**n/a[a]**	**0.3**	**19.7**	**60.2**
A-1	CAAN-10-24773	AN-612816	0–16	0–0.52	1.04 (U)	—[b]	—	—	—	—	—	—	—	—	—	0.000765 (J)	—	—	—
A-1	CAAN-10-24774	AN-612817	0–26	0–0.85	1.02 (U)	—	—	—	—	—	1.13	—	23.2	—	—	—	—	—	—
A-1	CAAN-10-24775	AN-612817	26–56	0.85–1.84	1.03 (U)	—	—	—	—	—	—	—	—	—	—	—	—	24.1	—
A-1	CAAN-10-24776	AN-612819	0–19	0–0.62	1.03 (U)	—	—	—	—	—	0.942	—	—	—	—	—	—	—	—
A-1	CAAN-10-24777	AN-612820	4–28	0.13–0.92	1.06 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-1	CAAN-10-24778	AN-612821	0–16	0–0.52	1.12 (U)	—	—	—	—	—	—	—	—	—	—	0.001 (J)	—	—	—
A-1	CAAN-10-24779	AN-612821	16–44	0.52–1.44	1.09 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-1	CAAN-10-24780	AN-612823	11–40	0.36–1.31	1.07 (U)	—	—	—	—	—	—	—	—	—	—	—	—	20.2	—
A-1	CAAN-10-24781	AN-612824	0–18	0–0.59	1.14 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-1	CAAN-10-24782	AN-612825	0–31	0–1.02	1.1 (U)	—	0.549 (U)	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24783	AN-612826	0–46	0–1.51	0.963 (U)	—	0.481 (U)	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24784	AN-612827	0–14	0–0.46	1.02 (U)	—	—	—	—	—	—	—	—	—	—	0.000679 (J)	—	—	—
A-2	CAAN-10-24785	AN-612828	0–44	0–1.44	1.01 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24786	AN-612829	0–16	0–0.52	1.04 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24787	AN-612830	0–18	0–0.59	0.994 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24788	AN-612831	15–35	0.49–1.15	0.942 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24789	AN-612832	0–17	0–0.56	1.01 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24790	AN-612832	17–46	0.56–1.51	0.978 (U)	—	0.489 (U)	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24791	AN-612834	0–29	0–0.95	1.04 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	CAAN-10-24792	AN-612834	29–49	0.95–1.61	1.03 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24793	AN-612836	0–15	0–0.49	1.32 (U)	—	0.661 (U)	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24794	AN-612837	0–17	0–0.56	1.27 (U)	—	0.635 (U)	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24795	AN-612838	0–11	0–0.36	1.02 (U)	—	0.511 (U)	—	—	—	—	—	—	—	—	0.00104 (J)	—	—	—
A-3	CAAN-10-24796	AN-612838	11–52	0.36–1.71	4.96 (U)	—	0.496 (U)	—	—	—	—	—	—	—	—	0.00129 (J)	—	—	—
A-3	CAAN-10-24797	AN-612840	0–16	0–0.52	1.77 (U)	—	0.491 (U)	—	—	—	—	—	—	—	—	0.000669 (J)	—	—	—
A-3	CAAN-10-24798	AN-612841	0–20	0–0.66	1.16 (U)	—	0.582 (U)	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24799	AN-612842	0–10	0–0.33	1.05 (U)	—	0.524 (U)	—	—	—	—	—	—	—	—	0.00112 (J)	—	—	—
A-3	CAAN-10-24800	AN-612843	0–37	0–1.21	1.04 (U)	—	0.52 (U)	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24801	AN-612844	0–35	0–1.15	1 (U)	—	0.501 (U)	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24802	AN-612845	0–19	0–0.62	1.07 (U)	—	0.533 (U)	—	—	—	—	—	—	—	—	0.000619 (J)	—	—	—
AN-1	CAAN-10-24803	AN-612846	0–26	0–0.85	1.01 (U)	—	—	—	—	—	—	—	—	—	—	0.00128 (J)	—	—	—
AN-1	CAAN-10-24804	AN-612846	26–44	0.85–1.44	1.05 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24805	AN-612848	0–17	0–0.56	1.02 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 6.2-2 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Cyanide (Total)	Iron	Lead	Manganese	Mercury	Perchlorate	Selenium	Vanadium	Zinc
Sediment BV					**0.83**	**3.98**	**0.4**	**10.5**	**4.73**	**11.2**	**0.82**	**13,800**	**19.7**	**543**	**0.1**	**n/a**[a]	**0.3**	**19.7**	**60.2**
AN-1	CAAN-10-24806	AN-612849	0–13	0–0.43	0.957 (U)	—	—	—	—	—	—	—	—	—	—	0.000596 (J)	—	—	—
AN-1	CAAN-10-24807	AN-612849	13–49	0.43–1.61	1.01 (U)	—	—	—	—	—	—	—	—	—	—	0.000835 (J)	—	—	—
AN-1	CAAN-10-24808	AN-612851	0–26	0–0.85	1.01 (U)	—	0.503 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24809	AN-612852	0–27	0–0.89	0.988 (U)	—	0.494 (U)	—	4.79	—	—	—	—	—	—	—	—	20.8	—
AN-1	CAAN-10-24810	AN-612853	0–19	0–0.62	1.04 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24811	AN-612854	32–59	1.05–1.94	1.01 (U)	—	—	—	—	—	—	15,900	—	—	—	—	—	26.1	—
AN-1	CAAN-10-24812	AN-612855	8–31	0.26–1.02	1.03 (U)	—	—	—	—	—	—	—	—	—	—	—	—	20.2	—
AN-2	CAAN-10-24813	AN-612856	0–19	0–0.62	1.02 (U)	—	0.51 (U)	—	—	—	—	—	—	—	—	0.000653 (J)	—	—	—
AN-2	CAAN-10-24814	AN-612857	0–51	0–1.67	1.01 (U)	—	0.504 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24815	AN-612858	0–22	0–0.72	0.998 (U)	—	—	—	—	—	—	—	—	—	—	0.000995 (J)	—	—	—
AN-2	CAAN-10-24816	AN-612859	0–19	0–0.62	0.979 (U)	—	0.49 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24817	AN-612860	0–29	0–0.95	0.984 (U)	—	—	—	—	13.2 (J)	—	—	—	—	0.468	0.000537 (J)	—	—	—
AN-2	CAAN-10-24818	AN-612860	38–79	1.25–2.59	1.04 (U)	—	0.518 (U)	—	—	—	—	—	—	—	—	0.000683 (J)	—	—	—
AN-2	CAAN-10-24819	AN-612862	0–67	0–2.2	1 (U)	—	0.501 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24820	AN-612863	0–30	0–0.98	0.961 (U)	—	—	—	—	18.5 (J)	—	—	—	—	0.807	0.00169 (J)	—	—	—
AN-2	CAAN-10-24821	AN-612864	0–34	0–1.12	0.987 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24822	AN-612865	0–28	0–0.92	1 (U)	—	—	—	—	—	—	—	—	—	—	0.000582 (J)	—	—	—
AN-3	CAAN-10-24823	AN-612866	0–39	0–1.28	0.996 (U)	—	0.498 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24824	AN-612867	0–17	0–0.56	1.05 (U)	—	—	—	—	—	—	—	—	—	0.246	0.00207 (J)	—	—	—
AN-3	CAAN-10-24825	AN-612868	0–24	0–0.79	0.954 (U)	—	0.477 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24826	AN-612869	0–23	0–0.75	0.998 (U)	—	—	—	—	—	—	—	—	—	—	0.00114 (J)	—	—	—
AN-3	CAAN-10-24827	AN-612870	0–93	0–3.05	0.98 (U)	—	0.49 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24828	AN-612871	0–58	0–1.9	0.982 (U)	—	0.491 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24829	AN-612872	0–17	0–0.56	0.988 (U)	—	0.494 (U)	—	—	—	—	—	—	—	—	0.00182 (J)	—	—	—
AN-3	CAAN-10-24830	AN-612873	0–9	0–0.3	0.934 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24831	AN-612874	0–29	0–0.95	1.04 (U)	—	—	—	—	—	—	—	—	—	0.144	0.00118 (J)	—	—	—
AN-3	CAAN-10-24832	AN-612875	0–30	0–0.98	1 (U)	—	0.501 (U)	—	—	—	—	—	—	—	—	0.00131 (J)	—	—	—
AN-4	CAAN-08-16457	Ancho north fork below SR-4	0–2	0–0.07	0.983 (U)	—	0.492 (U)	—	—	—	NA[c]	—	—	—	—	NA	—	—	—
AN-4	CAAN-08-16460	AN-603933	0–4	0–0.13	0.995 (U)	4.84	0.497 (U)	—	—	—	NA	—	—	—	—	NA	—	—	—
AN-4	CAAN-08-16461	AN-603934	0–10	0–0.33	—	4.79	0.54 (U)	—	—	—	NA	—	—	—	—	NA	—	—	—
AN-4	CAAN-10-24833	AN-612876	0–32	0–1.05	0.984 (U)	—	0.492 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24834	AN-612877	0–20	0–0.66	1 (U)	—	0.501 (U)	—	—	—	—	—	—	—	0.194	—	—	—	—
AN-4	CAAN-10-24835	AN-612878	26–51	0.85–1.67	0.98 (U)	—	0.49 (U)	—	—	—	0.95	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24836	AN-612879	0–24	0–0.79	0.994 (U)	—	0.497 (U)	—	—	—	—	—	—	—	—	—	—	—	—

Table 6.2-2 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Cyanide (Total)	Iron	Lead	Manganese	Mercury	Perchlorate	Selenium	Vanadium	Zinc
Sediment BV					**0.83**	**3.98**	**0.4**	**10.5**	**4.73**	**11.2**	**0.82**	**13,800**	**19.7**	**543**	**0.1**	**n/a**[a]	**0.3**	**19.7**	**60.2**
AN-4	CAAN-10-24837	AN-612879	24–80	0.79–2.62	1.02 (U)	—	0.51 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24838	AN-612881	0–38	0–1.25	0.985 (U)	—	0.492 (U)	—	—	—	—	—	—	—	0.126	—	—	—	—
AN-4	CAAN-10-24839	AN-612882	9–48	0.3–1.57	1 (U)	—	0.501 (U)	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24840	AN-612883	0–15	0–0.49	0.981 (U)	—	0.491 (U)	—	—	—	—	—	—	—	—	0.00138 (J)	—	—	—
AN-4	CAAN-10-24841	AN-612884	0–34	0–1.12	4.73 (U)	—	0.473 (U)	—	—	—	—	—	—	—	0.141	0.00133 (J)	—	—	—
AN-4	CAAN-10-24842	AN-612885	0–26	0–0.85	0.954 (U)	—	0.477 (U)	—	—	—	—	—	—	—	0.169	—	—	—	—
AN-4	CAAN-10-4836	Ancho north fork below SR-4	0–2	0–0.07	0.988 (U)	—	0.494 (U)	—	—	—	NA	—	—	—	—	NA	—	—	—
CH-1	CACH-10-25593	CH-612916	0–23	0–0.75	1.09 (U)	—	—	—	—	—	—	—	—	—	—	0.00134 (J)	—	—	—
CH-1	CACH-10-25594	CH-612917	0–15	0–0.49	0.881 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25595	CH-612918	0–28	0–0.92	—	—	0.481 (J)	13.8 (J)	—	—	—	25,600	—	549	—	—	—	48.8	80.9
CH-1	CACH-10-25596	CH-612918	28–53	0.92–1.74	0.929 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25597	CH-612920	0–21	0–0.69	0.971 (U)	—	—	—	—	—	4.68	—	—	—	—	0.00117 (J)	—	—	—
CH-1	CACH-10-25598	CH-612921	0–20	0–0.66	0.93 (U)	—	—	—	—	—	3.81	—	—	—	—	—	—	—	—
CH-1	CACH-10-25599	CH-612922	0–31	0–1.02	0.944 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25600	CH-612923	0–20	0–0.66	1.04 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25601	CH-612924	0–42	0–1.38	0.977 (U)	—	—	—	—	—	—	—	—	—	—	0.00154 (J)	—	—	—
CH-1	CACH-10-25602	CH-612924	42–70	1.38–2.3	0.932 (U)	—	—	—	—	—	2.97	—	—	—	—	0.00103 (J)	—	—	—
CH-2	CACH-10-4838	CH-609842	0–16	0–0.52	1.08 (U)	—	0.538 (U)	—	—	—	NA	17,200 (J)	—	—	—	NA	—	27.9	—
CH-2	CACH-10-25603	CH-612926	18–38	0.59–1.25	1.07 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25604	CH-612927	21–44	0.69–1.44	1.07 (U)	—	—	—	—	—	—	—	—	—	—	0.000609 (J+)	—	—	—
CH-2	CACH-10-25605	CH-612928	44–71	1.44–2.33	0.958 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25606	CH-612929	54–86	1.77–2.82	1.03 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25607	CH-612930	0–37	0–1.21	1.01 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25608	CH-612931	0–73	0–2.4	0.952 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25609	CH-612932	22–56	0.72–1.84	1.01 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25610	CH-612933	56–96	1.84–3.15	1 (U)	—	0.502 (U)	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25611	CH-612934	8–46	0.26–1.51	1.02 (U)	—	0.51 (U)	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25612	CH-612935	0–28	0–0.92	1.06 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25613	CH-612936	0–20	0–0.66	1.03 (U)	—	—	—	—	—	—	—	—	—	—	0.000583 (J)	—	22.8	—
CHN-1	CACH-10-25614	CH-612937	0–15	0–0.49	1.05 (U)	—	—	—	—	—	—	—	—	—	—	0.0013 (J)	—	—	—
CHN-1	CACH-10-25615	CH-612937	15–46	0.49–1.51	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25616	CH-612939	0–30	0–0.98	1.06 (U)	—	—	—	—	—	—	—	—	—	—	0.000695 (J)	—	21.3	—
CHN-1	CACH-10-25617	CH-612940	0–19	0–0.62	—	—	—	—	—	—	—	—	—	—	—	0.00169 (J)	—	25.9	—
CHN-1	CACH-10-25618	CH-612941	0–19	0–0.62	1.01 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 6.2-2 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Cyanide (Total)	Iron	Lead	Manganese	Mercury	Perchlorate	Selenium	Vanadium	Zinc
Sediment BV					**0.83**	**3.98**	**0.4**	**10.5**	**4.73**	**11.2**	**0.82**	**13,800**	**19.7**	**543**	**0.1**	**n/a[a]**	**0.3**	**19.7**	**60.2**
CHN-1	CACH-10-25619	CH-612942	0–16	0–0.52	—	—	—	—	—	—	—	—	—	—	—	0.000592 (J)	—	27.5	—
CHN-1	CACH-10-25620	CH-612943	0–14	0–0.46	0.987 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25621	CH-612944	0–19	0–0.62	0.93 (U)	—	—	—	—	—	—	15,200	—	—	—	0.000706 (J)	—	31.8	—
CHN-1	CACH-10-25622	CH-612945	0–23	0–0.75	1.02 (U)	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-1	CAIN-10-25632	IN-612966	1–29	0.03–0.95	0.977 (U)	—	—	—	—	—	—	—	—	—	—	—	0.984 (U)	—	—
I-1	CAIN-10-25633	IN-612967	0–18	0–0.59	0.943 (U)	—	0.471 (U)	—	—	—	—	—	—	—	—	—	0.984 (U)	—	—
I-1	CAIN-10-25634	IN-612968	0–21	0–0.69	0.999 (U)	—	—	—	—	—	—	—	—	—	—	0.000693 (J)	0.98 (U)	—	—
I-1	CAIN-10-25635	IN-612969	7–58	0.23–1.9	0.998 (U)	—	0.499 (U)	—	—	—	—	—	—	—	—	—	1.02 (U)	—	—
I-1	CAIN-10-25636	IN-612970	0–22	0–0.72	0.911 (U)	—	—	—	—	—	—	—	—	—	—	0.00182 (J)	1.02 (U)	—	—
I-1	CAIN-10-25637	IN-612971	0–22	0–0.72	1.02 (U)	—	—	—	—	—	—	—	—	—	—	0.00146 (J)	1.04 (U)	—	—
I-1	CAIN-10-25638	IN-612972	0–26	0–0.85	0.975 (U)	—	—	—	—	—	—	—	—	—	—	0.000889 (J)	1.01 (U)	—	—
I-1	CAIN-10-25639	IN-612973	0–28	0–0.92	1.04 (U)	—	—	—	—	—	—	—	—	—	—	0.000611 (J)	1.03 (U)	—	—
I-1	CAIN-10-25640	IN-612974	0–32	0–1.05	1.03 (U)	—	—	—	—	—	—	—	—	—	—	0.000592 (J)	1.06 (U)	—	—
I-1	CAIN-10-25641	IN-612975	0–30	0–0.98	0.996 (U)	—	—	—	—	—	—	—	—	—	—	0.000575 (J)	0.965 (U)	—	—

Notes: Samples with no COPCs in suite are not included in table. All values are in mg/kg.

[a] n/a = Not applicable.

[b] — = Not above BV in sample, or not detected for analytes with no BV.

[c] NA = Not analyzed.

Table 6.2-3
Organic Chemicals Detected in Ancho, Chaquehui, and Indio Canyon Sediment Samples

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Acenaphthene	Acetone	Aldrin	Anthracene	Aroclor-1248	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	BHC[alpha-]	BHC[beta-]	BHC[delta-]
A-2	CAAN-10-24790	AN-612832	17–46	0.56–1.51	—*	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24794	AN-612837	0–17	0–0.56	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24795	AN-612838	0–11	0–0.36	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24797	AN-612840	0–16	0–0.52	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24799	AN-612842	0–10	0–0.33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24800	AN-612843	0–37	0–1.21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24803	AN-612846	0–26	0–0.85	—	0.00209 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24804	AN-612846	26–44	0.85–1.44	—	0.00201 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24805	AN-612848	0–17	0–0.56	—	0.00189 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24807	AN-612849	13–49	0.43–1.61	—	0.0018 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24810	AN-612853	0–19	0–0.62	—	0.00198 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24811	AN-612854	32–59	1.05–1.94	—	0.00203 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24813	AN-612856	0–19	0–0.62	—	—	—	—	0.0025 (J)	0.0031 (J)	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24815	AN-612858	0–22	0–0.72	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24817	AN-612860	0–29	0–0.95	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24822	AN-612865	0–28	0–0.92	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24823	AN-612866	0–39	0–1.28	—	—	0.000421 (J)	—	—	—	—	—	—	—	—	—	0.000436 (J)	0.000462 (J)	0.000366 (J)
AN-3	CAAN-10-24824	AN-612867	0–17	0–0.56	—	—	0.000287 (J)	—	—	—	—	—	—	—	—	—	0.000341 (J)	0.000344 (J)	0.000304 (J)
AN-3	CAAN-10-24825	AN-612868	0–24	0–0.79	—	—	—	—	—	0.0017 (J)	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24830	AN-612873	0–9	0–0.3	—	—	—	—	—	0.0021 (J)	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24831	AN-612874	0–29	0–0.95	—	—	—	—	—	—	0.0021 (J)	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24834	AN-612877	0–20	0–0.66	—	—	—	—	—	—	—	—	0.014 (J)	0.0109 (J)	0.0171 (J)	0.0133 (J)	—	—	—
AN-4	CAAN-10-24835	AN-612878	26–51	0.85–1.67	0.0532	—	—	—	—	0.0059	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24836	AN-612879	0–24	0–0.79	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24838	AN-612881	0–38	0–1.25	—	—	—	—	—	—	—	—	—	—	0.0192 (J)	—	—	—	—
AN-4	CAAN-10-24839	AN-612882	9–48	0.3–1.57	—	—	—	—	—	—	—	—	0.0209 (J)	0.0199 (J)	—	0.0236 (J)	—	—	—
AN-4	CAAN-10-24840	AN-612883	0–15	0–0.49	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24842	AN-612885	0–26	0–0.85	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25593	CH-612916	0–23	0–0.75	—	—	—	—	—	0.0034 (J)	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25597	CH-612920	0–21	0–0.69	—	—	—	—	—	0.0073	0.0022 (J)	—	—	—	—	—	—	—	—
CH-1	CACH-10-25598	CH-612921	0–20	0–0.66	—	—	—	—	—	0.004	0.0018 (J)	—	—	—	—	—	—	—	—
CH-1	CACH-10-25599	CH-612922	0–31	0–1.02	—	—	—	—	—	0.0026 (J)	—	—	—	—	—	—	—	—	—

Table 6.2-3 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Acenaphthene	Acetone	Aldrin	Anthracene	Aroclor-1248	Aroclor-1254	Aroclor-1260	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	BHC[alpha-]	BHC[beta-]	BHC[delta-]
CH-1	CACH-10-25600	CH-612923	0–20	0–0.66	—	—	—	—	—	0.0015 (J)	—	—	—	—	—	—	—	—	—
CH-2	CACH-10-25604	CH-612927	21–44	0.69–1.44	—	—	—	—	—	—	—	0.00666	—	—	—	—	—	—	—
CH-2	CACH-10-25607	CH-612930	0–37	0–1.21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25614	CH-612937	0–15	0–0.49	—	—	—	—	—	—	0.0019 (J)	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25615	CH-612937	15–46	0.49–1.51	—	—	—	—	—	—	0.0042	0.0258	0.0392	—	—	—	—	—	—
CHN-1	CACH-10-25616	CH-612939	0–30	0–0.98	—	—	—	0.00744 (J)	—	—	0.0079	0.0294 (J)	0.0287 (J)	0.0351 (J)	0.0159 (J)	0.0145 (J)	—	—	—
CHN-1	CACH-10-25617	CH-612940	0–19	0–0.62	—	—	—	0.0425 (J)	—	0.0057	0.0076	0.0797	0.0854	0.11	—	—	—	—	—
CHN-1	CACH-10-25618	CH-612941	0–19	0–0.62	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25619	CH-612942	0–16	0–0.52	—	—	—	—	—	—	—	0.00215 (J)	—	—	—	—	—	—	—
CHN-1	CACH-10-25622	CH-612945	0–23	0–0.75	—	—	—	—	—	—	0.0027 (J)	—	—	—	—	—	—	—	—
I-1	CAIN-10-25632	IN-612966	1–29	0.03–0.95	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-1	CAIN-10-25641	IN-612975	0–30	0–0.98	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 6.2-3 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	BHC[gamma-]	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-]	DDE[4,4'-]	DDT[4,4'-]	Dieldrin	Diethylphthalate	Di-n-butylphthalate	Endosulfan I	Endosulfan II	Endosulfan Sulfate	Endrin
A-2	CAAN-10-24790	AN-612832	17–46	0.56–1.51	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24794	AN-612837	0–17	0–0.56	—	—	—	0.0116	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24795	AN-612838	0–11	0–0.36	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24797	AN-612840	0–16	0–0.52	—	—	—	0.00337	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24799	AN-612842	0–10	0–0.33	—	—	—	0.00197	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24800	AN-612843	0–37	0–1.21	—	—	—	0.00301	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24803	AN-612846	0–26	0–0.85	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24804	AN-612846	26–44	0.85–1.44	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24805	AN-612848	0–17	0–0.56	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24807	AN-612849	13–49	0.43–1.61	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24810	AN-612853	0–19	0–0.62	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24811	AN-612854	32–59	1.05–1.94	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24813	AN-612856	0–19	0–0.62	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24815	AN-612858	0–22	0–0.72	—	—	—	—	—	—	—	—	3.45	—	—	—	—	—
AN-2	CAAN-10-24817	AN-612860	0–29	0–0.95	—	—	—	—	—	—	—	—	—	0.107 (J)	—	—	—	—
AN-2	CAAN-10-24822	AN-612865	0–28	0–0.92	—	—	—	—	—	0.000354 (J)	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24823	AN-612866	0–39	0–1.28	0.000446 (J)	0.000483 (J)	0.000458 (J)	—	0.00132 (J)	0.0014	0.00145 (J)	0.00127 (J)	—	—	0.000391 (J)	0.00127 (J)	0.00139	0.00148
AN-3	CAAN-10-24824	AN-612867	0–17	0–0.56	0.000353 (J)	0.000301 (J)	0.000355 (J)	—	0.000791 (J)	0.0011 (J)	0.000947 (J)	0.000858 (J)	—	—	0.00026 (J)	0.000839 (J)	0.000864 (J)	0.000967 (J)
AN-3	CAAN-10-24825	AN-612868	0–24	0–0.79	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24830	AN-612873	0–9	0–0.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24831	AN-612874	0–29	0–0.95	—	—	—	—	—	0.000742 (J)	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24834	AN-612877	0–20	0–0.66	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24835	AN-612878	26–51	0.85–1.67	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24836	AN-612879	0–24	0–0.79	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24838	AN-612881	0–38	0–1.25	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24839	AN-612882	9–48	0.3–1.57	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24840	AN-612883	0–15	0–0.49	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24842	AN-612885	0–26	0–0.85	—	—	—	0.00213	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25593	CH-612916	0–23	0–0.75	—	—	—	—	—	0.00109 (J)	—	—	1.4	—	—	—	—	—
CH-1	CACH-10-25597	CH-612920	0–21	0–0.69	—	—	—	—	—	0.000866 (J)	—	—	—	—	—	—	—	—
CH-1	CACH-10-25598	CH-612921	0–20	0–0.66	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25599	CH-612922	0–31	0–1.02	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25600	CH-612923	0–20	0–0.66	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 6.2-3 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	BHC[gamma-]	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-]	DDE[4,4'-]	DDT[4,4'-]	Dieldrin	Diethylphthalate	Di-n-butylphthalate	Endosulfan I	Endosulfan II	Endosulfan Sulfate	Endrin
CH-2	CACH-10-25604	CH-612927	21–44	0.69–1.44	—	—	—	0.00498	—	—	—	—	—	—	0.000196 (J)	—	—	—
CH-2	CACH-10-25607	CH-612930	0–37	0–1.21	—	—	—	—	—	0.000362 (J)	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25614	CH-612937	0–15	0–0.49	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25615	CH-612937	15–46	0.49–1.51	—	—	—	0.0191	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25616	CH-612939	0–30	0–0.98	—	—	—	0.0259 (J)	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25617	CH-612940	0–19	0–0.62	—	—	—	0.0587	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25618	CH-612941	0–19	0–0.62	—	—	—	0.00234 (J)	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25619	CH-612942	0–16	0–0.52	—	—	—	—	—	—	—	—	0.483	—	—	—	—	—
CHN-1	CACH-10-25622	CH-612945	0–23	0–0.75	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-1	CAIN-10-25632	IN-612966	1–29	0.03–0.95	—	—	—	—	—	—	—	—	—	0.0899 (J)	—	—	—	—
I-1	CAIN-10-25641	IN-612975	0–30	0–0.98	—	—	—	—	—	—	—	—	—	—	0.001	—	—	—

Table 6.2-3 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Endrin Aldehyde	Endrin Ketone	Fluoranthene	Heptachlor	Heptachlor Epoxide	Indeno(1,2,3-cd)pyrene	Methoxychlor[4,4'-]	Methylene Chloride	Phenanthrene	Pyrene	TATB
A-2	CAAN-10-24790	AN-612832	17–46	0.56–1.51	—	—	—	—	—	—	—	0.0027 (J)	—	—	—
A-3	CAAN-10-24794	AN-612837	0–17	0–0.56	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24795	AN-612838	0–11	0–0.36	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24797	AN-612840	0–16	0–0.52	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24799	AN-612842	0–10	0–0.33	—	—	—	—	—	—	—	—	—	—	—
A-3	CAAN-10-24800	AN-612843	0–37	0–1.21	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24803	AN-612846	0–26	0–0.85	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24804	AN-612846	26–44	0.85–1.44	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24805	AN-612848	0–17	0–0.56	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24807	AN-612849	13–49	0.43–1.61	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24810	AN-612853	0–19	0–0.62	—	—	—	—	—	—	—	—	—	—	—
AN-1	CAAN-10-24811	AN-612854	32–59	1.05–1.94	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24813	AN-612856	0–19	0–0.62	—	—	—	—	—	—	—	—	—	—	—
AN-2	CAAN-10-24815	AN-612858	0–22	0–0.72	—	—	—	—	—	—	—	—	—	—	0.373 (J)
AN-2	CAAN-10-24817	AN-612860	0–29	0–0.95	—	—	—	—	—	—	—	—	—	—	1.58
AN-2	CAAN-10-24822	AN-612865	0–28	0–0.92	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24823	AN-612866	0–39	0–1.28	0.00128 (J)	0.00151	—	0.000474 (J)	0.000359 (J)	—	0.00603 (J)	—	—	—	—
AN-3	CAAN-10-24824	AN-612867	0–17	0–0.56	0.000655 (J)	0.00109 (J)	—	0.000319 (J)	0.000331 (J)	—	0.00455 (J)	—	—	—	—
AN-3	CAAN-10-24825	AN-612868	0–24	0–0.79	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24830	AN-612873	0–9	0–0.3	—	—	—	—	—	—	—	—	—	—	—
AN-3	CAAN-10-24831	AN-612874	0–29	0–0.95	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24834	AN-612877	0–20	0–0.66	—	—	—	0.000423 (J)	—	0.0178 (J)	—	—	—	—	—
AN-4	CAAN-10-24835	AN-612878	26–51	0.85–1.67	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24836	AN-612879	0–24	0–0.79	—	—	0.00284	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24838	AN-612881	0–38	0–1.25	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24839	AN-612882	9–48	0.3–1.57	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24840	AN-612883	0–15	0–0.49	—	—	—	—	—	—	—	—	—	—	—
AN-4	CAAN-10-24842	AN-612885	0–26	0–0.85	—	—	—	—	—	0.0184 (J)	—	—	—	—	—
CH-1	CACH-10-25593	CH-612916	0–23	0–0.75	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25597	CH-612920	0–21	0–0.69	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25598	CH-612921	0–20	0–0.66	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25599	CH-612922	0–31	0–1.02	—	—	—	—	—	—	—	—	—	—	—
CH-1	CACH-10-25600	CH-612923	0–20	0–0.66	—	—	—	—	—	—	—	—	—	—	—

Table 6.2-3 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Endrin Aldehyde	Endrin Ketone	Fluoranthene	Heptachlor	Heptachlor Epoxide	Indeno(1,2,3-cd)pyrene	Methoxychlor[4,4'-]	Methylene Chloride	Phenanthrene	Pyrene	TATB
CH-2	CACH-10-25604	CH-612927	21–44	0.69–1.44	—	—	0.0119	—	—	—	—	—	0.0161 (J)	0.0132	—
CH-2	CACH-10-25607	CH-612930	0–37	0–1.21	—	—	—	—	—	—	—	—	—	—	—
CHN-1	CACH-10-25614	CH-612937	0–15	0–0.49	—	—	0.0295	—	—	—	—	—	—	0.0237	—
CHN-1	CACH-10-25615	CH-612937	15–46	0.49–1.51	—	—	0.0595	—	—	—	—	—	0.0571 (J)	0.058	—
CHN-1	CACH-10-25616	CH-612939	0–30	0–0.98	—	—	0.0576	—	—	0.0159 (J)	—	—	0.0528 (J)	0.0729	—
CHN-1	CACH-10-25617	CH-612940	0–19	0–0.62	—	—	0.195	—	—	—	—	—	0.18	0.166	—
CHN-1	CACH-10-25618	CH-612941	0–19	0–0.62	—	—	0.0058	—	—	—	—	—	0.00484 (J)	0.00579	—
CHN-1	CACH-10-25619	CH-612942	0–16	0–0.52	—	—	—	—	—	—	—	—	—	0.00471	—
CHN-1	CACH-10-25622	CH-612945	0–23	0–0.75	—	—	—	—	—	—	—	—	0.00301 (J)	—	—
I-1	CAIN-10-25632	IN-612966	1–29	0.03–0.95	—	—	—	—	—	—	—	—	—	—	—
I-1	CAIN-10-25641	IN-612975	0–30	0–0.98	—	—	—	—	—	—	—	—	—	—	—

Notes: Samples with no COPCs in suite are not included in table. All values are in mg/kg.

* — = Not detected in sample.

Table 6.2-4
Radionuclides Detected above BVs in Ancho, Chaquehui, and Indio Canyon Sediment Samples

Reach	Sample ID	Location ID	Depth (cm)	Depth (ft)	Cesium-137	Plutonium-239/240	Tritium	Uranium-234	Uranium-235/236	Uranium-238
Sediment BV					**0.9**	**0.068**	**0.093**	**2.59**	**0.2**	**2.29**
A-1	CAAN-10-24773	AN-612816	0–16	0–0.52	1.22	—[a]	—	—	—	2.44
A-1	CAAN-10-24774	AN-612817	0–26	0–0.85	3.52	0.128	—	2.82 (J+)	—	3.31 (J+)
A-1	CAAN-10-24776	AN-612819	0–19	0–0.62	1.32	—	—	—	—	2.55
A-1	CAAN-10-24778	AN-612821	0–16	0–0.52	1.16	—	—	—	—	—
A-2	CAAN-10-24786	AN-612829	0–16	0–0.52	1.18	—	—	—	—	—
A-2	CAAN-10-24789	AN-612832	0–17	0–0.56	1.1	—	—	—	—	—
AN-1	CAAN-10-24804	AN-612846	26–44	0.85–1.44	1.42	0.0693	—	—	—	—
AN-2	CAAN-10-24813	AN-612856	0–19	0–0.62	—	—	—	—	—	3
AN-2	CAAN-10-24814	AN-612857	0–51	0–1.67	—	—	—	7.66	0.624	21.6
AN-2	CAAN-10-24816	AN-612859	0–19	0–0.62	—	—	—	—	—	10.1
AN-2	CAAN-10-24817	AN-612860	0–29	0–0.95	—	—	—	—	—	7.51
AN-2	CAAN-10-24820	AN-612863	0–30	0–0.98	—	—	—	3.34	0.227	11.9
AN-2	CAAN-10-24822	AN-612865	0–28	0–0.92	—	—	—	—	—	2.39
AN-3	CAAN-10-24824	AN-612867	0–17	0–0.56	—	—	—	—	—	4.9
AN-3	CAAN-10-24831	AN-612874	0–29	0–0.95	—	—	—	—	—	3.21
AN-4	CAAN-08-16460	AN-603933	0–4	0–0.13	NA[b]	—	—	—	—	4.28
AN-4	CAAN-08-16461	AN-603934	0–10	0–0.33	NA	—	0.0982571	—	—	—
AN-4	CAAN-10-24834	AN-612877	0–20	0–0.66	—	—	—	—	—	3.09
AN-4	CAAN-10-24838	AN-612881	0–38	0–1.25	—	—	—	—	—	2.5
AN-4	CAAN-10-24840	AN-612883	0–15	0–0.49	—	—	—	—	—	2.61
AN-4	CAAN-10-24842	AN-612885	0–26	0–0.85	—	—	—	—	—	2.82
CH-2	CACH-10-25608	CH-612931	0–73	0–2.4	—	—	0.0948771	—	—	—
CH-2	CACH-10-25612	CH-612935	0–28	0–0.92	—	—	0.116448	—	—	—
CHN-1	CACH-10-25615	CH-612937	15–46	0.49–1.51	—	—	0.207654	—	—	—
CHN-1	CACH-10-25616	CH-612939	0–30	0–0.98	—	—	0.320581	—	—	—
CHN-1	CACH-10-25617	CH-612940	0–19	0–0.62	—	—	0.382755	—	—	—

Note: Samples with no COPCs in suite are not included in table. All values are in pCi/g.

[a] — = Not detected above BV in sample.

[b] NA = Not analyzed.

Table 6.2-5
Summary of Inorganic COPCs in Ancho, Chaquehui, and Indio Canyon Sediment Samples

Reach	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Cyanide (Total)	Iron	Lead	Manganese	Mercury	Perchlorate	Selenium	Vanadium	Zinc
BV (mg/kg)[a]	**0.83**	**3.98**	**0.4**	**10.5**	**4.73**	**11.2**	**0.82**	**13800**	**19.7**	**543**	**0.1**	**na[b]**	**0.3**	**19.7**	**60.2**
Minimum Soil ESL[c]	**0.05**	**6.8**	**0.27**	**2.3**	**13**	**15**	**0.1**	**na**	**14**	**220**	**0.013**	**na**	**0.52**	**0.025**	**48**
Residential SSL[d]	**31.3**	**3.9**	**77.9**	**219[e]**	**23[f]**	**3130**	**1560**	**54800**	**400**	**10700**	**23[f]**	**54.8**	**391**	**391**	**23500**
Source	**NMED**	**NMED**	**NMED**	**NMED**	**RSL[g]**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**RSL**	**NMED**	**NMED**	**NMED**	**NMED**
A-1	1.14 (U)	—[h]	0.549 (U)	—	—	—	1.13	—	23.2	—	—	0.001 (J)	1.14 (UJ)	24.1	—
A-2	1.04 (U)	—	0.489 (U)	—	—	—	—	—	—	—	—	0.000679 (J)	1.05 (U)	—	—
A-3	4.96 (U)	—	0.661 (U)	—	—	—	—	—	—	—	—	0.00129 (J)	1.35 (U)	—	—
AN-1	1.05 (U)	—	0.503 (U)	—	4.79	—	—	15900	—	—	—	0.00128 (J)	1.04 (UJ)	26.1	—
AN-2	1.04 (U)	—	0.518 (U)	—	—	18.5 (J)	—	—	—	—	0.807	0.00169 (J)	1.03 (U)	—	—
AN-3	1.05 (U)	—	0.501 (U)	—	—	—	—	—	—	—	0.246	0.00207 (J)	1.04 (U)	—	—
AN-4	4.73 (U)	4.84	0.54 (U)	—	—	—	0.95	—	—	—	0.194	0.00138 (J)	1.07 (U)	—	—
CH-1	1.09 (U)	—	0.481 (J)	13.8 (J)	—	—	4.68	25600	—	549	—	0.00154 (J)	1.05 (U)	48.8	80.9
CH-2	1.08 (U)	—	0.538 (U)	—	—	—	—	17200 (J)	—	—	—	0.000609 (J+)	1.1 (U)	27.9	—
CHN-1	1.06 (U)	—	—	—	—	—	—	15200	—	—	—	0.00169 (J)	1.07 (UJ)	31.8	—
I-1	1.04 (U)	—	0.499 (U)	—	—	—	—	—	—	—	—	0.00182 (J)	1.06 (U)	—	—

Notes: Values are in mg/kg. Values are maximum values greater than the sediment BV for analytes with a BV, and the maximum detected value for analytes without a BV. Gray shading indicates the residential SSL was exceeded. All SSLs adjusted to a target risk of 10^{-5}.

[a] BVs are from LANL (1998, 059730).

[b] na = Not available.

[c] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).

[d] SSLs are from NMED (2009, 108070) unless otherwise noted.

[e] SSL for hexavalent chromium used as surrogate for chromium.

[f] SSL regional screening level (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[g] RSL = EPA regional screening level.

[h] — = Not a COPC in that reach (not detected if no BV, not > BV, or not analyzed).

Table 6.2-6
Summary of Organic COPCs in Ancho, Chaquehui, and Indio Canyon Sediment Samples

Reach	Acetone	Aldrin	Anthracene	Aroclor-1248	Aroclor-1254	Aroclor-1260	BHC[a][alpha-]	BHC[beta-]	BHC[delta-]	BHC[gamma-]	Benzo[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-][b]	DDE[4,4'-][c]
Minimum Soil ESL[d]	**1.2**	**0.037**	**6.8**	**0.0072**	**0.041**	**0.14**	**58**	**0.27**	**na[e]**	**0.0094**	**3**	**53**	**18**	**0.27**	**2.2**	**2.4**	**0.0063**	**0.11**
Residential SSL[f]	**67500**	**0.284**	**17200**	**2.22**	**1.12**	**2.22**	**0.772**	**2.7**	**5.17[g]**	**5.17**	**6.21**	**0.62**	**6.21**	**16.2[h,i]**	**16.2[h,i]**	**621**	**20.3**	**14.3**
Source	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**RSL**	**RSL**	**NMED**	**NMED**	**NMED**
A-1	—[j]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0116	—	—
AN-1	0.00209 (J)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	—	—	—	0.0025 (J)	0.0031 (J)	—	—	—	—	—	—	—	—	—	—	—	—	0.000354 (J)
AN-3	—	0.000421 (J)	—	—	0.0021 (J)	0.0021 (J)	0.000436 (J)	0.000462 (J)	0.000366 (J)	0.000446 (J)	—	—	—	0.000483 (J)	0.000458 (J)	—	0.00132 (J)	0.0014
AN-4	—	—	—	—	0.0059	—	—	—	—	—	—	—	—	—	—	0.00213	—	—
CH-1	—	—	—	—	0.0073	0.0022 (J)	—	—	—	—	—	—	—	—	—	—	—	0.00109 (J)
CH-2	—	—	—	—	—	—	—	—	—	—	0.00666	—	—	—	—	0.00498	—	0.000362 (J)
CHN-1	—	—	0.0425 (J)	—	0.0057	0.0079	—	—	—	—	0.0797	0.0854	0.11	—	—	0.0587	—	—
I-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 6.2-6 (continued)

Reach	DDT[4,4'-]	Di-n-butylphthalate	Dieldrin	Diethylphthalate	Endosulfan I	Endosulfan II	Endosulfan Sulfate	Endrin	Endrin Aldehyde	Endrin Ketone	Fluoranthene	Heptachlor	Heptachlor Epoxide	Methoxychlor[4,4'-]	Methylene Chloride	Phenanthrene	Pyrene	TATB
Minimum Soil ESL[d]	**0.044**	**0.011**	**0.0045**	**100**	**0.64[k]**	**0.64[k]**	**0.0014[l]**	**0.0014**	**0.0014[l]**	**0.0014[l]**	**10**	**0.059**	**0.059[m]**	**5**	**2.6**	**5.5**	**10**	**na**
Residential SSL[f]	**17.2**	**6110**	**0.304**	**48900**	**367[k]**	**367[k]**	**18.3[l]**	**18.3**	**18.3[l]**	**18.3[l]**	**2290**	**1.08**	**0.53[h]**	**310[h]**	**199**	**1830**	**1720**	**2200[h,n]**
Source	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**NMED**	**RSL**	**RSL**	**NMED**	**NMED**	**NMED**	**RSL**
A-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0027 (J)	—	—	—
A-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00716	—
AN-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	—	0.107 (J)	—	3.45	—	—	—	—	—	—	—	—	—	—	—	—	0.00262	1.58
AN-3	0.00145 (J)	—	0.00127 (J)	—	0.000391 (J)	0.00127 (J)	0.00139	0.00148	0.00128 (J)	0.00151	—	0.000474 (J)	0.000359 (J)	0.00603 (J)	—	—	—	—
AN-4	—	—	—	—	—	—	—	—	—	—	0.00284	0.000423 (J)	—	—	—	—	0.00291	—
CH-1	—	—	—	1.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	—	—	—	—	0.000196 (J)	—	—	—	—	—	0.0119	—	—	—	—	0.0161 (J)	0.0132	—
CHN-1	—	—	—	0.483	—	—	—	—	—	—	0.195	—	—	—	—	0.18	0.166	—
I-1	—	0.0899 (J)	—	—	—	—	—	—	—	—	—	0.001	—	—	—	—	—	—

Notes: Values are in mg/kg. Values are maximum detected values. No residential SSL was exceeded. All SSLs adjusted to a target risk of 10^{-5}.

[a] BHC = Benzene hexachloride.

[b] DDD[4,4'-] = Dichlorodiphenyldichloroethane.

[c] DDE[4,4'-] = Dichlorodiphenyltrichloroethylene.

[d] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).

[e] na = Not available.

[f] SSLs are from NMED (2009, 108070) unless otherwise noted.

[g] BHC[gamma-] used as a surrogate for BHC[delta-].

[h] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[i] Chlordane used as a surrogate for alpha-chlordane and gamma-chlordane.

[j] — = Not a COPC in that reach (not detected or not analyzed).

[k] Endosulfan used as a surrogate for endosulfan I and endosulfan II.

[l] Endrin used as a surrogate for endrin aldehyde, endrin ketone, and endosulfan sulfate.

[m] Heptachlor is used as surrogate for heptachlor epoxide.

[n] 1,3,5-Trinitrobenzene used as a surrogate for TATB.

Table 6.2-7
Summary of Radionuclide COPCs in Ancho, Chaquehui, and Indio Canyon Sediment Samples

Reach	Cesium-137	Plutonium-238	Plutonium-239/240	Tritium	Uranium-234	Uranium-235/236	Uranium-238
BV (pCi/g)[a]	**0.9**	**0.006**	**0.068**	**0.093**	**2.59**	**0.2**	**2.29**
Minimum Soil ESL[b]	**680**	**44**	**47**	**36000**	**51**	**55**	**55**
Residential SAL[c]	**5.6**	**37**	**33**	**750**	**170**	**17**	**87**
A-1	3.52	—[d]	0.128	—	2.82 (J+)	—	3.31 (J+)
A-2	1.18	—	—	—	—	—	—
A-3	—	—	—	—	—	—	—
AN-1	1.42	—	0.0693	—	—	—	—
AN-2	—	—	—	—	7.66	0.624	21.6
AN-3	—	—	—	—	—	—	4.9
AN-4	—	—	—	0.0983	—	—	4.28
CH-1	—	—	—	—	—	—	—
CH-2	—	—	—	0.116	—	—	—
CHN-1	—	—	—	0.383	—	—	—
I-1	—	0.0191	—	—	—	—	—

Notes: Values are in pCi/g. Values are maximum detected values greater than the sediment BV. No residential SAL was exceeded.

[a] BVs are from LANL (1998, 059730).

[b] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).

[c] SALs are from LANL (2009, 107655) unless otherwise noted.

[d] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.3-1
Samples Collected and Analyses Performed for Nonstorm-Related Surface Water and Springs from Ancho and Chaquehui Canyons

Location ID	Reach	Media Code	Sample ID	Field Preparation	Field QC Type	Collection Date	General Inorganics	Herbicides	Explosive Compounds	Isotopes	Metals	Pesticides and Polychlorinated Biphenyls	Radionuclides	Semivolatile Organic Analytes	Volatile Organic Analytes
Ancho at Rio Grande	A-3	WS[a]	GF03080WGRA01	Filtered	n/a[b]	10/07/03	X[c]	—[d]	—	—	X	—	—	—	—
Ancho at Rio Grande	A-3	WS	FU03080WGRA01	Unfiltered	n/a	10/07/03	X	—	—	—	—	—	—	—	—
Ancho at Rio Grande	A-3	WS	GU03080WGRA01	Unfiltered	n/a	10/07/03	X	—	X	—	X	X	X	X	X
Ancho at Rio Grande	A-3	WS	GF04090WGRA01	Filtered	n/a	09/14/04	X	—	—	—	X	—	—	—	—
Ancho at Rio Grande	A-3	WS	FU04090WGRA01	Unfiltered	n/a	09/14/04	X	—	—	—	—	—	—	—	—
Ancho at Rio Grande	A-3	WS	GU04090WGRA01	Unfiltered	n/a	09/14/04	X	—	X	—	X	X	X	X	X
Ancho at Rio Grande	A-3	WS	UU04090WGRA01	Unfiltered	n/a	09/14/04	—	—	—	—	—	—	X	—	—
Ancho at Rio Grande	A-3	WS	GF05090PGRA01	Filtered	n/a	09/27/05	X	—	—	—	X	—	X	—	—
Ancho at Rio Grande	A-3	WS	GF05090PGRA90	Filtered	Field Duplicate	09/27/05	X	—	—	—	X	—	X	—	—
Ancho at Rio Grande	A-3	WS	FU05090PGRA01	Unfiltered	n/a	09/27/05	X	—	—	—	—	—	—	—	—
Ancho at Rio Grande	A-3	WS	GU05090PGRA01	Unfiltered	n/a	09/27/05	X	—	X	—	X	X	X	X	X
Ancho at Rio Grande	A-3	WS	GU05090PGRA90	Unfiltered	Field Duplicate	09/27/05	X	—	X	—	X	X	X	X	X
Ancho at Rio Grande	A-3	WP[e]	GF060900PGRA01	Filtered	n/a	09/19/06	X	—	—	—	X	—	X	—	—
Ancho at Rio Grande	A-3	WP	FU060900PGRA01	Unfiltered	n/a	09/19/06	X	—	—	—	—	—	—	—	—
Ancho at Rio Grande	A-3	WP	GU060900PGRA01	Unfiltered	n/a	09/19/06	X	—	—	—	X	X	X	X	X
Ancho at Rio Grande	A-3	WP	SU060900PGRA01	Unfiltered	n/a	09/19/06	—	—	X	—	—	—	—	—	—
Ancho at Rio Grande	A-3	WP	UU060900PGRA01	Unfiltered	n/a	09/19/06	—	—	—	—	—	—	X	—	—

Table 6.3-1 (continued)

Location ID	Reach	Media Code	Sample ID	Field Preparation	Field QC Type	Collection Date	General Inorganics	Herbicides	Explosive Compounds	Isotopes	Metals	Pesticides and Polychlorinated Biphenyls	Radionuclides	Semivolatile Organic Analytes	Volatile Organic Analytes
Ancho at Rio Grande	A-3	WP	UU070900PGRA01	Unfiltered	n/a	09/25/07	—	—	—	—	—	—	X	—	—
Ancho at Rio Grande	A-3	WS	GF070900PGRA01	Filtered	n/a	09/25/07	X	—	—	—	X	—	X	—	—
Ancho at Rio Grande	A-3	WS	FU070900PGRA01	Unfiltered	n/a	09/25/07	X	—	—	—	—	—	—	—	—
Ancho at Rio Grande	A-3	WS	GU070900PGRA01	Unfiltered	n/a	09/25/07	X	X	X	—	X	X	X	X	X
Ancho at Rio Grande	A-3	WS	SU070900PGRA01	Unfiltered	n/a	09/25/07	—	—	X	—	—	—	—	—	—
Ancho at Rio Grande	A-3	WS	CAWR-08-15455	Filtered	n/a	09/30/08	X	—	—	—	X	—	X	—	—
Ancho at Rio Grande	A-3	WS	CAWR-08-15454	Unfiltered	n/a	09/30/08	X	—	X	—	X	—	X	X	X
Ancho at Rio Grande	A-3	WS	CAWR-09-12578	Filtered	n/a	09/30/09	X	—	—	—	X	—	—	—	—
Ancho at Rio Grande	A-3	WS	CAWR-09-12577	Unfiltered	n/a	09/30/09	X	—	—	—	X	—	X	—	X
Ancho at Rio Grande	A-3	WS	CAWR-10-25407	Filtered	n/a	09/28/10	X	—	—	—	X	—	—	—	—
Ancho at Rio Grande	A-3	WS	CAWR-10-25406	Unfiltered	n/a	09/28/10	X	—	—	—	X	—	X	—	X
Doe Spring	CH-2	WG[f]	GF03080GSDW01	Filtered	n/a	10/08/03	X	—	—	—	X	—	X	—	—
Doe Spring	CH-2	WG	GU03080GSDW01	Unfiltered	n/a	10/08/03	X	—	X	—	X	X	X	X	X
Doe Spring	CH-2	WG	GU04030GSDW01	Unfiltered	n/a	03/18/04	X	—	—	—	—	—	—	—	—
Doe Spring	CH-2	WG	GF04090GSDW01	Filtered	n/a	09/15/04	X	—	—	—	X	—	X	—	—
Doe Spring	CH-2	WG	GU04090GSDW01	Unfiltered	n/a	09/15/04	X	—	X	—	X	—	—	—	—
Doe Spring	CH-2	WG	UU04090GSDW01	Unfiltered	n/a	09/15/04	—	—	—	—	—	—	X	—	—
Doe Spring	CH-2	WG	DOE-9-28-05	Filtered	n/a	09/28/05	—	—	—	X	—	—	—	—	—
Doe Spring	CH-2	WG	GF05080GSDW01	Filtered	n/a	09/28/05	X	—	—	—	X	—	X	—	—
Doe Spring	CH-2	WG	GU05080GSDW01	Unfiltered	n/a	09/28/05	X	—	X	—	X	—	X	—	—

Table 6.3-1 (continued)

Location ID	Reach	Media Code	Sample ID	Field Preparation	Field QC Type	Collection Date	General Inorganics	Herbicides	Explosive Compounds	Isotopes	Metals	Pesticides and Polychlorinated Biphenyls	Radionuclides	Semivolatile Organic Analytes	Volatile Organic Analytes
Doe Spring	CH-2	WG	GF060900GSDW01	Filtered	n/a	09/20/06	X	—	—	—	X	—	X	—	—
Doe Spring	CH-2	WG	GU060900GSDW01	Unfiltered	n/a	09/20/06	X	—	—	—	X	X	X	X	X
Doe Spring	CH-2	WG	SU060900GSDW01	Unfiltered	n/a	09/20/06	—	—	X	—	—	—	—	—	—
Doe Spring	CH-2	WG	UU060900GSDW01	Unfiltered	n/a	09/20/06	—	—	—	—	—	—	X	—	—
Doe Spring	CH-2	WG	GF070900GSDW01	Filtered	n/a	09/26/07	X	—	—	—	X	—	X	—	—
Doe Spring	CH-2	WG	GU070900GSDW01	Unfiltered	n/a	09/26/07	X	—	X	—	X	X	X	X	X
Doe Spring	CH-2	WG	SU070900GSDW01	Unfiltered	n/a	09/26/07	—	—	X	—	—	—	—	—	—
Doe Spring	CH-2	WG	UU070900GSDW01	Unfiltered	n/a	09/26/07	—	—	—	—	—	—	X	—	—
Spring 9A	CH-2 [?]	WG	GF03080GA9S01	Filtered	n/a	10/08/03	X	—	—	—	X	—	X	—	—
Spring 9A	CH-2 [?]	WG	GU03080GA9S01	Unfiltered	n/a	10/08/03	X	—	X	—	X	X	—	X	X
Spring 9A	CH-2 [?]	WG	UU03080GA9S01	Unfiltered	n/a	10/08/03	—	—	—	—	—	—	X	—	—
Spring 9A	CH-2 [?]	WG	GU04030GA9S01	Unfiltered	n/a	03/18/04	X	—	—	—	—	—	—	—	—
Spring 9A	CH-2 [?]	WG	GF04090GA9S01	Filtered	n/a	09/14/04	X	—	—	—	X	—	X	—	—
Spring 9A	CH-2 [?]	WG	GU04090GA9S01	Unfiltered	n/a	09/14/04	X	—	X	—	X	—	—	—	—
Spring 9A	CH-2 [?]	WG	UU04090GA9S01	Unfiltered	n/a	09/14/04	—	—	—	—	—	—	X	—	—
Spring 9A	CH-2 [?]	WG	Spr 9A-7-20-05	Filtered	n/a	07/20/05	—	—	—	X	—	—	—	—	—
Spring 9A	CH-2 [?]	WG	GF05090GA9S01	Filtered	n/a	09/28/05	X	—	—	—	X	—	X	—	—
Spring 9A	CH-2 [?]	WG	Spr 9A-9-28-05	Filtered	n/a	09/28/05	—	—	—	X	—	—	—	—	—
Spring 9A	CH-2 [?]	WG	GU05090GA9S01	Unfiltered	n/a	09/28/05	X	—	X	—	X	—	X	—	—
Spring 9A	CH-2 [?]	WG	9A-2-3-06	Filtered	n/a	02/03/06	—	—	—	X	—	—	—	—	—

Table 6.3-1 (continued)

Location ID	Reach	Media Code	Sample ID	Field Preparation	Field QC Type	Collection Date	General Inorganics	Herbicides	Explosive Compounds	Isotopes	Metals	Pesticides and Polychlorinated Biphenyls	Radionuclides	Semivolatile Organic Analytes	Volatile Organic Analytes
Spring 9A	CH-2 [?]	WG	GF060900GA9S01	Filtered	n/a	09/20/06	X	—	—	—	X	—	X	—	—
Spring 9A	CH-2 [?]	WG	GU060900GA9S01	Filtered	n/a	09/20/06	X	—	—	—	—	—	—	—	—
Spring 9A	CH-2 [?]	WG	GU060900GA9S01	Unfiltered	n/a	09/20/06	X	—	X	—	X	X	X	X	X
Spring 9A	CH-2 [?]	WG	SU060900GA9S01	Unfiltered	n/a	09/20/06	—	—	X	—	—	—	—	—	—
Spring 9A	CH-2 [?]	WG	UU060900GA9S01	Unfiltered	n/a	09/20/06	—	—	—	—	—	—	X	—	—
Spring 9A	CH-2 [?]	WG	GF070900GA9S01	Filtered	n/a	09/26/07	X	—	—	—	X	—	X	—	—
Spring 9A	CH-2 [?]	WG	GU070900GA9S01	Unfiltered	n/a	09/26/07	X	—	X	—	X	X	X	X	X
Spring 9A	CH-2 [?]	WG	SU070900GA9S01	Unfiltered	n/a	09/26/07	—	—	X	—	—	—	—	—	—
Spring 9A	CH-2 [?]	WG	UU070900GA9S01	Unfiltered	n/a	09/26/07	—	—	—	—	—	—	X	—	—
Spring 9A	CH-2 [?]	WG	CAWR-08-15540	Filtered	n/a	10/01/08	X	—	—	—	X	—	X	—	—
Spring 9A	CH-2 [?]	WG	CAWR-08-15539	Unfiltered	n/a	10/01/08	X	—	X	—	X	—	X	—	—
Spring 9A	CH-2 [?]	WG	CAWR-09-12569	Filtered	n/a	09/30/09	X	—	—	—	X	—	—	—	—
Spring 9A	CH-2 [?]	WG	CAWR-09-12567	Unfiltered	n/a	09/30/09	X	—	X	—	X	—	X	—	X
Spring 9A	CH-2 [?]	WG	CAWR-10-25397	Filtered	n/a	09/28/10	X	—	—	—	X	—	—	—	—
Spring 9A	CH-2 [?]	WG	CAWR-10-25398	Unfiltered	n/a	09/28/10	X	—	X	—	X	—	X	X	X

[a] WS = Base flow.

[b] n/a = Not applicable (not a field QC sample).

[c] X = Analysis was performed.

[d] — = Analysis was not performed.

[e] WP = Persistent flow.

[f] WG = Groundwater.

Table 6.3-2
Inorganic COPCs in Filtered Nonstorm-Related Surface-Water Samples

Location	Aluminum	Ammonia as Nitrogen	Arsenic	Barium	Boron	Bromide	Calcium	Chloride	Chromium	Fluoride	Hardness	Iron	Lead	Magnesium	Manganese	Molybdenum	Nickel	Nitrate—Nitrite as Nitrogen	Perchlorate	Potassium	Selenium	Silicon Dioxide	Sodium	Strontium	Sulfate	Thallium	Total Kjeldahl Nitrogen	Total Phosphate as Phosphorus	Uranium	Vanadium	Zinc
ESL[a]	**87**	**na[b]**	**150**	**3.8**	**540**	**na**	**na**	**230000**	**77**	**1600**	**na**	**1000**	**1.2**	**na**	**80**	**230**	**28**	**na**	**35000**	**na**	**5**	**na**	**na**	**620**	**na**	**18**	**na**	**na**	**1.8**	**19**	**66**
Standard Level (ephemeral stream classification)	**750**	**1320**	**9**	**na**	**5000**	**na**	**na**	**na**	**213**	**na**	**na**	**na**	**17**	**na**	**na**	**1000**	**169**	**na**	**na**	**na**	**50**	**na**	**na**	**na**	**na**	**0.47**	**na**	**na**	**30**	**100**	**42**
Standard Type	**AqAcF[c]**	**AcNH3[d]**	**HHEF[e]**	**na**	**LWF[f]**	**na**	**na**	**na**	**AqAcF**	**na**	**na**	**na**	**AqAcF**	**na**	**na**	**IrF[g]**	**AqAcF**	**na**	**na**	**na**	**LWF**	**na**	**na**	**na**	**na**	**HHEF**	**na**	**na**	**DCG**	**LWF**	**AqAcF**
NMED Tap Water[h]	**36500**	**na**	**0.448**	**7300**	**7300**	**na**	**na**	**na**	**110[i]**	**2190**	**na**	**25600**	**na**	**na**	**876**	**183**	**730**	**na**	**na**	**na**	**183**	**na**	**na**	**21900**	**na**	**2.41**	**na**	**na**	**110**	**183**	**11000**
Ancho at Rio Grande	15 (J-)	147 (J)	—[j]	35.8 (J)	15.8	—	14100	2770	2.69 (J)	511	51000	66.5 (J)	0.16	3830	3.44 (J)	1.46	0.8	42.1 (J)	0.175 (J)	2460	7.04	78900	12000	69.4	2460	0.91	556	65.7	0.31	10.4	—
Doe Spring	—	9	2.9	15.6	13.7	—	12200	2230	2.1	513	48200	25.4	—	3430	6.39	2.3	—	127	0.232	1710	—	74400	12500	57.6	2520	0.48	612	21	0.23	8.4	5.4
Spring 9A	—	88 (J-)	1.88 (J)	10.4	13.3	53	10800	2240	3.29 (J)	575	40200	16	0.82	3210	0.86	2.3	—	317	0.296	1650	—	74600	11700	50.8	2090	—	—	24	0.73	9.2	5.7

Notes: Values are in µg/L. Values are maximum values. Gray shading indicates concentrations were greater than a standard.

[a] Water ESL. LANL ECORISK Database Version 2.5 (LANL 2010, 110846).

[b] na = Not available.

[c] AqAcF = NMAC 20.6.4, Aquatic Life Acute (filtered) Hardness = 30 mg/L.

[d] AcNH3 = NMAC 20.6.4, Acute Criteria Total Ammonia (as N), Salmonids Absent. The minimum tabled value was selected (for pH = 9, higher than recorded in sampled data).

[e] HHEF = NMAC 20.6.4, Human Health (filtered) for persistent toxic chemicals (applies to all segments, including Ephemeral).

[f] LWF = NMAC 20.6.4, Livestock Watering (filtered).

[g] IrF = NMAC 20.6.4, Irrigation Standard (filtered).

[h] NMED tap water SLs from NMED Technical Background Document for Development of Soil Screening Levels, Rev 5.0, December 2009 (NMED 2009, 108070).

[i] The NMED tap water value for hexavalent chromium is used for filtered chromium.

[j] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.3-3
Inorganic COPCs in Nonfiltered Nonstorm-Related Surface-Water Samples

Location	Aluminum	Arsenic	Barium	Boron	Calcium	Chloride	Chromium	Cobalt	Copper	Fluoride	Hardness	Iron	Magnesium	Manganese	Molybdenum	Nickel	Nitrate—Nitrite as Nitrogen	Perchlorate	Potassium	Silicon Dioxide	Sodium	Strontium	Sulfate	Total Kjeldahl Nitrogen	Uranium	Vanadium	Zinc
ESL[a]	**87**	**150**	**3.8**	**540**	**na[b]**	**230000**	**77**	**3**	**5**	**1600**	**na**	**1000**	**na**	**80**	**230**	**28**	**na**	**35000**	**na**	**na**	**na**	**620**	**na**	**na**	**1.8**	**19**	**66**
Standard Level (ephemeral stream classification)	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**132000**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**30**	**na**	**na**
Standard Type	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**LWU[c]**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**DCG[d]**	**na**	**na**
NMED Tap Water[e]	**36500**	**0.448**	**7300**	**7300**	**na**	**na**	**110[f]**	**na**	**1460**	**2190**	**na**	**25600**	**na**	**876**	**183**	**730**	**na**	**na**	**na**	**na**	**na**	**21900**	**na**	**na**	**110**	**183**	**11000**
Ancho at Rio Grande	112	—[g]	37.2 (J)	16.3 (J)	14400	2430	3 (J)	—	—	—	50200	92.5 (J)	3450	6.38 (J)	1.29	0.97	—	0.18	2340	70800	11300	69.4	2270	88 (JN-, J)	0.34	8.4	2.3 (J)
Doe Spring	245	—	13.3	11.7	11500	1990	2.7	—	3.1 (J-)	497 (J+)	41600	237	3150	13.4	—	0.67	—	0.232	1490	74600	11700	53.1	1820	147 (J+)	0.38	8.3	—
Spring 9A	107	—	11	12.6	11200	1900	4.14 (J)	1.3	—	—	41600	59.4	3350	—	1.34	0.525 (J)	102	0.293	1600	72800	11800	53.6	1980	—	0.554	8.6	—

Notes: Values are in µg/L. Values are maximum values. No constituent exceeded a standard level.

[a] Water ESL. LANL ECORISK Database Version 2.5 (LANL 2010, 110846).

[b] na = Not available.

[c] LWU = NMAC 20.6.4, Livestock Watering (nonfiltered).

[d] DCG = DOE Derived Concentration Guide based on 4 mrem/yr.

[e] NMED tap water SLs from NMED Technical Background Document for Development of Soil Screening Levels, Rev 5.0, December 2009 (NMED 2009, 108070).

[f] The NMED tap water value for hexavalent chromium is used for nonfiltered chromium.

[g] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.3-4
Radionuclide COPCs in Filtered Nonstorm-Related Surface-Water Samples

Location	Gross Beta	Uranium-234	Uranium-238
ESL[a]	**na[b]**	**22**	**24**
Standard Level (ephemeral stream classification)	**na**	**200**	**200**
Standard Type	**na**	**BCG[c]**	**BCG**
Ancho at Rio Grande	—[d]	0.195	0.153
Doe Spring	7.97	0.161	0.101 (J)
Spring 9A	7.29 (J)	0.245	0.0933 (J)

Notes: Values are in pCi/L. Values are the maximum detected value. No constituent exceeded a standard level.

[a] Water ESL. LANL ECORISK Database Version 2.5 (LANL 2010, 110846).

[b] na = Not available.

[c] BCG = DOE Biota Concentration Guides (DOE-STD-1153-2002) (DOE 2008, 085637).

[d] — = Not a COPC in that reach (not detected or not analyzed).

Table 6.3-5
Radionuclide COPCs in Nonfiltered Nonstorm-Related Surface-Water Samples

Location	Gross Beta	Radium-226	Thorium-232	Tritium	Uranium-234	Uranium-235/236	Uranium-238
ESL[a]	**na**[b]	**0.1**	**0.81**	**160000000**	**22**	**24**	**24**
Standard Level (ephemeral stream classification)	**na**	**60**	**300**	**20000**	**200**	**300**	**200**
Standard Type	**na**	**NMRPS**[c]	**BCG**[d]	**LWU**[e]	**BCG**	**NMRPS**	**BCG**
Ancho at Rio Grande	1.8 (J)	0.741 (J)	1.6 (J+)	2.59	0.208	—	0.115
Doe Spring	3.24 (J)	—[f]	—	229 (J)	0.209 (J)	—	0.11 (J)
Spring 9A	4.66 (J)	—	—	0.89404	1.91	0.0394	0.893

Notes: Values are in pCi/L. Values are maximum values greater than the regional groundwater BV for analytes with a BV, and the maximum detected value for analytes without a BV. No constituent exceeded a standard level. All standards adjusted to a target risk of 10^{-5}.

[a] Water ESL. LANL ECORISK Database Version 2.5 (LANL 2010, 110846).

[b] na = Not available.

[c] NMRPS = NMEIB Radiation Protection Standards (http://www.nmcpr.state.nm.us/nmac/parts/title20/20.003.0004.htm).

[d] BCG = DOE Biota Concentration Guides (DOE-STD-1153-2002) (LANL 2008, 085637).

[e] LWU = NMAC 20.6.4, Livestock Watering (unfiltered).

[f] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.3-6
Organic COPCs in Nonfiltered Nonstorm-Related Surface-Water Samples

Location	Acetone	Chloromethane	Di-n-octylphthalate	Dichlorobenzene[1,3-]	Toluene
ESL[a]	**11000**	**na[b]**	**320**	**na**	**130**
Standard Level (ephemeral stream classification)	**na**	**na**	**na**	**na**	**na**
Standard Type	**na**	**na**	**na**	**na**	**na**
NMED Tap Water[c]	**21800**	**17.8**	**na**	**18.3[d]**	**2280**
Ancho at Rio Grande	10.3	—[e]	—	—	—
Doe Spring	—	—	—	—	—
Spring 9A	2.3	0.375 (J)	3.61 (J+)	0.513 (J)	0.42

Notes: Values are in µg/L. Values are maximum values. No constituent exceeded a standard level.

[a] Water ESL. LANL ECORISK Database Version 2.5 (LANL 2010, 110846).

[b] na = Not available.

[c] NMED tap water from the NMED Technical Background Document for Development of Soil Screening Levels, Rev 5.0, December 2009. (NMED 2009, 108070).

[d] NMED 2006, 092513.

[e] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.3-7
Inorganic COPCs in Filtered Spring Water Samples

Location	Fluoride	Thallium	Total Kjeldahl Nitrogen
LANL Regional GW BV[a]	**540**	**0.4**	**290**
Standard Level	**1600**	**2**	**na[b]**
Standard Type	**NMGSF[c]**	**MCL[d]**	**na**
NMED Tap Water[e]	**2190**	**2.41**	**na**
Doe Spring	—[f]	0.48	612
Spring 9A	575	—	—

Notes: Values are in µg/L. Values are maximum values greater than the regional groundwater BV for analytes with a BV, and the maximum detected value for analytes without a BV. All standards adjusted to a target risk of 10^{-5}.

[a] Regional groundwater (GW) BVs are from LANL (2010, 110535).

[b] na = Not available.

[c] NM Groundwater Standards (dissolved fraction, filtered sample), NMAC 20.6.2.3103 [A], [B] (http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.htm).

[d] MCL = EPA maximum contaminant level.

[e] NMED tap water values from NMED Technical Background Document for Development of Soil Screening Levels, Rev 5.0, December 2009 (NMED 2009, 108070).

[f] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.3-8
Inorganic COPCs in Nonfiltered Spring Water Samples

Location	Aluminum	Barium	Boron	Calcium	Chloride	Chromium	Cobalt	Copper	Fluoride	Hardness	Iron	Magnesium	Manganese	Molybdenum	Nickel	Nitrate—Nitrite as Nitrogen	Perchlorate	Potassium	Silicon Dioxide	Sodium	Strontium	Sulfate	Total Kjeldahl Nitrogen	Uranium	Vanadium
LANL Regional GW BV[a]	**na[b]**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**0.48**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
Standard Level	**37000**	**2000**	**7300**	**na**	**na**	**100**	**11**	**1300**	**4000**	**na**	**26000**	**na**	**na**	**180**	**730**	**10000**	**15**	**na**	**na**	**1.1**	**22000**	**na**	**na**	**30**	**180**
Standard Type	**tapRSL[c]**	**MCL[d]**	**tapRSL**	**na**	**na**	**MCL**	**tapRSL**	**MCL**	**MCL**	**na**	**tapRSL**	**na**	**na**	**tapRSL**	**tapRSL**	**MCL**	**MCL**	**na**	**na**	**tapRSL**	**tapRSL**	**na**	**na**	**MCL**	**tapRSL**
NMED Tap Water[e]	**36500**	**7300**	**7300**	**na**	**na**	**110**	**na**	**1460**	**2190**	**na**	**25600**	**na**	**876**	**183**	**730**	**na**	**na**	**na**	**na**	**na**	**21900**	**na**	**na**	**110**	**183**
Doe Spring	245	13.3	11.7	11500	1990	2.7	—[f]	3.1 (J-)	497 (J+)	41600	237	3150	13.4	—	0.67	—	4	1490	74600	11700	53.1	1820	147 (J+)	0.38	8.3
Spring 9A	107	11	12.6	11200	1900	4.14 (J)	1.3	—	—	41600	59.4	3350	—	1.34	0.525 (J)	102	4	1600	72800	11800	53.6	1980	—	0.554	8.6

Notes: Values are in µg/L. Values are maximum values greater than the regional groundwater BV for analytes with a BV, and the maximum detected value for analytes without a BV. No constituent exceeded a standard level. All standards adjusted to a target risk of 10^{-5}.

[a] Regional groundwater (GW) BVs are from LANL (2010, 110535).

[b] na = Not available.

[c] Tap water values from EPA Regional Screening Level Table (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] MCL = EPA maximum contaminant level.

[e] NMED tap water (values from NMED Technical Background Document for Development of Soil Screening Levels, Rev 5.0, December 2009 (NMED 2009, 108070).

[f] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.3-9
Radionuclide COPCs in Filtered Spring Water Samples

Location	Gross Beta
LANL Regional GW BV[a]	**4.92**
Standard Level	**50**
Standard Type	**SMCL[b]**
Doe Spring	7.97
Spring 9A	7.29 (J)

Notes: Values are in pCi/L. Values are maximum values greater than the regional groundwater BV for analytes with a BV, and the maximum detected value for analytes without a BV. No constituent exceeded a standard level. All standards adjusted to a target risk of 10^{-5}.

[a] Regional groundwater (GW) BVs are from LANL (2010, 110535).

[b] SMCL = EPA secondary maximum contaminant level.

Table 6.3-10
Radionuclide COPCs in Nonfiltered Spring Water Samples

Location	Gross Beta	Tritium	Uranium-234	Uranium-235/236	Uranium-238
LANL Regional GW BV[a]	**na[b]**	**6.26**	**na**	**na**	**na**
Standard Level	**50**	**20000**	**300**	**300**	**300**
Standard Type	**SMCL[c]**	**LWU[d]**	**NMRPS[e]**	**NMRPS**	**NMRPS**
Doe Spring	3.24 (J)	229 (J)	0.209 (J)	—[f]	0.11 (J)
Spring 9A	4.66 (J)	—	1.91	0.0394	0.893

Notes: Values are in pCi/L. Values are maximum values greater than the regional groundwater BV for analytes with a BV, and the maximum detected value for analytes without a BV. No constituent exceeded a standard level. All standards adjusted to a target risk of 10^{-5}.

[a] Regional groundwater BVs are from LANL (2010, 110535).

[b] na = Not available.

[c] SMCL = EPA secondary maximum contaminant level.

[d] LWU = NMAC 20.6.4, Livestock Watering (unfiltered). The surface water Livestock Watering value is used for tritium.

[e] NMRPS = NMEIB Radiation Protection Standards (http://www.nmcpr.state.nm.us/nmac/parts/title20/20.003.0004.htm).

[f] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.3-11
Organic COPCs in Nonfiltered Spring Water Samples

Location	Acetone	Chloromethane	Di-n-octylphthalate	Dichlorobenzene[1,3-]	Toluene
Standard Level	**22000**	**190**	**6**	**na[a]**	**750**
Standard Type	**tapRSL[b]**	**tapRSL**	**MCL[c]**	**na**	**NMGSU[d]**
NMED Tap Water[e]	**21800**	**17.8**	**48**	**18.3[f]**	**2280**
Doe Spring	—[g]	—	—	—	—
Spring 9A	2.3	0.375 (J)	3.61 (J+)	0.513 (J)	0.42

Notes: Values are in μg/L. Values are maximum values greater than the regional groundwater BV for analytes with a BV, and the maximum detected value for analytes without a BV. No constituent exceeded a standard level. All standards adjusted to a target risk of 10^{-5}.

[a] na = Not available.

[b] Tap water values from EPA Regional Screening Level Table (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[c] MCL = EPA maximum contaminant level.

[d] NM Groundwater Standards (nonfiltered sample), NMAC 20.6.2.3103 [A], [B] (http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.htm).

[e] NMED tap water values from NMED Technical Background Document for Development of Soil Screening Levels, Rev 5.0, December 2009 (NMED 2009, 108070).

[f] NMED 2006, 092513.

[g] — = Not a COPC in that reach (not detected, not detected > BV, or not analyzed).

Table 6.4-1
Samples Collected and Analyses Performed for Stormwater from Ancho and Chaquehui Canyons

Location ID	Applicable Reach	Media Code	Sample ID	Field Preparation	Collection Date	Dioxins and Furans	General Inorganics	Explosive Compounds	Metals	Pesticides and Polychlorinated Biphenyls	Radionuclides
Ancho below SR-4	A-3	WM[a]	GF080200M27501	Filtered	01/28/08	—[b]	X[c]	—	X	—	—
Ancho below SR-4	A-3	WM	FU080200M27501	Unfiltered	01/28/08	—	X	—	—	—	—
Ancho below SR-4	A-3	WM	GU080200M27501	Unfiltered	01/28/08	—	X	—	X	—	X
Ancho below SR-4	A-3	WT[d]	GU03050E27501	Unfiltered	05/26/03	—	X	—	X	—	—
Ancho below SR-4	A-3	WT	GF080800E27501	Filtered	08/04/08	—	X	—	X	—	—
Ancho below SR-4	A-3	WT	GU080800E27501	Unfiltered	08/04/08	—	X	—	X	—	—
Ancho below SR-4	A-3	WT	GF080800E27502	Filtered	08/23/08	—	X	—	X	—	—
Ancho below SR-4	A-3	WT	GU080800E27502	Unfiltered	08/23/08	—	X	X	X	X	X
Ancho below SR-4	A-3	WT	GF090700E27501	Filtered	07/28/09	—	X	—	X	—	—
Ancho below SR-4	A-3	WT	AU090700E27501	Unfiltered	07/28/09	X	—	—	—	X	—
Ancho below SR-4	A-3	WT	GU090700E27501	Unfiltered	07/28/09	—	X	—	X	—	X
Ancho below SR-4	A-3	WT	GF090800E27501	Filtered	07/30/09	—	X	—	X	—	—
Ancho below SR-4	A-3	WT	AU090800E27501	Unfiltered	07/30/09	X	—	—	—	X	—

Table 6.4-1 (continued)

Location ID	Applicable Reach	Media Code	Sample ID	Field Preparation	Collection Date	Dioxins and Furans	General Inorganics	Explosive Compounds	Metals	Pesticides and Polychlorinated Biphenyls	Radionuclides
Ancho below SR-4	A-3	WT	GU090800E27501	Unfiltered	07/30/09	—	X	—	X	—	X
Ancho north fork below SR-4	AN-4	WT	GF080800E27401	Filtered	08/04/08	—	X	—	X	—	—
Ancho north fork below SR-4	AN-4	WT	GU080800E27401	Unfiltered	08/04/08	—	X	—	X	—	X
Chaquehui at TA-33	CH-1	WT	GF061000E33801	Filtered	10/15/06	—	X	—	X	—	—
Chaquehui at TA-33	CH-1	WT	GU061000E33801	Unfiltered	10/15/06	—	X	—	X	—	—
Chaquehui at TA-33	CH-1	WT	FN061000E33801	Unfiltered	10/16/06	—	X	—	—	—	—
Chaquehui at TA-33	CH-1	WT	AU090800E33801	Unfiltered	07/30/09	X	—	—	—	—	—
Chaquehui at TA-33	CH-1	WT	GU090800E33801	Unfiltered	07/30/09	—	X	—	—	—	X
Chaquehui tributary at TA-33	CHN-1	WM	GF080100M34001	Filtered	01/28/08	—	X	—	X	—	—
Chaquehui tributary at TA-33	CHN-1	WM	FU080100M34001	Unfiltered	01/28/08	—	X	—	—	—	—
Chaquehui tributary at TA-33	CHN-1	WM	GU080100M34001	Unfiltered	01/28/08	—	X	—	X	—	X
Chaquehui tributary at TA-33	CHN-1	WT	GU03050E34001	Unfiltered	05/26/03	—	X	—	X	—	—

[a] WM = Snowmelt.

[b] — = Analysis was not performed.

[c] X = Analysis was performed.

[d] WT = Storm runoff.

Table 6.4-2
Stormwater Comparison Values

Pollutant	Field Preparation	Analyte Reporting Name	Chemical Abstract Service Number	NMWQCC[a] Livestock Watering (µg/L)	NMWQCC Wildlife Habitat (µg/L)	NMWQCC Human Health Persistent (µg/L)	NMWQCC Acute Aquatic Life (µg/L)
Aluminum	Filtered	Aluminum, dissolved	7429-90-5	—[b]	—	—	750
Antimony	Filtered	Antimony, dissolved	7440-36-0	—	—	640	—
Arsenic	Filtered	Arsenic, dissolved	7440-38-2	200	—	9	340
Boron	Filtered	Boron, dissolved	7440-42-8	5,000	—	—	—
Cadmium[c]	Filtered	Cadmium, dissolved	7440-43-9	50	—	—	0.6
Chromium[c]	Filtered	Chromium, dissolved	18540-29-9	1,000	—	—	213
Cobalt	Filtered	Cobalt, dissolved	7440-48-4	1,000	—	—	—
Copper[c]	Filtered	Copper, dissolved	7440-50-8	500	—	—	4.3
Lead[c]	Filtered	Lead, dissolved	7439-92-1	100	—	—	17
Mercury	Filtered	Mercury, dissolved	7439-97-6	—	—	—	1.4
Mercury	Nonfiltered	Mercury	7439-97-6	10	0.77	—	—
Nickel[c]	Filtered	Nickel, dissolved	7440-02-0	—	—	4,600	169
Selenium	Filtered	Selenium, dissolved	7782-49-2	50	—	4,200	—
Selenium	Nonfiltered	Selenium	7782-49-2	—	5	—	20
Silver[c]	Filtered	Silver, dissolved	7440-22-4	—	—	—	0.4
Thallium	Filtered	Thallium, dissolved	7440-28-0	—	—	0.47	—
Vanadium	Filtered	Vanadium, dissolved	7440-62-2	100	—	—	—
Zinc[c]	Filtered	Zinc, dissolved	7440-66-6	25,000	—	26,000	42
Cyanide, weak acid dissociable	Nonfiltered	Cyanide, weak acid dissociable	57-12-5	—	5.2	—	22
Ra-226 + Ra-228 (pCi/L)	Nonfiltered	Ra-226 + Ra-228	—	30 pCi/L	—	—	—
Gross-Alpha (pCi/L)	Nonfiltered	Gross alpha	—	15 pCi/L	—	—	—
Aldrin	Nonfiltered	Aldrin	309-00-2	—	—	0.0005	3
Benzo(a)pyrene	Nonfiltered	Benzo(a)pyrene	50-32-8	—	—	0.18	—
Gamma-BHC (Lindane)	Nonfiltered	Gamma-BHC (Lindane)	58-89-9	—	—	—	0.95
Chlordane	Nonfiltered	Chlordane	57-74-9	—	—	0.0081	2.4
4,4'-DDT	Nonfiltered	4,4'-DDT	50-29-3	—	0.001	0.0022	1.1
4,4'-DDD	Nonfiltered	4,4'-DDD	72-54-8	—	0.001	0.0022	1.1
4,4'-DDE	Nonfiltered	4,4'-DDE	72-55-9	—	0.001	0.0022	1.1
Dieldrin	Nonfiltered	Dieldrin	60-57-1	—	—	0.00054	0.24
2,3,7,8-TCDD Dioxin	Nonfiltered	2,3,7,8-TCDD Dioxin	1746-01-6	—	—	5.10E-08	—
alpha-Endosulfan	Nonfiltered	alpha-Endosulfan	959-98-8	—	—	—	0.22
beta-Endosulfan	Nonfiltered	beta-Endosulfan	33213-65-9	—	—	—	0.22
Endrin	Nonfiltered	Endrin	72-20-8	—	—	—	0.086
Heptachlor	Nonfiltered	Heptachlor	76-44-8	—	—	—	0.52
Heptachlor epoxide	Nonfiltered	Heptachlor epoxide	1024-57-3	—	—	—	0.52

Table 6.4-2 (continued)

Pollutant	Field Preparation	Analyte Reporting Name	Chemical Abstract Service Number	NMWQCC[a] Livestock Watering (µg/L)	NMWQCC Wildlife Habitat (µg/L)	NMWQCC Human Health Persistent (µg/L)	NMWQCC Acute Aquatic Life (µg/L)
Hexachlorobenzene	Nonfiltered	Hexachlorobenzene	118-74-1	—	—	0.0029	—
PCBs	Nonfiltered	PCBs	1336-36-3	—	0.014	0.00064	—
Pentachlorophenol	Nonfiltered	Pentachlorophenol	87-86-5	—	—	—	19
Toxaphene	Nonfiltered	Toxaphene	8001-35-2	—	—	—	0.73

[a] NMWQCC comparison values from the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC).
[b] — = None available.
[c] Hardness dependent screening values are based on a hardness value of 30 µg/L.

Table 6.4-3
Ancho and Chaquehui Canyons Stormwater Screen

Location Name	Field Preparation	Type of Analyte	Analyte	Total Number of Analyses	Count of Detected Analytes	Count of Nondetected Analytes	Average Detected Concentration	Minimum Detected Concentration	Maximum Detected Concentration	Count of Detected Analytes with Concentrations Greater than the Lowest Comparison Value[a]	Lowest Comparison Value[a]	Units
Ancho below SR-4	Filtered	Inorganic	Aluminum	4	4	0	1808.25	503	2660	3	750	µg/L
Chaquehui tributary at TA-33	Filtered	Inorganic	Aluminum	1	1	0	1990	1990	1990	1	750	µg/L
Ancho north fork below SR-4	Filtered	Inorganic	Aluminum	1	1	0	1660	1660	1660	1	750	µg/L
Chaquehui at TA-33	Filtered	Inorganic	Aluminum	1	1	0	1550	1550	1550	1	750	µg/L
Ancho north fork below SR-4	Filtered	Inorganic	Copper	1	1	0	8.1	8.1	8.1	1	4.3	µg/L
Ancho below SR-4	Nonfiltered	Inorganic	Mercury	5	2	3	0.449	0.07	0.828	1	0.77	µg/L
Ancho below SR-4	Nonfiltered	Inorganic	Selenium	5	2	3	3.89	2	5.78	1	5	µg/L
Ancho below SR-4	Nonfiltered	Organic	Total PCB	2	2	0	0.0485	0.0223	0.0746	2	0.00064	µg/L
Ancho below SR-4	Nonfiltered	Organic	TCDD TEC[b]	33	30	3	4.01×10^{-6}	7.35×10^{-8}	3.25×10^{-5}	30	5.10×10^{-8}	µg/L
Chaquehui at TA-33	Nonfiltered	Organic	TCDD TEC[b]	17	16	1	1.62×10^{-6}	7.62×10^{-8}	7.55×10^{-6}	16	5.10×10^{-8}	µg/L
Ancho below SR-4	Nonfiltered	Rad	Gross alpha	4	4	0	445.175	65.7	889	4	15	pCi/L
Chaquehui at TA-33	Nonfiltered	Rad	Gross alpha	1	1	0	472	472	472	1	15	pCi/L

[a] See Table 6.4-1 for comparison value.
[b] Dioxin furan analytes expressed in 2,3,7,8-TCDD dioxin (TCDD) toxicity equivalent concentration (TEC).

Table 6.4-4
Ecologically Relevant Stormwater Comparisons

Analyte	Field Preparation	Maximum Detected Concentration (µg/L)	Benchmark (µg/L)*	Maximum > Benchmark?	Location with Maximum Detected Result
Aluminum	Filtered	2660	750	Yes	Gage E275, Ancho below SR-4
Copper	Filtered	8.1	4.3	Yes	Gage E274, Ancho north fork below SR-4

*Basis from State of New Mexico Standards for Acute Aquatic Life (20.6.4.900[H], 20.4.6.900[I], and 20.4.6.900[J] NMAC).

Table 6.5-1
Ancho, Chaquehui, and Indio Canyons COPC and Stormwater Summary

Analyte	Sediment[a]	Stormwater[b]	Surface Water[c]	Spring[d]
Inorganic Chemicals				
Aluminum	—[e]	X[f]	X	X
Ammonia as Nitrogen	—	X	X	—
Antimony	X	—	—	—
Arsenic	X	X	X	—
Barium	—	X	X	X
Beryllium	—	X	—	—
Boron	—	X	X	X
Bromide	—	—	X	—
Cadmium	X	X	—	—
Calcium	—	X	X	X
Chloride	—	—	X	X
Chromium	X	X	X	X
Cobalt	X	X	X	X
Copper	X	X	X	X
Cyanide (total)	X	X	—	—
Fluoride	—	—	X	X
Hardness	—	X	X	X
Iron	X	X	X	X
Lead	X	X	X	—
Magnesium	—	X	X	X
Manganese	X	X	X	X
Mercury	X	X	—	X
Molybdenum	—	X	X	X
Nickel	—	X	X	X
Nitrate—Nitrite as Nitrogen	—	—	X	X
Perchlorate	X	—	X	X

Table 6.5-1 (continued)

Analyte	Sediment[a]	Stormwater[b]	Surface Water[c]	Spring[d]
Inorganic Chemicals (continued)				
Potassium	—	X	X	X
Selenium	X	X	X	—
Silicon Dioxide	—	X	X	X
Silver	—	X	—	—
Sodium	—	X	X	X
Strontium	—	X	X	X
Sulfate	—	—	X	X
Thallium	—	X	X	X
Tin	—	X	—	—
Total Kjeldahl Nitrogen	—	—	X	X
Total Phosphate as Phosphorus	—	—	X	—
Uranium	—	X	X	X
Vanadium	X	X	X	X
Zinc	X	X	X	—
Organic Chemicals				
Acetone	X	—	X	X
Aldrin	X	—	—	—
Anthracene	X	—	—	—
Aroclor-1248	X	—	—	—
Aroclor-1254	X	—	—	—
Aroclor-1260	X	—	—	—
Benzo[a]anthracene	X	—	—	—
Benzo[a]pyrene	X	—	—	—
Benzo[b]fluoranthene	X	—	—	—
BHC[alpha-]	X	—	—	—
BHC[beta-]	X	—	—	—
BHC[delta-]	X	—	—	—
BHC[gamma-]	X	—	—	—
Chlordane[alpha-]	X	—	—	—
Chlordane[gamma-]	X	—	—	—
Chloromethane	—	—	X	X
Chrysene	X	—	—	—
DDD[4,4'-]	X	—	—	—
DDE[4,4'-]	X	—	—	—
DDT[4,4'-]	X	—	—	—
Di-n-butylphthalate	X	—	—	—
Di-n-octylphthalate	—	—	X	X

Table 6.5-1 (continued)

Analyte	Sediment[a]	Stormwater[b]	Surface Water[c]	Spring[d]
Organic Chemicals (continued)				
Dichlorobenzene[1,3-]	—	—	X	X
Dieldrin	X	—	—	—
Diethylphthalate	X	—	—	—
Dioxins/Furans	—	X	—	—
Endosulfan I	X	—	—	—
Endosulfan II	X	—	—	—
Endosulfan Sulfate	X	—	—	—
Endrin	X	—	—	—
Endrin Aldehyde	X	—	—	—
Endrin Ketone	X	—	—	—
Fluoranthene	X	—	—	—
Heptachlor	X	—	—	—
Heptachlor Epoxide	X	—	—	—
Methoxychlor[4,4'-]	X	—	—	—
Methylene Chloride	X	—	—	—
PCB congeners	—	X	—	—
Phenanthrene	X	—	—	—
Pyrene	X	—	—	—
TATB	X	—	—	—
Toluene	—	—	X	X
Total PCBs	—	X	—	—
Radionuclides				
Americium-241	—	X	—	—
Cesium-137	X	X	—	—
Gross-alpha	—	X	—	—
Gross-beta	—	X	X	X
Plutonium-238	X	X	—	—
Plutonium-239/240	X	X	—	—
Potassium-40	—	X	—	—
Radium-226	—	X	X	—
Radium-228	—	X	—	—
Strontium-90	—	X	—	—
Thorium-228	—	X	—	—
Thorium-230	—	X	—	—
Thorium-232	—	X	X	—
Tritium	X	—	X	X

Table 6.5-1 (continued)

Analyte	Sediment[a]	Stormwater[b]	Surface Water[c]	Spring[d]
Radionuclides (continued)				
Uranium-234	X	X	X	X
Uranium-235/236	X	X	X	X
Uranium-238	X	X	X	X

[a] Sediment COPCs are defined by comparison to BVs or detection if no BVs; shaded COPCs are greater than SSLs (see Tables 6.2-2 to 6.2-4).

[b] Stormwater COPCs are defined by detection; shaded COPCs are greater than comparison values (see Tables 6.4-2 to 6.4-4).

[c] Surface-water COPCs are defined by detection; shaded COPCs are greater than standards (see Tables 6.3-2 to 6.3-6).

[d] Spring COPCs are defined by comparison to BVs or detection if no BVs; shaded COPCs are greater than standards (see Tables 6.3-7 to 6.3-11).

[e] — = Analyte is not a COPC in sediment or springs or not detected in other water samples.

[f] X = Analyte is a COPC in sediment or springs or was detected in other water samples.

Table 7.1-1
Inferred Primary Sources and Downcanyon Extent of Select COPCs in Sediment in Ancho, Chaquehui, and Indio Canyons

Type of COPC	COPC	Inferred Primary Source(s) in the Ancho, Chaquehui, and Indio Watersheds[a]	Inferred Downcanyon Extent from Laboratory Sources[b]
Inorganic chemical	Antimony	Natural background	n/a[c]
	Arsenic	Natural background	n/a
	Chromium	Natural background	n/a
	Copper	TA-39	North fork of Ancho Canyon between reaches AN-2 and AN-3
	Cyanide	TA-33, La Mesa fire ash, and possibly minor releases from TA-39	Chaquehui Canyon between reaches CH-1 and CH-2 and possibly Ancho Canyon between the north fork confluence and reach A-3
	Iron	Natural background	n/a
	Mercury	TA-39	Ancho Canyon between the north fork confluence and reach A-3
	Perchlorate	Natural background	n/a
	Selenium	Natural background	n/a
	Vanadium	Natural background and minor releases from TA-33	North fork of Chaquehui Canyon between CHN-1 and CH-2

Table 7.1-1 (continued)

Type of COPC	COPC	Inferred Primary Source(s) in the Ancho, Chaquehui, and Indio Watersheds[a]	Inferred Downcanyon Extent from Laboratory Sources[b]
Organic chemical	Aroclor-1248	TA-39	North fork of Ancho Canyon between reaches AN-2 and AN-3
	Aroclor-1254	TA-33 and TA-39	Chaquehui Canyon and north fork Chaquehui Canyon above reach CH-2 and Ancho Canyon between the north fork confluence and reach A-3
	Aroclor-1260	TA-33 and TA-39	Chaquehui Canyon and north fork Chaquehui Canyon above reach CH-2 and north fork of Ancho Canyon between reaches AN-3 and AN-4
	Di-n-butylphthalate	TA-39	North fork of Ancho Canyon between reaches AN-2 and AN-3
	Heptachlor	TA-39	Ancho Canyon between the north fork confluence and reach A-3
	TATB	TA-39	North fork of Ancho Canyon between reaches AN-2 and AN-3
Radionuclide	Cesium-137	Atmospheric fallout, concentrated in La Mesa fire ash	n/a
	Plutonium-238	Atmospheric fallout	n/a
	Plutonium-239/240	Atmospheric fallout, concentrated in La Mesa fire ash	n/a
	Tritium	TA-33	Rio Grande or Chaquehui Canyon between reach CH-2 and the Rio Grande
	Uranium-234	TA-39 and minor releases from TA-49	North fork of Ancho Canyon between reaches AN-2 and AN-3 and Ancho Canyon between reaches A-1 and A-2
	Uranium-235/236	TA-39	North fork of Ancho Canyon between reaches AN-2 and AN-3
	Uranium-238	TA-39 and minor releases from TA-49	Ancho Canyon between the north fork confluence and reach A-3 and Ancho Canyon between reaches A-1 and A-2

[a] Primary source(s) indicated by maximum concentrations and/or spatial distribution.

[b] Downcanyon extent indicates area where COPC remains detected and/or above background and can probably or possibly be traced to an upcanyon Laboratory source.

[c] n/a = Not applicable (inferred source is natural background or atmospheric fallout).

Table 8.1-1
HQs Based on Maximum Concentrations of Inorganic COPCs in Ancho, Chaquehui, and Indio Canyon Sediment Samples and Soil ESLs

Reach	Antimony	Arsenic	Cadmium	Chromium	Cobalt	Copper	Cyanide (Total)	Iron	Lead	Manganese	Mercury	Perchlorate	Selenium	Vanadium	Zinc
Sediment BV (mg/kg)[a]	**0.83**	**3.98**	**0.4**	**10.5**	**4.73**	**11.2**	**0.82**	**13800**	**19.7**	**543**	**0.1**	**na[b]**	**0.3**	**19.7**	**60.2**
Minimum Soil ESL (mg/kg)[c]	**0.05**	**6.8**	**0.27**	**2.3**	**13**	**15**	**0.1**	**pH dependent[d]**	**14**	**220**	**0.013**	**na**	**0.52**	**0.025**	**48**
A-1	23[e]	—[f]	2.0[e]	—	—	—	11	—	1.7	—	—	no ESL	2.2[e]	960	—
A-2	21[e]	—	1.8[e]	—	—	—	—	—	—	—	—	no ESL	2.0[e]	—	—
A-3	99[e]	—	2.5[e]	—	—	—	—	—	—	—	—	no ESL	2.6[e]	—	—
AN-1	21[e]	—	1.9[e]	—	0.37	—	—	5< pH <8	—	—	—	no ESL	2.0[e]	1000	—
AN-2	21[e]	—	1.9[e]	—	—	1.2	—	—	—	—	62	no ESL	2.0[e]	—	—
AN-3	21[e]	—	1.9[e]	—	—	—	—	—	—	—	19	no ESL	2.0[e]	—	—
AN-4	95[e]	0.71	2.0[e]	—	—	—	9.5	—	—	—	15	no ESL	2.1[e]	—	—
CH-1	22[e]	—	1.8	6.0	—	—	47	5< pH <8	—	2.5	—	no ESL	2.0[e]	2000	1.7
CH-2	22[e]	—	2.0[e]	—	—	—	—	5< pH <8	—	—	—	no ESL	2.1[e]	1100	—
CHN-1	21[e]	—	—	—	—	—	—	5< pH <8	—	—	—	no ESL	2.1[e]	1300	—
I-1	21[e]	—	1.9[e]	—	—	—	—	—	—	—	—	no ESL	2.0[e]	—	—

Notes: Gray shading indicates HQ greater than 1. Values reported are HQs (unitless).

[a] BVs are from LANL (1998, 059730).

[b] na = Not available.

[c] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).

[d] EPA 2003, 111415.

[e] Not detected but detection limits greater than BV, HQ is calculated from maximum detection limit in reach.

[f] — = Not a COPC (no value above BV).

Table 8.1-2
HQs Based on Maximum Detected Concentrations of Radionuclide COPCs in Ancho, Chaquehui, and Indio Canyon Sediment Samples and Soil ESLs

Reach	Cesium-137	Plutonium-238	Plutonium-239/240	Tritium	Uranium-234	Uranium-235/236	Uranium-238
Sediment BV (pCi/g)[a]	**0.9**	**0.006**	**0.068**	**0.093**	**2.59**	**0.2**	**2.29**
Minimum Soil ESL (pCi/g)[b]	**680**	**44**	**47**	**36000**	**51**	**55**	**55**
A-1	0.01	—[c]	<0.01	—	0.06	—	0.06
A-2	<0.01	—	—	—	—	—	—
A-3	—	—	—	—	—	—	—
AN-1	<0.01	—	<0.01	—	—	—	—
AN-2	—	—	—	—	0.15	0.01	0.39
AN-3	—	—	—	—	—	—	0.09
AN-4	—	—	—	<0.01	—	—	0.08
CH-1	—	—	—	—	—	—	—
CH-2	—	—	—	<0.01	—	—	—
CHN-1	—	—	—	<0.01	—	—	—
I-1	—	<0.01	—	—	—	—	—

Notes: No gray shading based on all HQs less than 1. Values reported are HQs (unitless).
[a] BVs are from LANL (1998, 059730).
[b] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).
[c] — = Not a COPC.

Table 8.1-3
HQs Based on Maximum Detected Concentrations of Organic COPCs in Ancho, Chaquehui, and Indio Canyon Sediment Samples and Soil ESLs

Reach	Acetone	Aldrin	Anthracene	Aroclor-1248	Aroclor-1254	Aroclor-1260	Benzo[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	BHC[alpha-]	BHC[beta-]	BHC[delta-]	BHC[gamma-]	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-]	DDE[4,4'-]
Minimum Soil ESL (mg/kg)[a]	**1.2**	**0.037**	**6.8**	**0.0072**	**0.041**	**0.14**	**3**	**53**	**18**	**58**	**0.27**	**0.0094**	**0.0094**	**0.27**	**2.2**	**2.4**	**0.0063**	**0.11**
A-1	—[b]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	—	—
AN-1	<0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	—	—	—	0.35	0.08	—	—	—	—	—	—	—	—	—	—	—	—	<0.01
AN-3	—	0.01	—	—	0.05	0.02	—	—	—	<0.01	<0.01	0.04	0.05	<0.01	<0.01	—	0.21	0.01
AN-4	—	—	—	—	0.14	—	—	—	—	—	—	—	—	—	—	<0.01	—	—
CH-1	—	—	—	—	0.18	0.02	—	—	—	—	—	—	—	—	—	—	—	0.01
CH-2	—	—	—	—	—	—	<0.01	—	—	—	—	—	—	—	—	<0.01	—	<0.01
CHN-1	—	—	0.01	—	0.14	0.06	0.03	<0.01	0.01	—	—	—	—	—	—	0.02	—	—
I-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 8.1-3 (continued)

Reach	DDT[4,4'-]	Di-n-butylphthalate	Dieldrin	Diethylphthalate	Endosulfan I	Endosulfan II	Endosulfan Sulfate	Endrin	Endrin Aldehyde	Endrin Ketone	Fluoranthene	Heptachlor	Heptachlor Epoxide	Methoxychlor[4,4'-]	Methylene Chloride	Phenanthrene	Pyrene	TATB
Minimum Soil ESL (mg/kg)[a]	**0.044**	**0.011**	**0.0045**	**100**	**0.64**	**0.64**	**0.0014**	**0.0014**	**0.0014**	**0.0014**	**10**	**0.059**	**0.059**	**5**	**2.6**	**5.5**	**10**	**na[c]**
A-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	—	—	—
A-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	—
AN-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	—	9.7	—	0.03	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	no ESL
AN-3	0.03	—	0.28	—	<0.01	<0.01	0.99	1.1	0.91	1.1	—	0.01	0.01	<0.01	—	—	—	—
AN-4	—	—	—	—	—	—	—	—	—	—	<0.01	0.01	—	—	—	—	<0.01	—
CH-1	—	—	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	—	—	—	—	<0.01	—	—	—	—	—	<0.01	—	—	—	—	<0.01	<0.01	—
CHN-1	—	—	—	<0.01	—	—	—	—	—	—	0.02	—	—	—	—	0.03	0.02	—
I-1	—	8.2	—	—	—	—	—	—	—	—	—	0.02	—	—	—	—	—	—

Notes: Gray shading indicates HQ greater than 1. Values reported are HQs (unitless).

[a] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).

[b] — = Not a COPC.

[c] na = Not available.

Table 8.1-4
Minimum Soil, Sediment, and Water L-ESLs

Medium	COPEC	Minimum L-ESL	Units	Receptor	TRV No Effect	TRV Lowest Effect	TRV Units	Basis of L-ESL Derivation*
Soil	Antimony	0.5	mg/kg	Plant	0.05	0.5	mg/kg	Chronic LOEC is extrapolated from a LOEC taken from the literature by applying an appropriate uncertainty factor.
Soil	Cadmium	2.7	mg/kg	Shrew	0.77	7.7	mg/kg/d	LOAEL is the pair to the NOAEL, which is the highest bounded NOAEL below the lowest bounded LOAEL.
Soil	Chromium	12	mg/kg	Plant	2.45	12.6	mg/kg	LOEC is calculated from the geometric mean of available studies for hexavalent chromium.
Soil	Copper	46	mg/kg	Robin (invertebrate diet)	4.05	12.1	mg/kg/d	LOAEL is the pair to the NOAEL, which is the highest bounded NOAEL below the lowest bounded LOAEL.
Soil	Cyanide (total)	1	mg/kg	Robin	0.04	0.4	mg/kg/d	The LOAEL is extrapolated from the NOAEL by applying an uncertainty factor of 10.
Soil	Lead	28	mg/kg	Robin (invertebrate diet)	1.63	3.26	mg/kg/d	LOAEL is equal to the lowest bounded LOAEL for reproduction or growth. NOAEL was extrapolated from the LOAEL by applying an uncertainty factor of 10.
Soil	Manganese	1100	mg/kg	Plant	220	1100	mg/kg	Extrapolate to a LOEC from the geometric mean of the other effect-level data set by applying an appropriate uncertainty factor to each value in the data set and then calculating the geometric mean of these extrapolated values. An uncertainty factor of 5 is applied to maximum acceptable toxic concentration values, and an uncertainty factor of 10 to effect concentration (EC) 20 and EC10 values.
Soil	Mercury	0.13	mg/kg	Robin (invertebrate diet)	0.019	0.19	mg/kg/d	LOAEL is equal to a LOAEL taken directly from the literature.
Soil	Selenium	0.99	mg/kg	Shrew	0.143	0.215	mg/kg/d	LOAEL is the pair to the NOAEL, which is the highest bounded NOAEL below the lowest bounded LOAEL.
Soil	Vanadium	0.25	mg/kg	Plant	0.025	0.25	mg/kg	Chronic LOEC is extrapolated from a LOEC taken from the literature by applying an appropriate uncertainty factor.
Soil	Zinc	480	mg/kg	Robin (invertebrate diet)	66.1	661	mg/kg/d	Extrapolate to a LOAEL from a geometric mean NOAEL TRV by applying an uncertainty factor of 10.
Soil	Di-n-butylphthalate	0.11	mg/kg	Robin (invertebrate diet)	0.14	1.4	mg/kg/d	LOAEL is equal to a LOAEL taken directly from the literature. NOAEL was extrapolated from the LOAEL by applying an uncertainty factor of 10.
Soil	Endrin	0.014	mg/kg	Robin (invertebrate diet)	0.01	0.1	mg/kg/d	LOAEL is equal to a LOAEL taken directly from the literature. NOAEL was extrapolated from the LOAEL by applying an uncertainty factor of 10.
Soil	Endrin ketone	0.014	mg/kg	Robin (invertebrate diet)	0.01	0.1	mg/kg/d	Used endrin as a surrogate.
Sediment	Antimony	3	mg/kg	Aquatic community organisms - sediment	3	3	mg/kg	Upper effects threshold
Sediment	Cadmium	3.3	mg/kg	Occult little brown myotis bat	0.77	7.7	mg/kg/d	LOAEL is the pair to the NOAEL, which is the highest bounded NOAEL below the lowest bounded LOAEL.
Sediment	Selenium	1.3	mg/kg	Occult little brown myotis bat	0.143	0.215	mg/kg/d	LOAEL is the pair to the NOAEL, which is the highest bounded NOAEL below the lowest bounded LOAEL.
Sediment	Di-n-butylphthalate	0.14	mg/kg	Violet-green swallow	0.14	1.4	mg/kg/d	LOAEL is equal to a LOAEL taken directly from the literature. NOAEL was extrapolated from the LOAEL by applying an uncertainty factor of 10.
Water	Aluminum	750	µg/L	Aquatic community organisms - water	87	750	µg/L	Chronic water quality criterion
Water	Barium	69	µg/L	Aquatic community organisms - water	3.8	69.1	µg/L	Tier II secondary acute value (Suter 1996, 062805)
Water	Lead	30	µg/L	Aquatic community organisms - water	1.2	30.1	µg/L	Chronic water quality criterion, hardness 50 mg/L
Water	Selenium	13	µg/L	Aquatic community organisms - water	5	13	µg/L	Chronic water quality criterion calculated from selenite and selenate; range of 13–186 µg/L from the National Oceanic and Atmospheric Administration Screening Quick Reference Tables (SQuiRTs) (http://response.restoration.noaa.gov/book_shelf/122_NEW-SQuiRTs.pdf).
Water	Radium-226	1	pCi/L	Algae - water	0.1	1	rad/d	LOAEL is extrapolated from a NOAEL by applying an uncertainty factor of 10.
Water	Thorium-232	8.1	pCi/L	Algae - water	0.1	1	rad/d	LOAEL is extrapolated from a NOAEL by applying an uncertainty factor of 10.

* Some COPECs (e.g., inorganic chemicals from EPA Eco-SSL documents) do not have LOAELs or LOEC provided. In these cases, an uncertainty factor of 10 was applied to the NOAEL/no effect concentration (i.e., EC10 and EC20) data in accordance with the acknowledged uncertainty between the LOAEL/ lowest effect concentration and NOAEL/no effect concentration in Dourson and Stara (1983, 073474), Calbrese and Baldwin (1993, 110405), and EPA (http://www.epa.gov/epawaste/hazard/tsd/td/combust/ecorisk.htm).

Table 8.1-5
HQs Based on Maximum Detected Concentrations of COPECs in Ancho, Chaquehui, and Indio Canyon Sediment Samples and Soil L-ESLs

Reach	Antimony	Cadmium	Chromium	Copper	Cyanide (Total)	Lead	Manganese	Mercury	Selenium	Vanadium	Zinc	Di-n-butylphthalate	Endrin	Endrin Ketone
Sediment BV (mg/kg)[a]	**0.83**	**0.4**	**10.5**	**11.2**	**0.82**	**19.7**	**543**	**0.1**	**0.3**	**19.7**	**60.2**	**na[b]**	**na**	**na**
Minimum Soil L-ESL (mg/kg)[c]	**0.5**	**2.7**	**12**	**46**	**1**	**28**	**1100**	**0.13**	**0.99**	**0.25**	**480**	**0.11**	**0.014**	**0.014**
A-1	2.3[d]	0.20[d]	—[e]	—	1.1	0.83	—	—	1.2[d]	96	—	—	—	—
A-2	2.1[d]	0.18[d]	—	—	—	—	—	—	1.1[d]	—	—	—	—	—
A-3	9.9[d]	0.24[d]	—	—	—	—	—	—	1.4[d]	—	—	—	—	—
AN-1	2.1[d]	0.19[d]	—	—	—	—	—	—	1.1[d]	100	—	—	—	—
AN-2	2.1[d]	0.19[d]	—	0.40	—	—	—	6.2	1.0[d]	—	—	0.97	—	—
AN-3	2.1[d]	0.19[d]	—	—	—	—	—	1.9	1.1[d]	—	—	—	0.11	0.11
AN-4	9.5[d]	0.20[d]	—	—	—	—	—	1.5	1.1[d]	—	—	—	—	—
CH-1	2.2[d]	0.18	1.2	—	4.7	—	0.50	—	1.1[d]	200	0.17	—	—	—
CH-2	2.2[d]	0.20[d]	—	—	—	—	—	—	1.1[d]	110	—	—	—	—
CHN-1	2.1[d]	—	—	—	—	—	—	—	1.1[d]	130	—	—	—	—
I-1	2.1[d]	0.18[d]	—	—	—	—	—	—	1.1[d]	—	—	0.82	—	—

Notes: Gray shading indicates HQ greater than 1. Values reported are HQs (unitless).

[a] BVs are from LANL (1998, 059730).

[b] na = Not available.

[c] L-ESLs are from Table 8.1-4.

[d] Not detected but detection limits greater than BV, HQ is calculated from maximum detection limit in reach.

[e] — = Not a COPC (no value above BV).

Table 8.1-6
HQs Based on Maximum Detected Concentrations of Inorganic and Organic COPCs in Ancho, Chaquehui, and Indio Canyon c1 Sediment Samples and Minimum Sediment ESLs

Reach	Antimony	Cadmium	Iron	Selenium	Vanadium	Acetone	Chrysene	Di-n-butylphthalate	Fluoranthene	Phenanthrene	Pyrene
Sediment ESL (mg/kg)[a]	**0.36**	**0.33**	**20000[b]**	**0.9**	**30**	**0.065**	**0.5**	**0.014**	**2.9**	**0.85**	**0.57**
A-1	3.1[c]	1.7[c]	—[d]	1.3[c]	—	—	—	—	—	—	—
A-2	2.7[c]	1.5[c]	—	1.2[c]	—	—	—	—	—	—	—
A-3	3.7[c]	2.0[c]	—	1.5[c]	—	—	—	—	—	—	—
AN-1	2.9[c]	1.5[c]	—	1.2[c]	—	0.03	—	—	—	—	—
AN-2	2.8[c]	1.5[c]	—	1.1[c]	—	—	—	—	—	—	—
AN-3	2.7[c]	1.5[c]	—	1.2[c]	—	—	—	—	—	—	—
AN-4	2.8[c]	1.5[c]	—	1.2[c]	—	—	—	—	<0.01	—	<0.01
CH-1	2.4[c]	—	—	1.2[c]	—	—	—	—	—	—	—
CH-2	3.0[c]	1.6[c]	0.86	1.2[c]	0.93	—	—	—	—	—	—
CHN-1	2.8[c]	—	—	1.2[c]	—	—	<0.01	—	<0.01	<0.01	0.01
I-1	2.7[c]	—	—	1.2[c]	—	—	—	6.4	—	—	—

Notes: Gray shading indicates HQ greater than 1. Values reported are HQs (unitless).

[a] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).

[b] ESL from the ECORISK Database, Version 2.5 (LANL 2010, 110846) is 20 mg/kg but there was an error in calculating this effect level. The correct value is 2% iron by weight or 20,000 mg/kg.

[c] Not detected but detection limits greater than BV, HQ is calculated from maximum detection limit in reach.

[d] — = Not a COPC.

Table 8.1-7
HQs Based on Maximum Detected Concentrations of Radionuclide COPCs in Ancho, Chaquehui, and Indio Canyon c1 Sediment Samples and Minimum Sediment ESLs

Reach	Plutonium-238	Uranium-234	Uranium-235/236	Uranium-238
Sediment ESL (pCi/g)[a]	**110**	**620**	**670**	**690**
A-1	—[b]	—	—	—
A-2	—	—	—	—
A-3	—	—	—	—
AN-1	—	—	—	—
AN-2	—	0.01	<0.01	0.03
AN-3	—	—	—	—
AN-4	—	—	—	—
CH-1	—	—	—	—
CH-2	—	—	—	—
CHN-1	—	—	—	—
I-1	<0.01	—	—	—

Notes: No gray shading based on HQ less than 1. Values reported are HQs (unitless).
[a] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).
[b] — = Not a COPC.

Table 8.1-8
HQs Based on Maximum Detected Concentrations of COPECs in Ancho, Chaquehui, and Indio Canyon c1 Sediment Samples and Minimum Sediment L-ESLs

Reach	Antimony	Cadmium	Selenium	Di-n-butylphthalate
Sediment L-ESL (mg/kg)[a]	**3**	**3.3**	**1.3**	**0.14**
A-1	0.37[b]	0.17[b]	0.88[b]	—[c]
A-2	0.32[b]	0.15[b]	0.81[b]	—
A-3	0.44[b]	0.20[b]	1.0[b]	—
AN-1	0.35[b]	0.15[b]	0.80[b]	—
AN-2	0.34[b]	0.15[b]	0.79[b]	—
AN-3	0.33[b]	0.15[b]	0.80[b]	—
AN-4	0.34[b]	0.15[b]	0.82[b]	—
CH-1	0.29[b]	—	0.81[b]	—
CH-2	0.36[b]	0.16[b]	0.85[b]	—
CHN-1	0.34[b]	—	0.82[b]	—
I-1	0.33[b]	—	0.82[b]	0.64

Notes: No gray shading based on HQ less than or equal to 1. Values reported are HQs (unitless).

[a] L-ESLs are from Table 8.1-4.

[b] Not detected but detection limits greater than BV, HQ is calculated from maximum detection limit in reach.

[c] — = Not a COPC.

Table 8.1-9
HQs Based on Maximum Detected Concentrations of Inorganic COPCs in Ancho and Chaquehui Canyon Nonstorm-Related Surface-Water Samples and Minimum Water ESLs

Location ID	Reach	Aluminum	Arsenic	Barium	Boron	Chloride	Chromium	Cobalt	Copper	Fluoride	Iron	Lead	Manganese	Molybdenum	Nickel	Perchlorate	Selenium	Strontium	Uranium	Vanadium	Zinc
Water ESL (µg/L)[a]		**87**	**150**	**3.8**	**540**	**230000**	**77**	**3**	**5**	**1600**	**1000**	**1.2**	**80**	**230**	**28**	**35000**	**5**	**620**	**1.8**	**19**	**66**
Ancho at Rio Grande	A-3	1.3	—[b]	9.8	0.03	0.01	0.04	—	—	0.32	0.09	0.13	0.08	<0.01	0.03	<0.01	1.4	0.11	0.19	0.55	0.03
Doe Spring	CH-2	2.8	0.02	4.1	0.03	<0.01	0.04	—	0.62	0.32	0.24	—	0.17	0.01	0.02	<0.01	—	0.09	0.21	0.44	0.08
Spring 9A	CH-2	1.2	0.01	2.9	0.02	<0.01	0.05	0.43	—	0.36	0.06	0.68	0.01	0.01	0.02	<0.01	—	0.09	0.41	0.48	0.09

Notes: Values reported are HQs (unitless). Gray shading indicates HQ > 1.
[a] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).
[b] — = Not a COPC.

Table 8.1-10
HQs Based on Maximum Detected Concentrations of Radionuclide COPCs in Ancho and Chaquehui Canyon Nonstorm-Related Surface-Water Samples and Minimum Water ESLs

Location ID	Reach	Radium-226	Thorium-232	Tritium	Uranium-234	Uranium-235/236	Uranium-238
Water ESL (pCi/L)[a]		**0.1**	**0.81**	**160000000**	**22**	**24**	**24**
Ancho at Rio Grande	A-3	7.4	2.0	<0.01	0.01	—[b]	<0.01
Doe Spring	CH-2	—	—	<0.01	0.01	—	<0.01
Spring 9A	CH-2	—	—	<0.01	0.09	<0.01	0.04

Notes: Values reported are HQs (unitless). Gray shading indicates HQ > 1.
[a] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).
[b] — = Not a COPC.

Table 8.1-11
HQs Based on Maximum Detected Concentrations of Organic COPCs in Ancho and Chaquehui Canyon Nonstorm-Related Surface-Water Samples and Minimum Water ESLs

Location ID	Reach	Acetone	Chloromethane	Di-n-octylphthalate	Dichlorobenzene[1,3-]	Toluene
Water ESL (µg/L)[a]		**11000**	**na[b]**	**320**	**na**	**130**
Ancho at Rio Grande	A-3	<0.01	—[c]	—	—	—
Doe Spring	CH-2	—	—	—	—	—
Spring 9A	CH-2	<0.01	no ESL[d]	0.01	no ESL	<0.01

Notes: Values reported are HQs (unitless). No gray shading based on HQ less than 1.

[a] ESLs are from the ECORISK Database, Version 2.5 (LANL 2010, 110846).

[b] na = Not available.

[c] — = Not a COPC.

[d] no ESL = Compound detected; no screening level available.

Table 8.1-12
HQs Based on Maximum Detected Concentrations of COPECs in Ancho and Chaquehui Canyon Nonstorm-Related Surface-Water Samples and Minimum Water L-ESLs

Location ID	Reach	Aluminum (µg/L)	Barium (µg/L)	Selenium (µg/L)	Radium-226 (pCi/L)	Thorium-232 (pCi/L)
Water L-ESL[a]		**750**	**69**	**13**	**1**	**8.1**
Ancho at Rio Grande	A-3	0.15	0.54	0.54	0.74	0.20
Doe Spring	CH-2	0.33	0.23	—[b]	—	—
Spring 9A	CH-2	0.14	0.16	—	—	—

Notes: Values reported are HQs (unitless). No gray shading based on HQ less than 1.

[a] L-ESLs are from Table 8.1-4.

[b] — = Not a COPC.

Table 8.1-13
COPECs Retained for Soil for Ancho, Chaquehui, and Indio Canyons

COPEC	Ancho, Chaquehui, and Indio Watershed Maximum Concentration (mg/kg)	Minimum L-ESL (mg/kg)	Receptor
Antimony	4.96 (U)	0.5	Plant
Chromium	13.8	12	Plant
Cyanide (total)	4.68	1	Robin (insectivore)
Mercury	0.807	0.13	Robin (insectivore)
Selenium	1.35 (U)	0.99	Shrew
Vanadium	48.8	0.25	Plant

Table 8.1-14
Comparison of Concentrations for Plant COPECs in Ancho, Chaquehui, and Indio Canyons with Concentrations from Sediment Evaluated in Previous Plant Studies

COPEC	Sediment BV (mg/kg)	Soil BV (mg/kg)	Plant L-ESL (mg/kg)	Ancho, Chaquehui, and Indio Canyons Maximum (mg/kg)	Los Alamos and Pueblo Canyons Maximum (mg/kg)	Mortandad Canyon Maximum (mg/kg)	Pajarito Canyon Maximum (mg/kg)	Sandia Canyon Maximum (mg/kg)
Chromium	10.5	19.3	12	13.8	18.4	524	28.2	5040
Vanadium	19.7	39.6	0.25	48.8	20.3	29.7	35.9	111

Note: Gray shading indicates maximum detected concentration from a previous study that exceeds the maximum detected concentration in the Ancho, Chaquehui, and Indio watershed.

Table 8.1-15
Home Range and Population Areas for Ecological Receptors

Receptor	Home Range (ha)	Reference; Notes	Population Area* (ha)
Robin	0.42	EPA 1993, 059384, p. 2-199; Home range data represent average territory size in an open, semi-urban environment	16.8
Shrew	0.39	EPA 1993, 059384, p. 2-212; Reported average of home range	15.6

*Derived by 40 times home range.

Table 8.1-16
Wildlife COPECs in Ancho, Chaquehui, and Indio Canyons

COPEC	Sediment BV (mg/kg)	Soil BV (mg/kg)	L-ESL (mg/kg)	Receptor	Reach	Reach Area (ha)	Reach Maximum (mg/kg)	HQ	HQ*AUF[a]	HQ*PAUF[b]
Cyanide (total)	0.82	0.5	1	Robin	A-1	0.07	1.13	1.1	0.19	<0.01
					AN-4	0.15	0.95	0.95	0.34	0.01
					CH-1	0.29	4.68	4.7	3.2	0.08
Mercury	0.1	0.1	0.13	Robin	AN-2	0.64	0.807	6.2	6.2	0.24
					AN-3	1.17	0.246	1.9	5.3	0.13
					AN-4	0.15	0.194	1.5	0.53	0.01
Selenium	0.3	1.52	0.99	Shrew	A-1	0.07	1.14 (U)	1.2	0.21	0.01
					A-2	0.15	1.05 (U)	1.1	0.41	0.01
					A-3	0.18	1.35 (U)	1.4	0.63	0.02
					AN-1	0.08	1.04 (U)	1.1	0.22	0.01
					AN-2	0.64	1.03 (U)	1.0	1.0	0.04
					AN-3	1.2	1.04 (U)	1.1	1.1	0.08
					AN-4	0.15	1.07 (U)	1.1	0.42	0.01
					CH-1	0.29	1.05 (U)	1.1	0.79	0.02
					CH-2	0.22	1.1 (U)	1.1	0.63	0.02
					CHN-1	0.07	1.07 (U)	1.1	0.19	<0.01
					I-1	0.30	1.06 (U)	1.1	0.82	0.02

[a] AUF is the reach area divided by the receptor home range, but is no larger than 1 if the reach is larger than the home range.
[b] PAUF is the reach area divided by the receptor population area, but is no larger than 1 if the reach is larger than the population area.

Table 8.1-17
Comparison of Concentrations for
Bird COPECs in Ancho, Chaquehui, and Indio Canyons with
Concentrations from Sediment Evaluated in Previous Bird Studies

COPEC	Sediment BV (mg/kg)	Soil BV (mg/kg)	Bird L-ESL* (mg/kg)	Ancho, Chaquehui, and Indio Canyons Maximum (mg/kg)	Mortandad Canyon Maximum (mg/kg)	Pajarito Canyon Maximum (mg/kg)	Sandia Canyon Maximum (mg/kg)
Cyanide (total)	0.82	0.5	1	4.68	Not detected	1.69	11.6
Mercury	0.1	0.1	0.13	0.807	0.32	1.58	5.57

Note: Gray shading indicates maximum detected concentration from a previous study that exceeds the maximum detected concentration in Ancho, Chaquehui, and Indio Canyons.

*ESL is lowest L-ESL for birds, American robin (avian insectivore).

Table 8.1-18
Weight of Evidence Summary for Soil COPECs
Retained for Ancho, Chaquehui, and Indio Canyons

COPEC	Receptor	Observations
Antimony	Plant	5 of 115 total samples are detections All detected values are less than the BV The two largest nondetected sample results are 4.96 and 4.73 mg/kg The next largest nondetected sample result is 1.77 mg/kg Sources, if any, of antimony in the watershed are unclear Canyons bioassays do not bound nondetected samples Reaches have diverse and abundant plant cover
Chromium	Plant	The maximum concentration is greater than sediment BV but less than soil BV Canyons bioassays do bound the maximum sample result
Cyanide (total)	Robin (insectivore)	Detected in three reaches with potential for adverse effects on birds Population area use adjustments indicated no potential for risk
Mercury	Robin (insectivore)	Detected in three reaches with potential for adverse effects on birds Population area use adjustments indicated no potential for risk
Selenium	Shrew	0 of 115 total samples are detections The maximum concentration is greater than sediment BV but less than soil BV Population area use adjustments indicated no potential for risk
Vanadium	Plant	The maximum concentration is greater than sediment BV and the soil BV All other concentrations are bounded by the soil BV Canyons bioassays do bound the maximum sample result

Table 8.2-1
Residential Risk Ratios Used to Identify Sediment COPCs for Human Health Risk Assessment, Noncarcinogens

Reach	Antimony	Cadmium	Chromium	Cobalt	Copper	Cyanide(Total)	Iron	Lead	Manganese	Mercury	Perchlorate	Selenium	Vanadium	Zinc	Acetone	Anthracene	Aroclor-1254	Di-n-butylphthalate	Diethylphthalate	Endosulfan I	Endosulfan II	Endosulfan Sulfate	Endrin	Endrin Aldehyde	Endrin Ketone	Fluoranthene	Methoxychlor[4,4'-]	Phenanthrene	Pyrene	TATB	SOF
Residential SSL (mg/kg)[a]	**31.3**	**77.9**	**219[b]**	**23[c]**	**3130**	**1560**	**54800**	**400**	**10700**	**23[c]**	**54.8**	**391**	**391**	**23500**	**67500**	**17200**	**1.12**	**6110**	**6110**	**367[d]**	**367[d]**	**18.3[e]**	**18.3**	**18.3[e]**	**18.3[e]**	**2290**	**310[c]**	**1830**	**1720**	**2200[c,f]**	
A-1	0.04[g]	<0.01[g]	—[h]	—	—	<0.01	—	0.06	—	—	<0.01	<0.01[g]	0.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.17
A-2	0.03[g]	<0.01[g]	—	—	—	—	—	—	—	—	<0.01	<0.01[g]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.04
A-3	0.16[g]	<0.01[g]	—	—	—	—	—	—	—	—	<0.01	<0.01[g]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	—	0.17
AN-1	0.03[g]	<0.01[g]	—	0.21	—	—	0.29	—	—	—	<0.01	<0.01[g]	0.07	—	<0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.61
AN-2	0.03[g]	<0.01[g]	—	—	<0.01	—	—	—	—	0.04	<0.01	<0.01[g]	—	—	—	—	<0.01	<0.01	<0.01	—	—	—	—	—	—	—	—	—	<0.01	<0.01	0.09
AN-3	0.03[g]	<0.01[g]	—	—	—	—	—	—	—	0.01	<0.01	<0.01[g]	—	—	—	—	<0.01	—	—	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	—	<0.01	—	—	—	0.06
AN-4	0.15[g]	<0.01[g]	—	—	—	—	—	—	—	0.01	<0.01	<0.01[g]	—	—	—	—	<0.01	—	—	—	—	—	—	—	—	<0.01	—	—	<0.01	—	0.17
CH-1	0.03[g]	<0.01	0.06	—	—	<0.01	0.47	—	0.05	—	<0.01	<0.01[g]	0.12	<0.01	—	—	<0.01	—	<0.01	—	—	—	—	—	—	—	—	—	—	—	0.76
CH-2	0.03[g]	<0.01[g]	—	—	—	—	0.31	—	—	—	<0.01	<0.01[g]	0.07	—	—	—	—	—	—	<0.01	—	—	—	—	—	<0.01	—	<0.01	<0.01	—	0.43
CHN-1	0.03[g]	—	—	—	—	—	0.28	—	—	—	<0.01	<0.01[g]	0.08	—	—	<0.01	<0.01	—	<0.01	—	—	—	—	—	—	<0.01	—	<0.01	<0.01	—	0.40
I-1	0.03[g]	<0.01[g]	—	—	—	—	—	—	—	—	<0.01	<0.01[g]	—	—	—	—	—	<0.01	—	—	—	—	—	—	—	—	—	—	—	—	0.04

[a] SSLs are from NMED (2009, 108070) unless otherwise noted.

[b] Hexavalent chromium is used as surrogate for chromium.

[c] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[d] Endosulfan used as a surrogate for endosulfan I and endosulfan II.

[e] Endrin used as a surrogate for endrin aldehyde, endrin ketone, and endosulfan sulfate.

[f] 1,3,5-Trinitrobenzene used as a surrogate for TATB.

[g] Not detected but detection limits greater than BV, Risk ratio is calculated from maximum detection limit in reach.

[h] — = Not a COPC.

Table 8.2-2
Residential Risk Ratios Used to Identify Sediment COPCs for Human Health Risk Assessment, Carcinogens

Reach	Arsenic	Aldrin	Aroclor-1248	Aroclor-1260	Benzo[a]anthracene	Benzo[a]pyrene	Benzo[b]fluoranthene	BHC[alpha-][a]	BHC[beta-]	BHC[delta-]	BHC[gamma-]	Chlordane[alpha-]	Chlordane[gamma-]	Chrysene	DDD[4,4'-][b]	DDE[4,4'-][c]	DDT[4,4'-][d]	Dieldrin	Heptachlor	Heptachlor Epoxide	Methylene Chloride	SOF
Residential SSL (mg/kg)[e]	**3.9**	**0.284**	**2.22**	**2.22**	**6.21**	**0.62**	**6.21**	**0.772**	**2.7**	**5.17[f]**	**5.17**	**16.2[g]**	**16.2[g]**	**621**	**20.3**	**14.3**	**17.2**	**0.304**	**1.08**	**0.53[h]**	**199**	
A-1	—[i]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	<0.01
A-3	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	—	—	—	—	—	—	—	<0.01
AN-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	—	—	<0.01	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	—	—	—	—	—	<0.01
AN-3	—	<0.01	—	<0.01	—	—	—	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	—	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	—	<0.01
AN-4	1.2	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	—	—	—	—	<0.01	—	—	1.2
CH-1	—	—	—	<0.01	—	—	—	—	—	—	—	—	—	—	—	<0.01	—	—	—	—	—	<0.01
CH-2	—	—	—	—	<0.01	—	—	—	—	—	—	—	—	<0.01	—	<0.01	—	—	—	—	—	<0.01
CHN-1	—	—	—	<0.01	0.01	0.14	0.02	—	—	—	—	—	—	<0.01	—	—	—	—	—	—	—	0.17
I-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.01	—	—	<0.01

Note: Shaded cells indicate which reaches have SOFs >1 and which analytes have ratios > 0.1.

[a] BHC = benzene hexachloride.

[b] DDD = dichlorodiphenyldichloroethane.

[c] DDE = dichlorodiphenyltrichloroethylene.

[d] DDT = dichlorodiphenyltrichloroethane.

[e] SSLs are from NMED (2009, 108070) unless otherwise noted.

[f] BHC[gamma-] used as a surrogate for BHC[delta-].

[g] Chlordane used as a surrogate for Chlordane[alpha-] and Chlordane[gamma-].

[h] SSL from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).

[i] — = Not a COPC.

Table 8.2-3
Residential Dose Ratios Used to Identify
Sediment COPCs for Human Health Risk Assessment, Radionuclides

Reach	Cesium-137	Plutonium-238	Plutonium-239/240	Tritium	Uranium-234	Uranium-235/236	Uranium-238	SOF
Residential SAL (pCi/g)[a]	**5.6**	**37**	**33**	**750**	**170**	**17**	**87**	
A-1	0.63	—[b]	<0.01	—	0.02	—	0.04	0.69
A-2	0.21	—	—	—	—	—	—	0.21
A-3	—	—	—	—	—	—	—	—
AN-1	0.25	—	<0.01	—	—	—	—	0.26
AN-2	—	—	—	—	0.05	0.04	0.25	0.33
AN-3	—	—	—	—	—	—	0.06	0.06
AN-4	—	—	—	<0.01	—	—	0.05	0.05
CH-1	—	—	—	—	—	—	—	—
CH-2	—	—	—	<0.01	—	—	—	<0.01
CHN-1	—	—	—	<0.01	—	—	—	<0.01
I-1	—	<0.01	—	—	—	—	—	<0.01

[a] SALs are from LANL (2009, 107655).
[b] — = Not a COPC.

Table 8.2-4
Residential Risk Ratios Used to Identify Surface-Water COPCs for Human Health Risk Assessment, Noncarcinogens

Location ID	Reach	Aluminum	Barium	Boron	Chloride	Chromium	Cobalt	Copper	Fluoride	Iron	Lead	Manganese	Molybdenum	Nickel	Perchlorate	Selenium	Strontium	Sulfate	Thallium	Uranium	Vanadium	Zinc	Acetone	Dichlorobenzene[1,3-]	Di-n-octylphthalate	Toluene	SOF
Residential SL (µg/L)[a]		**36500**	**7300**	**7300**	**250000[b]**	**110[c]**	**11[d]**	**1460**	**2190**	**25600**	**15[b]**	**876**	**183**	**730**	**26**	**183**	**21900**	**250000[b]**	**2.41**	**110**	**183**	**11000**	**21800**	**18.3**	**1460[e]**	**2280**	
Ancho at Rio Grande	A-3	<0.01	<0.01	<0.01	0.01	0.03	—[f]	—	0.23	<0.01	0.01	0.01	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	0.38	<0.01	0.06	<0.01	<0.01	—	—	—	0.81
Doe Spring	CH-2	<0.01	<0.01	<0.01	<0.01	0.02	—	<0.01	0.23	<0.01	—	0.02	0.01	<0.01	<0.01	—	<0.01	<0.01	0.20	<0.01	0.05	<0.01	—	—	—	—	0.59
Spring 9A	CH-2	<0.01	<0.01	<0.01	<0.01	0.04	0.12	—	0.26	<0.01	0.05	<0.01	0.01	<0.01	0.01	—	<0.01	<0.01	—	<0.01	0.05	<0.01	<0.01	0.03	<0.01	<0.01	0.61

Note: Unless otherwise noted, all screening levels are for tap water.
[a] Tap water screening value from NMED (2009, 108070).
[b] MCL = EPA drinking water standard.
[c] The NMED tap water value for hexavalent chromium is used for chromium.
[d] Tap water screening value from EPA regional screening tables (http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm).
[e] EPA Region 6 (2005, 091002).
[f] — = All results were nondetections or no data were available.

Table 8.2-5
Residential Risk Ratios Used to Identify
Surface-Water COPCs for Human Health Risk Assessment, Carcinogens

Location ID	Reach	Arsenic	Chloromethane	SOF
Residential SL (µg/L)[a]		**0.448**	**17.8**	
Ancho at Rio Grande	A-3	—[b]	—	—
Doe Spring	CH-2	6.5	—	6.5
Spring 9A	CH-2	4.2	0.02	4.2

Note: Shaded cells indicate which reaches have SOFs >1 and which analytes have ratios > 0.1.
[a] Tap water screening values are from NMED (2009, 108070).
[b] — = All results were nondetections or no data were available.

Table 8.2-6
Residential Risk Ratios Used to Identify Surface-Water COPCs for Human Health Risk Assessment, Radionuclides

Location ID	Reach	Radium-226	Thorium-232	Tritium	Uranium-234	Uranium-235/236	Uranium-238	SOF
Residential SL (pCi/L)[a]		**4**	**2**	**80000**	**20**	**24**	**24**	
Ancho at Rio Grande	A-3	0.19	0.80	<0.01	0.01	—[b]	<0.01	1.0
Doe Spring	CH-2	—	—	<0.01	0.01	—	<0.01	0.02
Spring 9A	CH-2	—	—	<0.01	0.10	<0.01	0.04	0.13

[a] All screening levels are from DOE DCGs (DOE Order 5400.5, "Radiation Protection of the Public and the Environment").
[b] — = All results were nondetects or no data were available.

Table 8.2-7
Reaches and Analyte Classes Evaluated for Sediment, Surface Water, and Multimedia Exposure

Reach	Sediment	Surface Water	Multimedia
A-1	—*	—	—
A-2	—	—	—
A-3	—	—	—
AN-1	—	—	—
AN-2	—	—	—
AN-3	—	—	—
AN-4	Carcinogen	—	—
CH-1	—	—	—
CH-2	—	Carcinogen	—
CHN-1	—	—	—
I-1	—	—	—

*— = Not evaluated (see Tables 8.2-1 through 8.2-6).

Table 8.2-8
Site-Specific Exposure Scenarios and Complete Exposure Pathways

Exposure Pathways	Exposure Scenarios	
	Recreational	Residential
Incidental ingestion of soil	X[a]	X
Inhalation of dust	X	X
Dermal contact with soil	X	X
Ingestion of surface water	X	—[b]
Dermal contact with surface water	X	—
External irradiation	X	X

[a] X = Complete pathway.
[b] — = Incomplete pathway.

Table 8.2-9
Risk-Based Screening Values

Medium	COPC	Endpoint	Target Adverse-Effect Level	Recreational Screening Level	Units	Reference
Sediment	Arsenic	Carcinogen	1×10^{-5}	27.7	mg/kg	LANL (2010, 108613)
Surface water	Arsenic	Carcinogen	1×10^{-5}	78.4	µg/L	LANL (2004, 087390), calculated

Table 8.2-10
Summary of Recreational
Risk Assessment Results

Reach	Total Sediment Risk	Total Surface-Water Risk	Total Multimedia Risk
AN-4	1×10^{-6}	—*	—
CH-2	—	4×10^{-7}	—

*— = Incomplete pathway.

Table 8.2-11
Risk Ratio Based on Recreational EPC for Sediment

Reach	Arsenic	SOF	Total Risk
Recreational SL (mg/kg)	**27.7**		
AN-4	0.096	0.096	1 x 10^{-6}

Table 8.2-12
Risk Ratio Based on Recreational EPC for Surface Water

Reach	Arsenic	SOF	Total Risk
Recreational SL (µg/L)	**78.4**		
CH-2	0.037	0.037	4 x 10^{-7}

Table 8.2-13
EPC for Sediment COPC

Reach	Endpoint	Analyte	UCL (mg/kg)
AN-4	Carcinogen	Arsenic	2.66

Table 8.2-14
EPC for Surface-Water COPC

Reach	Endpoint	Analyte	Maximum (µg/L)
CH-2	Carcinogen	Arsenic	2.9

Appendix A

Acronyms and Abbreviations,
Metric Conversion Table, and Data Qualifier Definitions

A-1.0 ACRONYMS AND ABBREVIATIONS

2,4-D	2,4-dichlorophenoxyacetic acid
2,4-DB	2,4-dichlorophenoxybutyric acid
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
2,4,5-TP	2,4,5-trichlorophenoxypropionic acid
AOC	area of concern
AUF	area use factor
asl	above sea level
ASTM	American Society for Testing and Materials
BCG	Biota Concentration Guide (DOE)
bgs	below ground surface
BHC	benzene hexachloride
BV	background value
CCV	continuing calibration verification
cfs	cubic feet per second
Consent Order	Compliance Order on Consent
COPC	chemical of potential concern
COPEC	chemical of ecological concern
CRDL	contract-required detection limit
CWA	Clean Water Act
DCG	Derived Concentration Guide (DOE)
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyltrichloroethylene
DDT	dichlorodiphenyltrichloroethane
DNX	hexahydro-1,3-dinitro-5-nitro-1,3,5-triazine
DOE	Department of Energy (U.S.)
DRI	Desert Research Institute
EC	effect concentration
ED	exposure duration
EDL	estimated detection limit
EPA	Environmental Protection Agency (U.S.)
EPC	exposure point concentration
ERAGS	Ecological Risk Assessment Guidance for Superfund (EPA)

ESL	ecological screening level
GENINORG	general inorganics (analytical suite)
GW	groundwater
HEXP	high explosives (analytical suite)
HIR	historical investigation report
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	hazard quotient
ICPES	inductively coupled plasma emission spectroscopy
ICV	initial calibration verification
IP	Individual Permit (for stormwater discharges from SWMUs/AOCs)
IRIS	Integrated Risk Information System (EPA)
IS	internal standard
Laboratory	Los Alamos National Laboratory
LAL	lower acceptance level
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
L-ESL	lowest effect ecological screening level
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
MCPA	methyl-4-chlorophenoxyacetic(2-) acid
MCPP	methyl-4-chlorophenoxypropionic(2-) acid
MDA	material disposal area
MDC	minimum detectable concentration
MCL	maximum contaminant level (EPA)
MDL	method detection limit
MNX	hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
MS	matrix spike
MSD	matrix spike duplicate
NMAC	New Mexico Administrative Code
NMWQCC	New Mexico Water Quality Control Commission
NMED	New Mexico Environment Department
NMEIB	New Mexico Environmental Improvement Board
NMRPS	NMEIB Radiation Protection Standards
NOAEL	no observed adverse effect level

NOD	notice of disapproval
NOEC	no observed effect concentration
NPDES	National Pollutant Discharge Elimination System
NRAO	National Radio Astronomy Observatory
%D	percent difference
%R	percent recovery
P&A	plugging and abandonment
PAH	polycyclic aromatic hydrocarbon
PAUF	population area use factor
PCB	polychlorinated biphenyl
PETN	pentaerythritol tetranitrate
QA	quality assurance
QC	quality control
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RfD	reference dose
RME	reasonable maximum exposure
RPD	relative percent difference
RPF	Records Processing Facility
RRF	relative response factor
RSD	relative standard deviation
RSL	regional screening level (EPA)
SAL	screening action level
SF	slope factor
SL	screening level
SLERA	screening level ecological risk assessment
SMDB	Sample Management Database
SOF	sum of fractions
SOP	standard operating procedure
SOW	statement of work
SQuiRTs	Screening Quick Reference Tables (National Oceanic and Atmospheric Administration)
SSL	soil screening level
SVOA	semivolatile organic analyte
SVOC	semivolatile organic compound
SMCL	secondary maximum contaminant level (EPA)

SWMU	solid waste management unit
T&E	threatened and endangered
TA	technical area
TATB	triaminotrinitrobenzene
TCDD	tetrachlorodibenzo-p-dioxin
TEC	toxic equivalent concentration
TNX	hexahydro-1,3,5-trinitroso-1,3,5-triazine
TPU	total propagated uncertainty
TRV	toxicity reference value
TSS	total suspended solids
UAL	upper acceptance level
UCL	upper confidence limit
VOA	volatile organic analyte
VOC	volatile organic compound
WQC	water-quality criteria
WQDB	Water Quality Database

A-2.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain U.S. Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-3.0 DATA QUALIFIER DEFINITIONS

Data Qualifier	Definition
U	The analyte was analyzed for but not detected.
J	The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.
J+	The analyte was positively identified, and the result is likely to be biased high.
J-	The analyte was positively identified, and the result is likely to be biased low.
UJ	The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific detection or quantitation limit.
R	The data are rejected as a result of major problems with quality assurance/quality control parameters.

Appendix B

Field Investigation Methods and Results

B-1.0 SEDIMENT INVESTIGATIONS IN REACHES

This appendix summarizes the methods used and the results of field investigations of potentially contaminated sediment deposits in reaches in Ancho, Chaquehui, and Indio Canyons conducted in 2010 as part of implementation of the "South Canyons Investigation Work Plan" (LANL 2006, 093713). Geomorphic mapping at a scale of 1:200 occurred in each reach and focused on delineating geomorphic units with differences in physical characteristics and/or contaminant levels. These maps are presented on Plates 1, 2, and 3. Unit designations followed those used in previous reports on canyons in and near Los Alamos National Laboratory (LANL or the Laboratory) (LANL 2004, 087390; LANL 2006, 094161; LANL 2009, 106939; LANL 2009, 107453; LANL 2009, 107416; LANL 2009, 107497; LANL 2010, 111507), with "c" designating post-1942 channel units and "f" designating post-1942 floodplain units. Summaries of the physical characteristics of post-1942 geomorphic units in the Ancho, Chaquehui, and Indio Canyons investigation reaches are presented in Table B-1.0-1. Schematic cross-sections illustrating the topographic setting and sediment characteristics in different units in some of the investigation reaches are presented in Figures 7.1-1 to 7.1-4 of the main text.

Sediment thickness measurements distinguished between fine facies sediment, with typical median particle size of silt to fine sand (0.015 to 0.25 mm) in the less than 2-mm fraction, and coarse facies sediment, with typical median particle size of coarse to very coarse sand (0.5 to 2 mm) in the less than 2-mm fraction. Samples with median particle size of medium sand (0.25 to 0.5 mm) were classified either as fine or coarse facies, depending on the stratigraphic context and the particle size of adjacent layers. Coarse facies sediment is characteristic of material transported along the streambeds as bed load, and fine facies sediment is characteristic of material transported in suspension (Malmon 2002, 076038, pp. 94−97; Malmon et al. 2004, 093018). Several methods were used to identify the bottom of post-1942 sediment deposits, including determining the depth of buried trees and associated buried soils and noting the presence or absence of materials imported to the watersheds after 1942 (e.g., quartzite gravel, plastic). Sediment thickness measurements from the Ancho, Chaquehui, and Indio Canyons investigation reaches are presented in Table B-1.0-2 (see Attachment 1 on CD). Where uncertainty existed in the thickness of post-1942 sediment because of the absence of distinct stratigraphic breaks at depth, measurements were biased high to avoid underestimating the possible vertical extent of potentially contaminated sediment. For reaches with significant effects from the 1977 La Mesa fire (reaches A-1, A-2, and AN-1), the measurements in Table B-1.0-2 include the estimated thicknesses of both prefire and postfire sediment deposits. Stratigraphy associated with post−La Mesa fire deposits in upper Ancho Canyon is very similar to stratigraphy associated with post−Cerro Grande fire deposits, specifically a sharp contrast between the initial dark, ash-rich postfire sediment and the lighter prefire sediment.

Average facies thickness in each unit was combined with unit area, as determined from digitized geomorphic maps, to obtain estimated unit volumes in each reach. The estimates of unit volume were combined with estimates of relative contaminant levels to allocate samples using a stratified sample allocation process (Gilbert 1987, 056179, pp. 45−57) designed to reduce uncertainties in the contaminant inventory in each reach. In this process, samples were preferentially allocated to units and sediment facies with a large portion of the total inventory (e.g., Ryti et al. 2005, 093019). Because no previous data existed on relative contaminant concentrations in different units and sediment facies in the Ancho, Chaquehui, and Indio Canyon reaches, it was assumed that concentrations were 3 times higher in fine facies sediment relative to coarse facies sediment, based on previous results from other canyons. One result of this sample allocation process is a high bias in sample results because a disproportionately large number of samples were collected from the potentially more contaminated fine facies sediment.

Variations in the estimated width of potentially contaminated post-1942 geomorphic units and the volumes of post-1942 sediment in each investigation reach are shown in Table B-1.0-3 (see Attachment 1 on CD). Sediment volumes are normalized by reach length and shown in units of cubic meters per kilometer (m^3/km). The average width of the area affected or potentially affected by post-1942 floods varies from 3.2 m in upper Ancho Canyon (reach A-1) to 58.3 m in the north fork of Ancho Canyon (reach AN-3). Estimated volumes of post-1942 sediment vary from 803 m^3/km in the north fork of Chaquehui Canyon (reach CHN-1) to 17,163 m^3/km in AN-3. The relative volume of coarse and fine facies sediment also varies between reaches. The estimated percentage of coarse facies sediment is least in upper Ancho Canyon (reach A-2, 16%) and greatest in the lower part of north fork of Ancho Canyon (reach AN-4, 65%) (Table B-1.0-3). In reaches where it is possible to recognize pre- and post-La Mesa fire deposits (A-1, A-2, and AN-1), the postfire sediment accounts for an estimated 39% to 56% of the total post-1942 sediment volume (Table B-1.0-3).

Particle-size analyses of sediment samples were obtained at an off-site laboratory at the Desert Research Institute (DRI) following the procedures described in Janitzky (1986, 057674) to examine the effect of particle-size distribution on contaminant concentrations. Organic-matter content was also determined for sediment samples at DRI using the loss-on-ignition method to provide additional information about the physical characteristics of potentially contaminated sediment deposits, and pH data were also obtained because ecological screening levels can be pH-dependant for some analytes (aluminum and iron). Particle size, organic matter, and pH data from the Ancho, Chaquehui, and Indio Canyons investigation reaches are presented in Table B-1.0-4 (see Attachment 1 on CD).

Dendrochronological analyses (tree-ring dating) were performed in some reaches to provide supplemental information on the age of sampled sediment deposits in Ancho, Chaquehui, and Indio Canyons. Sediments burying trees of known age are constrained to be younger than the trees, and sediments beneath the base of trees are constrained to be older. In some cases, nearby trees of different ages can provide more precise determination of the ages of sediment deposits. For example, two adjacent trees of different ages can be buried by different thicknesses of sediment recording a variable number of floods since the germination of each tree and approximate ages for such floods, or different age trees can be buried by the same thickness of sediment recording the absence of deposition during specific time periods. Cores were collected from 16 trees in Ancho, Chaquehui, and Indio Canyons using a 5-mm-diameter increment borer. Each tree was assigned a unique three-letter, three-number identifier following the general convention used by the Laboratory of Tree-Ring Research at the University of Arizona, with the designation “ANC”, “CHA” and “IND” chosen to indicate trees cored in Ancho, Chaquehui, and Indio Canyons, respectively. These trees are located at or near sediment sampling locations, and data on the tree diameter and the thickness of sediment burying each tree were recorded. These analyses followed the methodology described in Stokes and Smiley (1996, 057644) and Phipps (1985, 058477), and the process is discussed further in Reneau et al. (1998, 065407; Appendix B, section B-1.0). Results of the dendrochronological analyses from the Ancho, Chaquehui, and Indio Canyon investigation reaches are presented in Table B-1.0-5 (see Attachment 1 on CD). The most trees were cored in reach AN-3, in the north fork of Ancho Canyon, including six ponderosa pines that have estimated pith dates of 1926 to 1993 These trees were buried by 0 to 30 cm of sediment. Examples of the relations of dendrochronologically-dated trees to sediment deposits in some of the reaches are shown in Figures 7.1-2 to 7.1-4 of the main text.

B-2.0 WATER INVESTIGATIONS

This section provides additional information concerning stream-flow measurements and observations of wells in Ancho Canyon since 1995, and in Indio Canyon since 2007. No rating curves have been developed for gages in Chaquehui Canyon, so no discharge estimates are possible. Stream-flow measurements at gages E274 (Ancho north fork below SR-4), E275 (Ancho below SR-4), and E264 (Indio Canyon at SR-4) (Figure 3.2-1 of the main text) were compiled from annual surface-water data reports (e.g., Ortiz and McCullough 2010, 109826)) and were used to evaluate flow magnitude and frequency. These data are summarized in Table B-2.0-1. Days with flow are included for gage E340 located in the north fork of Chaquehui Canyon.

The full set of wells used in water investigations is provided in Table B-2.0-2. A moisture profile for well 49-2-700-1 is provided in Figure B-2.0-1 and shows moisture levels generally below 15%, with a maximum moisture level of 16.5% in the Tsankawi Pumice Bed. Field visits to alluvial wells 39-UM-3, located upgradient of MDA Y, and 39-DM-6, located downgradient of MDA Y, were compiled from annual groundwater level status reports (Koch and Schmeer 2010, 108926) and are summarized in Table B-2.0-3.

B-3.0 REFERENCES

The following list includes all documents cited in this appendix. 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.

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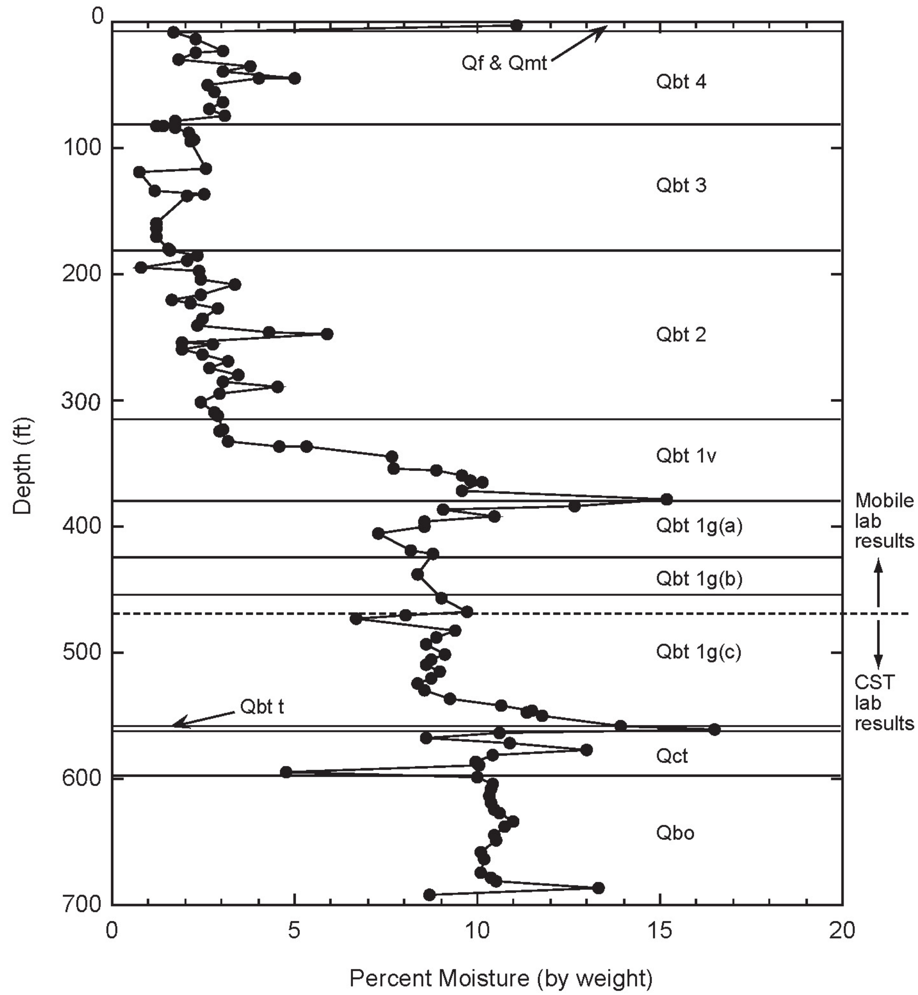

Figure B-2.0-1 Moisture profile for borehole 49-2-700-1. The top of the main aquifer is expected to be at about 1163 ft bgs based on nearby borehole DT-5A (Weir and Purtymun 1962, 011890). Figure modified from (Stimac et al. 2002, 073391).

Table B-1.0-1
Physical Characteristics of Post-1942 Geomorphic Units
in the Ancho, Chaquehui, and Indio Canyons Investigation Reaches

Reach	Geomorphic Unit	Average Unit Width (m)[a]	Sediment Facies	Estimated Average Sediment Thickness (m)	Typical Median Particle Size Class (<2 mm fraction)	Notes
A-1	c1	0.7	Fine	0.15	Very fine sand[b]	Active channel, with much post-1977 (post–La Mesa fire) sediment
			Coarse	0.10	Coarse sand	
	c1br	0.1	n/a[c]	0.00	n/a	Active channel on bedrock
	c2	2.1	Fine	0.31	Coarse silt	Abandoned post-1942 channel, with much post-1977 (post–La Mesa fire) sediment
			Coarse	0.13	Medium sand	
	f1	0.4	Fine	0.30	Very fine sand	Post-1942 floodplain, with much post-1977 (post–La Mesa fire) sediment
	Total	**3.2**				
A-2	c1	1.0	Fine	0.18	Very fine sand[b]	Active channel, dominated by post-1977 (post–La Mesa fire) sediment
			Coarse	0.23	Coarse sand	
	c1br	0.2	n/a	0.00	n/a	Active channel on bedrock
	c2	1.8	Fine	0.38	Coarse silt	Abandoned post-1942 channel, dominated by post-1977 (post–La Mesa fire) sediment
			Coarse	0.06	Medium sand[b]	
	f1	2.8	Fine	0.37	Coarse silt	Post-1942 floodplain, with much post-1977 (post–La Mesa fire) sediment
			Coarse	0.03	Medium sand[b]	
	f2	1.6	Fine	0.13	Fine sand	Possible post-1942 pre-1977 floodplain
	Total	**7.3**				
A-3	c1	2.1	Coarse	0.25	Coarse sand	Active channel
	c2	4.1	Fine	0.14	Medium sand	Abandoned post-1942 channel
			Coarse	0.15	Coarse sand	
	f1	2.7	Fine	0.32	Fine sand	Post-1942 floodplain
			Coarse	0.02	Medium sand[b]	
	Total	**8.9**				
AN-1	c1	0.9	Fine	0.13	Fine sand[b]	Active channel, dominated by post-1977 (post–La Mesa fire) sediment
			Coarse	0.22	Very coarse sand	
	c1br	0.1	n/a	0.00	n/a	Active channel on bedrock
	c2	2.3	Fine	0.31	Coarse silt	Abandoned post-1942 channel, dominated by post-1977 (post–La Mesa fire) sediment
			Coarse	0.05	Coarse sand	
	f1	0.7	Fine	0.17	Fine sand	Post-1942 floodplain, with much post-1977 (post–La Mesa fire) sediment
	Total	**3.9**				

Table B-1.0-1 (continued)

Reach	Geomorphic Unit	Average Unit Width (m)[a]	Sediment Facies	Estimated Average Sediment Thickness (m)	Typical Median Particle Size Class (<2 mm fraction)	Notes
AN-2	c1	7.1	Fine	0.02	Fine sand[b]	Active channel
			Coarse	0.46	Very coarse sand	
	c2	4.4	Fine	0.33	Fine sand	Younger abandoned post-1942 channel
			Coarse	0.32	Very coarse sand	
	c3	2.7	Fine	0.28	Fine sand	Older abandoned post-1942 channel
			Coarse	0.30	Very coarse sand[b]	
	f1	16.9	Fine	0.23	Fine sand	Post-1942 floodplain
	Total	**31.1**				
AN-3	c1	4.6	Coarse	0.62	Coarse sand	Active channel
	c2	2.4	Fine	0.07	Fine sand[b]	Younger abandoned post-1942 channel
			Coarse	0.43	Coarse sand	
	c3	9.7	Fine	0.17	Medium sand	Older abandoned post-1942 channel
			Coarse	0.30	Coarse sand	
	f1	36.0	Fine	0.22	Very fine sand	Post-1942 floodplain
	f2	5.6	Fine	0.12	Very fine sand[b]	Possible post-1942 floodplain
	Total	**58.3**				
AN-4	c1	3.0	Fine	0.01	Fine sand[b]	Active channel
			Coarse	0.56	Coarse sand	
	c2	4.0	Fine	0.30	Fine sand	Abandoned post-1942 channel
			Coarse	0.28	Coarse sand	
	f1	1.2	Fine	0.26	Very fine sand	Post-1942 floodplain
	Total	**8.2**				
CH-1	c1	1.7	Coarse	0.39	Coarse sand	Active channel
	c2	4.7	Fine	0.29	Fine sand	Abandoned post-1942 channel
			Coarse	0.34	Coarse sand	
	f1	7.9	Fine	0.19	Fine sand	Post-1942 floodplain
			Coarse	0.06	Medium sand[b]	
	Total	**14.3**				

Table B-1.0-1 (continued)

Reach	Geomorphic Unit	Average Unit Width (m)[a]	Sediment Facies	Estimated Average Sediment Thickness (m)	Typical Median Particle Size Class (<2 mm fraction)	Notes
CH-2	c1	2.4	Fine	0.01	Fine sand[b]	Active channel
			Coarse	0.26	Coarse sand	
	c2	2.9	Fine	0.37	Fine sand	Abandoned post-1942 channel
			Coarse	0.10	Coarse sand	
	f1	5.8	Fine	0.40	Fine sand	Post-1942 floodplain
			Coarse	0.14	Coarse sand	
	Total	**11.0**				
CHN-1	c1	1.0	Coarse	0.13	Coarse sand	Active channel
	c1br	0.3	n/a	0.00	n/a	Active channel on bedrock
	c2	1.8	Fine	0.21	Very fine sand	Abandoned post-1942 channel
			Coarse	0.10	Coarse sand	
	f1	0.5	Fine	0.18	Coarse silt	Post-1942 floodplain
	Total	**3.6**				
I-1	c1	1.5	Fine	0.03	Medium sand[b]	Active channel
			Coarse	0.38	Coarse sand	
	c2	5.4	Fine	0.15	Medium sand	Abandoned post-1942 channel
			Coarse	0.26	Coarse sand	
	f1	8.1	Fine	0.27	Fine sand	Post-1942 floodplain
	Total	**14.9**				

[a] Average unit width is total area of unit in reach divided by reach length.

[b] No particle size data from unit; median particle size inferred based on data from other units and field descriptions.

[c] n/a = Not applicable.

Table B-2.0-1
Summary of Surface-Water Measurements from Gages E264, E274, E275, and E340

Gage	Days With Flow	Volume of Water (acre ft)	Peak Discharge (cfs)	Days With Flow	Volume of Water (acre ft)	Peak Discharge (cfs)	Days With Flow	Volume of Water (acre ft)	Peak Discharge (cfs)	Days With Flow
	E264	E264	E264	E274	E274	E274	E275	E275	E275	E340
Description	Indio at SR 4	Indio at SR 4	Indio at SR 4	Ancho north fork below SR-4	Ancho north fork below SR-4	Ancho north fork below SR-4	Ancho below SR-4	Ancho below SR-4	Ancho below SR-4	Chaquehui Tributary at TA-33
1995	—*	—	—	—	—	—	5	12	520	—
1996	—	—	—	—	—	—	-	50.7	111	—
1997	—	—	—	—	—	—	2	10.4	98	—
1998	—	—	—	—	—	—	2	0.06	1.9	—
1999	—	—	—	—	—	—	18	11	1.91	—
2000	—	—	—	—	—	—	6	8.6	349	—
2001	—	—	—	—	—	—	6	4.5	34	—
2002	—	—	—	—	—	—	0	0	0	—
2003	—	—	—	—	—	—	2	39	534	—
2004	—	—	—	—	—	—	1	7.9	168	—
2005	—	—	—	—	—	—	8	2.5	38	—
2006	—	—	—	—	—	—	11	23	325	8
2007	10	0.2	0.03	—	—	—	4	1.6	25	0
2008	0	0	0.01	2	2.7	89	6	33	536	4
2009	4	0.08	0.01	3	0.06	0.53	5	17	414	6
Average	4.7	0.1	0.0	2.5	1.4	44.8	5.4	14.8	210.4	4.5
Count	14	—	—	5	—	—	76	—	—	18

* — = No data.

Table B-2.0-2
Ancho Canyon Wells, Boreholes, and Moisture Access Tubes

Well Name	Total Depth	Completion Depth	Type	Purpose	Status	Zone	Easting	Northing	Install Date	No. of Screens	Reference	Notes
39-DM-2	40	40	Well	Monitoring	Active	Alluvial	1639912	1743157	06/15/1994	1	LANL 1997, 055633; LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; unable to locate in 2009; recommend P&A in 2009, 2010
39-DM-4	25	25	Well	Monitoring	Active	Alluvial	1639844	1743548	06/15/1994	1	LANL 1997, 055633; LANL 2006, 093714; LANL 2010, 108592	Dry when drilled and in 2009 check; recommend P&A in 2009, 2010
39-DM-5	55	—*	Borehole	Monitoring	P&A	Alluvial	1637062	1747382	08/15/1994	—	LANL 2006, 093714	Dry when drilled; abandoned right away
39-DM-6	60	60	Well	Monitoring	Active	Alluvial	1637094	1747228	08/15/1994	1	LANL 1997, 055633; Koch and Schmeer 2010, 108926; LANL 2006, 093714; LANL 2010, 108592	Dry when drilled and during periodic sampling; recommend P&A in 2009, 2010
39-DMB-1	122	122.5	Well	Monitoring	Active	Vadose	1639992	1743176	06/16/1998	1	LANL 1997, 055633; LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; unable to locate in 2009; recommend P&A in 2009, 2010
39-UM-3	55	54	Well	Monitoring	Active	Alluvial	1637032	1747663	08/15/1994	1	Koch and Schmeer 2010, 108926; LANL 2006, 093714; LANL 2010, 108592	Dry when drilled and during periodic sampling; recommend P&A in 2009, 2010
49-9M-2	19	19	Moisture access tube	Monitoring	Unknown	Moisture Hole	1625794	1754576	03/01/1960	—	Purtymun 1995, 045344; LANL 2006, 093714	Dry when drilled
49-9M-3	19	19	Moisture access tube	Monitoring	Unknown	Moisture Hole	1626420	1754186	02/01/1960	—	Purtymun 1995, 045344; LANL 2006, 093714	Dry when drilled
49-9M-4	19	19	Moisture access tube	Monitoring	Unknown	Moisture Hole	1626017	1754513	02/01/1960	—	Purtymun 1995, 045344; LANL 2006, 093714	Dry when drilled
49-GAMMA	54	8	test hole	Monitoring	P&A	Alluvial	1626210	1752623	03/01/1960	—	Purtymun 1995, 045344; LANL 2006, 093714	Dry when drilled
ASC-0	80 (56.5)	80 (56.5)	Borehole-angled 45 °	contaminant characterization	Active	Alluvial	1639833	1743580	05/28/1998	—	LANL 2006, 093714; LANL 2010, 108592	Replacement for ASC-1; Dry when drilled; wet in 2009; recommend P&A in 2009, 2010
ASC-1	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	abandoned	Alluvial	1639844	1743554	05/28/1998	—	LANL 2006, 093714; LANL 2010, 108592	Abandoned when drilled; casing broke
ASC-11	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1637060	1747199	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; recommend P&A in 2009, 2010
ASC-12	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1637095	1747243	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; wet in 2009; recommend P&A in 2009, 2010
ASC-13	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1637014	1747265	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; wet in 2009; recommend P&A in 2009, 2010
ASC-14	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1637077	1747343	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; wet in 2009; recommend P&A in 2009, 2010
ASC-15	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1637071	1747361	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Recommend P&A in 2009, 2010; saturated conditions encountered when drilled
ASC-16	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1637104	1747399	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Recommend P&A in 2009, 2010; saturated conditions encountered when drilled
ASC-17	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1636984	1747412	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; wet in 2009; recommend P&A in 2009, 2010

Table B-2.0-2 (continued)

Well Name	Total Depth	Completion Depth	Type	Purpose	Status	Zone	Easting	Northing	Install Date	No. of Screens	Reference	Notes
ASC-18	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1636976	1747487	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Recommend P&A in 2009, 2010; saturated conditions encountered when drilled
ASC-19	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1637084	1747532	07/27/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; wet in 2009; recommend P&A in 2009, 2010
ASC-2	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1639850	1743618	05/28/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; wet in 2009; recommend P&A in 2009, 2010
ASC-3	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1639831	1743668	05/28/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; casing broken; well P&Aed - 2009
ASC-4	80 (56.5)	80 (56.5)	Borehole-angled - 45 °	contaminant characterization	Active	Alluvial	1639800	1743748	05/28/1998	—	LANL 2006, 093714; LANL 2010, 108592	Dry when drilled; wet in 2009; recommend P&A in 2009, 2010
R-31	1103	1077.7	Well	Monitoring	Active	Regional	1637354	1745648	12/01/2000	5	Vaniman et al. 2002, 072615	screen 1 dry
ACTH-7	55	0	Test hole	unused	P&A	Alluvial	1640744	1740462	04/01/1950	—	Purtymun 1995, 045344; LANL 2006, 093714	Dry when drilled; P&Aed right away
49-2-700-1	700	150	Borehole	core sampling	Active	Vadose	1625985	1755209	01/25/1994	—	Stimac et al. 2002, 073391; LANL 2006, 093714	Dry
49-CH-1	501	500	Corehole	core sampling	P&A planned	Vadose	1624469	1755478	12/07/1963	1	Purtymun 1995, 045344; LANL 2006, 093714	Dry; P&A planned - see 2011 P&A work plans
49-CH-2	507	507	Corehole	core sampling	P&A	Vadose	1625826	1755344	11/01/1959	1	Purtymun 1995, 045344; LANL 2006, 093714	P&A'd in August 1998
49-CH-3	300	300	Corehole	core samples	P&A planned	Vadose	1624196	1754493	02/15/1960	1	Purtymun 1995, 045344; LANL 2006, 093714	Dry; P&A planned - see 2011 P&A work plans
49-CH-4	303	300	Corehole	core samples	P&A planned	Vadose	1625537	1753898	02/15/1960	1	Purtymun 1995, 045344; LANL 2006, 093714	Dry; P&A planned - see 2011 P&A work plans
DT-10	1409	1408	Well	Monitoring	Active	Regional	1628989	1754449	03/13/1960	1	Purtymun 1995, 045344; Koch and Schmeer 2010, 108926; LANL 2006, 093714	
DT-5A	1821	1819.5	Well	Monitoring	Active	Regional	1625310	1754789	01/25/1960	1	Purtymun 1995, 045344; Koch and Schmeer 2010, 108926; LANL 2006, 093714	
DT-9	1501	1501	Well	Monitoring	Active	Regional	1628994	1751493	02/19/1960	1	Purtymun 1995, 045344; Koch and Schmeer 2010, 108926; LANL 2006, 093714	
R-30	1196	1171.8	Well	Monitoring	Active	Regional	1626288	1753921	04/01/2014	1	LANL 2010, 110478	
R-29	1248	1191.8	Well	Monitoring	Active	Regional	1626780	1755383	04/04/2014	1	LANL 2010, 110518	

* — = No data.

Table B-2.0-3
Manual Water-Level Observations
for Wells 39-UM-3 and 39-DM-6

Date	Comments
39-UM-3 Manual Water Levels	
03/09/2006	Dry
06/13/2006	Dry
09/07/2006	Dry
11/30/2006	Dry
12/12/2006	Dry
03/15/2007	Dry
05/10/2007	Dry
06/06/2007	Dry
09/05/2007	Dry
11/01/2007	Dry
01/16/2008	Dry
04/07/2008	Dry
07/26/2008	Dry
10/15/2008	Dry
03/31/2009	Dry
07/02/2009	Dry
39-DM-6-Manual Water Levels	
03/09/2006	Dry
06/13/2006	Dry
09/07/2006	Dry
11/30/2006	Dry
12/12/2006	Dry
03/15/2007	Dry
05/10/2007	Dry
06/06/2007	Dry
09/05/2007	Dry
11/01/2007	Dry
01/16/2008	Dry
04/07/2008	Dry
07/26/2008	Dry
10/15/2008	Dry
03/31/2009	Dry
07/02/2009	Dry

Note: Data from Koch and Schmeer (2010, 108926).

Appendix C

Analytical Data

C-1.0 ANALYTICAL RESULTS

All available data packages are included as Attachment C-1 on DVD. Sediment and water data from Ancho, Chaquehui, and Indio Canyons are presented on DVD as Attachment C-2. Data obtained from Los Alamos National Laboratory's (LANL's or the Laboratory's) Sample Management Database (SMDB) and Water Quality Database (WQDB) are grouped by sediment and water. Data are further subdivided in Attachment C-2 into analytical data (those data used in analyses presented in this report), field quality control (QC) data, and rejected data.

C-1.1 SMDB and WQDB Data

The following files containing SMDB and WQDB data are included as Attachment C-2 on DVD:

- Ancho, Chaquehui, and Indio Canyons sediment analytical data
- Ancho, Chaquehui, and Indio Canyons sediment field QC data
- Ancho, Chaquehui, and Indio Canyons sediment rejected data
- Ancho, Chaquehui, and Indio Canyons surface-water analytical data
- Ancho, Chaquehui, and Indio Canyons surface-water field QC data
- Ancho, Chaquehui, and Indio Canyons surface-water rejected data

C-2.0 SUMMARY OF SAMPLES COLLECTED

Samples collected in Ancho, Chaquehui, and Indio Canyons and analyses performed by the analytical laboratories are summarized in Tables C-2.0-1 (sediment) and C-2.0-2 (water), which are included in Attachment 1 on CD. Tables C-2.0-1 and C-2.0-2 include data for all collected sediment and water samples, respectively. However, only the water data from samples collected in 2003 and later are used in the chemical of potential concern screens because these data are most representative of current site conditions. Media code definitions are provided in Table C-2.0-3. The analytes included in each analytical suite are presented in Tables C-2.0-4 (sediment) and C-2.0-5 (water).

C-3.0 SAMPLE COLLECTION METHODS

Historical stormwater samples have been collected using an automated pump sampler, direct container grab sampling, or single-stage samplers.

Current Laboratory standard operating procedures (SOPs) for water sampling methods are

- SOP-5213, Collecting Storm Water Runoff Samples and Inspecting Samplers and
- SOP-5224, Spring and Surface Water Sampling.

Historical sediment samples have been collected using a spade and scoop. The current Laboratory SOP for this sediment sampling method is

- SOP-06.09, Spade and Scoop Method for Collection of Soil Samples.

C-4.0 ANALYTICAL PROGRAM

Data validation for data from the WQDB is performed by an outside contractor that validates the analytical data according to U.S. Environmental Protection Agency (EPA) protocols. All the data from the analytical laboratories that provide Level IV data packages are validated. Level IV data packages are defined as those containing chain-of-custody forms, quality assurance (QA) and QC documentation, the analytical laboratory form 1 (a summary of the analytical results), and the raw analytical data. Data validation packages are included in Attachment C-1 (on DVD).

Data validation for data from the SMDB is performed by the same outside contractor. Data validation procedures were implemented in accordance with the requirements of the Laboratory "Quality Assurance Project Plan Requirements for Sampling and Analysis" (LANL 1996, 054609) and the Laboratory's analytical services statements of work (SOWs) for contract laboratories (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962). All data obtained from the SMDB and included in this report have accompanying Level IV data packages and have undergone routine validation according to SOPs. The current SOPs include the following (available at http://www.lanl.gov/environment/all/qa/adep.shtml):

- SOP-5161, Routine Validation of Volatile Organic Data
- SOP-5162, Routine Validation of Semivolatile Organic Compound (SVOC) Analytical Data
- SOP-5163, Routine Validation of Organochlorine Pesticide and PCB Analytical Data
- SOP-5164, Routine Validation of High Explosive Analytical Data
- SOP-5165, Routine Validation of Metals Analytical Data
- SOP-5166, Routine Validation of Gamma Spectroscopy, Chemical Separation Alpha Spectrometry, Gas Proportional Counting, and Liquid Scintillation Analytical Data
- SOP-5167, Routine Validation of General Chemistry Analytical Data
- SOP-5169, Routine Validation of Dioxin Furan Analytical Data (EPA Method 1618 and SW-846 EPA Method 8290)
- SOP-5191, Routine Validation of LC/MS/MS Perchlorate Analytical Data (SW-846 EPA Method 6850)

Some analytical results were rejected for various reasons and are not usable. In some instances, the analysis was rerun and a valid result was obtained and is presented in the report. However, some rejected data represent data issues, and thus there is no valid result for the analyte for the given sample. Rejected results that represent data issues are provided in Attachment C-2 (on DVD) and are discussed in section C-9.0. Field duplicates are used for QC purposes and are not included in the summary tables in section 6 of the investigation report. When duplicate analytical results for an analyte in the same sample resulting from two methods are available, the result obtained from the more sensitive method (i.e., lower detection limit) is presented in the section 6 summary tables. Reporting qualifiers are presented in parentheses next to the results in the summary tables. Data qualifier definitions are listed in Appendix A.

C-5.0 INORGANIC CHEMICAL ANALYSIS METHODS

The analytical methods used for inorganic chemicals are listed in Tables C-5.0-1 (sediment) and C-5.0-2 (water).

Laboratory control samples (LCSs), method blanks, matrix spike (MS) samples, and laboratory duplicate samples were analyzed to assess accuracy and precision of inorganic chemical analyses. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962) and is described briefly below.

The LCS serves as a monitor of the overall performance of each step during the analysis, including sample digestion. The analytical results for the samples were qualified according to National Functional Guidelines (EPA 1994, 048639) if the individual LCS recovery indicated an unacceptable bias in the measurement of individual analytes. The LCS recoveries should be within the control limits of 75%–125% (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

Method blanks are used as a measurement of bias and potential cross-contamination. All target analytes should be below the contract-required detection limit (CRDL) in the blank (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

The accuracy of inorganic chemical analyses is also assessed using MS samples. An MS sample is designed to provide information about the effect of each sample matrix on the sample preparation procedures and analytical technique. The spike sample recoveries should be within the acceptance range of 75%–125% (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

Analyzing laboratory duplicate samples assesses the precision of analyses. All relative percent differences (RPDs) between the sample and laboratory duplicate should be ±35% for sediment samples and ±20% for water samples (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

The validation of inorganic chemical data using QA/QC samples and other methods may result in the rejection of the data or the assignment of various qualifiers to individual sample results.

C-6.0 ORGANIC CHEMICAL ANALYSIS METHODS

The analytical methods used for organic chemicals are listed in Tables C-6.0-1 (sediment) and C-6.0-2 (water).

QC samples are designed to produce a quantitative measure of the reliability of a specific part of an analytical procedure. The results of the QC samples provide confidence about whether the analyte is present and whether the concentration reported is correct. The validation of organic chemical data using QA/QC samples and other methods may result in rejecting the data or in assigning various qualifiers to individual sample results. Calibration verifications, instrument-performance checks, LCSs, method blanks, MS samples, surrogates, and internal standards (ISs) were analyzed to assess the accuracy and precision of the organic chemical analyses. Each of these QA/QC sample types is defined in the analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962) and is described briefly below.

Calibration verification, which consists of initial and continuing verification, is the establishment of a quantitative relationship between the response of the analytical procedure and the concentration of the target analyte. The initial calibration verifies the accuracy of the calibration curve and the individual calibration standards used to perform the calibration. The continuing calibration ensures that the initial calibration is still holding and is correct as the instrument is used to process samples. The continuing calibration also serves to determine whether analyte identification criteria, such as retention times and spectral matching, are being met.

The LCS is a sample of a known matrix that has been spiked with compounds representative of the target analytes, and it serves as a monitor of the overall performance of a “controlled” sample. Daily, the LCS is the primary demonstration of the ability to analyze samples with good qualitative and quantitative accuracy. The analytical results for the samples were qualified according to National Functional Guidelines (EPA 1999, 066649) if the individual LCS recoveries were not within method-specific acceptance criteria. The LCS recoveries should be within the control limits of 75%–125% (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

A method blank is an analyte-free matrix to which all reagents are added in the same volumes or proportions as those used in the environmental sample processing and which is extracted and analyzed in the same manner as the corresponding environmental samples. Method blanks are used to assess the potential for sample contamination during extraction and analysis. All target analytes should be below the CRDL in the method blank (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

The accuracy of organic chemical analyses is also assessed by using MS samples that are aliquots of the submitted samples spiked with a known concentration of the target analyte(s). MS samples are used to measure the ability to recover prescribed analytes from a native sample matrix. Spiking typically occurs before sample preparation and analysis. The spike sample recoveries should be within the acceptance range of 75%–125% (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

A surrogate compound (surrogate) is an organic chemical compound used in the analyses of organic target analytes that is similar in composition and behavior to the target analytes but that is not normally found in environmental samples. Surrogates are added to every blank, sample, and spike to evaluate the efficiency with which analytes are recovered during extraction and analysis. The recovery percentage of the surrogates must be within specified ranges or the sample may be rejected or assigned a qualifier (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

The ISs are chemical compounds added to every blank, sample, and standard extract at a known concentration. They are used to compensate for (1) analyte concentration changes that might occur during storage of the extract and (2) quantitation variations that can occur during analysis. ISs are used as the basis for quantitation of target analytes. The percent recovery (%R) for ISs should range between 50% and 200% (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962).

C-7.0 RADIOCHEMICAL ANALYSIS METHODS

Radionuclides were analyzed by the methods listed in Tables C-7.0-1 (sediment) and C-7.0-2 (water).

Radionuclides with reported values less than the minimum detectable concentration (MDC) were qualified as not detected (U). Each radionuclide result was also compared with the corresponding total propagated uncertainty (TPU). If the result was less than 3 times the TPU, the radionuclide was qualified as not detected (U).

The precision and bias of radiochemical analyses performed at off-site fixed laboratories were assessed using MS samples, LCSs, and method blanks. The analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962) specify that spike sample recoveries should be within ±25% of the certified value. LCSs were analyzed to assess the accuracy of radionuclide analyses. The LCSs serve as a monitor of the overall performance of each step during the analysis, including the radiochemical separation preparation. The analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962) specify that LCS recoveries should be within ±25% of the certified value. Method blanks are also used to assess bias. The analytical services SOWs (LANL 1995, 049738; LANL 2000, 071233; LANL 2008, 109962) specify that the method blank concentration should not exceed the required minimum detectable activity.

C-8.0 OTHER ANALYSIS METHODS

Other analyses of Ancho, Chaquehui, and Indio Canyon sediment samples consist of pH by analytical method SW-846:9045C. Other analyses of Ancho and Chaquehui Canyon water samples include pH, specific conductance, specific gravity, total dissolved solids, total organic carbon, and total suspended solids. These analyses were conducted by the methods listed in Table C-8.0-1.

C-9.0 DATA QUALITY

Data-quality issues, including rejected analytical results, are summarized by media. Because of the large number of records, the following sections provide a summary of the reasons for qualification, and the qualification is not addressed by individual records.

C-9.1 Sediment Data

A total of 23,672 results from sediment samples in Ancho, Chaquehui, and Indio Canyons reaches were reported. Of these results, 81 results were rejected during data validation. These rejected results represent less than 1% of all the sediment results and do not affect the ability to assess the contaminants within Ancho, Chaquehui, and Indio Canyons.

Eleven inorganic chemical results, all manganese, were rejected (R) because the associated matrix spike recovery was less than 10%. Sixty radionuclide results, all cesium-134, were rejected (R) because spectral interference prevented positive identification of the analyte. Ten organic chemical results, all trichloro-1,2,2-trifluoroethane[1,1,2-], were rejected (R) because the affected analytes were analyzed with a relative response factor (RRF) of < 0.05 in the initial calibration and/or continuing calibration verification (CCV).

A total of 708 inorganic chemical results were qualified as estimated (J, J-, or J+) or estimated, not detected (UJ).

Inorganic chemical results detected between the method detection limit (MDL) and the estimated detection limit were qualified as estimated (J).

Inorganic chemical results were qualified as J, J-, J+, or UJ for of one of the following reasons.

- The sample and the duplicate sample results were greater than five times the reporting limit and the duplicate RPD was greater than 35%.
- The analyte was considered estimated because the results are greater than five times the amount in the method blank.
- The associated MS recovery was less than the lower acceptance level (LAL) but greater than 10%.
- The associated MS recovery was greater than the upper acceptance level (UAL).
- The LCS percent recovery was less than 10%.
- The result was reported as estimated by the analytical laboratory.

A total of 2177 organic chemical results were qualified as estimated—either detected (J) or not detected (UJ).

Volatile Organic Compounds (VOCs), Semivolatile Organic Compounds (SVOCs), and Pesticides and Polychlorinated Biphenyls (PCBs): The results were qualified as J or UJ because either the result was reported as estimated by the analytical laboratory, the LCS percent recovery was less than the LAL but greater than 10%, the initial calibration verification (ICV) and/or CCV were recovered outside the method-specific limits, or the extraction/analytical holding time was exceeded by less than 2 times the published method for holding times.

Polycyclic Aromatic Hydrocarbons (PAHs): PAH results were qualified as J or UJ because the extraction holding time was exceeded by less than 2 times the published method for holding times.

Explosive Compounds: Explosive compound results were qualified as J or UJ because the MS/MS duplicate (MSD) percent recovery was greater than 10% but less than 70%; MS/MSD RPD was greater than 30%, the recovery limits were 70% to 130%, and the RPD was less than or equal to 30%; the ICV and/or CCV were recovered outside the method limits; the affected analytes were analyzed with a RRF of less than 0.05 in the initial calibration and/or CCV; or the results were reported as estimated by the analytical laboratory.

A total of eight radionuclide results were qualified as estimated—either detected (J+, J-) or not detected (UJ)—because either the tracer is less than the LAL but greater than 10% recovery or the tracer % recovery value is greater than the UAL.

C-9.2 Water Data

A total of 14,961 results from water samples collected in Ancho and Chaquehui Canyons were reported. The results from these samples are provided in Attachment C-2 (on DVD). Of the 14,961 results reported, 223 results were rejected during data validation. These rejected results represent less than 2% of all the water results and do not affect the ability to assess the contaminants within Ancho and Chaquehui Canyons.

A total of 139 inorganic chemical results were rejected (R) for at least one of the following reasons.

- The associated spike sample recovery was less than 30%.
- Negative blank sample results were greater than the MDL.
- Unspecified QC failure occurred.

A total of 67 organic chemical results were rejected (R) for at least one of the following reasons.

- The MS/MSD recovery was less than 10%.
- The analyte retention time shifted by more than 0.05 minutes from the midlevel standard of the initial calibration.
- The LCS recovery was less than 10%.
- The affected analytes were analyzed with an RRF of less than 0.05 in the initial calibration and/or CCV.
- The LCS recovery was greater than the acceptance criteria.

- The sample was improperly preserved.
- Unspecified QC failure occurred.

Seventeen radionuclide results were rejected (R) for unspecified QC failures.

A total of 313 inorganic chemical results were qualified as J, J-, J+ or UJ for at least one of the following reasons.

- The associated MS recovery was less than the LAL but greater than 10%.
- The associated MS recovery was greater than the UAL.
- The extraction/analytical holding time was exceeded by less than 2 times the published method for holding times.
- There was insufficient sample volume for an MS to be analyzed on a LANL sample.
- A serial dilution sample was not analyzed with the samples.
- The MS analysis was not performed on a sample associated with the request number.
- The RPD is greater than 10% in the serial dilution sample.
- The spike recovery value is less than 30%, which indicates a potential low bias.
- Reporting limit verification recovery was greater than the acceptance criteria.
- The MS/MSD percent recovery failed low.
- The duplicate sample was not analyzed with the samples for unspecified reasons.
- The result was reported as estimated by the analytical laboratory.
- The results are greater than 5 times the amount in the method blank.
- The analyte was recovered below the LAL but greater than 30% in the associated spike sample.
- Negative blank samples results were greater than the MDL.
- Unspecified QC failure occurred.

A total of 574 organic chemical results were qualified as J, J+ or UJ.

Dioxins/Furans: Results were qualified as J, J+ or UJ because there were unspecified QC failures.

Explosive Compounds: Explosive compound results were qualified as J or UJ for at least one of the following reasons.

- The MS/MSD percent recovery was greater than 10% but less than 70%.
- The MS/MSD RPD was greater than 30%, the recovery limits were 70% to 130%, and the RPD was less than or equal to 30%.
- The ICV and/or CCV were recovered outside the method limits.
- The affected analytes were analyzed with a RRF of less than 0.05 in the initial calibration and/or CCV.
- The extraction/analytical holding time was exceeded by less than 2 times the published method for holding times.

- Insufficient sample volume was received for a MS and/or a MSD analysis.
- The MS and/or MSD duplicate analyses were not performed on a sample associated with a LANL request number.
- The sample result is less than the estimated quantitation limit and less than five times the concentration of the analyte in the method blank, which indicates the reported detection is considered indistinguishable from contamination in the blank.
- The LCS analyte %R is less than the LAL and greater than or equal to 10% recovery.
- The RPD of the MS/MSD is greater than the acceptance criteria.
- The spike %R value is greater than 10% and less than the lower acceptance limit, which indicates a potential low bias in the results.
- The result was reported as estimated by the analytical laboratory.
- The CCV percent difference (%D) failed low.
- The CRDL check standard recovery failed low.
- An applicable MS/MSD analysis was not performed.
- The initial calibration slope or response factor criteria were not met.
- The LCS %R failed low.
- The MS/MSD %R failed low.
- Unspecified QC failure occurred.

Pesticides and Polychlorinated Biphenyls (PCBs): The results were qualified as J or UJ for at least one of the following reasons.

- The LCS percent recovery was greater than the UAL.
- The surrogate is less than the LAL but greater than 10% recovery.
- At least one surrogate is greater than the UAL and one surrogate is less than the LAL.
- The extraction/analytical holding time was exceeded by less than 2 times the published method for holding times.
- The RPD of the MS/MSD is greater than the acceptance criteria.
- The spike %R value is greater than 10% and less than the lower acceptance limit.
- Unspecified QC failure occurred.

Semivolatile Organic Analytes (SVOAs): The results were qualified as J+ or UJ for at least one of the following reasons.

- The LCS %R was less than the LAL but greater than 10%.
- The affected analytes were analyzed with an initial calibration curve that exceeded the % relative standard deviation (RSD) criteria, and/or the associated multipoint calibration correlation coefficient is <0.995.
- The affected analytes were analyzed with an RRF of < 0.05 in the initial calibration and/or CCV.
- The ICV and/or CCV were recovered outside the method-specific limits.

- The RPD of the MS/MSD is greater than the acceptance criteria.
- The spike %R value is greater than 10% and less than the lower acceptance limit.
- The LCS recovery was greater than the acceptance criteria.
- Calibration verification %D was greater than the acceptance criteria but less than 60%.
- Unspecified QC failure occurred.

Volatile Organic Analytes (VOAs): The results were qualified as J or UJ for at least one of the following reasons.

- The result was reported as estimated by the analytical laboratory.
- The LCS %R was greater than the UAL.
- The affected analytes were analyzed with an initial calibration curve that exceeded the %RSD criteria, and/or the associated multipoint calibration correlation coefficient is <0.995.
- The affected analytes were analyzed with an RRF of < 0.05 in the initial calibration and/or CCV.
- The ICV and/or CCV were recovered outside the method-specific limits.
- The RPD of the MS/MSD is greater than the acceptance criteria.
- The spike %R value is greater than 10% and less than the lower acceptance limit.
- Calibration %RSD was greater than the acceptance criteria but less than 60%.
- Calibration verification %D was greater than the acceptance criteria but less than 60%.

A total of 85 radionuclide results were qualified as J, J-, J+, or UJ because of at least one of the following reasons.

- The sample result is greater than five times the concentration of the related analyte in the method blank.
- The associated matrix spike recovery was above the UAL.
- The tracer %R value is 10−30% inclusive and the sample result is greater than the minimum detectable activity.
- The associated sample concentration was less than or equal to the MDC.
- The tracer was less than the LAL but greater than 10%R.
- The associated duplicate sample has a duplicate error ratio of greater than or equal to 2 but less than or equal to 4.
- Planchets were flamed.
- Results were less than 3 times the MDC.

Fifty-one other results (total organic carbon, total dissolved solids, total suspended solids and pH) were qualified as J or J- because of at least one of the following reasons.

- The result was reported as estimated by the analytical laboratory.
- The extraction holding time was exceeded by less than two times the published method for holding times.
- The duplicate sample was not analyzed with the samples for unspecified reasons.

C-10.0 REFERENCES

The following list includes all documents cited in this appendix. 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.

EPA (U.S. Environmental Protection Agency), February 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," EPA-540/R-94/013, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1994, 048639)

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LANL (Los Alamos National Laboratory), July 1995. "Statement of Work (Formerly Called "Requirements Document") - Analytical Support, (RFP number 9-XS1-Q4257), (Revision 2 - July, 1995)," Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1995, 049738)

LANL (Los Alamos National Laboratory), March 1996. "Quality Assurance Project Plan Requirements for Sampling and Analysis," Los Alamos National Laboratory document LA-UR-96-441, Los Alamos, New Mexico. (LANL 1996, 054609)

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LANL (Los Alamos National Laboratory), June 30, 2008. "Exhibit "D" Scope of Work and Technical Specifications, Analytical Laboratory Services for General Inorganic, Organic, Radiochemical, Asbestos, Low-Level Tritium, Particle Analysis, Bioassay, Dissolved Organic Carbon Fractionation, and PCB Congeners," Los Alamos National Laboratory document RFP No. 63639-RFP-08, Los Alamos, New Mexico. (LANL 2008, 109962)

Table C-2.0-3
Media Code Definitions

Media Code	Media Description
SED	Sediment
WG	Groundwater (Springs)
WM	Snowmelt
WP	Persistent Surface Water
WS	Surface Water
WT	Stormwater

Table C-2.0-4
Analytes by Analytical Suite for Sediment

Analytical Suite	Analyte
Americium-241	Americium-241
Gamma Spectroscopy	Cesium-134
	Cesium-137
	Cobalt-60
	Sodium-22
Tritium	Tritium
Explosive Compounds	2,4-Diamino-6-nitrotoluene
	2,6-Diamino-4-nitrotoluene
	3,5-Dinitroaniline
	Amino-2,6-dinitrotoluene[4-]
	Amino-4,6-dinitrotoluene[2-]
	Dinitrobenzene[1,3-]
	Dinitrotoluene[2,4-]
	Dinitrotoluene[2,6-]
	HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
	Nitrobenzene
	Nitrotoluene[2-]
	Nitrotoluene[3-]
	Nitrotoluene[4-]
	PETN (pentaerythritol tetranitrate)
	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
	TATB (triaminotrinitrobenzene)
	Tetryl
	Trinitrobenzene[1,3,5-]
	Trinitrotoluene[2,4,6-]
	Tris (o-cresyl) phosphate

Table C-2.0-4 (continued)

Analytical Suite	Analyte
Isotopic Plutonium	Plutonium-238
	Plutonium-239/240
Isotopic Thorium	Thorium-228
	Thorium-230
	Thorium-232
Isotopic Uranium	Uranium-234
	Uranium-235/236
	Uranium-238
Target Analyte List Metals	Aluminum
	Antimony
	Arsenic
	Barium
	Beryllium
	Cadmium
	Calcium
	Chromium
	Cobalt
	Copper
	Iron
	Lead
	Magnesium
	Manganese
	Mercury
	Nickel
	Potassium
	Selenium
	Silver
	Sodium
	Thallium
	Vanadium
	Zinc
Polycyclic Aromatic Hydrocarbons	Acenaphthene
	Acenaphthylene
	Anthracene
	Benzo(a)anthracene
	Benzo(a)pyrene
	Benzo(b)fluoranthene
	Benzo(g,h,i)perylene
	Benzo(k)fluoranthene

Table C-2.0-4 (continued)

Analytical Suite	Analyte
	Chrysene
	Dibenz(a,h)anthracene
	Fluoranthene
	Fluorene
	Indeno(1,2,3-cd)pyrene
	Naphthalene
	Phenanthrene
	Pyrene
Perchlorate	Perchlorate
Pesticides/Polychlorinated Biphenyls	Aldrin
	Aroclor-1016
	Aroclor-1221
	Aroclor-1232
	Aroclor-1242
	Aroclor-1248
	Aroclor-1254
	Aroclor-1260
	Benzene hexachloride (BHC)[alpha-]
	BHC[beta-]
	BHC[delta-]
	BHC[gamma-]
	Chlordane[alpha-]
	Chlordane[gamma-]
	Dichlorodiphenyldichloroethane (DDD)[4,4'-]
	Dichlorodiphenyltrichloroethylene (DDE)[4,4'-]
	Dichlorodiphenyltrichloroethane (DDT)[4,4'-]
	Dieldrin
	Endosulfan I
	Endosulfan II
	Endosulfan Sulfate
	Endrin
	Endrin Aldehyde
	Endrin Ketone
	Heptachlor
	Heptachlor Epoxide
	Methoxychlor[4,4'-]
	Toxaphene (Technical Grade)

Table C-2.0-4 (continued)

Analytical Suite	Analyte
Strontium-90	Strontium-90
Semivolatile Organic Compounds	Acenaphthene
	Acenaphthylene
	Aniline
	Anthracene
	Azobenzene
	Benzo(a)anthracene
	Benzo(a)pyrene
	Benzo(b)fluoranthene
	Benzo(g,h,i)perylene
	Benzo(k)fluoranthene
	Benzoic Acid
	Benzyl Alcohol
	Bis(2-chloroethoxy)methane
	Bis(2-chloroethyl)ether
	Bis(2-ethylhexyl)phthalate
	Bromophenyl-phenylether[4-]
	Butylbenzylphthalate
	Chloro-3-methylphenol[4-]
	Chloroaniline[4-]
	Chloronaphthalene[2-]
	Chlorophenol[2-]
	Chlorophenyl-phenyl[4-] Ether
	Chrysene
	Dibenz(a,h)anthracene
	Dibenzofuran
	Dichlorobenzene[1,2-]
	Dichlorobenzene[1,3-]
	Dichlorobenzene[1,4-]
	Dichlorobenzidine[3,3'-]
	Dichlorophenol[2,4-]
	Diethylphthalate
	Dimethyl Phthalate
	Dimethylphenol[2,4-]
	Di-n-butylphthalate
	Dinitro-2-methylphenol[4,6-]
	Dinitrophenol[2,4-]
	Dinitrotoluene[2,4-]
	Dinitrotoluene[2,6-]

Table C-2.0-4 (continued)

Analytical Suite	Analyte
	Di-n-octylphthalate
	Diphenylamine
	Fluoranthene
	Fluorene
	Hexachlorobenzene
	Hexachlorobutadiene
	Hexachlorocyclopentadiene
	Hexachloroethane
	Indeno(1,2,3-cd)pyrene
	Isophorone
	Methylnaphthalene[2-]
	Methylphenol[2-]
	Methylphenol[4-]
	Naphthalene
	Nitroaniline[2-]
	Nitroaniline[3-]
	Nitroaniline[4-]
	Nitrobenzene
	Nitrophenol[2-]
	Nitrophenol[4-]
	Nitrosodimethylamine[N-]
	Nitroso-di-n-propylamine[N-]
	Oxybis(1-chloropropane)[2,2'-]
	Pentachlorophenol
	Phenanthrene
	Phenol
	Pyrene
	Pyridine
	Trichlorobenzene[1,2,4-]
	Trichlorophenol[2,4,5-]
	Trichlorophenol[2,4,6-]
Volatile Organic Compounds	Acetone
	Benzene
	Bromobenzene
	Bromochloromethane
	Bromodichloromethane
	Bromoform
	Bromomethane
	Butanone[2-]

Table C-2.0-4 (continued)

Analytical Suite	Analyte
	Butylbenzene[n-]
	Butylbenzene[sec-]
	Butylbenzene[tert-]
	Carbon Disulfide
	Carbon Tetrachloride
	Chlorobenzene
	Chlorodibromomethane
	Chloroethane
	Chloroform
	Chloromethane
	Chlorotoluene[2-]
	Chlorotoluene[4-]
	Dibromo-3-chloropropane[1,2-]
	Dibromoethane[1,2-]
	Dibromomethane
	Dichlorobenzene[1,2-]
	Dichlorobenzene[1,3-]
	Dichlorobenzene[1,4-]
	Dichlorodifluoromethane
	Dichloroethane[1,1-]
	Dichloroethane[1,2-]
	Dichloroethene[1,1-]
	Dichloroethene[cis-1,2-]
	Dichloroethene[trans-1,2-]
	Dichloropropane[1,2-]
	Dichloropropane[1,3-]
	Dichloropropane[2,2-]
	Dichloropropene[1,1-]
	Dichloropropene[cis-1,3-]
	Dichloropropene[trans-1,3-]
	Ethylbenzene
	Hexanone[2-]
	Iodomethane
	Isopropylbenzene
	Isopropyltoluene[4-]
	Methyl-2-pentanone[4-]
	Methylene Chloride
	Propylbenzene[1-]
	Styrene

Table C-2.0-4 (continued)

Analytical Suite	Analyte
	Tetrachloroethane[1,1,1,2-]
	Tetrachloroethane[1,1,2,2-]
	Tetrachloroethene
	Toluene
	Trichloro-1,2,2-trifluoroethane[1,1,2-]
	Trichloroethane[1,1,1-]
	Trichloroethane[1,1,2-]
	Trichloroethene
	Trichlorofluoromethane
	Trichloropropane[1,2,3-]
	Trimethylbenzene[1,2,4-]
	Trimethylbenzene[1,3,5-]
	Vinyl Chloride
	Xylene[1,2-]
	Xylene[1,3-]+Xylene[1,4-]
Cyanide (Total)	Cyanide (Total)

Table C-2.0-5
Analytes by Analytical Suite for Water

Analytical Suite	Analyte
Dioxins/Furans	Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]
	Heptachlorodibenzodioxins (Total)
	Heptachlorodibenzofuran[1,2,3,4,6,7,8-]
	Heptachlorodibenzofuran[1,2,3,4,7,8,9-]
	Heptachlorodibenzofurans (Total)
	Hexachlorodibenzodioxin[1,2,3,4,7,8-]
	Hexachlorodibenzodioxin[1,2,3,6,7,8-]
	Hexachlorodibenzodioxin[1,2,3,7,8,9-]
	Hexachlorodibenzodioxins (Total)
	Hexachlorodibenzofuran[1,2,3,4,7,8-]
	Hexachlorodibenzofuran[1,2,3,6,7,8-]
	Hexachlorodibenzofuran[1,2,3,7,8,9-]
	Hexachlorodibenzofuran[2,3,4,6,7,8-]
	Hexachlorodibenzofurans (Total)
	Octachlorodibenzodioxin[1,2,3,4,6,7,8,9-]
	Octachlorodibenzofuran[1,2,3,4,6,7,8,9-]
	Pentachlorodibenzodioxin[1,2,3,7,8-]
	Pentachlorodibenzodioxins (Total)

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	Pentachlorodibenzofuran[1,2,3,7,8-]
	Pentachlorodibenzofuran[2,3,4,7,8-]
	Pentachlorodibenzofurans (Total)
	Tetrachlorodibenzodioxin[2,3,7,8-]
	Tetrachlorodibenzodioxins (Total)
	Tetrachlorodibenzofuran[2,3,7,8-]
	Tetrachlorodibenzofurans (Total)
General Inorganics	Alkalinity-CO3
	Alkalinity-CO3+HCO3
	Alkalinity-HCO3
	Ammonia
	Ammonia as Nitrogen
	Bromide
	Calcium
	Chemical Oxygen Demand
	Chloride
	Chlorine, Total Residual
	Cyanide (Total)
	Cyanide, Amenable to Chlorination
	Dissolved Oxygen
	Fluoride
	Hardness
	Instantaneous Stream Flow
	Iodide
	Loss on Ignition
	Magnesium
	Maximum Total Suspended Solids (TSS)
	Nitrate
	Nitrate as Nitrogen
	Nitrate-Nitrite as Nitrogen
	Perchlorate
	pH
	Phosphorus, Orthophosphate (Expressed as PO4)
	Potassium
	Silicon
	Silicon Dioxide
	Sodium
	Specific Conductance
	Specific Gravity

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	Sulfate
	Suspended Sediment Concentration
	Temperature
	Total Dissolved Solids
	Total Kjeldahl Nitrogen
	Total Organic Carbon
	Total Phosphate as Phosphorus
	Total Phosphorus
	TSS
	Turbidity
	Visual Inspection
Herbicides	D[2,4-] (2,4-dichlorophenoxyacetic acid)
	Dalapon
	DB[2,4-] (2,4-dichlorophenoxybutyric acid)
	Dicamba
	Dichlorprop
	Dinoseb
	MCPA (methyl-4-chlorophenoxyacetic[2-] acid)
	MCPP (methyl-4-chlorophenoxypropionic[2-] acid)
	T[2,4,5-] (2,4,5-trichlorophenoxyacetic acid)
	TP[2,4,5-] (2,4,5-trichlorophenoxypropionic acid)
Explosive Compounds	2,4-diamino-6-nitrotoluene
	2,6-diamino-4-nitrotoluene
	3,5-dinitroaniline
	Amino-2,6-dinitrotoluene[4-]
	Amino-4,6-dinitrotoluene[2-]
	Amino-dinitrotoluenes
	Dinitrobenzene[1,3-]
	Dinitrotoluene[2,4-]
	Dinitrotoluene[2,6-]
	Dinitrotoluene[3,4-]
	DNX (hexahydro-1,3-dinitro-5-nitro-1,3,5-triazine)
	HMX
	MNX (hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine)
	Nitrobenzene
	Nitrotoluene[2-]
	Nitrotoluene[3-]
	Nitrotoluene[4-]
	PETN

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	RDX
	TATB
	Tetryl
	TNX (hexahydro-1,3,5-trinitroso-1,3,5-triazine)
	Trinitrobenzene[1,3,5-]
	Trinitrotoluene[2,4,6-]
	Tris (o-cresyl) phosphate
Isotopes	Carbon-14 % Modern Carbon, Denormalized
	Carbon-14 % Modern Carbon, Normalized
	Carbon-14 Years Unadjusted, Based on Denormalized Fraction
	Chromium-53/52
	Delta C-13 Relative to Pee Dee Belemnite
Metals	Aluminum
	Antimony
	Arsenic
	Barium
	Beryllium
	Bismuth
	Boron
	Cadmium
	Cerium
	Cesium
	Chromium
	Cobalt
	Copper
	Dysprosium
	Erbium
	Europium
	Gadolinium
	Gallium
	Germanium
	Gold
	Hafnium
	Holmium
	Indium
	Iridium
	Iron
	Lanthanum

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	Lead
	Lithium
	Lutetium
	Manganese
	Mercury
	Molybdenum
	Neodymium
	Nickel
	Niobium
	Osmium
	Palladium
	Platinum
	Praseodymium
	Rhenium
	Rhodium
	Rubidium
	Ruthenium
	Scandium
	Selenium
	Settleable Matter
	Silicon
	Silicon Dioxide
	Silver
	Strontium
	Tantalum
	Tellurium
	Terbium
	Thallium
	Thorium
	Thulium
	Tin
	Titanium
	Tungsten
	Uranium
	Vanadium
	Ytterbium
	Yttrium
	Zinc
	Zirconium

Table C-2.0-5 (continued)

Analytical Suite	Analyte
Pesticides/Polychlorinated Biphenyls	Aldrin
	Aroclor-1016
	Aroclor-1221
	Aroclor-1232
	Aroclor-1242
	Aroclor-1248
	Aroclor-1254
	Aroclor-1260
	Aroclor-1262
	Benzene hexachloride (BHC)[alpha-]
	BHC[beta-]
	BHC[delta-]
	BHC[gamma-]
	Chlordane[alpha-]
	Chlordane[gamma-]
	Dichlorodiphenyldichloroethane (DDD)[4,4'-]
	Dichlorodiphenyltrichloroethylene (DDE)[4,4'-]
	Dichlorodiphenyltrichloroethane (DDT)[4,4'-]
	Dieldrin
	Endosulfan I
	Endosulfan II
	Endosulfan Sulfate
	Endrin
	Endrin Aldehyde
	Endrin Ketone
	Heptachlor
	Heptachlor Epoxide
	Methoxychlor[4,4'-]
	PCB-1
	PCB-100
	PCB-103
	PCB-104
	PCB-105
	PCB-106
	PCB-107
	PCB-108/112
	PCB-11
	PCB-110
	PCB-111

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	PCB-113
	PCB-114
	PCB-119
	PCB-12/13
	PCB-120
	PCB-121
	PCB-122
	PCB-123
	PCB-124
	PCB-126
	PCB-127
	PCB-128/162
	PCB-129
	PCB-130
	PCB-131
	PCB-132
	PCB-133
	PCB-134
	PCB-135
	PCB-136
	PCB-137
	PCB-138/163/164
	PCB-139/149
	PCB-14
	PCB-140
	PCB-141
	PCB-144
	PCB-145
	PCB-146
	PCB-147
	PCB-148
	PCB-15
	PCB-150
	PCB-151
	PCB-152
	PCB-153
	PCB-154
	PCB-155
	PCB-156

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	PCB-157
	PCB-158
	PCB-159
	PCB-16
	PCB-166
	PCB-167
	PCB-168
	PCB-169
	PCB-17
	PCB-170
	PCB-171
	PCB-172
	PCB-173
	PCB-174
	PCB-175
	PCB-176
	PCB-177
	PCB-178
	PCB-179
	PCB-18
	PCB-180
	PCB-181
	PCB-182
	PCB-183
	PCB-184
	PCB-185
	PCB-186
	PCB-188
	PCB-189
	PCB-19
	PCB-190
	PCB-191
	PCB-192
	PCB-193
	PCB-194
	PCB-195
	PCB-196
	PCB-197
	PCB-198

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	PCB-199
	PCB-2
	PCB-20/21/33
	PCB-200
	PCB-201
	PCB-202
	PCB-204
	PCB-205
	PCB-206
	PCB-207
	PCB-208
	PCB-209
	PCB-22
	PCB-23
	PCB-24
	PCB-25
	PCB-26
	PCB-28
	PCB-29
	PCB-3
	PCB-30
	PCB-31
	PCB-34
	PCB-35
	PCB-36
	PCB-37
	PCB-38
	PCB-39
	PCB-4
	PCB-40
	PCB-41
	PCB-42
	PCB-43
	PCB-44
	PCB-45
	PCB-46
	PCB-47
	PCB-48
	PCB-5

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	PCB-50
	PCB-51
	PCB-52
	PCB-53
	PCB-54
	PCB-55
	PCB-56
	PCB-57
	PCB-58
	PCB-6
	PCB-61/70
	PCB-62
	PCB-63
	PCB-65
	PCB-67
	PCB-68
	PCB-7
	PCB-73
	PCB-74
	PCB-76/66
	PCB-77
	PCB-78
	PCB-79
	PCB-80
	PCB-81
	PCB-82
	PCB-83
	PCB-84
	PCB-85/116
	PCB-86
	PCB-87/117/125
	PCB-88/91
	PCB-89
	PCB-90/101
	PCB-93
	PCB-94
	PCB-95
	PCB-96
	PCB-97

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	PCB-99
	Total Decachlorinated Biphenyls
	Total Dichlorinated Biphenyls
	Total Heptachlorinated Biphenyls
	Total Hexachlorinated Biphenyls
	Total Monochlorinated Biphenyls
	Total Nonachlorinated Biphenyls
	Total Octachlorinated Biphenyls
	Total PCBs
	Total Pentachlorinated Biphenyls
	Total Tetrachlorinated Biphenyls
	Total Trichlorinated Biphenyls
	Toxaphene (Technical Grade)
Radionuclides	Americium-241
	Cadmium-109
	Cesium-137
	Cobalt-60
	Europium-152
	Gross Alpha
	Gross Alpha/Beta
	Gross Beta
	Gross Gamma
	Iodine-133
	Lead-212
	Neptunium-237
	Plutonium-238
	Plutonium-239/240
	Potassium-40
	Plutonium-Total
	Radium-226
	Radium-228
	Sodium-22
	Strontium-85
	Strontium-90
	Thorium-228
	Thorium-230
	Thorium-232
	Tritium
	Uranium

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	Uranium-234
	Uranium-235/236
	Uranium-238
Semivolatile Organic Analytes	Acenaphthene
	Acenaphthylene
	Aniline
	Anthracene
	Atrazine
	Azobenzene
	Benzidine
	Benzo(a)anthracene
	Benzo(a)pyrene
	Benzo(b)fluoranthene
	Benzo(g,h,i)perylene
	Benzo(k)fluoranthene
	Benzo[a]anthracene
	Benzoic Acid
	Benzyl Alcohol
	Bis(2-chloroethoxy)methane
	Bis(2-chloroethyl)ether
	Bis(2-ethylhexyl)phthalate
	Bromophenyl-phenylether[4-]
	Butylbenzylphthalate
	Carbazole
	Chloro-3-methylphenol[4-]
	Chloroaniline[4-]
	Chlorodibromomethane
	Chloronaphthalene[2-]
	Chlorophenol[2-]
	Chlorophenyl-phenyl[4-] Ether
	Chrysene
	Dibenz(a,h)anthracene
	Dibenzofuran
	Dichlorobenzene[1,2-]
	Dichlorobenzene[1,3-]
	Dichlorobenzene[1,4-]
	Dichlorobenzidine[3,3'-]
	Dichlorophenol[2,4-]
	Diethylphthalate

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	Dimethyl Phthalate
	Dimethylphenol[2,4-]
	Di-n-butylphthalate
	Dinitro-2-methylphenol[4,6-]
	Dinitrophenol[2,4-]
	Dinitrotoluene[2,4-]
	Dinitrotoluene[2,6-]
	Di-n-octylphthalate
	Dinoseb
	Dioxane[1,4-]
	Diphenylamine
	Diphenylhydrazine[1,2-]
	Fluoranthene
	Fluorene
	Hexachlorobenzene
	Hexachlorobutadiene
	Hexachlorocyclopentadiene
	Hexachloroethane
	Indeno(1,2,3-cd)pyrene
	Isophorone
	Methylnaphthalene[1-]
	Methylnaphthalene[2-]
	Methylphenol[2-]
	Methylphenol[3-,4-]
	Methylphenol[4-]
	Methylpyridine[2-]
	Naphthalene
	Nitroaniline[2-]
	Nitroaniline[3-]
	Nitroaniline[4-]
	Nitrobenzene
	Nitrophenol[2-]
	Nitrophenol[4-]
	Nitrosodiethylamine[N-]
	Nitrosodimethylamine[N-]
	Nitroso-di-n-butylamine[N-]
	Nitroso-di-n-propylamine[N-]
	Nitrosodiphenylamine[N-]
	Nitrosopyrrolidine[N-]

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	Oxybis(1-chloropropane)[2,2'-]
	Pentachlorobenzene
	Pentachlorophenol
	Phenanthrene
	Phenol
	Pyrene
	Pyridine
	Tetrachlorobenzene[1,2,4,5]
	Tetrachlorophenol[2,3,4,6-]
	Trichlorobenzene[1,2,4-]
	Trichlorophenol[2,4,5-]
	Trichlorophenol[2,4,6-]
Volatile Organic Analytes	Acetone
	Acetonitrile
	Acrolein
	Acrylonitrile
	Benzene
	Bromobenzene
	Bromochloromethane
	Bromodichloromethane
	Bromoform
	Bromomethane
	Butanol[1-]
	Butanone[2-]
	Butylbenzene[n-]
	Butylbenzene[sec-]
	Butylbenzene[tert-]
	Carbon Disulfide
	Carbon Tetrachloride
	Chloro-1,3-butadiene[2-]
	Chloro-1-propene[3-]
	Chlorobenzene
	Chlorodibromomethane
	Chloroethane
	Chloroethyl vinyl ether[2-]
	Chloroform
	Chloromethane
	Chlorotoluene[2-]
	Chlorotoluene[4-]

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	Dibromo-3-chloropropane[1,2-]
	Dibromoethane[1,2-]
	Dibromomethane
	Dichlorobenzene[1,2-]
	Dichlorobenzene[1,3-]
	Dichlorobenzene[1,4-]
	Dichlorodifluoromethane
	Dichloroethane[1,1-]
	Dichloroethane[1,2-]
	Dichloroethene[1,1-]
	Dichloroethene[cis-1,2-]
	Dichloroethene[trans-1,2-]
	Dichloropropane[1,2-]
	Dichloropropane[1,3-]
	Dichloropropane[2,2-]
	Dichloropropene[1,1-]
	Dichloropropene[cis-1,3-]
	Dichloropropene[trans-1,3-]
	Diethyl Ether
	Dioxane[1,4-]
	Ethyl Methacrylate
	Ethylbenzene
	Hexachlorobutadiene
	Hexanone[2-]
	Iodomethane
	Isobutyl Alcohol
	Isopropylbenzene
	Isopropyltoluene[4-]
	Methacrylonitrile
	Methyl Methacrylate
	Methyl tert-butyl Ether
	Methyl-2-pentanone[4-]
	Methylene Chloride
	Naphthalene
	Propionitrile
	Propylbenzene[1-]
	Styrene
	Tetrachloroethane[1,1,1,2-]
	Tetrachloroethane[1,1,2,2-]

Table C-2.0-5 (continued)

Analytical Suite	Analyte
	Tetrachloroethene
	Toluene
	Trichloro-1,2,2-trifluoroethane[1,1,2-]
	Trichlorobenzene[1,2,3-]
	Trichlorobenzene[1,2,4-]
	Trichloroethane[1,1,1-]
	Trichloroethane[1,1,2-]
	Trichloroethene
	Trichlorofluoromethane
	Trichloropropane[1,2,3-]
	Trimethylbenzene[1,2,4-]
	Trimethylbenzene[1,3,5-]
	Vinyl Acetate
	Vinyl Chloride
	Xylene (Total)
	Xylene[1,2-]
	Xylene[1,3-]+Xylene[1,4-]

Table C-5.0-1
Analytical Methods Used for
Inorganic Chemicals in Sediment

Analytical Suite	Analytical Method
Metals	SW-846:6010B
	SW-846:6020
	SW-846:7471A
Perchlorate	SW-846:6850
Cyanide (Total)	SW-846:9012A

Table C-5.0-2
Analytical Methods Used for Inorganic Chemicals in Water

Analytical Suite	Analytical Method
GENINORG	ACOLR
	Calc (Hardness)
	Color
	EPA:160.2
	EPA:160.4
	EPA:200.7
	EPA:300.0
	EPA:310.1
	EPA:314.0
	EPA:335.1
	EPA:335.2
	EPA:335.3
	EPA:335.4
	EPA:340.2
	EPA:350.1
	EPA:351.2
	EPA:353.1
	EPA:353.2
	EPA:365.1
	EPA:365.4
	EPA:370.1
	EPA:410.1
	EPA:410.4
	FIA
	Field
	Gravimetric
	Hardness
	IC
	ICPES
	SM:4500
	SM:A2320B
	SM:A2340B
	SW-846:6010
	SW-846:6010B
	SW-846:6500
	SW-846:6850

Table C-5.0-2 (continued)

Analytical Suite	Analytical Method
	SW-846:9012A
	SW-846:9056
	TITR (titration)
METALS	Cold vapor atomic absorption
	EPA:200.7
	EPA:200.8
	EPA:245.1
	EPA:245.2
	EPA:245.5
	EPA:370.1
	Electrothermal vapor atomic absorption
	FIA
	ICPES
	ICPMS
	Kinetic phosphorescence analysis
	SW-846:6010
	SW-846:6010B
	SW-846:6020
	SW-846:6500
	SW-846:7060
	SW-846:7470A
	SW-846:7740

Table C-6.0-1
Analytical Methods for
Organic Chemicals in Sediment

Analytical Suite	Analytical Method
Explosive Compounds	SW-846:8321A_MOD
PAHs	SW-846:8310
PCBs	SW-846:8082
Pesticides/PCBs	SW-846:8081A
SVOCs	SW-846:8270C
VOCs	SW-846:8260B

Table C-6.0-2
Analytical Methods
for Organic Chemicals in Water

Analytical Suite	Analytical Method
DIOXIN/FURAN	EPA:1613B
HERB	SW-846:8151A
HEXP	High Explosives
	HPLC
	SW-846:8321
	SW-846:8321A
	SW-846:8330
PCB	EPA:1668A
	EPA:608
	PCB
	SW-846:8082
PEST/PCB	SW-846:8081A
SVOA	EPA:625
	Semivolatile organic analysis
	SW-846:8260
	SW-846:8270
	SW-846:8270C
VOA	EPA:624
	SW-846:8260
	SW-846:8260B
	Volatile organic analysis

Table C-7.0-1
Analytical Methods for Radionuclide Analysis in Sediment

Analytical Suite	Analytical Method
Americium-241 (AM_241)	HASL-300:AM-241
Gamma Spectroscopy (GAMMA_SPEC)	EPA:901.1
Tritium (H3)	EPA:906.0
Isotopic Plutonium (ISO_PU)	HASL-300:ISOPU
Isotopic Thorium (ISO_TH)	HASL-300:ISOTH
Isotopic Uranium (ISO_U)	HASL-300:ISOU
Strontium-90 (SR_90)	EPA:905.0

Table C-7.0-2
Analytical Methods for
Radionuclide Analysis in Water

Analytical Suite	Analytical Method
RAD	Alpha Spec
	EPA:900
	EPA:901.1
	EPA:903.1
	EPA:904
	EPA:905.0
	EPA:906.0
	Gamma Spec
	Gas Flow Proportional Counting
	GPC
	Gross Alpha
	Gross Beta
	Gross Gamma
	HASL-300
	LLEE
	Liquid scintillation counting

Table C-8.0-1
Analytical Methods
for Other Analyses in Water

Analyte	Analytical Method
pH	EPA:150.1
	Field
Specific Conductance	EPA:120.1
	SW-846:9050A
Specific Gravity	ASTM:D5057
Total Dissolved Solids	EPA:160.1
Total Organic Carbon	SW-846:9060
Total Suspended Solids	EPA:160.2
	Gravimetric

Attachments C-1 and C-2

Data Packages and Data from the
Sample Management and Water Quality Databases
(on DVD included with this document)

Appendix D

Contaminant Trends

D-1.0 SEDIMENT

This section presents information on contaminants in sediments in Ancho, Chaquehui, and Indio Canyons that supports the physical system conceptual model discussed in section 7 and the risk assessments presented in section 8 of the investigation report. It includes information on spatial variations in the concentrations of chemicals of potential concern (COPCs) that helps identify contaminant sources and provides an understanding of the effects of sediment redistribution by floods on contaminant concentrations and potential exposure to receptors.

D-1.1 Spatial Variations in Sample Results for COPCs

Figures D-1.1-1 through D-1.1-3 consist of plots showing sample results for all COPCs identified in sediment in Ancho, Chaquehui, and Indio Canyons plotted versus distance from the Rio Grande. Figure D-1.1-1 shows inorganic COPCs, Figure D-1.1-2 shows organic COPCs, and Figure D-1.1-3 shows radionuclide COPCs. These plots help to identify sources for the COPCs and show how concentrations change with distance from sources. Different colors on these plots are used for the main canyons of Ancho, Chaquehui, and Indio Canyons and the north forks of Ancho and Chaquehui Canyons. Each sample is plotted at a location represented by the distance from the Rio Grande to the approximate midpoint of the reach. For inorganic and organic chemicals, nondetected sample results are shown by an open circle, and the detected sample results are represented by a filled circle. For radionuclides, detection status is not indicated because radionuclide sample results are not censored. Only validated sediment data from Los Alamos National Laboratory's (LANL's or the Laboratory's) Sample Management Database with complete data packages are included in these plots.

Note that the sample results in Figure D-1.1-1 are biased high as a result of biases accompanying sample collection, as discussed in section B-1.0 of Appendix B. Specifically, samples were typically biased toward geomorphic units and sediment facies with higher concentrations of contaminants, and units and facies with low concentrations (e.g., coarse facies sediment in the active channels) are underrepresented.

D-1.2 Average Concentrations of Select Sediment COPCs

Tables D-1.2-1 through D-1.2-3 present average concentrations of sediment COPCs in Ancho, Chaquehui, and Indio Canyons that are discussed in section 7.1 of the investigation report. These calculated averages are used in the figures in section 7.1, and they support the identification of sources for the COPCs and examination of how concentrations change with distance from sources and vary with sediment facies. Averages were calculated separately for fine facies samples and coarse facies samples to highlight differences between concentrations in these facies.

For inorganic and organic COPCs with nondetected sample results, upper and lower bounds on average concentrations were calculated by replacing the sample result for nondetects with either the detection limit or zero, respectively, and the midpoint of this range was also calculated by substituting one-half of the detection limit for nondetects. For some COPCs and some reaches, considerable uncertainty exists in average concentrations because of a high frequency of nondetects and/or detection limits that are elevated above sediment background values, although for most COPCs and most reaches, uncertainties related to nondetects do not obscure the general spatial trends in COPC concentration. If improved estimates of average concentrations were warranted, these estimates could be refined using the more robust nondetect replacement methods used in Appendix E.

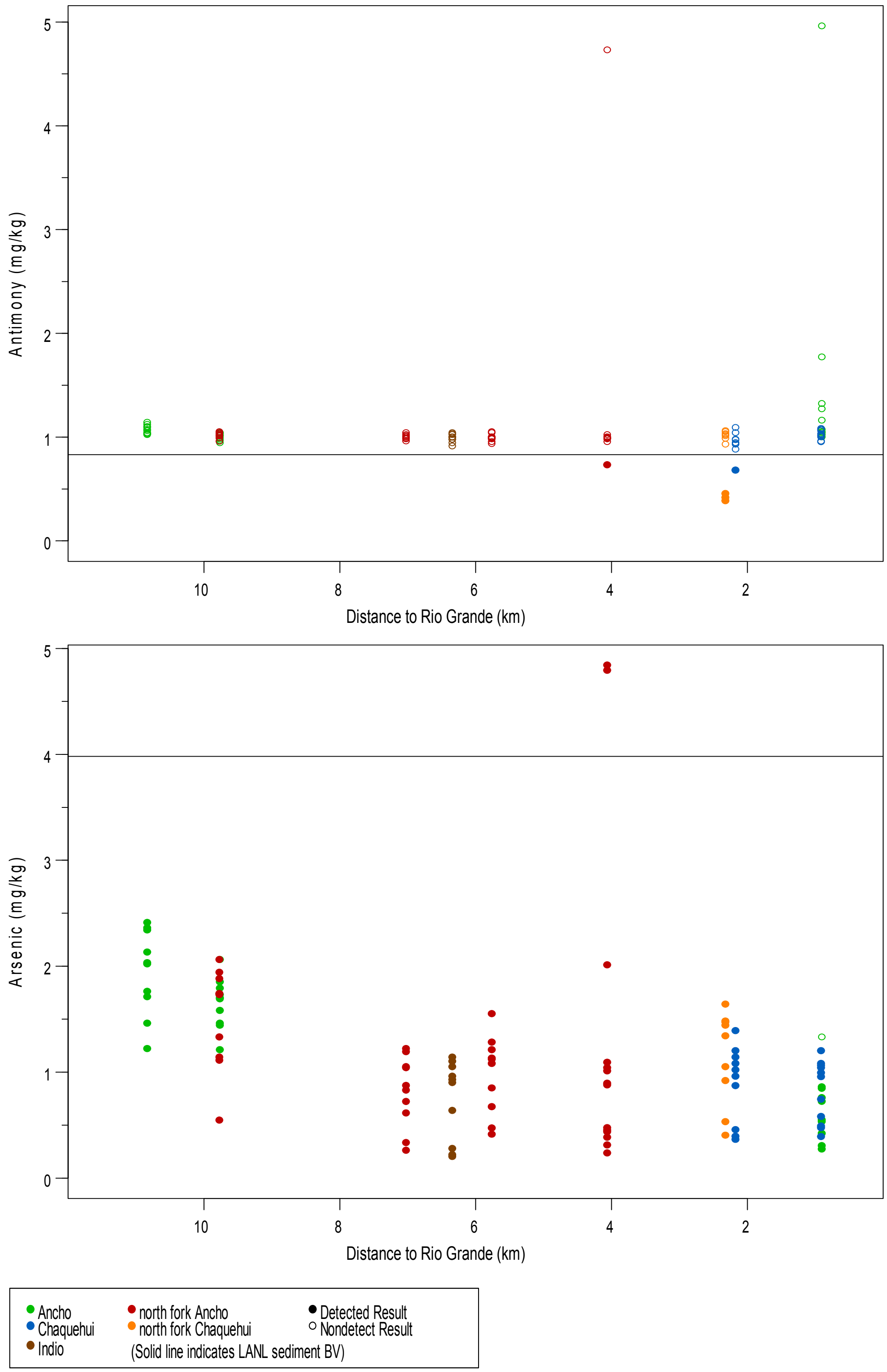


Figure D-1.1-1 Plots of sample results versus distance from the Rio Grande for all inorganic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed

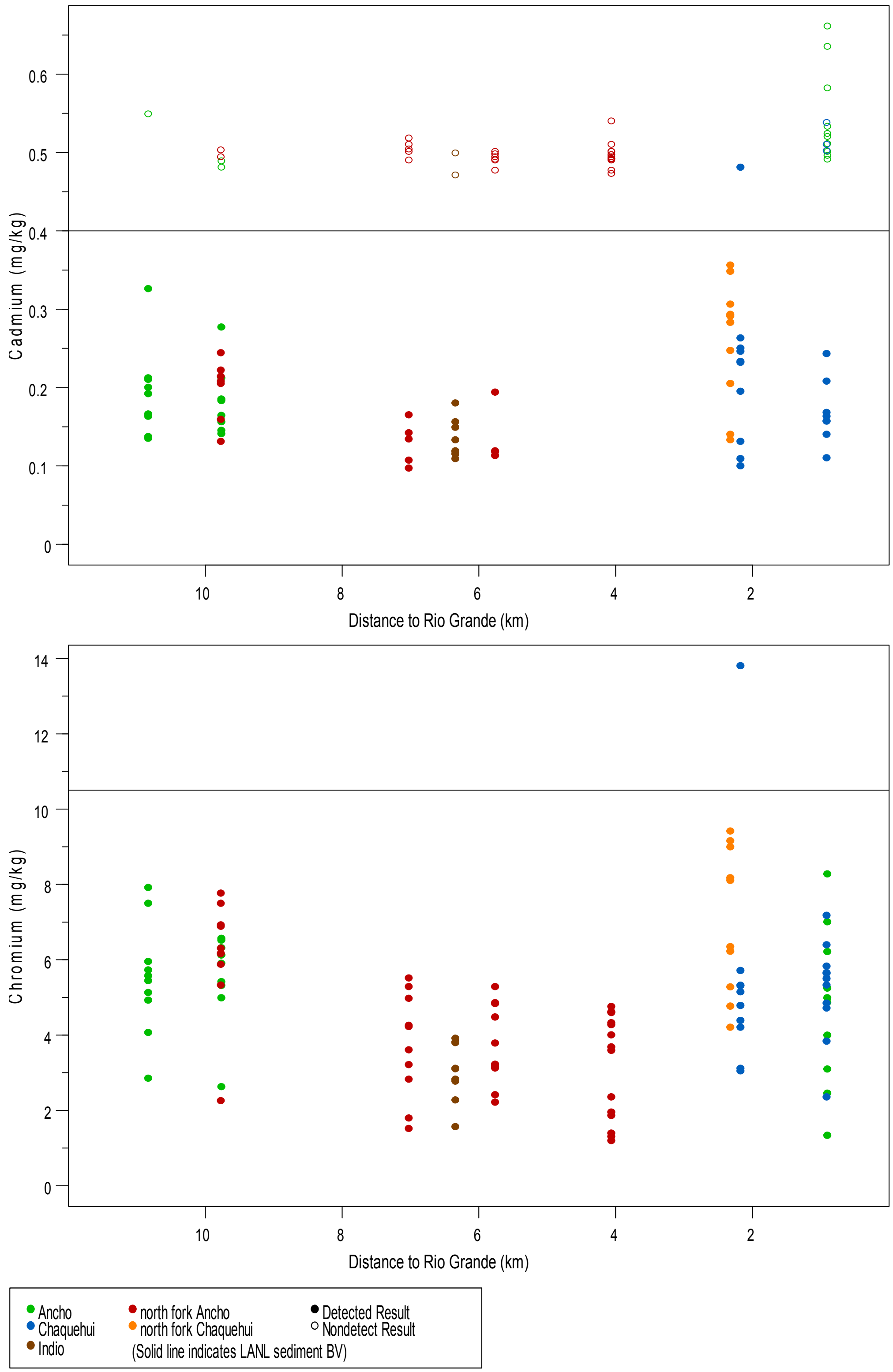


Figure D-1.1-1 (continued) **Plots of sample results versus distance from the Rio Grande for all inorganic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

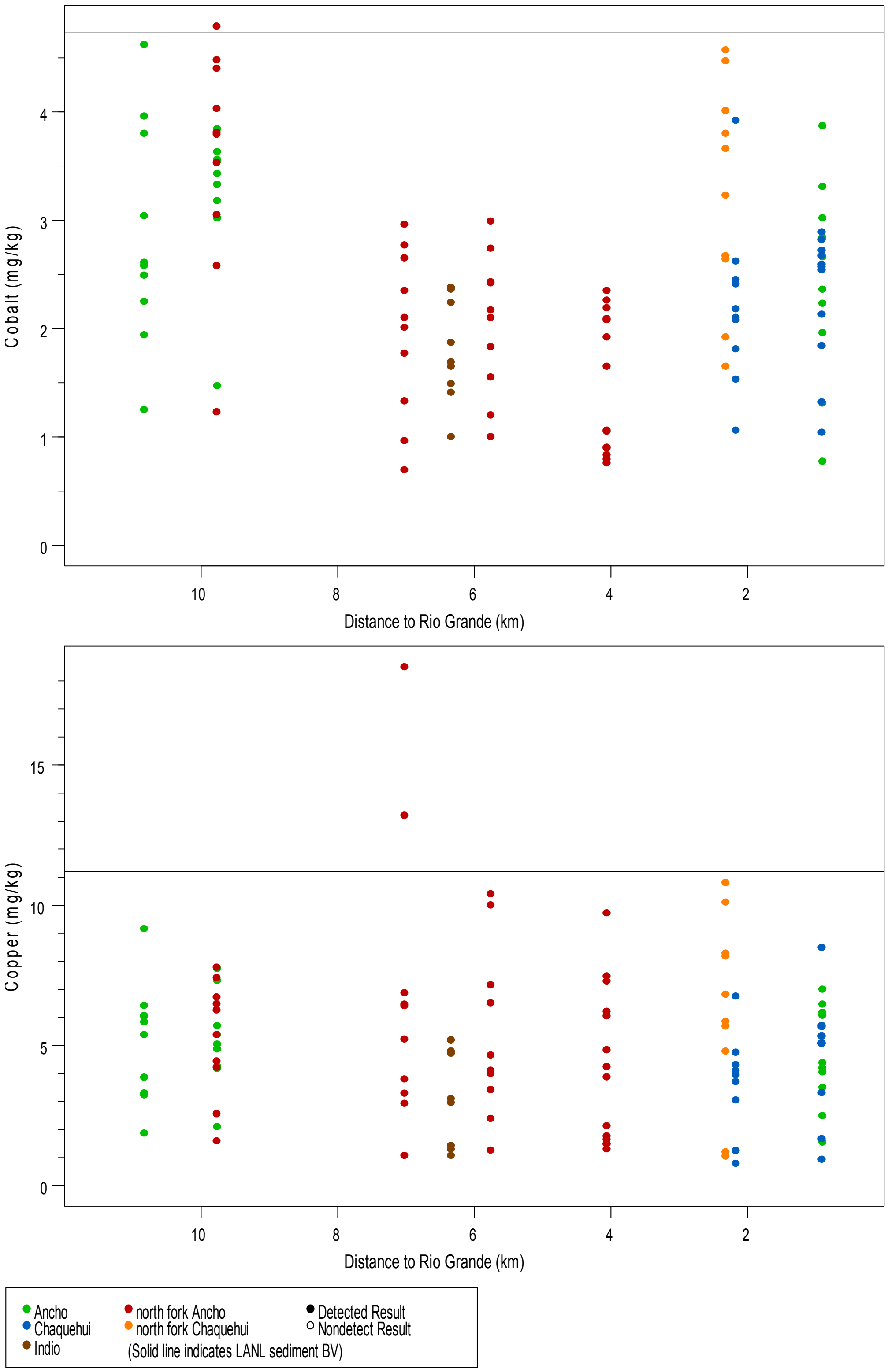
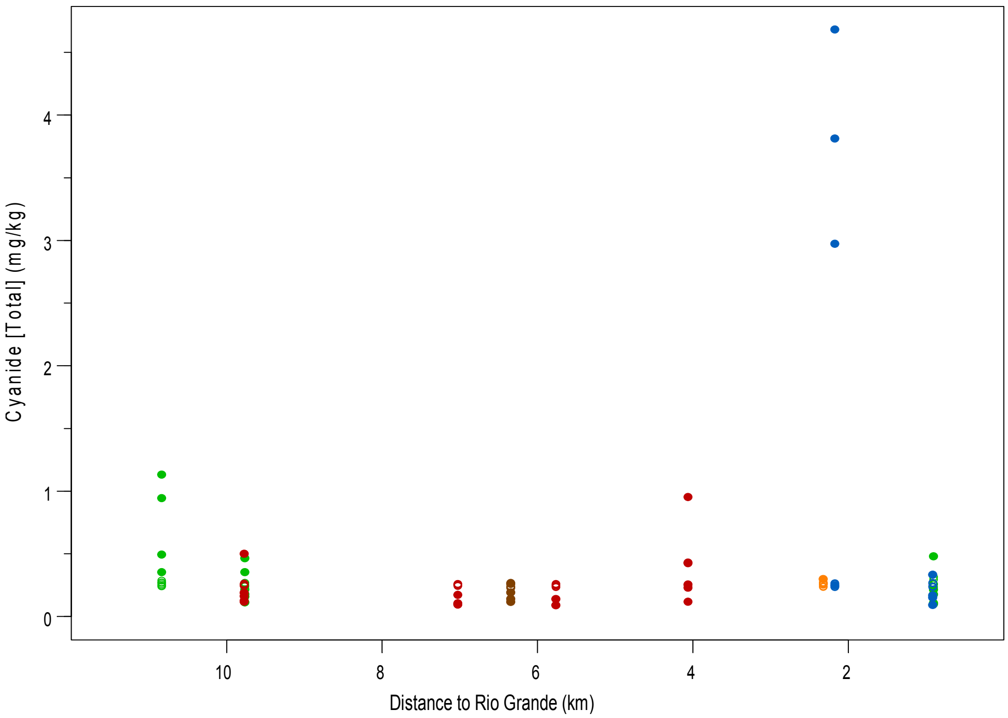


Figure D-1.1-1 (continued) Plots of sample results versus distance from the Rio Grande for all inorganic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed



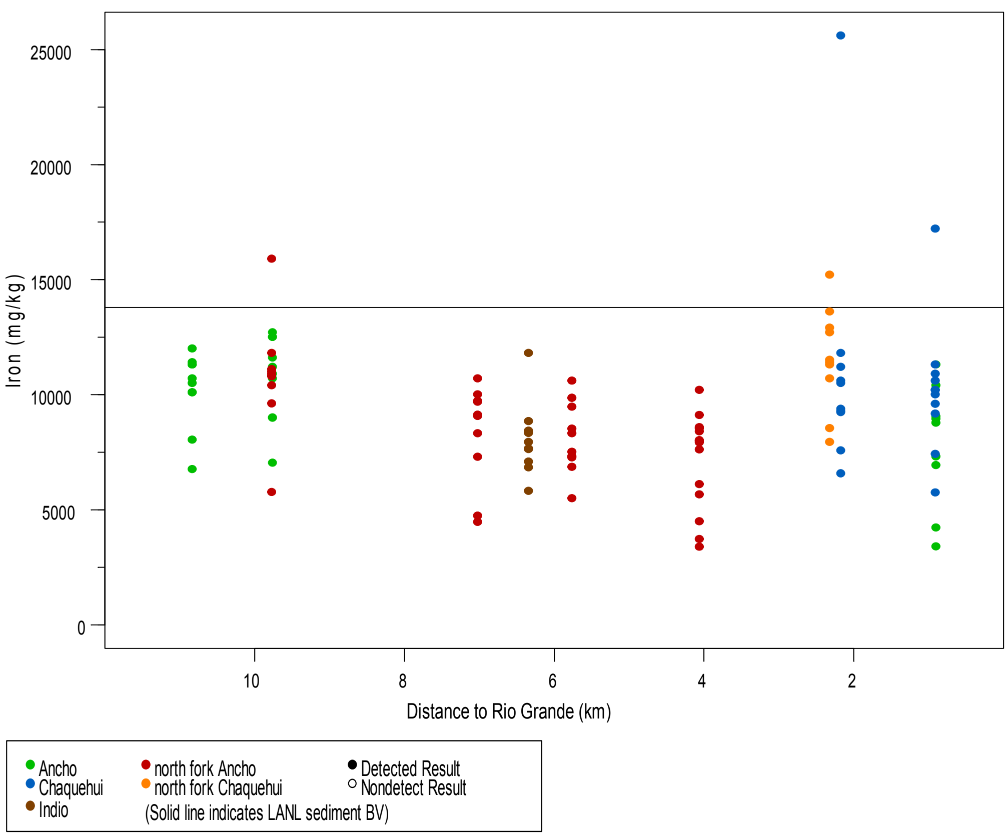


Figure D-1.1-1 (continued) **Plots of sample results versus distance from the Rio Grande for all inorganic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

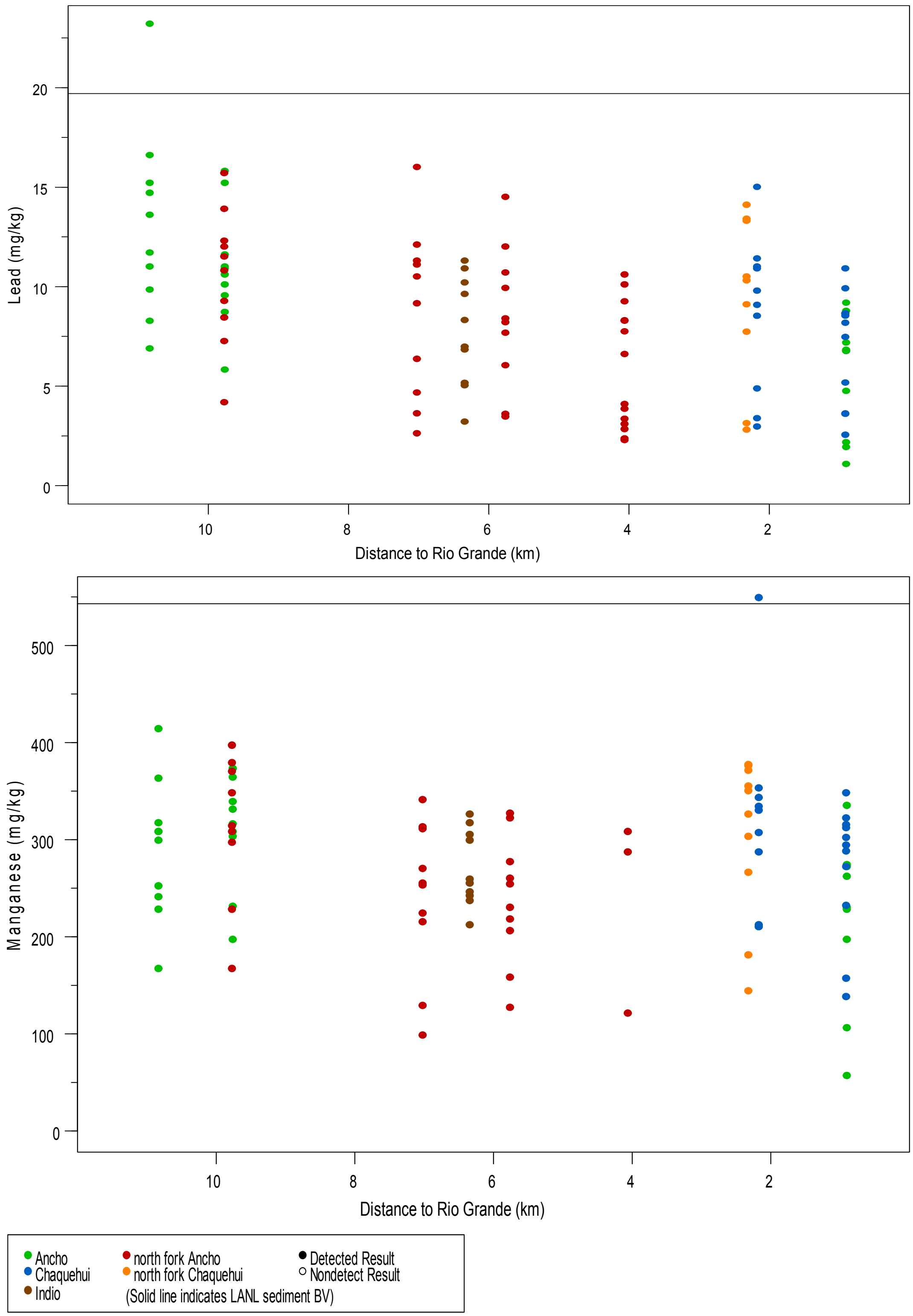


Figure D-1.1-1 (continued) **Plots of sample results versus distance from the Rio Grande for all inorganic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

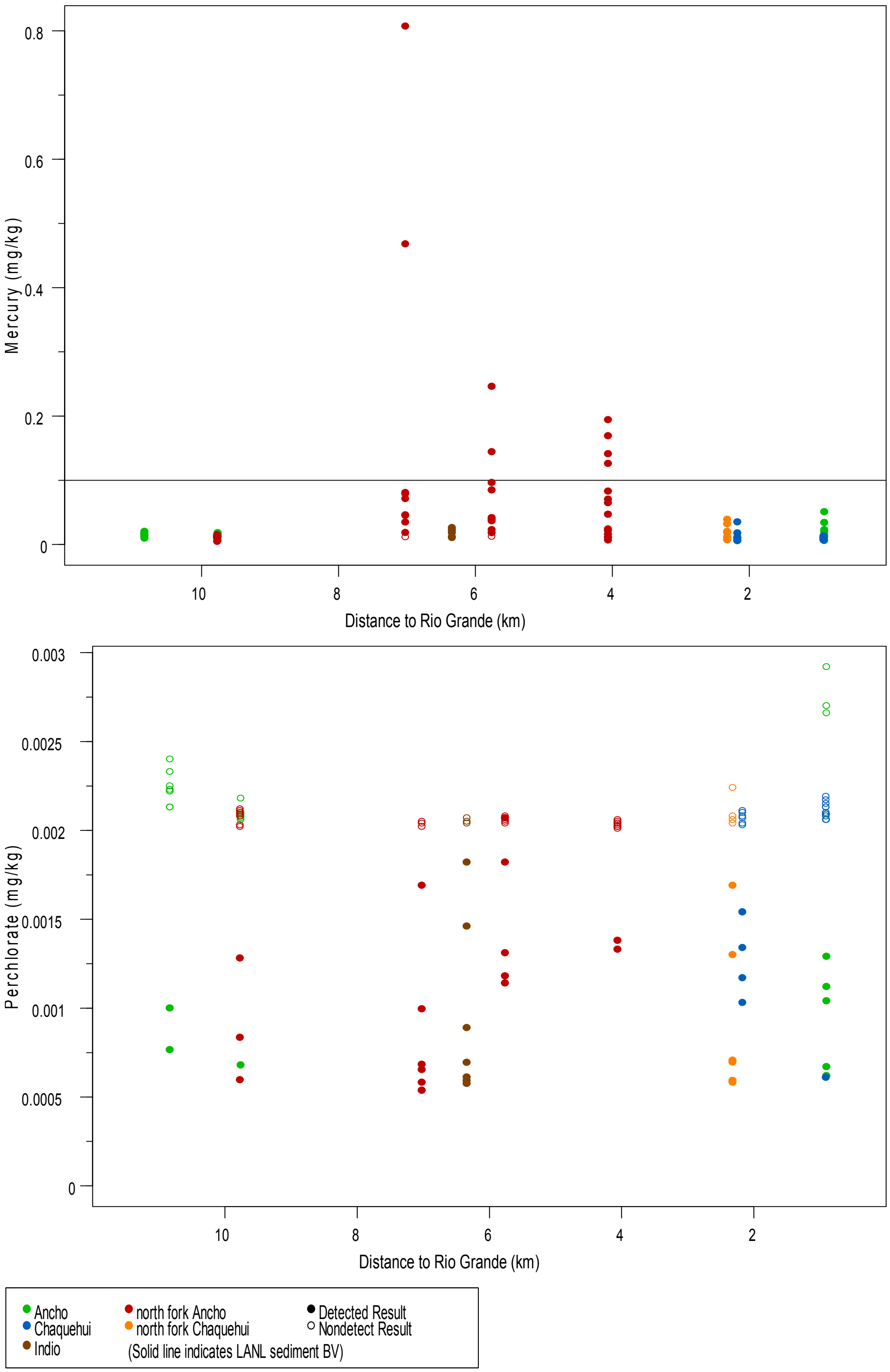


Figure D-1.1-1 (continued) Plots of sample results versus distance from the Rio Grande for all inorganic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed

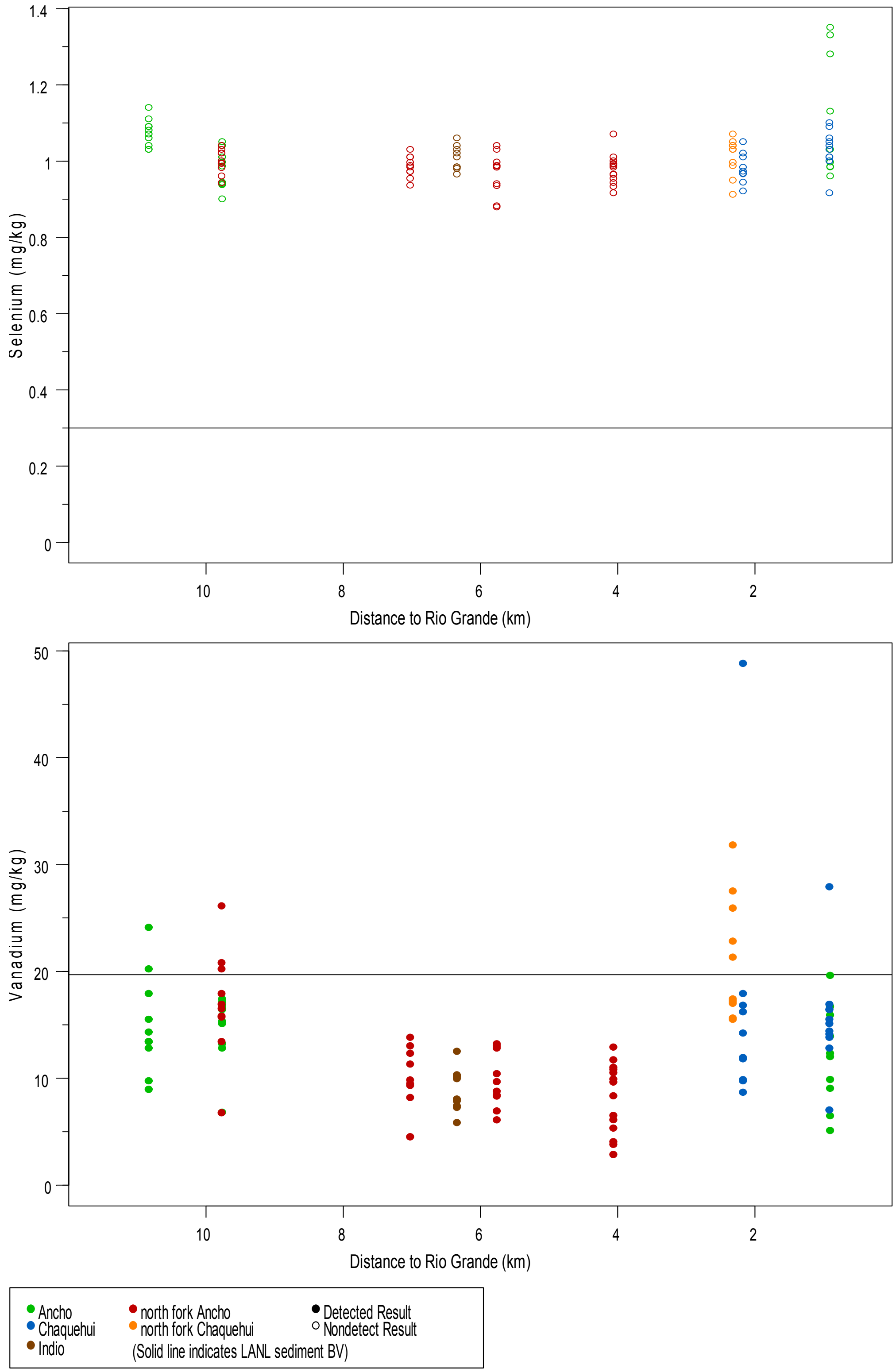


Figure D-1.1-1 (continued) **Plots of sample results versus distance from the Rio Grande for all inorganic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

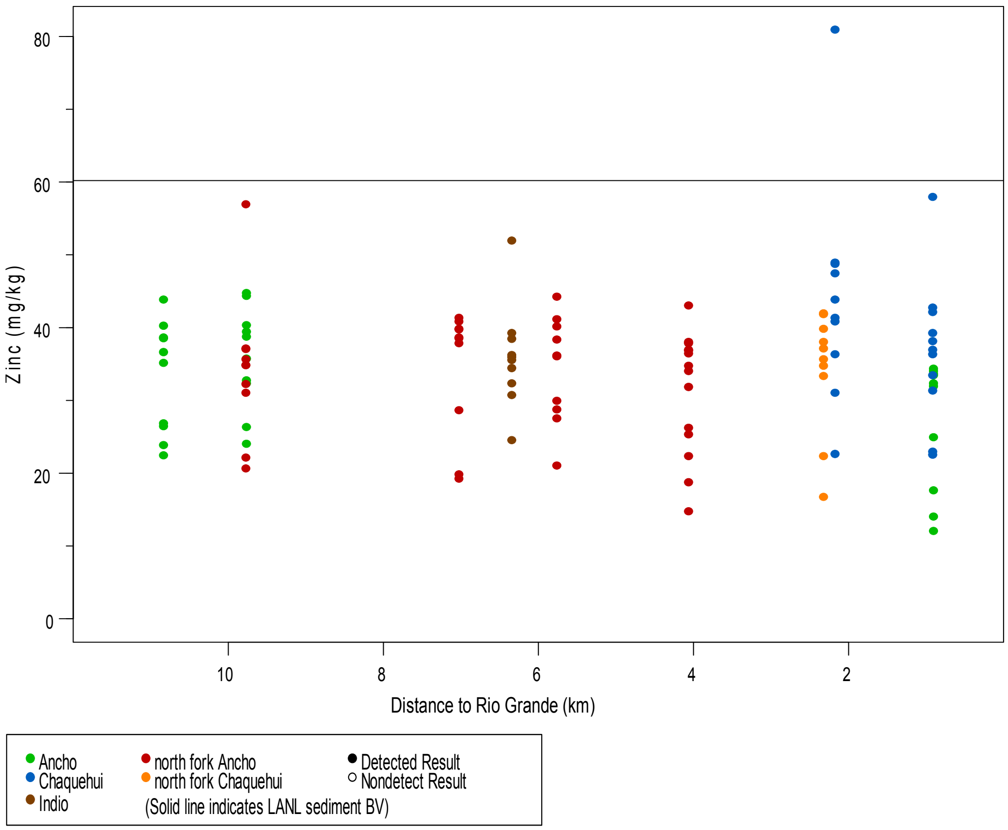


Figure D-1.1-1 (continued) **Plots of sample results versus distance from the Rio Grande for all inorganic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

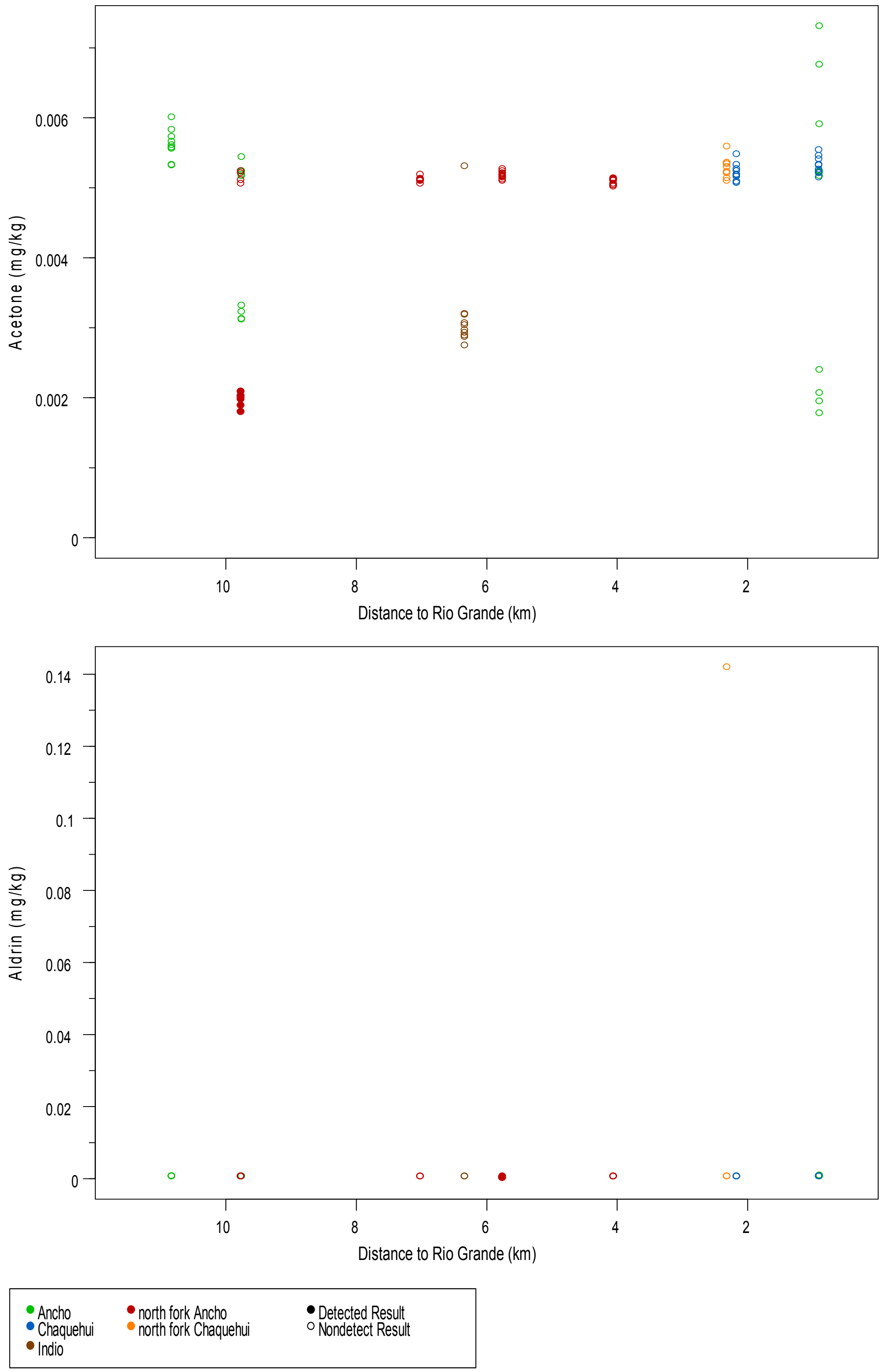


Figure D-1.1-2 Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed

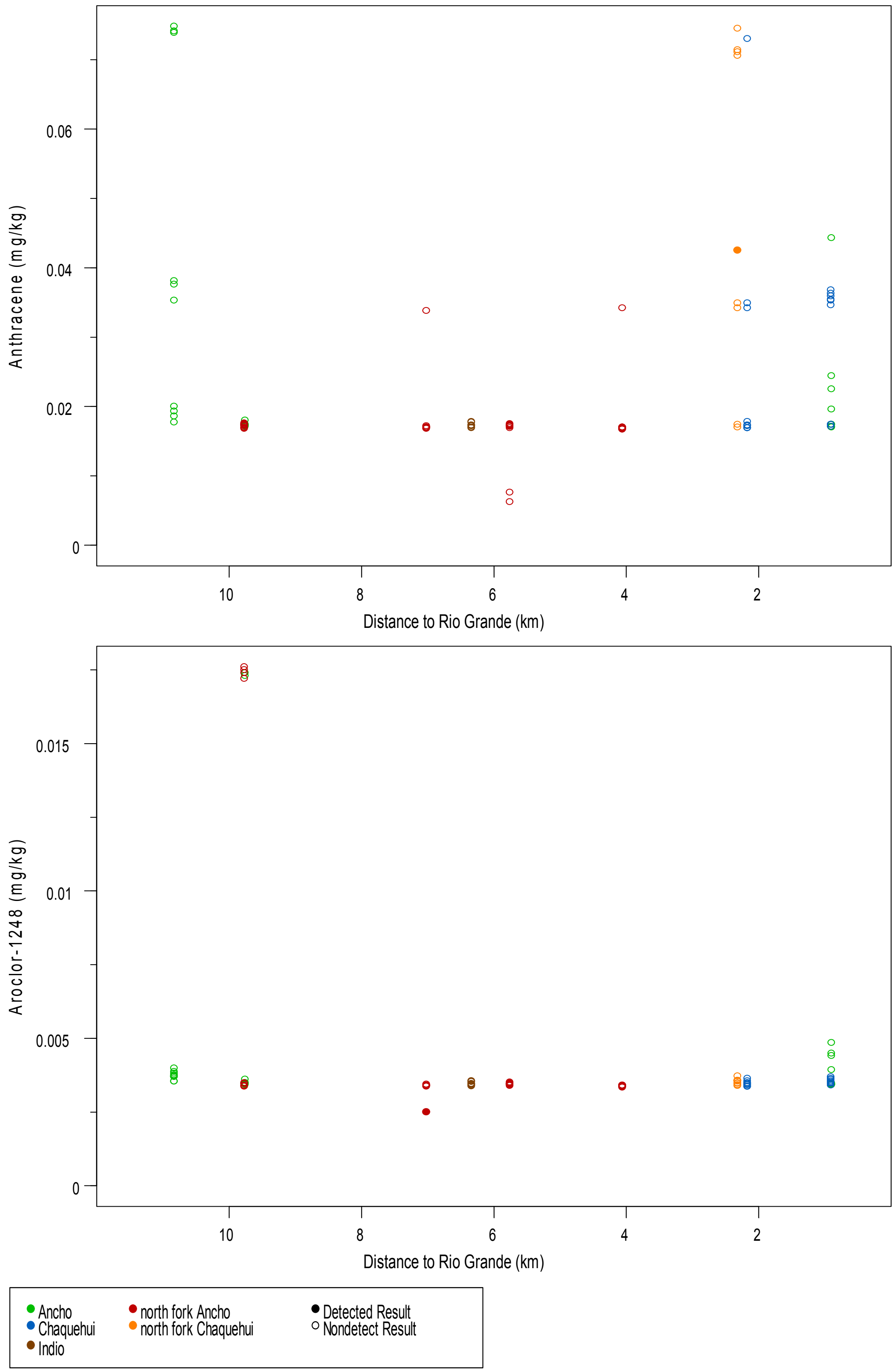


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

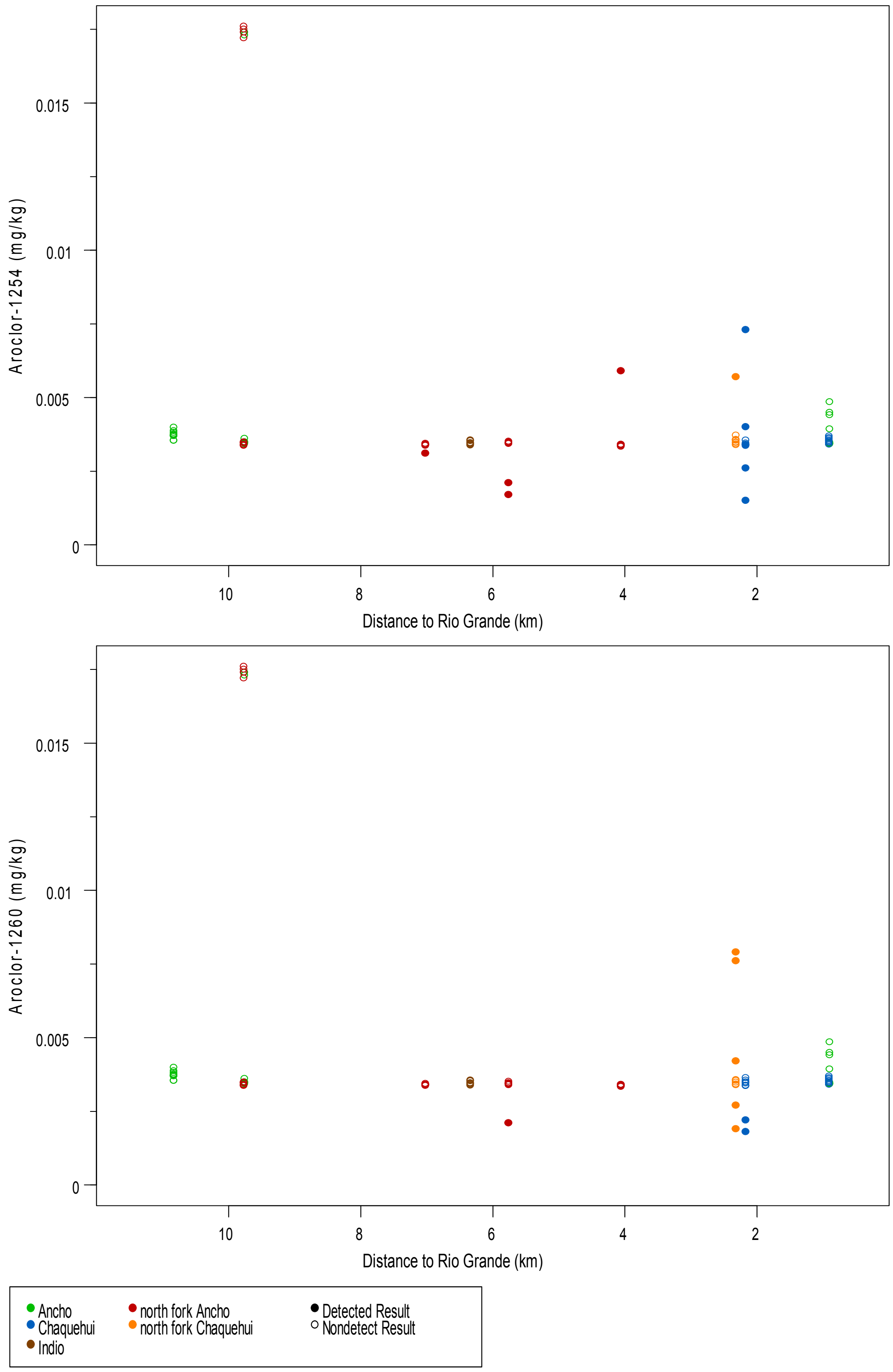


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

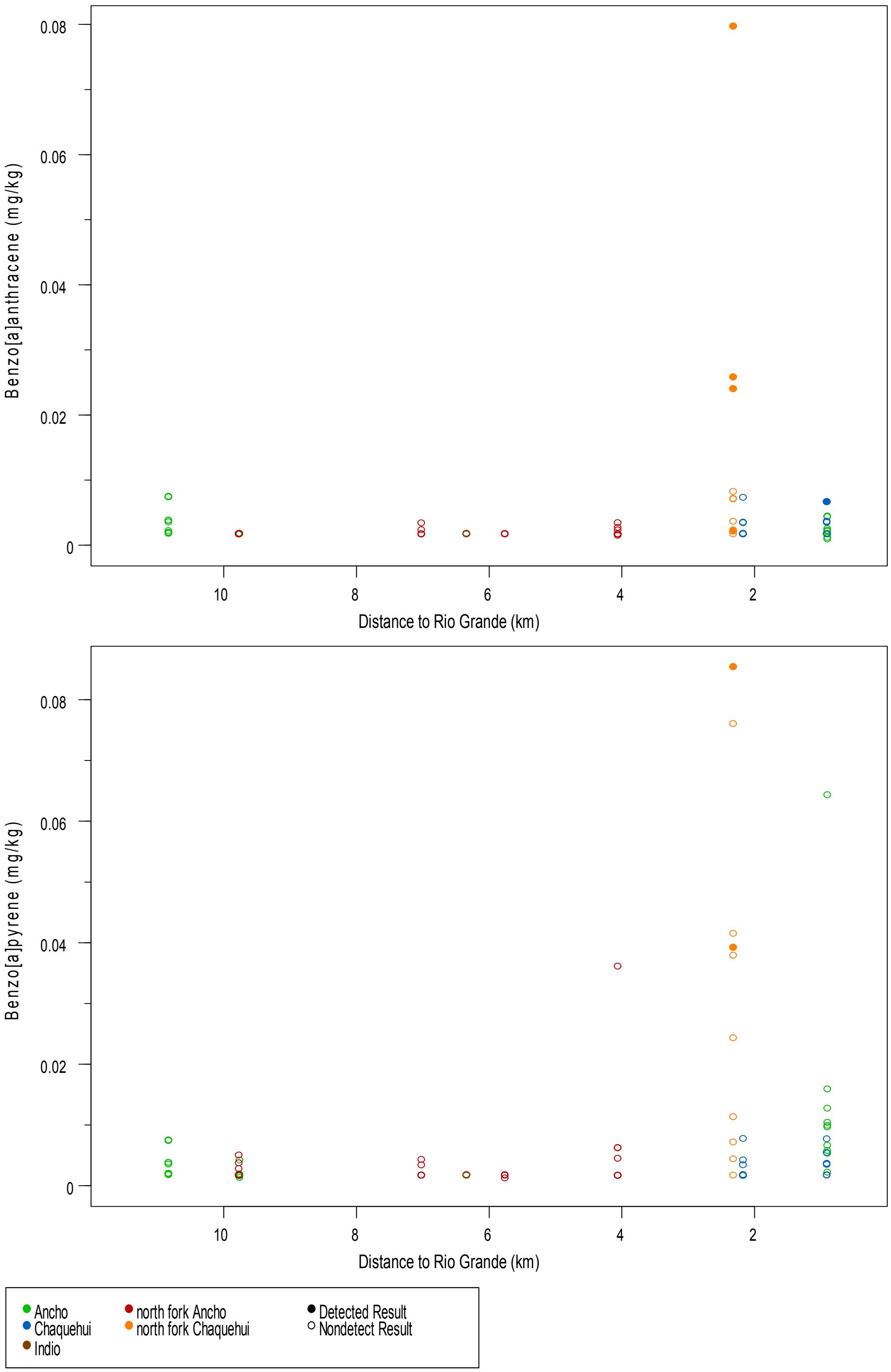


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

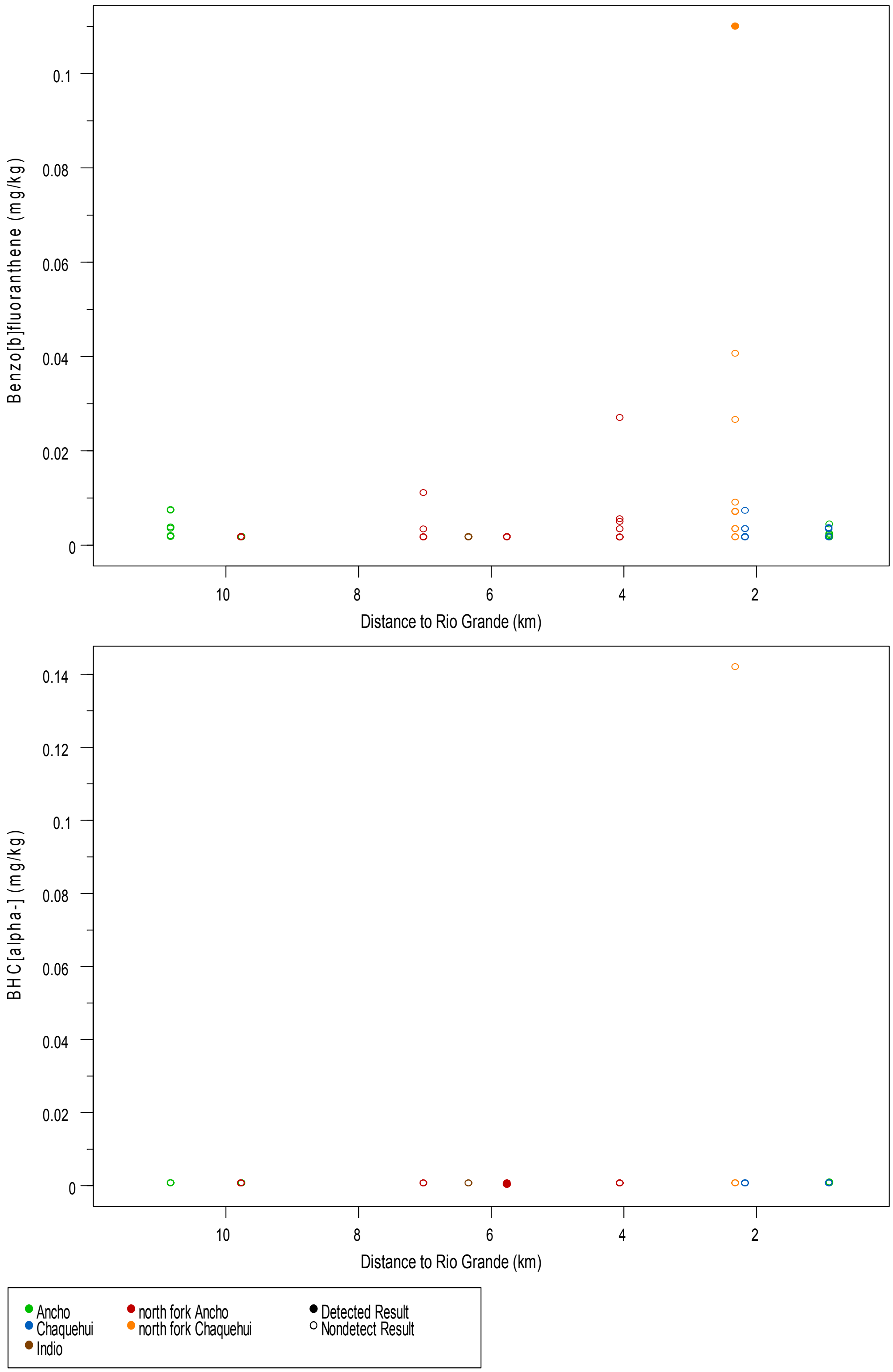


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

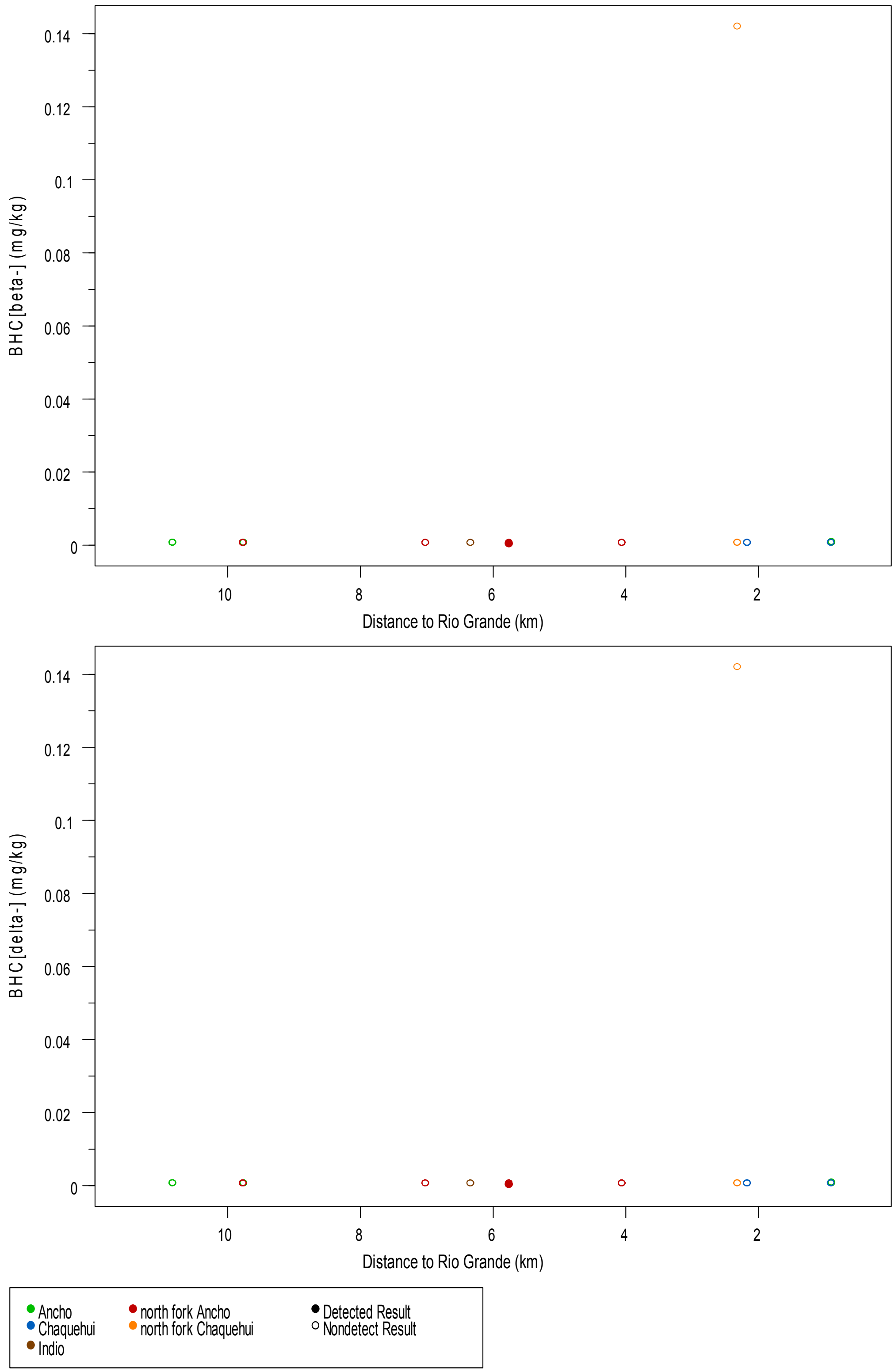
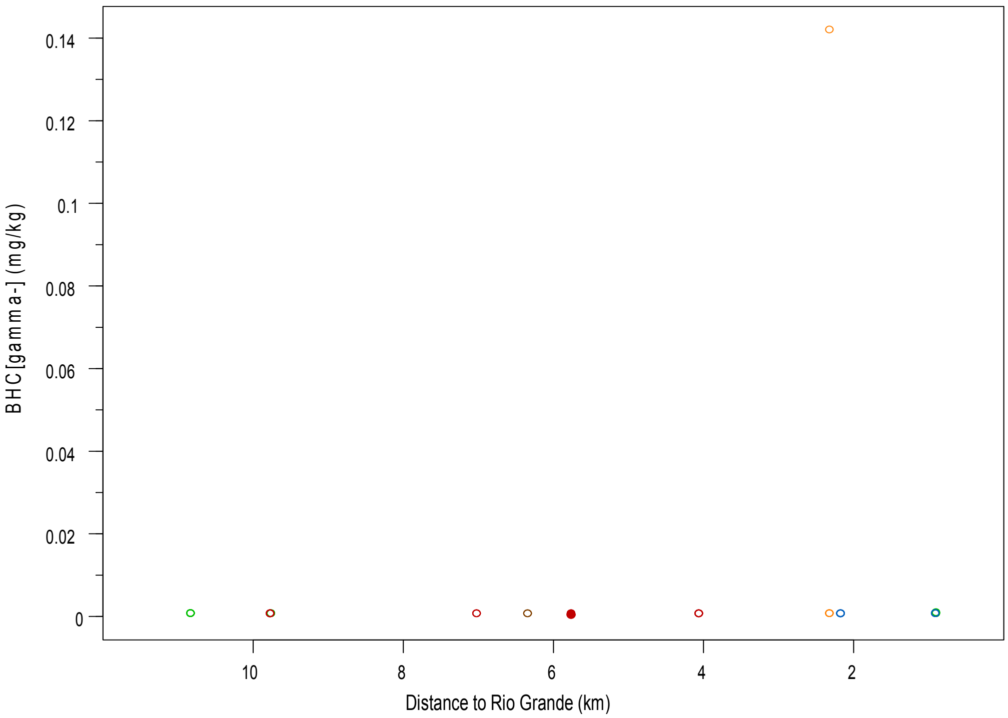


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**



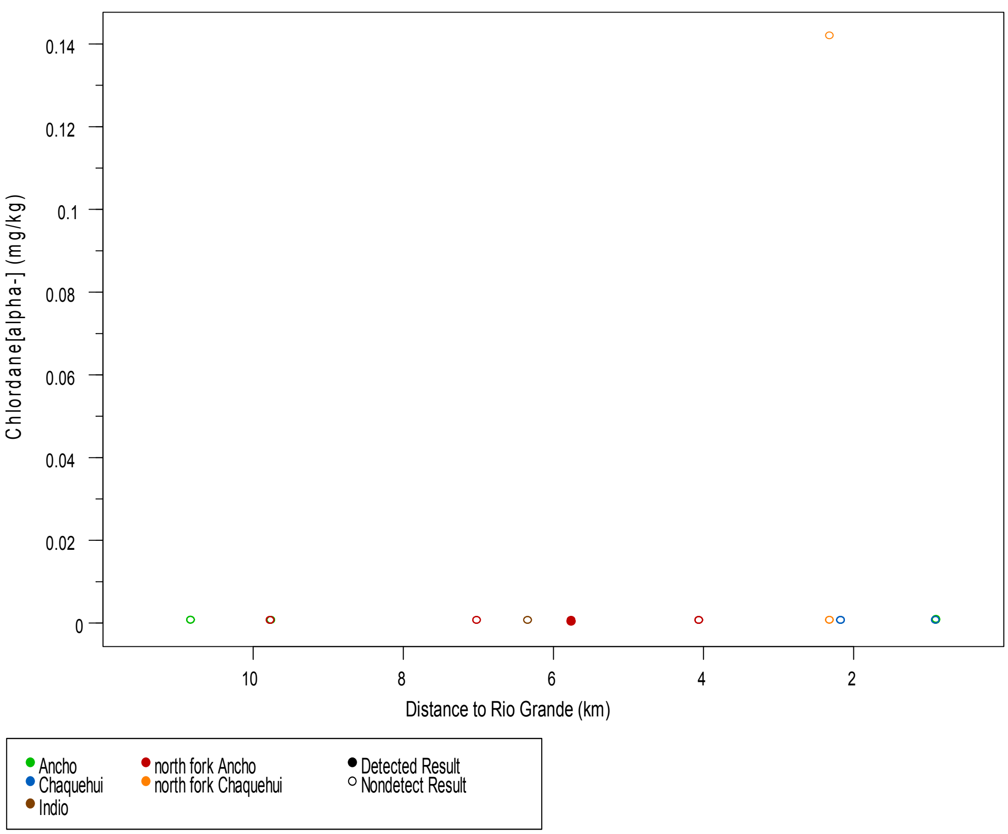


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

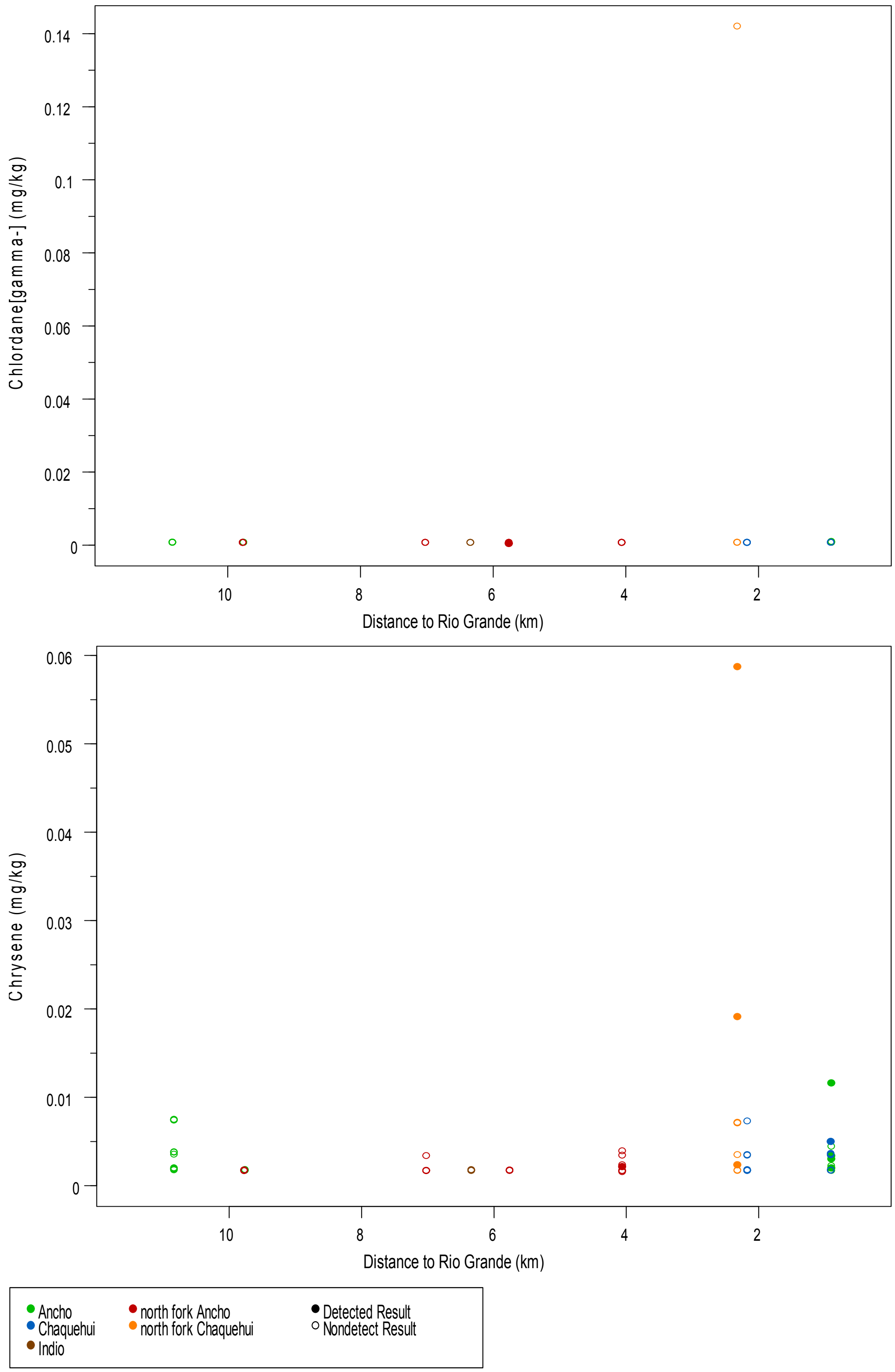


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

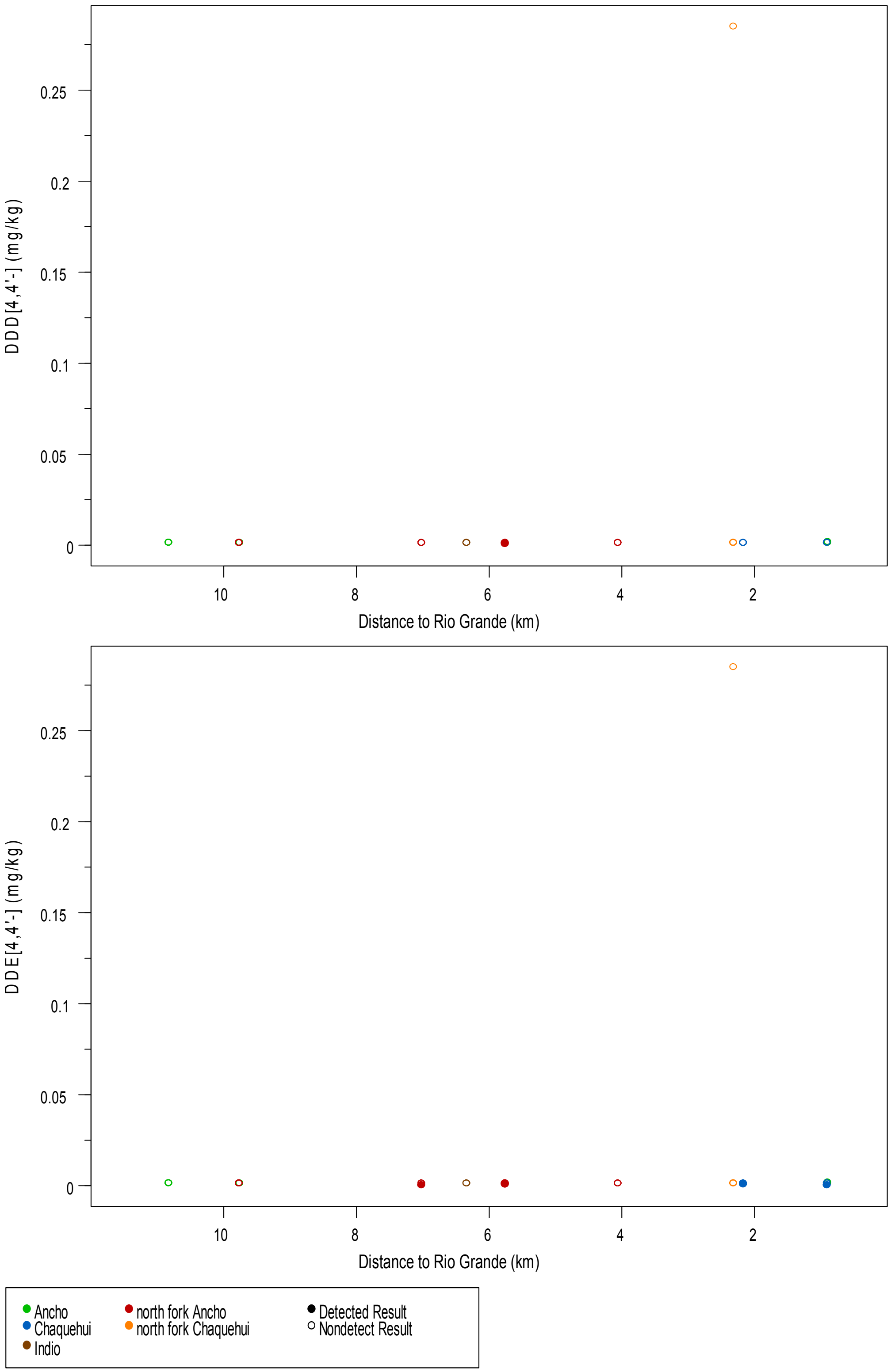


Figure D-1.1-2 (continued) Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed

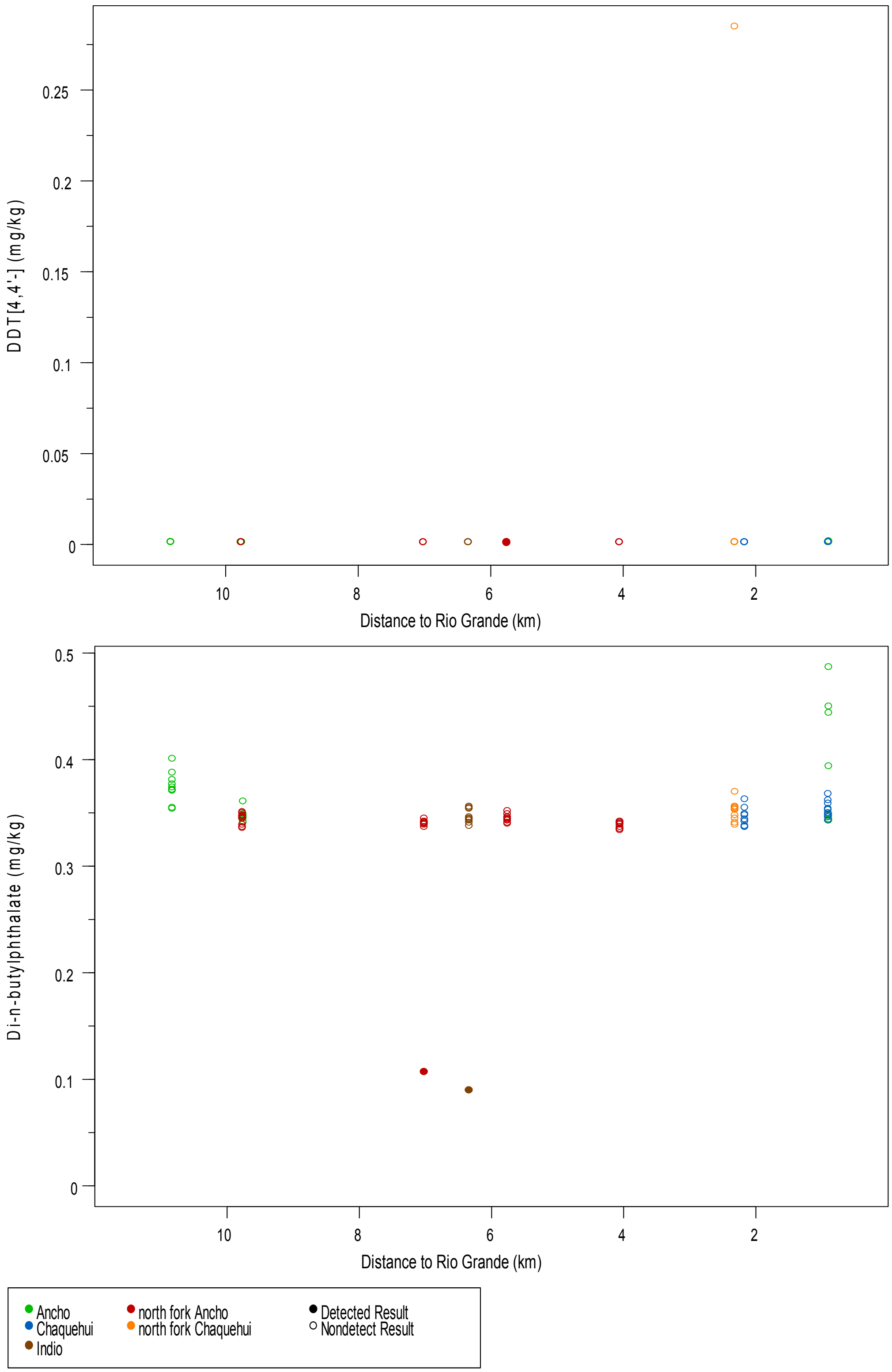


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

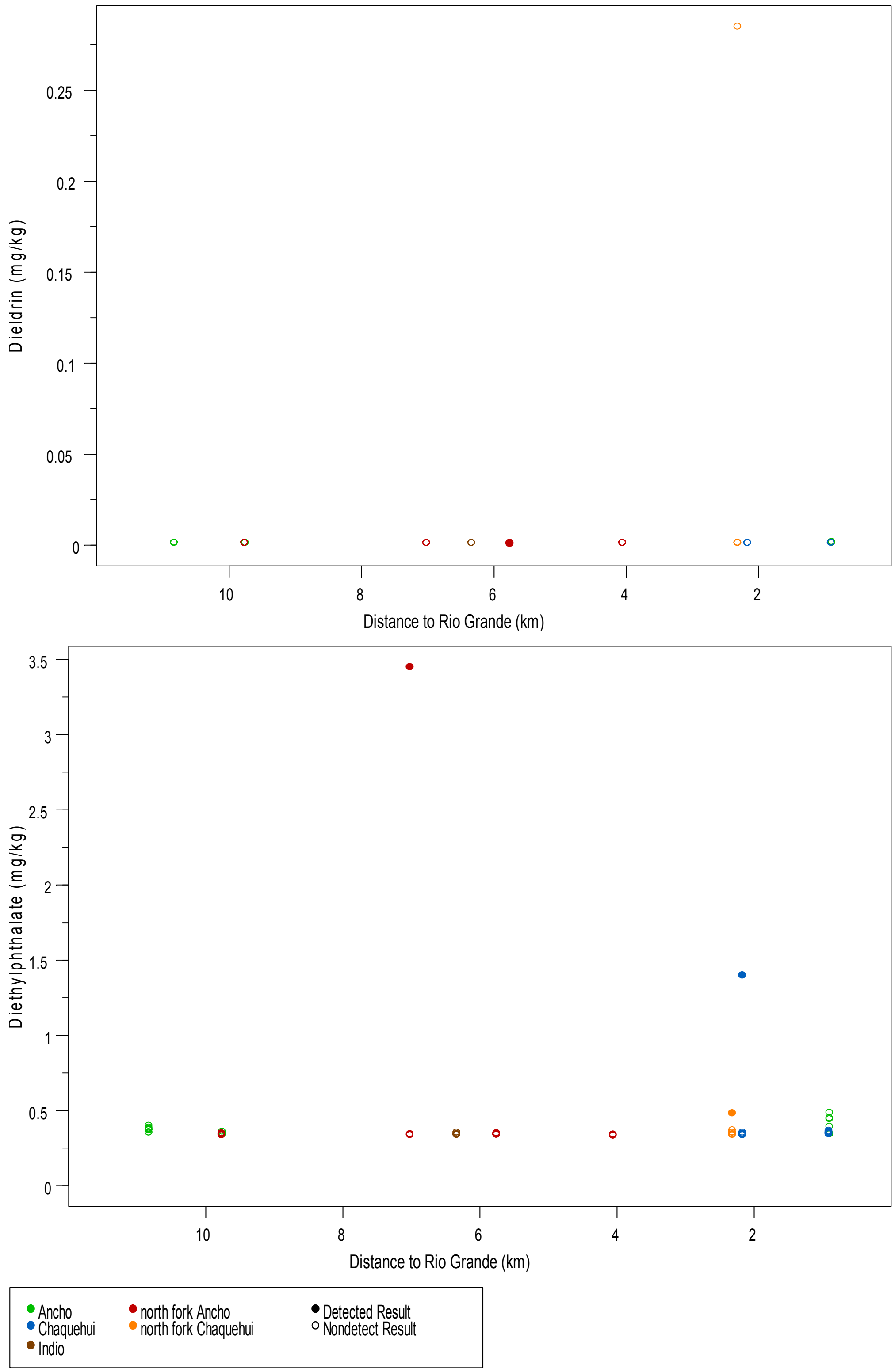


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

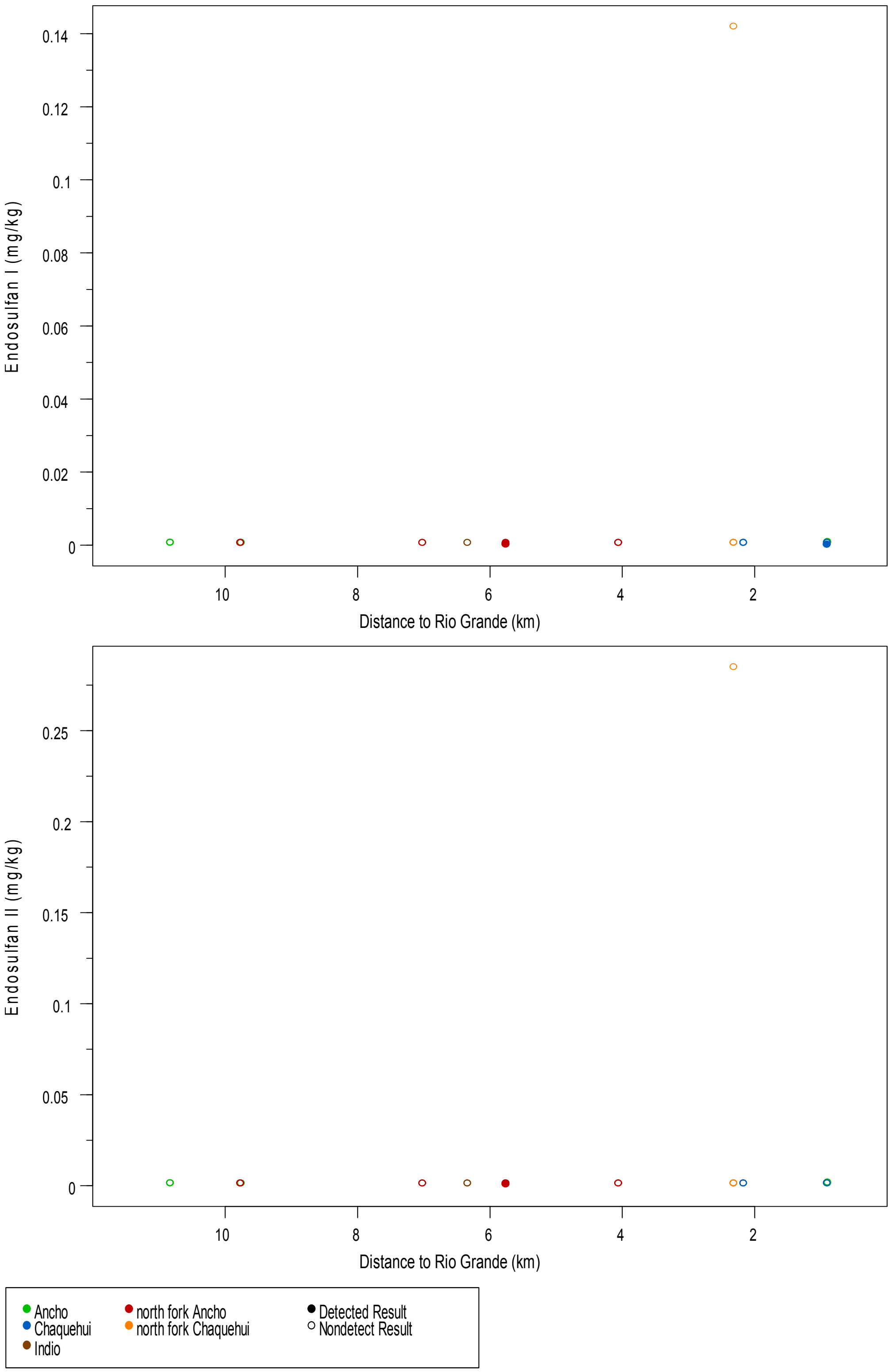


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

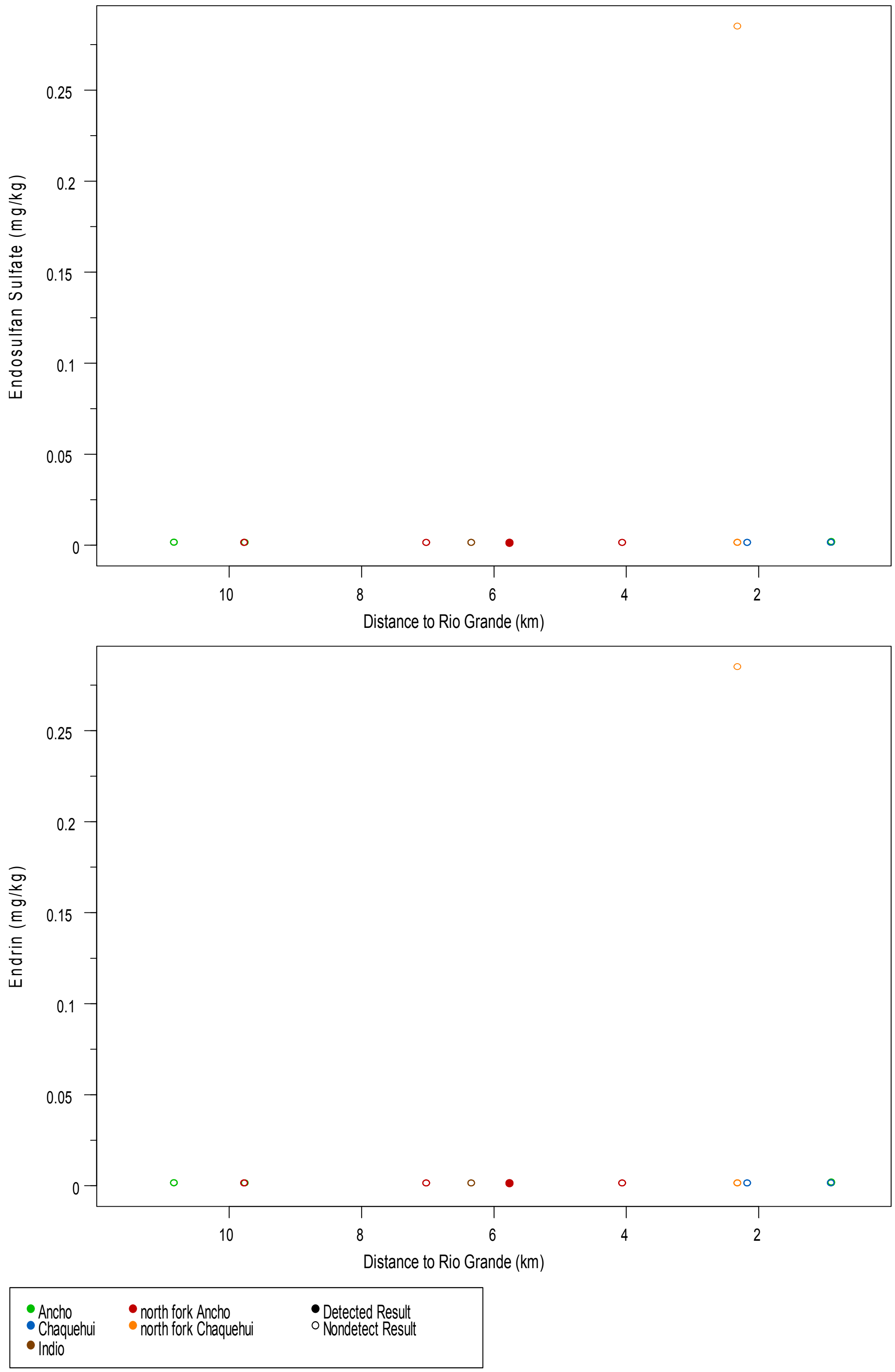


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

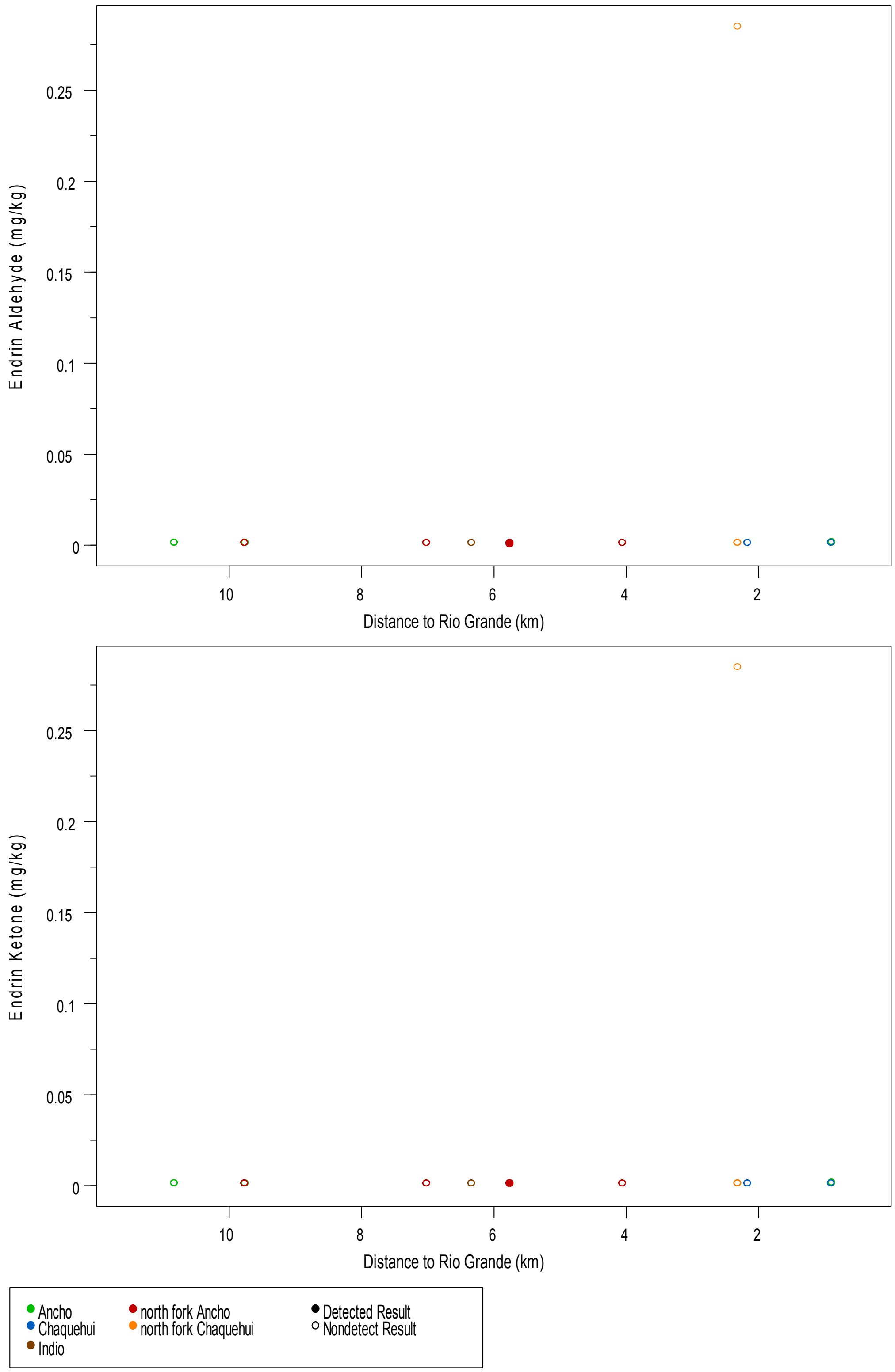


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

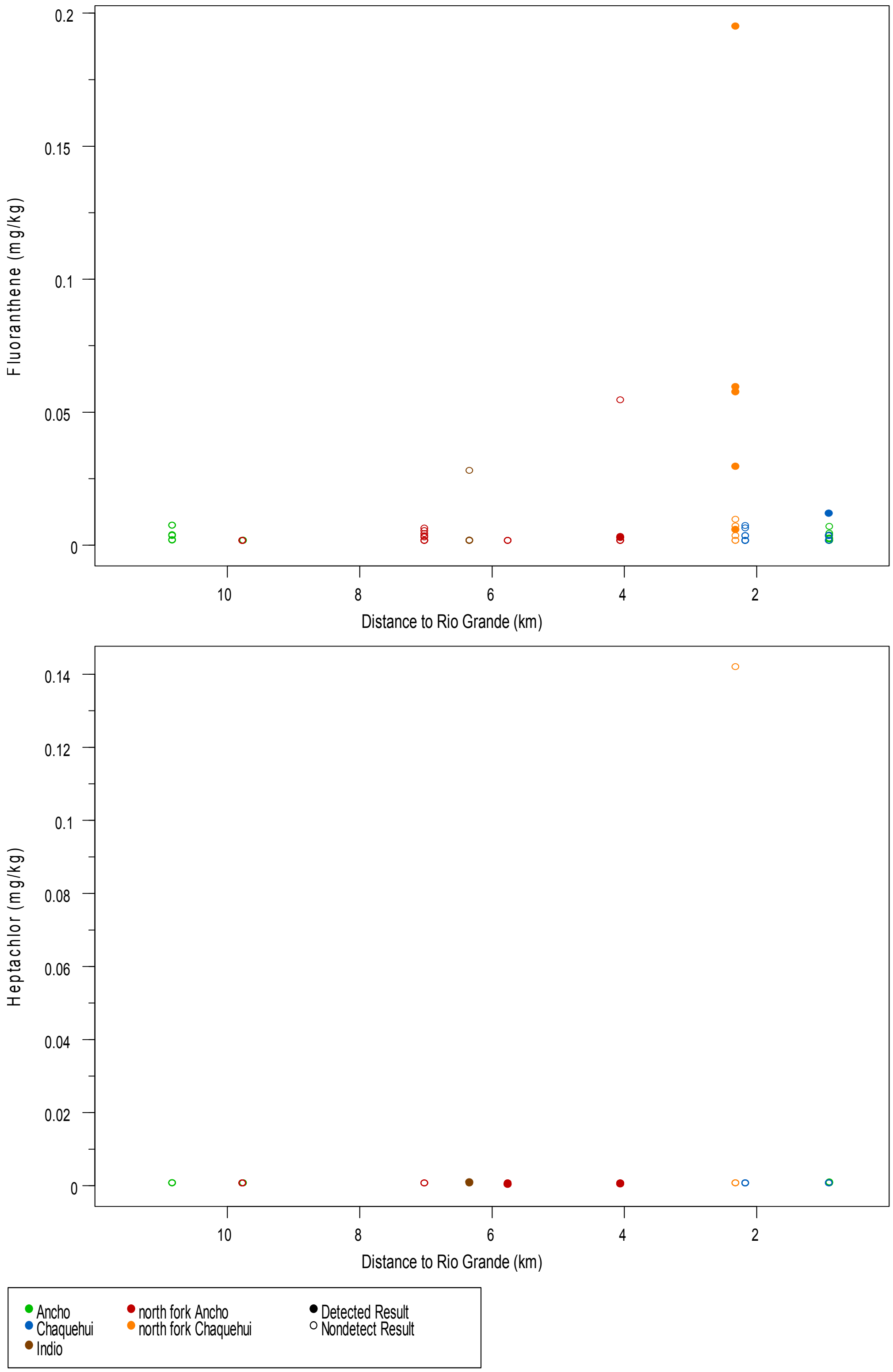


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

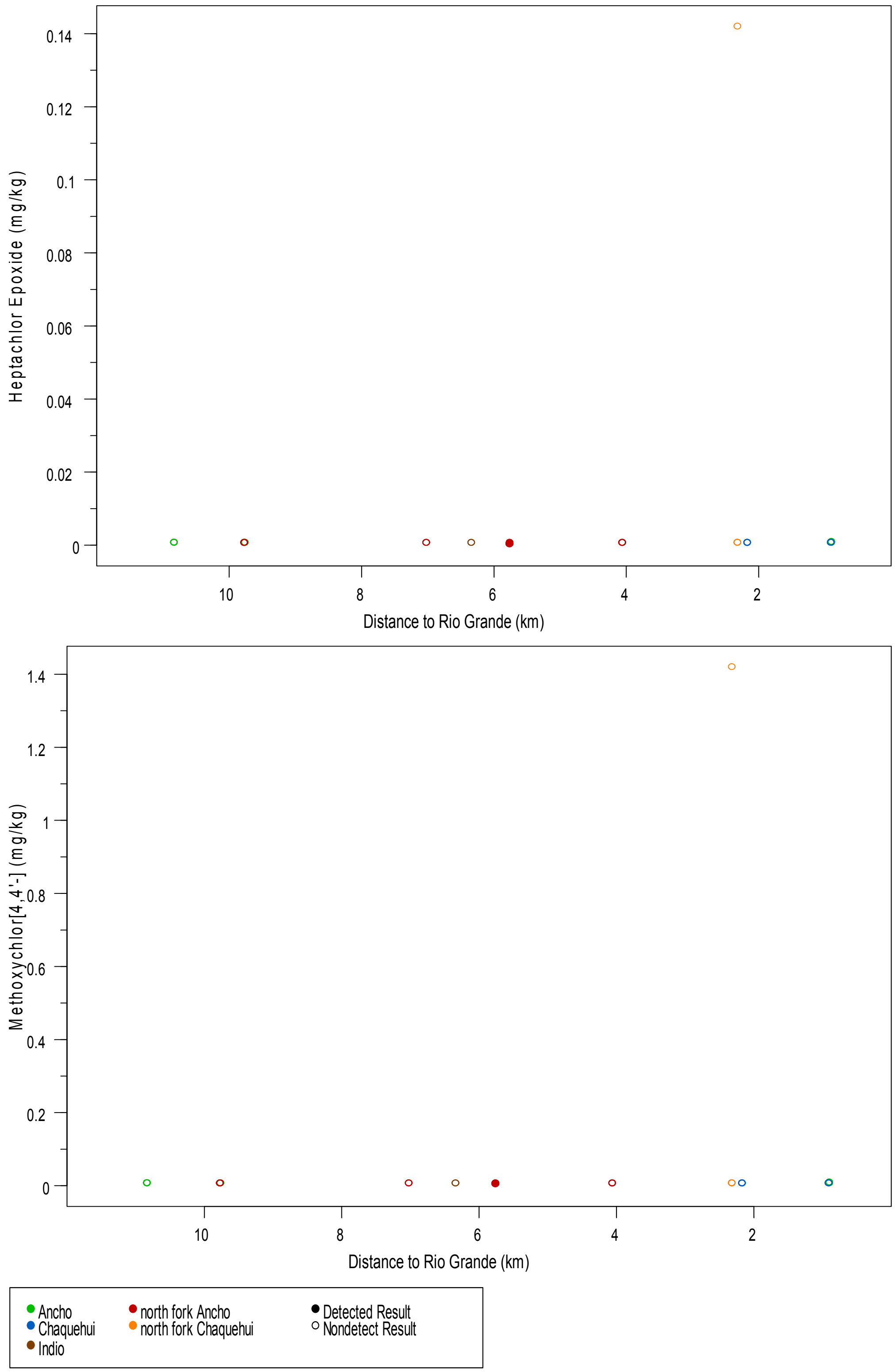


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

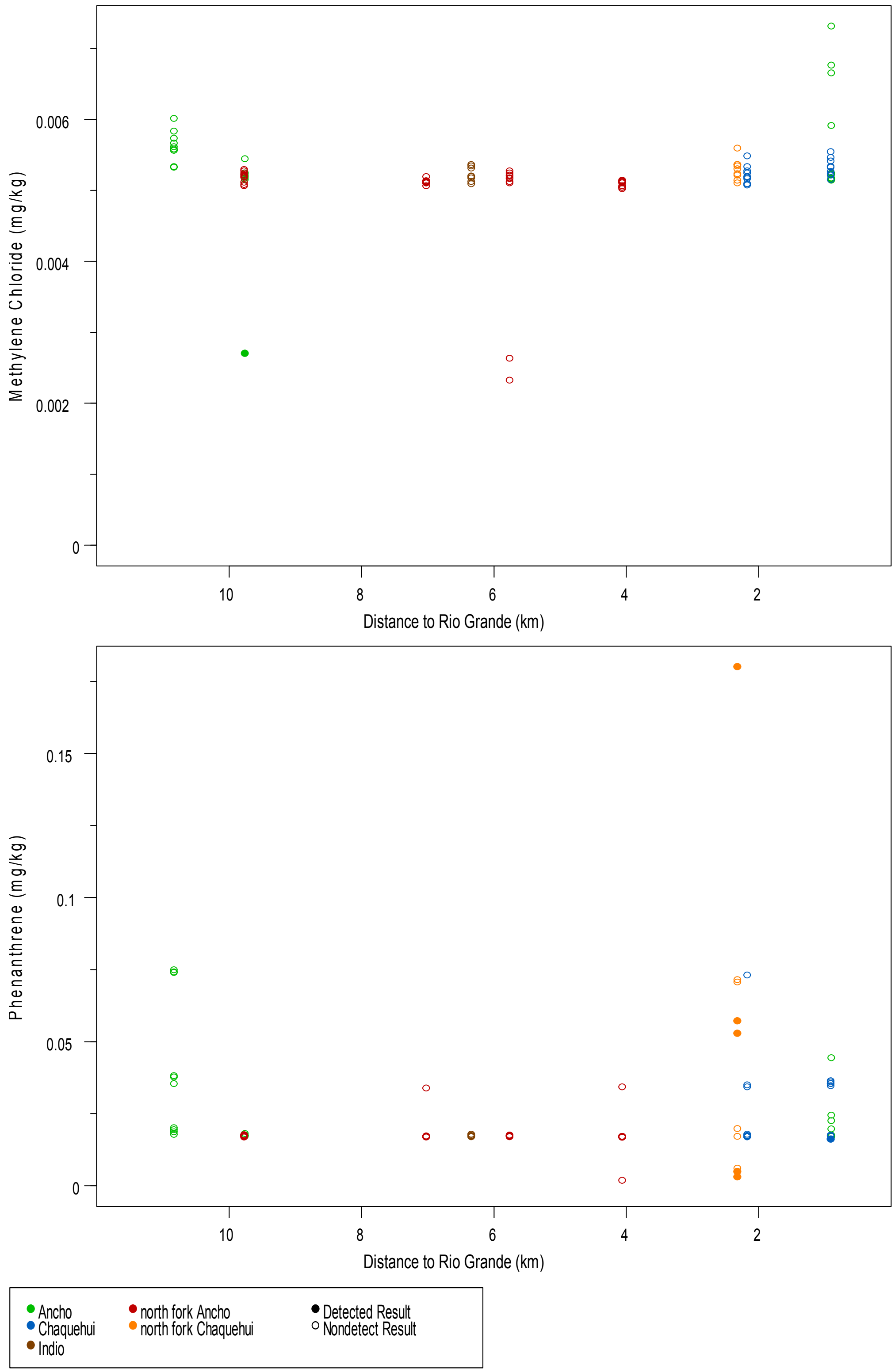


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

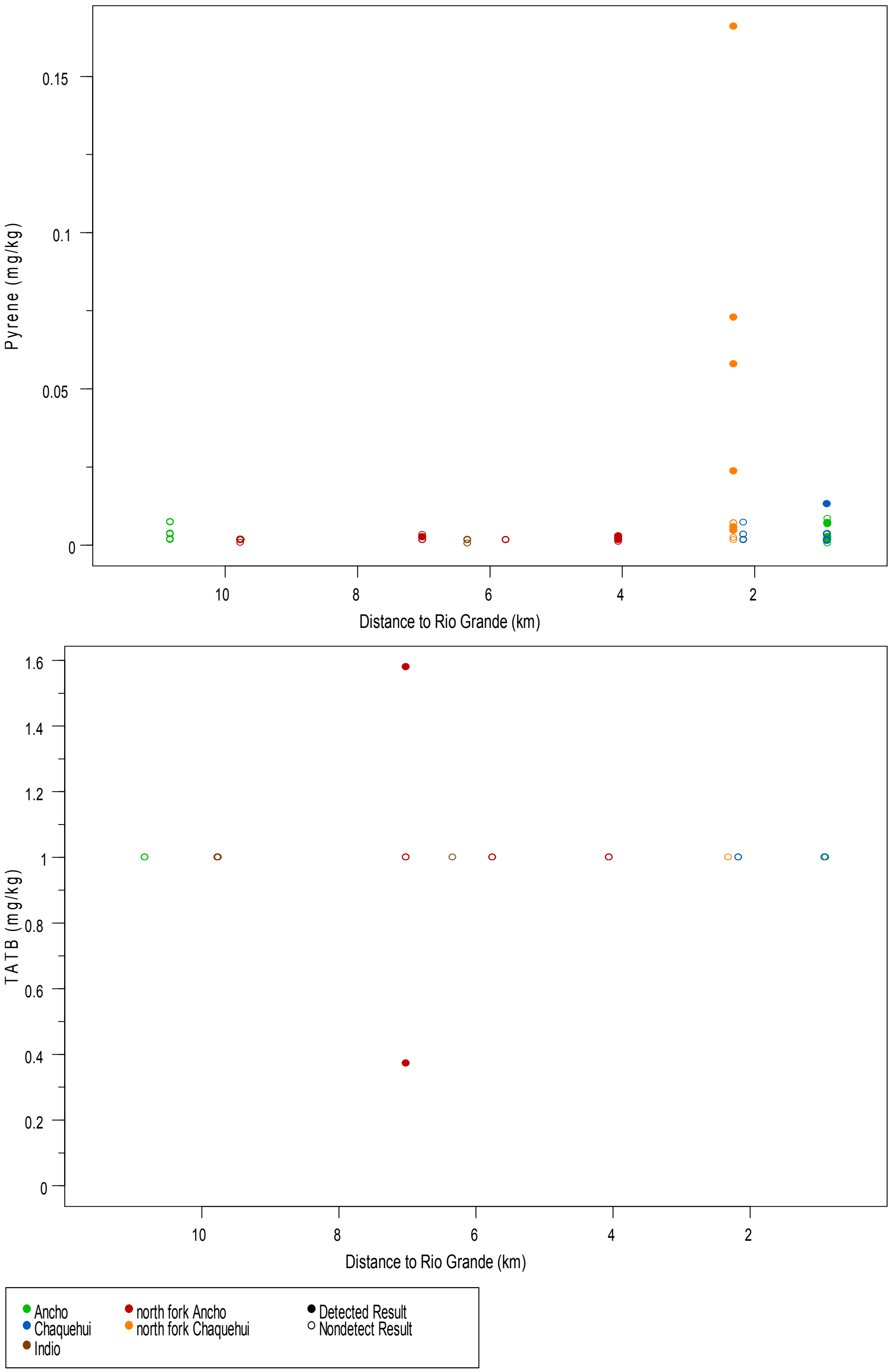


Figure D-1.1-2 (continued) **Plots of sample results versus distance from the Rio Grande for all organic COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

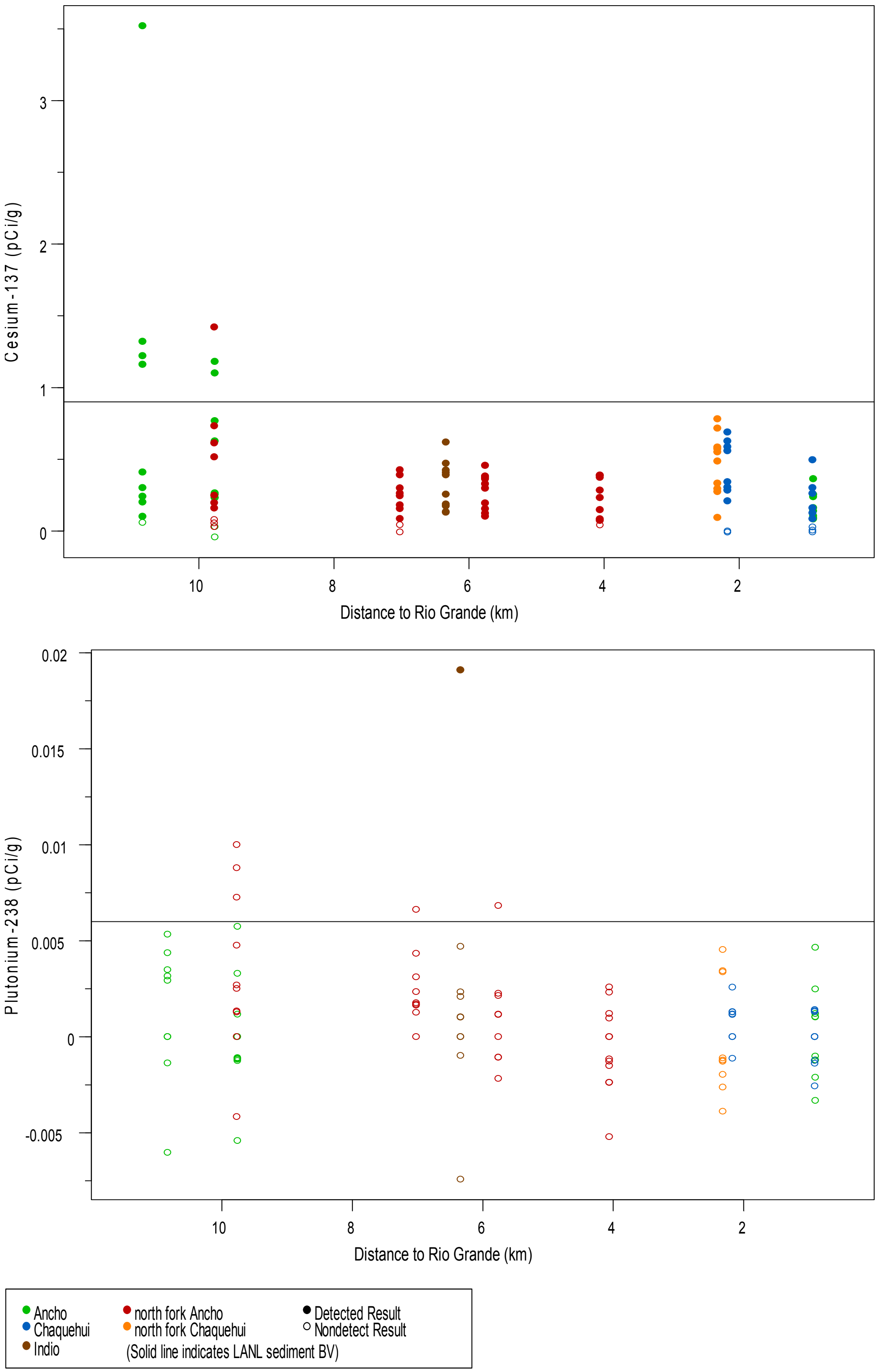


Figure D-1.1-3 Plots of sample results versus distance from the Rio Grande for all radionuclide COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed

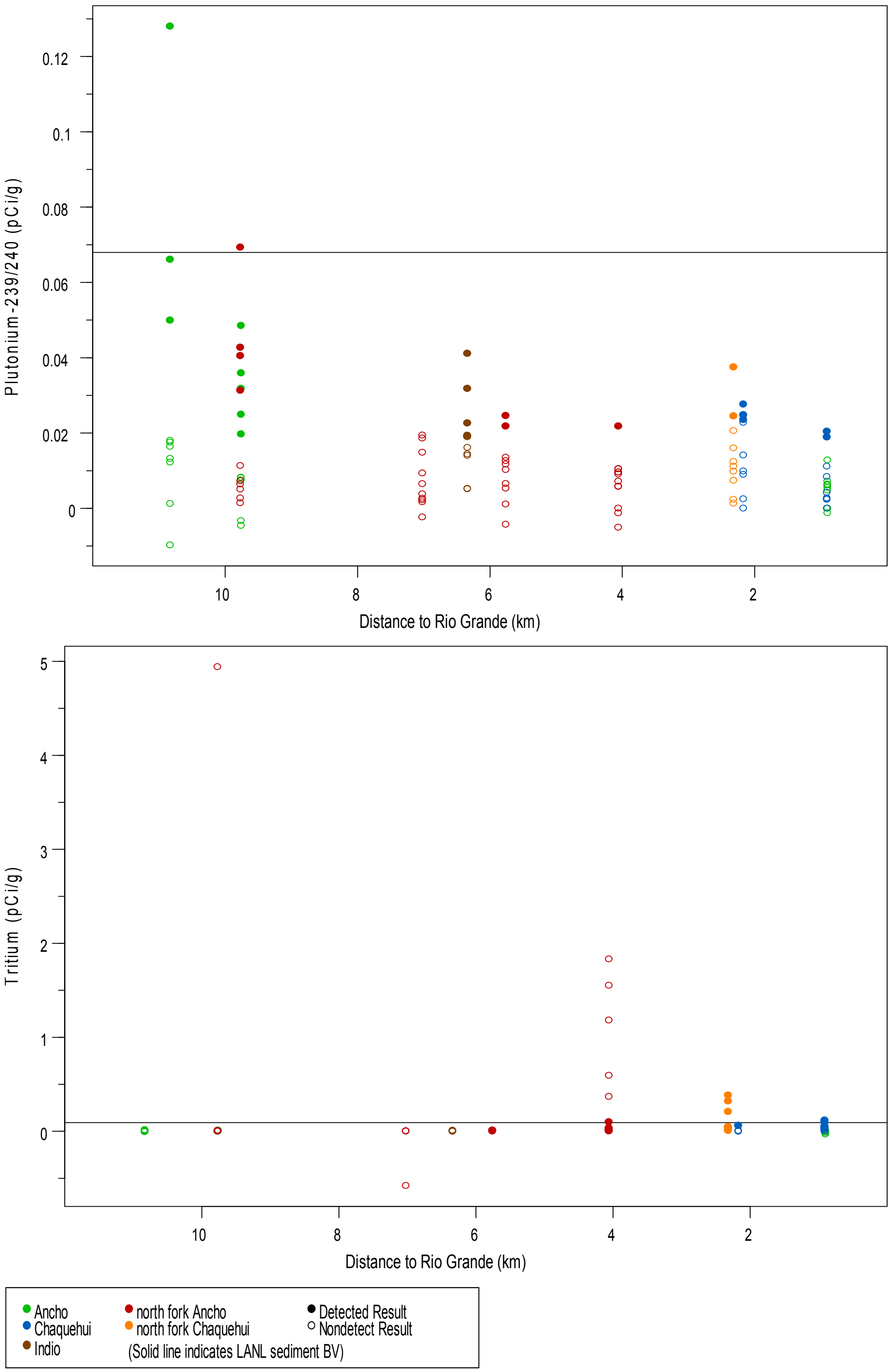
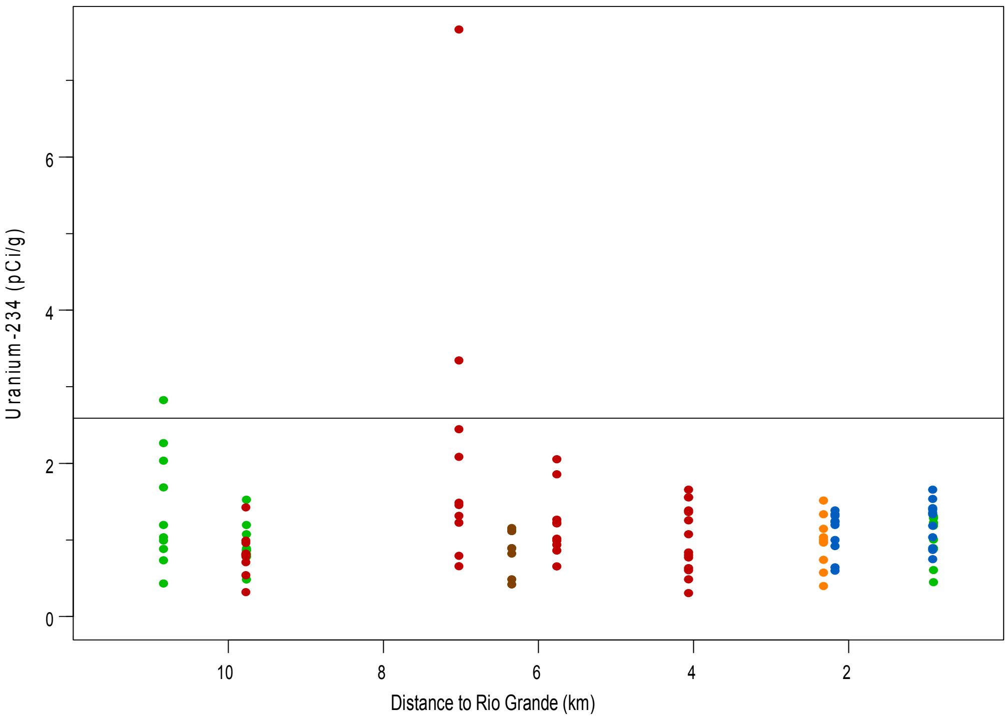


Figure D-1.1-3 (continued) **Plots of sample results versus distance from the Rio Grande for all radionuclide COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**



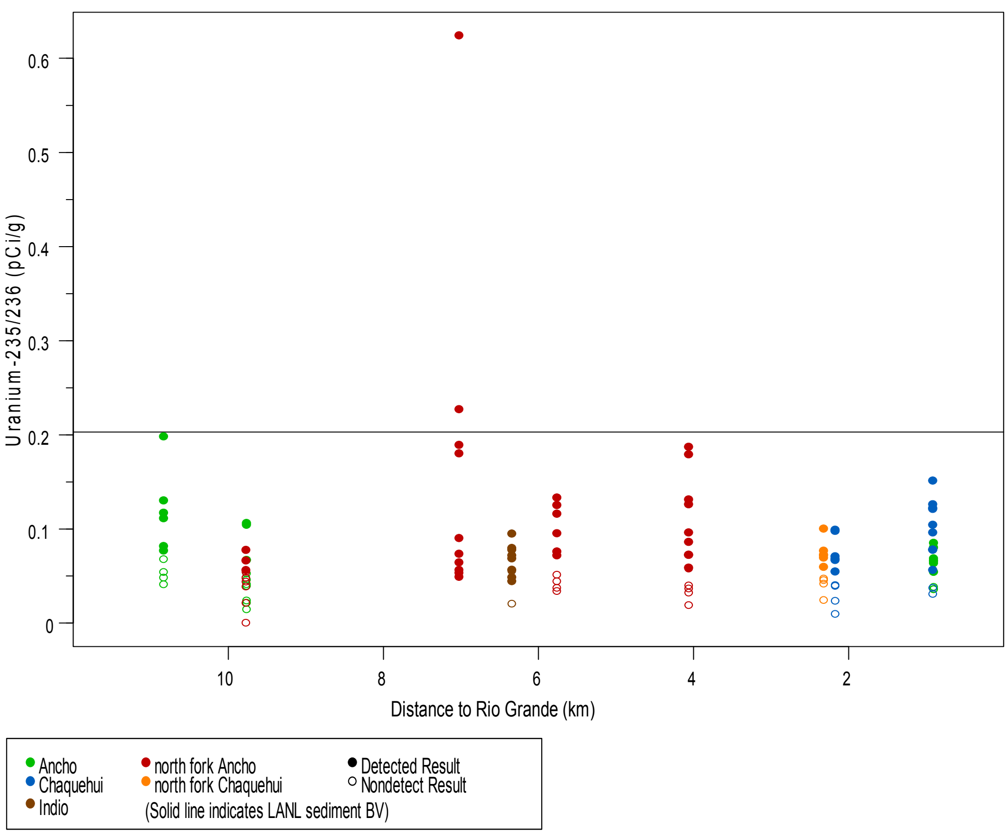


Figure D-1.1-3 (continued) **Plots of sample results versus distance from the Rio Grande for all radionuclide COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

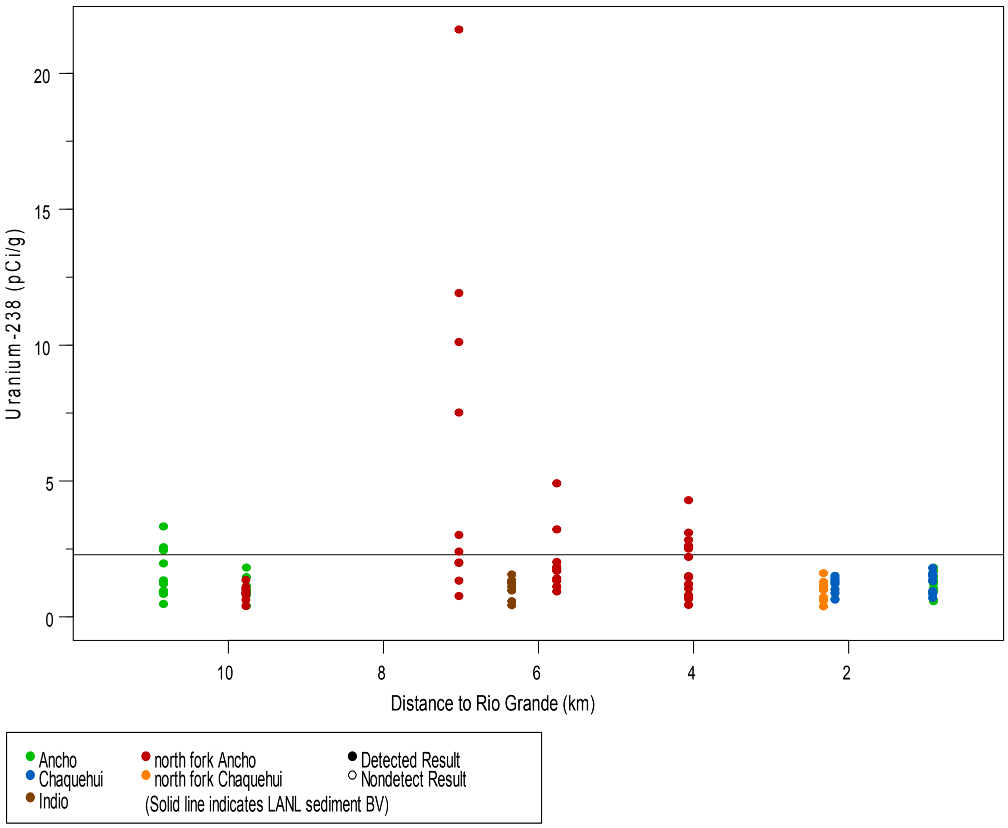


Figure D-1.1-3 (continued) **Plots of sample results versus distance from the Rio Grande for all radionuclide COPCs identified in sediment in the Ancho, Chaquehui, and Indio watershed**

Table D-1.2-1
Summary of Average Concentrations of Select Inorganic Chemicals in Ancho, Chaquehui, and Indio Canyon Sediment Samples

Reach	Antimony						Arsenic		Chromium		Copper		Cyanide (Total)						Iron		Mercury					
	Fine Facies			Coarse Facies			Fine Facies	Coarse Facies	Fine Facies	Coarse Facies	Fine Facies	Coarse Facies	Fine Facies			Coarse Facies			Fine Facies	Coarse Facies	Fine Facies			Coarse Facies		
	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Average	Average	Average	Average	Average	Average	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean
BV	**0.83**						**3.98**		**10.5**		**11.2**		**0.82**						**13800**		**0.1**					
A-1	1.06	0.53	0.00	1.12	0.56	0.00	—[a]	—	—	—	—	—	0.49	0.43	0.36	0.26	0.13	0.00	—	—	—	—	—	—	—	—
A-2	1.01	0.50	0.00	0.96	0.48	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	1.73	0.87	0.00	1.17	0.59	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	1.01	0.51	0.00	1.01	0.51	0.00	—	—	—	—	—	—	—	—	—	—	—	—	10801	10830	—	—	—	—	—	—
AN-2	0.99	0.49	0.00	1.02	0.51	0.00	—	—	—	—	8.64	2.43	—	—	—	—	—	—	—	—	0.22	0.22	0.22	0.03	0.03	0.03
AN-3	0.99	0.50	0.00	0.99	0.49	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.10	0.10	0.10	0.02	0.02	0.02
AN-4	1.48	0.79	0.10	0.99	0.50	0.00	2.08	0.61	—	—	—	—	0.29	0.29	0.29	0.39	0.29	0.19	—	—	0.12	0.12	0.12	0.02	0.02	0.02
CH-1	0.95	0.52	0.10	0.91	0.46	0.00	—	—	6.35	3.45	—	—	1.39	1.30	1.21	1.15	1.11	1.07	12427	8247	—	—	—	—	—	—
CH-2	1.04	0.52	0.00	1.00	0.50	0.00	—	—	—	—	—	—	—	—	—	—	—	—	10354	10110	—	—	—	—	—	—
CHN-1	0.85	0.49	0.12	0.79	0.46	0.13	—	—	—	—	—	—	—	—	—	—	—	—	12543	9327	—	—	—	—	—	—
I-1	1.00	0.50	0.00	0.97	0.49	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table D-1.2-1 (continued)

Reach	Perchlorate						Selenium						Vanadium	
	Fine Facies			Coarse Facies			Fine Facies			Coarse Facies			Fine Facies	Coarse Facies
	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Average	Average
BV	**na[b]**						**0.3**						**19.7**	
A-1	0.00189	0.00106	0.00022	0.00228	0.00114	0.00000	1.07	0.54	0.00	1.09	0.54	0.00	16.5	9.3
A-2	0.00193	0.00100	0.00008	0.00218	0.00109	0.00000	0.97	0.49	0.00	1.05	0.53	0.00	—	—
A-3	0.00139	0.00103	0.00068	0.00248	0.00124	0.00000	1.06	0.53	0.00	1.22	0.61	0.00	—	—
AN-1	0.00165	0.00100	0.00034	0.00203	0.00101	0.00000	1.00	0.50	0.00	0.98	0.49	0.00	17.2	16.4
AN-2	0.00122	0.00093	0.00064	0.00159	0.00091	0.00023	0.98	0.49	0.00	1.00	0.50	0.00	—	—
AN-3	0.00166	0.00137	0.00107	0.00207	0.00104	0.00000	0.95	0.47	0.00	1.00	0.50	0.00	—	—
AN-4	0.00177	0.00116	0.00054	0.00202	0.00101	0.00000	0.99	0.50	0.00	0.96	0.48	0.00	—	—
CH-1	0.00177	0.00118	0.00058	0.00170	0.00102	0.00034	0.99	0.49	0.00	0.98	0.49	0.00	18.7	11.7
CH-2	0.00184	0.00093	0.00012	0.00208	0.00104	0.00000	1.05	0.53	0.00	1.01	0.50	0.00	15.2	15.7
CHN-1	0.00109	0.00094	0.00080	0.00211	0.00106	0.00000	1.01	0.50	0.00	1.02	0.51	0.00	23.1	16.7
I-1	0.00096	0.00096	0.00096	0.00176	0.00099	0.00022	1.02	0.51	0.00	1.00	0.50	0.00	—	—

Note: All units are in mg/kg.

[a] — = Not a COPC in reach (no results > BV or no detects for analytes without BVs).

[b] na = Not available.

Table D-1.2-2
Summary of Average Concentrations of Select Organic Chemicals in Ancho, Chaquehui, and Indio Canyon Sediment Samples

Reach	Aroclor-1248						Aroclor-1254						Aroclor-1260					
	Fine Facies			Coarse Facies			Fine Facies			Coarse Facies			Fine Facies			Coarse Facies		
	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean
A-1	—*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	0.0033	0.0018	0.0004	0.0034	0.0017	0.0000	0.0034	0.0019	0.0004	0.0034	0.0017	0.0000	—	—	—	—	—	—
AN-3	—	—	—	—	—	—	0.0030	0.0018	0.0005	0.0034	0.0017	0.0000	0.0033	0.0018	0.0003	0.0034	0.0017	0.0000
AN-4	—	—	—	—	—	—	0.0034	0.0017	0.0000	0.0039	0.0025	0.0012	—	—	—	—	—	—
CH-1	—	—	—	—	—	—	0.0037	0.0032	0.0027	0.0034	0.0017	0.0000	0.0031	0.0018	0.0006	0.0034	0.0017	0.0000
CH-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CHN-1	—	—	—	—	—	—	0.0038	0.0023	0.0008	0.0035	0.0018	0.0000	0.0044	0.0036	0.0029	0.0037	0.0025	0.0014
I-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table D-1.2-2 (continued)

Reach	Di-n-butylphthalate						Heptachlor						TATB					
	Fine Facies			Coarse Facies			Fine Facies			Coarse Facies			Fine Facies			Coarse Facies		
	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean	Upper Bound on Mean	Midpoint of Range	Lower Bound on Mean
A-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-2	0.307	0.161	0.015	0.342	0.171	0.000	—	—	—	—	—	—	0.99	0.64	0.28	1.00	0.50	0.00
AN-3	—	—	—	—	—	—	—	0.00034	0.00005	0.00062	0.00039	0.00016	—	—	—	—	—	—
AN-4	—	—	—	—	—	—	0.00063	0.00036	0.00008	0.00067	0.00034	0.00000	—	—	—	—	—	—
CH-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CHN-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-1	0.350	0.175	0.000	0.278	0.150	0.022	0.00075	0.00046	0.00017	0.00068	0.00034	0.00000	—	—	—	—	—	—

Note: All units are in mg/kg.

* — = Not a COPC in reach (not detected).

Table D-1.2-3
Summary of Average Concentrations of Radionuclide COPCs in Ancho, Chaquehui, and Indio Canyon Sediment Samples

	Cesium-137		Plutonium-238		Plutonium-239/240		Tritium		Uranium-234		Uranium-235/236		Uranium-238	
	Fine Facies	Coarse Facies	Fine Facies	Coarse Facies	Fine Facies	Coarse Facies	Fine Facies	Coarse Facies	Fine Facies	Coarse Facies	Fine Facies	Coarse Facies	Fine Facies	Coarse Facies
Reach	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average
BV	**0.9**		**0.006**		**0.068**		**0.093**		**2.59**		**0.2**		**2.29**	
A-1	0.98	0.35	—*	—	0.037	0.009	—	—	1.58	0.71	—	—	1.79	0.84
A-2	0.49	0.23	—	—	—	—	—	—	—	—	—	—	—	—
A-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
AN-1	0.48	0.11	—	—	0.026	0.005	—	—	—	—	—	—	—	—
AN-2	—	—	—	—	—	—	—	—	1.90	3.03	0.12	0.24	5.55	7.89
AN-3	—	—	—	—	—	—	—	—	—	—	—	—	2.33	1.26
AN-4	—	—	—	—	—	—	0.019	0.794	—	—	—	—	2.71	0.90
CH-1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CH-2	—	—	—	—	—	—	0.046	0.027	—	—	—	—	—	—
CHN-1	—	—	—	—	—	—	0.121	0.082	—	—	—	—	—	—
I-1	—	—	0.001	0.003	—	—	—	—	—	—	—	—	—	—

Note: All units are in pCi/g.
* — = Not a COPC in reach (not detected or no detects > BV).

Appendix E

Statistics and Risk Information

E-1.0 BIOTA STUDY–RELEVANT EXPOSURE DATA FROM PREVIOUS CANYONS INVESTIGATIONS

As discussed in section 8.1.7 of the investigation report, most chemicals of potential ecological concern (COPECs) identified for Ancho, Chaquehui, and Indio Canyons have biota study–relevant data from previous canyons investigations. This appendix presents relevant COPEC exposure data for each Ancho, Chaquehui, and Indio Canyons assessment endpoint assembled from the Los Alamos and Pueblo Canyons, Mortandad Canyon, Pajarito Canyon, and Sandia Canyon investigation reports (LANL 2004, 087390; LANL 2006, 094161; LANL 2009, 106939; LANL 2009, 107453).

Samples with biota-relevant exposure data from the previous canyons investigations are tabulated in this appendix. Table E-1.0-1 lists the sediment samples (all sediment, including the active channel) evaluated for terrestrial receptors (plants, earthworms, small mammals, and birds) in Ancho, Chaquehui, and Indio Canyons and biota investigation reaches in other watersheds. Table E-1.0-2 lists the active channel sediment samples used for riparian and aquatic receptors (bats, swallow, and the aquatic community) in Ancho, Chaquehui, and Indio Canyons and biota investigation reaches in other watersheds. Table E-1.0-3 lists the water samples evaluated for the aquatic community in Ancho and Chaquehui Canyons and biota investigation reaches in other watersheds. Tables E-1.0-1, E-1.0-2, and E-1.0-3 are included in Attachment 1 on CD.

E-2.0 SUPPORTING INFORMATION FOR THE HUMAN HEALTH RISK ASSESSMENT

This section provides human health exposure parameters and toxicity information for the screening and risk assessments, exposure point concentrations (EPCs), and results for the supplemental human health risk scenario (residential). This information is restricted to inorganic and organic chemicals for the recreational scenario because no radionuclides were identified as chemicals of potential concern (COPCs) for further evaluation in section 8.2.

E-2.1 Exposure Parameters and Toxicity Information

Exposure parameters used to calculate soil screening levels (SSLs) for the residential and recreational scenarios and screening action levels (SALs) for the residential scenario only are provided in Tables E-2.1-1 and E-2.1-2. Table E-2.1-3 provides exposure parameters used to calculate surface-water ingestion for screening levels (SLs) for inorganic and organic chemicals. Table E-2.1-4 provides toxicity information for chemicals of potential concern (COPCs) for which surface-water SLs were calculated (inorganic chemicals).

E-2.2 Sediment EPC

This section provides information on the statistical methods used to calculate the EPC for the sediment COPC used in the human health risk assessment. All of the sample results for the single inorganic chemical COPC were detects. Therefore, no adjustments are needed for nondetects in the calculation of the EPC. Section E-2.2.1 describes the methods used to analyze these data.

E-2.2.1 Upper Confidence Limit Calculation Methods

The statistical methods used to calculate upper confidence limits (UCLs) are consistent with U.S. Environmental Protection Agency (EPA) guidance (EPA 1989, 008021). ProUCL, Version 4.00.05, was used to calculate UCLs to use as EPCs in the human health risk assessment.

The first step in calculating a UCL is to determine whether the data fit a probability distribution. The ProUCL software assesses normal, lognormal, gamma, and nonparametric distributions. The possible outcomes and UCL calculation approaches are as follows.

- The data show a normal distribution; normal distribution methods are used.
- The data show a lognormal distribution; lognormal distribution methods are used.
- The data show a gamma distribution; gamma distribution methods are used.
- The data are not different from either distribution; normal distribution methods are used.
- The data are different from all distributions; the Chebyshev or nonparametric methods are used.
- Insufficient data are available to evaluate the distribution; nonparametric methods (such as bootstrapping) are used.

Generally speaking, the method ProUCL recommends is based upon the sample size, distribution of the data, and sample standard deviation. Details are provided in the “ProUCL Version 4.00.05 User Guide” (EPA 2010, 109944) and “ProUCL Version 4.00.04 Technical Guide” (EPA 2009, 110368).

The calculated EPC for sediment based upon ProUCL is provided in Tables 8.2-11 and E-2.2-1. ProUCL data and assorted files are included in Attachment E-1 (on CD).

E-2.3 Supplemental Human Health Risk Scenario

The SSL used in the supplemental human health risk scenario (residential) is provided in Table E-2.3-1. The risk assessment result for the residential scenario is provided in Table E-2.3-2. The sediment EPC is provided in Tables 8.2-11 and E-2.3-1. Residential carcinogenic risk from the single COPC is less than 1×10^{-5} for the single reach evaluated (Table E-2.3-2). Note that the risk is overestimated because arsenic is a naturally occurring inorganic chemical and the UCL for arsenic in reach AN-4 (2.66 mg/kg) is less than the sediment background value (3.98 mg/kg).

E-2.4 Calculation of Surface-Water Recreational Screening Levels

The method used to calculate the surface-water SLs is based upon the methodology used to calculate the recreational soil screening values (LANL 2010, 108613) and EPA Risk Assessment Guidance for Superfund, Part E (EPA 2004, 090800). The equation used for carcinogens is detailed below. The parameter values used for the calculations were presented in Table E-2.1-3.

Carcinogens

$$SWSL\,(ug/L) = \frac{(1000\,ug/ml)\,x\,(AT_c\,x\,TR)}{(EF/ET)\,x\,[(IFSW\,x\,SFo) + (DFSW\,x\,Kp\,x\,SFd\,x\,0.001\,L/cm^3)]}$$

where $SFd = SFo \,/\, GIAbs\ Factor$

$RfDd = RfDo\ x\ GIAbs\ Factor$

$$IFSW = \frac{ED_c\ x\ Ing}{BW_c} + \frac{(ED - ED_c)\ x\ Ing}{BW}$$

$$DFSW = \frac{ED_c\ x\ SA_c}{BW_c} + \frac{(ED - ED_c)\ x\ SA}{BW}$$

and SWSL = surface-water SL

AT_c = averaging time, carcinogens

BW_c = body weight, child

BW = body weight, adult

EF = exposure frequency

ED = exposure duration

ET = exposure time

GIAbs factor = gastrointestinal absorption factor

SA_c = exposed surface area, child

SA = exposed surface area, adult

Kp = dermal permeability constant

Ing = surface-water ingestion quantity per event

IFSW = age-adjusted surface-water ingestion factor

DFSW = age-adjusted surface-water dermal absorption factor

SFo = oral slope factor

SFd = dermal slope factor

TR = target risk.

E-3.0 REFERENCES

The following list includes all documents cited in this appendix. 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.

EPA (U.S. Environmental Protection Agency), December 1989. "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A), Interim Final," EPA/540/1-89/002, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1989, 008021)

EPA (U.S. Environmental Protection Agency), August 1997. "Exposure Factors Handbook, Volume III, Activity Factors," EPA/600/P-95/002Fc, Office of Research and Development, Washington, D.C. (EPA 1997, 066598)

EPA (U.S. Environmental Protection Agency), July 2004. "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final," EPA/540/R/99/005, Office of Superfund Remediation and Technology Innovation, Washington, D.C. (EPA 2004, 090800)

EPA (U.S. Environmental Protection Agency), February 2009. "ProUCL Version 4.00.04 Technical Guide (Draft)," EPA/600/R-07/041, Office of Research and Development, Washington, D.C. (EPA 2009, 110368)

EPA (U.S. Environmental Protection Agency), May 2010. "ProUCL Version 4.00.05 User Guide (Draft)," EPA/600/R-07/038, Office of Research and Development, Washington, D.C. (EPA 2010, 109944)

LANL (Los Alamos National Laboratory), April 2004. "Los Alamos and Pueblo Canyons Investigation Report," Los Alamos National Laboratory document LA-UR-04-2714, Los Alamos, New Mexico. (LANL 2004, 087390)

LANL (Los Alamos National Laboratory), October 2006. "Mortandad Canyon Investigation Report," Los Alamos National Laboratory document LA-UR-06-6752, Los Alamos, New Mexico. (LANL 2006, 094161)

LANL (Los Alamos National Laboratory), December 2007. "Standard Human Health Risk Assessment Scenarios, Revision 3," Los Alamos National Laboratory document LA-UR-07-6427, Los Alamos, New Mexico. (LANL 2007, 099829)

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, 106939)

LANL (Los Alamos National Laboratory), October 2009. "Investigation Report for Sandia Canyon," Los Alamos National Laboratory document LA-UR-09-6450, Los Alamos, New Mexico. (LANL 2009, 107453)

LANL (Los Alamos National Laboratory), February 2010. "Technical Approach for Calculating Recreational Soil Screening Levels for Chemicals, Revision 1," Los Alamos National Laboratory document LA-UR-09-07510, Los Alamos, New Mexico. (LANL 2010, 108613)

NMED (New Mexico Environment Department), December 2009. "Technical Background Document for Development of Soil Screening Levels, Revision 5.0," with revised Table A-1, New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2009, 108070)

Table E-2.1-1
Parameters Used to Calculate Chemical Soil Screening Levels

Parameter	Residential Value[a]	Recreational Value[b]
Target hazard quotient (HQ)	1	1
Target cancer risk	1×10^{-5}	1×10^{-5}
Averaging time (carcinogen)	70 yr × 365 d	70 yr × 365 d
Averaging time (noncarcinogen)	Exposure duration × 365 d	Exposure duration × 365 d
Skin absorption factor	Semivolatile organic compound (SVOC) = 0.1 Others are chemical-specific	SVOC = 0.1 Others are chemical-specific
Adherence factor–child	0.2 mg/cm^2	0.2 mg/cm^2
Body weight–child	15 kg (0–6 yr-old)	31 kg (6–11-yr-old)
Cancer slope factor–oral (chemical-specific)	$mg/kg\text{-}d^{-1}$	$mg/kg\text{-}d^{-1}$
Cancer slope factor–inhalation (chemical-specific)	$mg/kg\text{-}d^{-1}$	$mg/kg\text{-}d^{-1}$
Exposure frequency	350 d/yr	200 events/yr
Exposure duration–child	6 yr (0–6-yr-old)	6 yr (6–11-yr-old)
Age-adjusted ingestion factor	114 mg-yr/kg-d	22.6 mg-yr/kg-d
Age-adjusted inhalation factor	11 m^3-yr/kg-d	0.8 m^3-yr/kg-d
Inhalation rate–child	10 m^3/d	1.2 m^3/h
Soil ingestion rate–child	200 mg/d	71.4 mg/d
Particulate emission factor	6.61×10^9 m^3/kg	6.61×10^9 m^3/kg
Reference dose–oral (chemical-specific)	mg/kg-d	mg/kg-d
Reference dose–inhalation (chemical-specific)	mg/kg-d	mg/kg-d
Exposed surface area–child	2800 cm^2/d (head, hands, forearms, lower legs, feet)	3525 cm^2/d (face, hands, forearms, lower legs, and feet)
Age-adjusted skin contact factor for carcinogens	361 mg-yr/kg-d	273.3 mg-yr/kg-d
Volatilization factor for soil (chemical-specific)	m^3/kg	m^3/kg
Body weight–adult	70 kg	70 kg
Exposure duration	30 yr[c]	30 yr
Adherence factor–adult	0.07 mg/cm^2	0.07 mg/cm^2
Soil ingestion rate–adult	100 mg/d	25.6 mg/event
Exposed surface area–adult	5700 cm^2/d (head, hands, forearms, lower legs)	5700 cm^2/d (head, hands, forearms, lower legs)
Inhalation rate–adult	20 m^3/d	1.6 m^3/h
Event time	n/a[d]	1 h

Note: $mg/kg\text{-}d^{-1}$= milligram per kilogram per day, mg-yr/kg-d = milligram year per kilogram day, m^3/d = cubic meters per day, m^3/kg = cubic meters per kilogram, m^3/h = cubic meters per hour, cm^2/d = centimeters squared per day.

[a] Parameter values from NMED (2009, 108070).

[b] Parameter values from LANL (2010, 108613).

[c] Exposure duration for lifetime resident is 30 yr. For carcinogens, the exposures are combined for child (6 yr) and adult (24 yr).

[d] n/a = Not applicable.

Table E-3.1-3
Parameters Used to Calculate Chemical Surface-Water Screening Levels

Parameter	Recreational Scenario Value[a]
Target HQ	1
Target cancer risk	$1. \times 10^{-5}$
Averaging time (carcinogen)	70 yr × 365 d
Averaging time (noncarcinogen)	Exposure duration × 365 d
Skin absorption factor	SVOC = 0.1 Others are chemical-specific
Cancer slope factor–oral (chemical-specific)	$mg/kg\text{-}d^{-1}$
Cancer slope factor–inhalation (chemical-specific)	$mg/kg\text{-}d^{-1}$
Reference dose–oral (chemical-specific)	mg/kg-d
Reference dose–inhalation (chemical-specific)	mg/kg-d
Body weight–child	31 kg (6–11-yr-old)
Exposure duration–child	6 yr (6–11-yr-old)
Exposed surface area–child	3140 cm^2 (hands, forearms, lower legs, and feet)
Body weight–adult	70 kg
Surface-water ingestion	0.2 L/event
Exposure duration–adult	30 yr
Exposed surface area[b]–adult	2130 cm^2 (hands and feet)
Exposure time	1 h/d
Exposure frequency[b]	20 d/yr

[a] Parameter values from LANL (2007, 099829), unless otherwise noted.
[b] Parameter value from LANL (2004, 087390).

Table E-3.1-5
Toxicity Values for Chemical COPCs for Surface-Water Chemical Screening Values

Chemical	Oral Slope Factor ($mg/kg\text{-}d^{-1}$)	Reference*
Arsenic	1.50	IRIS

*IRIS = Integrated Risk Information System.

Table E-2.1-2
Parameters Used to Calculate Radionuclide SALs, Residential Scenario

Parameters	Residential, Child	Residential, Adult
Inhalation rate (m^3/yr)	3652.5[a]	7305[b]
Mass loading (g/m^3)	1.5×10^{-7}[c]	1.5×10^{-7}[c]
Outdoor time fraction	0.2236[d]	0.0599[e]
Indoor time fraction	0.7347[f]	0.8984[g]
Soil ingestion (g/yr)	73[h]	36.5[i]

[a] Calculated as (10 m^3/d × 350 d/yr) / (indoor + outdoor time fractions), where 10 m^3/d is the daily inhalation rate of a child (NMED 2009, 108070).

[b] Calculated as (20 m^3/d × 350 d/yr) / (indoor + outdoor time fractions), where 20 m^3/d is the daily inhalation rate of an adult (NMED 2009, 108070).

[c] Calculated as (1/6.6 × 10^{+9} m^3/kg) x 1000 g/kg, where 6.6 × 10^{+9} m^3/kg is the particulate emission factor (NMED 2009, 108070).

[d] Calculated as (5.6 h/d × 350 d/yr) / 8766 h/yr, where 5.6 h/d is an estimate of time spent outdoors for a 3-to 11-yr-old child (EPA 1997, 066598, section 15.4-1).

[e] Calculated as (1.5 h/d × 350 d/yr) / 8766 h/yr, where 1.5 h/d is an estimate of time spent outdoors for an adult 12 yr and older (EPA 1997, 066598, section 15.4-1).

[f] Calculated as (24–5.6 h/d × 350 d/yr) / 8766 h/yr.

[g] Calculated as (24–1.5 h/d × 350 d/yr) / 8766 h/yr.

[h] Calculated as (0.2 g/d × 350 d/yr) / (indoor + outdoor time fractions), where 0.2 g/d is the child soil-ingestion rate (NMED 2009, 108070).

[i] Calculated as (0.1 g/d × 350 d/yr) / (indoor + outdoor time fractions), where 0.1 g/d is the adult soil-ingestion rate (NMED 2009, 108070).

Table E-2.2-1
EPC for Sediment COPC

Reach	Analyte	Number Detects	Number Nondetects	% Number Detects	Minimum Detected (mg/kg)	Maximum Detected (mg/kg)	Mean (mg/kg)	Median (mg/kg)	Standard Deviation (mg/kg)	Skewness (mg/kg)	Coefficient of Variation	UCL (mg/kg)	UCL Method
AN-4	Arsenic	14	0	100	0.235	4.84	1.346	0.885	1.54	1.918	1.144	2.66	95% H-UCL

Table E-2.3-1
Screening Level for the Residential Scenario

COPC	End Point	Target Level	Residential SSL (mg/kg)
Arsenic	Carcinogen	1×10^{-5}	3.9

Note: Residential SSL is from NMED (2009, 108070).

Table E-2.3-2
Risk Based on the Residential EPC for Sediment

Reach	Arsenic	Sum of Fractions	Total Risk
Residential SSL (mg/kg)	**3.9**		
AN-4	0.682	0.682	7E-6

Note: Residential SSL is from NMED (2009, 108070).

Attachment E-1

ProUCL Files
(on CD included with this document)

Attachment 1

Supplemental Tables for Appendixes B, C, and E
(on CD included with this document)