FINAL REVISION 1

PARCEL 3 GROUNDWATER BACKGROUND WELLS AND REPLACEMENT MONITORING WELLS INSTALLATION WORK PLAN

FORT WINGATE DEPOT ACTIVITY
MCKINLEY COUNTY, NEW MEXICO

June 2020

Contract No. W912PP-17-C-0003

Prepared for:

US Army Corps of Engineers®

Albuquerque District
4101 Jefferson St. NE
Albuquerque, New Mexico 87109

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14. ABSTRACT
This Final Revision 1 Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan outlines the activities and methodologies to install monitoring wells within the Parcel 3 Hazardous Waste Management Unit to replace abandoned wells due to on-site soil excavation activities. This Work Plan also outlines the activities to install three additional groundwater background wells for use in determining groundwater background values at Parcel 3.

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Upon approval by the New Mexico Environment Department–Hazardous Waste Bureau of this Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan, a copy of the signed approval letter will be placed here.

Document Certification

40 CFR 270.11

June 2020

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information; the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Ian M. Thomas

Mr. Ian Thomas
Base Realignment and Closure Division

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Document Distribution List

Final Revision 1

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan

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Notes:
BEC= Base Realignment and Closure Environmental Coordinator
BIA = U.S. Bureau of Indian Affairs
BRACD = Base Realignment and Closure Division
EPA = U.S. Environmental Protection Agency
FWDA = Fort Wingate Depot Activity
HWB = Hazardous Waste Bureau
NM = New Mexico
NMED = New Mexico Environment Department
NN = Navajo Nation
NRO = Navajo Regional Office
OH = Ohio
POZ = Pueblo of Zuni
USACE = U.S. Army Corps of Engineers

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Acronyms and Abbreviations

ADR	automated data review
APP	Accident Prevention Plan
ASTM	ASTM International
BEC	Base Realignment and Closure Environmental Coordinator
bgs	below ground surface
BRACD	Base Realignment and Closure Division
CFR	Code of Federal Regulations
CoPC	contaminant of potential concern
DoD	Department of Defense
DOT	U.S. Department of Transportation
DQSR	Data Quality Summary Report
EPA	U.S. Environmental Protection Agency
FWDA	Fort Wingate Depot Activity
GPS	global positioning system
HWB	Hazardous Waste Bureau
HWMU	hazardous waste management unit
IDW	investigation-derived waste
kg	kilogram
LDR	land disposal restriction
M&E	Metcalf & Eddy, Inc.
mph	mile per hour
msl	mean sea level
NM	New Mexico
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
OSE	Office of the State Engineer
PA	Programmatic Agreement
PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QASP	Quality Assurance Surveillance Plan
QC	quality control
QCP	Quality Control Plan
RCRA	Resource Conservation and Recovery Act

RFI	RCRA Facility Investigation
SQG	small quantity generator
SSHP	Site Safety and Health Plan
Sundance	Sundance Consulting, Inc.
TCP	traditional cultural properties
TPMC	Terranear-Project Management Company
TSDF	treatment, storage, and disposal
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance
Work Plan	Final Revision 1 Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan

ES.1 EXECUTIVE SUMMARY INTRODUCTION

This Final Revision 1 Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan (Work Plan) has been prepared by Sundance Consulting, Inc., for the U.S. Army Corps of Engineers for submission to the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) in response to comments 4, 7, 9, and 14 of NMED HWB letter dated June 14, 2019 (FWDA-HWB-18-001; NMED, 2019) and the Base Realignment and Closure Division (BRACD) response letter dated August 22, 2019 (BRACD, 2019). This Work Plan describes the specific field methods, activities, and procedures for installing additional bedrock background groundwater monitoring wells (background wells) and installing replacement groundwater monitoring wells (replacement wells) within the hazardous waste management unit (HWMU) boundary of Parcel 3 and adjacent areas of Parcel 2 and Parcel 1, Fort Wingate Depot Activity (FWDA), New Mexico.

ES.2 PURPOSE

The purpose of this Work Plan is to describe the specific field methods, activities, and procedures to install background wells to supplement the southern area groundwater background evaluation. The additional background monitoring wells are required to evaluate background metals concentrations within Parcel 3 water-bearing units and to determine if any contamination from other sources is migrating into the project site. This Work Plan also describes the specific field methods, activities, and procedures to install replacement wells for groundwater monitoring wells abandoned (abandoned wells) due to soil excavation activities performed within the HWMU. Replacing abandoned wells within the HWMU is required to maintain the groundwater monitoring well network and provide a sufficient data set for future groundwater monitoring of FWDA’s southern area.

ES.3 PROPOSED ACTIVITIES

Field activities proposed within this Work Plan include the following.

- **Install One Background Well in Parcel 2.** Drill one soil boring, collect soil samples, and install a background well in a water-bearing unit adjacent to an identified arroyo in Parcel 2 approximately 2,500 feet northeast of dry background monitoring well BGMW05.
- **Install Two Background Wells in Parcel 1.** Drill two soil borings, collect soil samples, and install two background wells in a water-bearing unit adjacent to the main drainage arroyo in Parcel 1, approximately 1 mile south of the southern boundary of Parcel 3.
- **Install 11 Replacement Wells in Parcel 3.** Drill 11 soil borings proximal to previously abandoned groundwater monitoring wells within the HWMU of Parcel 3, collect soil samples, and install 11 replacement wells screened to the specifications of the abandoned wells each new well will replace.
- **Perform Well Development.** Develop newly installed background wells and newly installed replacement wells.
- **Perform Well Survey.** Survey newly installed background wells and replacement wells.

- **Collect Groundwater Level Measurements.** Measure water levels at each newly installed and developed background well and monitoring well prior to groundwater sampling.
- **Collect Groundwater Samples from Newly Installed Wells.** Collect two rounds of groundwater samples of groundwater constituents of potential concern from each newly installed and developed background well and monitoring well.

1.0 INTRODUCTION

This Final Revision 1 Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan (Work Plan) has been prepared by Sundance Consulting, Inc. (Sundance) for the U.S. Army Corps of Engineers (USACE) for submission to the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB) in response to comments 4, 7, 9, and 14 of NMED HWB letter dated June 14, 2019 (FWDA-HWB-18-001; NMED, 2019) and the Base Realignment and Closure Division (BRACD) response letter dated August 22, 2019 (BRACD, 2019). This Work Plan describes the specific field methods, activities, and procedures to install three additional background groundwater monitoring wells in the southern Fort Wingate Depot Activity (FWDA) groundwater area and install groundwater monitoring wells to replace abandoned groundwater monitoring wells within the hazardous waste management unit (HWMU) boundary of Parcel 3, FWDA, New Mexico (NM).

This Work Plan was prepared in accordance with contract number W912PP-17-C-0003, Performance Work Statement, Section 5.11, Optional Task 42: Background/Replacement Wells Work Plan. The contract modification was issued by USACE-Albuquerque District, on October 1, 2019.

1.1 PURPOSE AND SCOPE

A Parcel 3 groundwater Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report, titled *Final, Revision 1 Parcel 3 Groundwater RCRA Facility Investigation Report, Fort Wingate Depot Activity, McKinley County, New Mexico* (Sundance, 2019), was previously submitted to NMED for review. NMED issued an Approval with Modification of the groundwater RFI report on June 14, 2019, however several comments required a work plan to install additional groundwater background monitoring wells (background wells) upgradient of Parcel 3 and adjacent to identified arroyos. Ongoing soil excavation operations in Parcel 3 have required abandoning several existing groundwater monitoring wells within the HWMU, so NMED also requested a work plan to replace abandoned groundwater monitoring well CMW18 because it was essential to the groundwater monitoring well network. Replacing other abandoned groundwater monitoring wells (abandoned wells) within the HWMU is required to maintain the southern groundwater monitoring well network and provide a sufficient data set for future groundwater monitoring. This Work Plan presents which abandoned wells within the HWMU are proposed to be replaced.

This Work Plan outlines the methods, activities, and procedures to install additional background wells and install replacement groundwater monitoring wells (replacement wells) for wells abandoned because of Parcel 3 excavation operations.

Field activities proposed within this Work Plan include the following.

- **Install One Background Well in Parcel 2.** Drill one soil boring, collect soil samples, and install a background well in a water-bearing unit adjacent to an identified arroyo in Parcel 2 approximately 2,500 feet northeast of dry background monitoring well BGMW05 (comment 7, NMED 2019).
- **Install Two Background Wells in Parcel 1.** Drill two soil borings, collect soil samples, and install two background wells in a water-bearing unit adjacent to the main drainage

arroyo in Parcel 1, approximately 1 mile south of the southern boundary of Parcel 3 (comment 9, NMED 2019).

- **Install 11 Replacement Wells in Parcel 3.** Drill 11 soil borings proximal to abandoned wells within the HWMU of Parcel 3, collect soil samples, and install 11 replacement wells screened to the specifications of the abandoned wells each new well will replace (comment 14, NMED 2019; response to comment 4, BRACD, 2019).
- **Perform Well Development.** Develop newly installed background wells and newly installed replacement wells.
- **Perform Well Survey.** Survey newly installed background wells and replacement wells.
- **Collect Groundwater Level Measurements.** Measure water levels at each newly installed and developed background well and monitoring well prior to groundwater sampling.
- **Collect Groundwater Samples from Newly Installed Wells.** Collect two rounds of groundwater samples of groundwater constituents of potential concern from each newly installed and developed background well and monitoring well.

1.2 DOCUMENT ORGANIZATION

The remainder of this Work Plan is organized into the following sections.

- **Section 2 –** Presents background information for FWDA and describes general site conditions and the cultural resources within and around the Parcel 3 boundary of FWDA.
- **Section 3 –** Describes the proposed field methodology including soil and groundwater sampling, provides detail of well screen intervals, and proposed well locations.
- **Section 4 –** Presents information for investigation-derived waste (IDW) management.
- **Section 5 –** Discusses project reporting, data validation, and management.
- **Section 6 –** Presents works cited within this Work Plan.

2.0 INSTALLATION AND SITE BACKGROUND

FWDA installation is located approximately 7 miles east of Gallup, NM, and currently occupies approximately 15,277 acres of land in McKinley County, NM (Figure 2-1). FWDA is mostly surrounded by federally owned or administered lands, including both national forest and tribal lands.

The installation has been divided into several sub-areas (parcels) based on their location and historical land use (Figure 2-2). This Work Plan focuses on the southern area of FWDA, specifically Parcel 3 and adjacent areas in Parcel 2 and Parcel 1 and will be referred to as the Study Area (Figure 2-2).

A groundwater RFI was conducted in 2017, which concluded shallow groundwater bearing units within Parcel 3 are located proximal to drainage arroyos (Sundance, 2019). The groundwater RFI indicated the need for additional groundwater background locations because background groundwater monitoring well locations within Parcel 3 did not produce sufficient, if any, groundwater to sample. It was determined additional background well locations should be installed outside of the Parcel 3 boundary and within proximity of identified arroyos. Three additional background well locations have been identified to potentially produce sufficient groundwater upgradient of known activities. Further detail is presented in Section 3.0.

The groundwater RFI field efforts preceded the current HWMU soil excavation removal action. Additional groundwater monitoring wells were installed during the groundwater RFI to supplement the existing groundwater monitoring well network within the parcel. The HWMU soil excavation operations have encroached on existing groundwater monitoring wells and required these wells to be abandoned before excavating surrounding soil. Nine groundwater monitoring wells within the HWMU have been abandoned as a result of the soil excavation operations. Two additional groundwater monitoring wells were damaged and/or buried during flooding events within Parcel 3. Monitoring well CMW19, located at the north gate of the HWMU, had monument cement slab damage that compromised the inner well casing; CMW21, located within an arroyo north of the HWMU, was buried with sand following high-energy flooding events. These two wells have also been abandoned. Eleven total replacement wells are proposed to replace abandoned wells and are proposed to be located approximately in the same location as the abandoned well being replaced.

2.1 CULTURAL RESOURCES

Traditional cultural properties (TCPs) and other cultural resources have been documented within the FWDA boundaries. Based on a review of available mapping (University of New Mexico/Office of Contract Archaeology, 1994), a limited number of identified sites are located within the southern FWDA groundwater area.

USACE-Fort Worth District has developed a Programmatic Agreement (PA) to specify procedures to be employed during environmental characterization and remediation activities. These procedures will be followed while performing field work. The PA has been presented in previous works and for this Work Plan is referenced from the Parcel 3 groundwater RFI work plan (Sundance, 2016).

Maps showing the locations of TCPs relative to proposed investigation locations are not included in this Work Plan because it is a public document. Instead, the consultation process will include review by tribal cultural resource personnel to confirm the presence or absence of identified cultural resources within the proposed investigation locations. During the Work Plan review period, tribal cultural staff may visit the Study Area and meet with U.S. Army representatives to view figures showing proposed monitoring well sites and inspect the area for cultural resources. Specific proposed monitoring well locations will not be flagged, but the area will be identified.

Pursuant to the PA, the U.S. Army will provide a letter to the Pueblo of Zuni, Navajo Nation, and State Historic Preservation Officer seeking comments on field operating procedures before beginning fieldwork.

2.2 SITE CONDITIONS

2.2.1 Climate

Northwestern NM is characterized by a semiarid continental climate. Most precipitation occurs from May through October. Most of the precipitation occurs as rain or hail in summer thunderstorms, and the remainder results from light winter snow accumulations (Metcalf & Eddy, Inc. [M&E], 1992). Average annual precipitation for Gallup, NM, and the surrounding area is approximately 12 inches of rainfall; the average snowfall amount is 35 inches. Most precipitation occurs during monsoon season from July through October, with minimal precipitation in the spring and late fall. Wind speed for the area averages approximately 6 miles per hour (mph) over the course of a year. However, wind gusts have been known to reach speeds of 60 mph or more (Sundance, 2019).

The average seasonal temperatures for the area vary with elevation and topographic features. During winter, daily temperatures fluctuate as much as 50°F to 70°F in a 24-hour period. In summer, daily high temperatures are between 85°F and 95°F (M&E, 1992). Average temperatures in winter are about 27°F and in summer 70°F, while extreme temperatures are as low as -30°F in winter and as high as 100°F in summer. There are 100 to 150 frost-free days during the year from the middle of May to the middle of October (M&E, 1992).

2.2.2 Topography

The topography of FWDA ranges from approximately 6,660 feet above mean sea level (msl) in the north to 8,200 feet above msl in the south. FWDA can be divided into three general topological areas: 1) the rugged north-to-south trending Nutria Monocline (also known as the Hogback) along the western and the southwestern boundaries, 2) the northern hill slopes of the Zuni Mountains in the southern portion, and 3) the alluvial plains marked by bedrock outcrops in the northern area. As shown on Figure 2-3, the Nutria Monocline comprises a significant portion of the western boundary of the Study Area. The highest elevation in the Study Area is approximately 7,820 feet above msl, located in the Nutria Monocline in Parcel 1 (Figure 2-3). The lowest elevation is approximately 7,320 feet above msl, located along the main north–south trending drainage arroyo. In general, topography is steep along the north-to-south trend of the Nutria Monocline and becomes more gradual toward the eastern parcel boundary.

Main drainages follow the topography, generally flowing from south to north, and discharging into the South Fork of the Rio Puerco near the FWDA northern boundary. Many local tributaries follow the regional trend of flowing from southwest to northeast. Drainages at FWDA are ephemeral with flow occurring only during and after heavy rainfall events or during snowmelt.

During these events, streams transport sediment to low-lying areas in the northern part of FWDA, creating extensive alluvial deposits among bedrock remnants.

Within Parcel 3, surface water runoff is conveyed through two arroyos that merge near the Study Area's northern boundary, and a third minor arroyo on the eastern portion of Parcel 3 that flows into Parcel 2 then merges with the other arroyos at the northeast corner of Parcel 3 (Figure 2-3). Drainages are fed by washes in the Zuni Mountains and the Nutria Monocline. The drainages from the Study Area generally flow north until they intersect the South Fork of the Rio Puerco.

2.2.3 Land Use

The current FWDA land use is commercial/industrial and it is expected to remain as such until federal property transfer. Parcel 3, specifically, is an improved conventional munitions-designated area that will require future land use controls. The U.S. Army intends to maintain ownership of most of Parcel 3 indefinitely.

2.2.4 Vegetation/Habitat

The vegetation cover for the Study Area consists of moderate grasslands, sagebrush, and piñon-juniper woodlands. The Study Area provides habitat for antelope, rattlesnakes, field mice, various other insects and animals, and occasionally mountain lions and bears.

2.2.5 Soils

Soil types found on FWDA are consistent with those occurring in cool plateau and mountain regions of NM. Major FWDA soil types are variants and complexes of sand, loams, clay, and rock as shown on Figure 2-4. Surface soil layers are relatively thin, and the parent bedrock is either at or near the surface in more than one-quarter of FWDA.

Figure 2-4 presents the Natural Resources Conservation Service (NRCS) soil map for the Study Area (NRCS, 2018). Thickness of soil types vary widely over FWDA, with alluvium accumulations deepest along canyon floors and in the Rio Puerco valley. Wind and surface water runoff cause extensive soil erosion, especially where vegetation is absent.

2.2.6 Geology

Mapped geologic units exposed at ground surface in the southwestern portion of FWDA are shown on Figure 2-5. The geologic and stratigraphic setting described in the following sections is based on this geologic mapping in combination with available geologic literature and recent subsurface investigations in the southern areas of FWDA.

2.2.6.1 Structural Geology

FWDA lies within a small basin defined by the Zuni Mountains (Zuni Uplift) to the south and east, the Nutria Monocline to the west, and the South Fork of the Rio Puerco to the north (Figure 2-6; U.S. Geological Survey, 2009). Laramide Orogeny processes, occurring approximately 75 million to 35 million years ago, provided the main uplifting force for the formation of the Zuni Uplift's current configuration, tilting the bedrock underlying the majority of FWDA to the northwest at an angle of approximately 5 degrees (USACE, 2011).

The northern boundary of FWDA terminates in the strike valley of the South Fork of the Rio Puerco. The valley represents the transition between the Zuni Uplift to the south and the gently north-dipping Chaco Slope to the north (USACE, 2011).

To the west, the dominant FWDA topographic and structural feature is the Nutria Monocline. The Nutria Monocline is a regionally northwest trending sharp-crested ridge that dips steeply to the west–southwest and defines the northwestern flank of the Zuni Uplift. The Nutria Monocline rises as much as 2,000 feet above the surrounding area exposing Mesozoic formations whose dips commonly exceed 60 degrees (USACE, 2011).

To the west of the Study Area is the axis of the Nutria Monocline fold, cut by roughly north–south trending high-angle faults. This fault zone is overlain by Quaternary alluvium; with no surface exposure, the slip angle and direction have not been determined (Terranear-Project Management Company [TPMC], 2008).

2.2.6.2 Stratigraphy

The majority of FWDA is underlain by the Triassic-age Chinle Group, which is predominantly nonmarine, red-bed siliciclastics. A stratigraphic column with lithologic descriptions for FWDA is presented on Figure 2-7. The Chinle Group consists of the Shinarump, Bluewater Creek, Petrified Forest, and Owl Rock Formations (Anderson et al., 2003). The Petrified Forest Formation directly underlies much of the installation and is subdivided into three members: Blue Mesa, Sonsela, and Painted Desert. All three members of the Petrified Forest Formation crop out in various locations across the installation. The Blue Mesa, Sonsela, and Painted Desert lithologies are green-gray smectitic mudstone, light gray to yellowish-brown cross bedded sandstone, and reddish-brown and grayish-red smectitic mudstone, respectively (McCraw et al., 2009).

The Chinle Group is underlain by the older San Andres Limestone and Glorieta Sandstone, both Permian in age. The San Andres Limestone generally consists of fossiliferous limestone that intertongues the Glorieta Sandstone (Anderson et al., 2003). These two formations do not have outcrops within the boundaries of FWDA; however, the Glorieta Sandstone Formation does crop out south of the installation where a thrust fault juxtaposes Permian strata against the Cretaceous Dakota Sandstone. These two formations comprise the San Andres-Glorieta aquifer, which is the principal source of drinking water in the area (Malcolm Pirnie, Inc., 2000; Cooper and John, 1968).

Within the FWDA boundaries, bedrock outcrops of clastic sedimentary rocks are predominately Triassic in age, but in the western and southern portions of FWDA, Jurassic and Cretaceous sandstone, claystone, and shale are present. Jurassic and Cretaceous rocks are exposed in the Nutria Monocline, which is the dominant topographic feature within FWDA boundaries and west of the Study Area. Quaternary alluvial and colluvial deposits, derived from weathered bedrock, are present throughout FWDA.

Within the Study Area, the stratigraphy on the eastern side of the Nutria Monocline is largely the Triassic-aged Petrified Forest Formation. The Petrified Forest Formation is a purplish-red, cross-bedded, mudstone and sandstone containing greenish-gray calcrete nodules and petrified wood. The Petrified Forest Formation has low apparent permeability due to the fine to ultrafine muddy matrix. Extensive mudstone units of the underlying Blue Mesa Member of the Petrified Forest Formation, being of lower apparent permeability, will inhibit vertical movement of groundwater to underlying potable aquifer units, such as the San Andres-Glorieta aquifer (TPMC, 2008). The Petrified Forest Formation has a combined thickness of approximately 980 feet (Sundance, 2019).

2.2.7 Hydrogeologic Conceptual Model

Based on surface water flow and the overall groundwater gradient observed along the south-to-north arroyo east of the Nutria Monocline, limited shallow groundwater may enter beneath Parcel 3 from south of well CMW02, the southernmost groundwater monitoring well located along the main arroyo (Figure 2-8). Groundwater also may be encountered in wells in the south-to-north-trending arroyo along the west side of the monocline, which cuts across the monocline from west to east through Fenced-up Horse Valley to join the main arroyo near the northern limit of the Study Area (Figure 2-8). However, the limited groundwater found beneath Parcel 3 appears likely to result from recharge from local precipitation and surface runoff in the arroyos.

As observed and presented in the Parcel 3 RFI report, groundwater monitoring wells located along the north–south trending arroyo east of the Nutria Monocline have sufficient groundwater for sampling and include CMW36A, CMW36B, CMW28B, CMW27B, and CMW26 (Sundance, 2019; Figure 2-8). Groundwater monitoring wells BGMW05 and CMW32, located outside and east of the arroyo, and KMW15B located outside and west of the main arroyo did not recharge following well development or purging activities during the 2017 RFI and are currently dry. The dry wells represent a boundary between water producing wells within close proximity of the arroyo and wells that do not produce sufficient volume to sample or are dry. These wells exhibit an approximate distance away from the arroyo where groundwater is generally not encountered. The locations of groundwater-producing monitoring wells provide evidence that groundwater recharge is correlated to surface infiltration from arroyos (Sundance, 2019).

3.0 FIELD METHODOLOGY

The U.S. Army has identified the locations to install three background wells to supplement the southern area groundwater background evaluation (Figure 3-1). The U.S. Army will also replace 11 abandoned wells within Parcel 3; nine wells that were abandoned during the Parcel 3 soil removal action and two wells (CMW19 and CMW21) that were abandoned due to flood damage (Figure 3-2). The replacement wells will be designed and located according to the specifications of the abandoned wells they are replacing.

The following sections summarize the permitting, field planning documentation, unexploded ordnance (UXO) avoidance, and specific field methods and standards to be used to drill, install, develop, and sample the proposed background wells and replacement wells.

3.1 PERMITTING

Documents will be submitted to the NM Office of the State Engineer (OSE), District 1, for review and approval to drill the proposed groundwater monitoring wells. A form *WR-07 Application for Permit to Drill a Well with No Water Right* will be completed and filed with the OSE District 1 office for review and approval before beginning field activities. In the event any soil boring needs abandonment, a *Well Plugging Plan of Operations* will be completed and filed with the OSE District 1 office for review and approval. Field operations will be conducted in accordance with current OSE guidance for drilling groundwater monitoring wells (OSE, 2019). Global positioning system (GPS) coordinates of the proposed groundwater monitoring well locations will be collected to use in the location submission to OSE.

Coordination will be made with the FWDA caretakers to obtain a written utility clearance sign-off for the proposed groundwater monitoring wells per the GPS locations. The on-site representative will work with the FWDA caretakers and USACE to ground truth the proposed locations before beginning field operations. Notifications will be submitted to NMED, OSE, the Bureau of Indian Affairs, and White Sands Missile Range representatives before mobilizing field personnel.

A dig permit will be submitted to NM One Call, also known as NM-811. This site is a U.S. Army Installation in closure, so it is expected that NM-811 will not have access or utilities within the boundaries of FWDA; however, a proper submission will be conducted to verify and confirm no utilities from private entities exist at the proposed locations. Written documentation for submission to NM-811 will be retained for the project file.

Operations will not be performed until a signed clearance has been received from the FWDA caretakers, and concurrence of the operations is received from applicable stakeholders, including any inquiries from tribal cultural resource personnel. As outlined in Section 2.1, the U.S. Army will provide a letter to the Pueblo of Zuni, Navajo Nation, and State Historic Preservation Officer seeking comments on field operating procedures before beginning fieldwork.

3.2 FIELD PLANNING DOCUMENTS

Along with this Work Plan, the U.S. Army will use an approved Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). The approved APP/SSHP, along with the corresponding accident hazard analyses, covers drilling operations as well as mobilization and vehicle operation. Most of the proposed locations are located within areas of known historic ordnance operations (within the HWMU boundary), so the requirement for UXO support is necessary. Additional information regarding UXO avoidance operations is provided in the following section and will also be addressed in the APP/SSHP.

3.3 Unexploded Ordnance Avoidance

This section discusses the UXO avoidance processes to safely enter work areas within Parcel 3 for drilling soil borings, installing groundwater monitoring wells, and returning to well locations for data collection. This includes activities such as location surveying and site inspection. Each field team will have a designated UXO Technician III provide 100% escort and oversight during field activities performed under this Work Plan.

The project UXO Technician III will survey the area where the proposed soil boring is to be advanced, including the vehicle staging and work area(s) and ingress/egress locations, using a handheld magnetometer. The boring location will be surveyed to determine if any shallow subsurface anomalies are present. Once a location is deemed safe, site personnel and the UXO Technician III will hand-auger to the less than subsurface extent of the detection range of the instrument. The magnetometer will then be lowered down the hole to detect a depth ahead of the boring advancement. If deemed clear, personnel will continue to hand-auger to less than the extent of detection of the instrument. After reaching a depth of approximately 3 feet, a down-hole magnetometer will be used to monitor the boring as it is advanced. This process will continue until a depth of 8 feet below ground surface (bgs) or refusal, whichever comes first. At this depth, the drill rig will be staged over the soil boring location and advanced to the hand-augered depth. The down-hole magnetometer will be lowered down the boring ahead of the boring advancement to determine if there are any subsurface anomalies. The drill rig will then advance to less than the extent of detection of the instrument, and the instrument will, once again, be lowered down the boring to detect for anomalies. This process will continue until a determined safe depth has been achieved, or the total depth of the boring is reached.

For activities that do not involve intrusive activities, the project UXO Technician III or designated UXO Technician II will survey the area where the proposed activity is to take place, including the vehicle staging and work area(s) and ingress/egress locations, using a handheld magnetometer. The location will be surveyed to determine if any shallow subsurface anomalies are present. Once an area is deemed safe, site personnel will be allowed to perform the required activities with oversight by the designated UXO technician.

3.4 Monitoring Well Installation

Groundwater monitoring well installation procedures are described in this section. Groundwater monitoring well installation will be performed in accordance with NM OSE regulations (OSE, 2019), the RCRA permit, and the NM Administrative Code (NMAC) 19.27.4.29 and 19.27.4.30 (NMAC, 2017). Three background wells are proposed for installation. The proposed background wells are strategically located proximal to identified drainage arroyos upgradient and away from known site activities (Figure 3-1). As discussed in Section 2.2.7, groundwater recharge is correlated to surface infiltration from arroyos. Table 3-1 provides the well construction information for the three proposed background wells. The proposed screened intervals for background wells are estimated based on similar groundwater monitoring wells located adjacent to arroyos in Parcel 3. The total depths and screened intervals for the background wells may vary based on observed subsurface lithology, observed saturated zones, and the field geologist's professional judgment. The screened interval will be placed to capture first water, thus will not drill through multiple water-bearing zones.

In addition to installing background wells, installing replacement wells within the HWMU are proposed to replace monitoring wells abandoned due to HWMU soil excavation activities. These replacement wells are to be installed approximately to the same specifications as the abandoned well being replaced. Table 3-2 shows the well identification numbers of the proposed replacement wells, the abandoned well each new well will replace, well construction information, screen intervals, and location coordinates. Figure 3-2 presents the locations of the replacement wells within Parcel 3. The proposed replacement well depths were determined based on existing data of the abandoned well construction. Some monitoring wells being replaced had a shallow screened interval, and thus were determined dry. Efforts to screen the replacement well in a water-bearing zone will be made, including advancing the borings to a deeper total depth, moving the well location laterally up to 100 feet, and/or installing temporary wells in the event a saturated zone within the planned depth of the boring is not encountered before well monument completion.

During the execution of this Work Plan, measures to eliminate contamination or cross contamination of groundwater at the proposed well sites will be performed. Selection of well installation and development supplies and materials, as well as performance of equipment decontamination procedures, worksite housekeeping, and IDW management practices are preventative measures to mitigate well contamination during drilling, construction, and completion (NMED, 2017; BRACD, 2018a). Precautions will be taken in the field consisting of material inventories to ensure appropriately selected materials, liquids, and tooling on site are utilized, as well as ensuring clean disposable gloves are worn and changed between activities, and decontamination procedures are performed and documented as planned. The following sections further discuss the planned drilling, construction, and decontamination procedures.

3.4.1 Drilling and Well Construction

For both the background wells and replacement wells, a track-mounted sonic drill rig will be used to continuously core the boring and advance a core barrel, drill string, and temporary steel conductor casing to the proposed total depth at each location. The conductor casing seals off the formation above the targeted zone preventing cross contamination during well advancement and construction. Sonic drilling technology also generates continuous soil and rock cores from the subsurface. Soil and rock cores will be contained in boxes and maintained on site, thus eliminating soil IDW; however, soil and rock core IDW will be characterized to determine if the cores are non-hazardous and are clean. Upon any analytical results showing a sampled core is not clean, it will be disposed of off site as IDW. Further IDW management detail is presented in Section 4.0.

Field personnel will install 2-inch diameter schedule 40 polyvinyl chloride (PVC) groundwater monitoring wells with a minimum 2-inch annulus for each proposed monitoring well (Table 3-1; Table 3-2). The core barrel and drill string will be removed from the boring, leaving the temporary steel casing in place. Lengths of slotted PVC screen and solid PVC riser, equal to the total depth of the boring plus any well stick up above ground surface, will be screwed together and placed into the boring inside of the temporary steel casing. The temporary steel casing will then be slowly retracted as the well is constructed, keeping the water-bearing unit sealed from the formation above (BRACD, 2018b). For monitoring wells planned to be drilled deeper than 80 feet bgs, schedule 80 PVC will be utilized (Table 3-2). The PVC well materials used for all wells installed under this Work Plan are free of the additive bis(2-ethylhexyl) phthalate and will meet National Sanitary Foundation Standard 14 type well casing (NMED, 2018). Replacement wells will be installed with the same screen length and screen elevations as the abandoned well being replaced (Table 3-2). The well screen will be 2-inch inside diameter, schedule 40 PVC 0.010-inch machine-slotted screen with a cap attached to the bottom. For monitoring wells screened below 80 feet bgs, schedule 80 PVC 0.010-inch machine-slotted screen will be used. Groundwater monitoring wells will have centralizers placed at the top and bottom of the screen when appropriate. The filter pack will be silica sand and will extend from the bottom of the borehole to 2 feet above the screened interval (Figure 3-3).

Above the filter pack, a bentonite chip or pellet seal will be installed with a thickness of approximately 5 feet and hydrated with potable water at every 1-foot interval to provide a competent seal. The bentonite chips or pellets will be installed by a tremie pipe.

Above the bentonite seal, a neat cement grout will be installed from the top of the bentonite seal to 3 feet bgs by a tremie pipe.

The surface completion for each groundwater monitoring well will consist of an 8-inch diameter by 6-foot long protective steel monument, which will be installed with 3 feet above the concrete pad and 3 feet into the ground. An approximate well monument stick-up height of 3 feet is required to accommodate a potential dedicated pump system. The concrete pad will be 4 feet long by 4 feet wide by 6 inches thick (Figure 3-3). The finished pad should be slightly sloped so that drainage will flow away from the protective casing and off the pad. A minimum of one inch of the finished pad should be below grade. Field personnel will install four 4-inch diameter by 5-feet tall steel protective bollards at each outside corner of the square concrete pad. Bollards will be installed to a minimum depth of 2 feet below the ground surface in a concrete footing and extend a minimum of 3 feet above ground surface. Concrete should also be placed into the steel pipe to provide additional strength. The well will be equipped with a security lock and will be tagged with corrosion-resistant identification. The well monument and protective bollards will be coated with protective orange paint, as required by FWDA. The paint will be carefully applied to the well monument and bollards before installing so the groundwater monitoring well is not cross contaminated (NMED, 2017).

3.4.2 Subsurface Soil Sampling

Soil sampling will be conducted to determine if surface or subsurface contaminants in soil exist at the location of each soil boring advanced. Each soil boring advanced will be sampled for the same analytical suite. The soil sampling matrix is presented in Table 3-3.

During soil boring advancement, core samples will be extruded into plastic sleeves before placing into wooden core boxes. Soil samples will be collected at three intervals at each boring. One sample will be collected within the first 3 feet from ground surface, one from the saturated zone, and the final sample collected at the borehole termination depth. Core recoveries and depth measurements will be recorded, then samples will be collected from core samples once placed into the wooden core boxes. Samples will be placed in the appropriate sample container, labeled, and provided a unique sample identifier. The soil sample identification will consist of a combination of the parcel number, the soil boring number, source of the sample, type of sample collected, sample depth, and sample matrix. The following provides additional descriptions of the proposed sample nomenclature system.

Soil Boring Parcel:	Parcel number (i.e., 21)
Boring or Well Number:	TMW50
Source of Sample:	SB (soil boring), TB (trip blank), EB (equipment blank)
Type of Sample:	-D01 (discrete near surface) -D02 (discrete saturated zone), -D03 (discrete boring termination)
Sample Depth:	-0001 (0 to 1 foot bgs), -1011 (10 feet to 11 feet bgs)
Matrix of Sample:	-SO (soil)

Using this nomenclature, a soil sample taken from soil boring CMW40 from Parcel 3 in the saturated zone at 46 feet bgs would be identified as:

03CMW40SB-D02-4546-SO

Quality assurance (QA)/quality control (QC) samples will carry the same sample nomenclature as the parent sample with a unique suffix and numeral (if required) to distinguish individual samples. Duplicate samples will simply be described as Dup 1, Dup 2, etc., so that the laboratory will not be able to relate it to the original field sample. A duplicate relation table will be generated and documented in daily reports to track associations to parent samples.

3.4.3 Decontamination

Field personnel will perform decontamination of reusable equipment to prevent cross contamination. Disposable nitrile gloves (or similar) will be utilized by field personnel during decontamination procedures and changed to prevent contaminated gloves contacting decontaminated equipment and materials. A temporary cleaning area will be designated at each proposed well location. The cleaning area will be a minimum of 30 feet away from the sampling location, or at the equipment staging area outside of the Study Area. Field personnel will use the standard equipment decontamination procedures during completion of drilling activities and between drilling locations. These procedures are as follows.

- Drillers will decontaminate drilling rigs (sonic) before entering the Study Area. This consists of spray-washing or steam-cleaning dirt and debris from rig exterior and components and fully inspecting for any oil, hydraulic fluid, fuels, or operational fluid leaks. If any leaks are detected, the deficient rig will not be allowed on site until the deficiency is resolved.
- Drillers will decontaminate drilling rigs and equipment between soil boring locations, also consisting of spray-washing or steam-cleaning dirt and debris from rig exterior and components. A temporary decontamination pad will be constructed within the cleaning area away from the proposed well and/or sampling location. Drill rig decontamination activities will be performed within the temporary decontamination pad.

- Drillers will decontaminate drilling casing (drill string), drilling bits, and down-hole equipment by steam cleaning and washing with a deionized water and non-phosphate detergent cleaning solution, then rinsing with deionized water and allow to air-dry. Drilling components will also be decontaminated within the temporary decontamination pad.

Field personnel will collect and manage decontamination fluids as outlined in Section 4.0. Field personnel will also dispose of the plastic sheeting, after fluids are removed, and associated decontamination pad materials in an approved on-installation dumpster. After field cleaning, personnel will don clean gloves before handling equipment to prevent recontamination. Personnel will move the equipment away from the cleaning area to prevent recontamination. If the equipment is not to be immediately reused, personnel will cover the equipment with plastic sheeting to prevent recontamination. The area where the equipment is stored prior to reuse must be free of contaminants.

Non-dedicated measurement equipment such as water-level meters and submersible pumps will be decontaminated before and after each use. Water-level meters will be decontaminated during extraction from monitoring wells using deionized water and a non-phosphate detergent cleaning solution. Non-dedicated measurement equipment will be decontaminated using the following procedure.

1. If necessary, remove particulate matter or debris using a brush or handheld sprayer filled with deionized water.
2. Scrub the surfaces of the equipment using deionized water and a non-phosphate detergent cleaning solution and reusable dedicated decontamination brushes.
3. Rinse the equipment thoroughly with deionized water.
4. Place the equipment on a clean surface and allow to air dry.
5. Containerize all decontamination liquids and manage as IDW, as described in Section 4.5.
6. After decontamination operations, handle equipment to prevent recontamination. The area where the equipment is stored before reuse will be free of contaminants.

Equipment dedicated for use at specific wells will not require decontamination before use. Disposable equipment that is used once and then disposed of will not require decontamination before use, provided it is wrapped in the manufacturer’s packaging or otherwise protected from inadvertent contamination before use.

3.5 WELL DEVELOPMENT

Completed background wells and replacement wells will be developed in accordance with NM OSE regulations (OSE, 2019) and NMAC 19.27.4.29 and NMAC 19.27.4.30 (NMAC, 2017) as applicable. The groundwater monitoring wells will be developed after a minimum of 48 hours have elapsed after completion of the well installation. Field personnel will develop groundwater monitoring wells by surge blocking, bailing, and/or pumping until the turbidity of the extracted water is less than 100 nephelometric turbidity units (NTUs), if obtainable. The water-bearing units at FWDA contain high volumes of fines and silts, so a determination whether a well has sufficiently developed may need to be made in the field and authorized by the Field Team Lead and the USACE Technical Lead.

3.6 WELL SURVEY

Initial survey for the proposed replacement well locations will be conducted to verify the ground elevation at the location of each well. This initial elevation survey is needed to verify the starting elevation for each boring. The replacement wells are intended to be installed and screened at approximately the same elevation as the abandoned well being replaced; however, the HWMU area has undergone extensive soil excavation and back fill. Once the ground elevation at each replacement well is verified, the total well depth can be calculated and adjusted to allow placing the screened interval consistent with the abandoned well's screened interval.

Following well completion, the background well and replacement well locations will be surveyed by a NM-licensed professional surveyor to the nearest tenth of a foot (horizontal). The surveyor will measure elevations for the new monitoring wells at ground surface, top of the surface monument, and top of inner well casing (PVC) at points on the north side of the well to the nearest one hundredth of a foot (vertical).

The professional surveyor will reference horizontal coordinates for all sample locations to the North American Datum of 1983, State Plane NM West Grid represented in units of feet. They will also reference vertical coordinates for monitoring well elevations to the North American Vertical Datum of 1988, or NAVD 88.

3.7 GROUNDWATER LEVEL MEASUREMENT

Static groundwater levels at each newly installed groundwater monitoring well will be recorded prior to purging and groundwater sampling activities. Groundwater elevation data will be collected no sooner than 72 hours following well development, and during a 24-hour period to provide representative groundwater data. Depth to groundwater will be measured with an electronic water-level meter following these steps.

1. Lower the probe of the water-level meter down into the well casing until the indicator lights or chimes.
2. Record measurement to the nearest 0.01 foot to the top of casing reference notch and document in field logbook.
3. Remeasure the water level to ensure accurate measurement and document any variance from the first measurement recorded.
4. Remove water-level probe from the well casing and decontaminate with non-phosphate detergent and deionized water as described in Section 3.4.3.

3.8 INITIAL GROUNDWATER SAMPLING

Groundwater samples will be collected from newly installed background wells and replacement wells as outlined in groundwater sample matrix provided in Table 3-4. The sampling matrix for the replacement wells are based on identified contaminants of potential concern (CoPCs) in the Parcel 3 Groundwater RFI Report (Sundance, 2019). The three background well locations are outside of the previously conducted RFI footprint, so additional analytes (herbicides, pesticides, and polychlorinated biphenyls) are added to the sampling suite in accordance with comment 5 of NMED's Approval with Modification letter dated December 30, 2017 (NMED, 2017) regarding the installation of additional background monitoring wells in the FWDA northern area.

Two separate but consecutive sampling events will be performed at each newly installed background well and replacement well. The two sampling rounds of the newly installed wells will be considered the initial sampling before the wells' integration into the monitoring program. Analytical results will be compared to screening values outlined in the last-approved groundwater monitoring work plan at time of sample collection and will be reported in the groundwater well installation report following analysis. If herbicides, pesticides, and polychlorinated biphenyls are not detected at the background wells in the two sampling rounds, these analytes will be removed from future sampling.

Before purging and sampling, a minimum of 72 hours will elapse from completing development of a given groundwater monitoring well. This timeframe is recommended to allow for aquifer normalization following development activities. Historically, some of the existing groundwater monitoring wells at FWDA require alternative methods of purging and sampling due to extremely low yield/low water level. For these wells, purging and sampling are performed with one of the following: disposable bailers, a 12-volt-battery pump, or a dedicated Bennett pump (Sundance, 2018). An attempt to purge and sample the proposed monitoring wells with a low-flow pump will be made; however, if yield, recharge, or overall water level is insufficient to sample using low-flow techniques, disposable bailers or a 12-volt-battery pump will be used.

The following procedures emphasize the need to remove a sufficient volume of water from each well to ensure that the sampled groundwater is representative of the surrounding formation. Removal of a quantity of water equal to three times the calculated volume of standing water in the well (including the saturated annulus) will be completed wherever possible.

As described in Section 3.7, the field team will measure depth to groundwater from the top of casing reference notch and record the measurement to the nearest 0.01 foot. The well volume will be calculated using the measured groundwater level and casing dimensions as follows.

$$\text{Borehole Volume} = \text{Saturated Casing Volume} + \text{Saturated Filter Pack Volume}$$

Where:

$$\text{Saturated Casing Volume} = \pi \times WR2 \times (TD - DTW)$$

$$\text{Saturated Filter Pack Volume} = ((\pi \times BR2 \times SFPL) - (\pi \times WR2 \times SFPL)) \times 0.2 \text{ and}$$

WR = well screen radius

TD = total well depth

DTW = depth to water

BR = borehole radius

SFPL = saturated filter pack length.

Groundwater elevation and well volume calculations will be recorded in the field logbook and/or on a groundwater sampling field data sheet.

During purging, groundwater field parameters consisting of temperature, acidity or alkalinity (pH), conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity will be measured and recorded. Field parameters will be monitored at a time interval determined by the purge rate, and values will be recorded on the sample collection form. Purging is considered complete and sampling will occur under one of the three following scenarios.

1. Before three well volumes are evacuated, three consecutive readings of the field parameters will be recorded within the following limits:
    - +/-10% of temperature, conductivity, and oxidation reduction potential
    - +/- 10% OR < 1.0 NTU for turbidity
    - +/- 10% OR < 1.0 milligram per liter for dissolved oxygen
    - +/- 5% for pH.

    This will indicate that stabilization has occurred. Purging will be discontinued, and the samples will then be collected.
2. After evacuating three well volumes, if the field parameters have not stabilized, purging will be discontinued. Samples will then be collected and the attempts to achieve stabilization will be recorded.
3. Before three well volumes can be evacuated, if the monitoring well is emptied due to very slow recovery, and a minimum of three field parameter readings have been collected, groundwater samples will be collected as soon as the monitoring well has recharged to sufficient volume for the required analyses. Several days may be needed to collect the full suite of parameters based on previous groundwater sampling conducted in the area.

Once purging is completed, samples will be collected using low-flow sample pumps or disposable bailers. No groundwater samples will be collected from a 12-volt-battery pump. Sampling method and equipment used will be documented. Sample collection volumes, bottle requirements, preservation, and holding times are described in Table 3-5.

Samples will be packaged and shipped to a U.S. Department of Defense (DoD) Environmental Laboratory Accreditation Program-certified analytical laboratory. The contracted analytical laboratory will analyze samples in accordance with the project quality objectives and requirements with Quality Systems Manual version 5.3 (DoD and Department of Energy, 2019) or the latest issued version at time of analysis. Also, if any U.S. Environmental Protection Agency (EPA) method is revised by the time fieldwork begins, the newer method will supersede the listed EPA method provided in this Work Plan. Sample containers, preservation, and hold times for both soil and groundwater are presented in Table 3-5.

3.9 FIELD DOCUMENTATION

Field personnel will maintain appropriate field documentation for all activities as part of the formal project documentation. Field sampling documentation and data reporting will provide sufficient information to verify well installation report conclusions and demonstrate that QC procedures were followed while implementing proposed field activities.

A soil classification log will be used by the field geologist to record the drilled soil borings. The soil classification log conforms to industry standards and includes the following information.

- Project number
- Soil boring name/number
- Names of the drilling company and the operator
- Name of the geologist completing the log information
- Soil logging information
- Dates drilling begins and ends
- Observed drilling conditions (hard or soft drilling, rig chattering, sticky conditions, etc.).

Each soil boring will be logged in accordance with ASTM International (ASTM) Standards D-2487, D-2488, and D-653 (ASTM, 2006; ASTM, 2009a; and ASTM, 2009b). Soil descriptions and classification will conform to the ASTM Unified Soil Classification System. Location and names for the proposed groundwater wells are provided on Figure 3-1 and Figure 3-2, and in Table 3-1 and Table 3-2.

Other documentation may be generated as a part of this field effort and are listed below.

- Daily tailgate safety meeting forms
- Daily field logbooks
- Field work variances
- Soil classification logs
- Equipment calibration records
- IDW characterization documents
- Decontamination activity documentation
- Photo documentation.

3.9.1 Quality Assurance

QA will be monitored by USACE in accordance with the Quality Assurance Surveillance Plan (QASP). USACE will evaluate field activities to verify the approved Work Plan is being followed. QA audits and inspections will be performed in accordance with established USACE guidelines and the project QASP.

3.9.2 Quality Control

A project Quality Control Plan (QCP) will describe the QC approach and chain of command to be followed to ensure activities are performed in accordance with this Work Plan. The QCP is a standalone document separate from this Work Plan.

4.0 INVESTIGATION-DERIVED WASTE MANAGEMENT

Investigations and remedial activities at FWDA will generate IDW such as potentially contaminated soil, sediment, and groundwater; equipment decontamination fluids; disposable sampling equipment; used personal protective equipment (PPE); and general refuse. Properly managing IDW, as specified in this Work Plan, is required to ensure compliance with federal, state, and U.S. Army regulations applicable to the collection, storage, transport, and disposal of potentially hazardous materials.

IDW generated during the monitoring well installation activities will consist of water produced from drilling activities, decontamination fluids, disposable sampling equipment, and PPE. Soil and rock IDW will be generated and all recovered material (soil and rock cores) will be contained in boxes; however, soil and rock core IDW will be characterized to determine if the cores are non-hazardous and are clean. If any analytical results show that a sampled core is not clean, it will be disposed of off site as IDW as appropriate to the analytical data received. Any soil and rock cores determined clean will be stored on site for lithologic reference.

4.1 IDW SEGREGATION

Generated IDW will be segregated by monitoring well type. IDW generated from background well locations will be separate from IDW generated from replacement well locations. IDW categories will also be segregated. Identified IDW categories are as follows.

1. **Drilling Fluids—**Large volumes of groundwater, potable drilling water, monitoring well development water, and pre-sample purge water from drilling activities are anticipated. Field personnel will use portable water tanks to collect, manage, and characterize groundwater and related drilling fluids during drilling. The collected water will be stored for appropriate characterization and disposal.
2. **Decontamination Fluids—**Small volumes of decontamination fluids are anticipated. Decontamination fluids consist of detergents, rinse water, and laboratory-grade detergents used to decontaminate non-disposable sampling equipment and PPE. Decontamination fluids will be contained within the temporary decontamination pad areas during active sampling and decontamination activities on site. Accumulated wash and rinse water will then be containerized for appropriate characterization and disposal.
3. **Solid Wastes—**Used, non-decontaminated disposable sampling equipment, PPE, and general refuse are anticipated. Field personnel will place these items in polyethylene trash bags and treat as general refuse. Field personnel will place refuse in the approved on-installation dumpster daily.
4. **Soil/Rock Cores—**Small volumes of soil and rock cores will be generated from each boring, extracted from the core barrel into a plastic bag, and placed into a core box. Previous activities have documented soils and subsurface material as non-hazardous, thus it is anticipated soil and rock cores generated during activities under this Work Plan will also be non-hazardous. Field personnel will sample the soil and rock cores to determine if the material is hazardous and to determine if any concentrations of CoPCs exceed soil screening levels.

Process knowledge for the HWMU, such as historical operational records, previous analytical data, and field screening results obtained during previous investigations and remedial actions has indicated only non-hazardous IDW has been generated within the HWMU and during groundwater activities within and adjacent to Parcel 3. Hazardous IDW is not anticipated during the work described in this Work Plan.

Characterization sampling will be composite samples of the segregated groups as listed above. Sample analysis will include flash point, reactivity, corrosivity, and toxicity tests in accordance with Title 40 of the Code of Federal Regulations (CFR) at Part 261, as well as the analytical suites for soil and water presented in Table 3-3 and Table 3-4. In the event analytical data indicate soils and/or waters are a RCRA hazardous waste, a U.S. Department of Transportation (DOT)-certified hazardous waste transport and disposal company will be contacted to collect the hazardous IDW and ship it off site to the appropriate disposal facility within 90 days. Shipment volume and disposal documentation will include waste manifests and confirmation of receipt by the receiving waste disposal facility.

4.2 IDW CONTAINERIZATION AND LABELING

Field personnel will dispose of used, non-decontaminated sampling equipment and PPE in polyethylene trash bags. Field personnel will use portable water tanks and/or drums to collect, manage, and characterize groundwater during drilling. The collected water will be disposed of off site as non-hazardous waste. Drums and tanks will conform to United Nations Performance-Oriented Packaging standards and DOT specifications in 49 CFR 178. General refuse and decontaminated sampling equipment and PPE will be placed in polyethylene trash bags or other suitable containers.

A label reading *“Caution: This Drum/Container May Contain Hazardous Material”* or similar will be affixed to each container containing IDW. In addition, each drum, roll-off, or portable tank containing IDW will be labeled with a unique 12-character identifier: The first two characters are "FW;" the second two are the soil boring/well number; the next six are the day, month, and year (dd/mm/yy) on which filling commenced; and the last two are the consecutive number of the container among all being filled on a given day.

For example, an IDW container from:

FW - Fort Wingate Depot Activity

18 - Groundwater well number CMW18

-0609 - 6 September

23 - 2023

-01 - Container 01

would be identified and labeled as FW18-060923-01.

The label will also indicate the contents (groundwater, decontamination fluids, soil/rock cores) and the date on which filling is completed (the 90-day start date).

4.3 TEMPORARY STORAGE

Small IDW containers, such as drums, core boxes, and tanks, will be transported to designated holding areas or “satellites” within 3 days of the date that project activity is completed. Bulk

IDW containers, such as roll-off containers, will be lined, covered, and secured at their respective staging area.

Currently, FWDA is considered a small quantity generator (SQG), which places restrictions on the amount of hazardous material that can be shipped off site and stored on site. Under the SQG status, FWDA can ship up to 1,000 kilograms (kg) of IDW per month (kg/month) off site and can store up to 6,000 kg on site while awaiting disposal. Based on a 55-gallon drum of water weighing 459 pounds, this translates into a shipping capacity of roughly 5 drums of water per month (or 264 gallons per month) and a storage capacity of roughly 29 drums of water (or 1,585 gallons). Additionally, based on a 55-gallon drum of soil weighing approximately 735 pounds, this translates into a shipping capacity of roughly three drums of soil per month and a storage capacity of roughly 18 drums of soil.

Characterization sampling will be composite samples of soil waste generated from like areas that were generated during the same timeframe. Soil IDW is expected to be low and only contain the soil cores from each boring, so a maximum of three borings within proximity of each other will be grouped as a like area. A minimum of three subsamples from each boring's soil cores taken from near surface, the midpoint, and at termination will be composited and represent the characterization for the boring group. This approach will make nine subsamples from three borings, or six subsamples from two borings grouped together for a characterization sample.

Liquid IDW will be bulked into tanks that hold 800 gallons or less. A grab sample from each liquid IDW container will be collected for analysis.

Inventory forms will be completed for all IDW containers placed at the satellites. Information on the form will be verified with respect to container labeling. The Field Team Lead or person in charge will provide copies of inventory forms to the FWDA Base Realignment and Closure Environmental Coordinator (BEC). An example inventory form is provided on Figure 4-1.

4.4 IDW CHARACTERIZATION

4.4.1 IDW Sampling

Field personnel will collect representative samples from each container of groundwater or decontamination fluids consisting of a composite of the material to characterize IDW for disposal as hazardous, special, or non-hazardous waste. Samples may be collected as containers are filled at the soil boring/well location, or within 5 days of transfer to the satellite area. The analytical laboratory will provide analysis results within 15 business days of sampling. Small volumes of decontamination fluids are anticipated. Decontamination fluids will be contained within the temporary decontamination pad areas during active decontamination activities at a well site. Accumulated wash and rinse water will be collected from the decontamination pad and bulked with other decontamination fluids.

A complete list of waste characterization parameters and analytical methods approved by EPA is published in Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, also known as SW-846. Process knowledge will be used to evaluate the physical state of the IDW to determine which specific parameters will be required to properly characterize waste generated from a given soil boring/well location.

Upon receipt of waste characterization results, copies of the data will be provided to the FWDA BEC and USACE Technical Manager. The inventory forms will then be updated with IDW classifications and applicable EPA waste codes for the containers located within the satellites.

4.4.2 IDW Classification

IDW will be classified as hazardous waste if the material exhibits the characteristics of ignitibility, corrosivity, reactivity, or toxicity as listed by EPA in 40 CFR 261.20-24 (Subpart C). Solid IDW not classified as hazardous waste will be classified as special waste if the material is listed as such by NMED in NMAC 20.9.8 (NMAC, 2007a).

IDW will be classified as non-hazardous waste if potential contaminants are not detected or are detected at concentrations less than applicable regulatory limits.

4.5 IDW DISPOSAL

The U.S. Army will manifest IDW and transport off site within 30 days of receipt of characterization results or within 90 days of placement at the satellites, whichever occurs first. No IDW containers will be stored beyond 90 days at the satellites unless the FWDA BEC grants an extension.

4.5.1 Hazardous Waste

IDW classified as hazardous waste will be disposed of off site at a RCRA Subtitle C permitted treatment, storage, and disposal facility (TSDF). Before transport, containers will be labeled according to DOT regulations in 49 CFR 172. Additionally, those containers with a capacity of 110 gallons or less will be labeled as follows, in accordance with DOT requirements in 49 CFR 172.304:

> HAZARDOUS WASTE – Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.
>
> Generator's Name and Address: ______________________________
>
> Manifest Document Number: ______________________________

Manifests will be prepared according to EPA requirements in 40 CFR 262.20. Acquisition, copies, and use of the manifest will be in accordance with EPA requirements in 40 CFR 262.21-23. The FWDA site representative will sign the manifest as the generator. The transporter, who will be fully licensed and insured to transport hazardous waste, will then sign the manifest and provide a copy to the FWDA BEC, USACE Technical Manager, and the Project Manager. Inventory forms at the less-than-90-day storage area will be annotated with the transport date and manifest number.

Concurrent with the manifest, a land disposal restriction (LDR) will be prepared in accordance with EPA requirements in 40 CFR 268.7 and submitted for review and signature by the FWDA site representative. The signed LDR will accompany each shipment of hazardous waste and serve as notification to the receiving TSDF of any requirements for treatment before land disposal.

4.5.2 Special Waste

In the event IDW classified as special waste is generated, it will be disposed of off site at a solid waste landfill authorized for disposal of such material. Containers will be labeled, manifested, and transported in accordance with NMED requirements in 20 NMAC 20.9.7 (NMAC, 2007b). Requirements for manifest signatures, distribution of copies, and annotation of inventory forms at the satellite storage areas will be the same as those for hazardous waste.

4.5.3 Non-Hazardous/Non-Regulated Waste

Sampling equipment, PPE, and general refuse will be disposed of in an approved on-installation dumpster. If large quantities of material are generated, the materials will be transported off site for disposal as municipal waste. Liquid IDW classified as non-hazardous waste will be transported off site and disposed of at an appropriate disposal facility.

5.0 DATA VALIDATION, REPORTING, AND PROJECT MANAGEMENT

A groundwater well installation report summarizing field activities conducted and analytical data results will be submitted. Analytical data received from the laboratory will be validated. The Contractor will prepare a Data Quality Summary Report (DQSR) that discusses the quality of the data, its usability, flagged data, rejected data, and an overall assessment of laboratory performance. The DQSR and a level II analytical data report from the laboratory will be an appendix to the well installation report. Also, a searchable electronic file (in Microsoft Excel or Microsoft Access) containing the analytical data collected during execution of this Work Plan will be included as an appendix to the report.

5.1 LABORATORY DATA REVIEW REQUIREMENTS

All analytical data generated by the laboratory will be verified before submittal to the project chemist. The internal data review process, which is multi-tiered, will include all aspects of data generation, reduction, and QC assessment. In each laboratory analytical section, the analyst performing the tests will review 100% of the definitive data. After the analyst review has been completed, 100% of the data will be reviewed independently by a senior analyst or by the supervisor of the respective analytical section using the same criteria.

Elements for review or verification at each level must include, but not be restricted to, the following.

- Sample receipt procedures and conditions
- Sample preparation
- Appropriate standard operating procedures and analytical methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established control limits
- Documentation completeness (for example, all anomalies in the preparation and analysis have been identified, appropriate corrective actions have been taken and documented in the case narrative[s], associated data have been appropriately qualified, and anomaly forms are complete)
- Accuracy and completeness of data deliverables (PDF and electronic).

5.2 ANALYTICAL DATA VERIFICATION AND VALIDATION

5.2.1 Data Verification

Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. It applies to both field and laboratory records. The objective of the data validation is to assess the performance associated with the analysis to determine the quality of the data.

Field data, records, logs, and other project generated documents will be subject to data review and verification. Discussions will summarize the findings of the data verification process in the well installation report.

5.2.2 Data Validation

Data validation will be accomplished by evaluating whether the collected data comply with the predefined project requirements (including method, procedural, or contractual requirements) and by comparing the collected data with criteria established based on the project quality objectives.

Analytical results will be subjected to 100% stage 2 validation at a minimum using automated data review (ADR) software. ADR output files will be entered into the FWDA electronic document management system database; 10% of the laboratory data packages will be subjected to stage 4 validation.

5.3 PROJECT REPORTING AND PROPOSED SCHEDULE

The expected schedule for conducting activities under this Work Plan follows.

Well installation field activities	Start within 45 days following completion of Parcel 3 HWMU removal field activities. Well installation and soil sampling will take approximately 12 weeks.
Initial groundwater sampling activities	Groundwater sampling activities will begin after newly installed wells are developed. Each sampling event will take approximately 7 days. The second sampling round will be conducted 60 days following the first sampling round.
Data analysis and evaluation	Standard 30-day turnaround for analytical laboratory analysis and 30-day turnaround for data validation (soil and groundwater).
Submit draft report	Submit draft report 30 days following completion of field activities under this Work Plan
Submit final report	Submit final report 30 days after receipt of USACE comments on draft report.

6.0 REFERENCES

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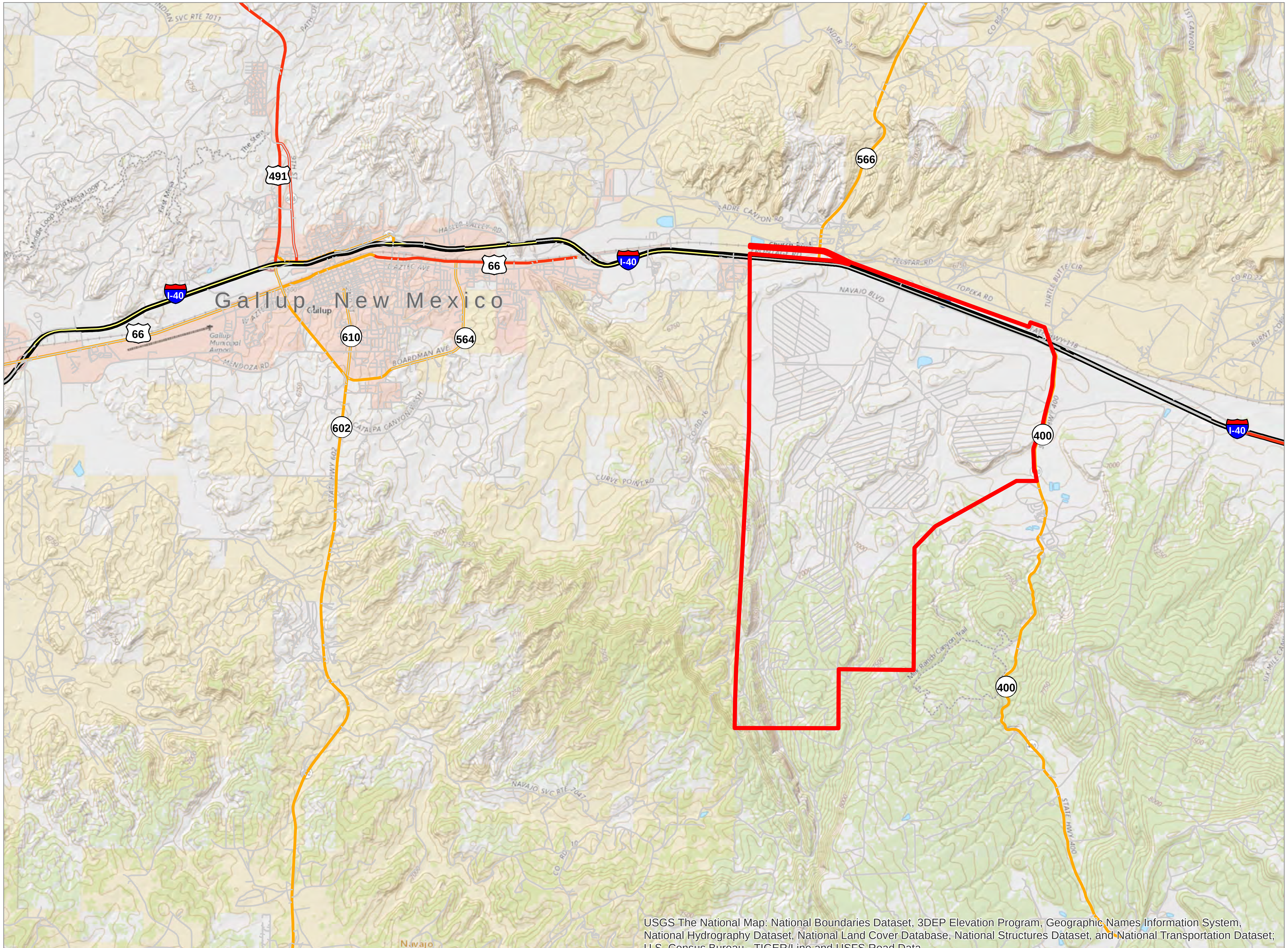
FIGURES



Legend

- FWDA Site Boundary
- Interstate
- US Highway
- State Highway
- County, Arterial Road

Notes

FWDA = Fort Wingate Depot Activity

N W E S

Kilometers: 0, 1, 2, 4

Miles: 0, 0.75, 1.5, 3

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 2-1

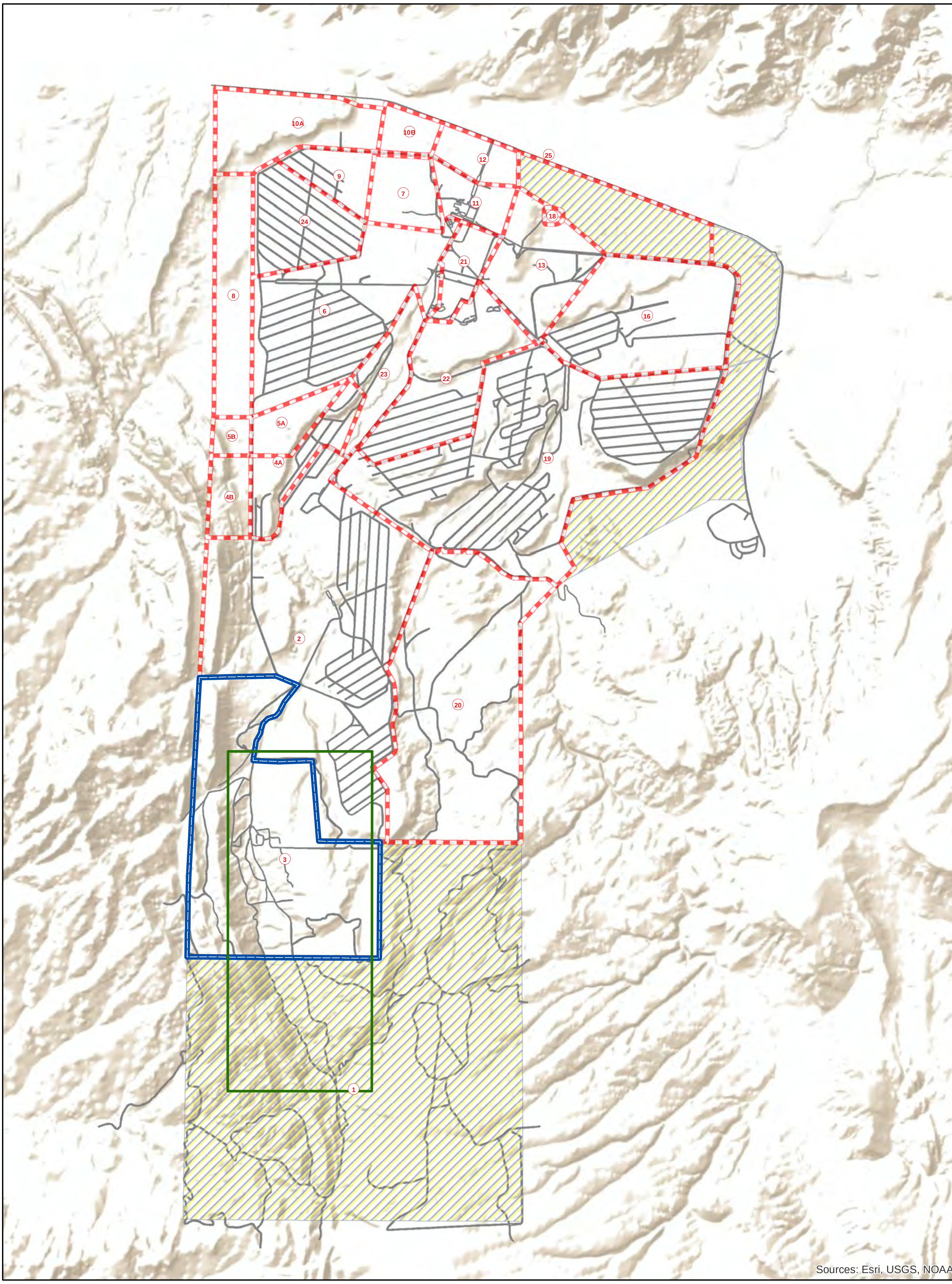
FWDA Site Location Map

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Author: L. Beasley Document Path: N:\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\Parcel 3\section1\Figure1-2_updated_background.mxd Document Name: Figure1-2_updated_background Updated on: 1/19/2018



Legend

Study Area

Parcel 3

FWDA Parcels

Transferred FWDA Property (includes Parcel 1)

Roads

Notes

FWDA = Fort Wingate Depot Activity

N W E S

0 2,050 4,100 8,200

Feet

0 0.5 1 2

Miles

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 2-2

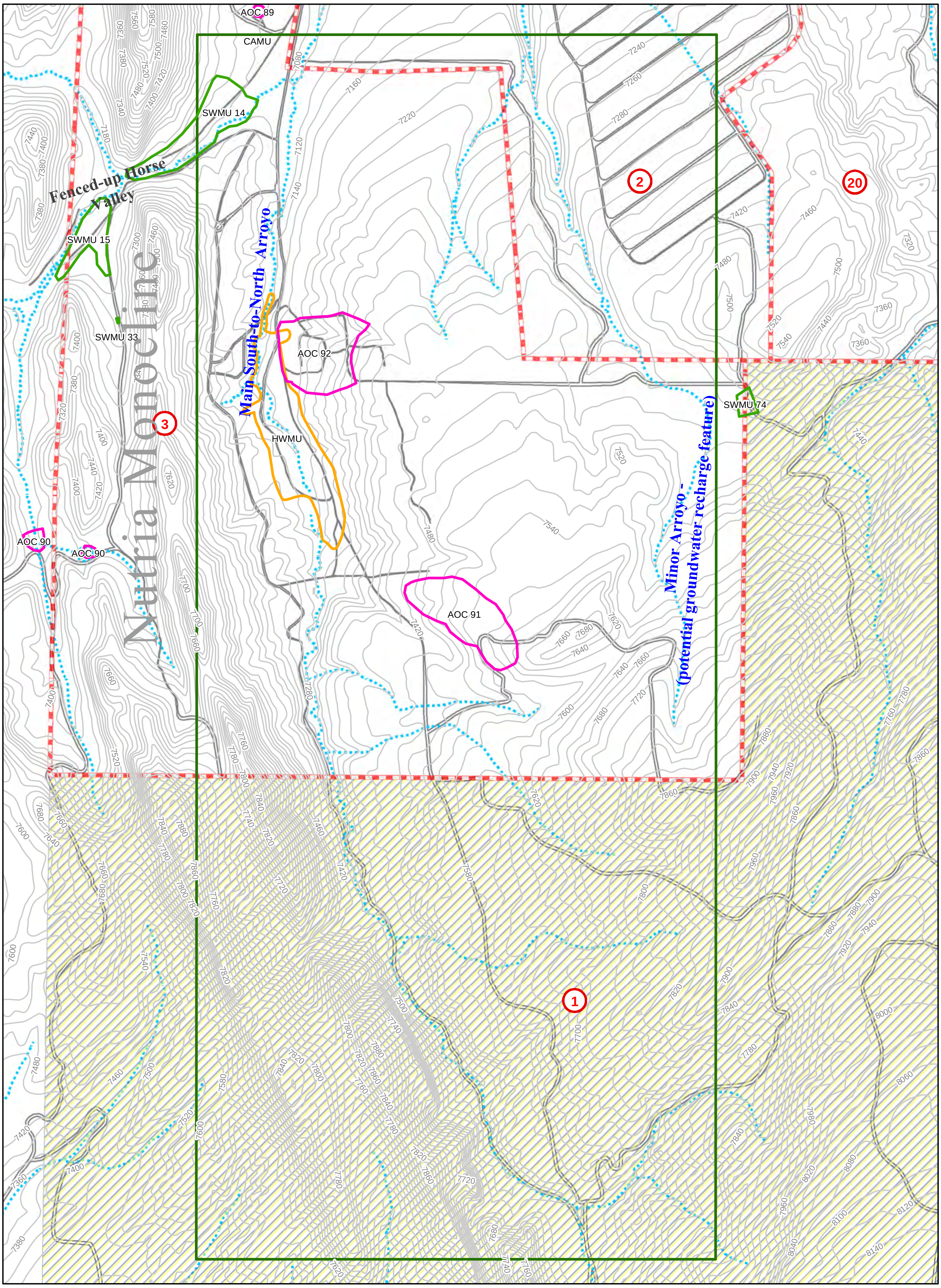
FWDA Parcel Locations and Study Area Map

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Author: L. Beasley Document Path: \\abq-dc2\DataFiles\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\Figure_2-2_ParcelLocationMap.mxd Updated on: 10/18/2019



Legend

- AOCs
- HWMU
- SWMUs
- Study Area
- Contours
- FWDA Parcels
- Transferred FWDA Property (includes Parcel 1)
- Arroyo
- Roads

Notes

AOC = Area of Concern
FWDA = Fort Wingate Depot Activity
HWMU = Hazardous Waste Management Unit
SWMU = Solid Waste Management Unit

N W E S

0 0.125 0.25 0.5
Miles

0 550 1,100 2,200
Feet

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 2-3

Elevation Contour Map

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

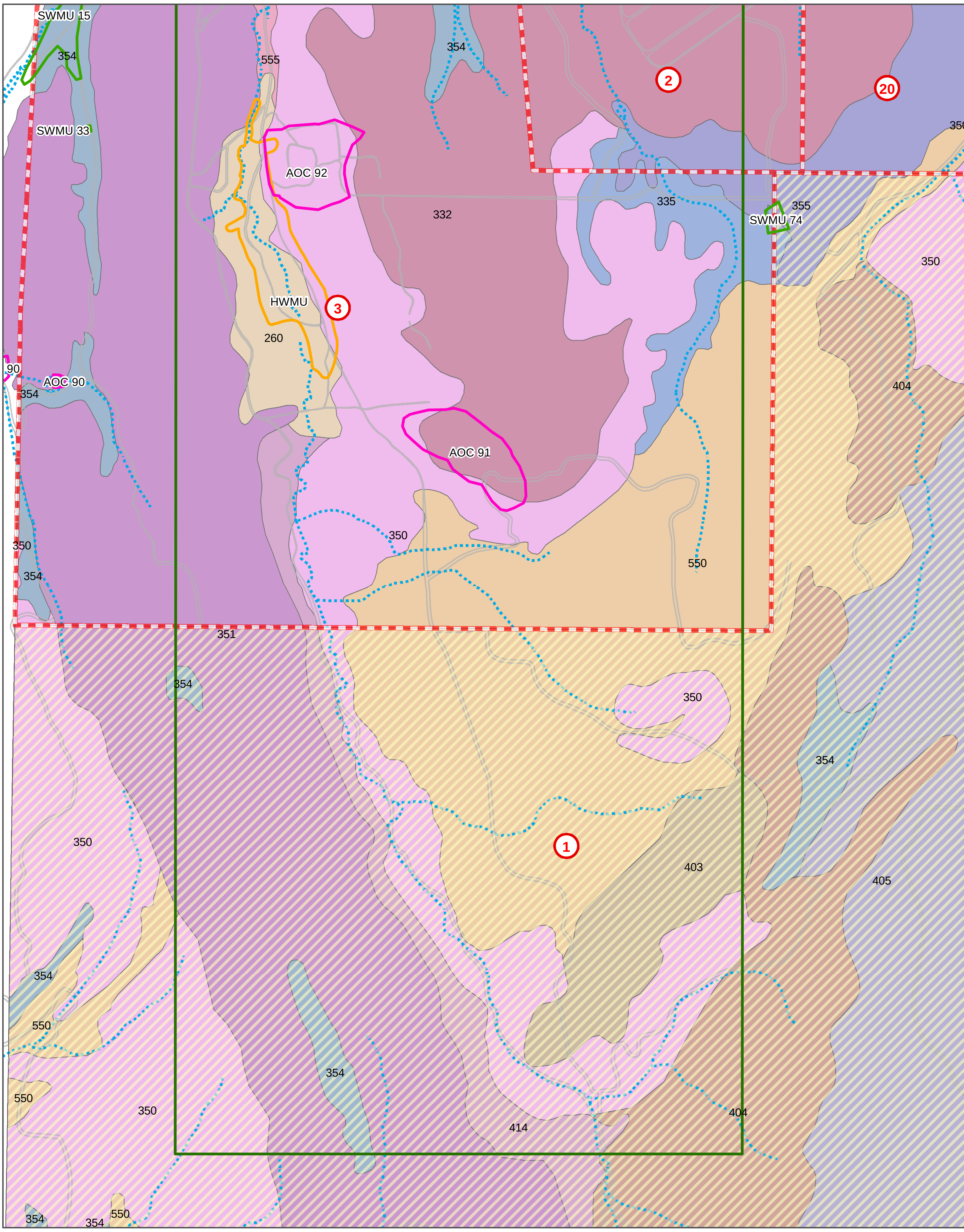
Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Updated on: 10/18/2019Author: Luke Beasley Document Path: \\abq-dc2\DataFiles\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\Figure 2-3 Topographic map_mb.mxd Document Name: Figure 2-3 Topographic map_mb

Soil Legend

- 260, QUARRIES AND PITS/DEMOLITION
- 332, EVPARK-ARABRAB COMPLEX
- 335, VENADITO CLAY
- 350, TOLDOHN-VESSILLA-ROCK OUTCROP COMPLEX
- 351, ROCK OUTCROP-VESSILLA COMPLEX
- 354, KNIFEHILL LOAM
- 355, ROCK OUTCROP-RIZNO-TEKAPO COMPLEX
- 403, VALNOR-TECHADO COMPLEX
- 404, ROCK OUTCROP-TECHADO-STOZUNI COMPLEX
- 405, LOSEGATE-OWLROCK COMPLEX
- 414, ZUNALEI-CORZUNI LOAMY FINE SANDS
- 550, BRYWAY-GALZUNI LOAMS
- 555, PARKELEI-EVPARK FINE SANDY LOAM



Legend

- AOCs
- HWMU
- SWMUs
- Transferred FWDA Property (includes Parcel 1)
- Arroyo
- Roads
- Study Area
- FWDA Parcels

Notes

AOC = Area of Concern
FWDA = Fort Wingate Depot Activity
HWMU = Hazardous Waste Management Unit
SWMU = Solid Waste Management Unit

N, W, E, S

0 485 970 1,940
Feet

0 0.125 0.25 0.5
Miles

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Soil data provided from the Natural Resources Conservation Service (NRCS).

Figure 2-4

Soils Map

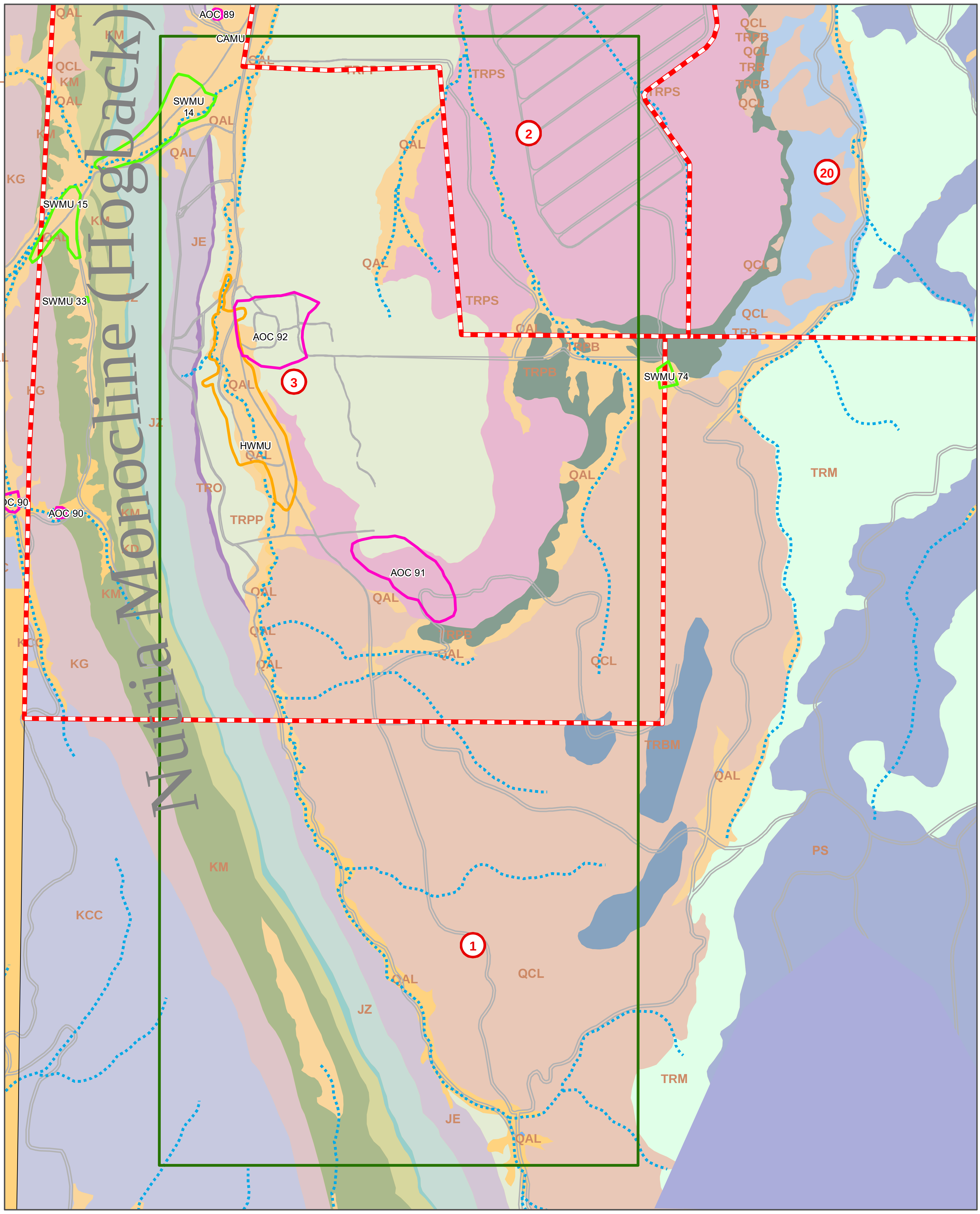
Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Updated on: 10/18/2019Author: Luke Beasley Document Path: \\abq-dc2\DataFiles\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\Figure_2-4_SoilsMap.mxd Document Name: Figure_2-4_SoilsMap

Surface Geology

JE- Entrada Sandstone	KD-Dakota Sandstone	QCL-Quarternary Colluvial Deposits	PS-San Andreas Limestone
JM-Morrison Formation	KG-Gallup Sandstone	TRB-Bluewater Creek Formation	TRPB-Petrified Forest Formation-Blue Mesa Member
JZ-Zuni Sandstone	KM-Mancos Shale	TRBM-Bluewater Creek Formation Member	TRPP-Petrified Forest Formation - Painted Desert Memeber
KCC-Crevasse Canyon Formation	QAL-Quarternary Alluvial Deposits	TRO-Owl Rock Formation	TRPS-Petrified Forest Formation-Sonsela Sandstone Member
			TRM-Shinarump Formation and Moenkopi Formation Divided



Legend

- AOCs
- HWMU
- SWMUs
- Study Area
- FWDA Parcels
- Arroyo
- Roads
- Parcel 1 - Transferred Property

Notes

AOC = Area of Concern
FWDA = Fort Wingate Depot Activity
HWMU = Hazerdous Waste Management Unit
SWMU = Solid Waste Management Unit

N W E S

0 550 1,100 2,200
Feet

0 0.15 0.3 0.6
Miles

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 2-5

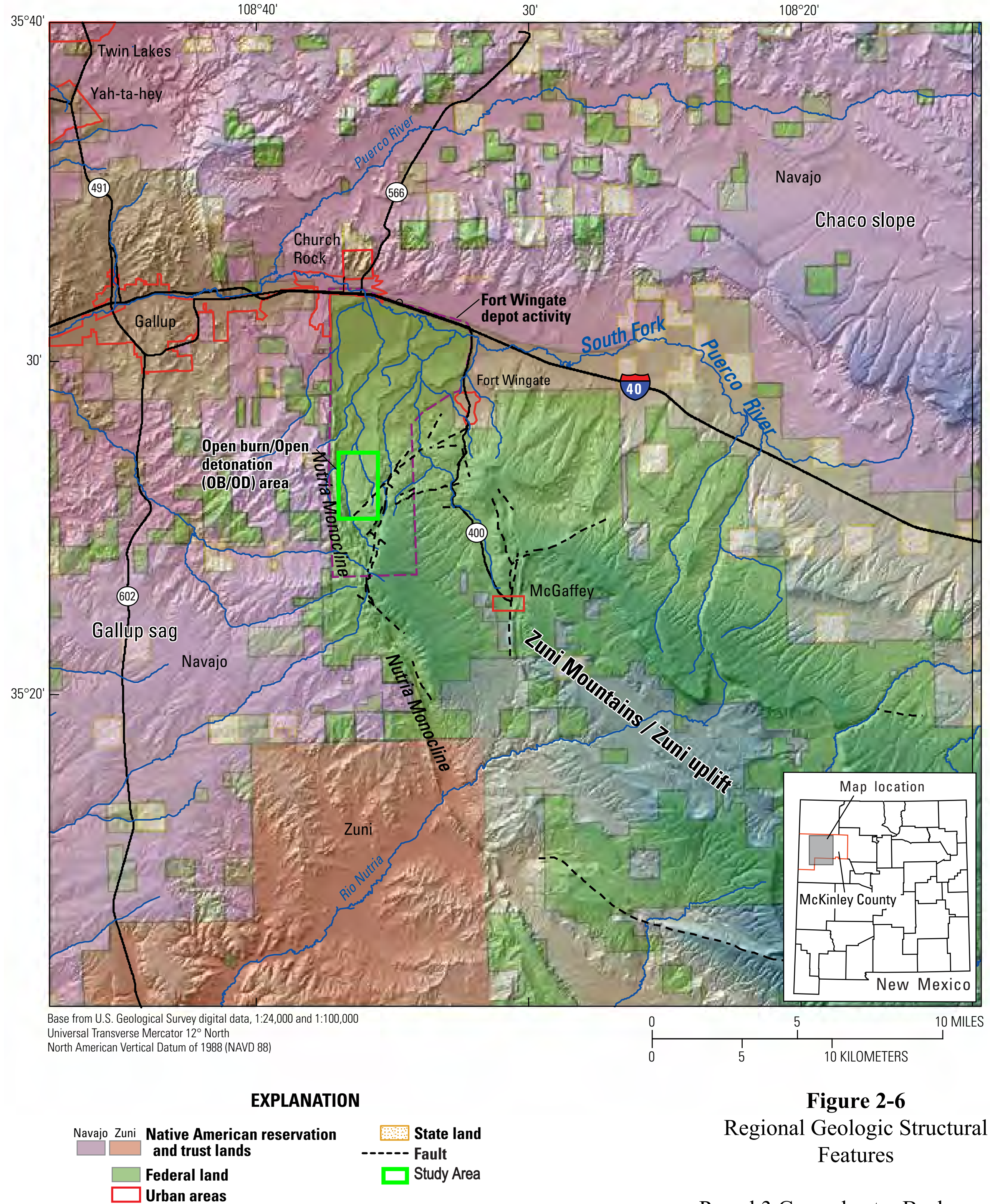
Geologic Map

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Updated on: 10/18/2019Author: Luke Beasley Document Path: \\abq-dc2\DataFiles\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\Figure 2-5_GeologicMap.mxd Document Name: Figure 2-5_GeologicMap



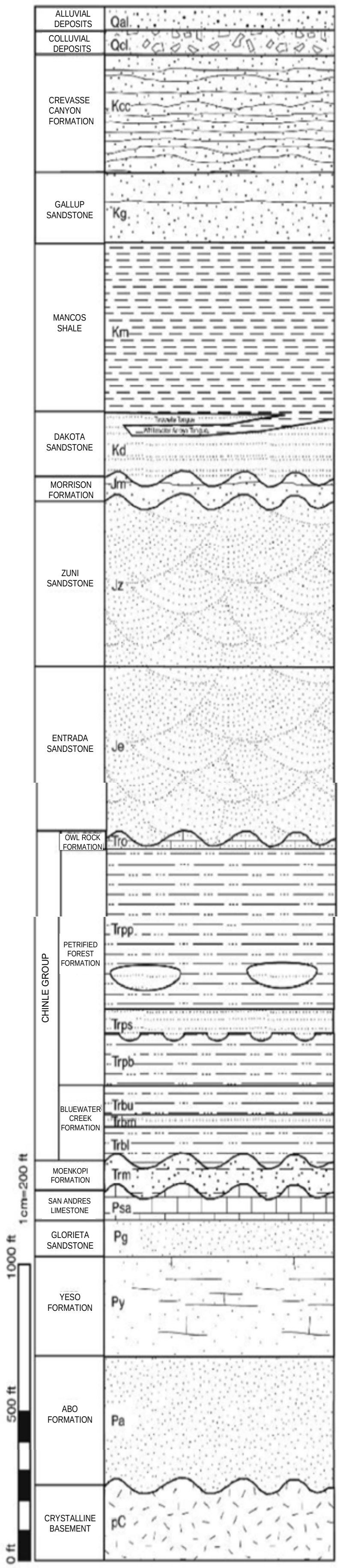
Adapted and altered from Figure 1, *Location of Fort Wingate Depot Activity, New Mexico*. USGS, 2009. *Geochemical Evidence of Groundwater Flow Paths and the Fate and transport of Constituents of Concern in the Alluvial Aquifer at Fort Wingate Deport Activity, New Mexico*. United States Geological Survey for the United States Army Corps of Engineers, 2009.

Figure 2-6
Regional Geologic Structural Features

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.



Description of Units

Qal - Alluvial deposits (Quaternary); sand, gravel, and clay in young valleys and drainages

Qcl – Colluvial deposits (Quaternary); landslides, and cobble deposits in young valleys and on steep slopes

Kcc – Crevasse Canyon Formation (Upper Cretaceous, 88 Ma); mudstone, shale, very fine- to medium-grained sandstone, carbonaceous shale, and thin lenticular coal beds; outcrops in southwest corner only; 400 feet thick

Kg – Gallup Sandstone (Upper Cretaceous, 90 Ma); tan to pale-orange, medium-grained, well-sorted calcareous sandstone, silty-sandstone, and coaly-carbonaceous layers; three prominent ridge-forming sandstone layers (<20 feet) are separated by silty, and carbonaceous intervals (<8 feet); sandstone layers have only minor amounts of cement and minimal matrix material resulting in high apparent-permeability; <220 feet thick

Km – Mancos Shale (Upper Middle Cretaceous, 97-90 Ma); light to dark-grey and mudstone, silty-mudstone, and shale; minor amounts of lenticular sandy-siltstone, limestone, and calcareous-sandstone present in upper portions; sandy layers have abundant cement and ultrafine matrix resulting in very low apparent-permeability; the Whitewater Arroyo Tongue of the Mancos Shale is inter-tongued with and underlies the Towels Tongue of the Dakota Sandstone, abundant fossil corrals and cephalopods in Whitewater Arroyo Tongue; <600 feet thick, excluding the Whitewater Arroyo Tongue which varies in thickness from 0-80 feet.

Kd – Dakota Sandstone (Upper Middle Cretaceous, 97-90 Ma); tan to pale-yellow, fine- to medium-grained, sub-angular to well-rounded, grain-supported sandstone; small amounts of matrix and grain support result in a very high apparent-permeability; Towels Tongue of Dakota Sandstone is inter-tongued with and overlies the Whitewater Arroyo Tongue of the Mancos Shale; basal contact of Dakota Sandstone unconformably overlies an irregular erosional surface developed in the Morrison Formation; <230-310 feet thick including the Whitewater Arroyo Tongue

Jm – Morrision Formation (Upper Jurassic, 160-145 Ma); greyish-white to pale-orange, subangular to well-rounded, fine- to coarse-grained sandstone and conglomeratic-sandstone; trough cross-stratification locally; clay-rich fine-grained intervals present near upper contact highly variable apparent-permeability; variable thickness possibly due to bedding-plane slip along monoclonal fold axis; <65 feet thick in northern part of base, thinning to <20 feet to the south

Jz – Zuni Sandstone (Middle Jurassic, 170-165 Ma); white, pink, and reddish-orange, well-rounded, clast-supported, fine- to very-fine-grained sandstone and silty-sandstone; horizontal color banding common; crossbedding in relatively thin sets (compared to Entrada Sandstone); siltier intervals correlate to shallow slopes and cleaner intervals correlate to steep slopes; very high apparent-permeability; <620 feet thick

Je – Entrada Sandstone (Middle Jurassic, 170-165 Ma); red, and pinkish-grey, moderately-rounded, matrix supported, fine- to medium-grained sandstone; large-scale crossbedding; less competent than Zuni Sandstone; calcareous cement; very high apparent-permeability; <650 feet thick

Tro – Owl Rock Formation (Upper Triassic, 225-210 Ma); white, greyish-pink, and orange, crystalline-limestone, sandy-limestone, and calcareous-sandstone; variable thickness possibly due to bedding plane slip along monoclonal fold axis; <30 feet thick

Trpp - Petrified Forest Formation, Painted Desert Member (Middle Triassic, 225-210 Ma); purplish-red, orangish-red and rust coloured, mudstone, siltstone, sandstone, and sandstone-conglomerate; sandstone intervals (<20 feet) have tabular and trough cross beds, abundant ultrafine matrix, and are generally dirty resulting in low apparent-permeability; abundant 1-2 cm greenish grey calcrete nodules present forming a distinctive mottled or speckled surface; shallow (<6 feet) channel deposits with inter-formational conglomerates containing mudstone and carbonate clasts; lenticular bodies of sandstone with similar lithology to the Sonsela Sandstone are laterally discontinuous; <600 feet thick

Trps - Petrified Forest Formation, Sonsela Sandstone Member (Middle Triassic, 225-210 Ma); yellow, tan, and olive-coloured, well-rounded, clast-supported, medium- to coarse-grained sandstone and conglomeratic-sandstone; conglomeratic intervals containing intra-formational (mudstone, carbonate) and extra-formational (chert, quartzite) clasts; thin crossbedding common; minimal matrix and grain support result in very high apparent-permeability; <100 feet thick, highly-variable thickness typical of large-scale channel deposits

Trpb - Petrified Forest Formation, Blue Mesa Member (Middle Triassic, 230-225 Ma); purple, and purplish-red, mudstone, and muddy sandstone, mudstones are smectitic; light-grey sandy-smectitic-siltstone interval (<8 feet) serves as marker bed for the base of the Petrified Forest Formation; high quantity of ultrafine matrix results in a very low apparent-permeability; petrified wood very common in upper portions; <280 feet thick

Trbu - Bluewater Creek Formation, Upper Member (Upper Triassic, 230-225 Ma); pinkish-grey to reddish-brown siltstone and mudstone; calcrete nodules present locally; high silt and ultrafine matrix result in low apparent-permeability; <100 feet thick

Trbm- Bluewater Creek Formation, McGaffey Member (upper Triassic, 230-225 Ma); white, pale-red and grey, medium-grained, ripple-laminated sandstone; color banding common; basal interval has carbonated-clast-conglomerate; calcareous cement; high apparent-permeability; <80 feet thick, highly-variable thickness typical of large-scale channel deposits, locally not recognized

Trbl - Bluewater Creek Formation, Lower Member (Middle to Upper Triassic, 240-225 Ma); yellowish-grey, and reddish-brown mudstone and siltstone; calcrete nodules are present locally; low apparent-permeability; <115 feet thick

Trm - Shinarump Formation and Moenkopi Formation Undivided (Middle Triassic, 240-225 Ma); Shinarump Formation is purple and reddish-grey, mottled chert- and quartzite-pebble-conglomerate and conglomeratic-sandstone with reddish-brown matrix; Moenkopi is red, tan, and black calcareous-mottled-sandstone and calcareous-mudstone; massive to thinly-laminated and ripple-laminated siltstone and very fine-grained sandstones; 30-200 feet thick combined

Psa - San Andres Limestone (Middle Permian, 275-250 Ma); grey and white, fossiliferous, crystalline-limestone and dolomitic-limestone; locally absent due to karsting; <165 feet thick

Pg - Glorieta Sandstone (280-275 Ma); greyish-orange to orange, well-sorted, moderate- to well-rounded, fine- to medium-grained quartzose-sandstone; horizontal and low-angle crossbedding locally; <130 feet thick

Py - Yeso Formation (280-275 Ma); dark-orange to reddish-oranged, very fine-grained gypsiferous-sandstone and silty-sandstone; three light-grey, dolomitic, carbonate beds present in formation; <375 feet thick

Pa - Abo Formation (280-275 Ma); greyish-red, very fine-grained silty-sandstone; non-calcareous; flat-bedded; basalt 3-12 feet are arkosic; <450 feet thick

pC - Precambrian Basement; typically granitic, to dioritic-igneous and metamorphic rocks

Notes

< = less than
cm = centimeters
FWDA = Fort Wingate Depot Activity
Ma = mega-annum (million years) R

Definitions apply to geologic formations found on Figure 2-5 of this Well Installation Work Plan.

Adapted from TerranearPMC, 2006, Supplemental Groundwater Investigation – Administration and TNT Leaching Beds Areas, Submitted to the FWDA 24 March 2006

Figure 2-7

Stratigraphic Column

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

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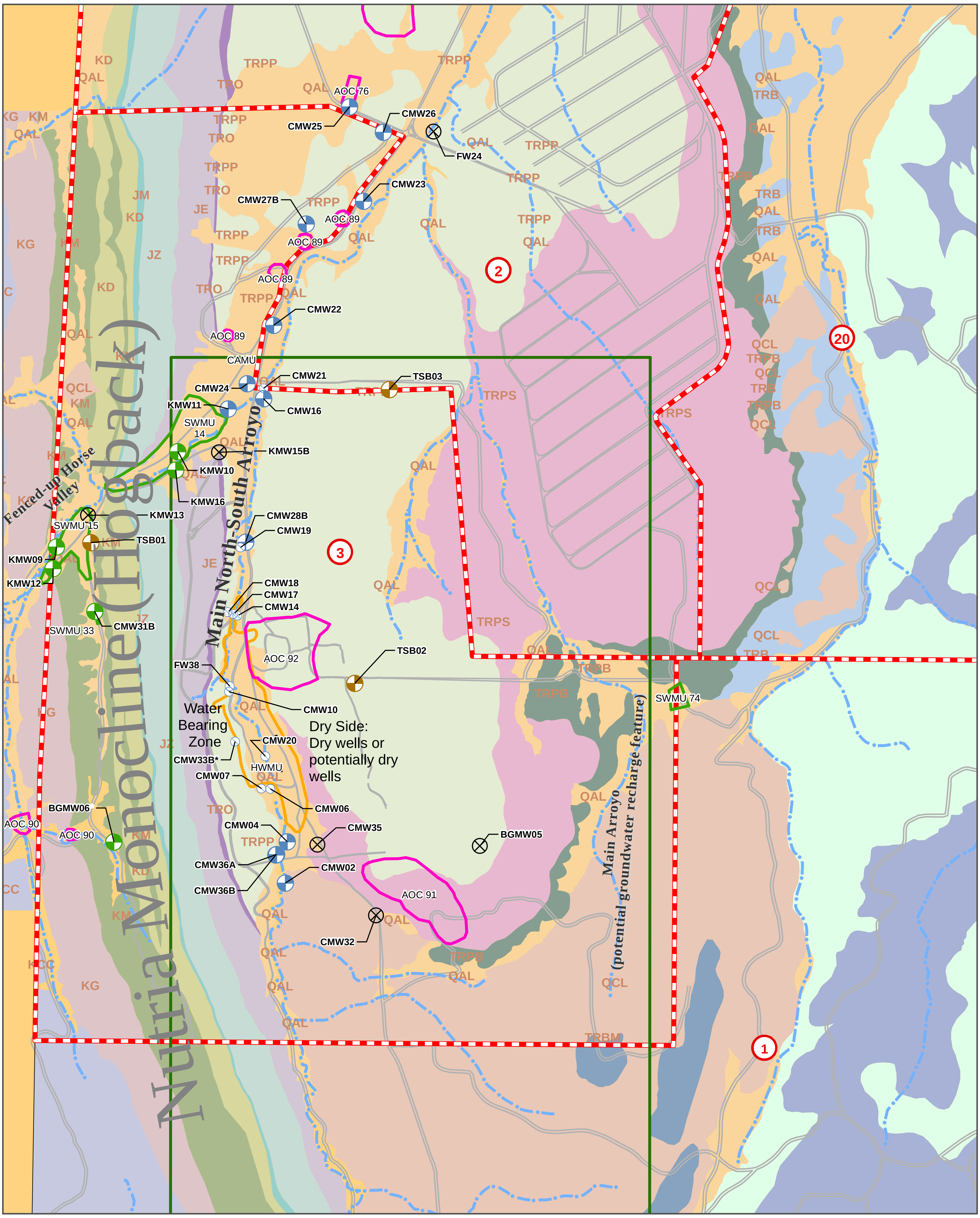
Surface Geology

JE- Entrada Sandstone	KD-Dakota Sandstone	QCL-Quaternary Colluvial Deposits	TRPB-Petrified Forest Formation-Blue Mesa Member
JM-Morrison Formation	KG-Gallup Sandstone	TRB-Bluewater Creek Formation	TRPP-Petrified Forest Formation - Painted Desert Memeber
JZ-Zuni Sandstone	KM-Mancos Shale	TRBM-Bluewater Creek Formation Member	TRPS-Petrified Forest Formation-Sonsela Sandstone Member
KCC-Crevasse Canyon Formation	QAL-Quaternary Alluvial Deposits	TRO-Owl Rock Formation	



Legend

- Arroyo
- Roads
- Abandoned Well
- East Hogback Well
- West Hogback Well
- Exploratory Soil Boring
- Dry Well
- AOCs
- HWMU
- SWMUs
- Study Area
- FWDA Parcels

Notes

Dry Line is estimated extent from the main arroyo where groundwater is located. Groundwater located in proximity to arroyo.

AOC = Area of Concern
FWDA = Fort Wingate Depot Activity
HWMU = Hazardous Waste Management Unit
SWMU = Solid Waste Management Unit

N W E S

0 550 1,100 2,200 Feet

0 0.125 0.25 0.5 Miles

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 2-8

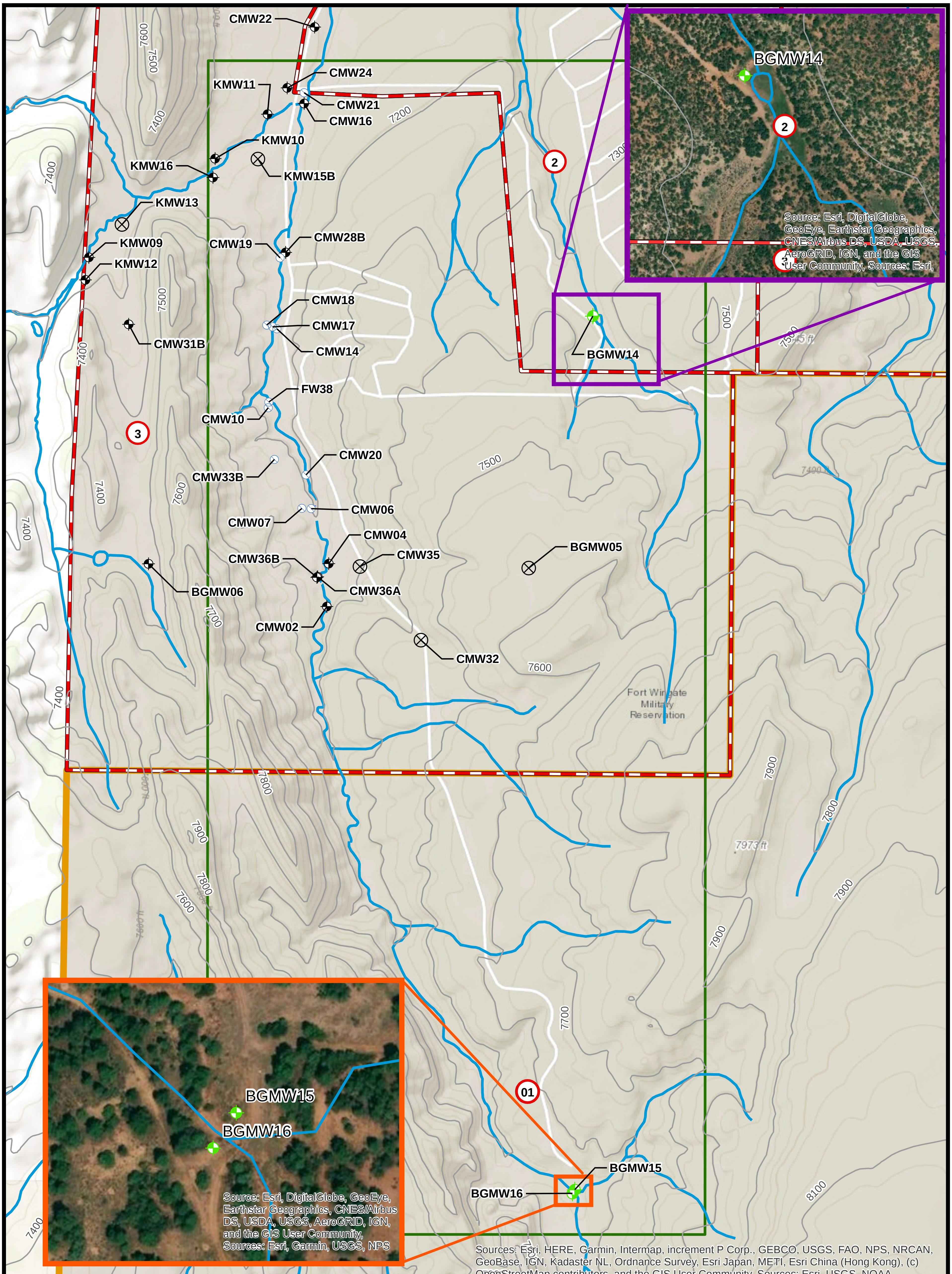
Hydrogeologic Map

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Updated on: 3/9/2020 Document Path: N:\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\Figure_2-8_HydrogeologicMap.mxd Document Name: Figure_2-8_HydrogeologicMap



Legend

- Drainage Arroyos
- Elevation Contours
- Proposed Well Location
- Abandoned Well
- Existing Well
- Dry Well
- FWDA Parcel Boundaries
- Transferred FWDA Property (Parcel 1)

Notes

FWDA = Fort Wingate Depot Activity

0 0.25 0.5
Miles

0 1,100 2,200
Feet

N W E S

Coordinate System:
NAD 1983 StatePlane New Mexico West FIPS 3003 Feet

Figure 3-1

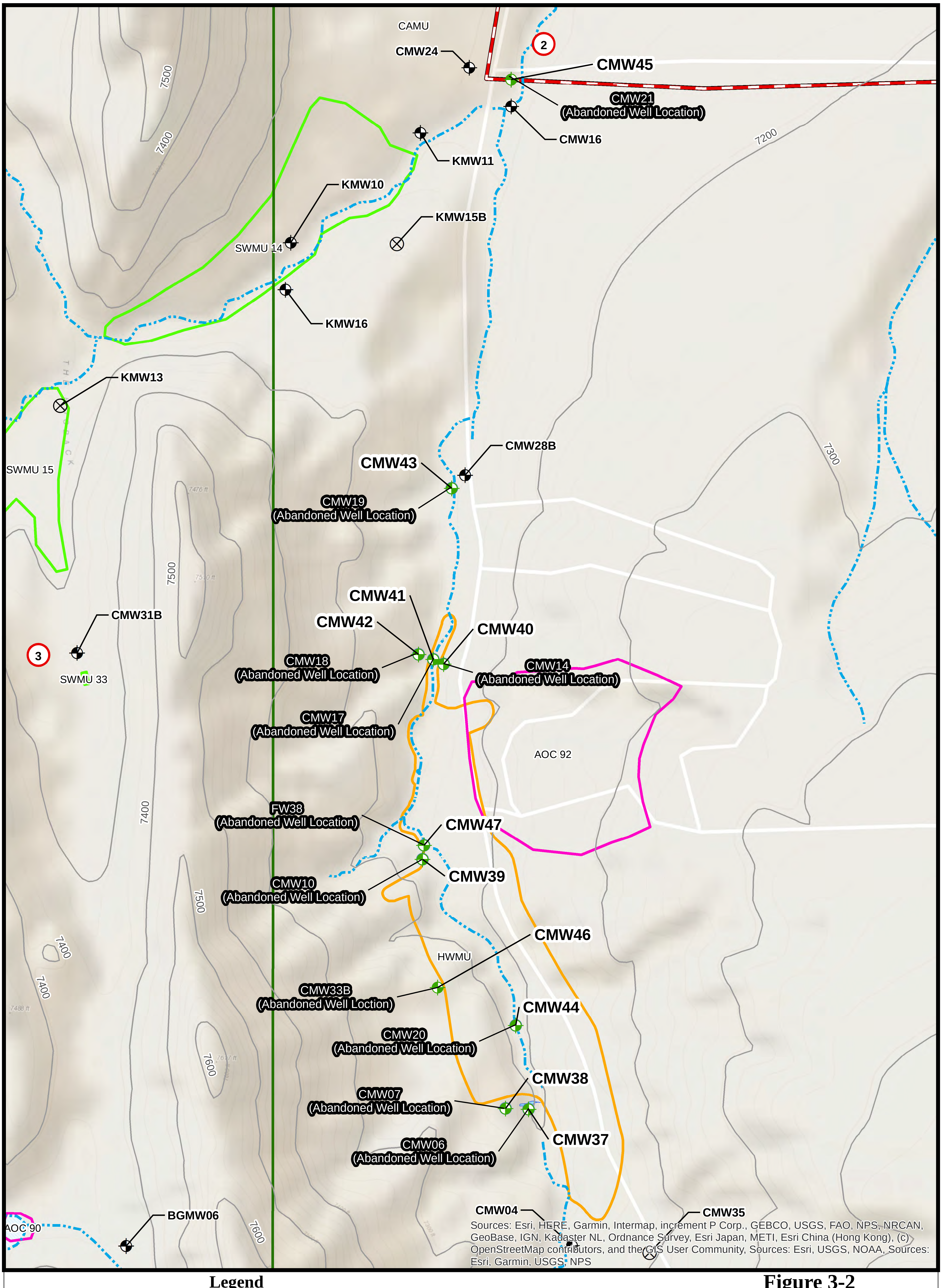
Proposed Background Well Locations

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Sundance Consulting Inc.

Updated on: 3/10/2020Document Path: N:\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\Figure_3-1_ProposedBkgrnd.mxd



Legend

- Elevation Contours
- Drainage Arroyos
- Proposed Replacement Monitoring Wells
- Dry Well
- Existing Well
- Study Area
- AOCs
- HWMU
- SWMUs
- FWDA Parcel Boundaries

N W E S

Scale: 0 – 0.1 – 0.2 Miles; 0 – 450 – 900 Feet

Notes

FWDA = Fort Wingate Depot Activity
Proposed wells are in the same location as the abandoned wells. Well numbers for abandoned wells and the corresponding replacement wells are shown for each well location.

Coordinate System:
NAD 1983 StatePlane
New Mexico West FIPS 3003 Feet

Figure 3-2

Proposed Replacement Well Locations

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Updated on: 3/10/2020Document Path: N:\Fort_Wingate\FortWingate_Groundwater\GIS_Projects\P3_Well_Install_WP\Figure_3-2_ReplacementWells_SN.mxd

-- Figure is not to scale --

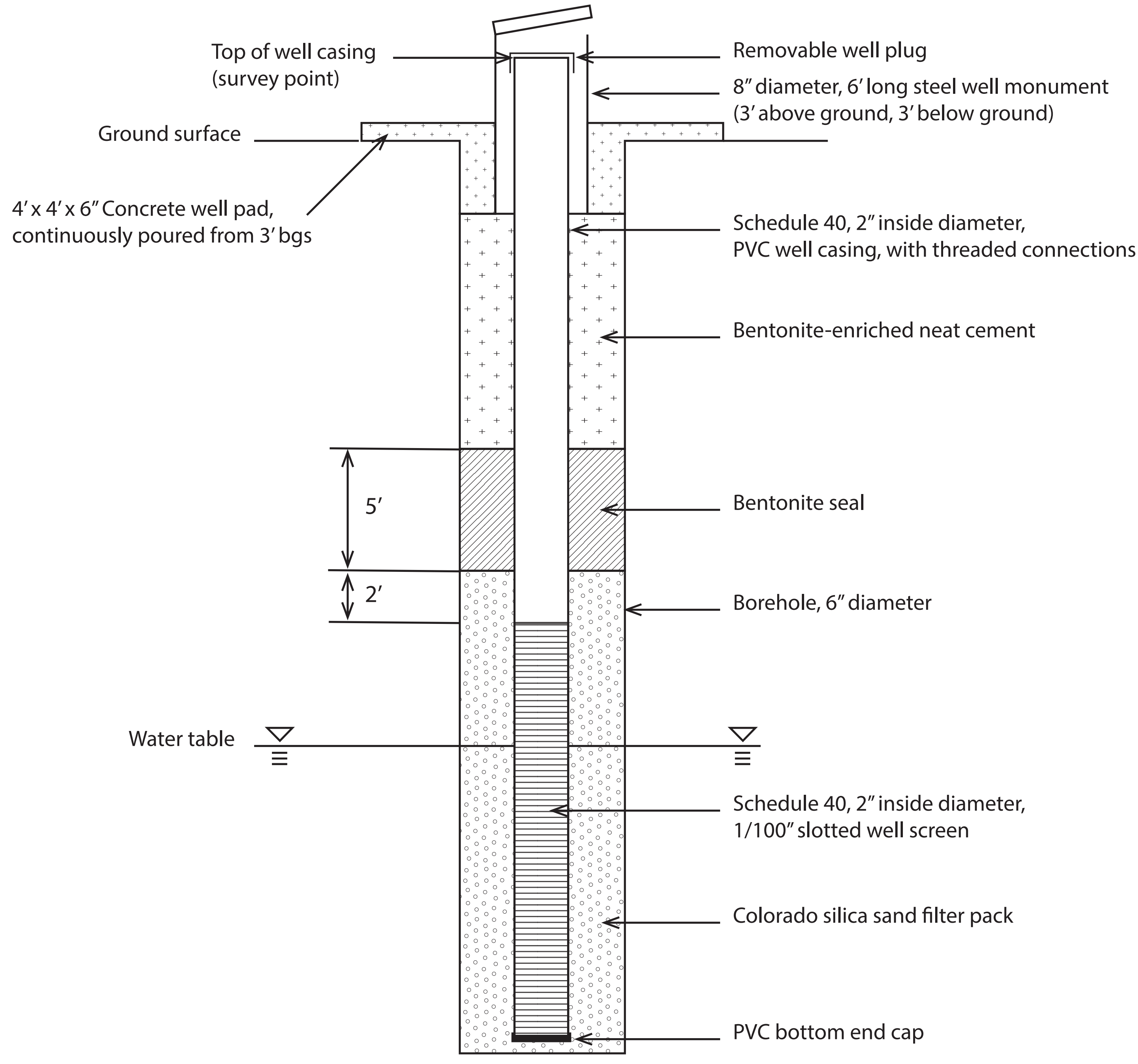


Figure 3-3
Schematic of Proposed Well Construction

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

Modified from Monitoring Well Guidelines Revision 1.1 (NMED, 2011)

FORT WINGATE
CARETAKERS
90-DAY FACILITY CHECK SHEET

CONTAINER NUMBER	NOMENCLATURE DESCRIPTION	START DATE	CHARACTERIZATION STATUS

CARETAKER SIGNATURE: **DATE:**

Figure 4-1

Sample IDW Inventory Form

Parcel 3 Groundwater Background Wells and Replacement Monitoring Wells Installation Work Plan,

Fort Wingate Depot Activity
McKinley County, New Mexico

TABLES

Table 3-1: Proposed Background Well Construction Detail

Proposed Background Well ID	FWDA Parcel	Drilling Method	Northing[a]	Easting[a]	Proposed Well Depth (ft bgs)	Boring Diameter (in)	Casing Diameter (in)	Casing/ Screen Type	Proposed Screen Length (ft)	Proposed Screened Interval (ft bgs)
BGMW14	2	Sonic	1613477.48	2489087.84	75.00	6.00	2.00	PVC	20.0	55.0 - 75.0
BGMW15	1	Sonic	1613481.11	2488966.19	65.00	6.00	2.00	PVC	20.0	45.0 - 65.0
BGMW16	1	Sonic	1614801.68	2488525.71	65.00	6.00	2.00	PVC	20.0	45.0 - 65.0

Notes:
[a] Horizontal coordinate system: NM NAD83 State Plane West

Acronyms and Abbreviations:
bgs = below ground surface
ft = foot / feet
ID = idendification
in = inch / inches
NAD83 = North American Datum of 1983
NM = New Mexico
PVC = polyvinyl chloride
Sonic = sonic drilling method

Table 3-2: Replacement Monitoring Well Construction Detail

Replacement Well ID	Abandoned Well ID	FWDA Parcel	Drilling Method	Northing[a]	Easting[a]	Previous Ground Elevation (ft amsl)[b]	Well Depth (ft bgs)	Previous Boring Diameter (in)	Proposed Boring Diameter (in)	Casing Diameter (in)	Casing/ Screen Type	Proposed Screen Length (ft)	Previous Screened Interval (ft bgs)	Proposed Screened Interval (ft amsl)	Screened Formation
CMW37	*CMW06*	3	Sonic	1613477.48	2489087.84	7214.13	18.6+	4.00	6.00	2.00	PVC	10.0	8.3 - 18.3	7204-7194	Alluvium
CMW38	*CMW07*	3	Sonic	1613481.11	2488966.19	7233.04	65.80	8.00	6.00	2.00	PVC	20.0	44.0 - 64.0	7188-7168	Painted Desert Member
CMW39	CMW10	3	Sonic	1614801.68	2488525.71	7177.40	70.85	8.00	6.00	2.00	PVC	20.0	50.5 - 70.5	7126-7106	Painted Desert Member
CMW40[c]	*CMW14*	3	Sonic	1615835.54	2488638.31	7151.34	94.55	9.00	6.00	2.00	PVC	10.0	84.2 - 94.2	7066-7056	Painted Desert Member
CMW41	*CMW17*	3	Sonic	1615860.63	2488582.47	7143.72	53.00	8.00	6.00	2.00	PVC	20.0	32.0 - 52.0	7111-7091	Painted Desert Member
CMW42	*CMW18*	3	Sonic	1615886.04	2488504.59	7156.24	53.00	8.00	6.00	2.00	PVC	20.0	32.0 - 52.0	7124-7104	Painted Desert Member
CMW43	CMW19	3	Sonic	1616766.18	2488680.46	7128.11	52.80	8.00	6.00	2.00	PVC	15.0	33.5 - 48.5	7093-7078	Painted Desert Member
CMW44	*CMW20*	3	Sonic	1613921.71	2489020.26	7193.14	5.8+	4.00	6.00	2.00	PVC	3.0	2.5 - 5.5	7189-7186	Painted Desert Member
CMW45	*CMW21*	3	Sonic	1618931.48	2488996.15	7192.70	74.50	6.00	6.00	2.00	PVC	10.0	57.0-67.0	7025-7015	Sonsela Member
CMW46[c]	*CMW33B*	3	Sonic	1614122.30	2488606.09	7231	155.00	6.00	6.00	2.00	PVC	20.0	135-155	7096-7076	Sonsela Member
CMW47	*FW38*	3	Sonic	1614875.40	2488533.75	7169.43	7.5+	3.00	6.00	2.00	PVC	ND	ND	ND	Alluvium

Notes:

[a] Horizontal coordinate system: NM NAD83 State Plane West

[b] Vertical coordinate system: NAVD88

[c] monitoring well planned total depth is greater than 80 feet bgs. Well will utilize schedule 80 PVC.

Monitroing wells will be constructed with schedule 40 PVC unless otherwise noted.

yellow highlight = due to shallow intervals of the abandoned well, the proposed well likely will be advanced to a deeper total depth to reach a viable water bearing zone.

Acronyms and Abbreviations:

amsl = above mean sea level
bgs = below ground surface
ft = foot / feet
ID = idendification
in = inch / inches
NAD83 = North American Datum of 1983
NAVD88 = North American Vertical Datum of 1988
NM = New Mexico
PVC = polyvinyl chloride
Sonic = sonic drilling method

Table 3-3: Subsurface Soil Sample Matrix

Soil Boring Name	# of Field Samples[a]	Sample IDs[b]	VOCs	SVOCs	Explosives	TAL Metals	Nitrate/ Nitrite	Perchlorate	PCBs	Cyanide	Dioxins/ Furans
BGMW14	3	02BGMW14SB-D01-0003-SO; 02BGMW14SB-D02-xxxx-SO; 02BGMW14SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
BGMW15	3	01BGMW15SB-D01-0003-SO; 01BGMW15SB-D02-xxxx-SO; 01BGMW15SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
BGMW16	3	01BGMW16SB-D01-0003-SO; 01BGMW16SB-D02-xxxx-SO; 01BGMW16SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW37	3	03CMW37SB-D01-0003-SO; 03CMW37SB-D02-xxxx-SO; 03CMW37SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW38	3	03CMW38SB-D01-0003-SO; 03CMW38SB-D02-xxxx-SO; 03CMW38SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW39	3	03CMW39SB-D01-0003-SO; 03CMW39SB-D02-xxxx-SO; 03CMW39SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW40	3	03CMW40SB-D01-0003-SO; 03CMW40SB-D02-xxxx-SO; 03CMW40SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW41	3	03CMW41SB-D01-0003-SO; 03CMW41SB-D02-xxxx-SO; 03CMW41SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW42	3	03CMW42SB-D01-0003-SO; 03CMW42SB-D02-xxxx-SO; 03CMW42SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW43	3	03CMW43SB-D01-0003-SO; 03CMW43SB-D02-xxxx-SO; 03CMW43SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW44	3	03CMW44SB-D01-0003-SO; 03CMW44SB-D02-xxxx-SO; 03CMW44SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW45	3	03CMW45SB-D01-0003-SO; 03CMW45SB-D02-xxxx-SO; 03CMW45SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 3-3: Subsurface Soil Sample Matrix

Soil Boring Name	# of Field Samples[a]	Sample IDs[b]	VOCs	SVOCs	Explosives	TAL Metals	Nitrate/ Nitrite	Perchlorate	PCBs	Cyanide	Dioxins/ Furans
CMW46	3	03CMW46SB-D01-0003-SO; 03CMW46SB-D02-xxxx-SO; 03CMW46SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW47	3	03CMW47SB-D01-0003-SO; 03CMW47SB-D02-xxxx-SO; 03CMW47SB-D03-xxxx-SO	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total field samples	**42**										
Total duplicate samples[a]	**5**										
Total matrix spike samples[a]	**5**										
Total matrix spike duplicate samples[a]	**5**										

Notes:

IDW Characterization samples will include the analytical suite listed on this table, as well as flash point, reactivity, corrosivity, and toxicity tests in accordance with Title 40 of the Code of Federal Regulations (CFR) at Part 261

1) [a] = One duplicate, matrix spike, and matrix spike duplicate will be collected at 10% of the total field samples collected.

2) [b] = Sample IDs will have the well name, plus the numeric day, month, and year the sample was collected. Duplicates will be labeled "DUP-XX" with the XX being sequential number, matrix spikes will have a suffix "MS," and matrix spike duplicates will have a suffix "MSD."

3) Duplicates will be tracked on a parent / duplicate sample relation table.

4) The most current version of each analytical method will be applied at time of sample collection.

Analytical Methods:

VOCs by EPA Method 8260C
SVOCs by EPA Method 8270D
Explosives by EPA Method 8330B
TAL metals by EPA Method 6010C/6020A/7471A
Nitrate/Nitrite by EPA Method 9056A
Perchlorate by EPA Method 6860A
PCBs by EPA Method 8082A
Dioxins/Furans by EPA Method 8290A
Cyanide by EPA Method 9016

Acronyms and Abbreviations:

✓ = analyte to be sampled
# = number
EPA = U.S. Environmental Protection Agency
ID = idendification
PCB = polychlorinated biphenyl
TAL = target analyte list
VOC = volatile organic compound

Table 3-4: Groundwater Sample Matrix

Well Name	# of Field Samples[a]	Sample IDs[b]	VOCs	SVOCs	Explosives	TAL Total Metals	TAL Dissolved Metals	Nitrate/ Nitrite	Perchlorate	Herbicides	Pesticides	PCBs
BGMW14	1	BGMW14ddmmyyyy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BGMW15	1	BGMW15ddmmyyyy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BGMW16	1	BGMW16ddmmyyyy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CMW37	1	CMW37ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW38	1	CMW38ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW39	1	CMW39ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW40	1	CMW40ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW41	1	CMW41ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW42	1	CMW42ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW43	1	CMW43ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW44	1	CMW44ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW45	1	CMW45ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW46	1	CMW46ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
CMW47	1	CMW47ddmmyyyy	✓	✓	✓	✓	✓	✓	✓			
Total field samples	**14**											
Total duplicate samples[a]	**2**											
Total matrix spike samples[a]	**2**											
Total matrix spike duplicate samples[a]	**2**											

Notes:

IDW Characterization samples will include VOCs, explosives, TAL metals, nitrate and perchlorate; as well as flash point, reactivity, corrosivity, and toxicity tests in accordance with Title 40 of the Code of Federal Regulations (CFR) at Part 261

1) [a] = One duplicate, matrix spike, and matrix spike duplicate will be collected at 10% of the total field samples collected.

2) [b] = Sample IDs will have the well name, plus the numeric day, month, and year the sample was collected. Duplicates will have a suffix "DUP," matrix spikes will have a suffix "MS," and matrix spike duplicates will have a suffix "MSD."

3) Equipment blanks will be collected prior to initial sampling and for each week of sampling. Equipment blanks will be numbered sequentially as collected in the field.

4) The most current version of each analytical method will be applied at time of sample collection.

Analytical Methods:

VOCs by EPA Method 8260C
SVOCs by EPA Method 8270D
Explosives by EPA Method 8330B
Nitrate/Nitrite by EPA Method 9056A
Perchlorate by EPA Method 6860A
TAL total metals by EPA Method 6010C/6020A/7470A
TAL dissolved metals by EPA Method 6010C/6020A/7470A
Pesticides by EPA Method 8081A
PCBs by EPA Method 8082A
Herbicides by EPA Method 8151A

Acronyms and Abbreviations:

✓ = analyte to be sampled
# = number
EPA = U.S. Environmental Protection Agency
ID = idendification
PCB = polychlorinated biphenyl
TAL = target analyte list
VOC = volatile organic compound
SVOC = semi-volatile organic compound

Table 3-5: Sample Containers, Preservation, and Holding Time

Analyte/ Analytical Group	Matrix	EPA Analytical Method*	Container Size/Type	Preservation	Preparation Holding Time
Explosives	Soil	EPA Method SW846 8330	(1) 4- or 8-ounce glass jar with Teflon®-lined lid or stainless-steel liner	Cool to ≤6°C; not frozen	14 days from sample collection until extraction
TAL Metals and Mercury	Soil	EPA Method SW846 6010/6020/ 7471	(1) 4- or 8-ounce glass jar with Teflon®-lined lid or stainless-steel liner	Cool to ≤6°C; not frozen	180 days from sample collection until analysis
Perchlorate	Soil	EPA Method SW846 6860	(1) 4- or 8-ounce amber glass jar with Teflon®-lined lid or stainless-steel liner	Cool to ≤6°C	28 days from sample collection until analysis
VOCs	Soil	EPA Method SW846 8260	(1) 4- or 8-ounce glass jar with Teflon®-lined lid or stainless-steel liner	Cool to ≤6°C; not frozen	48 hours from sample collection until preservation; 14 days from sample collection until analysis
SVOCs	Soil	EPA Method SW846 8270	(1) 4- or 8-ounce glass jar with Teflon®-lined lid or stainless-steel liner	Cool to ≤6°C; not frozen	14 days from sample collection until extraction
PCBs	Soil	EPA Method SW846 8082	1) 4- or 8-ounce glass jar with Teflon®-lined lid or stainless-steel liner	Cool to ≤6°C	365 days from sample collection until extraction
Nitrate/Nitrite	Soil	EPA Method SW846 9056/9056A	(1) 4- or 8-ounce glass jar with Teflon®-lined lid or stainless-steel liner	Cool to ≤6°C	48 hours from sample collection until extraction
Dioxins/Furans	Soil	EPA Method SW846 8280B	(1) 4-ounce amber glass jar with Teflon®-lined lid or stainless-steel liner	Cool <4°C	30 days from sample collection to extration; 45 days to analysis
Cyanide	Soil	EPA Method SW846 9016	(1) 4-ounce amber glass jar with Teflon®-lined lid or stainless-steel liner	Cool <4°C	14 days from sample collection until analysis
TCL VOC	Water	EPA Method SW846 8260C	3 40-mL VOC glass vials with Teflon®-lined lid	No headspace; cool <6°C, HCL to pH<2	14 days preserved from sample collection until analysis
TCL SVOCs	Water	EPA Method SW846 8270D	2 1-L amber bottles	Cool <6°C	7 days to extraction, 40 days to analysis

Table 3-5: Sample Containers, Preservation, and Holding Time

Analyte/ Analytical Group	Matrix	EPA Analytical Method*	Container Size/Type	Preservation	Preparation Holding Time
Herbicides	Water	EPA Method SW846 8271	2 1-L amber bottles	Cool <6°C	7 days from sample collection until analysis
Pesticides	Water	EPA Method SW846 8272	2 1-L amber bottles	Cool <6°C	7 days from sample collection until analysis
PCBs	Water	EPA Method SW846 8273	2 1-L amber bottles	Cool <6°C	7 days from sample collection until analysis
Explosives	Water	EPA Method SW846 8274	2 1-L amber bottles	Cool <6°C	7 days to extraction, 40 days to analysis
Nitrate/Nitrite	Water	EPA Method SW846 8275	1 250-mL poly bottle, field filtered	Cool <6°C	48 hours from sample collection until analysis
Perchlorate	Water	EPA Method SW846 8276	1 250-mL poly bottle, field filtered	One third bottle headspace; cool <6°C	28 days from sample collection until analysis
TAL total metals and mercury (unfiltered)	Water	EPA Method SW846 8277	1 250-mL poly bottle, field filtered	Cool <6°C, HNO3 to pH<2	28 days from sample collection until analysis
TAL dissolved metals and mercury (filtered)	Water	EPA Method SW846 8278	1 1-L poly bottle	Cool <6°C, HNO3 to pH<2	28 days from sample collection until analysis

Note:

* The most current version of each method will be used.

Acronyms and Abbreviations:

°C = degrees Celsius
< = less than
< = less than or equal to
EPA = U.S. Environmental Protection Agency
HCl = hydrochloric acid
HDPE = high-density polyethylene
HNO3 = nitric acid
L = liter
mL = milliliter
PCB = polychorinated biphenyl
pH = potential of hydrogen
SOP = standard operating procedure
SVOC = semivolatile organic compound
TAL = target analyte list
TCL = target compound list
VOC = volatile organic compound