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Completion Report for Sandia Canyon Grade-Control Structure

Los Alamos
NATIONAL LABORATORY

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CONTENTS

Acronyms and Abbreviations

BMP	best management practice
DOE	Department of Energy (U.S.)
DRO	diesel-range organics
EPA	Environmental Protection Agency (U.S.)
ES&H	environment, safety, and health
ET	evapotranspiration
gpd	gallons per day
HEC-RAS	Hydrologic Engineering Center River Analysis System (U.S. Army Corps of Engineers surface model)
IWD	integrated work document
LANL	Los Alamos National Laboratory
NMED	New Mexico Environment Department
NWP	nationwide permit
PAH	polycyclic aromatic hydrocarbon
RPF	Records Processing Facility
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

Los Alamos National Laboratory (LANL or the Laboratory) has prepared this completion report in response to the New Mexico Environment Department's (NMED's) approval of the "Work Plan and Final Design for Stabilization of the Sandia Canyon Wetland" (LANL 2011, 207053; NMED 2011, 208094) and in response to requirements set forth originally in NMED's "Approval with Modification, Interim Measures Work Plan for Stabilization of the Sandia Canyon Wetland" (NMED 2011, 203806). The "Interim Measures Work Plan for Stabilization of the Sandia Canyon Wetland" (LANL 2011, 203454) was prepared in response to NMED's "Approval with Modification, Phase II Investigation Work Plan for Sandia Canyon" (NMED 2011, 111518). This completion report provides project goals and objectives, design and performance criteria, and as-built drawings of the Sandia Canyon wetland grade-control structure. The grade-control structure consists of three stepped sheet-pile walls that were constructed as a measure to physically stabilize the Sandia Canyon wetland.

The overall project goals and objectives were to arrest the headcut in the lower portion of the wetland and to maintain hydrologic and geochemical conditions to minimize contaminant migration. The project consisted of installing three stepped sheet-pile walls to form a grade-control structure to stabilize the headcut and allow a grade transition from the wetland surface upstream of the grade-control structure to the stream grade near stream gage E123 (Figure 1). Design features should also allow reduction of effluent in the canyon without compromising physical and geochemical function of the wetland. The area behind the grade-control structure was backfilled and wetland vegetation was planted to allow expansion of the wetland area. These measures will physically stabilize the wetland by reducing sediment and associated contaminant transport into the lower sections of the canyon and should also maintain reducing conditions within the wetland sediments, thus contributing to the goal of reducing potential contaminant transport.

The wetland is located in reach S-2 of Sandia Canyon. The largest drainage contributing to the wetland flows through a 72-in. corrugated metal pipe culvert a short distance upstream of the wetland. A single stream channel is present within the upper one-third of the wetland, and wetland vegetation is established on floodplains inset relative to older wetland surfaces. In the lower two-thirds of the wetland, surface water is generally present across much of the width of the wetland. Prior to construction of the grade-control structure, the terminus of the wetland had an active headcut. Willows had been planted in and around the headcut but failed to stabilize it. Downstream of the wetland, the stream system enters a narrow canyon reach and is stable, with bedrock exposed along much of the stream bed. Stream gage E123 is located a short distance below the wetland.

2.0 ENGINEERING

2.1 Design Objectives

The grade-control structure was designed to meet the following objectives:

- Provide an even grade to allow wetland expansion and further stabilization
- Be sufficiently impervious to prevent the draining of alluvial soils
- Facilitate nonchannelized flow
- Minimize erosion during large flow events
- Support wetland function under reduced effluent conditions

2.2 Design Criteria

2.2.1 Base Flow Hydrology

Stream flow from combined effluent sources in Sandia Canyon has averaged approximately 250,000 to 350,000 gallons per day (gpd). These base flows feed the groundwater within the reach, providing adequate hydrology and soil moisture conditions where the wetland vegetation can flourish.

2.2.2 Storm Flow Hydrology

A 25-yr, 2-h storm event with a peak design flow of 500 cubic feet per second was used for the design of the grade-control structure as required by the Laboratory's design guidance. The primary goal was to reduce the stream velocity in the area of the grade-control structure to less than 6 ft per second. Design parameters were determined using Hydrologic Engineering Center River Analysis System (HEC-RAS) modeling. The hydrologic calculations can be found in Appendix A, and hydraulics calculations can be found in Appendix B.

2.2.3 Water Balance

The wetland currently receives approximately 250,000 to 350,000 gpd of inflow from combined effluent sources. To address the potential for reduced effluent volumes into Sandia Canyon, estimations of the evapotranspiration (ET) across the wetland footprint was performed using Penman-Monteith equations. Modeling indicates that the maximum 30-day ET is approximately 11 in. This results in an estimated minimum effluent volume to maintain wetland vegetation in Sandia Canyon of approximately 30,000 gpd.

2.2.4 Design Features

The grade-control structure, as shown in the as-built drawings (Appendix C), transitions the grade approximately 11 vertical feet from the elevation of the current wetland just upgradient of the former headcut location to the natural stream bed just upstream of stream gage E123. To maintain grade and to reduce the overall fill and size of a single structure, a set of three steel-sheet-pile walls was installed with smaller elevation drops. Downstream of the third sheet-pile wall, a cascade pool was constructed of boulders and cobbles to transition to the final grade.

Three sheet-pile walls were installed with the following design elements:

- The sheet piles were installed into 2-ft-deep trenches into bedrock. Trenches were backfilled to the elevation of the bedrock with bentonite.
- Seep holes were cut into the sheet piles at consistent elevations across each sheet pile to encourage smaller, braided channels through the restored sections of wetland to establish vegetation.
- Stone splash pools were installed just downgradient of each sheet pile to prevent scour holes and to slow the water.
- Sheet piles were capped with reinforced concrete curbs to provide a spillway to establish even flows.
- A stone cascade and pool structure was installed downstream of the third sheet-pile wall to complete the final transition into the native channel just upgradient of gage station E123.

The walls are seated in bedrock to prevent groundwater from seeping through the structure as noted above. The transition from the wetland above the grade-control structure to the stream channel below is gradual, smooth, and in a stepped fashion to prevent erosive flows that could scour and destabilize the stream reach below the structure. In addition, the stepped nature of the design reduces the risk of catastrophic failure of the grade-control structure in the event of a localized failure. Engineered fill was placed behind each wall to replace the area of the wetland that had been eroded. These areas were filled to match the elevation of the surrounding wetland area to prevent the formation of pools behind the grade-control walls. A variety of wetland species was planted in 18-in. of native top soil to stabilize the wetland and expand the footprint.

2.3 Permitting

2.3.1 General

The Laboratory's Design Engineering and Environmental Compliance groups performed a review of the design model and the construction documents. Table 1 lists the permits and permissions that were obtained to meet state and federal requirements.

2.3.2 Reporting

All monitoring data collected during the previous year will be submitted to NMED annually for up to 5 yr in a Sandia Canyon performance monitoring report to be submitted by April 30 of each year. The report will summarize alluvial, water level, and storm water monitoring data collected above and below the grade-control structure. A series of repeat cross-section locations will be established in the upper portion of reach S-2 and in the vicinity of the head location to document geomorphic changes. In addition, the Laboratory will submit a yearly vegetation monitoring report to the U.S. Army Corps of Engineers (USACE) for up to 3 yr by December 1 of each year. This is in support of the 401/404 Clean Water Act Permit, which required annual vegetation transects, photographs from certain locations, and delineation of wetland boundaries.

3.0 CONSTRUCTION

3.1 General

The Laboratory placed Portage, Inc., under contract in November 2012 to build the Sandia Canyon grade-control structure. Construction of the Sandia Canyon grade-control structure began on April 22, 2013, and the structure was substantially complete and functional on September 9, 2013. Site stabilization activities were completed November 22, 2013, with demobilization completed November 27, 2013. Appendix D presents photo documentation of the grade-control structures.

3.2 Safety and Health

Under the guidance and approval of the Laboratory, Portage developed and implemented an environment, safety, and health (ES&H) plan to ensure the project met safety and health goals. In addition to the ES&H plan, all site activities were analyzed and addressed within task-specific integrated work documents (IWDs). Site personnel were subsequently trained to these IWDs prior to commencing field activities. As a result of safe construction practices, there were no lost-time accidents or incidents during the entire project.

3.3 Quality Control

Under the guidance and approval of the Laboratory, Portage developed and implemented a quality assurance plan to ensure the project met quality construction goals. In addition to the quality assurance plan, Portage was also contractually obligated to develop and adhere to a project-specific test and inspection plan that captured all project tests, inspections, and hold points. Finally, Portage assigned a quality control inspector to oversee field activities and ensure project requirements were achieved.

3.4 Occurrences

Two major categories of events occurred during construction of the grade-control structure that impacted the construction schedule. These events are the discovery of a tar-like substance during initial excavations and significant flooding.

3.4.1 Tar-Like Substance

On May 16, 2013, the field crew notified Laboratory management that a black tar-like substance was observed oozing out of the initial side cut of the second grade-control wall. Regulatory and technical personnel visited the site, and the event was reported to Dave Cobrain at the NMED – Hazardous Waste Bureau on May 16, 2013. A sample of the material was collected and analyzed for diesel-range organics (DRO), total petroleum hydrocarbon (TPH), and semivolatile organic compounds (SW-846 U.S. Environmental Protection Agency [EPA] Method 8270).

The personnel who received sample CASA-13-34678 at the Laboratory's Sample Management Office described it as wet, ground asphalt. Table 2 lists the analytes detected using SW-846 EPA Method 8270.

The analytes listed in Table 2 are all polycyclic aromatic hydrocarbons (PAHs) that are created from the production of coal tar. Coal tar is a ready source of asphaltenes necessary for the production of asphalt. Based on the description of this sample and the PAHs detected, this sample was almost certainly asphalt. This sample was also analyzed for TPH-DRO. TPH-DRO measures total petroleum hydrocarbons with a carbon range from C-10 through C-38, which includes the PAHs listed above. The TPH-DRO detection of 11,000 mg/kg for sample CASA-13-34678 further verifies that this sample is coal tar–based asphalt.

Because the tar material was limited in extent, nonmobile, and within the boundaries of the grade-control structure, the material was left in place and construction was continued. This event resulted in a 2-day delay to the project schedule.

3.4.2 Rainfall and Flooding

Two significant rainfall events occurred during the construction phase and impacted the project schedule. These events are described as follows:

1. On June 30, 2013, approximately 0.5 in. of rain fell on and around the construction site; water traveled down Sandia Canyon and overcame the diversion pond but was stopped by the earthen fill run-on control above the first sheet-pile wall of the grade-control structure. The site also received heavy run-on from the Los Alamos County landfill diversion channel northeast of the construction site. This run-on flooded all three grade-control structure trenches. No damage to the structures occurred during this flooding, but significant efforts were required to dewater the site and remove sediments received as a result of the run-on from the landfill. It took 1 wk to reestablish the site and resume construction.

2. During the week of September 10, 2013, the site was inundated with unprecedented rainfall. Rainfall totals in some areas of the Laboratory exceeded 7 in. in a 1-wk time period, and much of the rain fell during an extremely intense event that occurred between September 12 and 13, 2013. These storm events were accompanied by record run-on, flooding, and erosion at the site.

   On the morning of September 17, 2013, damage to the site was summarized as follows:

   - The cascade pool lost roughly 25% of its boulders downstream.
   - Roughly 75% of recently planted site-restoration plants were lost.
   - The diversion pond overflowed, and some plastic lining was lost.
   - Cobbles rolled downstream from the rock aprons.
   - Roughly 600 cubic yards of material from the Los Alamos County landfill was deposited between the first and second steel-sheet piles.

The second event resulted in significant delays to completing construction. Extensive repairs were required, including the design and construction of best management practice (BMP) run-on control structures (see Appendix E), repair of the sump pond and diversion system, replacement of boulders and repair of the cascade pool liner, removal of deposited sediments and regrading, and replanting of the lost plants. One month of work was required to recover from this event.

3.5 As-Built Drawings

A set of as-built drawings after construction for the grade-control structure can be found in Appendix C.

3.6 Photo Documentation

Photos of the grade-control structure can be found in Appendix D as well as photos of the run-on BMPs.

3.7 Deviations

The following deviation from the work plan occurred. NMED's approval with modification of the interim measures work plan required that "In the final design, the Permittees must propose to remove all post-1942 alluvial sediments that are present within reach S-2 of Sandia Canyon below the grade-control structure, and to place these sediments as fill behind the grade-control structure" (NMED 2011, 203806).

As previously discussed, the Sandia Wetland grade-control structure project was permitted under the USACE Nationwide Permit (NWP) 38 for Cleanup of Hazardous and Toxic Waste (USACE 2013, 251704). The Laboratory pursued permission from the USACE to fulfill the NMED requirement (LANL 2013, 251705), but it was concluded that NWP 38 General Condition 6 would be violated by the placement of sediments that contain toxic pollutants in toxic amounts into jurisdictional waters (USACE 2013, 251706). Thus, the Laboratory did not remove post-1942 alluvial sediments within reach S-2 of Sandia Canyon and use them as fill behind the grade-control structure.

4.0 REFERENCES

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

Copies of the master reference set are maintained at the 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.

LANL (Los Alamos National Laboratory), May 2011. "Interim Measures Work Plan for Stabilization of the Sandia Canyon Wetland," Los Alamos National Laboratory document LA-UR-11-2186, Los Alamos, New Mexico. (LANL 2011, 203454)

LANL (Los Alamos National Laboratory), September 2011. "Work Plan and Final Design for Stabilization of the Sandia Canyon Wetland," Los Alamos National Laboratory document LA-UR-11-5337, Los Alamos, New Mexico. (LANL 2011, 207053)

LANL (Los Alamos National Laboratory), September 4, 2013. "Action No. SPA-2012-00050-ABQ Potential Removal and Placement of Sediments at Sandia Canyon Wetland," Los Alamos National Laboratory letter (ENV-DO-13-0073) to W. Oberle (USACE) from A.R. Grieggs (LANL) and G.E. Turner (DOE-NA-00-LA), Los Alamos, New Mexico. (LANL 2013, 251705)

NMED (New Mexico Environment Department), January 4, 2011. "Approval with Modification, Phase II Investigation Work Plan for Sandia Canyon," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 111518)

NMED (New Mexico Environment Department), June 9, 2011. "Approval with Modification, Interim Measures Work Plan for Stabilization of the Sandia Canyon Wetland," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 203806)

NMED (New Mexico Environment Department), November 15, 2011. "Approval with Modification, Work Plan and Final Design for Stabilization of the Sandia Canyon Wetland," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M.J. Graham (LANL) from J.E. Kieling (NMED-HWB), Santa Fe, New Mexico. (NMED 2011, 208094)

USACE (U.S. Army Corps of Engineers), March 27, 2013. "Action No. SPA-2012-00050-ABQ, McCann, LANL, Sandia Canyon, Wetland, Los Alamos County, NM," USACE letter to J. McCann (LANL) from W. Oberle (USACE), Albuquerque, New Mexico. (USACE 2013, 251704)

USACE (U.S. Army Corps of Engineers), September 5, 2013. "Potential Violation - Action No. SPA-2012-00050-ABQ, McCann, LANL, Sandia Canyon, Wetland, Los Alamos County, NM," USACE letter to G. Turner (DOE-NA-00-LA) and A.R. Grieggs (LANL) from W. Oberle (USACE), Albuquerque, New Mexico. (USACE 2013, 251706)

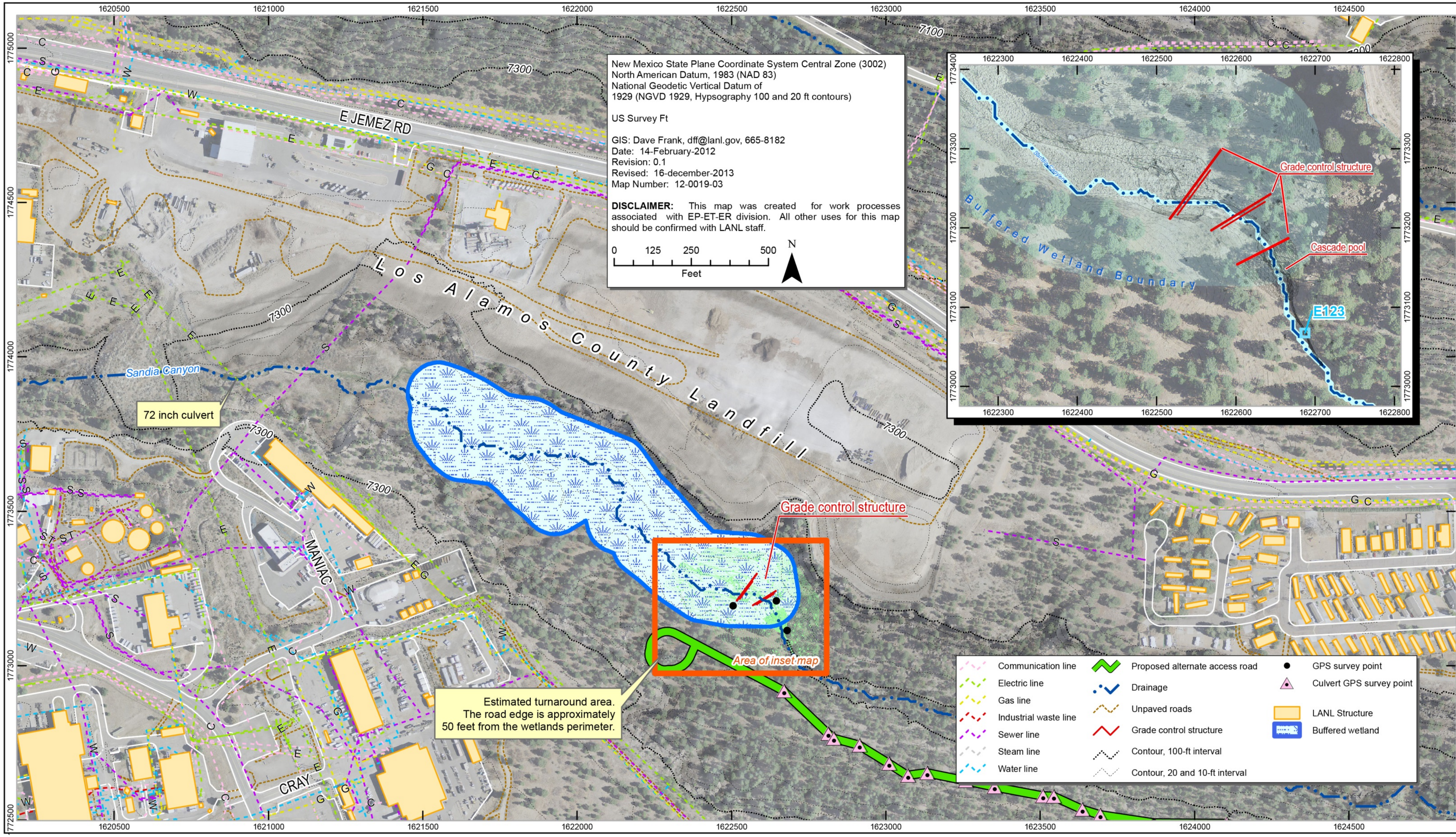

Figure 1 Location of Sandia Canyon grade-control structure

Table 1
Permits and Permissions Obtained

Permit	Agency
National Environmental Policy Act Assessment	U.S. Department of Energy
Section 7 Biological Assessment Consultation under the Endangered Species Act	U.S. Department of Interior Fish and Wildlife Service
National Pollutant Discharge Elimination System Construction General Permit	EPA
Section 404 NWP 38 for Cleanup of Hazardous and Toxic Waste under the Clean Water Act	USACE
Section 401 Water Quality Certification Permit under the Clean Water Act	NMED Surface Water Quality Bureau

Table 2
Analytical Results for Sample CASA-13-34678
Using SW-846 EPA Method 8270

Analyte Name	Result	Units
Anthracene	18,000	µg/kg
Carbazole	3400	µg/kg
Dibenzofuran	21,000	µg/kg
Fluorene	9200	µg/kg
2-Methylnaphthalene	38,000	µg/kg
Naphthalene	8800	µg/kg
Phenanthrene	8300	µg/kg
Pyrene	5500	µg/kg
TPH-DRO	11,000	mg/kg