Western Refining Southwest LLC
A subsidiary of Marathon Petroleum Corporation
I-40 Exit 39
Jamestown, NM 87347

December 17, 2021

Mr. Kevin Pierard, Chief
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505

RE:

Response to Disapproval dated August 3, 2021, Investigation Report Solid Waste Management Units (SWMU) No. 4 Old Burn Pit and No. 5 Landfill Areas
Western Refining Southwest LLC, D/B/A Marathon Gallup Refinery
(dba Western Refining Southwest LLC)
EPA ID# NMD000333211
HWB-WRG-17-006

Dear Mr. Pierard:

Western Refining Southwest LLC, DBA Marathon Gallup Refinery is submitting this *Response to Disapproval, Response to Comments Disapproval, Investigation Report Solid Waste Management Units (SWMU) No. 4 Old Burn Pit and No. 5 Landfill Areas.* A timeline of the reports and investigations for the burn pits and landfill areas is provided below.

- Investigation Work Plan, submitted June 24, 2014
- Disapproval, received August 17, 2015
- Response to Disapproval, submitted November 19, 2015
- Approval with Modifications, submitted April 18, 2016
- Investigation Report, submitted March 13, 2017
- Disapproval, received June 7, 2018
- Response to Disapproval, submitted October 19, 2018
- Disapproval, received March 15, 2021
- Response to Disapproval of October 2018, submitted June 30, 2021
- Response to Disapproval, submitted July 7, 2021
- Disapproval, received August 3, 2021

If there are any questions, please call Mr. John Moore at (505) 879-7643.

MARATHON

Western Refining Southwest LLC

A subsidiary of Marathon Petroleum Corporation

I-40 Exit 39
Jamestown, NM 87347

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to 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.

Sincerely,
Western Refining Southwest LLC, DBA Marathon Gallup Refinery

Ruth a Cade

Ruth Cade
Vice-President

Enclosures

cc: D. Cobrain, NMED HWB
L. Tsinnajinnie, NMED HWB
M. Suzuki, NMED HWB
L. Barr, NMOCD
G. McCartney, Marathon Petroleum Corporation
K. Luka, Marathon Petroleum Corporation
J. Moore, Marathon Gallup Refinery
H. Jones, Trihydro Corporation

Attachment A: Response to Comments

New Mexico Environment Department (NMED) to Western Southwest Refining LLC (Western) Comment Letter "Disapproval Response to Disapproval Investigation Report Solid Waste Management Units (SWMU) No. 4 Old Burn Pit and No. 5 Landfill Areas" (August 3, 2021)

NMED General Comment	Western Response
Comment 1:	**Response 1:**
The Permittee submitted the response letters with replacement pages but neglected to submit the required documents. Comment 1 of the NMED's March 15, 2021 Disapproval requires the Permittee to submit two hard copies, an electronic and a red-line strikeout (RLSO) version of the revised report. Similarly, the NMED's June 7, 2018 Disapproval states, "[p]rovide NMED with two hard copies and an electronic version of the revised Report. Include a red-line strikeout version, in electronic format, showing where all the revisions to the Report have been made." Submit all documents required by NMED in future submittals.	This comment has been acknowledged.
NMED Comment for July 7, 2021 Response	**Western Response**
Comment 2:	**Response 2:**
The response to NMED's March 15, 2021 Disapproval Comment 2 states, "MPC does not propose recollected soil samples in the Solid Waste Management Unit (SWMU) 4 and 5 area. In May 2021, MPC conducted a sitewide Laser Induced Fluorescence (LIF) investigation. Based on the EB-LIF-138 log in the SWMU 4 area, minimal response was encountered indicating clean soil. In the surrounding area (including the French Drain), EB-LIF-101, EB-LIF-102, WB-LIF-110, WB-LIF-116, and WB-LIF-118 also show clean soil. The LIF locations and logs will be provided as an attachment in the Sitewide Laser Induced Fluorescence/Hydraulic Profiling (LIF/HP) Report, which will be submitted no later than October 31, 2021." According the Figure 1, the locations of the LIF borings are shown; however, the boundaries of SWMUs 4 and 5 are not identified. Therefore, it is not clear how the LIF borings are relevant to the investigation of SWMUs 4 and 5. The figure must be revised to identify the boundaries of SWMUs 4 and 5. Note that the LIF investigation results may be incorporated to assess the presence/absence of non-aqueous (NAPL) in the SWMUS 4 and 5 areas; however, LIF data cannot be used to identify exceedance of the	Because it is not clear how the laser induced fluorescence (LIF) borings are relevant to the investigation of solid waste management units (SWMU) 4 and 5, the discussion regarding the LIF borings will be disregarded. Additional soil/groundwater samples will be collected from SWMUs 4 and 5 to confirm that recent activities have not adversely affected the areas. An investigation work plan for the additional soil and groundwater samples will be submitted no later than April 30, 2022. SWMUs 4 and 5 have been added to the LIF Figure 1.

New Mexico Environment Department (NMED) to Western Southwest Refining LLC (Western) Comment Letter "Disapproval Response to Disapproval Investigation Report Solid Waste Management Units (SWMU) No. 4 Old Burn Pit and No. 5 Landfill Areas" (August 3, 2021)

NMED General Comment	Western Response
screening level for each individual constituent and cannot be used to demonstrate compliance. Accordingly, the LIF investigation results do not preclude the requirement for a recollection of the samples from the SWMUS 4 and 5 areas. Propose to collect additional soil/groundwater samples from SWMUs 4 and 5 to confirm that recent activities (e.g., releases) have not adversely affected the areas in the revised Report, as appropriate.	
In addition, the log for LIF boring EB-LIF-103 was also included in Appendix B but the elevated LIF responses recorded in the log were not discussed in the response. The EB-LIF-103 boring log indicates the presence of NAPL at depths between 16 feet and 23 feet below ground surface (bgs) which may be consistent with the depth of the water table. Include the discussion regarding the elevated LIF responses relative to the investigation of SWMUs 4 and 5 in the revised Report.	A discussion regarding boring EB-LIF-103 has not been included in the revised Report. As mentioned above, additional soil/groundwater samples will be collected in closer proximity to SWMU 4 to better evaluate subsurface conditions in the area.
Furthermore, NMED already issued a disapproval for the *Marketing Tank Farm Laser-Induced Fluorescence/Hydraulic Profiling Investigation Report* on June 2, 2021. The Permittee intends to provide additional/new data as part of the referenced report. The additional/new data must be evaluated separately. Submit the additional/new data as a standalone letter report or as a supplemental report.	A Site Wide LIF report, "Tank 570 Release and Additional Areas LIF/HP Investigation Report", was submitted to NMED on October 27, 2021. This report evaluated the eastern, northern, and northwestern areas of the refinery. An addendum to the "Marketing Tank Farm Laser-Induced Fluorescence/Hydraulic Profiling Investigation Report" was submitted to NMED on December 2, 2021. This addendum detailed additional data collected in the Marketing Tank Farm area in May 2021.
NMED Comment for June 30, 2021 Response	**Western Response**
Comment 3:	**Response 3:**
The response to NMED's June 7, 2018 Disapproval Comment 2 states, "Section 4.2.2 (Hydrogeology), pages 4-2 and 4-3, have been revised to state [w]ell OW-56 is screened in a sandy, gravelly clay. Moisture observed in the gravelly clay/clayey gravel in soil borings SWMU 4-1	Section 4.2.2 (Hydrogeology), page 4-2, has been revised to state, "Well OW-56 is screened in a sandy, gravelly clay. Moisture observed in the gravelly clay/clayey gravel in soil borings SWMU 4-1

New Mexico Environment Department (NMED) to Western Southwest Refining LLC (Western) Comment Letter "Disapproval Response to Disapproval Investigation Report Solid Waste Management Units (SWMU) No. 4 Old Burn Pit and No. 5 Landfill Areas" (August 3, 2021)

NMED General Comment	Western Response
and SWMU 5-2 may represent shallow groundwater. Shallow groundwater may be present in the general area of the two SWMUs, but its occurrence is sporadic." Although Section 4.2. was revised for clarity, Section 7.1 (Conclusions) was not revised to resolve the discrepancy. Section 7.1 contradicts Section 4.2.2 by stating that, "[g]roundwater was not encountered and there was no evidence of historical impacts to groundwater beneath the Old Burn Pit," and "there is no evidence of any threats to groundwater [in the Landfill Areas] and the soil cap is preventing any potential direct contact exposures to buried waste materials." Section 7.1 must be revised to resolve the discrepancy in the revised Report. In addition, the historical groundwater measurement data indicates that shallow groundwater is consistently detected in wells OW-56 and OW-62; therefore, shallow groundwater may be present regularly rather than sporadically in the SWMUs 4 and 5 areas. Correct the statement in the revised Report, as appropriate.	and SWMU 5-2 may represent shallow groundwater. Shallow groundwater may be present in the general area of the two SWMUs." Section 7.1 (Conclusions), page 7-2, has been revised to state, "Groundwater was not encountered; however, moisture was observed in the gravelly clay/clayey gravel in SWMU 4-1 that may indicate shallow groundwater. There was no evidence of historical impacts to groundwater beneath the Old Burn Pit." Section 7.1 (Conclusions), page 7-3, has been revised to state "Groundwater was not encountered at SWMU 5-2; however, moisture was observed in the gravelly clay/clayey gravel in SWMU 5-2 that may indicate shallow groundwater." Modifications have been made as detailed above to indicate the possibility of shallow groundwater in the areas of SWMU 4 and SWMU 5.

Attachment B: Text Revisions

- **B-1: Clean**
- **B-2: December Redline Edits**
- **B-3: All Redline Edits**

Attachment B-1: Clean Text

Executive Summary

The Gallup Refinery, which is located 17 miles east of Gallup, New Mexico, has been in operation since the 1950s. Past inspections by State [New Mexico Environment Department (NMED)] and federal environmental inspectors have identified locations where releases to the environment may have occurred. These locations are generally referred to as Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs). Pursuant to the terms and conditions of the facility's Resource Conservation and Recovery Act (RCRA) Post-Closure Care Permit and 20.4.1.500 New Mexico Administrative Code (NMAC), this environmental site investigation was completed for SWMUs No. 4 (Old Burn Pit) and No. 5 (Landfill Areas).

The Old Burn Pit occupied a small triangular shaped area of approximately 20 feet by 40 feet, which was located approximately 700 feet north of the refinery's main tank farm and a short distance northwest of the fire training area. The pit was used to burn acid soluble oils from the alkylation unit and was operated from 1958 through 1976. A RCRA Facility Investigation (RFI) was conducted in the area in early 1990s (three soil borings with depths of 4.5 feet in May 1992, which were extended to a depth of 10 feet in 1994) with the finding that the area did have relatively low concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals present in surface soils. Giant Refining Company recommended a soil cap be placed over the area of the burn pit and it was subsequently installed in 1997 pursuant to the United States Environmental Protection Agency's (EPA) approval of the Voluntary Corrective Action Plan.

The Land Fill Areas were determined to include four small areas used to dispose of waste generated from refinery construction, maintenance, and operations. Three of the landfill areas were contiguous and were located northwest of the main refinery tank farm, approximately 500 feet northwest of Tank 337. The fourth landfill area was located approximately 200 feet north of the other three landfills. The main landfill area is estimated to have been 100 feet wide by 350 feet long in a kidney shape. The separate landfill area to the north is estimated to have been 20 feet by 20 feet. The landfill areas were operated from 1958 through 1979. An RFI was conducted in the area in early 1990s (twelve soil borings to a depth of 9.5 feet in May 1992, with seven of these borings drilled deeper to a depth of 20 feet in 1994). The soil samples were analyzed for priority pollutant volatile organics and metals, with the finding that the area did primarily have metals present at

concentrations above background. Giant Refining Company recommended a soil cap be placed over the area of the landfills and it was subsequently installed in early 1998 pursuant to the EPA's approval of the Voluntary Corrective Action Plan.

Giant Refining Company submitted documentation demonstrating proper closure of the Old Burn Pit and the Landfill Areas in 1998 (Practical Environmental Services, Inc., 1998a and b). The investigation and remediation (i.e., capping) of both SWMUs was overseen and approved by the US EPA. In 2001, Giant Refining again submitted information on the remediation of the Old Burn Pit and the Landfill Areas in the "Petition for *No Further Action*" (Giant Refining Company, 2001). NMED commented on the 2001 *No Further Action* petition and requested additional information for the Old Burn Pit and the Landfill Areas. All of the additional information requested by NMED for the Old Burn Pit and the Landfill Areas was submitted to NMED on October 2, 2002. Western Refining Southwest, Inc. submitted another request for NMED to respond to the previously submitted Petition for *No Further Action* on June 24, 2013.

NMED requested additional assessment of, in particular, deeper soils and groundwater, if present, beneath both SWMUs. The current investigation began on September 20, 2016 and continued through October 3, 2016. One soil boring was completed at SWMU No. 4 (Old Burn Pit) and two soil borings were completed at SWMU 5 No. (Landfill Areas). Soil samples were collected from any intervals indicating potential impacts and at deeper intervals to define the vertical extent of impacts to soils. Groundwater was not encountered in any of the three soil borings. The three soil samples (excluding additional quality control samples) collected at SWMU No. 4 were analyzed for RCRA metals, VOCs (including MTBE), SVOCs, total petroleum hydrocarbons (TPH) and dioxins/furans. The five soil samples collected at SWMU No. 5 were analyzed for RCRA metals, VOCs (including MTBE), SVOCs, and TPH.

At SWMU No. 4, the soil boring was drilled to the top of bedrock and did not encounter groundwater. There were no organic constituents detected at concentrations above the screening level. Arsenic was the only metal detected at concentrations above the soil screening levels and these soil samples were collected from below the soil cap. The area at SWMU No. 4 was previously capped and there is no evidence of any threat to groundwater resources or any other threats to human health or the environment from SWMU No. 4.

SWMU No. 5 was assessed with the completion of two soil borings, neither of which encountered groundwater. There is no evidence of any threats to groundwater from SWMU No. 5. No organic constituents were detected above the soil screening levels in any of the soil samples and arsenic was the only metal detected at concentrations above the screening level. The detected arsenic concentrations ranged from 1.9 mg/kg to 5.3 mg/kg and may be representative of background concentrations. All but one of these detections were from soil samples collected beneath the cap, which would not require further evaluation. Based on a slightly elevated reading with a photo ionization detector (PID), a soil sample was collected from the land surface (0-2') where the highest arsenic concentration of 5.3 mg/kg was detected. This concentration exceeds the residential direct contact screening level and should be further evaluated upon completion of a site-specific evaluation of background concentrations.

Noting the potentially elevated arsenic concentration observed on top of the existing cap at SWMU No. 5, the previously approved and implemented remedial efforts have addressed any threats posed to the environment and/or human health that may have been present at the Old Burn Pit and the Landfill Areas prior to placement of the caps.

Section 1
Introduction

The Gallup Refinery is located approximately 17 miles east of Gallup, New Mexico along the north side of Interstate Highway I-40 in McKinley County. The physical address is I-40, Exit #39 Jamestown, New Mexico 87347. The Gallup Refinery property covers approximately 810 acres. Figure 1 presents the refinery location and the regional vicinity, which is characterized as high desert plain comprised primarily of public lands used for grazing by cattle and sheep.

The Gallup Refinery generally processes crude oil from the Four Corners area transported to the facility by pipeline or tanker truck. Various process units are operated at the facility, including crude distillation, reforming, fluidized catalytic cracking, alkylation, isomerization, sulfur recovery, merox treater, and hydrotreating. Current and past operations have produced gasoline, diesel fuels, jet fuels, kerosene, propane, butane, and residual fuel.

The area of investigation that is the subject of this report is shown on Figure 2 for the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5). The purpose of the site investigation is to supplement previous investigations of both SWMUs and address NMED's request for additional assessment of deeper soils and groundwater, if present, beneath both SWMUs. The investigation was completed pursuant to the *SWMU No. 4 and No. 5 Investigation Work Plan* dated November 2015 (approved with modification April 18, 2016).

Section 2 presents background information for SWMUs No. 4 and No. 5, including a review of historical waste management activities to help identity the types of waste handled, sources of releases, and previously known impacts to the environment. Section 3 describes the scope of work completed during the site investigation, including completion of soil borings and sample collection. The fourth section of the report explains the results of the field investigation, including the general surface and subsurface conditions and detailed site-specific information acquired during subsurface investigations. Section 5 explains the regulatory standards that are used for comparison to the analytical results and Section 6 presents the analytical results of soil samples analyzed for VOCs, SVOCs, TPH, and metals. The results of these analyses are compared to applicable State or federal screening levels. Section 7 summarizes and provides an evaluation of the potential impacts and provides recommendations for any future actions.

Section 2
Background

This section presents background information for the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5), including a review of historical waste management activities to identity the following:

- Type and characteristics of waste and contaminants handled in the SWMU;
- Known and possible sources of impacts;
- History of releases; and
- Known extent of impacts prior to the current investigation.

2.1 Old Burn Pit (SWMU No. 4)

The Old Burn Pit was originally included as a SWMU in the 1988 Hazardous and Solid Waste Act (HSWA) permit and subsequently included for investigation in the 1990 RFI Work Plan. The Old Burn Pit was put into service in 1958 and was removed from service in 1976, when the pit area was apparently covered with a layer of soil. It covered an area of approximately 20 feet by 40 feet with a triangular shape and had a depth of 10 to 12 feet (Figure 3). A Visual Site Inspection (VSI) was conducted on November 19 and 20, 1986 as part of the RCRA Facility Assessment. During this inspection, "An old metal box uphill from the pit" was described as being used to feed oil through a metal pipe to the burn pit. There is no subsequent mention of the steel box or pipe in the *SWMU Site-Specific Facility Investigation Workplan*, which provided a detailed discussion of site features and sampling locations (Applied Earth Sciences, Inc., 1990). Apparently the metal box and pipe were removed after the VSI was conducted in 1986 and sometime before preparation of the *SWMU Site-Specific Facility Investigation Workplan* in 1990. Acid soluble oils from the alkylation unit were placed in the pit and burned. It is possible that spent silicon dioxide catalysts may have also been placed in the pit.

In 1992, during the Phase III RFI three soil borings (RFI0401V, RFI0402V, and RFI0403V) were completed to depths of 4.5 feet below ground surface (bgs) using a hand auger (Figure 3) (Giant Refining Company, 1992). Soil samples were collected from depths of 0.0 feet bgs, 3.0 feet bgs, and 4.5 feet bgs at each of the three soil borings. The soil samples were analyzed for metals (arsenic, barium, beryllium, cadmium, chromium, lead, nickel, mercury, and vanadium), VOCs,

SVOCs, and pH and the results are presented in Table 1. For comparison the NMED soil screening levels (*Risk Assessment Guidance for Site Investigation and Remediation*, dated December 2014) and EPA Regional Screening Levels are also included in Table 1. Based on the detection of constituents in the samples collected in 1992, EPA directed that deeper samples be collected from the same three locations. As shown on Figure 4, three soil borings (RFI0404V, RFI0405V, and RFI0406V) were drilled using hollow-stem augers at the same locations in 1994 with soil samples collected at depths of 6.0 feet bgs and 10.0 feet bgs (Giant Refining Company, 1994). The soil samples were analyzed for VOCs, SVOCs, and metals and the results are summarized in Table 1.

One VOC and one SVOC were detected at concentrations above the soil screening levels developed to protect groundwater assuming a dilution attenuation factor (DAF) of 20, but all reported concentrations were less than the residential soil screening level for direct contact. The soil samples were also screened in the field with a photo ionization detector (PID). Many of the PID readings were 0.0, but those with higher readings are as follows; RFI0402 V3.0 at 16 parts per million (ppm), RFI0402 V4.5 at 8.4 ppm, RFI0403 V3.0 at 3.2 ppm, and RFI0403 V4.5 at 12 ppm. The field data sheets are included in Appendix A.

Ethylbenzene was found at concentrations above the DAF 20 screening level of 0.262 mg/kg in three soil samples. These three soil samples were RFI0402 V3.0, RFI0403 V3.0, and RFI0403 V4.5 with concentrations of ethylbenzene of 1.0 mg/kg, 0.910 mg/kg, and 0.510 mg/kg, respectively. Naphthalene was the only SVOC to have a concentration in soil above the DAF 20 screening level of 0.0823 mg/kg. Naphthalene was detected at a concentration of 0.520 mg/kg in sample RFI0402 V3.0.

Based on the detection of constituents in soils discovered during the Phase III RFI, Giant Refining Company recommended the placement of a soil cap over the area occupied by the burn pit. This activity was completed in 1997. During the week of March 23, 1998, an on-site inspection was conducted by Practical Environmental Services, Inc. in support of preparation of a RCRA Post-Closure Care Permit for the Gallup Refinery Land Treatment Unit. This inspection report, the applicable section of which is included in Appendix C of the *Investigation Work Plan SWMU No. 4 Old Burn Pit and SWMU No. 5 Landfill Areas*, documents the remediation (i.e., construction of a low permeability soil cap) of the Old Burn Pit (DiSorbo, 2015). The remediation was conducted under the review and authority of both EPA and NMED.

2.2 Landfill Areas (SWMU No. 5)

The Landfill Areas included four areas used to dispose of waste generated from refinery construction, maintenance, and operations. The construction waste is reported to have included asphalt paving, concrete, and scrap metal. Some office, residential, and shop wastes were also identified. Wastes associated with operations may have included defluorinator bauxite and hydrotreating catalyst (cobalt, molybdenum, and nickel), and possibly outdated laboratory chemicals. Three of the landfill areas were contiguous and were located northwest of the main refinery tank farm, approximately 500 feet northwest of Tank 337 (Figure 5). The fourth landfill area was located approximately 200 feet north of the other three landfills. The main landfill area is estimated to have been 100 feet wide by 350 feet long in a kidney shape. The separate landfill area to the north is estimated to have been 20 feet by 20 feet. The landfill areas were operated from 1958 through 1979.

An RFI was conducted in the area in May 1992 with twelve soil borings (RFI0501 through RFI0512) completed with a hand auger to a depth of 9.5 feet bgs (Figure 5). The soil samples were collected from depths of 0.0 feet bgs, 3.0 feet bgs, 7.0 feet bgs, and 9.5 feet bgs and analyzed for VOCs, metals, and pH. Based on the presence of waste materials at depths of 9.5 feet bgs, seven additional soil borings were drilled deeper to a minimum depth of 20 feet bgs in 1994. The deeper borings (RFI0513 through RFI0519) were completed using hollow-stem augers and were completed at the same location of previous soil borings RFI0502, RFI0503, RFI0504, RFI0505, RFI0506, RFI0507, and RFI0509 (Figure 6). Soil samples were collected from depths of 11.0 feet bgs, 16.0 feet bgs, and 20.0 feet bgs and analyzed for VOCs, SVOCs, and metals. The analytical results are presented in Table 2.

One constituent (arsenic) was detected at concentrations above the soil screening levels developed to protect groundwater assuming a dilution attenuation factor (DAF) of 20.0 (0.299 mg/kg) and arsenic was also reported at concentrations above the residential soil screening level for direct contact (4.25mg/kg). The soil samples were also screened in the field with a PID. Many of the PID readings were 0.0, but those with higher readings are as follows; RFI0504 V3.0 at 0.01 ppm and RFI0504 V9.5 at 0.4 ppm. The field data sheets are included in Appendix A.

As shown in Table 2, all of the detected results for arsenic are above the DAF 20 screening level of 0.299 mg/kg. Many of the reported arsenic concentrations also exceed the residential direct

contact screening level of 4.25 mg/kg. Arsenic concentrations ranged from non-detect (< 2.5 mg/kg) to 35 mg/kg.

Based on the detection of constituents in soils discovered during the Phase III RFI, Giant Refining Company recommended the placement of a soil cap over the area occupied by the landfills. This activity was completed in early 1998. During the week of March 23, 1998, an on-site inspection was conducted by Practical Environmental Services, Inc. to document the closure of SWMU No. 5. A Landfill Closure Certification Report was prepared, which documents the remediation (i.e., construction of a low permeability soil cap) of the Landfill Areas (Practical Environmental Services, 1998b). The remediation was conducted under the review and authority of both EPA and NMED, in accordance with the Voluntary Corrective Action Plan approved by EPA on January 5, 1994.

Section 3
Scope of Activities

3.1 Soil Boring Installation and Sample Collection

Pursuant to the approved Investigation Work Plan (2015), an investigation of soils was conducted to define the vertical extent of any impacts to soil and evaluate the presence of and potential for impacts to groundwater. To accomplish this objective, soil borings were installed at the Old Burn Pit and the Landfill Areas. As outlined in the Investigation Work Plan, there is the potential for constituents to have been released to soils at known locations and therefore a judgmental sampling design was implemented.

3.1.1 Site Investigation

The scope of work for the investigation at the Old Burn Pit consisted of the installation of one soil boring in the center of the former pit. Two soil borings were completed at the Landfill Areas with one in the center of the area previously identified as Landfill Area 1 and the second in the center of the main landfill area. The soil boring at the Old Burn Pit was to be drilled to a minimum depth of two feet into the native soils (i.e., beneath any apparent waste materials identified or any other indications of fill material). The soil borings at the Landfill Areas were to be drilled to a minimum depth of two feet into the native soils or to a depth of 20 feet, whichever is deeper. If field evidence of impacts at greater depths was observed, then soil borings were to be drilled deeper to achieve full vertical delineation. The investigation also focused on identifying any zones of saturated soils. If saturation was encountered, then temporary wells were to be installed to allow collection of groundwater samples.

Three soil samples were collected at SWMU No. 4 and five soil samples were collected at SWMU 5 No. (excluding additional quality assurance samples). The soil samples were analyzed for potential site-related constituents including volatile and semi-volatile organics, total petroleum (i.e., gasoline, diesel, and motor oil range) hydrocarbons, and RCRA metals. In addition, soil samples collected at SWMU No. 4 were analyzed for dioxins and furans. No groundwater samples were collected, as saturation was not encountered in any of the soil borings (SWMU 4-1, SWMU 5-1 or SWMU 5-2).

All three soil borings were advanced using hollow-stem augers. The following list provides a summary of the soil borings:

- SWMU 4-1; advanced to 22 feet below ground level (bgl); terminated in bedrock;
- SWMU 5-1; advanced to 20 feet bgl; terminated in dry sandy clay after penetrating 13 feet of apparent native soils; and
- SWMU 5-2; advanced to 16 feet bgl; terminated in bedrock.

3.2 Collection and Management of Investigation Derived Waste

Drill cuttings, excess sample material and decontamination fluids, and all other investigation derived waste (IDW) associated with soil borings were contained and are currently being characterized for disposal.

3.3 Surveys

A global positioning system receiver was used to record the coordinates of each soil boring. These coordinates were recorded on the field boring logs.

Section 4
Field Investigation Results

This section provides a summary of the surface and subsurface conditions at the refinery, including the area near the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5). A discussion is included on the installation of soil borings, field screening of soils, and collection of soil samples for analysis.

4.1 Surface Conditions

A topographic map of the area near the Old Burn Pit and Landfill Areas is included as Figure 7. Local site topographic features include high ground in the southeast gradually decreasing to lowland fluvial plain in the northwest. Elevations on the refinery property range from 7,040 feet to 6,860 feet. The area of the site near SWMU No. 4 is at an approximate elevation of 6,925 feet and the elevations near SWMU No. 5 range from 6,915 to 6,940 feet above mean sea level (msl).

The McKinley County soil survey identifies the soil in the area of SWMUs No. 4 and No. 5 as primarily the Simitarq-Celavar sandy loams (USDA, 2005). The Simitarq-Celavar soils are well drained with a conservative permeability of 0.20 in/hr and minimal salinity. Simitarq soils have nearly neutral pH values ranging from 7.2 to 7.4 standard units.

Regional surface water features include the refinery evaporation ponds and aeration lagoons and a number of small ponds. The site is located in the Puerco River Valley, north of the Zuni Uplift with overland flows directed northward to the tributaries of the Puerco River. The Puerco River continues to the west to the confluence with the Little Colorado River. The South Fork of the Puerco River is intermittent and retains flow only during and immediately following precipitation events.

4.2 Subsurface Conditions

No underground utilities were identified during clearance of the soil borings for the Old Burn Pit or Landfill Areas.

4.2.1 Geology

The shallow subsurface soils consist of fluvial and alluvial deposits comprised of clay and silt with minor inter-bedded sand layers. The Quaternary alluvium, which occurs at the land surface in the

area of the Old Burn Pit and the Landfill Areas, is mapped regionally as a narrow band trending west-northwest and running just north of I-40 (Figure 8). The Quaternary alluvium is thought to be the parent material of the Simitarq-Celavar soils discussed above in Section 4.1. A cross section of the shallow subsurface in the immediate vicinity of the Old Burn Pit and Landfill Areas is included as Figure 9. Figure 2 shows the location of the cross section. As shown on the cross section, the predominant lithology is silty clay.

Subcropping beneath the Quaternary alluvium is the Triassic Chinle Group (Figure 8). The stratigraphy of the Chinle Group was described in detail for the nearby Fort Wingate quadrangle by Lucas et al, 1997. The Painted Desert Member of the Petrified Forest Formation is the uppermost member of the Chinle Group present in the area of the refinery. The Painted Desert Member is described as reddish-brown and grayish red mudstone with minor beds of resistant, laminated or crossbedded, litharenite. This is consistent with the bedrock encountered at the refinery, as depicted on cross section A-A' (Figure 9). Beneath the Painted Desert Member is the Sonsela Member, which is described by Lucas et al (1997) as gray to yellowish-brown, fine-grained to conglomeratic, crossbedded sandstone. The base of the Sonsela Member is recognized as a basin wide unconformity, which was termed the Tr-4 unconformity (Heckert and Lucas, 1996). The Blue Mesa Member, which underlies the Sonsela Member, is the lowest member of the Petrified Forest Formation. The Blue Mesa Member is described as mostly purple and greenish-gray mudstone.

4.2.2 Hydrogeology

None of the three soil borings completed at SWMUs No. 4 and No. 5 encountered groundwater. Soil boring SWMU 4-1 encountered bedrock (mudstone/claystone) at a depth of 20 feet with a dry sandy clay on top of the bedrock. (Figure 9). Damp soil was observed in gravelly clay at an approximate depth of 17 feet. Soil Boring SWMU 5-1 was drilled to a depth of 20 feet pursuant to the Investigation Work Plan and was terminated in a dry sandy clay. As indicated on Figure 9, the depth to bedrock near SWMU 5-1 may be at depths of 35 to 40 feet. Bedrock was encountered at a depth of 14 feet in SWMU 5-2, with a dry stiff clay overlying the bedrock surface. Damp soil was observed at approximately 12 feet in a clayey gravel layer. The damp soil noted in soil borings SWMU 4-1 and SWMU 5-2 are at a depth similar to the water level depth measured in well OW-56. Well OW-56 is screened in a sandy, gravelly clay. Moisture observed in the gravelly clay/clayey gravel in soil borings SWMU 4-1 and SWMU 5-2 may represent shallow groundwater. Shallow groundwater may be present in the general area of the two SWMUs.

The diverse properties and complex, irregular stratigraphy of the Quaternary alluvium across the refinery cause a wide range of hydraulic conductivity ranging from less than 10^{-2} cm/sec for gravelly sands immediately overlying the Painted Desert Member to 10^{-8} cm/sec in the clay soils located near the surface (Western Refining, 2009). Permeability tests performed on the Quaternary alluvium beneath the nearby Land Treatment Unit (LTU) indicated an average permeability of 1.9E-05 cm/sec (Appendix B). Permeability tests performed on soils in the area of the firewater pond indicated an average permeability of 1.1E-07 cm/sec (Appendix B). Because damp soil was observed in soil borings SWMU 4-1 and SWMU 5-2, it may be representative of shallow groundwater in the area. However, due to the tight clays the presence of groundwater may not be observed in the open boreholes in a timely manner. None of the soil borings were completed as a temporary well so the presence of groundwater cannot be confirmed.

As described above, the bedrock (i.e., Petrified Forest Formation) is mainly composed of low permeability materials (e.g., mudstone) with the exception of the Sonsela Member and some thinner sandstones within the overlying Painted Desert Member. Yield tests, including slug tests and pumping tests have been performed at the refinery to estimate the hydraulic conductivity of the Painted Desert Member (Appendix B). A slug test performed on July 3, 1984 in well OW-4 indicated a hydraulic conductivity of 4.0E-7 cm/sec. A pump test was performed in well OW-24 on February 20, 1985 and it yielded a hydraulic conductivity of 2.5E-7 cm/sec. The Painted Desert Member appears to be a competent aquitard to reduce the potential for downward migration of contaminants from groundwater that may occur within the overlying Quaternary alluvium.

Generally, shallow groundwater at the refinery follows the upper contact of the Chinle Group with prevailing flow from the southeast to the northwest, with some flow potentially to the northeast on the northeastern portion of the refinery property. The Sonsela Member is identified as the uppermost aquifer for RCRA monitoring purposes at the LTU because the overlying groundwater bearing units are not capable of supplying sufficient quantities of groundwater to meet the definitions of an aquifer. Wells completed in a thinner permeable sandstone layer within the Painted Desert Member are also monitored near the LTU as a potential early warning network. The Sonsela's highest point occurs southeast of the site and slopes downward to the northwest as it passes under the refinery. The Sonsela Member forms a water-bearing reservoir with artesian conditions throughout the central and western portions of the refinery property (Western Refining, 2009). Aquifer test of the Sonsela Member conducted northeast of Prewitt indicated a transmissivity of

greater than 100 ft^2/day (Stone and others, 1983). Yield tests conducted at the site have shown a much lower hydraulic conductivity of 0.34 ft/day (1.2E-04 cm/sec) (Appendix B).

Sections 2.1 and 2.2 present the historical data collected for SWMU No. 4 and SWMU No. 5, respectively. In SWMU No. 4, two constituents (ethylbenzene and naphthalene) were detected at concentrations above the soil screening levels developed to protect groundwater but less than the residential soil screening level for direct contact. The detections were observed in samples collected between 3 ft bgs and 4.5 ft bgs; samples collected at 6 ft bgs and 10 ft bgs were below detection limits. The samples depths are approximately 10 ft above the observed damp gravelly clay layer.

In SWMU No. 5, arsenic was detected at concentrations above the soil screening levels developed to protect groundwater and was also reported at concentrations above the residential soil screening level for direct contact. The detections occurred between 0 ft bgs and 20 ft bgs. These samples depths are approximately 15 ft above the observed clayey gravel layer. No organic constituents were above any screening standards.

Information regarding the current investigation is presented in Section 4.3.

4.3 Exploratory Drilling Investigations, Soil Sampling and Boring Abandonment

This subsection provides a description of surface and subsurface investigations to define the vertical extent of any impacts to soil and evaluate the presence of and potential for impacts to groundwater. This includes soil field screening results, soil sampling intervals and methods for detection of surface and subsurface impacts in soils.

Discrete soil samples for laboratory analyses were scheduled for collection at the following intervals:

- From the interval in each soil boring with the greatest apparent degree of contamination, based on field observations and field screening;
- From the top of native soil immediately below the presence of any waste materials (e.g., burn residue in the Old Burn Pit or landfill waste in the Landfill Areas);
- From the bottom of each borehole;
- From the 6” interval at the top of saturation (applicable only to borings that reach saturation); and
- Any additional intervals as determined based on field screening results.

A description of the field screening and soil sampling procedures are presented in Appendix C – Field Methods. Copies of the boring logs are provided in Appendix D. In addition to being included on the soil boring logs, the soil vapor (i.e., headspace) screening results are summarized in Table 3. The locations of the soil borings appear on Figures 10 through 14.

4.3.1 Soil Investigation

Three soil borings were advanced using the hollow-stem auger (HSA) method and two of these soil borings were drilled to the bedrock (claystone/mudstone). The drilling equipment was decontaminated between each borehole, as described in Appendix C. The soil boring logs describe the subsurface lithology, the presence of saturation, and the field screening results. The installation of soil borings and collection of soil samples are discussed below in numerical order. Groundwater was not encountered in any of the soil borings.

<u>SWMU 4-1</u>

On October 3, 2016 the drilling rig was set up on location SWMU 4-1. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Three soil samples were collected from the following intervals:

- 12 feet bgl - 14 feet bgl – PID reading of 0.4 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of the silty clay located immediately below clayey silt (considered to be a more transmissive sediment). A duplicate soil sample was collected from this interval;
- 16 feet bgl - 18 feet bgl – PID reading of 0.1 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from an interval that was observed to be a clayey gravel. This interval did not appear to consist of transmissive sediments as the gravel was present in a low plastic clay matrix where pore space was not apparent; and
- 20 feet bgl - 22 feet bgl – Bottom of the borehole. PID reading of 1.0 ppm – No visual or olfactory evidence of impacted soils were present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Clayey Silt 0 feet bgl – 10 feet bgl (low plastic, soft, damp, brown, no odor);
- Clayey Silt 10 feet bgl – 12 feet bgl (low plastic, firm, damp, brown, no odor);
- Silty Clay 12 feet bgl – 16 feet bgl (low plastic, stiff, damp, brown, no odor);

- Clayey Gravel 16 feet bgl – 18 feet bgl (1/2" to 1/4" sandstone gravel in a low plastic clay matrix, damp, reddish brown, no odor);
- Sandy Clay 18 feet bgl – 20 feet bgl (low plastic, very stiff and potentially represents upper portion of weathered bedrock, dry, very fine grain sand present, grey and light brown, no odor); and
- Claystone 20 feet bgl – 22 feet bgl (similar to the 18 to 20 feet interval, very stiff, dry, no odor).

The PID readings range from 0.0 ppm (18 feet bgl – 20 feet bgl) to 2.9 ppm (0 feet bgl – 2 feet bgl). Saturation was not encountered.

The sampling terminated at 22 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On October 3, 2016 the borehole was grouted.

<u>SWMU 5-1</u>

On September 20, 2016 the drilling rig was set up on location SWMU 5-1. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Three soil samples were collected from the following intervals:

- 0 feet bgl - 2 feet bgl – PID reading of 28.6 ppm – This sample was collected at the surface from fill material. The sediment exhibited a petroleum hydrocarbon odor. There was no visual evidence of impacted soils;
- 7 feet bgl - 8 feet bgl – PID reading of 1.5 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of a silty clay located immediately below fill material; and
- 18 feet bgl - 20 feet bgl – Bottom of the borehole. PID reading of 0.1 ppm – No visual or olfactory evidence of impacted soils was present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Fill 0 feet bgl – 7 feet bgl (brown sand, gravel and clay, hydrocarbon odor was detected in the 0 feet bgl to 2 feet bgl interval, no odor was detected from the 2 feet bgl to 7 feet bgl interval);

- Silty Clay 7 feet bgl – 8 feet bgl (low plastic, very stiff, damp, brown, no odor);
- Silty Sandy Clay 8 feet bgl – 10 feet bgl (low plastic, firm, damp, brown, no odor);
- Clayey Sand 10 feet bgl – 12 feet bgl (very fine grain, compact, dry, brown, no odor); and
- Sandy Clay 12 feet bgl – 20 feet bgl (low plastic, very stiff, dry, brown, no odor).

The PID readings range from 0.1 ppm (18 feet bgl – 20 feet bgl) to 28.6 ppm (0 feet bgl – 2 feet bgl). Saturation was not encountered.

The sampling terminated at 20 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On September 20, 2016 the borehole was grouted.

SWMU 5-2

On September 29, 2016 the drilling rig was set up on location SWMU 5-2. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Two soil samples were collected from the following intervals:

- 10 feet bgl - 12 feet bgl – PID reading of 12.6 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of the clayey gravel located immediately below clayey sandy silt (considered to be more transmissive sediment); and
- 14 feet bgl - 16 feet bgl – Bottom of the borehole. PID reading of 5.1 ppm – No visual or olfactory evidence of impacted soils were present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Clayey Silt 0 feet bgl – 6 feet bgl (low plastic, firm, damp to dry, brown, no odor);
- Clayey Sandy Silt 6 feet bgl – 10 feet bgl (low plastic, stiff, damp, brown, no odor);
- Clayey Gravel 10 feet bgl – 12 feet bgl (dense, damp, calcareous, reddish brown clay matrix, no odor);
- Clay 12 feet bgl – 14 feet bgl (low to moderately plastic, very stiff and potentially represents weathered surface of bedrock, dry, reddish brown and light grey, no odor); and

- Claystone 14 feet bgl – 16 feet bgl (similar to the 12 to 14 feet interval, reddish brown and grey, no odor).

The PID readings range from 3.6 ppm (0 feet bgl – 2 feet bgl) to 12.6 ppm (10 feet bgl – 12 feet bgl). Saturation was not encountered.

The sampling terminated at 16 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On October 3, 2016 the borehole was grouted.

Section 5
Regulatory Criteria

The applicable screening and potential cleanup levels are specified in NMED's *Risk Assessment Guidance for Site Investigations and Remediation* dated July 2015 and in the Environmental Protection Agency's (EPA) Regional Screening Levels dated November 2015.

For non-residential properties (e.g., the Gallup Refinery), the soil screening levels must be protective of commercial/industrial workers throughout the upper one foot of surface soils and construction workers throughout the upper ten feet based on NMED criteria. NMED residential soil screening levels are applied to the upper ten feet and soil screening levels for protection of groundwater apply throughout the vadose zone. EPA soil screening levels for direct contact exposure apply to the upper two feet of the vadose zone. To achieve closure as "corrective action complete without controls", the affected media must meet residential screening levels, which are presented in Table 4. Table 4 also provides a list of the available NMED and EPA soil screening levels for non-residential properties. While Table 4 indicates the various depths to which the individual soil screening levels are applicable, Tables 5 and 6 discussed below do not include this level of detail.

Table 4 has soil screening levels for the soil-to-groundwater pathway that are based on a dilution/attenuation factor (DAF) of 1.0, which is NMED's most conservative screening level for this pathway. A review of site conditions (i.e., predominance of very fine-grained soils and limited occurrence of groundwater with low yields) indicates that a DAF of 1.0 is overly conservative, thus NMED's slightly higher DAF value of 20 presented in the 2015 risk assessment guidance is used for comparison in Tables 5 and 6 (NMED, 2015).

The screening levels included in Tables 5 and 6 cover both residential and non-residential land use. For the non-residential screening levels, the lower of the construction worker scenario and commercial/industrial scenario screening levels for each constituent is included in the data tables if NMED screening levels are available. If NMED soil screening levels are not available for a particular constituent, then EPA soils screening levels are used. If an EPA soil screening level is for a carcinogenic compound, then the screening level is multiplied by 10 to bring the risk level to 1E-05 to be consistent with the NMED screening levels. The screening levels in Tables 5 and 6 have not been segregated based on depth of the soil sample as discussed above for Table 4.

A review of the NMED guidelines for TPH indicates that the TPH screening levels were developed based on screening levels and compositional assumptions developed by the Massachusetts Department of Environmental Protection (MADEP). The analytical results, as presented in Tables 5 and 6, are reported for gasoline range organics (C6-C10), diesel range organics (>C10-C28), and motor oil range organics (>C28-C35). The applicable TPH screening levels for comparison to the individual soil samples are selected from Table 6-2 of the NMED guidance (NMED, 2015).

There are no soil screening levels for gasoline range organics and the individual compounds listed for groundwater (gasoline range criteria) are included in the list of analytes used for site samples. As there could have been a variety of petroleum types (e.g., crude oil or various refined products) going to the Old Burn Pit, the screening level for "unknown oil" was selected for comparison to the diesel range and motor oil range soil analytical results. The motor oil range analytical results are compared to the "unknown oil" screening level as directed by NMED. However, it is noted that the laboratory analyses for motor oil range organics only reports results for the >C28 to C35 hydrocarbon range, while the "unknown oil" screening level is based on a hydrocarbon mixture assumed to include only C11-C22 aromatics.

Some of the individual constituents reported by the laboratory do not have screening levels but were all non-detect with respect to soil except di-n-octyl-phthalate, which is not classified as a known carcinogen.

Section 6
Site Impacts

This section discusses the chemical analyses performed and presents the analytical results that were obtained through the analysis of soil samples, which were collected at the Old Burn Pit and Landfill Areas. The results for soils analyses are presented and compared to applicable screening levels, as described in Section 5.0.

6.1 Soil Analytical Results

Soil samples were analyzed by Hall Environmental Analysis Laboratory in Albuquerque, New Mexico using the following methods for organic constituents:

- SW-846 Method 8260/5035 volatile organic compounds;
- SW-846 Method 8270C semi-volatile organic compounds; and
- SW-846 Method 8015D gasoline, diesel, and motor oil range petroleum hydrocarbons.

Soil samples were analyzed for the following metals using the indicated analytical methods, respectively.

Analyte	Analytical Method
Arsenic	SW-846 Method 6010B
Barium	SW-846 Method 6010B
Cadmium	SW-846 Method 6010B
Chromium	SW-846 Method 6010B
Lead	SW-846 Method 6010B
Mercury	SW-846 Method 7471
Selenium	SW-846 Method 6010B
Silver	SW-846 Method 6010B

In addition, soil samples collected at SWMU No. 4 (Old Burn Pit) were analyzed for dioxins/furans by SW-846 Method 8290A.

The analytical results for soil samples collected at the Old Burn Pit are summarized in Table 5 and the results for the Landfill Areas are summarized in Table 6. The individual results that exceed the applicable cleanup levels are highlighted, as noted in the table footnotes. Maps showing the distribution of constituents detected in soils above the lowest applicable screening levels are included as Figures 10 through 14. The concentrations shown on figures that exceed the screening levels in Tables 5 and 6 are underlined on the figures. The laboratory analytical reports are included in Appendix E and the data validation of the results, which includes the analytical results for the associated QA/QC samples, is included in Appendix F. The constituents that have concentrations in soils above screening levels are discussed below.

SWMU No. 4 – Old Burn Pit

Arsenic was detected at a concentration above the residential screening level of 4.25 mg/kg in one soil sample [SWMU 4-1 (16-18')] at a concentration of 4.6 mg/kg. Soil samples SWMU 4-1 (12-14') and SWMU 4-1 (20-22') had reported arsenic concentrations of 2.2 and 2.0 mg/kg, respectively, which are above the DAF 20 screening level of 0.299 mg/kg. The concentrations are shown on Figure 10 and summarized in Table 5.

SWMU No. 5 – Landfill Areas

Arsenic was detected at concentrations above the DAF 20 screening level (0.299 mg/kg) in four of the five samples collected, including SWMU 5-1 (0-2'), SWMU 5-1 (7-8'), SWMU 5-1 (18-20'), and SWMU 5-2 (14-16'). The concentrations range from 1.9 mg/kg to 5.3 mg/kg. Sample SWMU 5-1 (0-2') with a concentration of 5.3 mg/kg exceeds the residential screening level of 4.25 mg/kg. The arsenic concentrations are shown on Figure 13 (plotted with 1992 samples results) and Figure 14 (plotted with 1994 sample results). It is noted that the sample depths for the 1992 and 1994 data are reflective of conditions prior to placement of the soil cap, which may have a thickness ranging from 4 feet to 8 feet based on historical reports (Practical Environmental Services, Inc., 1998b).

Section 7
Conclusions and Recommendations

This section summarizes and provides an evaluation of the potential impacts as shown in field screening data and analytical data. This is followed by recommendations for any future actions.

7.1 Conclusions

A cumulative risk evaluation for soils the Old Burn Pit is presented in Table 7 and the cumulative risk summary for the Landfill Areas is presented in Table 8. The evaluation was conducted by taking the maximum reported soil concentration of each detected constituent and dividing by the residential screening level and non-residential screening levels as shown in the equations below. The maximum concentration for metals includes both the historical analyses and recently collected data. These calculations are separated for carcinogenic and non-carcinogenic constituents. At the Old Burn Pit, the cumulative carcinogenic risk is 1.08 x 10^{-5} assuming residential land use and 2.14 x 10^{-6} for non-residential land use. The hazard index for residential land use is 0.477 and for non-residential land use is 0.622. At the Landfill Areas, the cumulative carcinogenic risk is 8.25 x 10^{-5} assuming residential land use and 1.63 x 10^{-5} for non-residential land use. The hazard index for residential land use is 3.09 and for non-residential land use is 2.49.

$$Site\ Risk = \left(\frac{conc_x}{SSL_x} + \frac{conc_y}{SSL_y} + \frac{conc_z}{SSL_z} + \cdots + \frac{conc_i}{SSL_i}\right) \times 10^{-5}$$

$$Site\ Hazard\ Index\ (HI) = \left(\frac{conc_x}{SSL_x} + \frac{conc_y}{SSL_y} + \frac{conc_z}{SSL_z} + \cdots + \frac{conc_i}{SSL_i}\right) \times 1$$

<u>SWMU No. 4 – Old Burn Pit</u>

There are no reported concentrations in soil for individual constituents that exceed the residential soil screening levels, with the exception of one sample [SWMU 4-1 (16-18')], which exceeded for arsenic (4.6 mg/kg). At the same location at a depth of 12-14', arsenic was reported at an estimated concentration of 2.2 mg/kg, which is below the residential screening level of 4.25 mg/kg. The presence of arsenic above the residential screening level at a depth of 16 feet does not pose an unacceptable risk to potential future residential use of the property. As noted in Section 2.2.1 of NMED's 2015 risk assessment guidance, the exposure scenario for residents assumes exposure to

only the upper 10 feet of soils. (NMED, 2015). The observed concentrations of arsenic may be representative of naturally occurring concentrations, but a site-specific evaluation of background values would be required to make that determination.

Arsenic was reported above the DAF 20 screening level in the three recently collected samples at boring SWMU 4-1 at depths of 12-14', 16-18', and 20-22'. The historical soil data presented in Table 1 included detections of ethylbenzene and naphthalene at concentrations above the DAF 20 screening level, which lead to the placement of a clay soil cap over the location of the former burn pit.

The new soil boring (SWMU 4-1) was placed in the center of the Old Burn Pit and drilled to a depth of 22 feet, which extended two feet into the bedrock, to ensure any vertical impacts from the Old Burn Pit were fully investigated. Groundwater was not encountered; however, moisture was observed in the gravelly clay/clayey gravel in SWMU 4-1 that may indicate shallow groundwater. There was no evidence of historical impacts to groundwater beneath the Old Burn Pit.

SWMU No. 5 – Landfill Areas

The only constituent with a concentration above either the DAF 20 or residential soil screening levels is arsenic. One recent sample [SWMU 5-1 (0-2')] had a reported concentration of 5.3 mg/kg, which exceeds the residential screening level of 4.25 mg/kg. Three other recent samples [(SWMU 5-1 (7-8'), SWMU 5-1 (18-20'), and SWMU 5-2 (14-16')] contained concentrations of arsenic above the DAF 20 screening level. The historical soil samples summarized in Table 2 also contained arsenic at concentrations above the residential and DAF 20 screening levels. The clay soil cap was placed over the impacted soils and all but sample SWMU 5-1 (0-2') are contained beneath the soil cap.

Soil sample SWMU 5-1 (0-2') was collected based on an elevated PID reading (the only elevated reading in this boring) and observation of a hydrocarbon odor. The sample was collected from the top of the existing cap and is not related to historical operations at SWMU No. 5. As noted above for SWMU No. 4, this generally low concentration of arsenic and may be reflective of naturally occurring concentrations. No other constituents were detected at concentrations above screening levels.

Boring SWMU 5-1 was drilled to a depth of 20 feet and did not encounter groundwater or evidence of waste materials. The termination depth of 20 feet is well below the deepest recorded depth of waste burial of 9.5 feet based on earlier investigations (Giant Refining Company, 1991). Boring SWMU 5-2 was drilled to a depth of 16 feet, two feet into the bedrock. Groundwater was not encountered at

SWMU 5-2; however, moisture was observed in the gravelly clay/clayey gravel in SWMU 5-2 that may indicate shallow groundwater. Based on the borings completed per the Investigation Work Plan, there is no evidence of any threats to groundwater and the soil cap is preventing any potential direct contact exposures to buried waste materials.

7.2 Recommendations

Based on the recent sampling effort there is no threat to groundwater from the Old Burn Pit and the previous remedy (soil cap) is sufficient to address any potential threat to human health and the environment from past operations. No further action is recommended for SWMU No. 4.

While the cap at SWMU No. 5 is protecting against potential threats to human health and the environment from any buried waste materials or associated releases, the detection of arsenic at the surface in soil sample SWMU 5-1 (0-2') should be further evaluated. It is recommended to compare the detected arsenic concentration to a site-specific background value upon completion of a site-specific background study.

Section 8
References

DiSorbo, 2015, Investigation Work Plan SWMU No. 4 Old Burn Pit and SWMU No. 5 Landfill Areas, Gallup Refinery, p.96.

Giant Refining Company, 1992, RCRA Facility Investigation Phase III – Giant Refining Company, Gallup New Mexico, p. 139.

Giant Refining Company, 1994, Report on Additional RFI Sampling, Ciniza Refinery, Gallup New Mexico.

Heckert, A.B. and Lucas, S.G., 1996, *Stratigraphic description of the Tr-4 unconformity in west-central New Mexico and eastern Arizona*: New Mexico Geology, Vol. 18, No. 3, pp. 61-70.

Lucas, S. G., Heckert, A.B., and Anderson, O. J., 1997, *Triassic Stratigraphy and Paleontology on the Fort Wingate quadrangle, west-central New Mexico*, New Mexico Geology, Vol. 19, No. 2. pp 33 - 42.

NMED, 2015, *Risk Assessment Guidance for Site Investigations and Remediation*, New Mexico Environment Department, p.91.

Practical Environmental Services, Inc., 1998a, SWMU 4 Summary Report, Old Burn Pit Area, Ciniza Refinery, McKinley County, New Mexico, p. 5.

Practical Environmental Services, Inc., 1998b, SWMU 5 Closure Certification Report, Solid Waste Landfill Areas, Ciniza Refinery, McKinley County, New Mexico, p. 5.

Stone, W.J., Lyford, F.P., Frenzel, P.F., Mizel, N.H., and Padgett, E.T., 1983, *Hydrogeology and Water Resources of San Juan Basin, New Mexico*; Hydrogeologic Report 6, New Mexico Bureau of Mines and Mineral Resources, p. 70.

USDA, 2005, *Soil Survey of McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties*, p. 683.

Western Refining, 2009, *Facility Wide Groundwater Monitoring Work Plan*, Western Refining Company Southwest, Inc., p. 78.

Attachment B-2: December Redline Edits

INVESTIGATION REPORT
Solid Waste Management Units (SWMU) No. 4 Old Burn Pit and No. 5 Landfill Areas

Western Refining™

Gallup Refinery
Western Refining Southwest, ~~Inc.~~LLC
Gallup, New Mexico

EPA ID# NMD000333211

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DiSorbo
Environmental Consulting Firm

8501 North Mopac Expy | Suite 300 | Austin, TX 78759
512.693.4190 (P) | 512.279.3118 (F) | www.disorboconsult.com

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List of Acronyms

AOCs	areas of concern
BTEX	benzene, toluene, ethylbenzene, and xylene
bgl	below ground level
bgs	below ground surface
CFR	Code of Federal Regulations
DRO	diesel range organics
DAF	dilution/attenuation factor
EPA	Environmental Protection Agency
gpm	gallons per minute
HI	hazard index
HSA	hollow-stem auger
HSWA	Hazardous and Solid Waste Act
IDW	investigation derived waste
LTU	Land Treatment Unit
MADEP	Massachusetts Department of Environmental Protection
MCL	maximum contaminant level
msl	mean sea level
MW	monitoring well
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
PID	photoionization detector
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SVOC	semi-volatile organic compound
SWMUs	Solid Waste Management Units
TPH	total petroleum hydrocarbon
TVOC	total volatile organic content
TCLP	toxicity characteristic leaching procedure
USCS	unified soil classification system
VOC	volatile organic compound

VSI	Visual Site Inspection
WQCC	Water Quality Control Commission

Executive Summary

The Gallup Refinery, which is located 17 miles east of Gallup, New Mexico, has been in operation since the 1950s. Past inspections by State [New Mexico Environment Department (NMED)] and federal environmental inspectors have identified locations where releases to the environment may have occurred. These locations are generally referred to as Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs). Pursuant to the terms and conditions of the facility's Resource Conservation and Recovery Act (RCRA) Post-Closure Care Permit and 20.4.1.500 New Mexico Administrative Code (NMAC), this environmental site investigation was completed for SWMUs No. 4 (Old Burn Pit) and No. 5 (Landfill Areas).

The Old Burn Pit occupied a small triangular shaped area of approximately 20 feet by 40 feet, which was located approximately 700 feet north of the refinery's main tank farm and a short distance northwest of the fire training area. The pit was used to burn acid soluble oils from the alkylation unit and was operated from 1958 through 1976. A RCRA Facility Investigation (RFI) was conducted in the area in early 1990s (three soil borings with depths of 4.5 feet in May 1992, which were extended to a depth of 10 feet in 1994) with the finding that the area did have relatively low concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals present in surface soils. Giant Refining Company recommended a soil cap be placed over the area of the burn pit and it was subsequently installed in 1997 pursuant to the United States Environmental Protection Agency's (EPA) approval of the Voluntary Corrective Action Plan.

The Land Fill Areas were determined to include four small areas used to dispose of waste generated from refinery construction, maintenance, and operations. Three of the landfill areas were contiguous and were located northwest of the main refinery tank farm, approximately 500 feet northwest of Tank 337. The fourth landfill area was located approximately 200 feet north of the other three landfills. The main landfill area is estimated to have been 100 feet wide by 350 feet long in a kidney shape. The separate landfill area to the north is estimated to have been 20 feet by 20 feet. The landfill areas were operated from 1958 through 1979. An RFI was conducted in the area in early 1990s (twelve soil borings to a depth of 9.5 feet in May 1992, with seven of these borings drilled deeper to a depth of 20 feet in 1994). The soil samples were analyzed for priority pollutant volatile organics and metals, with the finding that the area did primarily have metals present at

concentrations above background. Giant Refining Company recommended a soil cap be placed over the area of the landfills and it was subsequently installed in early 1998 pursuant to the EPA's approval of the Voluntary Corrective Action Plan.

Giant Refining Company submitted documentation demonstrating proper closure of the Old Burn Pit and the Landfill Areas in 1998 (Practical Environmental Services, Inc., 1998a and b). The investigation and remediation (i.e., capping) of both SWMUs was overseen and approved by the US EPA. In 2001, Giant Refining again submitted information on the remediation of the Old Burn Pit and the Landfill Areas in the "Petition for *No Further Action*" (Giant Refining Company, 2001). NMED commented on the 2001 *No Further Action* petition and requested additional information for the Old Burn Pit and the Landfill Areas. All of the additional information requested by NMED for the Old Burn Pit and the Landfill Areas was submitted to NMED on October 2, 2002. Western Refining Southwest, Inc. submitted another request for NMED to respond to the previously submitted Petition for *No Further Action* on June 24, 2013.

NMED requested additional assessment of, in particular, deeper soils and groundwater, if present, beneath both SWMUs. The current investigation began on September 20, 2016 and continued through October 3, 2016. One soil boring was completed at SWMU No. 4 (Old Burn Pit) and two soil borings were completed at SWMU 5 No. (Landfill Areas). Soil samples were collected from any intervals indicating potential impacts and at deeper intervals to define the vertical extent of impacts to soils. Groundwater was not encountered in any of the three soil borings. The three soil samples (excluding additional quality control samples) collected at SWMU No. 4 were analyzed for RCRA metals, VOCs (including MTBE), SVOCs, total petroleum hydrocarbons (TPH) and dioxins/furans. The five soil samples collected at SWMU No. 5 were analyzed for RCRA metals, VOCs (including MTBE), SVOCs, and TPH.

At SWMU No. 4, the soil boring was drilled to the top of bedrock and did not encounter groundwater. There were no organic constituents detected at concentrations above the screening level. Arsenic was the only metal detected at concentrations above the soil screening levels and these soil samples were collected from below the soil cap. The area at SWMU No. 4 was previously capped and there is no evidence of any threat to groundwater resources or any other threats to human health or the environment from SWMU No. 4.

SWMU No. 5 was assessed with the completion of two soil borings, neither of which encountered groundwater. There is no evidence of any threats to groundwater from SWMU No. 5. No organic constituents were detected above the soil screening levels in any of the soil samples and arsenic was the only metal detected at concentrations above the screening level. The detected arsenic concentrations ranged from 1.9 mg/kg to 5.3 mg/kg and may be representative of background concentrations. All but one of these detections were from soil samples collected beneath the cap, which would not require further evaluation. Based on a slightly elevated reading with a photo ionization detector (PID), a soil sample was collected from the land surface (0-2') where the highest arsenic concentration of 5.3 mg/kg was detected. This concentration exceeds the residential direct contact screening level and should be further evaluated upon completion of a site-specific evaluation of background concentrations.

Noting the potentially elevated arsenic concentration observed on top of the existing cap at SWMU No. 5, the previously approved and implemented remedial efforts have addressed any threats posed to the environment and/or human health that may have been present at the Old Burn Pit and the Landfill Areas prior to placement of the caps.

Section 1
Introduction

The Gallup Refinery is located approximately 17 miles east of Gallup, New Mexico along the north side of Interstate Highway I-40 in McKinley County. The physical address is I-40, Exit #39 Jamestown, New Mexico 87347. The Gallup Refinery property covers approximately 810 acres. Figure 1 presents the refinery location and the regional vicinity, which is characterized as high desert plain comprised primarily of public lands used for grazing by cattle and sheep.

The Gallup Refinery generally processes crude oil from the Four Corners area transported to the facility by pipeline or tanker truck. Various process units are operated at the facility, including crude distillation, reforming, fluidized catalytic cracking, alkylation, isomerization, sulfur recovery, merox treater, and hydrotreating. Current and past operations have produced gasoline, diesel fuels, jet fuels, kerosene, propane, butane, and residual fuel.

The area of investigation that is the subject of this report is shown on Figure 2 for the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5). The purpose of the site investigation is to supplement previous investigations of both SWMUs and address NMED's request for additional assessment of deeper soils and groundwater, if present, beneath both SWMUs. The investigation was completed pursuant to the *SWMU No. 4 and No. 5 Investigation Work Plan* dated November 2015 (approved with modification April 18, 2016).

Section 2 presents background information for SWMUs No. 4 and No. 5, including a review of historical waste management activities to help identity the types of waste handled, sources of releases, and previously known impacts to the environment. Section 3 describes the scope of work completed during the site investigation, including completion of soil borings and sample collection. The fourth section of the report explains the results of the field investigation, including the general surface and subsurface conditions and detailed site-specific information acquired during subsurface investigations. Section 5 explains the regulatory standards that are used for comparison to the analytical results and Section 6 presents the analytical results of soil samples analyzed for VOCs, SVOCs, TPH, and metals. The results of these analyses are compared to applicable State or federal screening levels. Section 7 summarizes and provides an evaluation of the potential impacts and provides recommendations for any future actions.

Section 2
Background

This section presents background information for the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5), including a review of historical waste management activities to identity the following:

- Type and characteristics of waste and contaminants handled in the SWMU;
- Known and possible sources of impacts;
- History of releases; and
- Known extent of impacts prior to the current investigation.

2.1 Old Burn Pit (SWMU No. 4)

The Old Burn Pit was originally included as a SWMU in the 1988 Hazardous and Solid Waste Act (HSWA) permit and subsequently included for investigation in the 1990 RFI Work Plan. The Old Burn Pit was put into service in 1958 and was removed from service in 1976, when the pit area was apparently covered with a layer of soil. It covered an area of approximately 20 feet by 40 feet with a triangular shape and had a depth of 10 to 12 feet (Figure 3). A Visual Site Inspection (VSI) was conducted on November 19 and 20, 1986 as part of the RCRA Facility Assessment. During this inspection, "An old metal box uphill from the pit" was described as being used to feed oil through a metal pipe to the burn pit. There is no subsequent mention of the steel box or pipe in the *SWMU Site-Specific Facility Investigation Workplan*, which provided a detailed discussion of site features and sampling locations (Applied Earth Sciences, Inc., 1990). Apparently the metal box and pipe were removed after the VSI was conducted in 1986 and sometime before preparation of the *SWMU Site-Specific Facility Investigation Workplan* in 1990. Acid soluble oils from the alkylation unit were placed in the pit and burned. It is possible that spent silicon dioxide catalysts may have also been placed in the pit.

In 1992, during the Phase III RFI three soil borings (RFI0401V, RFI0402V, and RFI0403V) were completed to depths of 4.5 feet below ground surface (bgs) using a hand auger (Figure 3) (Giant Refining Company, 1992). Soil samples were collected from depths of 0.0 feet bgs, 3.0 feet bgs, and 4.5 feet bgs at each of the three soil borings. The soil samples were analyzed for metals (arsenic, barium, beryllium, cadmium, chromium, lead, nickel, mercury, and vanadium), VOCs,

SVOCs, and pH and the results are presented in Table 1. For comparison the NMED soil screening levels (*Risk Assessment Guidance for Site Investigation and Remediation*, dated December 2014) and EPA Regional Screening Levels are also included in Table 1. Based on the detection of constituents in the samples collected in 1992, EPA directed that deeper samples be collected from the same three locations. As shown on Figure 4, three soil borings (RFI0404V, RFI0405V, and RFI0406V) were drilled using hollow-stem augers at the same locations in 1994 with soil samples collected at depths of 6.0 feet bgs and 10.0 feet bgs (Giant Refining Company, 1994). The soil samples were analyzed for VOCs, SVOCs, and metals and the results are summarized in Table 1.

One VOC and one SVOC were detected at concentrations above the soil screening levels developed to protect groundwater assuming a dilution attenuation factor (DAF) of 20, but all reported concentrations were less than the residential soil screening level for direct contact. The soil samples were also screened in the field with a photo ionization detector (PID). Many of the PID readings were 0.0, but those with higher readings are as follows; RFI0402 V3.0 at 16 parts per million (ppm), RFI0402 V4.5 at 8.4 ppm, RFI0403 V3.0 at 3.2 ppm, and RFI0403 V4.5 at 12 ppm. The field data sheets are included in Appendix A.

Ethylbenzene was found at concentrations above the DAF 20 screening level of 0.262 mg/kg in three soil samples. These three soil samples were RFI0402 V3.0, RFI0403 V3.0, and RFI0403 V4.5 with concentrations of ethylbenzene of 1.0 mg/kg, 0.910 mg/kg, and 0.510 mg/kg, respectively. Naphthalene was the only SVOC to have a concentration in soil above the DAF 20 screening level of 0.0823 mg/kg. Naphthalene was detected at a concentration of 0.520 mg/kg in sample RFI0402 V3.0.

Based on the detection of constituents in soils discovered during the Phase III RFI, Giant Refining Company recommended the placement of a soil cap over the area occupied by the burn pit. This activity was completed in 1997. During the week of March 23, 1998, an on-site inspection was conducted by Practical Environmental Services, Inc. in support of preparation of a RCRA Post-Closure Care Permit for the Gallup Refinery Land Treatment Unit. This inspection report, the applicable section of which is included in Appendix C of the *Investigation Work Plan SWMU No. 4 Old Burn Pit and SWMU No. 5 Landfill Areas*, documents the remediation (i.e., construction of a low permeability soil cap) of the Old Burn Pit (DiSorbo, 2015). The remediation was conducted under the review and authority of both EPA and NMED.

2.2 Landfill Areas (SWMU No. 5)

The Landfill Areas included four areas used to dispose of waste generated from refinery construction, maintenance, and operations. The construction waste is reported to have included asphalt paving, concrete, and scrap metal. Some office, residential, and shop wastes were also identified. Wastes associated with operations may have included defluorinator bauxite and hydrotreating catalyst (cobalt, molybdenum, and nickel), and possibly outdated laboratory chemicals. Three of the landfill areas were contiguous and were located northwest of the main refinery tank farm, approximately 500 feet northwest of Tank 337 (Figure 5). The fourth landfill area was located approximately 200 feet north of the other three landfills. The main landfill area is estimated to have been 100 feet wide by 350 feet long in a kidney shape. The separate landfill area to the north is estimated to have been 20 feet by 20 feet. The landfill areas were operated from 1958 through 1979.

An RFI was conducted in the area in May 1992 with twelve soil borings (RFI0501 through RFI0512) completed with a hand auger to a depth of 9.5 feet bgs (Figure 5). The soil samples were collected from depths of 0.0 feet bgs, 3.0 feet bgs, 7.0 feet bgs, and 9.5 feet bgs and analyzed for VOCs, metals, and pH. Based on the presence of waste materials at depths of 9.5 feet bgs, seven additional soil borings were drilled deeper to a minimum depth of 20 feet bgs in 1994. The deeper borings (RFI0513 through RFI0519) were completed using hollow-stem augers and were completed at the same location of previous soil borings RFI0502, RFI0503, RFI0504, RFI0505, RFI0506, RFI0507, and RFI0509 (Figure 6). Soil samples were collected from depths of 11.0 feet bgs, 16.0 feet bgs, and 20.0 feet bgs and analyzed for VOCs, SVOCs, and metals. The analytical results are presented in Table 2.

One constituent (arsenic) was detected at concentrations above the soil screening levels developed to protect groundwater assuming a dilution attenuation factor (DAF) of 20.0 (0.299 mg/kg) and arsenic was also reported at concentrations above the residential soil screening level for direct contact (4.25mg/kg). The soil samples were also screened in the field with a PID. Many of the PID readings were 0.0, but those with higher readings are as follows; RFI0504 V3.0 at 0.01 ppm and RFI0504 V9.5 at 0.4 ppm. The field data sheets are included in Appendix A.

As shown in Table 2, all of the detected results for arsenic are above the DAF 20 screening level of 0.299 mg/kg. Many of the reported arsenic concentrations also exceed the residential direct

contact screening level of 4.25 mg/kg. Arsenic concentrations ranged from non-detect (< 2.5 mg/kg) to 35 mg/kg.

Based on the detection of constituents in soils discovered during the Phase III RFI, Giant Refining Company recommended the placement of a soil cap over the area occupied by the landfills. This activity was completed in early 1998. During the week of March 23, 1998, an on-site inspection was conducted by Practical Environmental Services, Inc. to document the closure of SWMU No. 5. A Landfill Closure Certification Report was prepared, which documents the remediation (i.e., construction of a low permeability soil cap) of the Landfill Areas (Practical Environmental Services, 1998b). The remediation was conducted under the review and authority of both EPA and NMED, in accordance with the Voluntary Corrective Action Plan approved by EPA on January 5, 1994.

Section 3
Scope of Activities

3.1 Soil Boring Installation and Sample Collection

Pursuant to the approved Investigation Work Plan (2015), an investigation of soils was conducted to define the vertical extent of any impacts to soil and evaluate the presence of and potential for impacts to groundwater. To accomplish this objective, soil borings were installed at the Old Burn Pit and the Landfill Areas. As outlined in the Investigation Work Plan, there is the potential for constituents to have been released to soils at known locations and therefore a judgmental sampling design was implemented.

3.1.1 Site Investigation

The scope of work for the investigation at the Old Burn Pit consisted of the installation of one soil boring in the center of the former pit. Two soil borings were completed at the Landfill Areas with one in the center of the area previously identified as Landfill Area 1 and the second in the center of the main landfill area. The soil boring at the Old Burn Pit was to be drilled to a minimum depth of two feet into the native soils (i.e., beneath any apparent waste materials identified or any other indications of fill material). The soil borings at the Landfill Areas were to be drilled to a minimum depth of two feet into the native soils or to a depth of 20 feet, whichever is deeper. If field evidence of impacts at greater depths was observed, then soil borings were to be drilled deeper to achieve full vertical delineation. The investigation also focused on identifying any zones of saturated soils. If saturation was encountered, then temporary wells were to be installed to allow collection of groundwater samples.

Three soil samples were collected at SWMU No. 4 and five soil samples were collected at SWMU 5 No. (excluding additional quality assurance samples). The soil samples were analyzed for potential site-related constituents including volatile and semi-volatile organics, total petroleum (i.e., gasoline, diesel, and motor oil range) hydrocarbons, and RCRA metals. In addition, soil samples collected at SWMU No. 4 were analyzed for dioxins and furans. No groundwater samples were collected, as saturation was not encountered in any of the soil borings (SWMU 4-1, SWMU 5-1 or SWMU 5-2).

All three soil borings were advanced using hollow-stem augers. The following list provides a summary of the soil borings:

- SWMU 4-1; advanced to 22 feet below ground level (bgl); terminated in bedrock;
- SWMU 5-1; advanced to 20 feet bgl; terminated in dry sandy clay after penetrating 13 feet of apparent native soils; and
- SWMU 5-2; advanced to 16 feet bgl; terminated in bedrock.

3.2 Collection and Management of Investigation Derived Waste

Drill cuttings, excess sample material and decontamination fluids, and all other investigation derived waste (IDW) associated with soil borings were contained and are currently being characterized for disposal.

3.3 Surveys

A global positioning system receiver was used to record the coordinates of each soil boring. These coordinates were recorded on the field boring logs.

Section 4
Field Investigation Results

This section provides a summary of the surface and subsurface conditions at the refinery, including the area near the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5). A discussion is included on the installation of soil borings, field screening of soils, and collection of soil samples for analysis.

4.1 Surface Conditions

A topographic map of the area near the Old Burn Pit and Landfill Areas is included as Figure 7. Local site topographic features include high ground in the southeast gradually decreasing to lowland fluvial plain in the northwest. Elevations on the refinery property range from 7,040 feet to 6,860 feet. The area of the site near SWMU No. 4 is at an approximate elevation of 6,925 feet and the elevations near SWMU No. 5 range from 6,915 to 6,940 feet above mean sea level (msl).

The McKinley County soil survey identifies the soil in the area of SWMUs No. 4 and No. 5 as primarily the Simitarq-Celavar sandy loams (USDA, 2005). The Simitarq-Celavar soils are well drained with a conservative permeability of 0.20 in/hr and minimal salinity. Simitarq soils have nearly neutral pH values ranging from 7.2 to 7.4 standard units.

Regional surface water features include the refinery evaporation ponds and aeration lagoons and a number of small ponds. The site is located in the Puerco River Valley, north of the Zuni Uplift with overland flows directed northward to the tributaries of the Puerco River. The Puerco River continues to the west to the confluence with the Little Colorado River. The South Fork of the Puerco River is intermittent and retains flow only during and immediately following precipitation events.

4.2 Subsurface Conditions

No underground utilities were identified during clearance of the soil borings for the Old Burn Pit or Landfill Areas.

4.2.1 Geology

The shallow subsurface soils consist of fluvial and alluvial deposits comprised of clay and silt with minor inter-bedded sand layers. The Quaternary alluvium, which occurs at the land surface in the

area of the Old Burn Pit and the Landfill Areas, is mapped regionally as a narrow band trending west-northwest and running just north of I-40 (Figure 8). The Quaternary alluvium is thought to be the parent material of the Simitarq-Celavar soils discussed above in Section 4.1. A cross section of the shallow subsurface in the immediate vicinity of the Old Burn Pit and Landfill Areas is included as Figure 9. Figure 2 shows the location of the cross section. As shown on the cross section, the predominant lithology is silty clay.

Subcropping beneath the Quaternary alluvium is the Triassic Chinle Group (Figure 8). The stratigraphy of the Chinle Group was described in detail for the nearby Fort Wingate quadrangle by Lucas et al, 1997. The Painted Desert Member of the Petrified Forest Formation is the uppermost member of the Chinle Group present in the area of the refinery. The Painted Desert Member is described as reddish-brown and grayish red mudstone with minor beds of resistant, laminated or crossbedded, litharenite. This is consistent with the bedrock encountered at the refinery, as depicted on cross section A-A' (Figure 9). Beneath the Painted Desert Member is the Sonsela Member, which is described by Lucas et al (1997) as gray to yellowish-brown, fine-grained to conglomeratic, crossbedded sandstone. The base of the Sonsela Member is recognized as a basin wide unconformity, which was termed the Tr-4 unconformity (Heckert and Lucas, 1996). The Blue Mesa Member, which underlies the Sonsela Member, is the lowest member of the Petrified Forest Formation. The Blue Mesa Member is described as mostly purple and greenish-gray mudstone.

4.2.2 Hydrogeology

None of the three soil borings completed at SWMUs No. 4 and No. 5 encountered groundwater. Soil boring SWMU 4-1 encountered bedrock (mudstone/claystone) at a depth of 20 feet with a dry sandy clay on top of the bedrock. (Figure 9). Damp soil was observed in gravelly clay at an approximate depth of 17 feet. Soil Boring SWMU 5-1 was drilled to a depth of 20 feet pursuant to the Investigation Work Plan and was terminated in a dry sandy clay. As indicated on Figure 9, the depth to bedrock near SWMU 5-1 may be at depths of 35 to 40 feet. Bedrock was encountered at a depth of 14 feet in SWMU 5-2, with a dry stiff clay overlying the bedrock surface. Damp soil was observed at approximately 12 feet in a clayey gravel layer. The damp soil noted in soil borings SWMU 4-1 and SWMU 5-2 are at a depth similar to the water level depth measured in well OW-56. Well OW-56 is screened in a sandy, gravelly clay. Moisture observed in the gravelly clay/clayey gravel in soil borings SWMU 4-1 and SWMU 5-2 may represent shallow groundwater. Shallow groundwater may be present in the general area of the two SWMUs~~, but its occurrence is sporadic~~.

The diverse properties and complex, irregular stratigraphy of the Quaternary alluvium across the refinery cause a wide range of hydraulic conductivity ranging from less than 10^{-2} cm/sec for gravelly sands immediately overlying the Painted Desert Member to 10^{-8} cm/sec in the clay soils located near the surface (Western Refining, 2009). Permeability tests performed on the Quaternary alluvium beneath the nearby Land Treatment Unit (LTU) indicated an average permeability of 1.9E-05 cm/sec (Appendix B). Permeability tests performed on soils in the area of the firewater pond indicated an average permeability of 1.1E-07 cm/sec (Appendix B). Because damp soil was observed in soil borings SWMU 4-1 and SWMU 5-2, it may be representative of shallow groundwater in the area. However, due to the tight clays the presence of groundwater may not be observed in the open boreholes in a timely manner. None of the soil borings were completed as a temporary well so the presence of groundwater cannot be confirmed.

As described above, the bedrock (i.e., Petrified Forest Formation) is mainly composed of low permeability materials (e.g., mudstone) with the exception of the Sonsela Member and some thinner sandstones within the overlying Painted Desert Member. Yield tests, including slug tests and pumping tests have been performed at the refinery to estimate the hydraulic conductivity of the Painted Desert Member (Appendix B). A slug test performed on July 3, 1984 in well OW-4 indicated a hydraulic conductivity of 4.0E-7 cm/sec. A pump test was performed in well OW-24 on February 20, 1985 and it yielded a hydraulic conductivity of 2.5E-7 cm/sec. The Painted Desert Member appears to be a competent aquitard to reduce the potential for downward migration of contaminants from groundwater that may occur within the overlying Quaternary alluvium.

Generally, shallow groundwater at the refinery follows the upper contact of the Chinle Group with prevailing flow from the southeast to the northwest, with some flow potentially to the northeast on the northeastern portion of the refinery property. The Sonsela Member is identified as the uppermost aquifer for RCRA monitoring purposes at the LTU because the overlying groundwater bearing units are not capable of supplying sufficient quantities of groundwater to meet the definitions of an aquifer. Wells completed in a thinner permeable sandstone layer within the Painted Desert Member are also monitored near the LTU as a potential early warning network. The Sonsela's highest point occurs southeast of the site and slopes downward to the northwest as it passes under the refinery. The Sonsela Member forms a water-bearing reservoir with artesian conditions throughout the central and western portions of the refinery property (Western Refining, 2009). Aquifer test of the Sonsela Member conducted northeast of Prewitt indicated a transmissivity of

greater than 100 ft^2/day (Stone and others, 1983). Yield tests conducted at the site have shown a much lower hydraulic conductivity of 0.34 ft/day (1.2E-04 cm/sec) (Appendix B).

Sections 2.1 and 2.2 present the historical data collected for SWMU No. 4 and SWMU No. 5, respectively. In SWMU No. 4, two constituents (ethylbenzene and naphthalene) were detected at concentrations above the soil screening levels developed to protect groundwater but less than the residential soil screening level for direct contact. The detections were observed in samples collected between 3 ft bgs and 4.5 ft bgs; samples collected at 6 ft bgs and 10 ft bgs were below detection limits. The samples depths are approximately 10 ft above the observed damp gravelly clay layer.

In SWMU No. 5, arsenic was detected at concentrations above the soil screening levels developed to protect groundwater and was also reported at concentrations above the residential soil screening level for direct contact. The detections occurred between 0 ft bgs and 20 ft bgs. These samples depths are approximately 15 ft above the observed clayey gravel layer. No organic constituents were above any screening standards.

Information regarding the current investigation is presented in Section 4.3.

4.3 Exploratory Drilling Investigations, Soil Sampling and Boring Abandonment

This subsection provides a description of surface and subsurface investigations to define the vertical extent of any impacts to soil and evaluate the presence of and potential for impacts to groundwater. This includes soil field screening results, soil sampling intervals and methods for detection of surface and subsurface impacts in soils.

Discrete soil samples for laboratory analyses were scheduled for collection at the following intervals:

- From the interval in each soil boring with the greatest apparent degree of contamination, based on field observations and field screening;
- From the top of native soil immediately below the presence of any waste materials (e.g., burn residue in the Old Burn Pit or landfill waste in the Landfill Areas);
- From the bottom of each borehole;
- From the 6" interval at the top of saturation (applicable only to borings that reach saturation); and
- Any additional intervals as determined based on field screening results.

A description of the field screening and soil sampling procedures are presented in Appendix C – Field Methods. Copies of the boring logs are provided in Appendix D. In addition to being included on the soil boring logs, the soil vapor (i.e., headspace) screening results are summarized in Table 3. The locations of the soil borings appear on Figures 10 through 14.

4.3.1 Soil Investigation

Three soil borings were advanced using the hollow-stem auger (HSA) method and two of these soil borings were drilled to the bedrock (claystone/mudstone). The drilling equipment was decontaminated between each borehole, as described in Appendix C. The soil boring logs describe the subsurface lithology, the presence of saturation, and the field screening results. The installation of soil borings and collection of soil samples are discussed below in numerical order. Groundwater was not encountered in any of the soil borings.

SWMU 4-1

On October 3, 2016 the drilling rig was set up on location SWMU 4-1. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Three soil samples were collected from the following intervals:

- 12 feet bgl - 14 feet bgl – PID reading of 0.4 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of the silty clay located immediately below clayey silt (considered to be a more transmissive sediment). A duplicate soil sample was collected from this interval;
- 16 feet bgl - 18 feet bgl – PID reading of 0.1 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from an interval that was observed to be a clayey gravel. This interval did not appear to consist of transmissive sediments as the gravel was present in a low plastic clay matrix where pore space was not apparent; and
- 20 feet bgl - 22 feet bgl – Bottom of the borehole. PID reading of 1.0 ppm – No visual or olfactory evidence of impacted soils were present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Clayey Silt 0 feet bgl – 10 feet bgl (low plastic, soft, damp, brown, no odor);
- Clayey Silt 10 feet bgl – 12 feet bgl (low plastic, firm, damp, brown, no odor);
- Silty Clay 12 feet bgl – 16 feet bgl (low plastic, stiff, damp, brown, no odor);

- Clayey Gravel 16 feet bgl – 18 feet bgl (1/2" to 1/4" sandstone gravel in a low plastic clay matrix, damp, reddish brown, no odor);
- Sandy Clay 18 feet bgl – 20 feet bgl (low plastic, very stiff and potentially represents upper portion of weathered bedrock, dry, very fine grain sand present, grey and light brown, no odor); and
- Claystone 20 feet bgl – 22 feet bgl (similar to the 18 to 20 feet interval, very stiff, dry, no odor).

The PID readings range from 0.0 ppm (18 feet bgl – 20 feet bgl) to 2.9 ppm (0 feet bgl – 2 feet bgl). Saturation was not encountered.

The sampling terminated at 22 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On October 3, 2016 the borehole was grouted.

SWMU 5-1

On September 20, 2016 the drilling rig was set up on location SWMU 5-1. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Three soil samples were collected from the following intervals:

- 0 feet bgl - 2 feet bgl – PID reading of 28.6 ppm – This sample was collected at the surface from fill material. The sediment exhibited a petroleum hydrocarbon odor. There was no visual evidence of impacted soils;
- 7 feet bgl - 8 feet bgl – PID reading of 1.5 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of a silty clay located immediately below fill material; and
- 18 feet bgl - 20 feet bgl – Bottom of the borehole. PID reading of 0.1 ppm – No visual or olfactory evidence of impacted soils was present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Fill 0 feet bgl – 7 feet bgl (brown sand, gravel and clay, hydrocarbon odor was detected in the 0 feet bgl to 2 feet bgl interval, no odor was detected from the 2 feet bgl to 7 feet bgl interval);

- Silty Clay 7 feet bgl – 8 feet bgl (low plastic, very stiff, damp, brown, no odor);
- Silty Sandy Clay 8 feet bgl – 10 feet bgl (low plastic, firm, damp, brown, no odor);
- Clayey Sand 10 feet bgl – 12 feet bgl (very fine grain, compact, dry, brown, no odor); and
- Sandy Clay 12 feet bgl – 20 feet bgl (low plastic, very stiff, dry, brown, no odor).

The PID readings range from 0.1 ppm (18 feet bgl – 20 feet bgl) to 28.6 ppm (0 feet bgl – 2 feet bgl). Saturation was not encountered.

The sampling terminated at 20 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On September 20, 2016 the borehole was grouted.

<u>SWMU 5-2</u>

On September 29, 2016 the drilling rig was set up on location SWMU 5-2. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Two soil samples were collected from the following intervals:

- 10 feet bgl - 12 feet bgl – PID reading of 12.6 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of the clayey gravel located immediately below clayey sandy silt (considered to be more transmissive sediment); and
- 14 feet bgl - 16 feet bgl – Bottom of the borehole. PID reading of 5.1 ppm – No visual or olfactory evidence of impacted soils were present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Clayey Silt 0 feet bgl – 6 feet bgl (low plastic, firm, damp to dry, brown, no odor);
- Clayey Sandy Silt 6 feet bgl – 10 feet bgl (low plastic, stiff, damp, brown, no odor);
- Clayey Gravel 10 feet bgl – 12 feet bgl (dense, damp, calcareous, reddish brown clay matrix, no odor);
- Clay 12 feet bgl – 14 feet bgl (low to moderately plastic, very stiff and potentially represents weathered surface of bedrock, dry, reddish brown and light grey, no odor); and

- Claystone 14 feet bgl – 16 feet bgl (similar to the 12 to 14 feet interval, reddish brown and grey, no odor).

The PID readings range from 3.6 ppm (0 feet bgl – 2 feet bgl) to 12.6 ppm (10 feet bgl – 12 feet bgl). Saturation was not encountered.

The sampling terminated at 16 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On October 3, 2016 the borehole was grouted.

Section 5
Regulatory Criteria

The applicable screening and potential cleanup levels are specified in NMED's *Risk Assessment Guidance for Site Investigations and Remediation* dated July 2015 and in the Environmental Protection Agency's (EPA) Regional Screening Levels dated November 2015.

For non-residential properties (e.g., the Gallup Refinery), the soil screening levels must be protective of commercial/industrial workers throughout the upper one foot of surface soils and construction workers throughout the upper ten feet based on NMED criteria. NMED residential soil screening levels are applied to the upper ten feet and soil screening levels for protection of groundwater apply throughout the vadose zone. EPA soil screening levels for direct contact exposure apply to the upper two feet of the vadose zone. To achieve closure as "corrective action complete without controls", the affected media must meet residential screening levels, which are presented in Table 4. Table 4 also provides a list of the available NMED and EPA soil screening levels for non-residential properties. While Table 4 indicates the various depths to which the individual soil screening levels are applicable, Tables 5 and 6 discussed below do not include this level of detail.

Table 4 has soil screening levels for the soil-to-groundwater pathway that are based on a dilution/attenuation factor (DAF) of 1.0, which is NMED's most conservative screening level for this pathway. A review of site conditions (i.e., predominance of very fine-grained soils and limited occurrence of groundwater with low yields) indicates that a DAF of 1.0 is overly conservative, thus NMED's slightly higher DAF value of 20 presented in the 2015 risk assessment guidance is used for comparison in Tables 5 and 6 (NMED, 2015).

The screening levels included in Tables 5 and 6 cover both residential and non-residential land use. For the non-residential screening levels, the lower of the construction worker scenario and commercial/industrial scenario screening levels for each constituent is included in the data tables if NMED screening levels are available. If NMED soil screening levels are not available for a particular constituent, then EPA soils screening levels are used. If an EPA soil screening level is for a carcinogenic compound, then the screening level is multiplied by 10 to bring the risk level to 1E-05 to be consistent with the NMED screening levels. The screening levels in Tables 5 and 6 have not been segregated based on depth of the soil sample as discussed above for Table 4.

A review of the NMED guidelines for TPH indicates that the TPH screening levels were developed based on screening levels and compositional assumptions developed by the Massachusetts Department of Environmental Protection (MADEP). The analytical results, as presented in Tables 5 and 6, are reported for gasoline range organics (C6-C10), diesel range organics (>C10-C28), and motor oil range organics (>C28-C35). The applicable TPH screening levels for comparison to the individual soil samples are selected from Table 6-2 of the NMED guidance (NMED, 2015).

There are no soil screening levels for gasoline range organics and the individual compounds listed for groundwater (gasoline range criteria) are included in the list of analytes used for site samples. As there could have been a variety of petroleum types (e.g., crude oil or various refined products) going to the Old Burn Pit, the screening level for "unknown oil" was selected for comparison to the diesel range and motor oil range soil analytical results. The motor oil range analytical results are compared to the "unknown oil" screening level as directed by NMED. However, it is noted that the laboratory analyses for motor oil range organics only reports results for the >C28 to C35 hydrocarbon range, while the "unknown oil" screening level is based on a hydrocarbon mixture assumed to include only C11-C22 aromatics.

Some of the individual constituents reported by the laboratory do not have screening levels but were all non-detect with respect to soil except di-n-octyl-phthalate, which is not classified as a known carcinogen.

Section 6
Site Impacts

This section discusses the chemical analyses performed and presents the analytical results that were obtained through the analysis of soil samples, which were collected at the Old Burn Pit and Landfill Areas. The results for soils analyses are presented and compared to applicable screening levels, as described in Section 5.0.

6.1 Soil Analytical Results

Soil samples were analyzed by Hall Environmental Analysis Laboratory in Albuquerque, New Mexico using the following methods for organic constituents:

- SW-846 Method 8260/5035 volatile organic compounds;
- SW-846 Method 8270C semi-volatile organic compounds; and
- SW-846 Method 8015D gasoline, diesel, and motor oil range petroleum hydrocarbons.

Soil samples were analyzed for the following metals using the indicated analytical methods, respectively.

Analyte	Analytical Method
Arsenic	SW-846 Method 6010B
Barium	SW-846 Method 6010B
Cadmium	SW-846 Method 6010B
Chromium	SW-846 Method 6010B
Lead	SW-846 Method 6010B
Mercury	SW-846 Method 7471
Selenium	SW-846 Method 6010B
Silver	SW-846 Method 6010B

In addition, soil samples collected at SWMU No. 4 (Old Burn Pit) were analyzed for dioxins/furans by SW-846 Method 8290A.

The analytical results for soil samples collected at the Old Burn Pit are summarized in Table 5 and the results for the Landfill Areas are summarized in Table 6. The individual results that exceed the applicable cleanup levels are highlighted, as noted in the table footnotes. Maps showing the distribution of constituents detected in soils above the lowest applicable screening levels are included as Figures 10 through 14. The concentrations shown on figures that exceed the screening levels in Tables 5 and 6 are underlined on the figures. The laboratory analytical reports are included in Appendix E and the data validation of the results, which includes the analytical results for the associated QA/QC samples, is included in Appendix F. The constituents that have concentrations in soils above screening levels are discussed below.

SWMU No. 4 – Old Burn Pit

Arsenic was detected at a concentration above the residential screening level of 4.25 mg/kg in one soil sample [SWMU 4-1 (16-18')] at a concentration of 4.6 mg/kg. Soil samples SWMU 4-1 (12-14') and SWMU 4-1 (20-22') had reported arsenic concentrations of 2.2 and 2.0 mg/kg, respectively, which are above the DAF 20 screening level of 0.299 mg/kg. The concentrations are shown on Figure 10 and summarized in Table 5.

SWMU No. 5 – Landfill Areas

Arsenic was detected at concentrations above the DAF 20 screening level (0.299 mg/kg) in four of the five samples collected, including SWMU 5-1 (0-2'), SWMU 5-1 (7-8'), SWMU 5-1 (18-20'), and SWMU 5-2 (14-16'). The concentrations range from 1.9 mg/kg to 5.3 mg/kg. Sample SWMU 5-1 (0-2') with a concentration of 5.3 mg/kg exceeds the residential screening level of 4.25 mg/kg. The arsenic concentrations are shown on Figure 13 (plotted with 1992 samples results) and Figure 14 (plotted with 1994 sample results). It is noted that the sample depths for the 1992 and 1994 data are reflective of conditions prior to placement of the soil cap, which may have a thickness ranging from 4 feet to 8 feet based on historical reports (Practical Environmental Services, Inc., 1998b).

Section 7
Conclusions and Recommendations

This section summarizes and provides an evaluation of the potential impacts as shown in field screening data and analytical data. This is followed by recommendations for any future actions.

7.1 Conclusions

A cumulative risk evaluation for soils the Old Burn Pit is presented in Table 7 and the cumulative risk summary for the Landfill Areas is presented in Table 8. The evaluation was conducted by taking the maximum reported soil concentration of each detected constituent and dividing by the residential screening level and non-residential screening levels as shown in the equations below. The maximum concentration for metals includes both the historical analyses and recently collected data. These calculations are separated for carcinogenic and non-carcinogenic constituents. At the Old Burn Pit, the cumulative carcinogenic risk is 1.08×10^{-5} assuming residential land use and 2.14×10^{-6} for non-residential land use. The hazard index for residential land use is 0.477 and for non-residential land use is 0.622. At the Landfill Areas, the cumulative carcinogenic risk is 8.25×10^{-5} assuming residential land use and 1.63×10^{-5} for non-residential land use. The hazard index for residential land use is 3.09 and for non-residential land use is 2.49.

$$Site\ Risk = \left(\frac{conc_x}{SSL_x} + \frac{conc_y}{SSL_y} + \frac{conc_z}{SSL_z} + \cdots + \frac{conc_i}{SSL_i}\right) \times 10^{-5}$$

$$Site\ Hazard\ Index\ (HI) = \left(\frac{conc_x}{SSL_x} + \frac{conc_y}{SSL_y} + \frac{conc_z}{SSL_z} + \cdots + \frac{conc_i}{SSL_i}\right) \times 1$$

SWMU No. 4 – Old Burn Pit

There are no reported concentrations in soil for individual constituents that exceed the residential soil screening levels, with the exception of one sample [SWMU 4-1 (16-18')], which exceeded for arsenic (4.6 mg/kg). At the same location at a depth of 12-14', arsenic was reported at an estimated concentration of 2.2 mg/kg, which is below the residential screening level of 4.25 mg/kg. The presence of arsenic above the residential screening level at a depth of 16 feet does not pose an unacceptable risk to potential future residential use of the property. As noted in Section 2.2.1 of NMED's 2015 risk assessment guidance, the exposure scenario for residents assumes exposure to

only the upper 10 feet of soils. (NMED, 2015). The observed concentrations of arsenic may be representative of naturally occurring concentrations, but a site-specific evaluation of background values would be required to make that determination.

Arsenic was reported above the DAF 20 screening level in the three recently collected samples at boring SWMU 4-1 at depths of 12-14', 16-18', and 20-22'. The historical soil data presented in Table 1 included detections of ethylbenzene and naphthalene at concentrations above the DAF 20 screening level, which lead to the placement of a clay soil cap over the location of the former burn pit.

The new soil boring (SWMU 4-1) was placed in the center of the Old Burn Pit and drilled to a depth of 22 feet, which extended two feet into the bedrock, to ensure any vertical impacts from the Old Burn Pit were fully investigated. Groundwater was not encountered; however, moisture was observed in the gravelly clay/clayey gravel in SWMU 4-1 that may indicate shallow groundwater. ~~and t~~There was no evidence of historical impacts to groundwater beneath the Old Burn Pit.

SWMU No. 5 – Landfill Areas

The only constituent with a concentration above either the DAF 20 or residential soil screening levels is arsenic. One recent sample [SWMU 5-1 (0-2')] had a reported concentration of 5.3 mg/kg, which exceeds the residential screening level of 4.25 mg/kg. Three other recent samples [(SWMU 5-1 (7-8'), SWMU 5-1 (18-20'), and SWMU 5-2 (14-16')] contained concentrations of arsenic above the DAF 20 screening level. The historical soil samples summarized in Table 2 also contained arsenic at concentrations above the residential and DAF 20 screening levels. The clay soil cap was placed over the impacted soils and all but sample SWMU 5-1 (0-2') are contained beneath the soil cap.

Soil sample SWMU 5-1 (0-2') was collected based on an elevated PID reading (the only elevated reading in this boring) and observation of a hydrocarbon odor. The sample was collected from the top of the existing cap and is not related to historical operations at SWMU No. 5. As noted above for SWMU No. 4, this generally low concentration of arsenic and may be reflective of naturally occurring concentrations. No other constituents were detected at concentrations above screening levels.

Boring SWMU 5-1 was drilled to a depth of 20 feet and did not encounter groundwater or evidence of waste materials. The termination depth of 20 feet is well below the deepest recorded depth of waste burial of 9.5 feet based on earlier investigations (Giant Refining Company, 1991). Boring SWMU 5-2 was drilled to a depth of 16 feet, two feet into the bedrock. Groundwater was not encountered at

SWMU 5-2; however, moisture was observed in the gravelly clay/clayey gravel in SWMU 5-2 that may indicate shallow groundwater.. Based on the borings completed per the Investigation Work Plan, there is no evidence of any threats to groundwater and the soil cap is preventing any potential direct contact exposures to buried waste materials.

7.2 Recommendations

Based on the recent sampling effort there is no threat to groundwater from the Old Burn Pit and the previous remedy (soil cap) is sufficient to address any potential threat to human health and the environment from past operations. No further action is recommended for SWMU No. 4.

While the cap at SWMU No. 5 is protecting against potential threats to human health and the environment from any buried waste materials or associated releases, the detection of arsenic at the surface in soil sample SWMU 5-1 (0-2') should be further evaluated. It is recommended to compare the detected arsenic concentration to a site-specific background value upon completion of a site-specific background study.

Section 8
References

DiSorbo, 2015, Investigation Work Plan SWMU No. 4 Old Burn Pit and SWMU No. 5 Landfill Areas, Gallup Refinery, p.96.

Giant Refining Company, 1992, RCRA Facility Investigation Phase III – Giant Refining Company, Gallup New Mexico, p. 139.

Giant Refining Company, 1994, Report on Additional RFI Sampling, Ciniza Refinery, Gallup New Mexico.

Heckert, A.B. and Lucas, S.G., 1996, *Stratigraphic description of the Tr-4 unconformity in west-central New Mexico and eastern Arizona*: New Mexico Geology, Vol. 18, No. 3, pp. 61-70.

Lucas, S. G., Heckert, A.B., and Anderson, O. J., 1997, *Triassic Stratigraphy and Paleontology on the Fort Wingate quadrangle, west-central New Mexico*, New Mexico Geology, Vol. 19, No. 2. pp 33 - 42.

NMED, 2015, *Risk Assessment Guidance for Site Investigations and Remediation*, New Mexico Environment Department, p.91.

Practical Environmental Services, Inc., 1998a, SWMU 4 Summary Report, Old Burn Pit Area, Ciniza Refinery, McKinley County, New Mexico, p. 5.

Practical Environmental Services, Inc., 1998b, SWMU 5 Closure Certification Report, Solid Waste Landfill Areas, Ciniza Refinery, McKinley County, New Mexico, p. 5.

Stone, W.J., Lyford, F.P., Frenzel, P.F., Mizel, N.H., and Padgett, E.T., 1983, *Hydrogeology and Water Resources of San Juan Basin, New Mexico*; Hydrogeologic Report 6, New Mexico Bureau of Mines and Mineral Resources, p. 70.

USDA, 2005, *Soil Survey of McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties*, p. 683.

Western Refining, 2009, *Facility Wide Groundwater Monitoring Work Plan*, Western Refining Company Southwest, Inc., p. 78.

Attachment B-3: All Redline Edits

INVESTIGATION REPORT
Solid Waste Management Units (SWMU)
No. 4 Old Burn Pit and No. 5 Landfill Areas

Western Refining™

Gallup Refinery
Western Refining Southwest, Inc.
Gallup, New Mexico

EPA ID# NMD000333211

JANUARY 2017

Revised JUNE 2021 by Trihydro Corporation

Scott Crouch, P.G
DiSorbo Consulting, LLC

DiSorbo
Environmental Consulting Firm

8501 North Mopac Expy | **Suite 300** | **Austin, TX 78759**
512.693.4190 (P) | 512.279.3118 (F) | www.disorboconsult.com

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List of Acronyms

AOCs	areas of concern
BTEX	benzene, toluene, ethylbenzene, and xylene
bgl	below ground level
bgs	below ground surface
CFR	Code of Federal Regulations
DRO	diesel range organics
DAF	dilution/attenuation factor
EPA	Environmental Protection Agency
gpm	gallons per minute
HI	hazard index
HSA	hollow-stem auger
HSWA	Hazardous and Solid Waste Act
IDW	investigation derived waste
LTU	Land Treatment Unit
MADEP	Massachusetts Department of Environmental Protection
MCL	maximum contaminant level
msl	mean sea level
MW	monitoring well
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
PID	photoionization detector
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SVOC	semi-volatile organic compound
SWMUs	Solid Waste Management Units
TPH	total petroleum hydrocarbon
TVOC	total volatile organic content
TCLP	toxicity characteristic leaching procedure
USCS	unified soil classification system
VOC	volatile organic compound

VSI	Visual Site Inspection
WQCC	Water Quality Control Commission

Executive Summary

The Gallup Refinery, which is located 17 miles east of Gallup, New Mexico, has been in operation since the 1950s. Past inspections by State [New Mexico Environment Department (NMED)] and federal environmental inspectors have identified locations where releases to the environment may have occurred. These locations are generally referred to as Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs). Pursuant to the terms and conditions of the facility's Resource Conservation and Recovery Act (RCRA) Post-Closure Care Permit and 20.4.1.500 New Mexico Administrative Code (NMAC), this environmental site investigation was completed for SWMUs No. 4 (Old Burn Pit) and No. 5 (Landfill Areas).

The Old Burn Pit occupied a small triangular shaped area of approximately 20 feet by 40 feet, which was located approximately 700 feet north of the refinery's main tank farm and a short distance northwest of the fire training area. The pit was used to burn acid soluble oils from the alkylation unit and was operated from 1958 through 1976. A RCRA Facility Investigation (RFI) was conducted in the area in early 1990s (three soil borings with depths of 4.5 feet in May 1992, which were extended to a depth of 10 feet in 1994) with the finding that the area did have relatively low concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals present in surface soils. Giant Refining Company recommended a soil cap be placed over the area of the burn pit and it was subsequently installed in 1997 pursuant to the United States Environmental Protection Agency's (EPA) approval of the Voluntary Corrective Action Plan.

The Land Fill Areas were determined to include four small areas used to dispose of waste generated from refinery construction, maintenance, and operations. Three of the landfill areas were contiguous and were located northwest of the main refinery tank farm, approximately 500 feet northwest of Tank 337. The fourth landfill area was located approximately 200 feet north of the other three landfills. The main landfill area is estimated to have been 100 feet wide by 350 feet long in a kidney shape. The separate landfill area to the north is estimated to have been 20 feet by 20 feet. The landfill areas were operated from 1958 through 1979. An RFI was conducted in the area in early 1990s (twelve soil borings to a depth of 9.5 feet in May 1992, with seven of these borings drilled deeper to a depth of 20 feet in 1994). The soil samples were analyzed for priority pollutant volatile organics and metals, with the finding that the area did primarily have metals present at

concentrations above background. Giant Refining Company recommended a soil cap be placed over the area of the landfills and it was subsequently installed in early 1998 pursuant to the EPA's approval of the Voluntary Corrective Action Plan.

Giant Refining Company submitted documentation demonstrating proper closure of the Old Burn Pit and the Landfill Areas in 1998 (Practical Environmental Services, Inc., 1998a and b). The investigation and remediation (i.e., capping) of both SWMUs was overseen and approved by the US EPA. In 2001, Giant Refining again submitted information on the remediation of the Old Burn Pit and the Landfill Areas in the "Petition for *No Further Action*" (Giant Refining Company, 2001). NMED commented on the 2001 *No Further Action* petition and requested additional information for the Old Burn Pit and the Landfill Areas. All of the additional information requested by NMED for the Old Burn Pit and the Landfill Areas was submitted to NMED on October 2, 2002. Western Refining Southwest, Inc. submitted another request for NMED to respond to the previously submitted Petition for *No Further Action* on June 24, 2013.

NMED requested additional assessment of, in particular, deeper soils and groundwater, if present, beneath both SWMUs. The current investigation began on September 20, 2016 and continued through October 3, 2016. One soil boring was completed at SWMU No. 4 (Old Burn Pit) and two soil borings were completed at SWMU 5 No. (Landfill Areas). Soil samples were collected from any intervals indicating potential impacts and at deeper intervals to define the vertical extent of impacts to soils. Groundwater was not encountered in any of the three soil borings. The three soil samples (excluding additional quality control samples) collected at SWMU No. 4 were analyzed for RCRA metals, VOCs (including MTBE), SVOCs, total petroleum hydrocarbons (TPH) and dioxins/furans. The five soil samples collected at SWMU No. 5 were analyzed for RCRA metals, VOCs (including MTBE), SVOCs, and TPH.

At SWMU No. 4, the soil boring was drilled to the top of bedrock and did not encounter groundwater. There were no organic constituents detected at concentrations above the screening level. Arsenic was the only metal detected at concentrations above the soil screening levels and these soil samples were collected from below the soil cap. The area at SWMU No. 4 was previously capped and there is no evidence of any threat to groundwater resources or any other threats to human health or the environment from SWMU No. 4.

SWMU No. 5 was assessed with the completion of two soil borings, neither of which encountered groundwater. There is no evidence of any threats to groundwater from SWMU No. 5. No organic constituents were detected above the soil screening levels in any of the soil samples and arsenic was the only metal detected at concentrations above the screening level. The detected arsenic concentrations ranged from 1.9 mg/kg to 5.3 mg/kg and may be representative of background concentrations. All but one of these detections were from soil samples collected beneath the cap, which would not require further evaluation. Based on a slightly elevated reading with a photo ionization detector (PID), a soil sample was collected from the land surface (0-2') where the highest arsenic concentration of 5.3 mg/kg was detected. This concentration exceeds the residential direct contact screening level and should be further evaluated upon completion of a site-specific evaluation of background concentrations.

Noting the potentially elevated arsenic concentration observed on top of the existing cap at SWMU No. 5, the previously approved and implemented remedial efforts have addressed any threats posed to the environment and/or human health that may have been present at the Old Burn Pit and the Landfill Areas prior to placement of the caps.

Section 1 Introduction

The Gallup Refinery is located approximately 17 miles east of Gallup, New Mexico along the north side of Interstate Highway I-40 in McKinley County. The physical address is I-40, Exit #39 Jamestown, New Mexico 87347. The Gallup Refinery property covers approximately 810 acres. Figure 1 presents the refinery location and the regional vicinity, which is characterized as high desert plain comprised primarily of public lands used for grazing by cattle and sheep.

The Gallup Refinery generally processes crude oil from the Four Corners area transported to the facility by pipeline or tanker truck. Various process units are operated at the facility, including crude distillation, reforming, fluidized catalytic cracking, alkylation, isomerization, sulfur recovery, merox treater, and hydrotreating. Current and past operations have produced gasoline, diesel fuels, jet fuels, kerosene, propane, butane, and residual fuel.

The area of investigation that is the subject of this report is shown on Figure 2 for the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5). The purpose of the site investigation is to supplement previous investigations of both SWMUs and address NMED's request for additional assessment of deeper soils and groundwater, if present, beneath both SWMUs. The investigation was completed pursuant to the *SWMU No. 4 and No. 5 Investigation Work Plan* dated November 2015 (approved with modification April 18, 2016).

Section 2 presents background information for SWMUs No. 4 and No. 5, including a review of historical waste management activities to help identity the types of waste handled, sources of releases, and previously known impacts to the environment. Section 3 describes the scope of work completed during the site investigation, including completion of soil borings and sample collection. The fourth section of the report explains the results of the field investigation, including the general surface and subsurface conditions and detailed site-specific information acquired during subsurface investigations. Section 5 explains the regulatory standards that are used for comparison to the analytical results and Section 6 presents the analytical results of soil samples analyzed for VOCs, SVOCs, TPH, and metals. The results of these analyses are compared to applicable State or federal screening levels. Section 7 summarizes and provides an evaluation of the potential impacts and provides recommendations for any future actions.

Section 2 Background

This section presents background information for the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5), including a review of historical waste management activities to identity the following:

- Type and characteristics of waste and contaminants handled in the SWMU;
- Known and possible sources of impacts;
- History of releases; and
- Known extent of impacts prior to the current investigation.

2.1 Old Burn Pit (SWMU No. 4)

The Old Burn Pit was originally included as a SWMU in the 1988 Hazardous and Solid Waste Act (HSWA) permit and subsequently included for investigation in the 1990 RFI Work Plan. The Old Burn Pit was put into service in 1958 and was removed from service in 1976, when the pit area was apparently covered with a layer of soil. It covered an area of approximately 20 feet by 40 feet with a triangular shape and had a depth of 10 to 12 feet (Figure 3). A Visual Site Inspection (VSI) was conducted on November 19 and 20, 1986 as part of the RCRA Facility Assessment. During this inspection, "An old metal box uphill from the pit" was described as being used to feed oil through a metal pipe to the burn pit. There is no subsequent mention of the steel box or pipe in the *SWMU Site-Specific Facility Investigation Workplan*, which provided a detailed discussion of site features and sampling locations (Applied Earth Sciences, Inc., 1990). Apparently the metal box and pipe were removed after the VSI was conducted in 1986 and sometime before preparation of the *SWMU Site-Specific Facility Investigation Workplan* in 1990. Acid soluble oils from the alkylation unit were placed in the pit and burned. It is possible that spent silicon dioxide catalysts may have also been placed in the pit.

In 1992, during the Phase III RFI three soil borings (RFI0401V, RFI0402V, and RFI0403V) were completed to depths of 4.5 feet below ground surface (bgs) using a hand auger (Figure 3) (Giant Refining Company, 1992). Soil samples were collected from depths of 0.0 feet bgs, 3.0 feet bgs, and 4.5 feet bgs at each of the three soil borings. The soil samples were analyzed for metals (arsenic, barium, beryllium, cadmium, chromium, lead, nickel, mercury, and vanadium), VOCs,

SVOCs, and pH and the results are presented in Table 1. For comparison the NMED soil screening levels (*Risk Assessment Guidance for Site Investigation and Remediation*, dated December 2014) and EPA Regional Screening Levels are also included in Table 1. Based on the detection of constituents in the samples collected in 1992, EPA directed that deeper samples be collected from the same three locations. As shown on Figure 4, three soil borings (RFI0404V, RFI0405V, and RFI0406V) were drilled using hollow-stem augers at the same locations in 1994 with soil samples collected at depths of 6.0 feet bgs and 10.0 feet bgs (Giant Refining Company, 1994). The soil samples were analyzed for VOCs, SVOCs, and metals and the results are summarized in Table 1.

One VOC and one SVOC were detected at concentrations above the soil screening levels developed to protect groundwater assuming a dilution attenuation factor (DAF) of 20, but all reported concentrations were less than the residential soil screening level for direct contact. The soil samples were also screened in the field with a photo ionization detector (PID). Many of the PID readings were 0.0, but those with higher readings are as follows; RFI0402 V3.0 at 16 parts per million (ppm), RFI0402 V4.5 at 8.4 ppm, RFI0403 V3.0 at 3.2 ppm, and RFI0403 V4.5 at 12 ppm. The field data sheets are included in Appendix A.

Ethylbenzene was found at concentrations above the DAF 20 screening level of 0.262 mg/kg in three soil samples. These three soil samples were RFI0402 V3.0, RFI0403 V3.0, and RFI0403 V4.5 with concentrations of ethylbenzene of 1.0 mg/kg, 0.910 mg/kg, and 0.510 mg/kg, respectively. Naphthalene was the only SVOC to have a concentration in soil above the DAF 20 screening level of 0.0823 mg/kg. Naphthalene was detected at a concentration of 0.520 mg/kg in sample RFI0402 V3.0.

Based on the detection of constituents in soils discovered during the Phase III RFI, Giant Refining Company recommended the placement of a soil cap over the area occupied by the burn pit. This activity was completed in 1997. During the week of March 23, 1998, an on-site inspection was conducted by Practical Environmental Services, Inc. in support of preparation of a RCRA Post-Closure Care Permit for the Gallup Refinery Land Treatment Unit. This inspection report, the applicable section of which is included in Appendix C of the *Investigation Work Plan SWMU No. 4 Old Burn Pit and SWMU No. 5 Landfill Areas*, documents the remediation (i.e., construction of a low permeability soil cap) of the Old Burn Pit (DiSorbo, 2015). The remediation was conducted under the review and authority of both EPA and NMED.

2.2 Landfill Areas (SWMU No. 5)

The Landfill Areas included four areas used to dispose of waste generated from refinery construction, maintenance, and operations. The construction waste is reported to have included asphalt paving, concrete, and scrap metal. Some office, residential, and shop wastes were also identified. Wastes associated with operations may have included defluorinator bauxite and hydrotreating catalyst (cobalt, molybdenum, and nickel), and possibly outdated laboratory chemicals. Three of the landfill areas were contiguous and were located northwest of the main refinery tank farm, approximately 500 feet northwest of Tank 337 (Figure 5). The fourth landfill area was located approximately 200 feet north of the other three landfills. The main landfill area is estimated to have been 100 feet wide by 350 feet long in a kidney shape. The separate landfill area to the north is estimated to have been 20 feet by 20 feet. The landfill areas were operated from 1958 through 1979.

An RFI was conducted in the area in May 1992 with twelve soil borings (RFI0501 through RFI0512) completed with a hand auger to a depth of 9.5 feet bgs (Figure 5). The soil samples were collected from depths of 0.0 feet bgs, 3.0 feet bgs, 7.0 feet bgs, and 9.5 feet bgs and analyzed for VOCs, metals, and pH. Based on the presence of waste materials at depths of 9.5 feet bgs, seven additional soil borings were drilled deeper to a minimum depth of 20 feet bgs in 1994. The deeper borings (RFI0513 through RFI0519) were completed using hollow-stem augers and were completed at the same location of previous soil borings RFI0502, RFI0503, RFI0504, RFI0505, RFI0506, RFI0507, and RFI0509 (Figure 6). Soil samples were collected from depths of 11.0 feet bgs, 16.0 feet bgs, and 20.0 feet bgs and analyzed for VOCs, SVOCs, and metals. The analytical results are presented in Table 2.

One constituent (arsenic) was detected at concentrations above the soil screening levels developed to protect groundwater assuming a dilution attenuation factor (DAF) of 20.0 (0.299 mg/kg) and arsenic was also reported at concentrations above the residential soil screening level for direct contact (4.25mg/kg). The soil samples were also screened in the field with a PID. Many of the PID readings were 0.0, but those with higher readings are as follows; RFI0504 V3.0 at 0.01 ppm and RFI0504 V9.5 at 0.4 ppm. The field data sheets are included in Appendix A.

As shown in Table 2, all of the detected results for arsenic are above the DAF 20 screening level of 0.299 mg/kg. Many of the reported arsenic concentrations also exceed the residential direct

contact screening level of 4.25 mg/kg. Arsenic concentrations ranged from non-detect (< 2.5 mg/kg) to 35 mg/kg.

Based on the detection of constituents in soils discovered during the Phase III RFI, Giant Refining Company recommended the placement of a soil cap over the area occupied by the landfills. This activity was completed in early 1998. During the week of March 23, 1998, an on-site inspection was conducted by Practical Environmental Services, Inc. to document the closure of SWMU No. 5. A Landfill Closure Certification Report was prepared, which documents the remediation (i.e., construction of a low permeability soil cap) of the Landfill Areas (Practical Environmental Services, 1998b). The remediation was conducted under the review and authority of both EPA and NMED, in accordance with the Voluntary Corrective Action Plan approved by EPA on January 5, 1994.

Section 3
Scope of Activities

3.1 Soil Boring Installation and Sample Collection

Pursuant to the approved Investigation Work Plan (2015), an investigation of soils was conducted to define the vertical extent of any impacts to soil and evaluate the presence of and potential for impacts to groundwater. To accomplish this objective, soil borings were installed at the Old Burn Pit and the Landfill Areas. As outlined in the Investigation Work Plan, there is the potential for constituents to have been released to soils at known locations and therefore a judgmental sampling design was implemented.

3.1.1 Site Investigation

The scope of work for the investigation at the Old Burn Pit consisted of the installation of one soil boring in the center of the former pit. Two soil borings were completed at the Landfill Areas with one in the center of the area previously identified as Landfill Area 1 and the second in the center of the main landfill area. The soil boring at the Old Burn Pit was to be drilled to a minimum depth of two feet into the native soils (i.e., beneath any apparent waste materials identified or any other indications of fill material). The soil borings at the Landfill Areas were to be drilled to a minimum depth of two feet into the native soils or to a depth of 20 feet, whichever is deeper. If field evidence of impacts at greater depths was observed, then soil borings were to be drilled deeper to achieve full vertical delineation. The investigation also focused on identifying any zones of saturated soils. If saturation was encountered, then temporary wells were to be installed to allow collection of groundwater samples.

Three soil samples were collected at SWMU No. 4 and five soil samples were collected at SWMU 5 No. (excluding additional quality assurance samples). The soil samples were analyzed for potential site-related constituents including volatile and semi-volatile organics, total petroleum (i.e., gasoline, diesel, and motor oil range) hydrocarbons, and RCRA metals. In addition, soil samples collected at SWMU No. 4 were analyzed for dioxins and furans. No groundwater samples were collected, as saturation was not encountered in any of the soil borings (SWMU 4-1, SWMU 5-1 or SWMU 5-2).

All three soil borings were advanced using hollow-stem augers. The following list provides a summary of the soil borings:

- SWMU 4-1; advanced to 22 feet below ground level (bgl); terminated in bedrock;
- SWMU 5-1; advanced to 20 feet bgl; terminated in dry sandy clay after penetrating 13 feet of apparent native soils; and
- SWMU 5-2; advanced to 16 feet bgl; terminated in bedrock.

3.2 Collection and Management of Investigation Derived Waste

Drill cuttings, excess sample material and decontamination fluids, and all other investigation derived waste (IDW) associated with soil borings were contained and are currently being characterized for disposal.

3.3 Surveys

A global positioning system receiver was used to record the coordinates of each soil boring. These coordinates were recorded on the field boring logs.

Section 4
Field Investigation Results

This section provides a summary of the surface and subsurface conditions at the refinery, including the area near the Old Burn Pit (SWMU No. 4) and the Landfill Areas (SWMU No. 5). A discussion is included on the installation of soil borings, field screening of soils, and collection of soil samples for analysis.

4.1 Surface Conditions

A topographic map of the area near the Old Burn Pit and Landfill Areas is included as Figure 7. Local site topographic features include high ground in the southeast gradually decreasing to lowland fluvial plain in the northwest. Elevations on the refinery property range from 7,040 feet to 6,860 feet. The area of the site near SWMU No. 4 is at an approximate elevation of 6,925 feet and the elevations near SWMU No. 5 range from 6,915 to 6,940 feet above mean sea level (msl).

The McKinley County soil survey identifies the soil in the area of SWMUs No. 4 and No. 5 as primarily the Simitarq-Celavar sandy loams (USDA, 2005). The Simitarq-Celavar soils are well drained with a conservative permeability of 0.20 in/hr and minimal salinity. Simitarq soils have nearly neutral pH values ranging from 7.2 to 7.4 standard units.

Regional surface water features include the refinery evaporation ponds and aeration lagoons and a number of small ponds. The site is located in the Puerco River Valley, north of the Zuni Uplift with overland flows directed northward to the tributaries of the Puerco River. The Puerco River continues to the west to the confluence with the Little Colorado River. The South Fork of the Puerco River is intermittent and retains flow only during and immediately following precipitation events.

4.2 Subsurface Conditions

No underground utilities were identified during clearance of the soil borings for the Old Burn Pit or Landfill Areas.

4.2.1 Geology

The shallow subsurface soils consist of fluvial and alluvial deposits comprised of clay and silt with minor inter-bedded sand layers. The Quaternary alluvium, which occurs at the land surface in the

area of the Old Burn Pit and the Landfill Areas, is mapped regionally as a narrow band trending west-northwest and running just north of I-40 (Figure 8). The Quaternary alluvium is thought to be the parent material of the Simitarq-Celavar soils discussed above in Section 4.1. A cross section of the shallow subsurface in the immediate vicinity of the Old Burn Pit and Landfill Areas is included as Figure 9. Figure 2 shows the location of the cross section. As shown on the cross section, the predominant lithology is silty clay.

Subcropping beneath the Quaternary alluvium is the Triassic Chinle Group (Figure 8). The stratigraphy of the Chinle Group was described in detail for the nearby Fort Wingate quadrangle by Lucas et al, 1997. The Painted Desert Member of the Petrified Forest Formation is the uppermost member of the Chinle Group present in the area of the refinery. The Painted Desert Member is described as reddish-brown and grayish red mudstone with minor beds of resistant, laminated or crossbedded, litharenite. This is consistent with the bedrock encountered at the refinery, as depicted on cross section A-A' (Figure 9). Beneath the Painted Desert Member is the Sonsela Member, which is described by Lucas et al (1997) as gray to yellowish-brown, fine-grained to conglomeratic, crossbedded sandstone. The base of the Sonsela Member is recognized as a basin wide unconformity, which was termed the Tr-4 unconformity (Heckert and Lucas, 1996). The Blue Mesa Member, which underlies the Sonsela Member, is the lowest member of the Petrified Forest Formation. The Blue Mesa Member is described as mostly purple and greenish-gray mudstone.

4.2.2 Hydrogeology

None of the three soil borings completed at SWMUs No. 4 and No. 5 encountered groundwater. Soil boring SWMU 4-1 encountered bedrock (mudstone/claystone) at a depth of 20 feet with a dry sandy clay on top of the bedrock. (Figure 9). Damp soil was observed in gravelly clay at an approximate depth of 17 feet. Soil Boring SWMU 5-1 was drilled to a depth of 20 feet pursuant to the Investigation Work Plan and was terminated in a dry sandy clay. As indicated on Figure 9, the depth to bedrock near SWMU 5-1 may be at depths of 35 to 40 feet. Bedrock was encountered at a depth of 14 feet in SWMU 5-2, with a dry stiff clay overlying the bedrock surface. Damp soil was observed at approximately 12 feet in a clayey gravel layer. The damp soil noted in soil borings SWMU 4-1 and SWMU 5-2 are at a depth similar to the water level depth measured in well OW-56. Well OW-56 is screened in a sandy, gravelly clay. Moisture observed in the gravelly clay/clayey gravel in soil borings SWMU 4-1 and SWMU 5-2 may represent shallow groundwater. Shallow groundwater may be present in the general area of the two SWMUs~~, but its occurrence is sporadic~~.

The diverse properties and complex, irregular stratigraphy of the Quaternary alluvium across the refinery cause a wide range of hydraulic conductivity ranging from less than 10^{-2} cm/sec for gravelly sands immediately overlying the Painted Desert Member to 10^{-8} cm/sec in the clay soils located near the surface (Western Refining, 2009). Permeability tests performed on the Quaternary alluvium beneath the nearby Land Treatment Unit (LTU) indicated an average permeability of 1.9E-05 cm/sec (Appendix B). Permeability tests performed on soils in the area of the firewater pond indicated an average permeability of 1.1E-07 cm/sec (Appendix B). Because damp soil was observed in soil borings SWMU 4-1 and SWMU 5-2, it may be representative of shallow groundwater in the area. However, due to the tight clays the presence of groundwater may not be observed in the open boreholes in a timely manner. None of the soil borings were completed as a temporary well so the presence of groundwater cannot be confirmed.

As described above, the bedrock (i.e., Petrified Forest Formation) is mainly composed of low permeability materials (e.g., mudstone) with the exception of the Sonsela Member and some thinner sandstones within the overlying Painted Desert Member. Yield tests, including slug tests and pumping tests have been performed at the refinery to estimate the hydraulic conductivity of the Painted Desert Member (Appendix B). A slug test performed on July 3, 1984 in well OW-4 indicated a hydraulic conductivity of 4.0E-7 cm/sec. A pump test was performed in well OW-24 on February 20, 1985 and it yielded a hydraulic conductivity of 2.5E-7 cm/sec. The Painted Desert Member appears to be a competent aquitard to reduce the potential for downward migration of contaminants from groundwater that may occur within the overlying Quaternary alluvium.

Generally, shallow groundwater at the refinery follows the upper contact of the Chinle Group with prevailing flow from the southeast to the northwest, with some flow potentially to the northeast on the northeastern portion of the refinery property. The Sonsela Member is identified as the uppermost aquifer for RCRA monitoring purposes at the LTU because the overlying groundwater bearing units are not capable of supplying sufficient quantities of groundwater to meet the definitions of an aquifer. Wells completed in a thinner permeable sandstone layer within the Painted Desert Member are also monitored near the LTU as a potential early warning network. The Sonsela's highest point occurs southeast of the site and slopes downward to the northwest as it passes under the refinery. The Sonsela Member forms a water-bearing reservoir with artesian conditions throughout the central and western portions of the refinery property (Western Refining, 2009). Aquifer test of the Sonsela Member conducted northeast of Prewitt indicated a transmissivity of

greater than 100 ft²/day (Stone and others, 1983). Yield tests conducted at the site have shown a much lower hydraulic conductivity of 0.34 ft/day (1.2E-04 cm/sec) (Appendix B).

Sections 2.1 and 2.2 present the historical data collected for SWMU No. 4 and SWMU No. 5, respectively. In SWMU No. 4, two constituents (ethylbenzene and naphthalene) were detected at concentrations above the soil screening levels developed to protect groundwater but less than the residential soil screening level for direct contact. The detections were observed in samples collected between 3 ft bgs and 4.5 ft bgs; samples collected at 6 ft bgs and 10 ft bgs were below detection limits. The samples depths are approximately 10 ft above the observed damp gravelly clay layer.

In SWMU No. 5, arsenic was detected at concentrations above the soil screening levels developed to protect groundwater and was also reported at concentrations above the residential soil screening level for direct contact. The detections occurred between 0 ft bgs and 20 ft bgs. These samples depths are approximately 15 ft above the observed clayey gravel layer. No organic constituents were above any screening standards.

Information regarding the current investigation is presented in Section 4.3.

4.3 Exploratory Drilling Investigations, Soil Sampling and Boring Abandonment

This subsection provides a description of surface and subsurface investigations to define the vertical extent of any impacts to soil and evaluate the presence of and potential for impacts to groundwater. This includes soil field screening results, soil sampling intervals and methods for detection of surface and subsurface impacts in soils.

Discrete soil samples for laboratory analyses were scheduled for collection at the following intervals:

- From the interval in each soil boring with the greatest apparent degree of contamination, based on field observations and field screening;
- From the top of native soil immediately below the presence of any waste materials (e.g., burn residue in the Old Burn Pit or landfill waste in the Landfill Areas);
- From the bottom of each borehole;
- From the 6” interval at the top of saturation (applicable only to borings that reach saturation); and
- Any additional intervals as determined based on field screening results.

A description of the field screening and soil sampling procedures are presented in Appendix C – Field Methods. Copies of the boring logs are provided in Appendix D. In addition to being included on the soil boring logs, the soil vapor (i.e., headspace) screening results are summarized in Table 3. The locations of the soil borings appear on Figures 10 through 14.

4.3.1 Soil Investigation

Three soil borings were advanced using the hollow-stem auger (HSA) method and two of these soil borings were drilled to the bedrock (claystone/mudstone). The drilling equipment was decontaminated between each borehole, as described in Appendix C. The soil boring logs describe the subsurface lithology, the presence of saturation, and the field screening results. The installation of soil borings and collection of soil samples are discussed below in numerical order. Groundwater was not encountered in any of the soil borings.

<u>SWMU 4-1</u>

On October 3, 2016 the drilling rig was set up on location SWMU 4-1. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Three soil samples were collected from the following intervals:

- 12 feet bgl - 14 feet bgl – PID reading of 0.4 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of the silty clay located immediately below clayey silt (considered to be a more transmissive sediment). A duplicate soil sample was collected from this interval;
- 16 feet bgl - 18 feet bgl – PID reading of 0.1 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from an interval that was observed to be a clayey gravel. This interval did not appear to consist of transmissive sediments as the gravel was present in a low plastic clay matrix where pore space was not apparent; and
- 20 feet bgl - 22 feet bgl – Bottom of the borehole. PID reading of 1.0 ppm – No visual or olfactory evidence of impacted soils were present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Clayey Silt 0 feet bgl – 10 feet bgl (low plastic, soft, damp, brown, no odor);
- Clayey Silt 10 feet bgl – 12 feet bgl (low plastic, firm, damp, brown, no odor);
- Silty Clay 12 feet bgl – 16 feet bgl (low plastic, stiff, damp, brown, no odor);

- Clayey Gravel 16 feet bgl – 18 feet bgl (1/2" to 1/4" sandstone gravel in a low plastic clay matrix, damp, reddish brown, no odor);
- Sandy Clay 18 feet bgl – 20 feet bgl (low plastic, very stiff and potentially represents upper portion of weathered bedrock, dry, very fine grain sand present, grey and light brown, no odor); and
- Claystone 20 feet bgl – 22 feet bgl (similar to the 18 to 20 feet interval, very stiff, dry, no odor).

The PID readings range from 0.0 ppm (18 feet bgl – 20 feet bgl) to 2.9 ppm (0 feet bgl – 2 feet bgl). Saturation was not encountered.

The sampling terminated at 22 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On October 3, 2016 the borehole was grouted.

SWMU 5-1

On September 20, 2016 the drilling rig was set up on location SWMU 5-1. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Three soil samples were collected from the following intervals:

- 0 feet bgl - 2 feet bgl – PID reading of 28.6 ppm – This sample was collected at the surface from fill material. The sediment exhibited a petroleum hydrocarbon odor. There was no visual evidence of impacted soils;
- 7 feet bgl - 8 feet bgl – PID reading of 1.5 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of a silty clay located immediately below fill material; and
- 18 feet bgl - 20 feet bgl – Bottom of the borehole. PID reading of 0.1 ppm – No visual or olfactory evidence of impacted soils was present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Fill 0 feet bgl – 7 feet bgl (brown sand, gravel and clay, hydrocarbon odor was detected in the 0 feet bgl to 2 feet bgl interval, no odor was detected from the 2 feet bgl to 7 feet bgl interval);

- Silty Clay 7 feet bgl – 8 feet bgl (low plastic, very stiff, damp, brown, no odor);
- Silty Sandy Clay 8 feet bgl – 10 feet bgl (low plastic, firm, damp, brown, no odor);
- Clayey Sand 10 feet bgl – 12 feet bgl (very fine grain, compact, dry, brown, no odor); and
- Sandy Clay 12 feet bgl – 20 feet bgl (low plastic, very stiff, dry, brown, no odor).

The PID readings range from 0.1 ppm (18 feet bgl – 20 feet bgl) to 28.6 ppm (0 feet bgl – 2 feet bgl). Saturation was not encountered.

The sampling terminated at 20 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On September 20, 2016 the borehole was grouted.

SWMU 5-2

On September 29, 2016 the drilling rig was set up on location SWMU 5-2. Sample collection was accomplished using the HSA drilling method and split spoon samplers. Two soil samples were collected from the following intervals:

- 10 feet bgl - 12 feet bgl – PID reading of 12.6 ppm – No visual or olfactory evidence of impacted soils were present. This sample was collected from the top of the clayey gravel located immediately below clayey sandy silt (considered to be more transmissive sediment); and
- 14 feet bgl - 16 feet bgl – Bottom of the borehole. PID reading of 5.1 ppm – No visual or olfactory evidence of impacted soils were present.

The lithology encountered consisted of the following alternating silt, clay, and gravel:

- Clayey Silt 0 feet bgl – 6 feet bgl (low plastic, firm, damp to dry, brown, no odor);
- Clayey Sandy Silt 6 feet bgl – 10 feet bgl (low plastic, stiff, damp, brown, no odor);
- Clayey Gravel 10 feet bgl – 12 feet bgl (dense, damp, calcareous, reddish brown clay matrix, no odor);
- Clay 12 feet bgl – 14 feet bgl (low to moderately plastic, very stiff and potentially represents weathered surface of bedrock, dry, reddish brown and light grey, no odor); and

- Claystone 14 feet bgl – 16 feet bgl (similar to the 12 to 14 feet interval, reddish brown and grey, no odor).

The PID readings range from 3.6 ppm (0 feet bgl – 2 feet bgl) to 12.6 ppm (10 feet bgl – 12 feet bgl). Saturation was not encountered.

The sampling terminated at 16 feet bgl. Soil samples were collected in the appropriate sample containers, sealed in sealable bags, and immediately placed in an ice chest containing ice.

A temporary well was not set at this location since saturation was not encountered during the soil sampling. On October 3, 2016 the borehole was grouted.

Section 5
Regulatory Criteria

The applicable screening and potential cleanup levels are specified in NMED's *Risk Assessment Guidance for Site Investigations and Remediation* dated July 2015 and in the Environmental Protection Agency's (EPA) Regional Screening Levels dated November 2015.

For non-residential properties (e.g., the Gallup Refinery), the soil screening levels must be protective of commercial/industrial workers throughout the upper one foot of surface soils and construction workers throughout the upper ten feet based on NMED criteria. NMED residential soil screening levels are applied to the upper ten feet and soil screening levels for protection of groundwater apply throughout the vadose zone. EPA soil screening levels for direct contact exposure apply to the upper two feet of the vadose zone. To achieve closure as "corrective action complete without controls", the affected media must meet residential screening levels, which are presented in Table 4. Table 4 also provides a list of the available NMED and EPA soil screening levels for non-residential properties. While Table 4 indicates the various depths to which the individual soil screening levels are applicable, Tables 5 and 6 discussed below do not include this level of detail.

Table 4 has soil screening levels for the soil-to-groundwater pathway that are based on a dilution/attenuation factor (DAF) of 1.0, which is NMED's most conservative screening level for this pathway. A review of site conditions (i.e., predominance of very fine-grained soils and limited occurrence of groundwater with low yields) indicates that a DAF of 1.0 is overly conservative, thus NMED's slightly higher DAF value of 20 presented in the 2015 risk assessment guidance is used for comparison in Tables 5 and 6 (NMED, 2015).

The screening levels included in Tables 5 and 6 cover both residential and non-residential land use. For the non-residential screening levels, the lower of the construction worker scenario and commercial/industrial scenario screening levels for each constituent is included in the data tables if NMED screening levels are available. If NMED soil screening levels are not available for a particular constituent, then EPA soils screening levels are used. If an EPA soil screening level is for a carcinogenic compound, then the screening level is multiplied by 10 to bring the risk level to 1E-05 to be consistent with the NMED screening levels. The screening levels in Tables 5 and 6 have not been segregated based on depth of the soil sample as discussed above for Table 4.

A review of the NMED guidelines for TPH indicates that the TPH screening levels were developed based on screening levels and compositional assumptions developed by the Massachusetts Department of Environmental Protection (MADEP). The analytical results, as presented in Tables 5 and 6, are reported for gasoline range organics (C6-C10), diesel range organics (>C10-C28), and motor oil range organics (>C28-C35). The applicable TPH screening levels for comparison to the individual soil samples are selected from Table 6-2 of the NMED guidance (NMED, 2015).

There are no soil screening levels for gasoline range organics and the individual compounds listed for groundwater (gasoline range criteria) are included in the list of analytes used for site samples. As there could have been a variety of petroleum types (e.g., crude oil or various refined products) going to the Old Burn Pit, the screening level for "unknown oil" was selected for comparison to the diesel range and motor oil range soil analytical results. The motor oil range analytical results are compared to the "unknown oil" screening level as directed by NMED. However, it is noted that the laboratory analyses for motor oil range organics only reports results for the >C28 to C35 hydrocarbon range, while the "unknown oil" screening level is based on a hydrocarbon mixture assumed to include only C11-C22 aromatics.

Some of the individual constituents reported by the laboratory do not have screening levels but were all non-detect with respect to soil except di-n-octyl-phthalate, which is not classified as a known carcinogen.

Section 6
Site Impacts

This section discusses the chemical analyses performed and presents the analytical results that were obtained through the analysis of soil samples, which were collected at the Old Burn Pit and Landfill Areas. The results for soils analyses are presented and compared to applicable screening levels, as described in Section 5.0.

6.1 Soil Analytical Results

Soil samples were analyzed by Hall Environmental Analysis Laboratory in Albuquerque, New Mexico using the following methods for organic constituents:

- SW-846 Method 8260/5035 volatile organic compounds;
- SW-846 Method 8270C semi-volatile organic compounds; and
- SW-846 Method 8015D gasoline, diesel, and motor oil range petroleum hydrocarbons.

Soil samples were analyzed for the following metals using the indicated analytical methods, respectively.

Analyte	Analytical Method
Arsenic	SW-846 Method 6010B
Barium	SW-846 Method 6010B
Cadmium	SW-846 Method 6010B
Chromium	SW-846 Method 6010B
Lead	SW-846 Method 6010B
Mercury	SW-846 Method 7471
Selenium	SW-846 Method 6010B
Silver	SW-846 Method 6010B

In addition, soil samples collected at SWMU No. 4 (Old Burn Pit) were analyzed for dioxins/furans by SW-846 Method 8290A.

The analytical results for soil samples collected at the Old Burn Pit are summarized in Table 5 and the results for the Landfill Areas are summarized in Table 6. The individual results that exceed the applicable cleanup levels are highlighted, as noted in the table footnotes. Maps showing the distribution of constituents detected in soils above the lowest applicable screening levels are included as Figures 10 through 14. The concentrations shown on figures that exceed the screening levels in Tables 5 and 6 are underlined on the figures. The laboratory analytical reports are included in Appendix E and the data validation of the results, which includes the analytical results for the associated QA/QC samples, is included in Appendix F. The constituents that have concentrations in soils above screening levels are discussed below.

SWMU No. 4 – Old Burn Pit

Arsenic was detected at a concentration above the residential screening level of 4.25 mg/kg in one soil sample [SWMU 4-1 (16-18')] at a concentration of 4.6 mg/kg. Soil samples SWMU 4-1 (12-14') and SWMU 4-1 (20-22') had reported arsenic concentrations of 2.2 and 2.0 mg/kg, respectively, which are above the DAF 20 screening level of 0.299 mg/kg. The concentrations are shown on Figure 10 and summarized in Table 5.

SWMU No. 5 – Landfill Areas

Arsenic was detected at concentrations above the DAF 20 screening level (0.299 mg/kg) in four of the five samples collected, including SWMU 5-1 (0-2'), SWMU 5-1 (7-8'), SWMU 5-1 (18-20'), and SWMU 5-2 (14-16'). The concentrations range from 1.9 mg/kg to 5.3 mg/kg. Sample SWMU 5-1 (0-2') with a concentration of 5.3 mg/kg exceeds the residential screening level of 4.25 mg/kg. The arsenic concentrations are shown on Figure 13 (plotted with 1992 samples results) and Figure 14 (plotted with 1994 sample results). It is noted that the sample depths for the 1992 and 1994 data are reflective of conditions prior to placement of the soil cap, which may have a thickness ranging from 4 feet to 8 feet based on historical reports (Practical Environmental Services, Inc., 1998b).

Section 7
Conclusions and Recommendations

This section summarizes and provides an evaluation of the potential impacts as shown in field screening data and analytical data. This is followed by recommendations for any future actions.

7.1 Conclusions

A cumulative risk evaluation for soils the Old Burn Pit is presented in Table 7 and the cumulative risk summary for the Landfill Areas is presented in Table 8. The evaluation was conducted by taking the maximum reported soil concentration of each detected constituent and dividing by the residential screening level and non-residential screening levels as shown in the equations below. The maximum concentration for metals includes both the historical analyses and recently collected data. These calculations are separated for carcinogenic and non-carcinogenic constituents. At the Old Burn Pit, the cumulative carcinogenic risk is 1.08 x 10^{-5} assuming residential land use and 2.14 x 10^{-6} for non-residential land use. The hazard index for residential land use is 0.477 and for non-residential land use is 0.622. At the Landfill Areas, the cumulative carcinogenic risk is 8.25 x 10^{-5} assuming residential land use and 1.63 x 10^{-5} for non-residential land use. The hazard index for residential land use is 3.09 and for non-residential land use is 2.49.

$$Site\ Risk = \left(\frac{conc_x}{SSL_x} + \frac{conc_y}{SSL_y} + \frac{conc_z}{SSL_z} + \cdots + \frac{conc_i}{SSL_i}\right) \times 10^{-5}$$

$$Site\ Hazard\ Index\ (HI) = \left(\frac{conc_x}{SSL_x} + \frac{conc_y}{SSL_y} + \frac{conc_z}{SSL_z} + \cdots + \frac{conc_i}{SSL_i}\right) \times 1$$

<u>SWMU No. 4 – Old Burn Pit</u>

There are no reported concentrations in soil for individual constituents that exceed the residential soil screening levels, with the exception of one sample [SWMU 4-1 (16-18')], which exceeded for arsenic (4.6 mg/kg). At the same location at a depth of 12-14', arsenic was reported at an estimated concentration of 2.2 mg/kg, which is below the residential screening level of 4.25 mg/kg. The presence of arsenic above the residential screening level at a depth of 16 feet does not pose an unacceptable risk to potential future residential use of the property. As noted in Section 2.2.1 of NMED's 2015 risk assessment guidance, the exposure scenario for residents assumes exposure to

only the upper 10 feet of soils. (NMED, 2015). The observed concentrations of arsenic may be representative of naturally occurring concentrations, but a site-specific evaluation of background values would be required to make that determination.

Arsenic was reported above the DAF 20 screening level in the three recently collected samples at boring SWMU 4-1 at depths of 12-14', 16-18', and 20-22'. The historical soil data presented in Table 1 included detections of ethylbenzene and naphthalene at concentrations above the DAF 20 screening level, which lead to the placement of a clay soil cap over the location of the former burn pit.

The new soil boring (SWMU 4-1) was placed in the center of the Old Burn Pit and drilled to a depth of 22 feet, which extended two feet into the bedrock, to ensure any vertical impacts from the Old Burn Pit were fully investigated. Groundwater was not encountered; however, moisture was observed in the gravelly clay/clayey gravel in SWMU 4-1 that may indicate shallow groundwater.~~ and t~~There was no evidence of historical impacts to groundwater beneath the Old Burn Pit.

SWMU No. 5 – Landfill Areas

The only constituent with a concentration above either the DAF 20 or residential soil screening levels is arsenic. One recent sample [SWMU 5-1 (0-2')] had a reported concentration of 5.3 mg/kg, which exceeds the residential screening level of 4.25 mg/kg. Three other recent samples [(SWMU 5-1 (7-8'), SWMU 5-1 (18-20'), and SWMU 5-2 (14-16')] contained concentrations of arsenic above the DAF 20 screening level. The historical soil samples summarized in Table 2 also contained arsenic at concentrations above the residential and DAF 20 screening levels. The clay soil cap was placed over the impacted soils and all but sample SWMU 5-1 (0-2') are contained beneath the soil cap.

Soil sample SWMU 5-1 (0-2') was collected based on an elevated PID reading (the only elevated reading in this boring) and observation of a hydrocarbon odor. The sample was collected from the top of the existing cap and is not related to historical operations at SWMU No. 5. As noted above for SWMU No. 4, this generally low concentration of arsenic and may be reflective of naturally occurring concentrations. No other constituents were detected at concentrations above screening levels.

Boring SWMU 5-1 was drilled to a depth of 20 feet and did not encounter groundwater or evidence of waste materials. The termination depth of 20 feet is well below the deepest recorded depth of waste burial of 9.5 feet based on earlier investigations (Giant Refining Company, 1991). Boring SWMU 5-2 was drilled to a depth of 16 feet, two feet into the bedrock. Groundwater was not encountered at

SWMU 5-2; however, moisture was observed in the gravelly clay/clayey gravel in SWMU 5-2 that may indicate shallow groundwater. Based on the borings completed per the Investigation Work Plan, there is no evidence of any threats to groundwater and the soil cap is preventing any potential direct contact exposures to buried waste materials.

7.2 Recommendations

Based on the recent sampling effort there is no threat to groundwater from the Old Burn Pit and the previous remedy (soil cap) is sufficient to address any potential threat to human health and the environment from past operations. No further action is recommended for SWMU No. 4.

While the cap at SWMU No. 5 is protecting against potential threats to human health and the environment from any buried waste materials or associated releases, the detection of arsenic at the surface in soil sample SWMU 5-1 (0-2') should be further evaluated. It is recommended to compare the detected arsenic concentration to a site-specific background value upon completion of a site-specific background study.

Section 8 References

DiSorbo, 2015, Investigation Work Plan SWMU No. 4 Old Burn Pit and SWMU No. 5 Landfill Areas, Gallup Refinery, p.96.

Giant Refining Company, 1992, RCRA Facility Investigation Phase III – Giant Refining Company, Gallup New Mexico, p. 139.

Giant Refining Company, 1994, Report on Additional RFI Sampling, Ciniza Refinery, Gallup New Mexico.

Heckert, A.B. and Lucas, S.G., 1996, *Stratigraphic description of the Tr-4 unconformity in west-central New Mexico and eastern Arizona*: New Mexico Geology, Vol. 18, No. 3, pp. 61-70.

Lucas, S. G., Heckert, A.B., and Anderson, O. J., 1997, *Triassic Stratigraphy and Paleontology on the Fort Wingate quadrangle, west-central New Mexico*, New Mexico Geology, Vol. 19, No. 2. pp 33 - 42.

NMED, 2015, *Risk Assessment Guidance for Site Investigations and Remediation*, New Mexico Environment Department, p.91.

Practical Environmental Services, Inc., 1998a, SWMU 4 Summary Report, Old Burn Pit Area, Ciniza Refinery, McKinley County, New Mexico, p. 5.

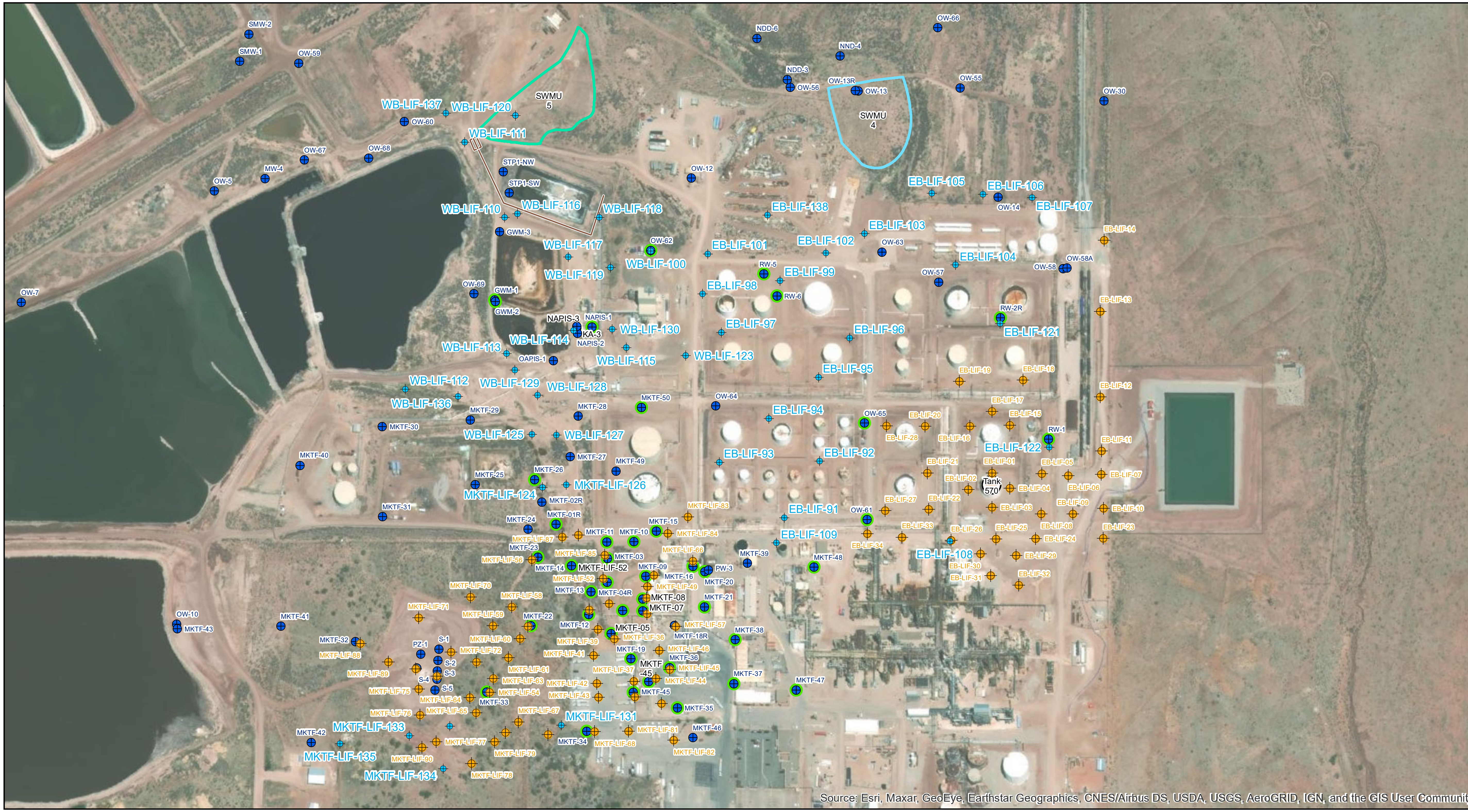
Practical Environmental Services, Inc., 1998b, SWMU 5 Closure Certification Report, Solid Waste Landfill Areas, Ciniza Refinery, McKinley County, New Mexico, p. 5.

Stone, W.J., Lyford, F.P., Frenzel, P.F., Mizel, N.H., and Padgett, E.T., 1983, *Hydrogeology and Water Resources of San Juan Basin, New Mexico*; Hydrogeologic Report 6, New Mexico Bureau of Mines and Mineral Resources, p. 70.

USDA, 2005, *Soil Survey of McKinley County Area, New Mexico, McKinley County and Parts of Cibola and San Juan Counties*, p. 683.

Western Refining, 2009, *Facility Wide Groundwater Monitoring Work Plan*, Western Refining Company Southwest, Inc., p. 78.

Attachment C: Figure Revisions



EXPLANATION

- PROPOSED LIF LOCATIONS
- ORIGINAL LIF LOCATIONS
- MONITORING WELLS
- SPH DETECTED IN 2020
- FRENCH DRAIN
- SWMU 4 - OLD BURN PIT
- SWMU 5 - LANDFILL AREAS
- TANK 570

N

0 360 '

Trihydro CORPORATION
1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 1

PROPOSED LIF SAMPLE LOCATIONS
MARKETING TANK FARM/LOADING RACK

MARATHON PETROLEUM COMPANY
GALLUP REFINING DIVISION
GALLUP, NEW MEXICO

Drawn By: KEJ	Checked By: CF	Scale: 1 " = 360 '	Date: 9/20/21	File: 1_LIF_EB_TankFarm_LoadingRack_Mar2021_Fig1.mxd

District I
1625 N. French Dr., Hobbs, NM 88240
Phone:(575) 393-6161 Fax:(575) 393-0720
District II
811 S. First St., Artesia, NM 88210
Phone:(575) 748-1283 Fax:(575) 748-9720
District III
1000 Rio Brazos Rd., Aztec, NM 87410
Phone:(505) 334-6178 Fax:(505) 334-6170
District IV
1220 S. St Francis Dr., Santa Fe, NM 87505
Phone:(505) 476-3470 Fax:(505) 476-3462

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Action 67037

CONDITIONS

Operator:	
Western Refining Southwest LLC 539 South Main Street Findlay, OH 45840	OGRID: 267595
	Action Number: 67037
	Action Type: [UF-DP] Discharge Permit (DISCHARGE PERMIT)

CONDITIONS

Created By	Condition	Condition Date
jburdine	Accepted for Record Retention Purposes-Only	11/22/2022