National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

June 15, 2023

Reply to Attn of: RE-23-104

Mr. Ricardo Maestas, Acting Bureau Chief
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Subject: Response to Approval with Modifications Revised WSTF Septic Tanks (SWMUs 21-27) Investigation Report

On March 16, 2023, NMED approved the *Revised WSTF Septic Tanks (SWMU 21-27) Investigation Report* with modifications. NMED provided two comments in the approval with modifications and directed NASA to address the comments and provide replacement pages for the revised investigation report by June 16, 2023.

This submittal includes a printed response table the cross-references NMED's comments as Enclosure 1. Printed replacement pages for the investigation report are provided as Enclosure 2. Enclosure 3 provides a CD-ROM that includes the final report, redline-strikeout version of the report, and the response table in electronic format.

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

If you have any questions or comments concerning this submittal, please contact Amanda Skarsgard of my staff at 575-571-9668.

TIMOTHY DAVIS
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Timothy J. Davis
Chief, NASA Environmental Office

3 Enclosures

cc:
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2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Comments for Approval with Modifications of the Revised WSTF Septic Tanks (SWMUs 21-27) Investigation Report

<table>
<tr><th>NMED Comment Number</th><th>NMED Comments</th><th>NASA Revisions/Responses/Discussion</th></tr>
<tr><td>1. Section 9.0, Recommendations, Page 29</td><td>NMED Comment: The WSTF Permit renewal is currently in process; therefore, corrective action status review for SWMUs 21 through 27 is not appropriate at this time. Corrective action status review can be addressed following completion of the pending Permit renewal and following consultation with NMED, as addressed in the section discussion.

Upon submittal, a petition for a Class 3 permit modification is subject to administrative completeness review and fees outlined 20.4.2.201 New Mexico Administrative Code (NMAC) and process outlined in 40 Code of Federal Regulations 270.42(c) and 20.4.1.900 and 901 NMAC.

In addition to SWMUs 21 through 27, a petition for Class 3 permit modification for the WSTF Septic tanks addressed in the Report must also include the eight septic tanks not currently designated as SWMUs for tracking purposes. Based on NMED review and determination, the additional septic tank sites will be listed in the Permit on the appropriate corrective action status tables as additional SWMUs.

To clarify, the characterization of contamination source areas is currently in progress, and significant uncertainty continues to exist regarding environmental contamination associated with SWMUs, AOCs, and Hazardous Waste Management Units (HWMUs) at WSTF. Therefore, corrective action status determinations for some SWMUs and AOCs may not be appropriate at this time and will be addressed on a case-by-case basis in accordance with the WSTF Permit and NMED's November 2022 Risk Assessment Guidance for Site Investigations and Remediation (as updated). Post-closure care at the five WSTF HWMUs must continue in accordance with the applicable provisions of the Permit.

No changes to the Report are required in response to this comment.</td><td>NASA acknowledges and understands NMED’s comment. The report was not changed.</td></tr>
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Comments for Approval with Modifications of the Revised WSTF Septic Tanks (SWMUs 21-27) Investigation Report

NMED Comment Number	NMED Comments	NASA Revisions/Responses/Discussion
2. Appendix E, Quality Assurance Report White Sands Test Facility Septic Tanks Soil Analytical Data, Table 7, Quality Assurance Narratives, Pages 5 and 6	**NMED Comment:** The table header lists TO-15 as the sample analysis method; this is not accurate. Revise Table 7 to indicate the appropriate sample methods used for SWMU 22 soil sample analysis and provide a revised replacement table.	NASA revised the Table 7 header and is providing a replacement table.

National Aeronautics and Space Administration

Revised WSTF Septic Tanks (SWMUs 21-27) Investigation Report

February 2018

Revised July 2019

Revised May 2021

Revised June 2023

NM8800019434

Revised WSTF Septic Tanks (SWMUs 21-27) Investigation Report

February 2018

Revised July 2019

Revised May 2021

Revised June 2023

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

TIMOTHY DAVIS Digitally signed by TIMOTHY DAVIS Date: 2023.06.15 14:21:34 -06'00'

See Electronic Signature

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Chief, Environmental Office

Date

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Executive Summary

The National Aeronautics and Space Administration (NASA) is required by the New Mexico Environment Department (NMED)-issued Hazardous Waste Permit (Permit; NMED, 2016) to determine the nature, extent, and potential migration pathways of contaminant releases from solid waste management units (SWMUs) at the Johnson Space Center (JSC) White Sands Test Facility (WSTF). This investigation report (IR) addresses applicable Permit and NMED regulatory requirements, describes the investigation activities, summarizes investigation results, provides an interpretation of the results, and presents conclusions and recommendations for all septic tanks located at WSTF. Seven WSTF septic tanks are identified in the Permit as SWMUs as follows:

- SWMU 21 – 100 Area Septic Tank at Guard Shack (Building 116)
- SWMU 22 – 100 Area Septic Tank at Building 114
- SWMU 23 – 200 Area Septic Tanks at Building 272 (Tanks A and B)
- SWMU 24 – 300 Area Septic Tank at Main Parking Lot
- SWMU 25 – 300 Area Septic Tank at Building 320
- SWMU 26 – 300 Area Septic Tank at Building 364
- SWMU 27 – 400 Area Septic Tank at Main Parking Lot

A Historical Information Summary (HIS; NASA, 2013a) was developed for the SWMU septic tanks listed above, as well as these additional eight known septic tanks at WSTF:

- 100 Area Septic Tank at Building 117 (WSTF Forward Guard Gate)
- 250 Area Septic Tank (Area of Interest)
- 200 Area Septic Tank at Building 272 (Tank C)
- 400 Area Septic Tank at Building 463
- 400 Area Septic Tank at Building 447
- 600 Area Septic Tank at Building 650
- 800 Area Septic Tank at Buildings 802/803
- Second Tracking and Data Relay Satellite System Ground Terminal (STGT) Facility Septic Tank

NASA recommended in the *WSTF Septic Tanks (SWMU 21-27) Investigation Work Plan* (IWP; NASA, 2013a) that a soils investigation not be conducted at SWMUs 21 and 23-27 because there was no evidence or documentation that these units ever received hazardous waste or hazardous constituents. NMED approved the IWP with a modification requiring NASA to examine all WSTF septic tanks for leaks during removal (NMED, 2013b). If evidence of any leaks/spills were observed during removal, NASA was required to inform NMED within 24 hours and potentially perform additional investigation(s). The tanks were removed and no evidence of leaks or spills was observed, thus no investigation was required at these tank locations. The only evidence located during HIS research of hazardous constituents discharged to any of the above listed septic tanks was at the 100 Area Septic Tank at Building 114 (SWMU 22). From research performed during preparation of the HIS, it was determined that silver and cyanide were possible contaminants of potential concern (COPCs) within SWMU 22 (NASA, 2013a).

This IR primarily describes the SWMU 22 investigation activities, summarizes investigation results, presents conclusions, and provides recommendations based on the findings. The report also summarizes the removal of and current status of all WSTF septic tanks.

During initial investigation activities, NASA discovered an unexpected configuration of the SWMU 22 septic tank. This septic tank was found to consist of only a single chamber and it contained no free liquids. A discharge pipe from the tank was not immediately recognized and NASA concluded that the bottom of the tank was compromised. This observed unexpected configuration of the Building 114 septic tank required modifications to the planned NMED-approved IWP.

To remedy this issue, NASA proposed modifying the soil investigation by removing borings originally identified in the leach field area for the SWMU 22 septic tank and installing five soil borings as described in the *Summary of SWMU 22 Sewage Sludge Analytical Results and Proposed SWMU 22 Soil Investigation Methodology Deviations* (Deviations; NASA, 2014a). NMED approved this document on May 6, 2014 (NMED, 2014a). Further field investigation revealed that the tank did have a discharge line, but this piping terminated abruptly approximately 60 feet (ft) north of the tank. No leach field was found and there was no evidence of wastewater in the discharge pipe or discharge of wastewater at its termination point. NASA compared the liquid wastewater marks inside the tank to the height of the tank discharge pipe and concluded that the septage within the septic tank was never discharged to the pipe.

During the investigation, two soil borings were installed downgradient from the Building 114 septic tank location, two were installed within the septic tank footprint, and one was installed upgradient of the septic tank location in accordance with the approved investigation modification. In addition to the planned five soil borings, and due to potential nitrate/nitrite interference with cyanide analyses, two additional soil borings were completed to 7 ft below ground surface (bgs) within the footprint of the SWMU 22 septic tank. One soil sample per additional boring was collected at 7 ft bgs and analyzed by Method 9012B, with a sulfamic acid pretreatment to avoid nitrate/nitrite interference. These samples replaced the original samples collected at that depth.

A total of seven soil boring locations with eighteen total soil samples and nine quality assurance/quality control (QA/QC) samples (three duplicates, three equipment blanks, one field blank, and two matrix spikes) were collected. As part of the data quality objectives (DQOs) performance acceptance criteria, soil chemical analytical data were reviewed and evaluated in accordance with the IWP (NASA, 2013a), and the *Summary of SWMU 22 Sewage Sludge Analytical Results and Proposed SWMU 22 Investigation Methodology Deviations* (Deviations; NASA, 2014a), incorporating Attachment 15 of the Permit (NMED, 2016). All soil chemical results were validated and determined to be appropriate for use to meet the investigation goals and to support risk screen evaluations for all receptor populations. Data validation identified that a high bias exists for cyanide concentrations due to nitrate interference. NASA included all chemical data in the risk screen evaluation while understanding that use of the high biased cyanide results generates risk and hazard values that are inherently conservative.

Initially, the IWP stated the following: "If COPC concentrations in vadose zone soils exceed the appropriate risk-based cleanup levels…. for direct exposure routes under the construction worker scenario (construction soil screening levels, CSSL), then a RCRA Corrective Measures Study will be performed to determine the appropriate soil remediation." However, based upon recent NMED communications, residential exposure scenarios must be evaluated to qualify for Corrective Action Complete without controls (CAC). For the purposes of this report, the RSSLs were used as the basis to determine whether or not to continue investigation and/or corrective actions. NASA utilized NMED's March 2019 *Risk Assessment Guidance for Site Investigations and Remediation* (RA Guidance; NMED, 2019) to determine remaining risk and hazard associated with existing site conditions under all exposure scenarios (residential, construction worker, soil-to-groundwater, and ecological).

Human health risk and hazard screenings were performed using both RSSLs and CSSLs, as well as risk-based and maximum contaminant level (MCL)-based SSLs protective of groundwater with a dilution attenuation factor (DAF) of 20 in accordance the RA Guidance and Attachment 15 of the Permit. Populations of WSTF background concentrations for metals were compared to SWMU 22 investigative data populations to identify COPCs for each exposure scenario. Based on results of comparison of WSTF background and SWMU 22 populations, identified COPCs for residential, construction worker, and ecological receptor exposure scenarios included cadmium, chromium, cyanide, and silver. Identified COPCs for the soil-to-groundwater exposure scenario also include arsenic, barium, and lead, due to the lack of WSTF soil background data at depths deeper than 12 ft bgs to compare to investigation data.

Results of health risk and hazard screening indicated that there were no SWMU 22 COPC concentrations above residential or construction worker soil screening levels (SSLs) and risk/hazard targets. For the soil-to-groundwater exposure scenario, two COPCs exceeded soil leachate SSLs: arsenic and cyanide. Evaluation of the soil chemical data indicate concentrations of arsenic and cyanide generally decrease with depth. Based on the observed decrease with depth of the two COPCs, the lack of a continuing source of liquid to vertically mobilize contaminants in the soil, the regional arid climate, and depth to groundwater, NASA concludes that the soil-to-groundwater pathway is incomplete.

Ecological risk screening indicated that identified total chromium and cyanide concentrations in site soils exceed Tier I Ecological Screening Levels for plants. However, non-burrowing animals and plant roots are not expected to come in contact with soils associated with SWMU 22 due to the depth of releases (> 5 ft bgs). No ecologically important habitats or organisms exist at, or adjacent to, the site, and evidence of deep-rooted flora and animal burrows was not observed within the SWMU 22 footprint and surrounding areas.

NASA concludes that there is no source of contamination in the SWMU 22 soil that would adversely impact human and ecological receptors or the environment.

Based on closure activities completed at SWMUs 21 and 23-27 and findings of research conducted during preparation of the HIS (NASA, 2013a), NASA recommends that no further action be performed at the septic tanks comprising SWMUs 21 and 23-27. Based on the investigation and risk screen evaluation results for SWMU 22, NASA also recommends that no further action be performed. NASA recommends that SWMUs 21-27 be considered for a corrective action complete status determination. NASA will consult with the NMED prior to preparation and submittal of a Class 3 Permit Modification in accordance with 40 CFR 270.42(c) that will include all supporting site history and investigation information for each SWMU.

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List of Acronyms

amsl	Above Mean Sea Level
bgs	Below Ground Surface
BTV	Background Threshold Value
CAC	Corrective Action Complete
CFR	Code of Federal Regulations
CLC POTW	City of Las Cruces Publicly Owned Treatment Works
COPC	Contaminant of Potential Concern
CSSL	Construction Soil Screening Level
DAF	Dilution Attenuation Factor
DP	Discharge Permit
DQO	Data Quality Objective
EPA	Environment Protection Agency
ESL	Ecological Screening Level
ft	Feet/foot
HI	Hazard Index
HIS	Historical Information Summary
HSA	Hollow Stem Auger
HWMU	Hazardous Waste Management Unit
IDW	Investigation-Derived Waste
in.	Inch(es)
IR	Investigation Report
IWP	Investigation Work Plan
JSC	Johnson Space Center
LWP	NMED Liquid Waste Program
MCL	Maximum Contaminant Level
mg/kg	Milligram per kilogram
mi	Mile(s)
MSDS	Material Safety Data Sheet
NASA	National Aeronautics and Space Administration
NMED	New Mexico Environment Department
NMGW	NMED Groundwater and Surface Water
OSHA	Occupational Safety and Health Administration
Permit	NMED Hazardous Waste Permit
PPE	Personal Protective Equipment
QA	Quality Assurance
QC	Quality Control
QAR	Quality Assurance Report
RA	Risk Assessment
RA Guidance	NMED Risk Assessment Guidance for Site Investigations and Remediation
RSSL	Residential Soil Screening Levels
RPD	Relative Percent Difference
SAM	San Andres Mountains
SCEM	Site Conceptual Exposure Model
SHP	Safety and Health Plan
SJDMB	Southern Jornada del Muerto Basin
SLHQ	Screening Level Hazard Quotient
SSL	Soil Screening Levels

STGT	Second Tracking and Data Relay Satellite System Ground Terminal
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
UCL95	95% Upper Confidence Level
USDA	United States Department of Agriculture
WSTF	White Sands Test Facility

1.0 Introduction

The National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) White Sands Test Facility (WSTF; Environmental Protection Agency [EPA] Identification Number NM8800019434) has supported testing of space flight equipment and hazardous materials since 1964. The facility contains five closed hazardous waste management units (HWMUs) that are under post-closure care and 37 solid waste management units (SWMUs) within the 100, 200, 300, 400, and 600 Areas. Post-closure care requirements are specified by the NASA WSTF Hazardous Waste Permit (Permit) issued by the New Mexico Environment Department (NMED) in 2009 (NMED, 2016). Specific regulatory requirements are discussed in Section 1.1.

This investigation was primarily conducted at SWMU 22, the 100 Area Septic Tank at Building 114 (hereafter referred to as the Building 114 septic tank or SWMU 22). However, the WSTF Permit identifies seven additional septic tanks as SWMUs. WSTF septic tanks are described in Section 1.3 of this report. A Historical Information Summary (HIS; NASA, 2013) was prepared for the SWMU septic tanks identified in the Permit and eight additional known septic tanks at WSTF. The only evidence located during HIS research of hazardous constituents discharged to any of the above listed septic tanks was at the Building 114 septic tank (NASA, 2013a).

There was no evidence that hazardous waste or hazardous constituents were discharged to the septic tanks at SWMUs 21 and 23-27; therefore, NASA recommended in the investigation work plan (IWP; NASA, 2013a) that soil investigations not be performed at these locations. NMED approved the IWP with modifications on November 8, 2013. In accordance with the NMED-approved IWP, a soil investigation was not conducted for SWMU 21, SWMUs 23-27, and the additional eight septic tanks at or adjacent to WSTF. However, a variety of field activities were performed at these septic tanks and at SWMU 22. This investigation report (IR) summarizes all field activities associated with septic tank identification and removal, and provides the current status of all septic tanks at WSTF. As required by the WSTF Permit, this IR summarizes SWMU 22 soil investigation field activities, presents the analytical results from soil samples collected during the SWMU 22 investigation, and provides interpretation of results and recommendations based on the results.

1.1 Regulatory Requirements

The Permit issued by NMED (NMED, 2016) requires the preparation of IWPs to assess the potential impact of any historical releases of hazardous waste or hazardous constituents that may have occurred at WSTF as part of the Resource Conservation and Recovery Act (RCRA) corrective action process (CAP). The CAP consists of investigation, characterization, and, if necessary, cleanup. The principal components of the CAP are:

- RCRA Facility Assessment
- RCRA Facility Investigation (RFI)
- Interim Corrective Measures (if necessary)
- Corrective Measures Study (if necessary)
- Corrective Measures Implementation (if necessary)

NASA is currently implementing interim corrective measures to address groundwater contamination and is conducting RCRA Facility Investigations (RFIs) for specific HWMUs, SWMUs, and any other areas of concern or areas of interest at WSTF. Attachment 16 of the Permit required submittal of an IWP for SWMUs 21-27 by June 30, 2013. The *NASA WSTF Septic Tanks (SWMU 21-27) Investigation Work Plan* was prepared in accordance with Permit Section VII.H and was submitted to NMED on June 27, 2013 (NASA, 2013a). NMED approved the IWP on November 8, 2013 with a modification requiring NASA to examine all WSTF septic tanks for leaks during removal (NMED, 2013b). If evidence of any leaks/spills were observed during removal, NASA was required to inform NMED within 24 hours and potentially perform additional investigation(s).

During investigation field activities, conditions at SWMU 22 required modifications to the planned soil boring investigation. NASA submitted the *Summary of SWMU 22 Sewage Sludge Analytical Results and Proposed SWMU 22 Soil Investigation Methodology Deviations* (Deviations) on March 4, 2014. On May 6, 2014, NMED approved the proposed investigation modifications (NMED, 2014).

1.2 Facility Location and Description

The NASA JSC WSTF is located at 12600 NASA Road in central Doña Ana County, New Mexico. The site is approximately 17 miles (mi) northeast of Las Cruces, New Mexico and 65 mi north of El Paso, Texas (Figure 1.1). The site was strategically constructed in a remote location adjacent to the San Andres Mountains (SAM). The Department of the Army owns the land occupied by WSTF, and NASA uses the land under a land use agreement (Department of Defense, 1976). Access to the site is provided by a paved road that intersects U.S. highway 70, 1 mi west of Organ, New Mexico.

1.3 SWMU 22 and Septic Tank Areas Location and Description

Eight WSTF septic tanks identified as SWMUs in the Permit. NASA identified an additional eight septic tanks in the HIS, for a total of 16 (Figure 1.2). Three septic tanks were located in the 100 Area, three were located in the 200 Area, one was located in the 250 Area, three were located in the 300 Area, three were located in the 400 Area, one was located in the 600 Area, one was located in the 800 Area, and one was located at the Second Tracking and Data Relay Satellite System Ground Terminal (STGT) Facility. A description of each tank is provided below.

Eight WSTF septic tanks are identified in the Permit as SWMUs:

- SWMU 21 – 100 Area Septic Tank at Guard Shack (Building 116)
- SWMU 22 – 100 Area Septic Tank at Building 114
- SWMU 23 – 200 Area Septic Tanks at Building 272 (Tanks A and B)
- SWMU 24 – 300 Area Septic Tank at Main Parking Lot
- SWMU 25 – 300 Area Septic Tank at Building 320
- SWMU 26 – 300 Area Septic Tank at Building 364
- SWMU 27 – 400 Area Septic Tank at Main Parking Lot

The eight additional known septic tanks at WSTF not identified as SWMUs are:

- 100 Area Septic Tank at Building 117 (WSTF Forward Guard Gate)
- 250 Area Septic Tank (Area of Interest identified in the 200 Area investigation)
- 200 Area Septic Tank at Building 272 (Tank C)
- 400 Area Septic Tank at Building 463
- 400 Area Septic Tank at Building 447

- 600 Area Septic Tank at Building 650
- 800 Area Septic Tank at Buildings 802/803
- STGT Facility Septic Tank

Locations of the WSTF industrial areas and septic tanks are provided on Figure 1.2. Access to the WSTF site is provided by NASA Road. Access to the 200, 300, 400, and 800 industrial areas are provided via Apollo Boulevard, the main access road through WSTF. Building 650 can be accessed from NASA Road to the Well Road, and STGT is reached via NASA Road to the STGT Access Road (Figure 1.2).

1.4 Purpose and Method of Investigation

The primary purpose of this investigation was to determine if historical activities as described in the HIS (NASA, 2013a) resulted in contamination of the soil beneath and adjacent to the SWMU 22 septic tank. If any staining or discoloration was discovered during the excavations of any of the other septic tanks included as part of this investigation, then the IWP would have been revised to include additional soil boring locations as part of the investigation. Soils were collected using a Central Mine Equipment CME-75 hollow stem auger (HSA) drill rig with a split spoon sampler. In total, seven boring locations, including four soil samples located within the footprint of the SWMU 22 septic tank. Samples were collected from the footprint of the SWMU 22 septic tank rather than the leach field after it was determined that the bottom of the septic tank had been compromised and no wastewater had been discharged to the leach field (NASA, 2014a).

During the investigation, NASA complied with all applicable internal site procedures regarding health and safety, investigation activities, soil sampling, data management, and quality assurance (QA)/quality control (QC), as well as external federal (Occupational Safety and Health Administration [OSHA]) and state (NMED) regulations. Sludge and soil samples were shipped to the contracted analytical laboratory, and resulting analytical reports were delivered to NASA. Analytical results from sludge and soil samples were evaluated and compared with appropriate regulatory criteria to determine if corrective actions are required.

Additionally, NASA conducted a health risk assessment to evaluate COPCs as a part of this investigation even though the requirement for a health risk assessment was not included in the IWP. The results of this assessment are provided in Section 7.0.

1.5 Type of Results

The type of results presented in this report include the following:

- Pre-investigation SWMU 22 septic tank sludge sampling results summary.
- Septic tank abandonment forms.
- SWMU 22 soil boring lithologic logs containing borehole identification information, descriptions of soil types, soil sampling locations, and the total depth drilled for each soil boring.
- SWMU 22 soil investigation results, including soil analytical data summaries and contract laboratory analytical data reports for soil samples collected from SWMU 22 soil borings.

2.0 Background

Prior to performing the investigation, a HIS was prepared and submitted to NMED in conjunction with the IWP (NASA, 2013a). The HIS contained detailed background research regarding the operational histories for each septic tank at WSTF. Research included review of WSTF environmental records (correspondence, discharge plans, analytical data, memoranda, reports, test preparation sheets, discrepancy reports, liquid waste applications and permits, maintenance records, WSTF utility drawings, photographs, etc.) and interviews with current and former long-term WSTF personnel. A summary of historical information, previous investigations, and contaminants of potential concern (COPCs) for SWMU 22 is included in this report. The HIS provides detailed operational history and details for each of the septic tanks (NASA, 2013a).

2.1 Historical Use

WSTF was designed as a hazardous testing facility with separate disposal systems for wastewater characterized as hazardous waste and non-hazardous wastewater. Septic tank systems were used at various locations at WSTF for non-hazardous wastewater. The Building 114 (SWMU 22), 250 Area, and the STGT septic tanks were installed prior to completion of sewage lagoons at WSTF. Other septic tanks were installed in WSTF industrial areas (300 and 400 Area main septic tanks [SWMUs 24 and 27]), or added as new buildings were constructed (Building 320 [SWMU 25], Building 364 [SWMU 26], Building 447, and Building 463). Remote working areas far from the sewage lagoons or areas where gravity feed to the sewage lagoons could not be completed also required septic tanks (Building 116 [SWMU 21], Building 117, Building 272 [SWMU 23 tanks and Tank C], Building 650, and Buildings 802/803). The historical use of each septic tank and associated buildings at WSTF was researched to determine if any hazardous constituents were discharged to any septic system. The only evidence discovered during HIS research of hazardous constituents discharged to any septic system at WSTF was at SWMU 22, the Building 114 septic tank. Between 1963 and the mid-to-late 1980s, Building 114 was used as a print reproduction facility at which electrostatic and photographic plate-maker processes were used. Machines were used to make master copies of forms or documents for reproduction on an offset press. Spent chemicals were historically discharged to the Building 114 septic tank (SWMU 22) via the bathroom sink (NASA, 2013a). COPCs are discussed below:

- Silver was identified as a COPC after septic tank HIS research discovered silver-bearing waste was discharged to a sink in Building 114 that drained to the septic tank. The septage in the tank and soil under the tank and within the leach field was sampled for RCRA metals using EPA SW-846 Methods 1311/6010C/7470A.
- Cyanide was also identified as a COPC after septic tank HIS research discovered waste containing cyanide salts was discharged to a sink in Building 114 that drained to the septic tank. The septage in the tank and soil under the tank and within the leach field was sampled for cyanide using EPA SW-846 Method 9012B.

2.2 Current Structures Near SWMU 22

The Building 114 septic tank was located in the 100 Area (Figure 1.2). The tank was referred to as "Building 114," since it was originally installed to service Building 114, which is currently unoccupied and used for storage. Adjacent to the SWMU 22 septic tank site to the northeast is a cleared soil area where equipment is stored (Figure 1.2). Close to Building 114 to the south is Building 119 (Figure 1.2), which was constructed in the mid-1990s and is currently used for communications. The original Building 114 septic tank was taken out of service and removed, and a new septic tank was installed on September 10, 2013 for use by employees working in Building 119 (NASA, 2017a). This septic tank was installed instead of connecting to the City of Las Cruces sewer system due to logistical constrains from underground utilities located close to the area. Underground utilities surrounding SWMU 22 can be seen in Figure 2.1.

2.3 Previous Investigations

No previous investigation or remediation activities have been conducted for SWMUs 21-27 or the eight additional septic tanks identified at WSTF.

2.4 Nature and Extent of Contamination

Information regarding the history of operations, historical waste management practices, and COPCs for the Building 114 septic tank were presented in the HIS (NASA, 2013a). A brief summary of historical information for the Building 114 septic tank is presented in this section. No evidence of hazardous waste or hazardous constituents being discharged to the septic tanks associated with SWMUs 21 and 23-27 was identified during research performed for the HIS.

Releases of hazardous constituents possibly discharged to the Building 114 septic tank included small amounts of spent process wastes from photographic and electrostatic plate-maker machines. Three different plate-maker machines were used historically at WSTF to make master copies of forms for reproduction on an offset press. The manufacturer of the plate-maker machines provided Material Safety Data Sheets (MSDS's) for the chemicals they believed were used in the machines utilized at WSTF. These MSDSs were provided in Appendix D of the HIS (NASA, 2013a).

Both photographic and electrostatic plate-making processes were used at WSTF. Residual chemicals from the photographic process were historically discharged to the Building 114 septic tank. Two different versions of the photographic process were used at Building 114, the first from 1963 until approximately 1974 and the second from approximately 1973 to the mid to late 1980s. As part of the reproduction process, these photographic chemicals were diluted with water before use in the machines. When the chemicals were spent, the contents of the machines were emptied into the bathroom sink in Building 114. Both machines were emptied approximately every two months, depending on how much the plate-maker was used, with a total discharge of approximately three gallons of waste each time (NASA, 2013a). These process waste discharges to the Building 114 septic tank ceased in 1985, when NASA began containerizing wastes from the reproduction facility.

Based on information collected during HIS research, it is believed that the photographic process plate-maker machines used the silver salt diffusion transfer reversal process to produce master copies of forms and documents. In the diffusion transfer reversal process, non-developed silver halide of an image-wise exposed photographic silver halide emulsion layer material is transformed with a silver halide solvent into soluble silver complex compounds. These are allowed to diffuse into an image-receiving element and are reduced with a developing agent. This is done generally in the presence of physical development nuclei to form a reversed silver image.

Based on process knowledge and information gained from interviews performed during preparation of the HIS, NASA determined that a silver-bearing waste stream was most likely discharged to SWMU 22. The waste stream consisted of silver salts dissolved in water (NASA, 2013a). The amount of silver present in the waste stream was dependent on usage. Waste streams generated from commercial industrial photographic and imaging processing are known to contain up to 12,000 parts per million of silver (EPA, 1999). Sampling of a similar photographic process at WSTF with similar amounts of waste yielded up to 200 parts per million of silver (NASA, 2013a).

Based on information obtained during HIS research, an electrostatic plate-maker machine was used at WSTF in addition to the photographic process plate-maker machines. It is unknown when use of this machine began at WSTF; however, use of the machine ended approximately in 1973. This machine contained approximately four quarts of liquid, which consisted of two types of hydrocarbons and a water-soluble cyanide chemical. Appendix D of the HIS provides the MSDSs for these chemicals. Chemicals were added to the machine as needed during use. It is believed that spent solutions containing these compounds were infrequently generated as part of the process. Though undocumented, these solutions could have been discharged to the Building 114 septic tank.

Based on an evaluation of the discharges as described above, it was determined that silver was discharged to the Building 114 septic tank and may have subsequently been discharged to the soil. In addition, cyanide salts may have been released to the environment at SWMU 22. Therefore, silver and cyanide have been designated as the COPCs for this investigation.

NASA also evaluated information regarding the use of two types of hydrocarbons in the electrostatic plate-maker machine while developing the NMED-approved IWP. The two hydrocarbon-based solutions used in the electrostatic plate-maker machine included the electrostatic dispersant that contains isoparaffinic hydrocarbons and exhibits a flash point of 105 °F and the ITEK Premium Plate Toner that contains isoparaffinic hydrocarbons and exhibits a flash point of 102 °F to 128 °F. Interviews with former workers at Building 114 indicate that these solutions were replenished and/or replaced infrequently on an as-needed basis once the solution was "spent." The solution became spent when the volatile hydrocarbon fraction of these solutions had evaporated to a point where the solution was no longer effective. Due to the limited potential for these two spent solutions to contain significant amounts of hydrocarbons, the high potential of these hydrocarbons to volatilize once exposed to ambient conditions within the septic tank, and the amount of time since these solutions were potentially discharged, NASA did not suspect that the spent hydrocarbon solution appreciably impacted soils and groundwater beneath the former septic tank. Silver and cyanide were the sole COPCs identified in the IWP, which was subsequently approved by the NMED. NASA does not consider the lack of volatile organic constituent analyses of subsurface soils to constitute a significant data gap. There was no evidence that any other hazardous waste or hazardous constituents were disposed of at any of the other septic tanks at WSTF (NASA, 2013a).

3.0 Scope of Activities

3.1 Summary of Activities

This section provides a brief overview of the various activities performed at the WSTF septic tanks. Prior to beginning investigation fieldwork at the septic tanks, NASA prepared for implementing the IWP by performing the following:

- An evaluation of each septic tank to determine whether to retain or remove the tank.
- Field verification of the location of each septic tank identified for abandonment to confirm accessibility for excavation equipment (to avoid intercepting underground utilities).
- Pre-task safety training attended by all project personnel.

NASA then performed preparatory fieldwork at the septic tanks to facilitate investigation fieldwork, including the following:

- Collection of sludge samples from the Building 114 septic tank (SWMU 22).
- Preparation and shipment of investigation sludge samples (including QA/QC field samples) to the contracted analytical laboratory.
- Laboratory analysis, analytical reporting, and data processing through the WSTF data management system.

- Resampling of sludge in SWMU 22 with associated samples preparation, shipment, laboratory analysis, analytical reporting, and data processing.
- Removal of the SWMU 22 septic tank and backfilling with clean fill.
- Removal of any remaining septage within the remaining septic tanks scheduled for abandonment.
- Recording of daily field activities in field logbooks and field data on required forms.
- Safety and health briefings conducted daily at the work site for pre-investigation activities

NASA then completed the primary investigation tasks that consisted of the following:

- Excavation and removal of the septic tanks scheduled for abandonment. The 100 Area septic tanks at Building 117 (WSTF Forward Guard Gate) and the new replacement tank at Building 119 was retained. Abandonment Forms were completed and submitted to NMED following excavation and removal of each tank.
- Field check of SWMU 22 soil boring locations to confirm accessibility by drilling equipment, site clearance to drill (to avoid intercepting underground utilities), and pre-task safety training attended by all project personnel.
- Recording of daily field activities in field logbooks and field data on required forms.
- Safety and health briefings conducted daily at the investigation site.
- Installation of soil borings and collection of soil chemical samples for COPCs at SWMU 22.
- Preparation and shipment of investigation soil samples (including QA/QC field samples) to the contracted analytical laboratory.
- Laboratory analysis, analytical reporting, and data processing through the WSTF data management system.
- Finalization of SWMU 22 soil analytical data for interpretation and presentation in this IR.

3.2 Data Quality Objectives

The Data Quality Objectives (DQOs) of the project are used to establish performance or acceptance criteria. These criteria are used to develop the sampling framework. The DQOs consist of the problem statement, information inputs, the spatial extent of the investigation, and the performance or acceptance criteria (the decision rule).

3.2.1 Problem Statement and Objective

The problem statement is: Confirm that soil beneath and downgradient of the SWMU 22 septic tank and leach field does not contain hazardous constituents at concentrations above regulatory limits as a result of present or past operations. The objective of this investigation is to compare any residual contamination present at SWMU 22 to appropriate regulatory criteria to make this decision.

3.2.2 Information Inputs

Primary decision inputs are analytical data generated from septic tank vadose zone soil sampling performed during this investigation. COPCs were identified based on the history of the Building 114 septic tank.

3.2.3 Spatial Extent of Investigation

The horizontal boundaries of the study represent the known extent of the SWMU 22. The vertical boundary of the study is limited to the uppermost vadose zone (to 27 feet [ft] below ground surface [bgs]) beneath SWMU 22 and surrounding (upgradient and downgradient), as approved in the IWP (NASA, 2013a) and investigation methodology deviation document (NASA, 2014a).

3.2.4 Decision Rule

In accordance with the NMED *Risk Assessment Guidance for Site Investigations and Remediation* (RA Guidance; NMED, 2019), validated analytical results from soil samples collected during the investigation will be compared to all applicable soil screening levels (SSLs) including human health risk and hazard screenings using both residential soil screening levels (RSSLs) and construction soil screening levels (CSSLs) as well as risk-based and maximum contaminant level (MCL)-based SSLs protective of groundwater for identified complete exposure pathways. In addition to comparison to complete exposure pathways, investigation data will also be compared to RSSLs to evaluate the investigation site for a potential "corrective action complete" determination, per requirements listed in the NMED RA Guidance (NMED, 2019).

If COPC concentrations in vadose zone soils exceed the appropriate NMED SSLs, then further investigation or a RCRA Corrective Measures Study may be required to determine the appropriate course of action. Otherwise, consider a no further action and corrective action complete determination.

3.3 Site Conceptual Exposure Model

A preliminary site conceptual exposure model (SCEM) was presented in the IWP (NASA, 2013a) for this investigation (Figure 3.1) to evaluate possible exposure to hazardous constituents or COPCs at SWMU 22. Components of the SCEM are the source(s) of contamination, the release mechanism, the exposure pathway, the potential receptor(s), and fate and transport of potential contamination. Although multiple exposures were evaluated as a part of this investigation, the construction worker scenario is the only plausible setting given the nature of WSTF operations and history.

3.3.1 Contamination Source(s)

The SWMU 22 septic tank and soil below and adjacent to the tank are considered the primary sources for the conceptual model. Exposed subsurface soil outside of the septic tank that may have come in contact with septage is a potential secondary source.

3.3.2 Release Mechanisms

1. Hydraulic Pressure. This release mechanism is most applicable to the septic tank because of its poor integrity. Hazardous constituents may have leaked from the tank to the soils beneath the source. Under this release mechanism, the mass of the hazardous substances is pulled by gravity toward the subsurface strata through the path of least resistance.

2. Leaching. This release mechanism refers to the movement of soluble chemicals via infiltration into subsurface soils. This release mechanism could be viewed as the combined mechanisms of gravitational force, hydraulic pressure, and solubility. Leaching also serves as a migration pathway that transports wastewater to other media or locations.

3. Digging. This mechanism refers to human activities that may intercept soils that have accumulated wastes as a result of infiltration, leaching, or runoff. Construction activities that entail soil or sediment excavation are examples of this release mechanism.

3.3.3 Exposure Pathways and Exposure Scenarios

Four potential exposure pathways are identified: 1) ingestion of groundwater; 2) incidental ingestion of soil; 3) inhalation of contaminants or particulate emissions (dust); and 4) dermal contact with soil.

The migration to groundwater pathway for any historical contamination from potential discharges or spills or residual soil contamination could result in groundwater contamination from SWMU 22. The groundwater underlying much of WSTF is known to be contaminated, and its future use and potential risk to receptors are part of ongoing site-wide evaluation and corrective actions. The only water supply wells for the site are located several miles to the west of the investigation area and are monitored regularly for the presence of any site-source contaminants. There is no complete groundwater exposure pathway. However, the NMED RA guidance requires that every investigation with potential soil contamination evaluate the soil-to-groundwater scenario (NMED, 2019).

There are no current or future residential land use scenarios anticipated in the vicinity of SWMU 22. The area is within a controlled test site located on the U.S. Army White Sands Missile Range. There are no encroaching residential areas. Therefore, there are no complete exposure pathways identified for residential land use scenarios.

If there is any residual soil contamination at SWMU 22, then a construction worker may encounter contaminated material when working in the areas in the future. Therefore, inadvertent ingestion of, inhalation of, or dermal contact with contaminated soil may be considered complete exposure pathways for this evaluation.

Identified exposure scenarios include the construction worker (for 0 to 10 ft bgs soils) and the soil-go-groundwater scenario (all depths bgs soils). NASA also evaluated the residential exposure scenario (for 0 to 10 ft bgs soils) to determine the long-term disposition of the SWMU 22 area.

3.3.4 Potential Receptors

There are no immediate plans for construction or facility expansion in the SWMU 22 area; however, a potential exposure scenario at SWMU 22 exists for unanticipated future growth or construction activities. Potential receptors under this scenario are workers conducting excavation or construction activities in the SWMU 22 area. Groundwater beneath SWMU 22 is also a potential receptor of contaminants leaching from potentially contaminated soils.

3.3.5 Fate and Transport

There are three general categories of processes affecting contaminant fate and transport: hydrodynamic; abiotic; and, biotic processes. Hydrodynamic processes include advection, dispersion, and preferential flow. Abiotic processes include adsorption, volatilization, ion exchange, hydrolysis, precipitation or dissolution, cosolvation, redox processes, and colloid transport. Biotic processes include metabolism and/or cometabolism by microorganisms.

At SWMU 22, the most likely mechanisms for transport of wastes or COPC(s) into the vadose zone would be any of the hydrodynamic processes as a result of leaching due to operation of the septic tank. Because septage comprises the majority of the discharge load to the septic tank, biotic as well as abiotic processes are also occurring. Subsurface analytical data was required to determine the presence and concentration of COPC(s) in the vadose zone.

3.4 Surface Conditions

3.4.1 Site Topography

WSTF topography is characteristic of the Bolson subsection, Mexican Highland section of the Basin and Range physiographic province of the southwestern United States, formed as a result of late Tertiary extensional tectonism. The WSTF industrial area is located on the piedmont slope west of the SAM, one of the most prominent north-south mountain ranges in southern New Mexico. The SAM extends from San Augustine Pass (6 mi south of WSTF) to Mockingbird Gap (75 mi north). The WSTF 100 Area is located between Bear Canyon to the northeast and Loman Canyon to the southeast. Foothills on the western pediment of the SAM at WSTF consist of thin layers of alluvium covering fractured Paleozoic and Cretaceous carbonate and clastic (shale, siltstone, and sandstone) and Tertiary volcanic bedrock (NASA, 1996). The elevation at the septic tank at Building 114 (SWMU 22) is 4,770 ft above mean sea level (amsl; Figure 3.2).

3.4.2 Soils

Soils at WSTF are typically characterized by the U.S. Department of Agriculture (USDA) Soil Classification (USDA, 1999) Nickel-Tencee Association (60% Nickel gravelly fine sandy loam and 25% Tencee very gravelly loam). The alluvium is classified as the piedmont slope facies of the Camp Rice Formation, which forms part of the Quaternary Santa Fe Group (Seager, 1981).

3.4.3 Water Bodies

Gardner Spring is the only major natural water body located in the vicinity of septic tank at Building. 114 (SWMU 22; Figure 3.3). Gardner Spring consists of a small intermittent surface seep located approximately 1 mi northeast of the 100 Area. With heavy mountain-front rainfall, the Gardner Spring Arroyo carries rainwater southwest and west toward the Southern Jornada del Muerto Basin (SJDMB). This rainwater infiltrates the sand and gravels of the arroyo floor and recharges local groundwater. The nearest natural water body of significant size is the ephemeral Isaacs Lake, located approximately 8 mi to the southwest of the 100 Area. Isaacs Lake is located at the lowest topographic point of the SJDMB, at an elevation of 4,285 ft amsl.

3.4.4 Vegetation

Vegetation at WSTF includes a combination of woody shrubs and grasses characteristic of the Chihuahuan Desert Shrub Biotic Community. These shrubs include Louisiana White Sage, Creosote bush, Honey Mesquite, Tarbush, Broom Snakeweed, and Lotebush. Common grasses include Alkali Sacaton, Side-Oats Grama, Fluff Grass, Tobosa Grass, and Purple Three Awn. The facility receives little use by wildlife species because it has been physically altered by human disturbance (NASA, 1996).

3.4.5 Erosional Features

The drainage pattern forming off the SAM east of the 100 Area consists of a network of arroyos cut through alluvial fans. These arroyos trend west to southwest from the mountains towards the SJDMB and consist of larger, deeper, more prominent drainages to subtle arroyos, generally hidden from sight within the low profile topography and vegetation (NASA, 1996; Figure 3.2).

3.4.6 Pre-Investigation Activities

Pre-investigation activities were conducted to provide site characterization data for planning for tank removal and disposal and site investigation details. These pre-investigation activities included determining which WSTF septic tanks to abandon or retain, installing a replacement septic tank for SWMU 22, assessing the condition/contents of the SWMU 22 septic tank system, and SWMU 22 sludge sampling to characterize the sludge for disposal.

3.4.7 WSTF Septic Tank Abandon or Retain Determinations

As part of planning and construction of the WSTF sanitary sewer system to connect to the City of Las Cruces Publicly Owned Treatment Works (CLC POTW), NASA evaluated all septic tank sites to determine which septic tank systems should be abandoned and whether any septic systems should be retained. NASA evaluated each septic tank at WSTF for current usage, anticipated future use, and ease of connection to the CLC POTW. The final status of each septic tank is provided in Table 3.1. For septic tanks scheduled for abandonment, the sites were evaluated to ensure fieldwork could be performed as planned. Sites were assessed for ease of access for excavation equipment and overhead and underground utilities to ensure safety. In addition, all project personnel attended pre-task safety training.

3.4.8 WSTF Septic Tank System Retention/Installation

NASA determined that the septic tank for Building 117 (Figure 1.2) would be retained due to the remoteness of the area and impracticality of connecting the WSTF Forward Guard Gate facilities to the CLC POTW. An application for the Building 117 septic system was submitted to the NMED Ground Water Quality Bureau (GWQB) on March 29, 2006 (NASA, 2006a). The NMED GWQB approved the application on May 12, 2006 (NMED, 2006) and provided temporary permission to discharge from the tank under the condition that an application be submitted to renew and modify Discharge Permit (DP) -392 to include all septic tank leach fields within the 100, 200, and 600 Areas. NASA complied with the condition of approval by filing an application to renew and modify DP-392 on November 20, 2006 (NASA, 2006b). The application identified the required septic tanks, including the Building 117 tank, and the six existing wastewater lagoons already permitted under DP-392. NMED took no final action on the application because NASA began planning to divert wastewater discharged to the lagoons and most septic tanks to the CLC POTW. Once it was determined that the tank would be retained, NASA filed a separate application with the NMED to permit the Building 117 tank through the Liquid Waste Program (LWP) on May 31, 2017 (NASA, 2017a). NMED LWP personnel inspected the tank, approved the application, and permitted the tank on July 10, 2017 (NMED, 2017b).

Building 119 is adjacent to Building 114 in the WSTF 100 Area and facilities within both buildings historically discharged septage to the Building 114 septic tank (SWMU 22). The location of Building 119 made it impractical for NASA to provide sanitary sewer service to the CLC POTW. Instead, a replacement septic tank was installed for Building 119 prior to removing and investigating SWMU 22. NASA submitted the *Application for Permit to Replace Septic Tank* for Buildings 114 and 119 to the NMED LWP on August 19, 2013 (NASA, 2013b). NMED LWP approved the permit to construct the new septic tank on August 30, 2013 (NMED, 2013a). The replacement septic tank was installed adjacent to SWMU 22 (Figure 1.2) to service Buildings 114 and 119 Area on September 10, 2013.

3.4.9 SWMU 22 Tank System Assessment

An initial measurement of the contents of the Building 114 septic tank was performed on August 13, 2013 prior to the tank being taken out of service. At that time, the tank contained 3 inches (in.) of sewage sludge, and 28 in. of liquid wastewater. An initial visual inspection of the inside of the tank was performed on November 13, 2013 by partially removing the tank cover. Discharges to the tank had ceased after installation of new tank for Building 119 facilities on September 10, 2013. It was expected the Building 114 tank would contain free liquid (wastewater), as was found in the initial inspection. However, in November, there was no free liquid in the SWMU 22 tank.

After the initial inspection, NASA questioned the integrity of the Building 114 septic tank to hold liquid waste. An effluent pipe was not initially observed in the tank (NASA, 2014a), but after completely removing the tank cover a discharge pipe was found. The discharge pipe was found to extend approximately 60 feet to the northeast of the tank. Extensive investigation was conducted, but no wastewater emitters or traditional leach field were located. No evidence of wastewater was observed in the pipe and there was no evidence of wastewater discharge at the effluent pipe termination point. Lack of staining and fluid fill lines near the effluent port in the tank also indicated that wastewater never flowed out the discharge pipe. The investigation methodology was modified because field observations indicated discharges at SWMU 22 occurred at the tank itself, not at a leach field (NASA, 2014a). The investigation was modified to determine if contaminants of concern seeped from the SWMU 22 septic tank downgradient or into the vadose zone alluvium below the tank (NASA, 2014a). During excavation and tank removal, no visible seepage or moisture was detected outside of the septic tank excavation. Soil staining was only visible on the first few inches of alluvium below the contact with clean fill sediment within the footprint of the tank. Appendix A contains photographs of the SWMU 22 septic tank, outlet pipe, and fill line.

3.4.10 SWMU 22 Sludge Sampling

On December 11, 2013, NASA performed sludge sampling at SWMU 22 to characterize the waste (sludge and tank) for disposal. Sampling consisted of collecting one sludge sample and duplicate sample from the center of the tank with a shovel that had initially been triple rinsed with deionized water and then air dried. Samples were analyzed for toxicity characteristic leaching procedure (TCLP) Metals by EPA Method 6010C/4770A and cyanide by EPA Method 9012B. Cyanide results were inconsistent between the sample and duplicate sample, with a 172.5% relative difference (4.87 mg/kg and 65.9 mg/kg). NASA's allowable percent difference is 25% (NASA, 2014a).

NASA compared the highest analytical results from sludge sampling to NMED's CSSLs to determine if the sludge or tank would be classified as hazardous or nonhazardous. No constituent exceeded any CSSL, including cyanide (with a CSSL of 186 mg/kg), and NASA preliminarily classified the sludge and tank as nonhazardous, However, due to the large percent difference between the sample cyanide result and the duplicate cyanide result, NASA proposed to resample the tank sludge prior to March 31, 2014. If the additional sampling results indicated that cyanide was present above the CSSL, then NASA would submit a new removal plan for the SWMU 22 tank, based on the sludge and tank waste being classified as hazardous waste (NASA, 2014a). NMED approved the results and NASA's proposed actions on May 6, 2014 (NMED, 2014a).

On March 12, 2014, NASA resampled the Building 114 septic tank sludge. A sample and duplicate sample were obtained from both the northwest and southeast corners of the tank (NASA, 2014b). Cyanide sample results between samples and duplicates still exceeded 25%. At the northwest corner of the septic tank, cyanide results in sludge sample and duplicate were 16.2 mg/kg and 30.6 mg/kg (61.5% relative difference). At the southeast corner of the septic tank, cyanide results in the sludge sample and duplicate were 1.81 mg/kg and 3.93 mg/kg (73.9% relative difference; NASA, 2014b).

NASA concluded that the SWMU 22 sludge and tank were nonhazardous waste, based on all cyanide results compared with the CSSL (186 mg/kg) and proposed disposing of the tank as planned in the original septic tanks removal plan that was included as Appendix A of the IWP (NASA, 2013a). NMED approved the second SWMU 22 sludge sampling results on June 26, 2014 (NMED, 2014b).

NMED released revised SSLs in December 2014 that decreased the cyanide CSSL from 186 mg/kg to 12.1 mg/kg (NMED, 2014c). When the previous cyanide results from SWMU 22 sludge samples were compared to the new regulatory criteria, the potential for the sludge and tank waste to be characterized as hazardous waste arose. NASA evaluated the cyanide results from previous sampling and determined that the cyanide concentrations in SWMU 22 sludge may have been impacted by nitrate/nitrite interference during analysis using SW-486 Method 9012B (NASA, 2015a). Method 9012B states that "high results may be obtained for samples that contain nitrate and/or nitrite…The possibility of interference of nitrate and nitrite is eliminated by pretreatment with sulfamic acid just before distillation" (EPA, 2004).

NASA resampled the SWMU 22 sludge on June 16, 2015 from the center of the tank. Results were 0.79 mg/kg and 0.17 mg/kg (129.2% relative difference). The laboratory was instructed to perform pretreatment with sulfamic acid prior to distillation to eliminate nitrate/nitrite interference; however, the laboratory did not perform the sulfamic acid pretreatment. An additional SWMU 22 tank cyanide resampling event was conducted on March 9, 2016 from the northwest corner of the tank. Sulfamic acid pretreatment was requested by NASA and conducted by the contracted laboratory. Total cyanide results were 0.09 mg/kg and 10.3 mg/kg. A final set of sludge samples was collected and analyzed for cyanide by Method 9012B with sulfamic acid pretreatment on June 9, 2016. Results were 1.53 mg/kg and 6 mg/kg.

NASA compared all of the cyanide results of sludge samples pretreated with sulfamic acid (to avoid nitrate/nitrite interference) to the NMED CSSLs for cyanide from the December 2014 RA guidance (NMED, 2014c). NMED soil screening levels were considered guidance for determining if cyanide was present in such a quantity that it may be considered reactive. It was assumed that cyanide present at or below the NMED soil screening levels is not reactive. This rationale was accepted by the NMED in a May 6, 2014 approval (NMED, 2014a) of NASA's March 4, 2014 Summary of SWMU 22 Sewage Sludge Analytical Results and Proposed SWMU 22 Soil Investigation Methodology Deviations (NASA, 2014a). All SWMU 22 total cyanide results were below the 2014 NMED CSSL of 12.1 mg/kg. After receipt of these results, NASA re-characterized the SWMU 22 septic tank and sludge as nonhazardous waste. The tank and sludge were removed in accordance with the revised removal strategy identified in the Summary of SWMU 22 Sewage Sludge Analytical Results (NASA, 2014a). Sewage sludge was removed and disposed of by a licensed septage pumper. The SWMU 22 septic tank was removed on November 9, 2016 and disposed of as solid waste in accordance with the NMED-approved IWP (NASA, 2013a).

4.0 Field Investigation Results

Planned investigation activities for the Building 114 septic tank were described in the IWP (NASA, 2013a) and the approved Deviations (NASA, 2014a; NMED, 2014a), and were developed based on project DQOs and other requirements of the Permit (NMED, 2016). These activities were adhered to as closely as possible during the investigation. Deviations from the planned investigation methodology are identified in Section 4.10 of this report. The following sections describe the field activities conducted for the septic tanks investigation from January 2015 to October 2017.

4.1 Field Data Collection

Contractor Environmental Department personnel including geologists, compliance personnel, and sampling technicians recorded day-to-day accounts of field activities in field logbooks, and any investigation data collected were recorded either in logbooks or on project-required forms. Investigation documentation included, but was not limited to the following:

- Field logbooks
- Daily tailgate safety meeting forms
- Lithologic logging forms
- GPS data for soil boring locations
- Survey forms including maps
- Sample documentation
- Internal and external chain-of-custody forms
- Sample shipment forms

4.2 Septic Tank Decommissioning and Removal

NASA evaluated each septic tank at WSTF to determine whether to remove or retain the tank. The results of the assessment are summarized in Table 3.1, which provides the final status of each WSTF septic tank. After determining that a septic tank was to be removed, NASA inspected the tank to determine if residual septage was present, and if so, coordinated its removal. Following waste removal, NASA excavated and removed the septic tanks and coordinated their disposal at an approved off-site facility (Table 3.1). All tanks were excavated, pumped, and removed in accordance with the septic tanks removal plan (Appendix A of the IWP; NASA, 2013a). Appendix B contains the required liquid waste system abandonment forms submitted the NMED LWP. As required by the NMED approval with modifications, NASA closely observed all septic tanks during removal. No evidence of leakage, spills, unauthorized discharges to the environment, or unexpected system configurations were observed during excavation or removal of any septic tank identified in the Permit as SWMUs 21 and 23-27. Tank excavations were backfilled with clean fill per the approved IWP. The clean fill was sourced from the WSTF borrow pit and, in some cases, stockpiled soil from recent excavations for new sewer lines in the area. The borrow pit is located east-northeast of the 100 Area upgradient of any site where use of or releases of hazardous constituents occurred. The borrow pit and surrounding area were undisturbed by other site activities and only used for excavation of materials for use in construction projects at WSTF. Likewise, the sewer line excavations from which fill material was obtained are not located near any area where WSTF industrial activities occurred. The fill consisted of clean native soil but was not sampled or certified. After backfilling operations, the ground surface was smoothed to grade and left to revegetate naturally. The following sections summarize the findings of septic tank assessments and describe the removal and disposal process for each SWMU and non-SWMU septic tank.

4.2.1 SWMU 21 – 100 Area Septic Tank at Guard Shack (Building 116)

The 100 Area septic tank at the WSTF original guard shack (at Building 116; SWMU 21) was pumped, excavated, and removed on July 17, 2017. NASA submitted the liquid waste system abandonment form to NMED LWP as required on August 8, 2017 (NASA, 2017b).

4.2.2 SWMU 22 – 100 Area Septic Tank at Building 114

Final SWMU 22 sludge sampling results indicated silver and cyanide concentrations were below the NMED CSSLs. The sewage sludge and the septic tank carcass were characterized as nonhazardous waste and tank removal SWMU 22 was conducted in accordance with the original septic tank removal plan (Appendix A of the IWP [NASA, 2013a]) that was approved by the NMED HWB (NMED, 2013b) and the NMED LWP (NMED, 2013c). Minimal water was added to the SWMU 22 tank during sewage sludge removal by a licensed subcontractor. The tank was pumped and removed on November 9, 2016. NASA submitted the required liquid waste system abandonment form to NMED LWP on November 15, 2016, (NASA, 2016e).

4.2.3 SWMU 23 – 200 Area Septic Tanks at Building 272 (Tanks A&B)

The 200 Area septic tanks (A&B) at Building 272 (SWMU 23) were both pumped, excavated, and removed on December 16, 2015. NASA submitted the liquid waste system abandonment form to NMED LWP as required on February 4, 2016 (NASA, 2016b).

4.2.4 SWMU 24 – 300 Area Septic Tank at Main Parking Lot

The 300 Area main septic tank (SWMU 24) was pumped, excavated, and removed on March 4, 2016. NASA submitted the liquid waste system abandonment form to NMED LWP as required on April 28, 2016 (NASA, 2016d).

4.2.5 SWMU 25 – 300 Area Septic Tank at Building 320

The 300 Area septic tank at Building 320 (SWMU 25) was pumped, excavated, and removed on February 10, 2016. NASA submitted the liquid waste system abandonment form to NMED LWP as required on March 30, 2016 (NASA, 2016c).

4.2.6 SWMU 26 – 300 Area Septic Tank at Building 364

The 300 Area septic tank at Building 364 (SWMU 26) was pumped, excavated, and removed on May 20, 2015. The liquid waste system abandonment form was submitted to NMED LWP as required on July 6, 2015 (NASA, 2015c).

4.2.7 SWMU 27 – 400 Area Septic Tank at Main Parking Lot

The 400 Area main septic tank (SWMU 27) was pumped, excavated, and removed on March 8, 2016. NASA submitted the NMED LWP liquid waste system abandonment form as required on April 28, 2016 (NASA, 2016d).

4.2.8 100 Area Septic Tank at Building 117 (WSTF Forward Guard Gate)

As discussed in Section 3.4.8, the 100 Area septic tank at Building 117 was retained for use at WSTF. The tank was inspected by the NMED LWP and Permit Number 002090 was issued for the on-going operation of this septic system (NMED, 2017b).

4.2.9 250 Area Septic Tank (Area of Interest)

Despite a thorough field inspection, the 250 Area septic tank (area of interest) was not located during this investigation. It was determined that the septic tank had been removed in the past without documentation, or had biodegraded. According to research performed during preparation of the HIS, the tank was intended to be temporary and was constructed mostly of redwood and "orangeburg drain pipe," which reportedly biodegrade over time. The HIS also contained a photograph from June 1977 showing an open pit surrounded by bollard posts in the area where the septic tank was reported to be located (NASA, 2013a; Appendix A). The tank may have been removed at that time.

4.2.10 200 Area Septic Tank at Building 272 (Tank C)

The 200 Area septic tank at Building 272 (Tank C) was pumped, excavated, and removed on December 16, 2015. NASA submitted the liquid waste system abandonment form to NMED LWP as required on February 4, 2016 (NASA, 2016b).

4.2.11 400 Area Septic Tank at Building 447

The 400 Area septic tank at Building 447 was pumped, excavated, and removed on February 18, 2016., NASA submitted the liquid waste system abandonment form to NMED LWP as required on March 30, 2016 (NASA, 2016c).

4.2.12 400 Area Septic Tank at Building T463

The 400 Area septic tank at Building T463 was pumped, excavated, and removed on January 28, 2015. NASA submitted the liquid waste system abandonment form to NMED LWP as required on March 16, 2015 (NASA, 2015b).

4.2.13 600 Area Septic Tank at Building 650

The 600 Area septic tank at Building 650 was pumped, excavated, and removed on February 17, 2016. NASA submitted the liquid waste system abandonment form was submitted to NMED LWP as required on March 30, 2016 (NASA, 2016c).

4.2.14 800 Area Septic Tank at Building 802/803

The 800 Area septic tank at Buildings 802/803 was pumped, excavated, and removed on June 21, 2017. NASA submitted the liquid waste abandonment form to NMED LWP as required on August 8, 2017 (NASA, 2017b).

4.2.15 STGT Septic Tank

The STGT septic tank was pumped, excavated, and removed on July 19, 2017. NASA submitted the liquid waste program abandonment form to NMED LWP as required on August 8, 2017 (NASA, 2017b).

4.3 Drilling Program

4.3.1 Overview of Drilling Program

Off-site contractors were used during drilling for this project with oversight by WSTF personnel. Initial soil boring locations (Figure 2.1) were presented in the IWP (NASA, 2013a). These locations were later changed within the Deviations (NASA, 2014a) and approved by NMED on May 6, 2014. All soil borings were completed in accordance with the Deviations (NASA, 2014a) except where noted in this report.

Seven soil borings were installed at or adjacent to the location of the Building 114 septic tank. Three shallow soil borings and two deeper borings were installed in April 2017. One boring upgradient and two borings downgradient were installed to 12 ft bgs. Two borings were drilled within the excavation area (footprint) of the septic tank to 27 ft bgs. Due to anomalous analytical results for samples collected from these borings at 6 to 8 ft bgs (the base of the former septic tank), two additional shallow borings were installed to 9 ft bgs in October 2017 within the excavation area. Appendix C contains lithologic logs of the soil borings installed during this investigation.

4.3.2 Building 114 Septic Tank (SWMU 22) Soil Boring Locations

Subsurface drilling and sampling activities were performed at the Building 114 septic tank on April 18, 2017 and April 19, 2017 by Terracon Consultants, Inc. of El Paso, TX, under the supervision of WSTF contractor Environmental Department personnel.

A truck mounted Central Mine Equipment CME-75 HSA drilling rig was used to drill the soil borings and to collect soil samples. Soil borings were advanced using a carbide-tipped bit and 5-ft length x 8.75-in. diameter steel augers. Original soil boring locations were presented in the IWP (NASA, 2013a) and approved by NMED (NMED, 2013b). Initially, five soil borings were planned for installation within the leach field, one boring was planned upgradient and one boring was planned downgradient of the leach field. Three potential supplemental borings were also originally proposed if any evidence of contamination was noted at the tank site: two within the tank footprint and one downgradient of the tank. However, during pre-investigation sludge sampling activities at the Building 114 septic tank, it was discovered that the tank bottom was compromised. The available evidence indicated that the septage had not reached the leach field. With NMED's approval (NMED, 2014a), NASA modified the planned soil investigation to include the installation of two borings within the footprint of the SWMU 22 septic tank, one boring downgradient of the tank, and one boring upgradient of the tank (NASA, 2014a). Soil borings were installed in the following order: upgradient soil boring 114-SB-01 to 12 ft bgs; downgradient soil borings 114-SB-04 and 114-SB-05 to 12 ft bgs; and, SWMU 22 soil borings (in footprint) 114-SB-02 and 114-SB-03 to 27 ft bgs.

On October 31, 2017, two additional soil borings were completed to 9 ft bgs within the footprint of the SWMU 22 tank due to anomalous cyanide results from soil samples collected at the 6 to 8 ft bgs interval in borings 114-SB-02 and 114-SB-03. Terracon Consultants also completed the additional borings, designated as 114-SB-07 and 114-SB-06, with WSTF contractor Environmental Department personnel supervision.

4.4 Soil Sampling

Soil sample depths were originally proposed in the IWP (NASA, 2013a), but were later changed in the Deviations (NASA, 2014a), which NMED approved on May 6, 2014. Both approved documents were used in conjunction with Permit Section 17.2.2.b.i. (NMED, 2016) to guide soil sampling operations in the field. The following sections describe the sampling activities performed during investigation fieldwork at SWMU 22.

4.4.1 Chemical Sampling and Analysis

At SWMU 22, samples collected during this investigation include investigation soil samples, duplicates, matrix spikes, and equipment rinsate samples. Soil samples, including duplicate and matrix spike samples, were obtained by advancing the auger to just above the sampling interval specified in the Deviations (NASA, 2014a). A 3-in. split spoon sampler was utilized to collect soil samples across the interval specified in the Deviations (NASA, 2014a).

At the Building 114 septic tank location, NASA collected soil samples for chemical analyses of total metals content and cyanide content. In April 2017, NASA installed the five soil borings 114-SB-01 through 114-SB-05 (three to 12 ft bgs and two to 27 ft bgs) and collected 16 (19 with duplicates and matrix spikes) soil chemical samples. The April 2017 soil samples from soil borings 114-SB-01 through -05 were analyzed at an off-site National Environmental Laboratory Accreditation Program accredited laboratory for total metals using SW-846 Methods 6010B/7471 and total cyanide using SW-846 Method 335.4 instead of using Method 9012B, as requested. Results of cyanide analyses of the April 2017 soil samples indicate that nitrate interference may have impacted cyanide results in the same manner as previously identified during sludge sample analyses as described in Section 3.4.10. The elevated cyanide concentrations were observed in samples collected from immediately beneath the former septic tank.

NASA evaluated the potential for nitrate interference impacts to cyanide analytical results by sampling soils from two additional shallow soil borings, 114-SB-06 and 114-SB-07, installed in October 2017 and analyzing these samples using SW-846 Method 9012B. Soil samples were collected adjacent to the two borings exhibiting the highest cyanide concentrations from soils immediately beneath the fill material. NASA selected an accredited laboratory that could analyze the October 2017 soil samples for total cyanide by SW-846 Method 9012B, using the sulfamic acid preparation modification. In areas where nitrate interference in cyanide analyses is probable, analyses for cyanide using sulfamic acid preparation and Method 9012B yield results that are more representative of subsurface conditions than results of cyanide analyses using Method 335.4.

4.4.2 SWMU 22 Shallow Boring Soil Sampling

At the Building 114 septic tank location, shallow soil samples were collected using a 3-in. split spoon sampler at designated intervals within borings updgradient boring 114-SB-01 and downgradient borings 114-SB-04 and 114-SB-05. In addition to soil chemical samples collected from the three shallow borings, NASA collected equipment rinsate samples from the 3-in. split spoon sampler prior to soil sampling on April 18 and 19, 2017. Soil chemical samples and related quality control samples were collected at:

- 114-SB-01: 5 to 7 ft bgs; 10 to 12 ft bgs (with duplicates)
- 114-SB-04: 5 to 7 ft bgs; 10 to 12 ft bgs
- 114-SB-05: 5 to 7 ft bgs; 10 to 12 ft bgs

Analytical results from cyanide samples collected in April 2017 from the 6 to 8 ft bgs interval within soil boring 114-SB-02 and the 7 to 8 ft bgs interval within soil boring 114-SB-03 may have been impacted by nitrate/nitrite interference. As a result, replacement samples were collected from the 7 to 9 ft bgs interval within additional shallow soil 114-SB-07 and 114-SB-06, installed in October 2017. During installation of these soil borings, fill material was identified from the ground surface to a depth of 7 ft bgs, therefore the selected sample interval for both boreholes was immediately beneath the fill material, from 7 to 9 ft bgs. The sampling interval lies directly beneath the clean fill sand that was used to fill in the excavation following excavation and removal of the septic tank. NASA collected equipment rinsate samples from the 3-in. split spoon sampler prior to soil sampling on October 31, 2017. A field blank was also collected at this sampling event. Soil chemical samples were collected as follows:

- 114-SB-06: 7 to 9 ft bgs
- 114-SB-07: 7 to 9 ft bgs

4.4.3 SWMU 22 Deep Boring Soil Sampling

At the Building 114 septic tank location, deep soil samples were collected using a 3-in. split spoon sampler at designated intervals within borings 114-SB-02 and 114-SB-03, both of which lay within the excavation area of the septic tank. Shallow soil samples were collected upgradient and downgradient from SWMU 22. NASA collected equipment rinsate samples from the 3-in. split spoon sampler prior to soil sampling on April 18 and 19, 2017. Soil chemicals and quality control samples were collected at the following locations:

- 114-SB-02: 6 to 8 ft bgs; 10 to 12 ft bgs; 15 to 17 ft bgs; 20 to 22 ft bgs; 25 to 27 ft bgs (with matrix spike).
- 114-SB-03: 7 to 8 ft bgs (with duplicates); 10 to 12 ft bgs; 15 to 17 ft bgs; 20 to 22 ft bgs; 25 to 27 ft bgs.

Photographs of the sampling event are included in Appendix A.

4.5 Subsurface Conditions

4.5.1 Man-made Structures

The complex network of underground electrical, gas, communication, and water lines in the vicinity of the Building 114 septic tank is shown in Figure 2.1.

4.5.2 Geology and Hydrogeology

Soils observed in this investigation were evaluated using the Munsell soil color system (Munsell, 2009) and consisted of pinkish white (5 YR 7/2) to light yellowish brown (10 YR 6/4) sand with gravel (Unified Soil Classification System group SW). No other soil investigations were conducted at the remaining septic tank SWMU sites. The alluvium in the area primarily consisted of well graded sand with gravel and significant amounts of silt.

4.6 Soil Boring Abandonment

Following the completion of the two deep and five shallow soil borings for the Building 114 septic tank (114-SB-01, 114-SB-02, 114-SB-03, 114-SB-04, 114-SB-05, 114-SB-06, 114-SB-07), each boring was filled with a Portland Type I/II cement-bentonite grout containing approximately 5% bentonite by weight from total depth of the borehole to 2 ft bgs. The grout was allowed to set, covered by 2 ft of cement, and staked with a brass cap. The brass caps were surveyed by WSTF personnel with Trimble®,[1] TSC3 Global Positioning System surveying equipment and stamped with the boring number and coordinates. The coordinates and the elevation were recorded in the applicable project documentation.

4.7 Safety and Health Measures

Field activities were conducted in accordance with requirements of OSHA Standards for Hazardous Waste Operations and Emergency Response (HAZWOPER; 29 CFR 1910.120[a]-[o]), EPA standards, the WSTF environmental contractor's Safety and Health Plan (SHP), and the IWP (NASA, 2015b). The SHP addressed safety and health issues pertaining to work activities, including known and reasonably anticipated hazards associated with project scope of work as well as contingencies for unexpected conditions. Requirements of the SHP applied to prime and sub-tier contractors as well as personnel requesting access to controlled areas of the investigation site.

Project field personnel were current in HAZWOPER training required under 29 CFR 1910.120(e). Safety professionals, or other designees, inspected subcontractor equipment prior to the commencement of work. There were no significant health and safety concerns identified. Beyond the federal, state, and site required health and safety measures listed above, key field personnel attended a safety presentation before commencement of field activities outlining possible hazards that may arise.

4.8 Decontamination Procedures

Decontamination procedures were performed by personnel who have completed the Occupational Safety and Health Administration (OSHA) standards for HAZWOPER 29 Code of Federal Regulations (CFR) 1910.120[a-o] 40-hour training personnel wearing appropriate personal protective equipment (PPE). The decontamination of heavy equipment was performed under the supervision of WSTF contractor

[1] Trimble is a registered trademark of Trimble, Inc. Corporation.

Environmental Department personnel. All decontamination was performed in accordance with the project specific Field Decontamination Plan.

Decontamination during sewage sludge sampling activities included rinsing reusable sampling equipment with purified deionized water prior to initiating sample collection. Following sampling activities, reusable sampling equipment was decontaminated using a 2% bleach solution and cleaned using a non-phosphate detergent at the project site. Decontamination water was properly contained until sample results were received and the final characterization of the water was performed.

Heavy equipment used for the soil borings at the Building 114 septic tank included an HSA drilling rig that was decontaminated at the large decontamination pad next to Building 637 with a high pressure heated water wash prior to drilling the soil borings. The split spoon barrel used for sampling was decontaminated first by washing the sampler with a non-phosphate detergent wash such as Alconox®,[2] and rinsed with water between sampling events. Nitrile gloves were donned for collection and handling of soil samples for chemical analysis and replaced for every sample interval. Following the drilling of the soil borings the HSA drilling rig and related equipment was decontaminated before being taken off site.

4.9 Investigation-Derived Waste Management

As required in Permit Attachment 20 (Section 20.2.13), an Investigation-Derived Waste (IDW) Management Plan was provided with the IWP in Attachment B (NASA, 2013a). The HIS associated with this investigation (NASA, 2013a) determined that limited amounts of silver and possibly cyanide bearing waste streams were discharged to the septic tank associated with SWMU 22 prior to 1985. No evidence of discharge of listed hazardous wastes to SWMU 22 or any other WSTF septic tank was found during the HIS research process. The IDW Management Plan addressed waste generated from removal and investigation activities at SWMU 22. Hazardous waste was not generated during the removal of septic tanks associated with SWMUs 21 and 23-27. The non-hazardous sewage sludge and septage from SWMUs 21 and 23-27 was removed and disposed of by a licensed septage pumper. The septic tanks associated with SWMUs 21 and 23-27 were removed and disposed of as solid waste in accordance with the NMED-approved IWP (NASA, 2013a).

The IDW Management Plan provided with the IWP included a description of the potential wastes that would be generated from SWMU 22 as well as procedures for waste management, characterization, and disposition. IDW generated during the SWMU 22 project was managed per the IDW Management Plan. Generated wastes included: concrete septic tank, septage, environmental media (soil); used non-dedicated sampling equipment; PPE; plastic sheeting; miscellaneous debris contaminated by IDW; and water and soap used for equipment decontamination.

Waste initially generated during SWMU 22 sewage sludge sampling was managed as hazardous waste in accordance with the requirements of 20.4.1.300 NMAC and 40 CFR 262.34(C) (2012) with hazardous waste codes D003 for cyanide reactivity and D011 for silver toxicity. Additional waste characterization was performed after receiving the sewage sludge results, and it was determined that the sewage sludge, IDW contact waste, and decontamination water could be managed as non-hazardous solid waste. IDW contact waste (i.e., gloves and wipes) from sampling events was bagged, disinfected with a 2% bleach solution as a best management practice, and disposed of in an onsite solid waste dumpster. Aqueous waste, such as decontamination water, was discharged to the WSTF sewage lagoons and sanitary sewer throughout the project. Sewage sludge from SWMU 22 was characterized as non-hazardous and removed by a licensed subcontractor septage pumper. The SWMU 22 septic tank carcass was also characterized as

[2] Alconox is a registered trademark of Alconox, Inc.

non-hazardous solid waste, and was removed by an on-site contractor who disposed of the concrete as solid waste at an appropriate disposal facility.

Environmental media generated during the SWMU 22 soil investigation consisted of two 55-gallon drums of drill cuttings from soil boring installation. The drill cuttings were initially characterized as hazardous waste with D003 (cyanide reactivity) and D011 (silver toxicity) waste codes, which correspond to the COCs for the project. Contaminated media may be considered hazardous waste if the media exhibits a characteristic of hazardous waste or was contaminated with listed hazardous waste. No listed hazardous waste constituents were identified during the investigation. The SWMU 22 soil investigation results indicated that the drill cuttings were non-hazardous because the soil was not reactive (D003) and did not contain silver above the D011 toxicity characteristic concentration. EPA guidance (1998) states that because the determination of characteristic hazardous waste can be made through relatively straightforward analytical testing, no formal "contained-in" determination by EPA or an authorized state is required. The EPA also states in the same document that generators of contaminated media may make independent determinations as to whether the media exhibits a characteristic of hazardous waste. Using the soil investigation results and EPA guidance, NASA determined that the environmental media was not characteristic hazardous waste, and it was returned to the immediate project area adjacent to the SWMU 22 tank location in accordance with the NMED-approved IWP Management Plan for the project (NASA, 2013a). Debris (i.e., wipes and gloves) from the soil investigation were re-characterized as non-hazardous waste and disposed of as solid waste in an on-site dumpster. Soil investigation decontamination fluids were also determined to be non-hazardous and were discharged to the sanitary sewer.

4.10 Deviations

During the course of this investigation, deviations from the approved IWP arose while still meeting required DQOs. Notable deviations implemented during the investigation are described below.

4.10.1 SWMU 22 Leach Field Borings

It was stated in the IWP that soil borings would be identified with Global Positioning System surveying equipment and samples would be collected to confirm that the soil below the leach field did not contain hazardous constituents. Following the inspection of the Building 114 septic tank, it was discovered that there was no leach field associated with the tank and that the bottom of the septic tank was compromised. As a result, the SWMU 22 soil investigation was modified to exclude soil borings within the proposed leach field, and instead focused on soil within the footprint of the Building 114 septic tank (NASA 2014a).

4.10.2 Soil Boring Depths and Locations

Three borings were proposed within the original IWP, two of which would be drilled within the leach field of the 100 Area septic tank at Building 114 (SWMU 22) and one soil boring would be drilled downgradient of the leach field. Following the discovery that wastewater was never discharged to the leach field and that the Building 114 septic tank had been compromised, new soil borings were proposed as a deviation in 2014 (NASA 2014a). This document proposed two borings within the footprint of the septic tank at base of the tank and every 5-ft interval thereafter to a total depth of 10 ft below the base of the tank. One soil boring would be installed upgradient and two would be installed downgradient from the SWMU 22 excavation site. Soil samples were proposed at 5 and 10 ft bgs.

The WSTF Hazardous Waste Permit (NMED, 2016) states that samples must be collected "Twenty feet below the base of the disposal units if contamination is not detected." As a result, soil samples were collected at intervals of 0, 5, 10, 15, and 20 ft below the base of the SMWU 22 excavation, which was estimated to be between 6 to 7 ft bgs according to measurements conducted with the HSA drilling rig.

4.10.3 Field Blanks

Collection of field blanks for the SWMU 22 soil investigation were not proposed in IWP, however, field blanks were collected in conjunction with the October 31, 2017 soil sampling event.

4.10.4 Risk Screening

The IWP states, "If COPC concentrations in vadose zone soils exceed the appropriate risk-based clean up levels… for direct exposure routes under the construction worker scenario, then a RCRA Corrective Measures Study will be performed to determine appropriate soil remediation. Otherwise, consider a no further action determination" (NASA, 2013a). Utilizing current NMED RA guidance (NMED, 2019), the comparison of COPC concentrations to SSLs would be inadequate to fully characterize potential risk and recommend no further action. NASA performed the more thorough risk screening in accordance with NMED RA guidance (NMED, 2019). A complete description of risk screening is provided in Section 7.0.

5.0 Regulatory Criteria

Soil was the media of concern in this investigation. The IWP stated the investigation results would be compared to the NMED CSSLs (NASA, 2013a). Based upon recent NMED communications, residential exposure scenarios must be evaluated to qualify for Corrective Action Complete without controls (CAC). For the purposes of this report, the RSSLs were used as the basis to determine whether or not to continue investigation and/or corrective actions. NASA performed human health and ecological risk screening in accordance with the RA Guidance (NMED, 2019), comparing detected constituent concentrations to SSLs for each identified exposure scenario listed in Section 3.2.3. NMED RSSLs applicable for this investigation are those for silver and cyanide.

6.0 Investigation Results

This section provides the soil chemical analytical results from sampling performed at the Building 114 septic tank. In accordance with the IWP, field and laboratory quality control samples were collected in order to produce data of known and sufficient quality to meet project objectives. This included field rinsate (equipment) blanks, field duplicate samples, matrix spike samples, and laboratory method blanks. Analytical data were validated upon review and verified usable in order to meet the project DQOs. The soil sample analytical results are summarized below and compared to applicable regulatory criteria. No contaminants were detected in any equipment blank samples.

6.1 Soil Chemical Results

Soil chemical sampling parameters are provided in Table 6.1. All collected soil samples were analyzed for total metals content using SW-846 Methods 6010B and 7471 (mercury). Soil samples from borings 114-SB-01, -02, -03, -04, and -05 were analyzed for cyanide using SW-846 Method 335.4, while samples from borings 114-SB-06, and -07 were analyzed for cyanide using SW-846 Method 9012B. Appendix D provides the analytical reports submitted by the contractor analytical laboratories. A Quality Assurance Report (QAR) was completed on the April and October 2017 sample events and is provided as Appendix E.

6.1.1 Data Quality

The QAR (Appendix E) did not identify negative quality issues with metals analyses using EPA Methods 6010B and 7471 or with the cyanide analyses using EPA Method 335.4 and SW-846 Method 9012B, making these data usable for the purposes of this investigation and the risk screen evaluation. However, cyanide analysis by SW-846 Methods 335.4 did exhibit elevated concentrations beneath the former septic tank due to nitrate interference, as discussed in Sections 3.4.10 and 4.4.1, and these samples exhibit high biased concentrations due to this interference. For the cyanide analyses using SW-846 Method 9012B, the primary and duplicate samples collected from soil boring 114-SB-06 exhibit a relative percent difference (RPD) of approximately 170%, exceeding the established RPD precision maximum of 20% for soil stated in WSTF Permit Attachment 17, Section 17.3.3.b, Field Duplicates. The NASA data validation indicates the elevated RPD is not due to laboratory error or other data validation issues, and these data suggest the difference is attributable to heterogeneity between the samples. For the purposes of this investigation and risk screen evaluation, the higher, more conservative concentration from the duplicate sample was used.

As part of the data validation, NASA assigns flags for method blank contamination "RB" based on the associated sample concentration as follows: (a) if the concentration in the associated samples is not over ten (10) times the identified concentration in the method blank, the "RB" flag is assigned to that sample indicating the sample concentration may be biased high, and; (b) If the concentration in the associated sample is over ten (10) times the identified method blank concentration, the "RB" flag is not assigned, since the identified blank concentration is not anticipated to affect the total sample concentration. For the 114-SB-06 samples, the associated method blank concentration is 0.04 mg/kg. The primary sample cyanide concentration was 0.17 mg/kg (less than 10 times 0.04 mg/kg) and was flagged "RB," and the duplicate sample cyanide concentration was 2.22 mg/kg (more than 10 times 0.04 mg/kg) and was not flagged.

Use of both the high biased cyanide data from the EPA Method 335.4 and the higher concentration duplicate sample results from boring 114-SB-06 constitute a conservative approach in evaluation of the investigation and associated risk screen evaluation.

6.1.2 Results of Soil Samples

Sample locations and a summary of all detections for both the April and October 2017 samples are provided in Table 6.2. The April 2017 samples were analyzed for cyanide by EPA Method 335.4; arsenic, barium, cadmium, chromium, lead, selenium, and silver by EPA Method 6010B; and mercury by EPA Method 7471. The October 2017 samples were analyzed for cyanide by EPA Method 9012B. A map of these locations and associated analytical results is provided in Figure 2.1.

Silver and cyanide were reported at concentrations above laboratory detection limits in soil samples collected during the Building 114 septic tank investigation. Silver was detected in only three samples analyzed for the investigation at only two locations. The detection was in soil boring 14-SB-03 at a depth of 7 to 8 ft bgs at concentrations of 0.29 mg/kg and 0.11 mg/kg. The duplicate result was accompanied by a "J" quality flag, indicating the reported concentration of silver was an estimated value below the practical quantitation limit, but above or equal to the method detection limit. The other detection of silver was in a sample collected from boring 114-SB-02 at a depth of 6 to 8 ft bgs and at a concentration of 0.94 mg/kg. Reported concentrations of silver did not exceed either the NMED Residential or Construction Worker SSL and did not exceed the NMED soil-to-groundwater soil leachate SSL.

In the April 2017 sampling event, cyanide was detected in 10 of 20 samples (including duplicates) analyzed. Three results for cyanide exceeded the RSSL: borings 114-SB-02 at a depth of 6 to 8 ft bgs (19.6 mg/kg) and 114-SB-03 at a depth of 7 to 8 ft bgs (47.3 mg/kg and 60.6 mg/kg in the duplicate).

As previously described, NASA believed that the elevated concentrations of cyanide in several borings sampled in April 2017 may have resulted from nitrate/nitrite interference during the analytical process. In order to further evaluate the potential for anomalous detections of cyanide, two additional borings were installed within the Building 114 septic tank excavation: 114-SB-06 and 114-SB-07. Additional soil samples were collected from these borings in October 2017: 114-SB-06 at a depth of 7 to 9 ft bgs and at 114-SB-07 at a depth of 7 to 9 ft bgs including a duplicate. The sampling interval was selected because the interface between native alluvium and backfill material was observed at approximately 7 ft bgs in April 2017.

The subcontracted analytical laboratory was directed to utilize sulfamic acid as part of the pretreatment process to reduce nitrate interference as provided for in the EPA guidance for Method 9012B. The total cyanide concentrations in the primary and duplicate soil samples collected from a depth of 7 to 9 ft bgs in boring 14-SB-06 were 0.17 mg/kg (primary) and 2.22 mg/kg (duplicate). The primary sample result was accompanied by the “J”, “RB”, and “QD” quality flags; a “J” flag indicates the reported concentration of cyanide was an estimated value below the practical quantitation limit, but above or equal to the method detection limit; the “RB” flag indicates the analyte was detected in the method blank, and: the “QD” flag indicates the relative percent difference for a field duplicate was outside standard limits. The duplicate sample concentration was flagged “QD”. The cyanide concentration in the sample collected from a depth of 7-9 ft bgs in boring 114-SB-07 was 0.09 mg/kg, and was also flagged “J”, “RB”, and “QD”.

6.2 Determination of Constituents of Potential Concern for Risk Screening

The information presented in NMED’s RA Guidance (NMED, 2019) was used for determination of site COPCs for the SWMU 22 human health risk and hazard screening evaluation. The HIS was used to determine what COPCs would likely be present, and appropriate analytical methods were chosen. As previously stated, silver and cyanide were the COPCs identified in the IWP. To search for these COPCs, soil samples were analyzed for metals and cyanide. Any analyte detected in SWMU 22 soil samples was initially considered to be a potential COPC. The list of potential COPCs was then evaluated in accordance with the RA Guidance to determine final COPCs.

The NMED RA guidance includes several receptor scenarios to determine if sites meet or exceed the recommended target risk from carcinogenic compounds and the target hazard (Hazard Index [HI]) from non-carcinogenic compounds. These exposure scenarios assess impacts from soil depth intervals deemed appropriate for each receptor scenario. SWMU 22 analytical data was separated by depth and evaluated per receptor scenario.

As described previously, analytical data generated during this investigation consisted of samples collected from soils from approximately 5 ft bgs to depths of up to 27 ft bgs. The exposure scenarios evaluated as part of the risk screening included residential (0 ft to10 ft bgs soils), construction worker (0 ft to10 ft bgs soils), soil-to-groundwater (soils from all depths), and burrowing ecological (0 ft to10 ft bgs soils).

Analyzed constituents for SWMU 22 included arsenic, barium, cadmium, total chromium, cyanide, lead, mercury, selenium, and silver. Selenium was the only constituent not detected at concentrations greater than laboratory detection limits, so was not carried forward as a COPC through the risk screening process.

6.2.1 QA/QC Duplicate Samples

Sample locations where duplicate samples were collected and analyzed for quality control purposes resulted in duplicate data points for these locations. The results of the primary and duplicate sample analyses were compared, and the most conservative value was selected and carried forward through the risk screening process.

6.2.2 Background versus Maximum Detected Concentration

NASA compared maximum detected analyte concentrations with the NMED approved background threshold values (BTV) as documented in the *Response to Notice of Disapproval for the Soil Background Study Investigation Report* (NASA, 2015d). The background study established BTVs for five distinct soil types present at the WSTF facility. SWMU 22 soils are characterized as Area 4 soils, therefore the Area 4 BTVs were used for comparison purposes.

The Area 4 BTVs included a background value for arsenic, barium, chromium, lead, and mercury, but did not establish background values for cadmium, cyanide, or silver. Cadmium, cyanide, and silver were carried through the risk screening process. For the remaining metals, maximum SWMU 22 constituent concentrations collected from soil interval 4 to 8 ft bgs and 8 to 12 ft bgs were compared to the approved 4 to 8 ft bgs and 8 to 12 ft bgs BTVs. The maximum concentration of chromium (1.90E+01 mg/kg) for 4 to 8 ft bgs and arsenic (1.40E+01 mg/kg) for 8 to 12 ft bgs exceeded the Area 4 corresponding BTVs (1.17E+01 mg/kg and 1.19E+01 mg/kg, respectively; Table 6.1 and Table 6.2). For constituents with maximum concentrations exceeding the respective BTV, the RA Guidance requires a population-to-population comparison be completed.

6.2.3 Background Population-To-Population Comparison

Arsenic and chromium, which exhibited maximum concentrations greater than the corresponding BTVs, were then evaluated using a two-sample hypothesis test. This test compared the distribution of the site data to the distribution of background data, also known as a population-to-population comparison. The EPA's ProUCL Version 5.1 statistical software was used for hypothesis testing (EPA, 2015). ProUCL was also used to determine the most appropriate test (parametric or nonparametric) based on the distribution of the data. Additionally, ProUCL was used to generate a Q-Q plot of the background and site data sets, and this graph was reviewed to support this determination. The ProUCL-generated statistical worksheets of the arsenic and chromium population-to-population comparisons and Q-Q plots are provided in Appendix F.

Results of the background population-to-population comparison for arsenic indicate the identified concentrations of arsenic are representative of background concentrations, so arsenic was eliminated as a COPC for the Residential and Construction Worker exposure scenarios. However, arsenic was not eliminated as a COPC for the soil-to-groundwater exposure scenario as BTVs are not established for soils deeper than 12 ft bgs. NASA observed that arsenic concentrations in samples collected from 0 to 10 ft bgs ranged from 3.8 to 14 mg/kg and in samples collected from depths greater than 10 ft bgs ranged from 5.1 to 12 mg/kg, possibly indicating that arsenic concentrations in deep soils at SWMU 22 may be indicative of background. Results of the background population-to-population comparison for chromium indicate the identified concentrations of chromium are greater than background concentrations, so chromium was retained as a COPC for all exposure scenarios.

6.2.4 SWMU 22 COPCs

The COPCs identified following background comparisons for SWMU 22 were cadmium, chromium, cyanide, and silver for the residential and construction worker exposure scenarios. For the soil-to-groundwater exposure scenario, additional COPCs were added due to lack of background data deeper than 12 ft bgs (cadmium, chromium, cyanide, and silver plus arsenic, barium, lead, and mercury added).

7.0 Risk and Hazard Screening

NASA completed a human health and ecological risk screening in accordance with NMED RA Guidance (NMED, 2019). Risk screening efforts included evaluation of residential, construction worker, soil-to-groundwater, and burrowing ecological exposure scenarios. Screening was not conducted for industrial and ecological non-burrowing scenarios because the Building 114 septic tank was buried approximately 5 ft bgs with no discharge to a leach field. Any potential discharge to the environment occurred deeper than 1 ft bgs, which resulted in no exposure for industrial and non-burrowing ecological receptors.

Risks and hazards were evaluated in a stepwise approach. For human health risk/hazards, maximum concentrations of COPCs were compared to NMED SSLs using equations from the guidance as described below. Then risks and hazards were summed to obtain the combined site risk and/or hazard for each exposure scenario. If there were no cancer risk or non-cancer hazard target exceedances for individual or combined COPCs, then no further risk or hazard screening was necessary for that scenario.

For residential and construction worker exposure scenarios, NMED established cancer and non-cancer SSLs based on toxicity (NMED, 2019). For COPCs with a cancer SSL, the maximum concentration was divided by the SSL, then multiplied by 10^{-5} to establish the individual COPC risk. The risk target was 1E-05. For COPCs with a non-cancer SSL, the maximum concentration was divided by the SSL, then multiplied by 1 to establish the HI. The hazard target was 1. COPCs could have both cancer and non-cancer SSLs (NMED, 2019).

For the soil-to-groundwater exposure scenario, the NMED has established a target soil leachate SSL for use with initial risk/hazard screening using a DAF of 20 (NMED, 2019). The maximum concentration at any depth was used to compare directly to the soil leachate SSL. For COPCs that exceeded the soil leachate SSL using the maximum concentration, the EPA software ProUCL was used to calculate the UCL95 concentration for the soil-to-groundwater scenario. The UCL95 concentrations for individual COPCs were then compared directly with the individual target soil leachate SSLs.

ProUCL-generated calculated statistical outputs for determination of the UCL95 values (for soils both 0 to 10 ft bgs for residential and construction worker scenarios and all results, all depths for the soil-to-groundwater scenario) are provided in Appendix F. UCL95 concentration values were not calculated for all COPC analytes because the total number of detections was insufficient (< 5) to perform valid statistical analyses. Therefore, the maximum concentration of these COPCs was carried through the UCL95 screening process.

7.1 SWMU 22 Residential Exposure Scenario

The residential receptor screening levels are based upon child and adult receptors. This receptor scenario is expected to be a conservative scenario and assumes that exposures occur 24 hours per day, 350 days per year over a 26-year exposure duration. In accordance with NMED RA Guidance (2019), risk and HIs were evaluated for COPCs having cancer and non-cancer RSSLs. As stated, risks and hazards were evaluated in a stepwise approach, initially calculated based on maximum concentrations. The residential exposure scenario includes exposure to soils from the ground surface to a depth of 10 ft (0 ft to 10 ft bgs).

Table 7.1 presents the results of the residential cancer risk screening based on maximum SWMU 22 concentrations for cadmium and chromium. Table 7.2 contains the results of residential non-cancer hazard screening based on maximum SWMU 22 cadmium, chromium, cyanide, and silver concentrations. Risk screening indicated the residential combined cancer risk was 1.97E-06, which did not exceed the target cancer risk of 1E-05. For non-cancer screening, the combined HI for SWMU 22 was 7.93E-01, which did not exceed the target HI of 1.

7.2 SWMU 22 Construction Worker Scenario

As stated in the RA Guidance (NMED, 2019), a construction worker is assumed to be a receptor that is exposed to contaminated soil during the workday for the duration of a single on-site construction project. If multiple construction projects are anticipated, it is assumed that different workers will be employed for each project. The construction worker exposure scenario includes exposure to soils from the ground surface to a depth of 10 ft (0 to 10 ft bgs).

Table 7.3 presents the results of the construction worker cancer risk screening based on maximum cadmium and chromium concentrations. Table 7.4 contains the results of the construction worker non-cancer hazard screening based on maximum cadmium, chromium, cyanide, and silver concentrations. Health risk screening indicated the construction worker combined cancer risk was 4.09E-07, which did not exceed the target cancer risk of 1E-05. Hazard screening indicated the construction worker combined non-cancer HI was 8.74E-01, which did not exceed the target HI of 1.

7.3 SWMU 22 Soil-to-Groundwater Scenario

Table 7.5 presents the results of the point comparison screening based on maximum COPC concentrations. Direct comparisons of maximum COPC concentrations to target soil leachate SSLs indicated that two COPCs exceeded soil leachate SSLs for the soil-to-groundwater exposure scenario. These COPCs were arsenic and cyanide.

Since maximum COPC screening resulted in exceeding two target soil leachate SSLs, the UCL95 concentrations for each COPC were calculated and compared directly to target SL-SSLs. Table 7.6 presents the results of the screening based on calculated UCL95 COPC concentrations. The UCL95 concentration value was not calculated for two of the eight COPC analytes (mercury and silver), because the total number of detections was insufficient (< 5) to perform valid statistical analyses. Therefore, the maximum concentration of these analytes was carried through the UCL95 screening process. The direct point comparisons indicated that calculated UCL95 concentrations for arsenic and cyanide exceeded target soil leachate screening SSL. Arsenic was eliminated as a COPC for the upper exposure intervals based on comparison with established BTVs. Detected arsenic concentrations at depths below 10 ft bgs may represent background conditions.

Investigation analytical results for cyanide and arsenic generally exhibit decreasing concentrations with increasing depth. Two graphs of sample concentrations versus depth are provided as Figure 7.1 for arsenic and Figure 7.2 for cyanide. Both figures demonstrate concentrations decrease with increasing depth.

7.4 Ecological Screening

A complete Tier I ecological risk evaluation, including the ecological site assessment checklist provided in Volume II of the RA Guidance (NMED, 2019) was completed for SWMU 22, and is provided in Appendix G. The COPC total chromium was identified at concentrations exceeding the Tier I ecological screening level (ESL) for plants at SWMU 22. Total chromium is known to bioaccumulate through trophic processes and, over long-term processes, could potentially be detrimental to plants and animals that persist within the site.

Vegetation and native soils within SWMU 22 are extremely limited. SWMU 22 is located within a surrounding environment of largely undeveloped Chihuahuan desert scrub habitat typical of the SJDMB of southern Dona Ana County, New Mexico. Thousands of acres of mixed desert scrub, playa lakebeds, bare ground, and desert grasslands define this portion the basin Chihuahuan desert habitat. Specific species dominant adjacent to this site include honey mesquite (Prosopis glandulosa), four-wing saltbush (Atriplex canescens), and mariola (Parthenium incanum).

SWMU 22 is limited in size at less than 1/10 of an acre. The site occurs adjacent to numerous buildings within a large gravel capped parking lot and within 180 ft of a paved roadway. No ecologically important habitats or organisms exist at, or adjacent to, the site. State endangered night blooming cereus are known to exist in desert habitats at or near WSTF, but none are known to occur at the site or within close proximity. The area at the previously existing septic tank is currently a gravel parking lot. The area leading to the north and east is fairly recently disturbed desert comprised of bare ground, gravel, and annual plants (primarily sunflowers [Asteracea spp]). Some invertebrates and small vertebrates may persist at or near SWMU 22. However, non-burrowing animals and plant roots are not expected to come in contact with soils associated with SWMU 22 due to the depth of releases (> 5 ft bgs). Evidence of deep-rooted flora and animal burrows was not observed within the SWMU 22 footprint and surrounding areas.

The RA Guidance (Volume II) states that selection of species for risk evaluation is based on the size of the site. SWMU 22 is approximately 1/10 acre, and the RA Guidance recommends evaluation of risk for plants, the deer mouse, and the horned lark. The results of the soil investigation identified elevated COPC concentrations at the site at depths greater than 5 ft bgs, so the exposure pathways to plant species and the deer mouse are considered complete. The exposure pathway for the horned lark is incomplete due to the depth of elevated COPC concentrations of over 1 ft bgs, and evaluation of site risk for this species is not warranted. The kit fox, red-tailed hawk, and pronghorn antelope were not evaluated as the RA Guidance states that impacts to these species from small sites is minimal. The minimum size of sites that require evaluation for the kit fox is 276 acres, for the red-tailed hawk is 177 acres, and for the pronghorn antelope is 342 acres, making the evaluation unnecessary.

The maximum identified COPC concentrations reported for investigation soil samples were evaluated using Tier I ESLs for plants (Appendix G, Table 1), and the deer mouse (Appendix G, Table 2) to determine the HIs for site COPCs, and the Screening Level Hazard Quotient (SLHQ; sum of HIs) for each receptor population. The maximum total chromium concentration (1.90E+01 mg/kg) exceeds Tier I ESLs for plants (3.50E-01 mg/kg), and the SLHQ for plants exceeds the NMED target hazard of 1. Based on the site inspection, deep-rooted plants were not identified at the site. Coupling this with the small size of the site, NASA identified no adverse impact to the overall plant community. The SLHQ for the deer mouse is essentially equal to the NMED target risk/hazard of 1, indicating no adverse risk.

8.0 Conclusions

Silver was detected in two soil samples collected at the 100 Area Septic Tank at Building 114 (SWMU 22) including one duplicate, and cyanide was detected in 13 of the 23 sample locations including duplicates collected as a part of this investigation.

NASA compared the concentrations of metals and cyanide in soil samples collected at SWMU 22 to NMED SSLs and conducted ecological and health risk screenings. Results of the cumulative human health and hazard screening at SWMU 22 are summarized in Table 8.1. Final individual risk/hazards can be reviewed in Table 7.1, Table 7.2, Table 7.3, and Table 7.4. Neither residential or construction worker exposure scenarios resulted in individual or cumulative carcinogenic risks or cumulative hazards greater than the targets. As a result, for residential and construction worker scenarios, NASA concludes that there are no adverse human health impacts at SWMU 22.

However, for the soil-to-groundwater exposure scenario, both the maximum and UCL95 concentrations of arsenic and cyanide exceeded soil leachate SSLs. NASA believes that arsenic concentrations are likely consistent with WSTF background concentration populations, but without sufficient background data to compare to, the metals were included in the risk screening process. Both arsenic and cyanide concentrations were observed to decrease with increasing depth as shown on Table 6.2, Figure 7.1, and Figure 7.2. Additionally, the source of liquid that previously mobilized COPCs downward to groundwater has been removed with removal of the septic tank.

Results of the ecological risk screening for SWMU 22 indicated total chromium concentrations exceeded ESLs for plants, and the corresponding SLHQ for plants exceeds the NMED target of 1. However, SWMU 22 occupies approximately 1/10 of an acre, and deep-rooted plants are not present within the boundary of site. For these reasons, NASA did not identify adverse risk to the overall plant community. Evaluation of the COPC concentrations and the effect on the deer mouse receptor population did not identify adverse risk.

9.0 Recommendations

Based on findings of research conducted during preparation of the HIS (NASA, 2013a), NASA recommends that no further action be performed at the septic tanks comprising SWMUs 21 and 23-27. Further, NASA recommends that the septic tanks comprising SWMUs 21 and 23-27 be considered for a corrective action complete status determination. NASA understands that prior to submittal of a Class 3 Permit Modification, the NMED should be consulted to discuss groundwater contamination and remediation, and ongoing source area investigations at WSTF. NASA will consult with the NMED prior to preparation and submittal of a Class 3 Permit Modification in accordance with 40 CFR 270.42(c) that will include all supporting site history and investigation information for each SWMU.

Results of the investigation indicate the soil-to-groundwater exposure pathway is incomplete due to: (a) generally decreasing arsenic and cyanide concentrations with depth based on soil chemical concentration data for SWMU 22 presented in Section 6.0 and Table 6.2; (b) the lack of a continuing source of liquid to vertically mobilize contaminants in the soil; (c) the regional arid climate, and (d) depth to groundwater of over 100 ft below ground. Therefore, further investigation of the soil-to-groundwater pathway at SWMU 22 is not warranted.

Based on results of the risk screen evaluation for human and ecological receptors, no adverse risk from COPCs remaining at the site was identified. NASA recommends that SWMU 22 be considered for a corrective action complete status. NASA will consult with the NMED prior to preparation and submittal of a Class 3 Permit Modification in accordance with 40 CFR 270.42(c). When submitted, a petition for corrective action complete and the Class 3 Permit Modification will include all supporting site history and investigation information.

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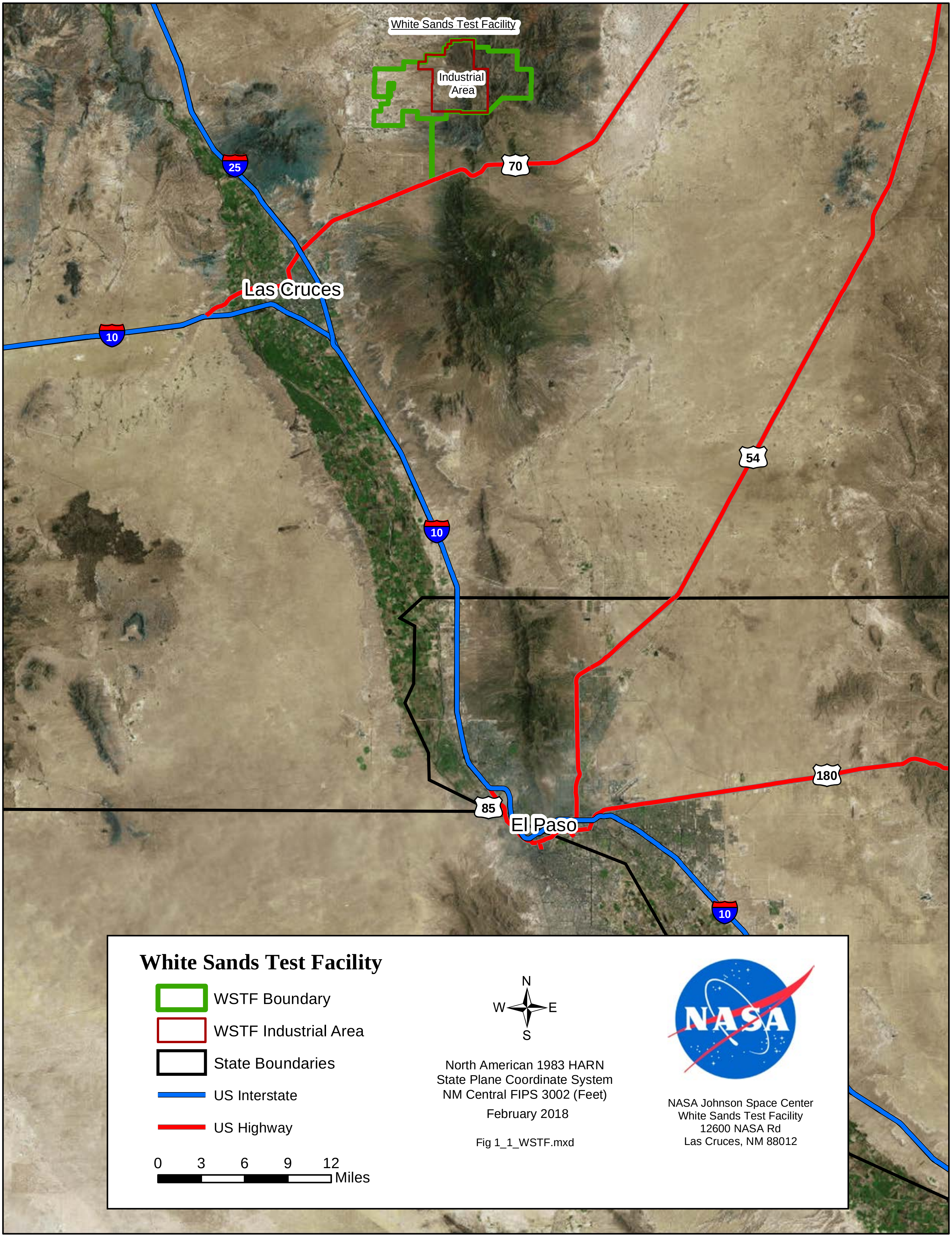
Figures

Figure 1.1 **WSTF Location Map**

(SEE NEXT PAGE)


White Sands Test Facility
Industrial Area
25
70
Las Cruces
10
10
54
180
85
El Paso
10
White Sands Test Facility
WSTF Boundary
WSTF Industrial Area
State Boundaries
US Interstate
US Highway
0 3 6 9 12
Miles
N
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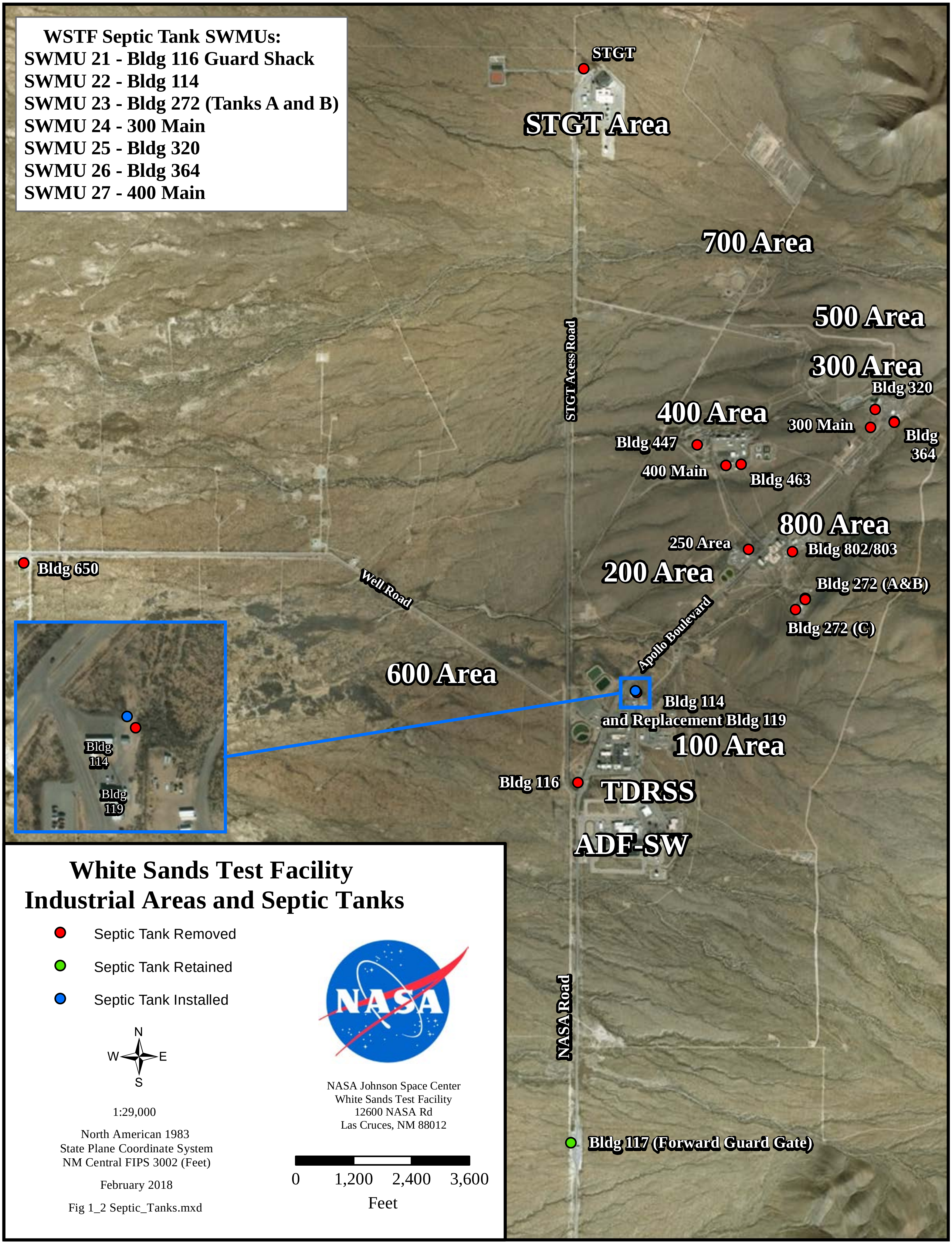
North American 1983 HARN
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
February 2018
Fig 1_1_WSTF.mxd
NASA Johnson Space Center
White Sands Test Facility
12600 NASA Rd
Las Cruces, NM 88012

Figure 1.2 WSTF Industrial Areas and Septic Tank Locations

(SEE NEXT PAGE)


WSTF Septic Tank SWMUs:
SWMU 21 - Bldg 116 Guard Shack
SWMU 22 - Bldg 114
SWMU 23 - Bldg 272 (Tanks A and B)
SWMU 24 - 300 Main
SWMU 25 - Bldg 320
SWMU 26 - Bldg 364
SWMU 27 - 400 Main
STGT
STGT Area
700 Area
500 Area
300 Area
Bldg 320
300 Main
Bldg 364
400 Area
Bldg 447
400 Main
Bldg 463
STGT Acess Road
800 Area
250 Area
Bldg 802/803
200 Area
Bldg 272 (A&B)
Bldg 272 (C)
Bldg 650
Well Road
Apollo Boulevard
600 Area
Bldg 114
and Replacement Bldg 119
100 Area
Bldg 114
Bldg 119
Bldg 116
TDRSS
ADF-SW
NASA Road
Bldg 117 (Forward Guard Gate)
White Sands Test Facility
Industrial Areas and Septic Tanks
Septic Tank Removed
Septic Tank Retained
Septic Tank Installed
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State Plane Coordinate System
NM Central FIPS 3002 (Feet)
February 2018
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NASA Johnson Space Center
White Sands Test Facility
12600 NASA Rd
Las Cruces, NM 88012
0
1,200
2,400
3,600
Feet

Figure 2.1 Building 114 Septic Tank Soil Boring Locations and Utilities

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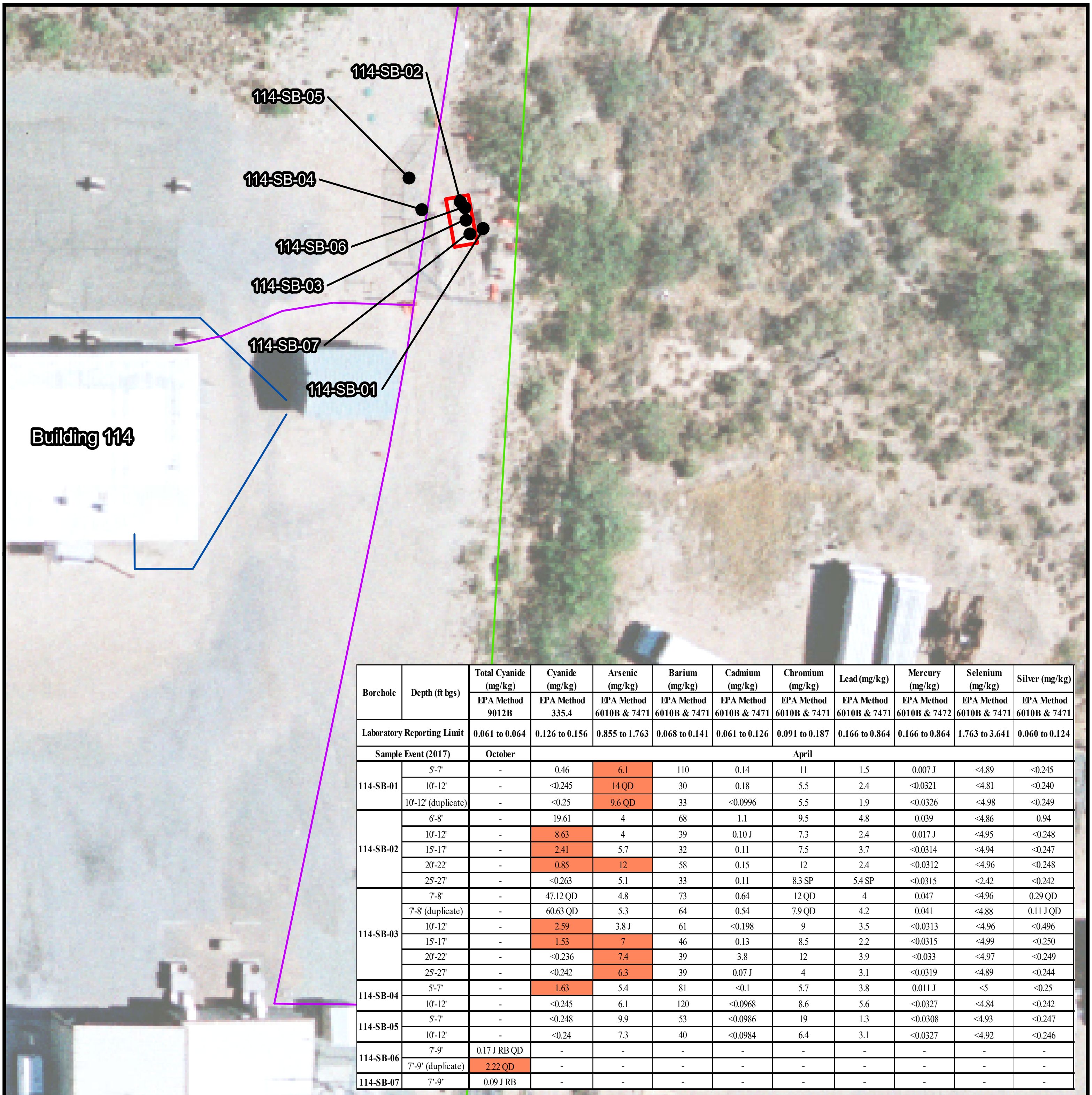

Borehole	Depth (ft bgs)	Total Cyanide (mg/kg) EPA Method 9012B	Cyanide (mg/kg) EPA Method 335.4	Arsenic (mg/kg) EPA Method 6010B & 7471	Barium (mg/kg) EPA Method 6010B & 7471	Cadmium (mg/kg) EPA Method 6010B & 7471	Chromium (mg/kg) EPA Method 6010B & 7471	Lead (mg/kg) EPA Method 6010B & 7471	Mercury (mg/kg) EPA Method 6010B & 7472	Selenium (mg/kg) EPA Method 6010B & 7471	Silver (mg/kg) EPA Method 6010B & 7471
Laboratory Reporting Limit		0.061 to 0.064	0.126 to 0.156	0.855 to 1.763	0.068 to 0.141	0.061 to 0.126	0.091 to 0.187	0.166 to 0.864	0.166 to 0.864	1.763 to 3.641	0.060 to 0.124
Sample Event (2017)		October	April								
114-SB-01	5'-7'	-	0.46	6.1	110	0.14	11	1.5	0.007 J	<4.89	<0.245
	10'-12'	-	<0.245	14 QD	30	0.18	5.5	2.4	<0.0321	<4.81	<0.240
	10'-12' (duplicate)	-	<0.25	9.6 QD	33	<0.0996	5.5	1.9	<0.0326	<4.98	<0.249
114-SB-02	6'-8'	-	19.61	4	68	1.1	9.5	4.8	0.039	<4.86	0.94
	10'-12'	-	8.63	4	39	0.10 J	7.3	2.4	0.017 J	<4.95	<0.248
	15'-17'	-	2.41	5.7	32	0.11	7.5	3.7	<0.0314	<4.94	<0.247
	20'-22'	-	0.85	12	58	0.15	12	2.4	<0.0312	<4.96	<0.248
	25'-27'	-	<0.263	5.1	33	0.11	8.3 SP	5.4 SP	<0.0315	<2.42	<0.242
114-SB-03	7'-8'	-	47.12 QD	4.8	73	0.64	12 QD	4	0.047	<4.96	0.29 QD
	7'-8' (duplicate)	-	60.63 QD	5.3	64	0.54	7.9 QD	4.2	0.041	<4.88	0.11 J QD
	10'-12'	-	2.59	3.8 J	61	<0.198	9	3.5	<0.0313	<4.96	<0.496
	15'-17'	-	1.53	7	46	0.13	8.5	2.2	<0.0315	<4.99	<0.250
	20'-22'	-	<0.236	7.4	39	3.8	12	3.9	<0.033	<4.97	<0.249
	25'-27'	-	<0.242	6.3	39	0.07 J	4	3.1	<0.0319	<4.89	<0.244
114-SB-04	5'-7'	-	1.63	5.4	81	<0.1	5.7	3.8	0.011 J	<5	<0.25
	10'-12'	-	<0.245	6.1	120	<0.0968	8.6	5.6	<0.0327	<4.84	<0.242
114-SB-05	5'-7'	-	<0.248	9.9	53	<0.0986	19	1.3	<0.0308	<4.93	<0.247
	10'-12'	-	<0.24	7.3	40	<0.0984	6.4	3.1	<0.0327	<4.92	<0.246
114-SB-06	7'-9'	0.17 J RB QD	-	-	-	-	-	-	-	-	-
	7'-9' (duplicate)	2.22 QD	-	-	-	-	-	-	-	-	-
114-SB-07	7'-9'	0.09 J RB	-	-	-	-	-	-	-	-	-

Building 114 Septic Tank Soil Boring Locations and Utilities

- Building 114 Septic Tank Soil Borings
- Telephone Lines
- Fiber Optic Lines
- Water Lines
- Building 114 Septic Tank Footprint

0 10 20 30 60 Feet

N W E S

1:355

Original Size: 8.5"x11"

North American 1983
State Plane Coordinate System
NM Centr002 (Feet)

May 2021

Fig 2_1 Bldg_114_Soil_Borings0051121.mxd

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Figure 3.1 **Site Conceptual Exposure Model**

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Building 114 Septic Tank (SWMU 22) Site Conceptual Exposure Model

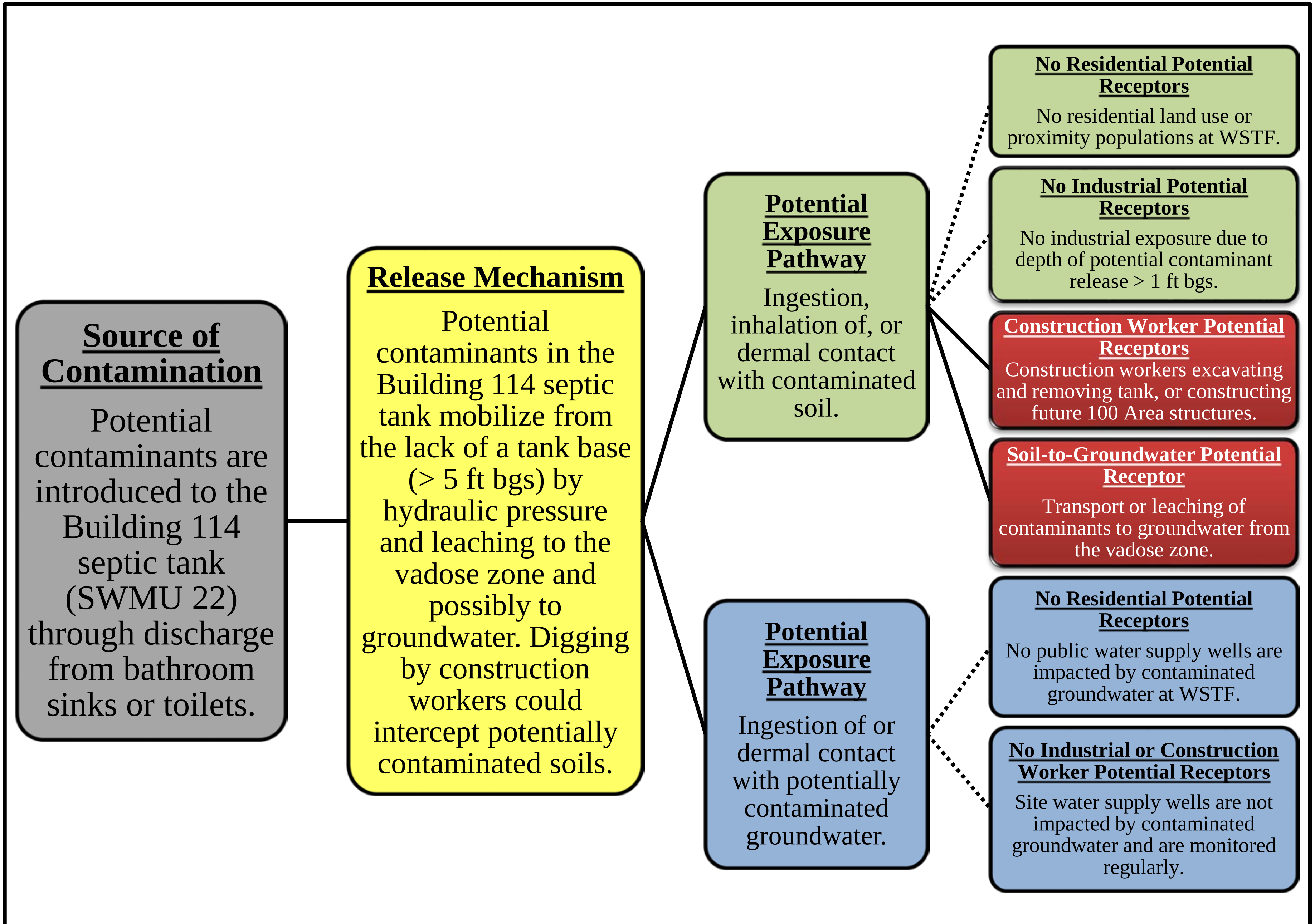

Figure 3.2 Topographic Map of WSTF Industrial Areas

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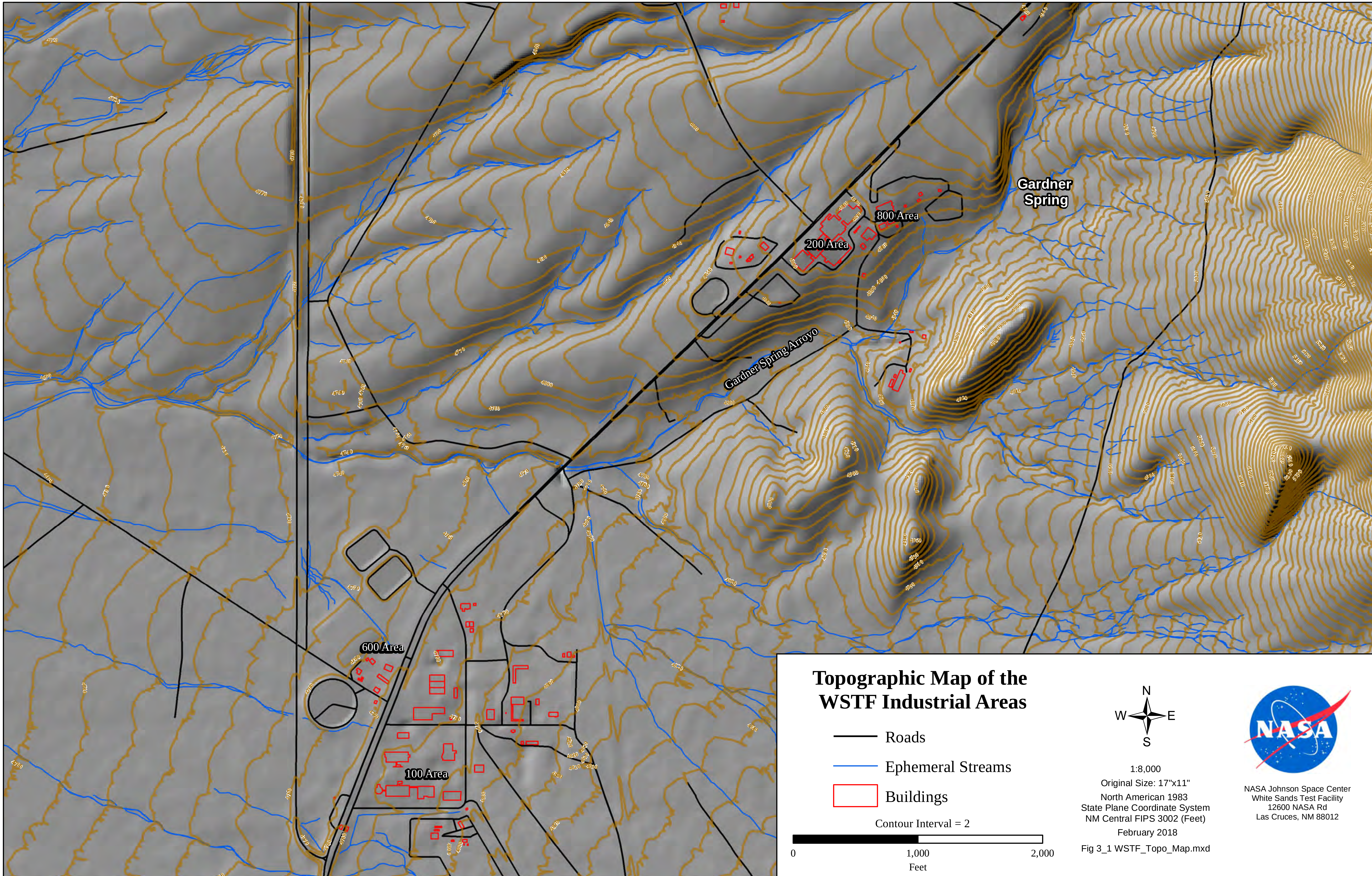
Gardner Spring
800 Area
200 Area
Gardner Spring Arroyo
600 Area
100 Area
Topographic Map of the WSTF Industrial Areas
Roads
Ephemeral Streams
Buildings
Contour Interval = 2
0
1,000
2,000
Feet
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Original Size: 17"x11"
North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
February 2018
Fig 3_1 WSTF_Topo_Map.mxd
NASA
NASA Johnson Space Center
White Sands Test Facility
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Figure 3.3 Natural Water Bodies in WSTF Industrial Area

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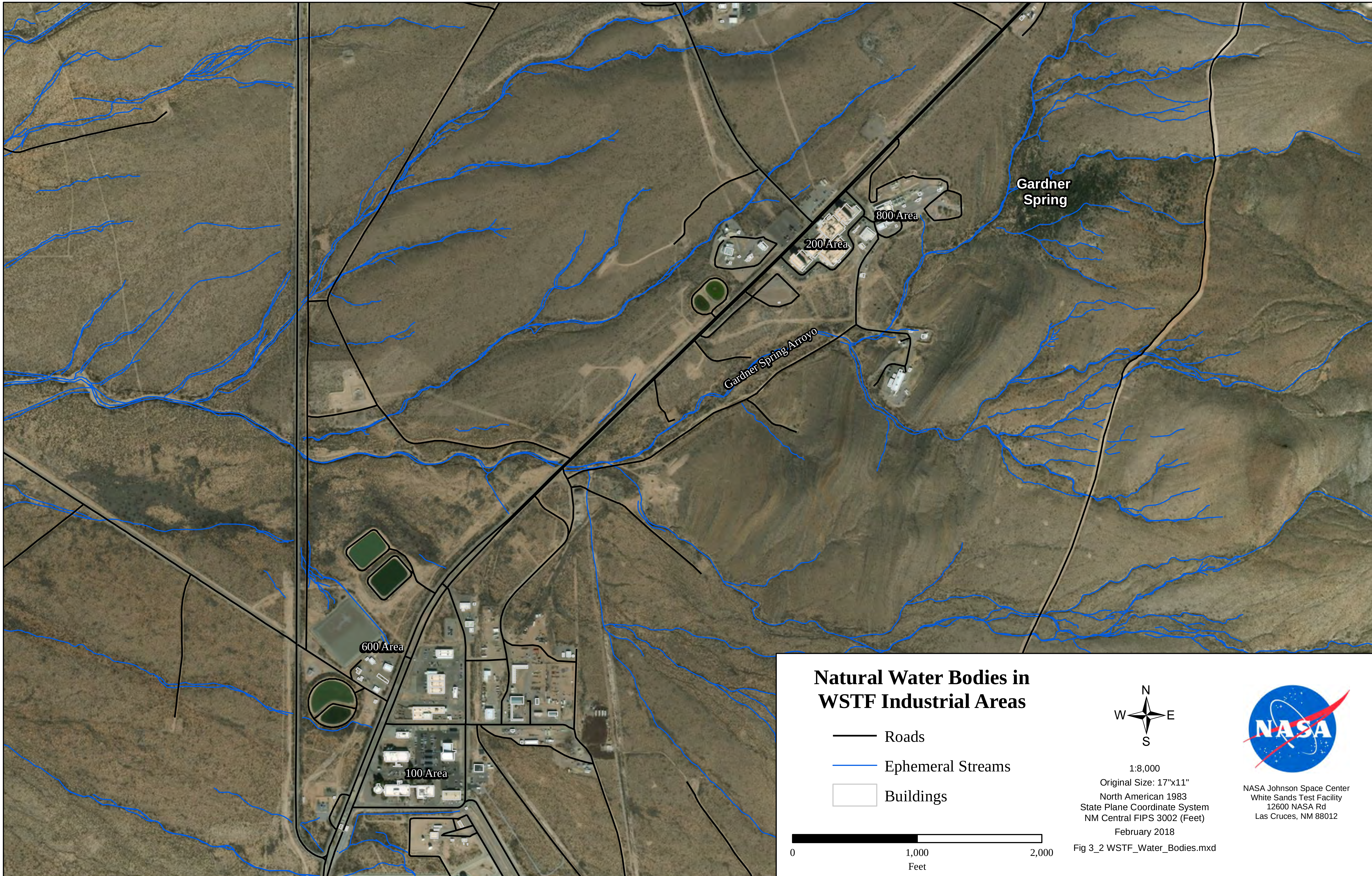
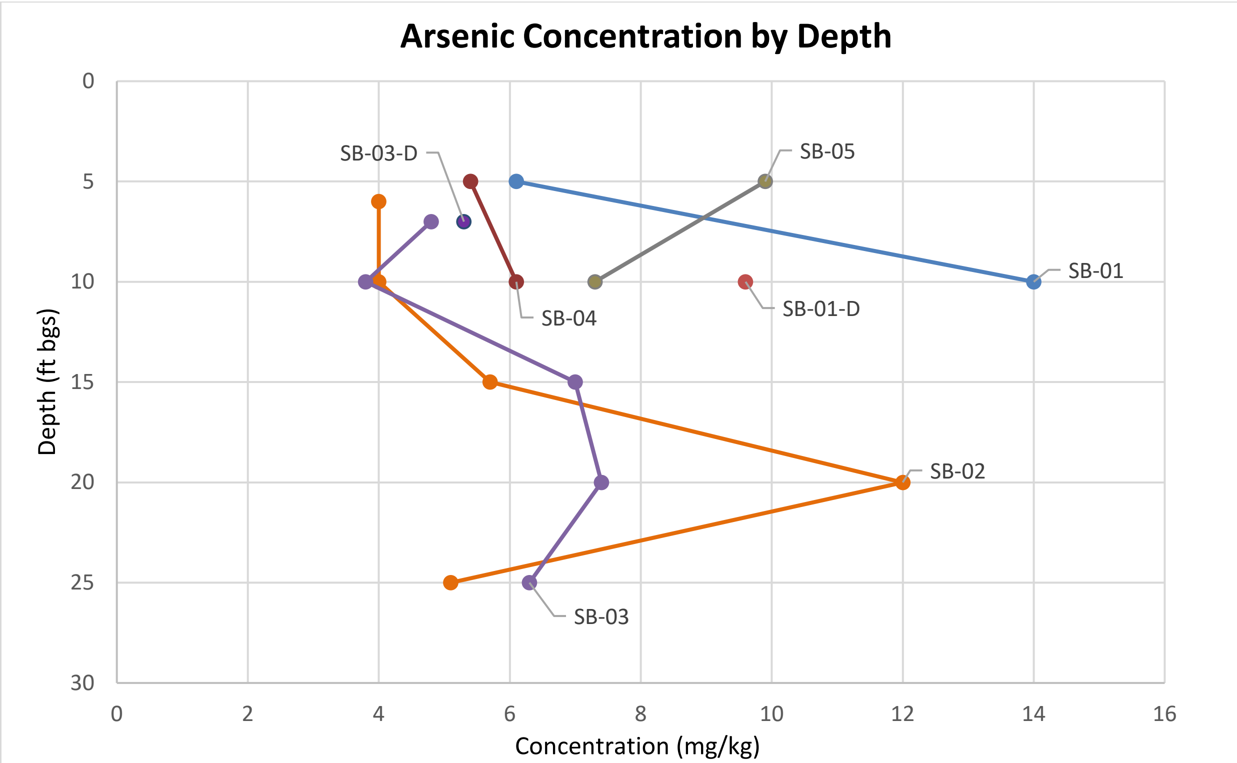


Gardner Spring
800 Area
200 Area
Gardner Spring Arroyo
600 Area
100 Area
Natural Water Bodies in WSTF Industrial Areas
Roads
Ephemeral Streams
Buildings
0
1,000
2,000
Feet
N
W
E
S
1:8,000
Original Size: 17"x11"
North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
February 2018
Fig 3_2 WSTF_Water_Bodies.mxd
NASA Johnson Space Center
White Sands Test Facility
12600 NASA Rd
Las Cruces, NM 88012

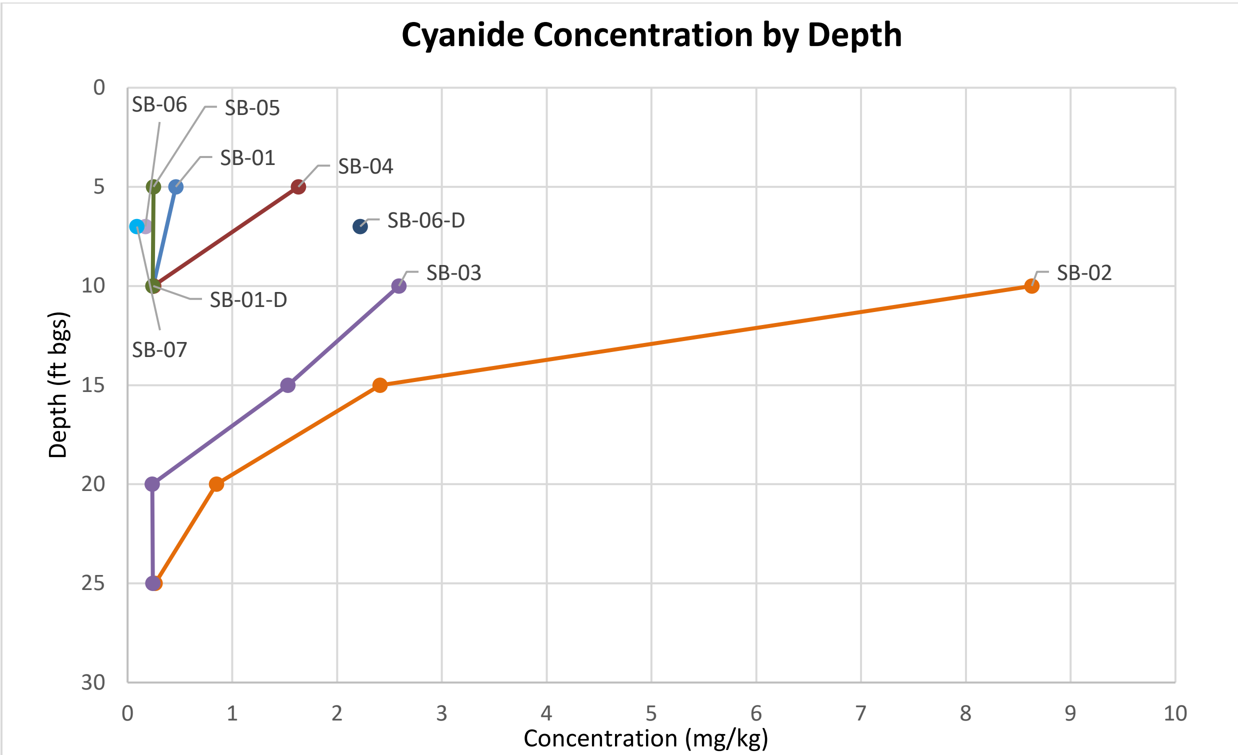
Figure 7.1 Arsenic Sample Concentrations Versus Depth



Notes:

1. Each plot line represents data from one soil boring, i.e., SB-03 includes all primary sample data collected from soil boring 114-SB-03.
2. "D" at the end of a boring label represents duplicate samples.

Figure 7.2 Cyanide Sample Concentrations Versus Depth



Notes:

1. Each plot line represents data from one soil boring, i.e., SB-03 includes all primary sample data collected from soil boring 114-SB-03.
2. "D" at the end of a boring label represents duplicate samples.

Tables

Table 3.1 Final Status of WSTF Septic Tanks

Area	SWMU	Location	Size/ Gal	Design Flow Rate	Install Date	Permit Number	Leach field Area (ft²)	Excav. Date	Disposal Location	Final Status	Comments
100	21	Bldg. 116- Guard Gate	500	200 gpd	1966	NA	1,250	07/17/17	Foothills Clean Fill Landfill	Removed	Installed during original facility construction. No leaching observed.
100	22	Bldg. 114	1,200	600 gpd	1963	DA 130309	NR	11/09/16	WSMR Landfill	Removed	Installed during original facility construction. No leaching observed.
100	NA	Bldg. 119	1,200	100 gpd	Sep-13	DA 130309	300	NA	NA	Retain	Installed due to challenges connecting to main sewer line.
200	NA	Bldg. 250 Area	NR	NR	1963 or 1964	NA	NR	NA	NA	Does not exist	Installed during original facility construction and ended use following Apollo Program. Two shallow soil vapor points from Phase I 200 Investigation showed very little VOCs.
200	23	Bldg. 272 (Tanks A & B)	1,200	600 gpd (each)	Dec-91	LC 910939	1,500	12/16/15	Foothills Clean Fill Landfill	Removed	Designed in series: Tank A for septage and Tank B for cooling water. No leaching observed.
200	23	Bldg. 272 (Tank C)	900	200 gpd	2004	DP-392	480	12/16/15	Foothills Clean Fill Landfill	Removed	No leaching observed.
300	24	300 - Main Parking Lot Location	5,800	680 gpd	1963	NA	11,000	03/04/16	WSMR Landfill	Removed	Installed during original facility construction. No leaching observed.
300	25	Bldg. 320	1,200	200 gpd	Aug-93	LC 930858	1,500	02/10/16	Foothills Clean Fill Landfill	Removed	Registered in Lockheed's name. No leaching observed.
300	26	Bldg. 364	1,200	300 gpd	Dec-91?/ Jan-92	LC 910918	1,500	05/20/15	Foothills Clean Fill Landfill	Removed	No leaching observed.

Area	SWMU	Location	Size/ Gal	Design Flow Rate	Install Date	Permit Number	Leach field Area (ft²)	Excav. Date	Disposal Location	Final Status	Comments
400	27	400 - South Main Parking Lot	5,800	780 gpd	1964	NA	11,000	03/08/16	WSMR Landfill	Removed	Installed during original facility construction; 1967 document describes tank capacity as 6,200 gallons. No leaching observed.
400	NA	Bldg. T463	1,200	400 gpd	Jun-92	LC 920527	1,500	01/28/15	Foothills Clean Fill Landfill	Removed	Listed in Sept 1996 as "Temporarily out of service awaiting future building"; WSTF TPS shows building T463 was removed 4/14/1994. No leaching observed.
400	NA	Bldg. 447	750	100 gpd	Apr-90	LC 900333	300	02/18/16	Foothills Clean Fill Landfill	Removed	Steam Team Support Building. No leaching observed.
800	NA	Bldgs 802 & 803	1,500	600 gpd	Apr-87	LC 870401	900	06/21/17	WSMR Landfill	Removed	Registered under Lockheed by Johnny's Septic Tank Company. No leaching observed.
600	NA	Bldg. 650 Plume-Front Area	1,200	40 gpd	Apr-01	DA 010359	1,500	02/17/16	Foothills Clean Fill Landfill	Removed	Remote area for emergency use only; originally permitted with "Honeywell" as the owner. No leaching observed.
NA	NA	Bldg. 117-Forward Guard Gate	900	80 gpd	Feb-06	LWP 002090	232	NA	NA	Retain	Remote area.
NA	NA	STGT	1,200	600 gpd	10/19/89	LC 890939	530	07/19/17	WSMR Landfill	Removed	Installed after the initial STGT lagoon failed to hold water for temporary use until the lagoon was completed. 1989-1991

NA = Not applicable
NR = No record drawings found

Table 6.1 Contaminants of Potential Concern

Parameter	Analytical Method	Quantity	Container and Preservative Requirements	Holding Times
Total Metals (Subsurface soils)	SW-846 Methods 6010B/7471	19 Total: (16 samples, two duplicates, one matrix spike)	1 each 4 oz. wide mouth sample jar; Preservation – Ice (≤6 C)	6 months, except mercury (28 days)
Cyanide (Subsurface soils)	SW-846 Method 335.4	19 Total: (16 samples, two duplicates, one matrix spike)	1 each 4 oz. wide mouth sample jar; Preservation - Ice (≤6 °C)	14 days
Cyanide (Subsurface soils)	SW-846 Method 9012B	4 Total: (two samples, one duplicate, one matrix spike)	1 each 4 oz. wide mouth sample jar; Preservation - Ice (≤6 °C)	14 days

Table 6.2 100 Area Septic Tank at Building 114 (SWMU 22) Soil Borings Sample Locations and Detections

Laboratory Reporting Limit		0.126 to 0.156	0.855 to 1.763	0.068 to 0.141	0.061 to 0.126	0.091 to 0.187	0.166 to 0.864	0.166 to 0.864	1.763 to 3.641	0.060 to 0.124
Borehole	**Depth (ft bgs)**	**Cyanide (mg/kg)**	**Arsenic (mg/kg)**	**Barium (mg/kg)**	**Cadmium (mg/kg)**	**Chromium (mg/kg)**	**Lead (mg/kg)**	**Mercury (mg/kg)**	**Selenium (mg/kg)**	**Silver (mg/kg)**
April 2017 Results Investigation Samples Analyzed for Metals by EPA Method 6010B/7471[1] and Cyanide by EPA Method 335.4										
114-SB-01	5'-7'	0.46	6.1	110	0.14	11.0	1.5	0.007 J	<4.89	<0.245
	10'-12'	<0.245	14.0 QD	30	0.18	5.5	2.4	<0.0321	<4.81	<0.240
	10'-12' (duplicate)	<0.25	9.6 QD	33	<0.0996	5.5	1.9	<0.0326	<4.98	<0.249
114-SB-02	6'-8'	19.6[2]	4.0	68	1.10	9.5	4.8	0.039	<4.86	0.94
	10'-12'	8.63	4.0	39	0.10 J	7.3	2.4	0.017 J	<4.95	<0.248
	15'-17'	2.41	5.7	32	0.11	7.5	3.7	<0.0314	<4.94	<0.247
	20'-22'	0.85	12.0	58	0.15	12.0	2.4	<0.0312	<4.96	<0.248
	25'-27'	<0.263	5.1	33	0.11	8.3 SP	5.4 SP	<0.0315	<2.42	<0.242
114-SB-03	7'-8'	47.1 QD[3]	4.8	73	0.64	12.0 QD	4	0.047	<4.96	0.29 QD
	7'-8' (duplicate)	60.6 QD[4]	5.3	64	0.54	7.9 QD	4.2	0.041	<4.88	0.11 J QD
	10'-12'	2.59	3.8 J	61	<0.198	9.0	3.5	<0.0313	<4.96	<0.496
	15'-17'	1.53	7.0	46	0.13	8.5	2.2	<0.0315	<4.99	<0.250
	20'-22'	<0.236	7.4	39	3.80	12.0	3.9	<0.033	<4.97	<0.249
	25'-27'	<0.242	6.3	39	0.07 J	4.0	3.1	<0.0319	<4.89	<0.244
114-SB-04	5'-7'	1.63	5.4	81	<0.1	5.7	3.8	0.011 J	<5	<0.25
	10'-12'	<0.245	6.1	120	<0.0968	8.6	5.6	<0.0327	<4.84	<0.242
114-SB-05	5'-7'	<0.248	9.9	53	<0.0986	19.0	1.3	<0.0308	<4.93	<0.247
	10'-12'	<0.24	7.3	40	<0.0984	6.4	3.1	<0.0327	<4.92	<0.246

Laboratory Reporting Limit		0.126 to 0.156	0.855 to 1.763	0.068 to 0.141	0.061 to 0.126	0.091 to 0.187	0.166 to 0.864	0.166 to 0.864	1.763 to 3.641	0.060 to 0.124
Borehole	**Depth (ft bgs)**	**Cyanide (mg/kg)**	**Arsenic (mg/kg)**	**Barium (mg/kg)**	**Cadmium (mg/kg)**	**Chromium (mg/kg)**	**Lead (mg/kg)**	**Mercury (mg/kg)**	**Selenium (mg/kg)**	**Silver (mg/kg)**
October 2017 Results Investigation Samples Analyzed for Cyanide by EPA Method 9012B										
114-SB-06	7'-9'	0.17 J RB QD	NA	NA	NA	NA	NA	NA	NA	NA
	7'-9' (duplicate)	2.22 QD	NA	NA	NA	NA	NA	NA	NA	NA
114-SB-07	7'-9'	0.09 J RB QD	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 = Arsenic, barium, cadmium, chromium, lead, selenium and silver analyzed by SW-846 Method 6010B, and mercury analyzed by SW-846 Method 7471. The April 2017 cyanide samples analyzed using SW-846 Method 335.4, and the October 2017 cyanide samples analyzed using SW-846 Method 9012B.
2 = Soil sample from 114-SB-02, 6'-8' bgs, is replaced by soil sample from 114-SB-07, 7'-9' bgs.
3 = Soil sample from 114-SB-03, 7'-8' bgs, is replaced by soil sample from 114-SB-06, 7'-9' bgs.
4 = Duplicate soil sample from 114-SB-03, 7'-8' bgs, is replaced by duplicate soil sample from 114-SB-06, 7'-9' bgs.
Analyte concentrations exceeding the NMED soil-to-groundwater SL-SSL are listed in red font color in this table and Figure 2.1.
J = Indicates the result is an estimated value less than the quantitation limit, but greater than or equal to the detection limit.
RB = The analyte was detected in the method blank.
QD = The relative percent difference for a field duplicate was outside standard limits.
NA = Not applicable/not analyzed.
Samples reported as less than (<) a concentration were not detected above the laboratory detection limit.
Boreholes 114-SB-02, 114-SB-03, 114-SB-06, and 114-SB-07 depths begin at the tank base, which is determined by color differences between clean fill sediment and native alluvium.

Table 7.1 SWMU 22 Risk Screening Maximum Concentration Evaluation - Residential Carcinogens

Carcinogens	Maximum Concentration 0'-10' bgs (mg/kg)	Residential SSL[1,2] (mg/kg)	Residential Risk (Conc/RSSL)x10^{-5}
Cadmium	1.10E+00	8.59E+04	1.28E-10
Chromium, total	1.90E+01	9.66E+01	1.97E-06
Site Residential Risk Sum			1.97E-06

Bold font indicates exceedance of SSL, Risk or Hazard Index.

[1]RSSLs are included for conservative risk. There are no complete residential pathways for SWMU 22.

[2]SSLs from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

RSSL = Residential Soil Screening Level

SSL = Soil Screening Level

Table 7.2 SWMU 22 Hazard Screening Maximum Concentration Evaluation - Residential Noncarcinogens

Noncarcinogens	Maximum Concentration 0'-10' bgs (mg/kg)	Residential SSL[1,2] (mg/kg)	Residential HI (Conc/RSSL)x1
Cadmium	1.10E+00	7.05E+01	1.56E-02
Chromium, total	1.90E+01	4.52E+04	4.21E-04
Cyanide	8.60E+00	1.11E+01	7.75E01
Silver	9.40E-01	3.91E+02	2.40E-03
Site Residential HI Sum			7.93E-01

Bold font indicates exceedance of SSL, Risk or Hazard Index.

[1]RSSLs are included for conservative risk. There are no complete residential pathways for SWMU 22.

[2]SSLs from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

HI = Hazard Index

RSSL = Residential Soil Screening Level

SSL = Soil Screening Level

Table 7.3 SWMU 22 Risk Screening Maximum Concentration Evaluation - Construction Worker Carcinogens

Carcinogens	Maximum Concentration 0'-10' bgs (mg/kg)	Construction Worker SSL[1] (mg/kg)	Construction Worker Risk (Conc/CSSL)x10^{-5}
Cadmium	1.10E+00	3.61E+03	3.05E-09
Chromium, total	1.90E+01	4.68E+02	4.06E-07
Site Construction Worker Risk Sum			4.09E-07

Bold font indicates exceedance of SSL, Risk or Hazard Index.

[1]SSLs from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

CSSL = Construction Worker Soil Screening Level

SSL = Soil Screening Level

Table 7.4 SWMU 22 Hazard Screening Maximum Concentration Evaluation - Construction Worker Noncarcinogens

Noncarcinogens	Maximum Concentration 0'-10' bgs (mg/kg)	Construction Worker SSL[1] (mg/kg)	Construction Worker HI (Conc/CSSL)x1
Cadmium	1.10E+00	7.21E+01	1.53E-02
Chromium, total	1.90E+01	1.34E+02	1.42E-01
Cyanide	8.60E+00	1.20E+01	7.17E-01
Silver	9.40E-01	1.77E+03	5.31E-04
Site Construction Worker HI Sum			8.74E-01

Bold font indicates exceedance of SSL, Risk or Hazard Index.

[1]SSLs from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

CSSL = Construction Worker Soil Screening Level

HI = Hazard Index

SSL = Soil Screening Level

Table 7.5 SWMU 22 Risk Screening Maximum Concentration Comparison with Soil Leachate SSL

COPC	Maximum Concentration All Depths bgs (mg/kg)	Cw, DAF 20 (mg/kg)
Arsenic	**1.40E+01**	5.83E+00
Barium	1.20E+02	2.70E+03
Cadmium	3.80E+00	9.39E+00
Chromium, total	1.90E+01	2.05E+05
Cyanide	**8.60E+00**	7.13E-01
Lead	5.60E+00	2.70E+02
Mercury	4.70E-02	2.09E+00
Silver	9.40E-01	1.38E+01

Bold font indicates exceedance of soil leachate SSL from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

SSL = Soil Screening Level

Table 7.6 SWMU 22 Risk Screening UCL95 Concentration Comparison with Soil Leachate SSL

COPC	UCL95 Concentration All Depths bgs (mg/kg)	Cw, DAF 20 (mg/kg)
Arsenic	**8.33E+00**	5.83E+00
Barium	6.96E+01	2.70E+03
Cadmium	1.49E+00	9.39E+00
Chromium, total	1.07E+01	2.05E+05
Cyanide	**3.45E+00**	7.13E-01
Lead	3.89E+00	2.70E+02
Mercury[1]	4.70E-02	2.09E+00
Silver[1]	9.40E-01	1.38E+01

Bold font indicates exceedance of soil leachate SSL from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

1 = Maximum concentration retained. Insufficient detections to support statistical analyses and calculation of UCL95 concentration

SSL = Soil Screening Level

Table 8.1 Summary of SWMU 22 Cumulative Risk/Hazards

Exposure Scenario	Site Risk, HI, or Ratio	Target	Exceeds Target?
Residential cancer[1]	1.97E-06	1.00E-05	No
Residential non-cancer[1]	7.93E-01	1	No
Construction Worker cancer[1]	4.09E-07	1.00E-05	No
Construction Worker non-cancer[1]	8.74E-01	1	No

Bold font indicates exceedance of cumulative target.
[1]Indicates maximum concentrations were used for cumulative risk/HI/ratio.

Appendix A
Photographic Documentation

Figure A.1 **250 Area Septic Tank – Uncovered (View to the east)**

Picture showing open pit at location of 250 Area septic tank. This may represent removal of the tank in June 1977.

Figure A.2 **SWMU 22 – Prior to Excavation (View to the northeast)**

Building 114 septic tank (SWMU 22) showing surface vent pipe.

Figure A.3 SWMU 22 – Excavating Septic Tank (View to the southwest)

This photograph shows the Building 114 (SWMU 22) septic tank during excavation.

Figure A.4 **SWMU 22 – Inlet Pipe (View to the northeast)**

Photograph showing the inlet pipe (from Building 114 to the septic tank) for SWMU 22.

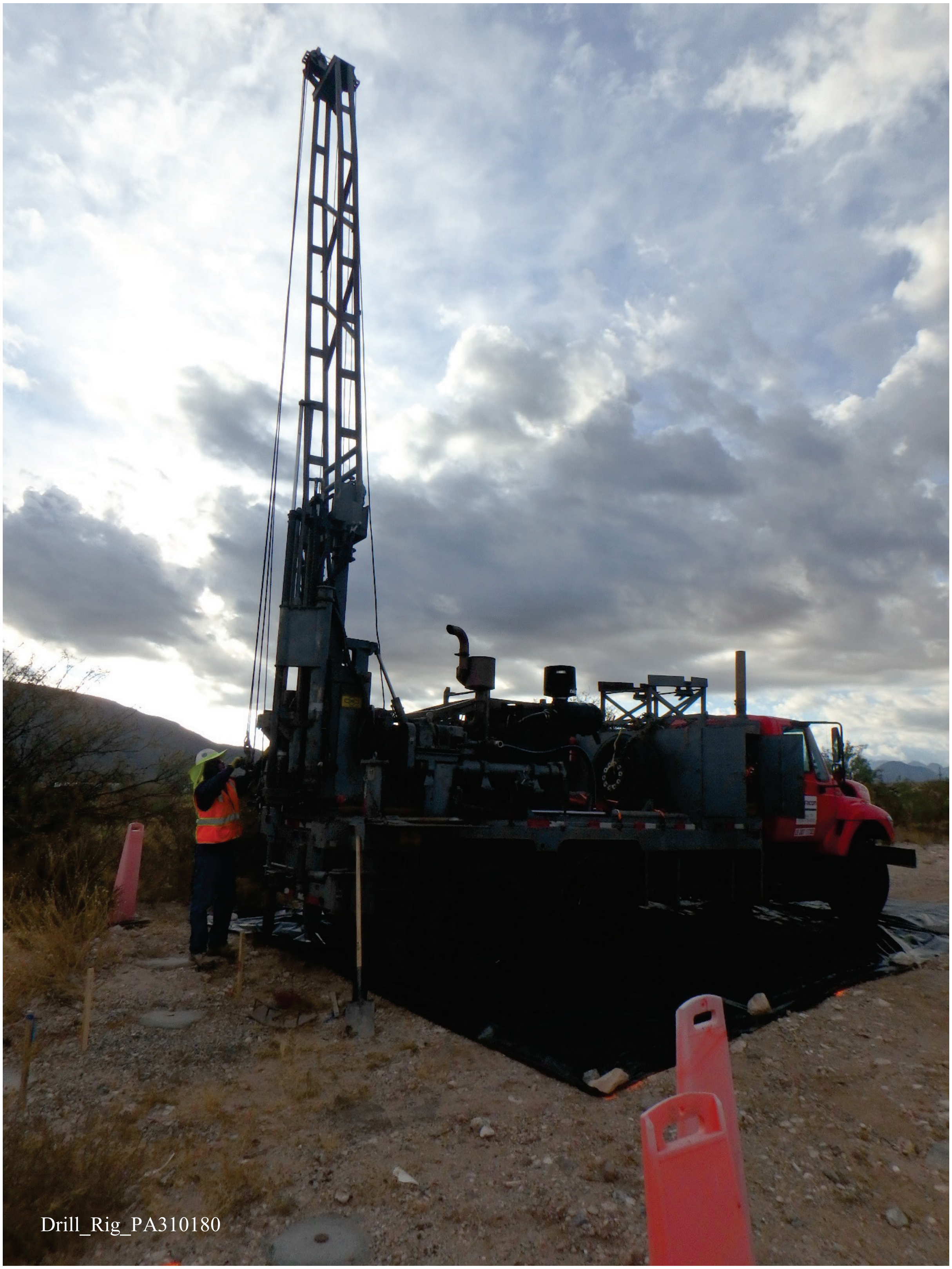
Figure A.5 **SWMU 22 – Outlet Pipe (view to the southwest)**

The vertical pipe is the vent. At the bottom of the vertical pipe, a dark area shows the entry to the discharge pipe from the septic tank (with no evidence of discharge within the pipe).

Figure A.6 **SWMU 22 – Septic Tank (View to the west)**

Building 114 (SWMU 22) septic tank. The surface vent can be seen with the tank top at the upper left of the photo. This photo was taken prior to removal of the tank. The tank contained no bottom.

Figure A.7 **SWMU 22 – Drill Rig (View to the east)**



Drill rig (CME-75 Hollow Stem Auger) at SWMU 22.

Soil sample is from boring 114-SB-07 at 7 to 9 ft bgs and was typical of the soil encountered during the drilling investigation. Soil is shown here within a stainless steel bowl.

Appendix B
NMED Liquid Waste Abandonment Forms
(chronological order by year)

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

March 16, 2015

Reply to Attn of: RE-15-029

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
1170 N. Solano Dr., Suite M
Las Cruces, NM 88001

Subject: NASA WSTF On-Site Liquid Waste System Abandonment Form for Building T463 Septic Tank

Enclosed is the On-Site Liquid Waste System Abandonment Form for the NASA WSTF Building T463 septic tank. The tank was removed in accordance with the NASA WSTF Septic Tanks Removal Plan on January 28, 2015. The remaining building sewer line was capped in accordance with Uniform Plumbing Code requirements and the excavation was backfilled with clean-fill. NASA also requests cancellation of the NMED Permit No. LC 92057 that is associated with this tank.

If you have any questions or comments, please contact Michael Jones of my staff at 575–524–5604.

Timothy J. Davis
Chief, Environmental Office

Enclosure

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 920527

System Owner's Name: NASA Johnson Space Center White Sands Test Facility

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

✓ ~~Connected to Sewer Lines or Plugged~~/Capped based on UPC Requirements

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [x] Septic Tank
- [ ] Sec./Tert. Treatment Unit
- [ ] Holding Tank
- [ ] Seepage Pit
- [ ] Other:
- [ ] Cesspool

ABANDONMENT PROCEDURE:

✓ System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

This septic tank was located at the former location of Building T463. It was removed in accordance with the WSTF Septic Tanks Removal Plan on January 28, 2015.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	N/C - Not Compliant
N/I - Not Inspected	N/V - Not Verified
N/A - Not Applicable	

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Space Administration

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White Sands Test Facility
Post Office Box 20
Las Cruces, NM 88004-0020

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- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Mr. Michael Montoya
Liquid Waste Program
New Mexico Enviromental Dept.
1170 North Solano Dr, Suite M
Las Cruces, NM 88001

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) Nohemi Montoya

C. Date of Delivery 3-25-15

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number
(*Transfer from service label*) 7011 3500 0003 2696 9907

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

July 6, 2015

Reply to Attn of: RE-15-072

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
1170 N. Solano Dr., Suite M
Las Cruces, NM 88001

Subject: NASA WSTF On-Site Liquid Waste System Abandonment Form for Building 364 Septic Tank

Enclosed is the On-Site Liquid Waste System Abandonment Form for the NASA WSTF Building 364 septic tank. The tank was removed in accordance with the NASA WSTF Septic Tanks Removal Plan on May 20, 2015. The tank excavation was backfilled with clean-fill. The building sewer line had been previously rerouted from the tank during sanitary sewer construction. NASA requests cancellation of NMED Liquid Waste Permit No. LC 910918 that is associated with this tank, and a copy of the completed and signed abandonment form after the NMED takes action on this submittal.

If you have any questions or comments, please contact Michael Jones of my staff at 575–524–5604.

Timothy J. Davis
Chief, Environmental Office

Enclosure

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 910918

System Owner's Name: NASA Johnson Space Center White Sands Test Facility

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

✓ Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [x] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

✓ System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

Septic tank is located near WSTF Building 364. It was removed in accordance with the WSTF Septic Tanks Removal Plan on May 20, 2015.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	N/C - Not Compliant
N/I - Not Inspected	N/V - Not Verified
N/A - Not Applicable	

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Space Administration

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Lyndon B. Johnson Space Center
White Sands Test Facility
Post Office Box 20
Las Cruces, NM 88004-0020

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- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Mr. Michael Montoya
Liquid Waste Program
New Mexico Enviromental Dept.
1170 North Solano Dr, Suite M
Las Cruces, NM 88001

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature] ☐ Agent ☐ Addressee

B. Received by (Printed Name) Isbet Herrera
C. Date of Delivery 7/08/15

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? *(Extra Fee)* ☐ Yes

2. Article Number *(Transfer from service label)* 7011 2970 0004 4020 0489

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

February 4, 2016

Reply to Attn of: RE-16-019

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms for WSTF Building 272 Septic Tanks A, B, and C

Enclosed are the On-Site Liquid Waste System Abandonment Forms for WSTF Building 272 septic tanks A, B, and C. The tanks were removed in accordance the WSTF Septic Tanks Removal Plan on December 16, 2015. The building sewer lines were rerouted to the WSTF sanitary sewer system and the tank excavations have been backfilled with clean fill. NASA also requests cancellation of Liquid Waste Permit No. LC 910939 that is associated with Building 272 septic tanks A & B. Septic tank C does not have an associated Liquid Waste Program permit number. This tank was installed with the permission of the NMED Ground Water Pollution Prevention Section (now Ground Water Quality Bureau) following a March 11, 2005 letter from NASA that requested to permit the tank under existing groundwater discharge permit number DP-392.

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

Amanda Skarsgard for

Timothy J. Davis
Chief, Environmental Office

Enclosure (2)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 910939 (Building 272 Tanks A&B)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes	System Pumped
N/A	Bottom of System Opened or Ruptured or Unit Collapsed
N/A	System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A	Top Cover Removed or Collapsed
N/A	System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A	System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
Building 272 septic tanks A&B were installed in series in December 1991. The tanks were removed in accordance with the WSTF Septic Tanks Removal Plan on December 16, 2015.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (Building 272 Tank C)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Sec./Tert. Treatment Unit
- [ ] Holding Tank
- [ ] Seepage Pit
- [ ] Other:
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

There is no liquid waste permit for Building 272 septic tank C. The tank was installed with NMED permission in 2005 per a request to install letter under DP-392. The tank was removed with Building 272 septic tanks A and B on December 16, 2015 in accordance with the WSTF Septic Tanks Removal Plan.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

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National Aeronautics and
Space Administration

Mail Code: RE-16-019
Lyndon B. Johnson Space Center
White Sands Test Facility
Post Office Box 20
Las Cruces, NM 88004-0020

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- Print your name and address on the reverse so that we can return the card to you.
- **Attach this card to the back of the mailpiece, or on the front if space permits.**

1. Article Addressed to:

Mr. Michael Montoya
Liquid Waste Program
New Mexico Enviromental Dept.
2301 Entrada Del Sol
Las Cruces, NM 88001

COMPLETE THIS SECTION ON DELIVERY

A. Signature ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) Nohemi Mendoza

C. Date of Delivery 2-8-16

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
☑ Certified Mail ☐ Express Mail
☐ Registered ☑ Return Receipt for Merchandise
☐ Insured Mail ☐ C.O.D.

4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number (*Transfer from service label*) 7011 2970 0004 4020 1288

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

March 30, 2016

Reply to Attn of: RE-16-049

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms for Septic Tanks Near WSTF Buildings 320, 447, and 650

Enclosed are the On-Site Liquid Waste System Abandonment Forms for septic tanks formerly located near WSTF Buildings 320, 447, and 650. These septic tanks were removed in accordance with the WSTF Septic Tanks Removal Plan during February 2016. The Building 320 tank was removed on February 10, the Building 650 tank was removed on February 17, and the Building 447 tank was removed on February 18. Building sewer lines previously connected to each tank were rerouted to the WSTF sanitary sewer system and the tank excavations have been backfilled with clean fill. NASA also requests cancellation of associated Liquid Waste Permits LC930858 (Building 320), LC900333 (Building 447), and DA010359 (Building 650).

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

Timothy J. Davis
Chief, Environmental Office

Enclosure (3)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC930858

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

X Septic Tank	Sec./Tert. Treatment Unit	Holding Tank
Seepage Pit	Other:	Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The WSTF Building 320 septic tank was installed in August 1993. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on February 10, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

Abandonment **Approved**
Abandonment **Approved w/conditions** (See Comments/Violations)
Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

Granted Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC900333

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The WSTF Building 447 septic tank was installed in April 1990. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on February 18, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: DA010359

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes — Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes — System Pumped
N/A — Bottom of System Opened or Ruptured or Unit Collapsed
N/A — System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A — Top Cover Removed or Collapsed
N/A — System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A — System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The WSTF Building 650 septic tank was installed in April 2001. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on February 17, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector — Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

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National Aeronautics and
Space Administration

Mail Code: RE-16-049
Lyndon B. Johnson Space Center
White Sands Test Facility
Post Office Box 20
Las Cruces, NM 88004-0020

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1. Article Addressed to:

Mr. Michael Montoya
Liquid Waste Program
New Mexico Enviromental Dept:
2301 Entrada Del Sol
Las Cruces, NM 88001

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature]
☐ Agent
☐ Addressee

B. Received by (Printed Name) Mchael Montoya

C. Date of Delivery 4-1-16

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2. Article Number
(Transfer from service label) 7011 2970 0004 4020 1639

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National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

April 28, 2016

Reply to Attn of: RE-16-066

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms for WSTF 300 Area and 400 Area Main Septic Tanks

Enclosed are the On-Site Liquid Waste System Abandonment Forms for the WSTF 300 Area and 400 Area Main septic tanks. These septic tanks were removed in accordance with the WSTF Septic Tanks Removal Plan on March 4 and March 8, 2016, respectively. The influent sewer lines previously connected to each tank were rerouted to the WSTF sanitary sewer system and the tank excavations have been backfilled with clean fill.

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

Timothy J. Davis
Chief, Environmental Office

Enclosure (2)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (300 Area Main Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

X Septic Tank	Sec./Tert. Treatment Unit	Holding Tank
Seepage Pit	Other:	Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The 300 Area Main septic tank was installed in 1963 during WSTF site construction.
The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on
March 4, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

Abandonment **Approved**
Abandonment **Approved w/conditions** (See Comments/Violations)
Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

Granted Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (400 Area Main Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:
[X] Septic Tank [ ] Sec./Tert. Treatment Unit [ ] Holding Tank
[ ] Seepage Pit [ ] Other: [ ] Cesspool

ABANDONMENT PROCEDURE:
Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
The 400 Area Main septic tank was installed in 1964 during WSTF site construction.
The tank was removed in accordance with the WSTF Septic Tanks Removal Plan
on March 8, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:
[ ] Abandonment **Approved**
[ ] Abandonment **Approved w/conditions** (See Comments/Violations)
[ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:
[ ] Granted [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

November 15, 2016

Reply to Attn of: RE-16-150

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms for WSTF Building 114 Septic Tank

The On-Site Liquid Waste System Abandonment Form for the WSTF Building 114 septic tank is enclosed. The septic tank was removed in accordance with the WSTF Septic Tanks Removal Plan on November 9, 2016, and the tank excavation was backfilled with clean fill. The influent sewer line connected to the tank was previously rerouted to a new septic tank that was installed on September 10, 2013 (Permit No. DA130309).

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

Timothy J. Davis
Chief, Environmental Office

Enclosure (1)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (Building 114 Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

[X] Septic Tank	[ ] Sec./Tert. Treatment Unit	[ ] Holding Tank
[ ] Seepage Pit	[ ] Other:	[ ] Cesspool

ABANDONMENT PROCEDURE:
Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
The Building 114 septic tank was installed in 1963 during WSTF site construction. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on November 9, 2016. The building sewer line was connected to a new septic tank (Permit No. DA130309).

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:
[ ] Abandonment **Approved**
[ ] Abandonment **Approved w/conditions** (See Comments/Violations)
[ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:
[ ] Granted [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

New Mexico Environment Department
Environmental Health Bureau

Application for Liquid Waste Permit or Registration

☐ Conventional-New ☐ Conventional Modification ■ Registration ☐ ATS/ADS - New ☐ ATS/ADS Modification ☐ Commercial ☐ Amendment

Section 1 General Information

NMED USE — Liquid Waste Processing Number: 002090 | Field Office ID: | Application Date:

Name (Property Legal owner, Inc., LLC, partnership, DBA, full legal name): National Aeronotical and Space Administration (NASA)

Facility Name:	Phone:	E-mail address(es):
Johnson Space Center White Sands Test Facility	575-524-5024	timothy.j.davis@nasa.gov

System Location: Physical Address, County - (if needed, attach directions): 12600 NASA Road (Dona Ana County)

Mailing Address (Invoices, permits, official correspondence): NASA JSC-WSTF, Attn: Timothy J. Davis Chief, Environmental Office, P.O. Box 20

City:	State:	Zip Code:	City:	State:	Zip Code:
Las Cruces	NM	88012	Las Cruces	NM	88004

Uniform Property Code:	Date of Record:	Lot Size (0.01 acres):	Total No. LW Systems on Property:	Total Design Flow on Property:
	1960	60,000	2	180 gpd

Subdivision:	Subdivision Plat Date:	Unit/Phase:	Block	Lot/Tract	Township	Range	Section
N/A	N/A	N/A	N/A	N/A	T21S	R03E	14

Water Supply Source: ■ Onsite ☐ Offsite; ☐ Private ☐ Shared ■ Public

No. Connections: 75

OSE Well Permit No. LRG-6369

Private or Shared Water Well Location (long., lat. or physical address, city, state): N/A

Public Water System Name: NASA JSC White Sands Test Facility - FF

Irrigation well, flood irrigation area on lot? ☐ YES NO ■

Enter all LW permit nos. for lot: DA130309 (Blds. 114 and 119)

Section 2 Installer Information

No person shall construct, install or modify an onsite liquid waste system unless that person holds a valid and appropriate classification of contractor's license issued by New Mexico CID.

Installer Name:	Phone:	Installer Company Name:
Johnny's Septic Tank Co.	575-526-5442	Johnny's Septic Tank Co.

☐ Corp., Inc. ☐ LLC ☐ Sole Prop. ☐ LP, LLP, GP

Mailing Address (street / PO Box, City, State, Zip): 2155 Dona Ana Road

E-mail address:

CID License Classification: ☐ MM-1 ☐ MM-98 ☐ MS-1 ■ MS-3 ☐ Homeowner

CID License No.: 25764

I am a licensed contractor by the State of New Mexico Regulation Licensing Department, Construction Industries Division (CID). I will either personally install the work myself or authorize my employee(s), ______ (named here) to provide the services and labor for this permit application under my direct supervision.

Section 3 Authentication / Verification

By signing below, I attest that the information in this application is correct and true to the best of my knowledge. I understand the issuing of this permit does not relieve me from the responsibility of complying with all applicable provisions of the New Mexico Plumbing Code and the New Mexico Liquid Waste Disposal and Treatment Regulations. Obtaining this permit does not relieve me from the responsibility of obtaining any permit required by state, city or county regulation or ordinance or other requirements of state or federal law.

☐ CID Licensed Contractor ☐ Qualified Homeowner ■ Authorized Rep (Registrations Only)

Printed Name: Timothy J. Davis; John J. Villegas

Signature: Cal Signed for T. Davis; J Villegas

Date Signed: 5/31/17

NMED USE ONLY

NMED PERMIT TO CONSTRUCT

NMED PERMIT TO CONSTRUCT NO:

A permit for construction of the Liquid Waste system described herein is hereby: ☐ Granted ☐ Granted with Conditions ☐ Denied ☐ Cancelled

Conditions, Reasons for Cancellation or Denial:

NMED Inspector Name Printed: | NMED Inspector Signature: | Date:

NMED LIQUID WASTE FEES

☐ Conventional-New $100	☐ Conventional Modification $50	☐ Registration $100	☐ ATS/ADS – New $150	☐ ATS/ADS Modification $75	☑ Commercial $150	☐ Variance $50

Total Fee Paid | Date Paid | Payment Received By

FINAL INSPECTION OF LW SYSTEM

☑ Final Inspection Conducted by NMED | Final Inspection Date: 6/21/17 | NMED Inspector Name Printed: Michael Montoya

☐ Contractor photo inspection authorized: | Photo inspection date: | Date photos and Completed Form Received by NMED:

NMED PERMIT TO OPERATE

NMED PERMIT TO OPERATE NO:

A permit for operation of the Liquid Waste system described herein is hereby: ☑ Granted ☐ Granted with Conditions ☐ Denied ☐ Cancelled

Conditions, Reasons for Cancellation of Denial:

NMED Inspector Name Printed: Michael Montoya | NMED Inspector Signature: [signature] | Date: 6-21-17

D WM NM

New Mexico Environment Department
Environmental Health Bureau

Application for Liquid Waste Permit or Registration

If your lot has more than one LW system, you must fill out a separate application for each system. The site plan drawing must show all liquid waste systems located on your lot. Existing permitted systems must be identified with their LW Permit #. New, modified or unpermitted systems must be clearly labelled on the site plan. NMED agents are not authorized to amend or complete any portion of this application.

Liquid Waste Processing Number: 00 2090

Treatment & Disposal System Design

Section 1 Design Flow, Hydrology, and Soil Description

A. Wastewater Sources & Design Flow Calculations

Facility		Units (enter number)	(Q) Flow, calculated: gpd
☐Single Family Residence		Bedrooms:	Total flow:
☐Multiple Family Units	No. Units:	Calculation Sheet Attached: ☐YES NO☐	Total flow:
☐Commercial / Institution (type): ☐Other:		Method of Design Flow Calculation: ☐ Table 201.1 ☐ PE (Calc. Sheet) ☐Water Meter Data Attached	Total flow:
☐Cluster ■Other (type): 4 employees x 20 gpd		No. of Units: 1 (Bldg. 117)	Total flow: 80 gpd
Total Flow for this LW System: *(see page 1 for total flow to property)*		Q	80 gpd

B. Hydrology Data

Depth from ground surface to:	Feet
Seasonal High Water table	175 ft
Bedrock, caliche, tight clay	< 20 ft
Gravel, cobbles, highly permeable soil	<20 ft
Test Hole / Soil Borings Used: ☐ YES NO ■	
Soil Classification Methodology used: ☐ Jar Test	
☐Laboratory: ☐Other:	■ Hand Sampling ☐Sieve

C. Soil Description

Type	AR
☐Type Ia: Coarse Sand (or up to 30% gravel)	1.25
☐Type Ib: Medium Sand, Loamy Sand	2.0
■Type II: Sandy Loam, Fine Sand, Loam	2.0
☐Type III: Silt, Silt Loam, Clay Loam, Silty Clay Loam, Sandy Clay Loam	2.0
☐Type IV: Sandy Clay, Silty Clay, Clay	5.0

Section 2. Treatment Unit and Pump Design:

1	Primary Treatment Unit ■Septic Tank(s)	No. Septic Tank(s): 1	Manufacturer: Johnny's Septic Tank Co.		Series / Model / Certification No.: NM97-9-265A	Capacity (gallons): 900	Burial Depth: 5 ft.
2 PUMP	☐Pump Tank	Manufacturer:			Series / Model:	Capacity (gallons):	Burial Depth:
	☐Pump ☐Dual Pump	Manufacturer:			Series / Model:	Pump Curve Attch'd: ☐YES NO☐	Effluent Pump: ☐YES NO☐
3 ATS	☐Secondary ☐Tertiary	☐Standard ☐Conditional ☐Experimental	☐Required ☐Voluntary	Manufacturer:	Series / Model:	Capacity (gallons):	Burial Depth:
	☐ Disinfection	☐UV ☐Ozone ☐Chlorine	☐Required ☐Voluntary	Manufacturer:	Series / Model:	Notes:	

Section 3 Disposal System Design, Components and Calculations

A. Minimum Required absorption area, calculated (Multiply Design Flow (Q) times Application Rate (AR)): Q 100 X AR 2 = Min. Sq. Ft. Required: 200

B. Design Components: ☐Distribution Box ☐Tee ☐ Drop Box ☐Alternating Drainfield Valve ☐ Other:

CONVENTIONAL DISPOSAL								
☐Pipe & Gravel	Trench Width:	Depth Gravel Below Pipe:	Total Linear Feet:	No. of Trenches:	Trench Depth:	Length, each trench:	Trench Spacing (ft):	Proposed Sq. Ft.:
■Chamber ☐Synthetic Agg. ☐Other:	Mfr. Model No & Sizing Credit (sf/ft. or unit): Gravelless Quick 4 Infiltrators		Total Linear Feet: 45	No. of Units: 3	Trench Depth: 4 ft	Length, each trench: Unknown	Trench Spacing (ft): N/A	Proposed Sq. Ft.: 231.6
☐Seepage Pit ☐Absorption Bed	Dimensions (L x W):		Depth below invert:	Proposed Sq. Ft.:	Trench Depth:	Notes:		

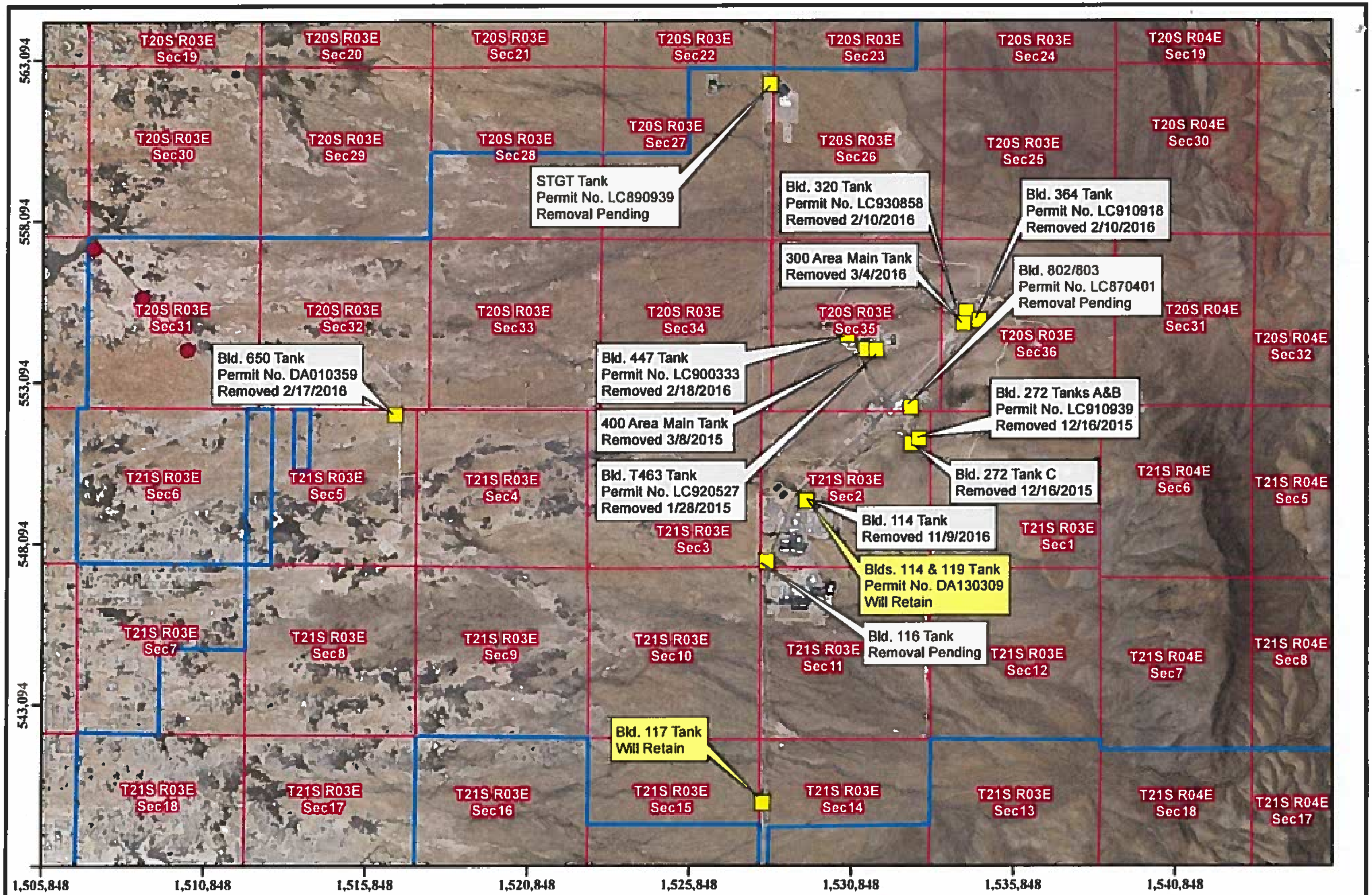
Section 4 Alternative Disposal System (ADS) Design, Components and Calculations

For all ADS's – calculation sheets & site plan drawings (plan view with cross section views) must be submitted with this permit application.

Alternative Disposal System						
Discharging	☐Wisconsin Mound	☐Elevated System	☐Unlined ET Bed	☐Effluent Irrigation Re-use	☐Sand-Lined Trench Sand ASTM Specs Attached? ☐ YES NO ☐	☐Bottomless Sand Filters Sand ASTM Specs Attached? ☐ YES NO ☐
	☐LPD	☐LPP	☐Graywater	☐Drip Irrigation		
	☐Split Flow (complete holding tank section & septic tank & conventional disposal section)			☐Wetland	☐Other (description):	
Non-Discharging	☐Holding Tank / No. of Tank(s)	Manufacturer:	NM Certification No.	Capacity:	Burial Depth:	High Water Alarm at 80%? ☐ YES NO ☐
	☐Lined ET Bed Sand ASTM Specs Attached? ☐ YES NO ☐	Liner Material & Thickness (mils):	Dimensions (L x W) & sq. ft.:	☐Lined Lagoon	Liner Material & Thickness (mils):	Dimensions (L x W) & sq. ft.:
	☐Vault	☐Privy (outhouse)	☐Other (description):			

Section 5 Setbacks / Site Plan & Attachments (check those that apply)

■ YES NO ☐	1. Does proposed system meet all setbacks required per 20.7.3.302 NMAC (see setback Table 302.1)?
■ YES NO ☐	2. Site plan attached w/ all structures shown, LW systems, wells & waters w/ 200' all setbacks clearly shown per 402.A.1 NMAC?
■ N/A ☐ YES NO ☐	3. If ATS or ADS, all requirements under section 403 are submitted, including calculations and drawings?
Supporting Documents Included:	☐Survey ☐Plat ☐Floorplan ☐Warranty Deed ☐Tax Bill ☐Other:



Application for Liquid Waste System Registration White Sands Test Facility Building 117

0 1,500 3,000 6,000 Feet

Coordinate System
NMSP, Central Zone, Feet, NAD83

NASA Johnson Space Center
White Sands Test Facility
Las Cruces, New Mexico

Location Map

Production Well
Septic Tank Location
PLSS Section
WSTF Boundary

N W E S

NASA

MAY 2017

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

March 29, 2006

Reply to Attn of: RA-E06-006

New Mexico Environment Department
Attn: Ms. Christina Kelso
Ground Water Pollution Prevention Section
Harold Runnels Building
P. O. Box 26110
Santa Fe, NM 87502

Subject: NASA White Sands Test Facility (WSTF) Discharge Plan DP-392 Permit Amendment Request to Install a New Septic Tank System and Leachfield

Per Liquid Waste Regulations promulgated at 20.7.3 NMAC, NASA is proposing to install a new septic tank and leachfield system with the concurrence of the New Mexico Environment Department (NMED) through the provisions of 20.6.2 NMAC. The septic tank system is designed to accommodate four employees who will be working on a daily basis at the new forward guard station along the existing access road to the facility. The new guard station will be on the east side of the road approximately 1.3 miles from the existing main gate. The Liquid Waste Permit form with sizing criteria, plans, and specifications is enclosed. The wastewater disposal program at WSTF is currently permitted under Discharge Plan DP-392, and this Permit can be amended to incorporate septic systems at the renewal date (expires May 24, 2007).

The proposed system will have a single, 900-gallon septic tank and high capacity infiltrators to be installed by Johnny's Septic Tank of Las Cruces (Construction Industries Division License No. 25764). The infiltrators will have 231.6 square feet of leachfield absorption area using the commercial gravelless design listed by NMED on the Liquid Waste Permit Application.

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

To the extent that information has been submitted electronically, I acknowledge that NMED will rely solely on the electronic information as accurate and complete information and that it is this data that will be used for compliance and enforcement purposes pursuant to the provisions set forth in the NASA WSTF Final Project Agreement. If you have any questions or comments concerning this submittal, please call me at 505–524–5733.

Original Signed By:

Radel Bunker-Farrah
Environmental Program Manager

Enclosure
bcc:
HTSI Team/P. H. Pache

RA/RBunker-Farrah:btm:3/29/06:5733

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NM ENVIRONMENT DEPARTMENT

APPLICATION FOR A LIQUID WASTE PERMIT

NMED Permit Number:____________

NMED Inspection Required ___ No ___ Yes, Call ____________ for Appointment

Date NMED Received:____________

Date Accepted as Complete:____________

SYSTEM OWNER'S NAME: Last, First, MI. Home Phone: Business Phone:
NASA (contractor is Sandoval Construction) 524-6878

MAILING ADDRESS: Street/PO Box, City, State, Zip Code

SYSTEM LOCATION: Street Address/ Location - give directions to site County:
Nasa Site - please see attached location map

SUBDIVISION BLOCK LOT UNIFORM PROPERTY CODE

TOWNSHIP RANGE SECTION QTR QTR QTR LATITUDE LONGITUDE

INSTALLER'S NAME & FIRM: PHONE:
Johnny's Septic Tank Co. 505-526-5442

MAILING ADDRESS: Street/PO Box, City State, Zip Code
2155 Dona Ana Rd Las Cruces, NM 88007

CID License No./ Certification MM-1 MM-98 MS-1 MS-3 Homeowner

I. PERMIT APPLICATION (Instructions on back of pink copy)

A. Proposed Liquid Waste System is for: X New construction
___ Replacement of an existing system ___ Modification to an existing system

B. Manufactured Housing (mobile) ___ Yes X No

C. Proposed System is: X Conventional ___ Mound ___ Holding Tank
___ Evapotranspiration ___ Other, Describe: ____________

II. WASTEWATER SOURCES & DESIGN FLOWS IN GALLONS PER DAY (gpd)

A. Proposed liquid waste system use and design flow:
___ Single family residence with ___ no. of bedrooms ______ gpd
___ Multiple family units; ___ no. of units; ___ no. bedrooms per unit ______ gpd
X Other (type) Guard Station Flow sizing units 4 80 gpd

B. Are there other sewage sources on this property? ___ Yes ___ No N/A gpd

TOTAL WASTEWATER FLOW ON PROPERTY = N/A GPD

III. SITE INFORMATION

A. Lot Size: N/A Acres (nearest 0.01 acre) Date of Record: N/A (Plat Date or Subdivision Date)

B. Depth from Ground Surface to:
Seasonal High Water Table >100 feet
Bedrock, Caliche, Tight Clay <20 feet
Gravel, Cobbles, Highly permeable soil <20 feet

C. Soil Description: (NMED may require both texture description and percolation rate)
Texture:
___ Coarse sand or gravel; (give percolation rate below)
___ Sand; (give percolation rate below) ___ Fine Sand
X Sandy Loam; ___ Loam; ___ Silty Loam;
___ Clay Loam; ___ Clay;
___ Other; (describe) ____________

Soil Percolation Rate: ____________ min/inch (attach percolation test record)

D. Domestic Water Source: ___ On-site X Off-site;
___ Private X Public ___ Shared
Irrigation Well or Flood Irrigated Area on the lot. ___ Yes ___ No

IV. SYSTEM DESIGN

A. Treatment Unit:
X Septic Tank Capacity 900 Gallons
Manufacturer: Johnny's Septic Certification No.: NM97-9-265A
___ Other (specify): ____________

B. Disposal System: X Trench ___ Bed ___ Seepage Pit ___ Mound
___ Evapotranspiration ___ Other, specify: ____________
Materials: ___ Pipe and gravel X Gravelless (specify) Infiltrators

C. Minimum required absorption area 231.6 square feet
Trench or Bed width 3 ft. Gravel depth below distribution pipe Infiltrators ft.
Total Trench or Bed length 45 ft. Number of trenches: 3
Number of gravelless units 2 quik 4's

D. Depth from ground surface to bottom of absorption area >< 4 ft.

#22

V. SITE PLAN: Diagram the lot and liquid waste system. Show setbacks to the objects listed below within 200 feet of system and the direction of groundwater flow. Give distances from:

Treatment Unit to:		Disposal System to:
>5 ft.	Property line	>8 ft.
>5 ft.	Property line	>8 ft.
>5 ft.	Buildings	>8 ft.
>5 ft.	Structures	>8 ft.
>200 ft.	Wells	>200 ft.
N/A ft.	Irrigation	N/A ft.
N/A ft.	Arroyos	N/A ft.
N/A ft.	Surface water	N/A ft.

Please see attached

VI. The foregoing information is correct and true to the best of my knowledge. I understand that the issuing of this permit does not relieve me from the responsibility of complying with all applicable provisions of the New Mexico Plumbing Code and the New Mexico Liquid Waste Disposal Regulations. Obtaining this permit does not relieve me from the responsibility of obtaining any permit required by state, city or county regulation or ordinance or other requirements of state or federal law.

Signature ______ Date 2-23-06

____ Owner X Contractor ____ Other ____________

VII. NMED PERMIT A permit for construction of the liquid waste disposal system described herein is hereby:

____ Granted ____ Granted subject to conditions ____ Denied

____ Conditions ____ Reasons for Denial:

____

____

____

NMED Representative ______ Date ______

NOTE: This permit may be canceled for failure to meet any condition specified; failure to complete the system within one year; for providing inaccurate or incomplete information; or for failure to notify NMED that the system is completed.

If you have questions call: ____________

NMED Inspection History	NMED Representative	Date

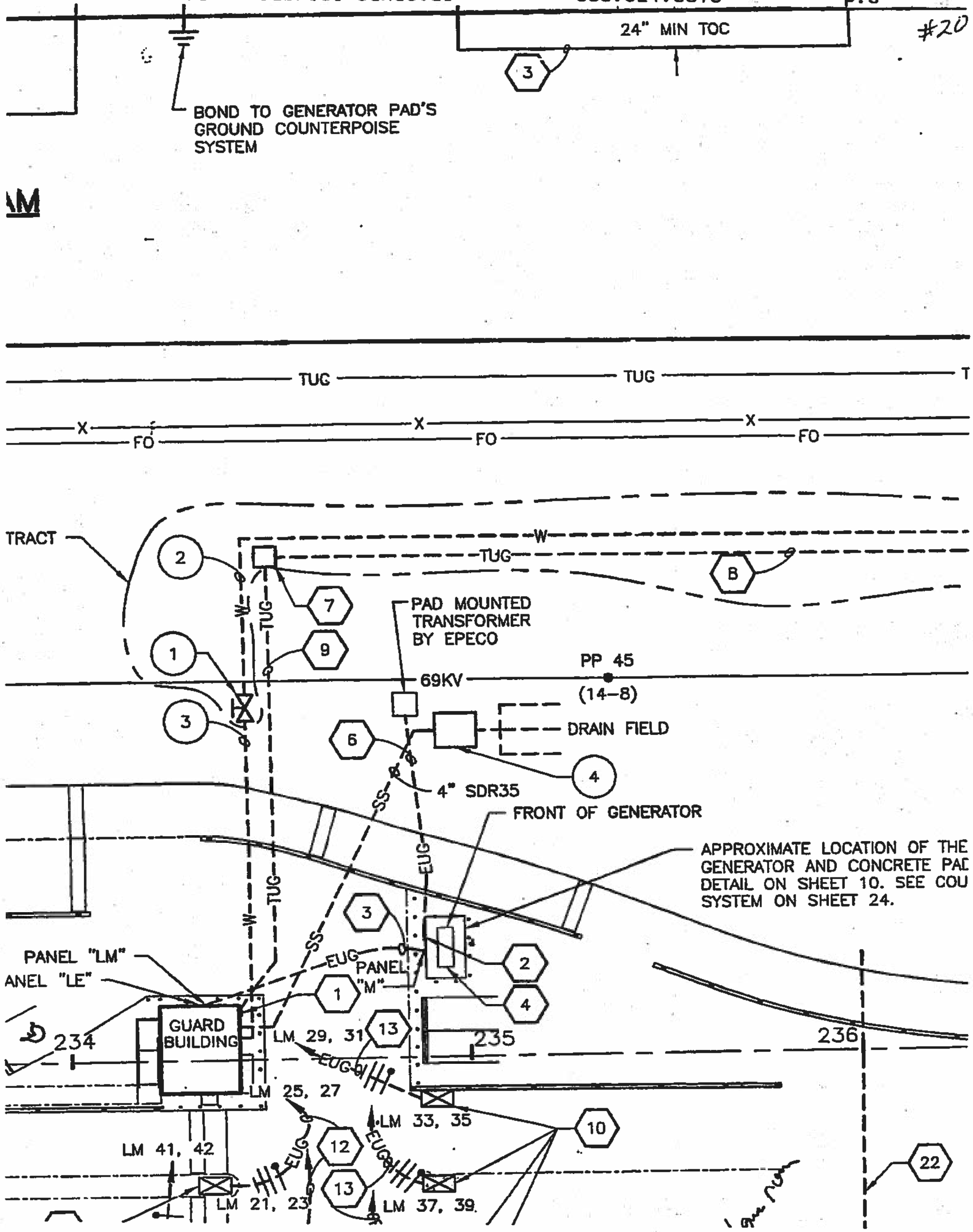
VIII. NMED FINAL APPROVAL:

The system described above ____ was ____ was not inspected.

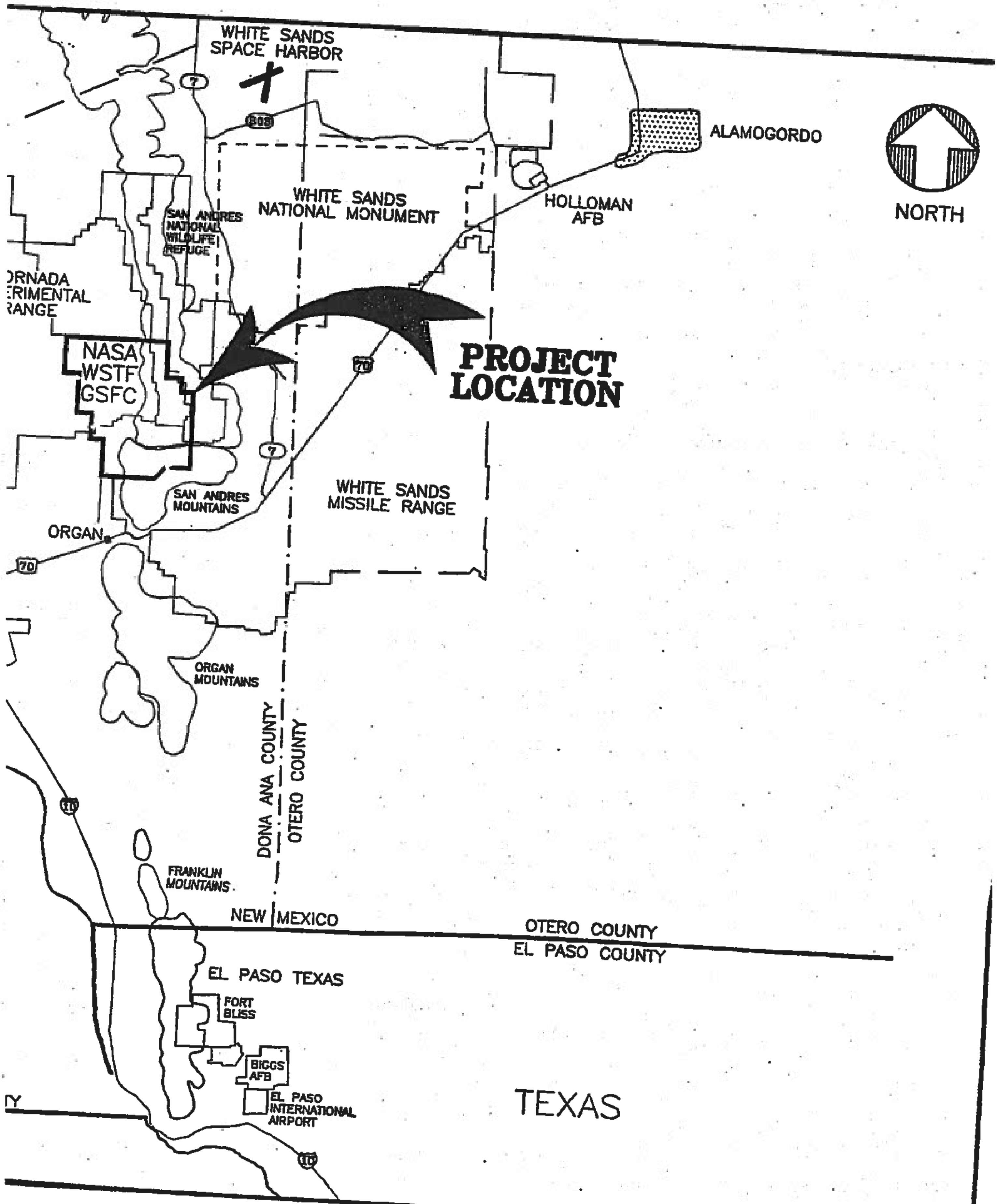
NMED Representative ______ Date ______

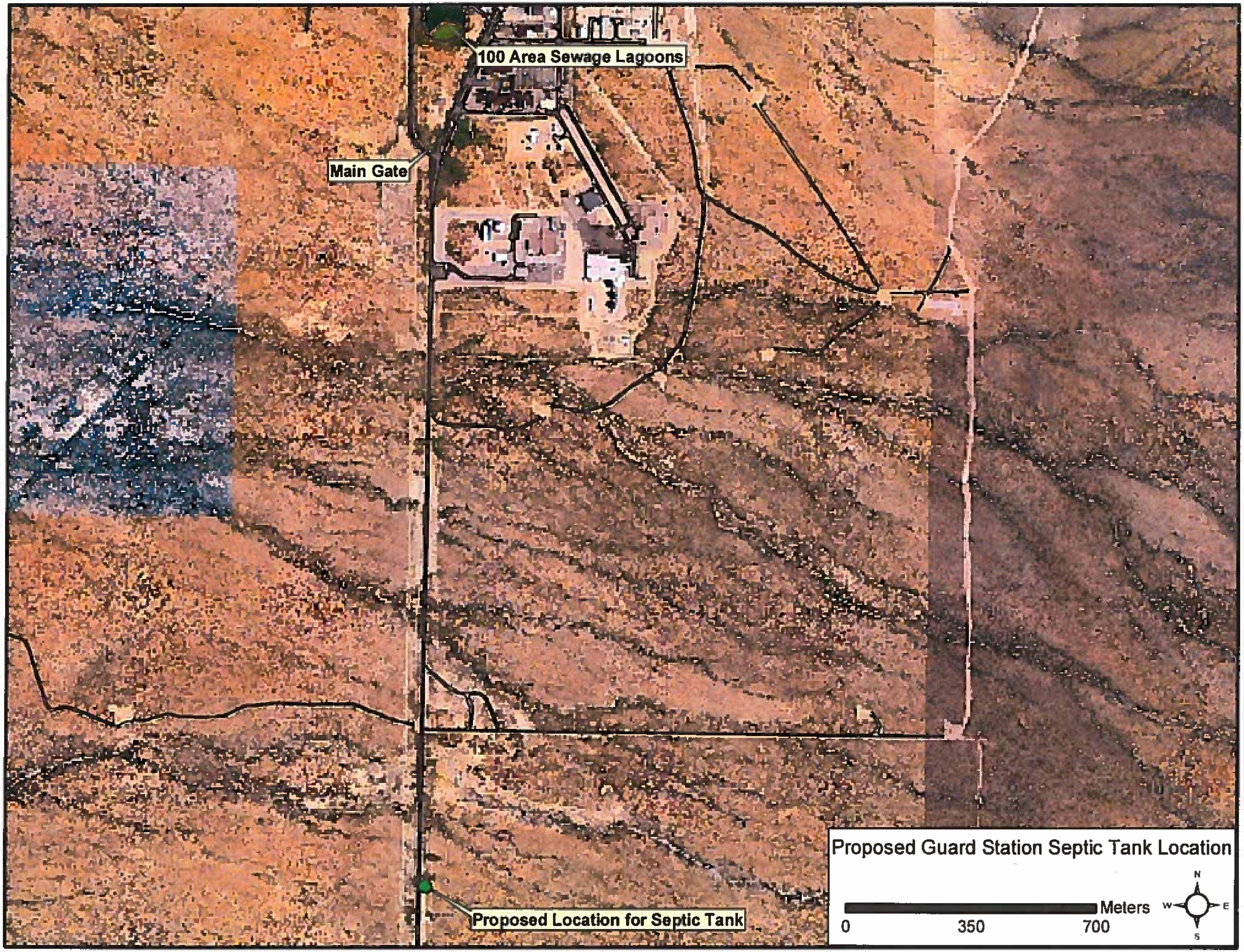
#20

#20


24" MIN TOC
3
BOND TO GENERATOR PAD'S GROUND COUNTERPOISE SYSTEM
AM
TUG
TUG
X
FO
TRACT
2
W
TUG
7
B
PAD MOUNTED TRANSFORMER BY EPECO
1
9
69KV
PP 45
(14-8)
3
6
DRAIN FIELD
4
4" SDR35
SS
FRONT OF GENERATOR
EUG
APPROXIMATE LOCATION OF THE GENERATOR AND CONCRETE PAD DETAIL ON SHEET 10. SEE COU SYSTEM ON SHEET 24.
PANEL "LM"
ANEL "LE"
PANEL "M"
GUARD BUILDING
234
235
236
LM 29, 31
13
LM 25, 27
LM 33, 35
10
LM 41, 42
12
LM 21, 23
LM 37, 39
22

#20


WHITE SANDS SPACE HARBOR
ALAMOGORDO
NORTH
WHITE SANDS NATIONAL MONUMENT
HOLLOMAN AFB
SAN ANDRES NATIONAL WILDLIFE REFUGE
ORNADA ERIMENTAL RANGE
NASA WSTF GSFC
PROJECT LOCATION
SAN ANDRES MOUNTAINS
WHITE SANDS MISSILE RANGE
ORGAN
ORGAN MOUNTAINS
DONA ANA COUNTY
OTERO COUNTY
FRANKLIN MOUNTAINS
NEW MEXICO
OTERO COUNTY
EL PASO COUNTY
EL PASO TEXAS
FORT BLISS
BIGGS AFB
EL PASO INTERNATIONAL AIRPORT
TEXAS


100 Area Sewage Lagoons
Main Gate
Proposed Location for Septic Tank
Proposed Guard Station Septic Tank Location
Meters
0
350
700
N
W
E
S

State of New Mexico
ENVIRONMENT DEPARTMENT
Ground Water Quality Bureau
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502-6110
Telephone (505) 827-2918
Fax (505) 827-2965

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

FAX TRANSMISSION

DATE: May 12, 2006 **PAGES, incl. cover** 5
TO: Timothy Davis
COMPANY: NASA JSC White Sands Test Facility
FAX: (505) 524-5798
PHONE: (505) 524-5024

FROM: Christina Kelso, Environmental Scientist CK
FAX: (505) 827-2965
PHONE: (505) 827-2782

COMMENTS: Attached are copies of the Temporary Permission letters the New Mexico Environment Department Ground Water Quality Bureau issued to NASA today to discharge air conditioning condenser cooler water at the Second Tracking and Data Relay Station Ground Terminal (DP-584), and to install and discharge from a septic tank leachfield at the 100, 200 and 600 Areas (DP-392). If you have any questions, let me know. The invoices will be sent under separate cover.

State of New Mexico
ENVIRONMENT DEPARTMENT
Ground Water Quality Bureau
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502-6110
Telephone (505) 827-2918
Fax (505) 827-2965

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

May 12, 2006

Radel Bunker-Farrah, Environmental Program Manager
NASA JSC White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

RE: Temporary Permission to Install and Discharge from a Septic Tank Leachfield, NASA - White Sands Test Facility, 100, 200, and 600 Areas, DP-392

Dear Ms. Bunker-Farrah:

The New Mexico Environment Department has reviewed your request, dated April 6, 2006, to discharge up to 80 gallons per day of domestic wastewater to a new septic tank leachfield system that will be installed at a new guard station. The guard station will be located approximately 1.3 miles south from the 100 Area main gate. The system consists of a 900-gallon septic tank and 231.6 square foot leachfield. The 100, 200, and 600 Areas domestic wastewater lagoons are permitted under Discharge Permit DP-392. Ground water beneath the site is at a depth of approximately 175 feet and has a total dissolved solids concentrations of approximately 600 milligrams per liter. The proposed discharge location is approximately 12 miles northeast from Las Cruces in Section 14, T21S, R3E, Dona Ana County.

Temporary permission to discharge is hereby granted pursuant to Section 20.6.2.3106.B NMAC for the above referenced discharge for 120 days from the date of this letter. This approval is contingent on your discharging as described in your April 6, 2006 request and upon the following condition:

1. Submit an application to renew and modify DP-392 to include all septic tank leachfields located at the 100, 200, and 600 Areas into the Discharge Permit.

This approval does not relieve you of your responsibility to comply with any other applicable federal, state, and/or local laws and regulations, such as zoning requirements and nuisance ordinances. Also, this approval does not relieve you of liability should your operation result in actual pollution of surface or ground waters.

If you have any questions, please contact Christina Kelso of the Ground Water Pollution Prevention Section at (505) 827-2782.

Sincerely,

George Schuman for W. Olson

William C. Olson, Chief
Ground Water Quality Bureau

WO:CK/ck

cc: Ken Smith, District Manager, NMED District 3
NMED Las Cruces Field Office
Dave Cobrain, NMED HWB
Timothy Davis, Environmental Scientist, NASA JSC White Sands Test Facility, P.O. Box 20, Las Cruces, NM 88004-0020

National Aeronautics and
Space Administration
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

May 31, 2017

Reply to Attn of: RE-17-063

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: Application for Liquid Waste System Registration

NASA is requesting to register an existing septic tank located at the White Sands Test Facility (WSTF) by filing the application provided in Enclosure 1. The septic tank was installed in 2006 during construction of a forward guard gate at WSTF (Building 117). A map identifying the location of the Building 117 septic tank is provided in Enclosure 2. The tank and leach field were constructed in accordance with an application (Enclosure 3) approved by the NMED Groundwater Quality Bureau (GWQB) on May 12, 2006 for temporary permission to install and discharge from the tank (Enclosure 4). NASA complied with the NMED GWQB condition of approval by filing an application to renew and modify Discharge Plan (DP)-392 to include septic tank leach fields in the 100, 200, and 600 Areas. The application was submitted to the NMED GWQB on November 20, 2006, and identified the required septic tanks, including the Building 117 tank, and the six existing wastewater impoundments already permitted under DP-392. No final action was taken on the application because NASA began planning to divert wastewater discharged to the lagoons and most septic tanks to the City of Las Cruces wastewater treatment system. Construction of an on-site sanitary sewer system was completed, and NASA started diverting wastewater effluent to the City of Las Cruces wastewater treatment system on July 9, 2015.

NASA initiated closure of the six lagoon cells associated with DP-392 after connection to the City of Las Cruces wastewater treatment system was completed and discharges to the wastewater lagoons ceased. NASA also began decommissioning and removing septic tanks located throughout the facility, as identified in the WSTF Septic Tanks Investigation Work Plan and Removal Plan. The location of these tanks, their removal status, and LWP permit number (if applicable) are identified in the provided location map (Enclosure 2). The WSTF Septic Tanks Investigation Work Plan and Removal Plan was acknowledged as received by the NMED Liquid Waste Program (LWP) through a letter dated December 5, 2013. NASA has submitted the required Onsite Liquid Waste System Abandonment forms for the tanks that have been removed, and is currently planning the removal of the remaining three decommissioned septic tanks.

The majority of wastewater flow at the facility has been diverted to the City of Las Cruces wastewater treatment system, with the exception of wastewater from WSTF Buildings 114/119 and WSTF Building 117. It was not practical to connect these buildings to the on-site sanitary sewer system. A new septic tank was installed at Buildings 114/119 on September 10, 2013, in accordance with NMED LWP permit number DA130309. NASA is requesting to register the septic tank at Building 117 to ensure discharges from this tank are recognized under a NMED LWP permit once DP-392 is terminated.

Please contact Amanda Skarsgard, Environmental Project Manager, at 575-524-5460 if you have any questions concerning this submittal.

Sincerely,

for

Timothy J. Davis
Chief, Environmental Office

John J. Villegas
Chief, Facility Engineering Office

4 Enclosures

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

July 5, 2017

Reply to Attn of: RE-17-078

New Mexico Environment Department
Las Cruces Field Office
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: Liquid Waste Permit Application Fee for the NASA White Sands Test Facility – Permit Number 2090

Enclosure 1 contains NMED Liquid Waste Program Invoice Number 1008993 dated June 8, 2017 requesting payment of the application fee for liquid waste permit number 2090. Check #44977 in the amount of one hundred and fifty dollars ($150.00) is provided in Enclosure 2.

If you have any questions or comments, please contact Amanda Skarsgard of my staff at 575-524-5460.

Amanda Skarsgard for

Timothy J. Davis
Chief, Environmental Office

2 Enclosures

New Mexico Environment Department Environmental Health Bureau

Inspection Report

LWP 002090

A. Basic Information

Site Name: NASA WSTF Permit #: ~~AP-330~~ DP-392

Site address/County: Dona Ana

Responsible Party: JR Hennesey

B. System Documentation

Design flow: 80 Gallons per day

Advanced treatment system

Describe system: ______

Risers/lids? Yes ___ No ___ Are lids secure? Yes ___ No ___ Signs? Yes ___ No ___ Fencing? Yes ___ No ___

Describe the disposal system: ______

Conventional Septic Tanks

Number of tanks: 1 Series: Yes No Parallel: Yes No 900 gal

Are there risers/lids? Yes ✓ No ___ Are risers secure? Yes ✓ No ___

Describe the disposal system: Chamber System

GPS of tank: N 32 29.054 W 106 36. 855 elev. 4760

Holding Tanks

Number of tanks: ______ Series: Yes No Parallel: Yes No

Are there risers/lids? Yes ___ No ___ Are lids secure? Yes ___ No ___ High water alarm? Yes ___ No ___

Impoundments (Lagoons)

Signs? Yes ___ No ___ Fencing? Yes ___ No ___ Number of lagoons: ______

Approximate freeboard: ______ Type of liner: ______

Condition of liner: ______

C. Other Information (If Applicable)

1. Lift station: Yes No
2. Surge Tank/Timer Dosed System: Yes No
3. Water supply well present: Yes No Appear to meet setback requirements: Yes No
4. Water supply meter present? Yes No

   Location: ______

   Meter reading during time of inspection: ______

   Collect sample and test for nitrate
5. Effluent water meter present? Yes No

   Location: ______

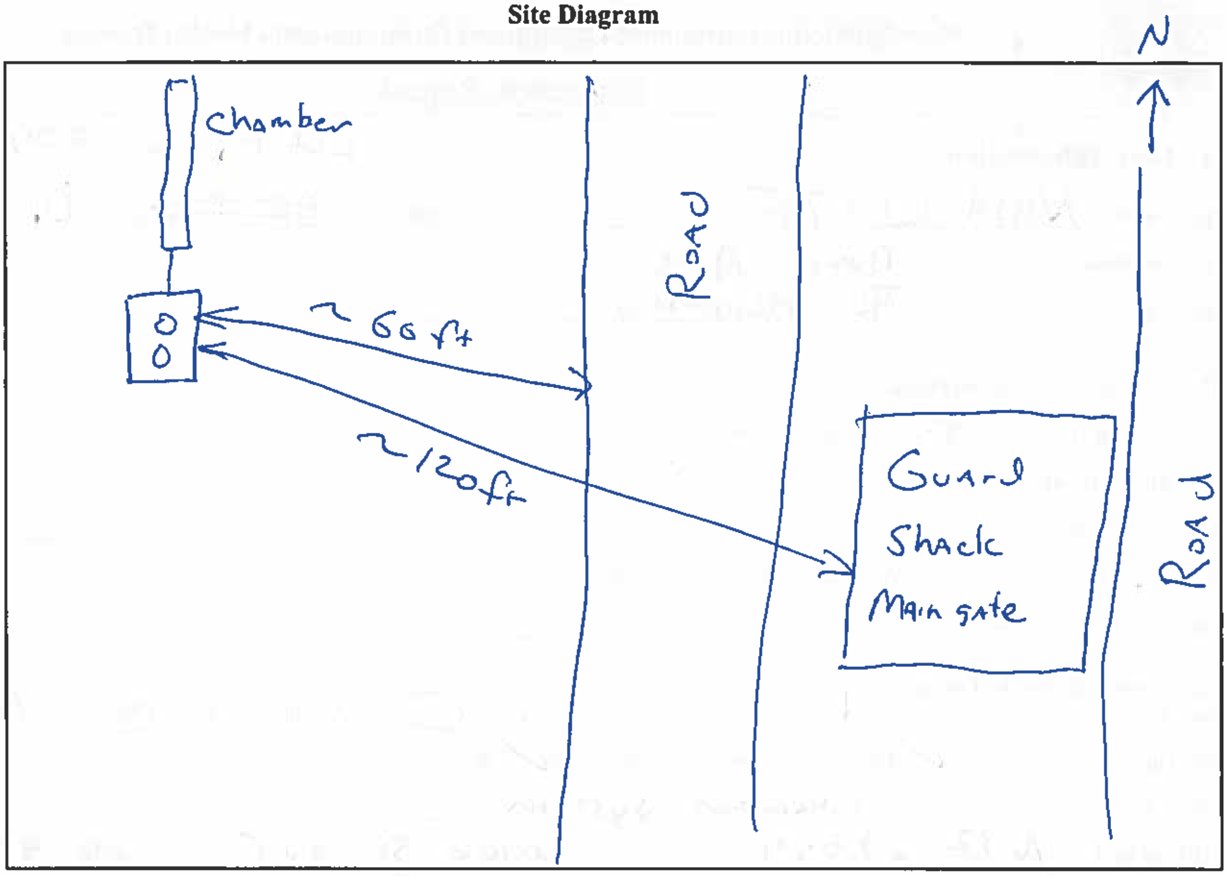
   Meter reading during time of inspection: ______
6. Monitoring Well(s) Present? Yes No

   Location from source component: ______

   Location from source component: ______

   Location from source component: ______

Site Diagram



D. Operational Status

1. Does site diagram match site plan as described on permit? Yes No

2. Does the system appear to be functioning and as described on permit? Yes No

3. Power is on to all components and electrical components appear to be functional? Yes No

4. System un-locatable, but appears to be functional? Yes No

5. Evidence of failure or previous failure? Yes No

E. NMED Evaluator

Inspector Name: Michael Montoya
Signature: [signature]
Date: 6/21/17

Final Approval

[✓] Granted

[ ] Granted with conditions (See Below)

[ ] Not Granted

Comments/Conditions: ______

NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH BUREAU

2301 Entrada Del Sol
Las Cruces, NM 88001
Phone (575) 288-2050 Fax (575) 526-6162
www.env.nm.gov

SUSANA MARTINEZ
Governor

JOHN SANCHEZ
Lt. Governor

BUTCH TONGATE
Secretary

J.C. BORREGO
Deputy Secretary

July 10, 2017

National Aeronotical and Space Administration (NASA)
NASA JSC-WSTF, ATTN: Timothy Davis, Environmental Office PO Box 20
Las Cruces, NM 88004

Subject: Notice of Action Taken, Permit #002090 has been *Granted* for the on-going Operation of the Liquid Waste Treatment & Disposal System (Septic System)

Dear National Aeronotical and Space Administration (NASA),

Your septic system has received final approval to Operate by the New Mexico Environment Department's (NMED's) Environmental Health Bureau. This is a permit for the ongoing operation of the septic system as described in your liquid waste permit application. Please review the following requirements:

Standard Requirements for Operating Your Liquid Waste System

1. The system owner is responsible for regular maintenance of their liquid waste system. This includes regular pumping of the septic tank to remove the build-up of solids, fats, oils and grease. The EPA recommends that you have your septic system inspected at least every 3 years by a professional and have your tank pumped every 3 to 5 years. The frequency of pumping may increase depending upon the number of people living in the home, water used and the amount of solids.
2. There is an effluent filter on your septic tank which keeps solids in your septic tank. Without this filter, solids will end up in your disposal system and decrease the life of your disposal system by causing clogging and premature failure. This filter will need to be cleaned regularly. It is recommended that you clean this filter semi-annually, but more often if needed.
3. What goes down your drain can have a major impact on how well your septic system works. Do not put the following down your drain because they can clog your system: Dental floss, feminine hygiene products, condoms, diapers, cotton swabs, cigarette butts, coffee grounds, cat litter, paper towels and flushable wipes. Household chemicals, gasoline, oil, pesticides, antifreeze, and paint can stress or destroy the biological treatment taking place in the system or might contaminate surface waters or groundwater.
4. Know the location of your septic tank and disposal system. Do not drive or park over any part of your system. Compaction of the soil above your disposal system will inhibit oxygen transfer to the bacteria that are treating your wastewater.
5. If you plan on adding a bedroom or a guest house to this system, you must submit a

modification permit to your local field office. If you plan on sub-dividing your lot, you should contact your local field office to determine whether you need to submit a modification permit or whether you can amend your permit.

6. Plant only grass over and near your septic disposal system and avoid over-irragtion of this area as damage and over-saturation may result. Roots from nearby trees or shrubs may clog or damage your disposal system. Plant choice is an important consideration to avoid root intrusion or damage to your liquid waste system.

7. Keep roof drains, basement sump pump drains, and other rainwater away from your disposal field. Flooding the disposal field with excessive water slows down or stops treatment processes and can cause plumbing fixtures to back up. Be aware that leaky toilets can lead to over-saturation and failure of your disposal system.

8. If you are a homeowner, you may occasionally empty waste from one personal RV into the on-site liquid waste system serving the residence, provided that the RV is not used as a permanent living quarters. The hose must be disconnected after discharge.

9. Prior to the transfer of a property with an established on-site liquid waste system, the property owner is required to have the system evaluated by a qualified Third Party Evaluator.

10. If you permit to Operate was "Granted with Conditions" you will receive a separate Permit Conditions Letter.

If you have any questions or comments, you may contact me at the address and telephone number stated above.

Sincerely,

Michael Montoya, Environmental Health Inspector
Environmental Health Bureau
New Mexico Environment Department

New Mexico Environment Department
Environmental Health Bureau

On-site Liquid Waste System

Permit to Operate

Owner Name: National Aeronotical and Space Administration (NASA)

Installer Name: Johnny's Septic Tank Co., Inc.

System Location:

System Type: Commercial

Permit Number: 002090

The New Mexico Environment Department may cancel this permit for failure to meet any of the following: failure to complete the system within one year, for providing inaccurate or incomplete information, or failure to notify NMED to schedule an inspection within a minimum of 2 working days prior to the inspection.

Date Issued: June 21, 2017

Authorizing Official
NMED

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

August 8, 2017

Reply to Attn of: RE-17-098

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms

Enclosed are the On-Site Liquid Waste System Abandonment Forms for septic tanks formerly located near White Sands Test Facility (WSTF) Building 116, Buildings 802/803, and the Second Tracking and Data Relay Satellite System Ground Terminal (STGT) guard station. These septic tanks were removed in accordance with the WSTF Septic Tanks Removal Plan during June and July 2017. The Building 116 tank was removed on July 17, 2017, the Buildings 802/803 tank was removed on June 21, 2017, and the STGT guard station tank was removed on July 19, 2017. The sewer service lines for Buildings 802/803 and the STGT guard station were rerouted to the WSTF sanitary sewer system, while the building sewer line to Building 116 was capped. The tank excavations were backfilled with clean fill. NASA also requests cancellation of associated Liquid Waste Permits LC 870401 (Buildings 802/803) and LC 890939 (STGT guard station). The Building 116 septic tank was installed in 1966 and was never permitted.

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

FOR

Timothy J. Davis
Chief, Environmental Office

Enclosure (3)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (Building 116 Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

No ~~Connected to Sewer Lines~~ or Plugged/Capped based on UPC Requirements

ON-SITE LIQUID WASTE SYSTEM TYPE:

[X] Septic Tank	[ ] Sec./Tert. Treatment Unit	[ ] Holding Tank
[ ] Seepage Pit	[ ] Other:	[ ] Cesspool

ABANDONMENT PROCEDURE:

Yes	System Pumped
N/A	Bottom of System Opened or Ruptured or Unit Collapsed
N/A	System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A	Top Cover Removed or Collapsed
N/A	System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A	System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The Building 116 septic tank was installed in 1966 during WSTF site construction. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on July 17, 2017. The building sewer line was capped.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

[ ] Granted [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 870401 (Blds. 802/803 Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The Building 803 septic tank was installed in 1987. The tank was removed
in accordance with the WSTF Septic Tanks Removal Plan on June 21, 2017.
The building sewer line was connected to the WSTF sanitary sewer system.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 890939 (STGT Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road

Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Sec./Tert. Treatment Unit
- [ ] Holding Tank
- [ ] Seepage Pit
- [ ] Other:
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The STGT guard shack septic tank was installed in 1989. The tank was removed
in accordance with the WSTF Septic Tanks Removal Plan on July 19, 2017.
The building sewer line was connected to the WSTF sanitary sewer system.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road

Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

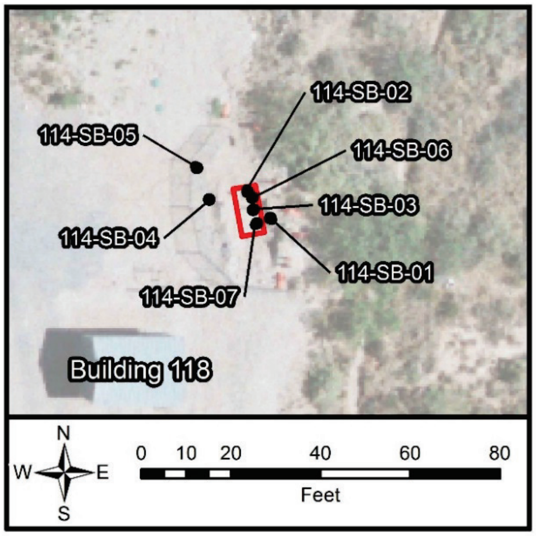
- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

Appendix C
Lithologic Logs

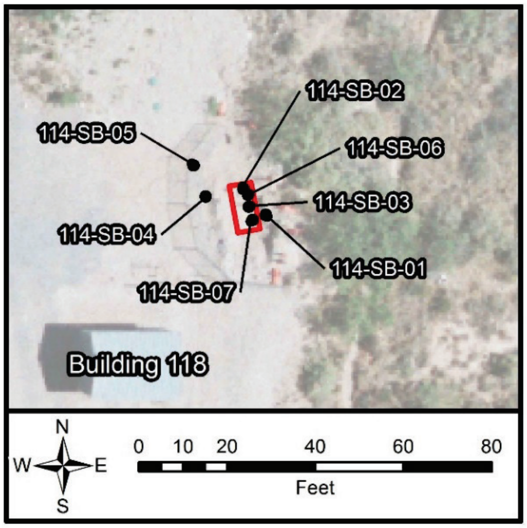
SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-01
SITE COORDINATES (ft.) N: 549392.072 **E:** 1529462.222
GROUND ELEVATION (ft. MSL): 4774.617
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 04/18/2017 - 04/19/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 12 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	5	7	16-27-29-22	100	Soil Chemical	1704191035 1704191036	ML	Color is pink 7.5 YR 7/4 (dry). Grains are subrounded sandy silt with gravel. Almost all clasts are marble or limestone with minimal quartzite. Large color variation between the top of the sample and the bottom of the sample.
15	N/A	10	12	102-106-54-60	70	Soil Chemical	1704191050 1704191051 1704191052 1704191053	SW	10' to 11' is light brown. Color is light brown 7.5 YR 6/3 bottom of sample is light grey, 7.5 YR 7/1. Well graded sand with gravel. Subangular clasts. 90% quartzite concentrated in the 11' to 12' section.
20									

SOIL BORING LITHOLOGIC LOG



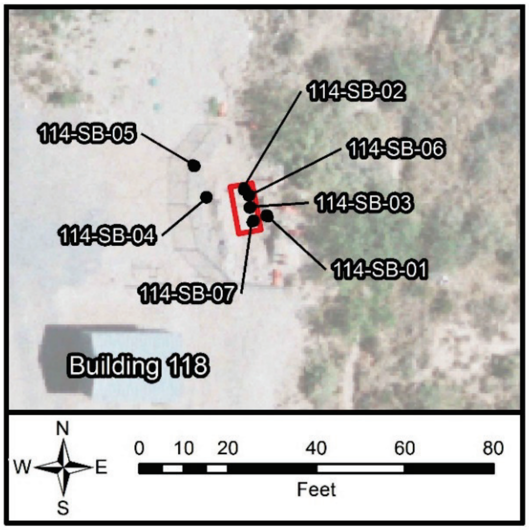
SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-02
SITE COORDINATES (ft.) N: 549398.445 **E:** 1529457.245
GROUND ELEVATION (ft. MSL): 4773.68
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 04/18/2017 - 04/19/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 27 ft.
COMMENTS:

DEPTH (ft. bgs)	PID	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
	(ppm)	Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	6	8	3-24 110-82	100	Soil Chemical	1704190835 1704190836	SW	Color is pinkish white 7.5 YR 7/2 (dry). Grains are subangular to subrounded. Well graded sand with gravel. 10% cemented alluvium, 50% limestone and marble with calcite precipitate.
15	N/A	10	12	21-19- 22-41	100	Soil Chemical	1704190845 1704190846	SW	Color is pink, 7.5 YR 7/3 (dry). Grains are angular to subangular. Well graded sand with gravel. Mix of limestone and quartzite with small amounts of marble.

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
20	N/A	15	17	28-45 -32-22	100	Soil Chemical	1704190855 1704190856	SW	Color is pink, 7.5 YR 7/4 (dry). Grains are angular to subangular . Well graded sand with gravel. Mix of marble, limestone and quartzite with calcite precipitation.
20 25	N/A	20	22	51-100-Augered	100	Soil Chemical	1704190915 1704190916	GW	Color is pink, 7.5 YR 7/4 (dry). Grains are angular. Wel graded gravel with sand. About 80% of the large gravel pieces are quartzite. More than likely drilled through a large cobble of quartzite.
30	N/A	25	27	22-24-26-22	100	Soil Chemical	1704190935 1704190936 1704190937 1704190938	ML	Color is reddish yellow 7.5 YR 6/6 (dry). Grains are subrounded. Sandy silt with gravel. Mostly clumps of silt and sand with some limestone.

NOTE: == indicates split-spoon refusal

SOIL BORING LITHOLOGIC LOG



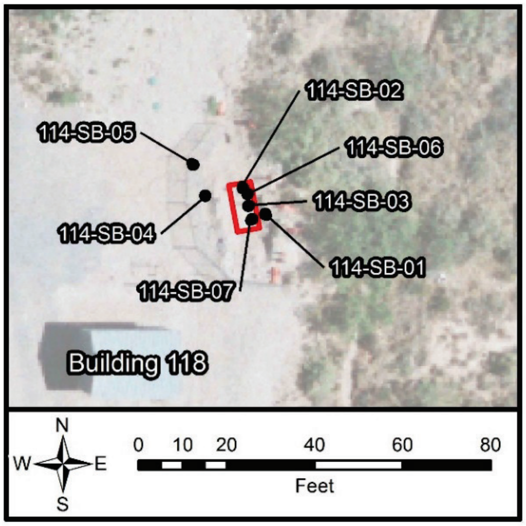
SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-03
SITE COORDINATES (ft.) N: 549394.007 **E:** 1529458.349
GROUND ELEVATION (ft. MSL): 4773.982
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 04/18/2017 – 04/19/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 27 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	5	7	5-3-2-3	100	Soil Chemical	1704181435 1704181436 1704181437 1704181438	SW	Color is pale brown 10 YR 6/3 (dry). Grains are subangular. Well graded sand with gravel. About 50% marble and 30% quartzite.
15	N/A	10	12	18-27-29-32	100	Soil Chemical	1704181450 1704181451	SW	Color is light yellowish brown 10 YR 6/4 (dry). Grains are subangular to angular. Well graded sand with gravel. About 50% limestone and 40% quartzite.

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
20	N/A	15	17	20-18-37-100	100	Soil Chemical	1704181500 1704181501	SW	Color is light brown 7.5 YR 6/4 (dry). Grains are subangular to subrounded. Well graded sand with gravel. About 35% limestone with calcite precipitation and 20% quartzite.
20 25	N/A	20	22	9-58-70-83	100	Soil Chemical	1704190740 1704190741	GW	Color is light brown 7.5 YR 6/4 (dry). Grains are subrounded. Well graded gravel with sand. 70% limestone and marble with calcite precipitation.
30	N/A	25	27	11-32-38-35	100	Soil Chemical	1704190750 1704190751	SW	Color is light yellowish brown, 10 YR 6/4 (dry). Grains are subrounded. Well graded sand with gravel. About 40% quartzite and 40% limestone and marble.

NOTE: == indicates split-spoon refusal

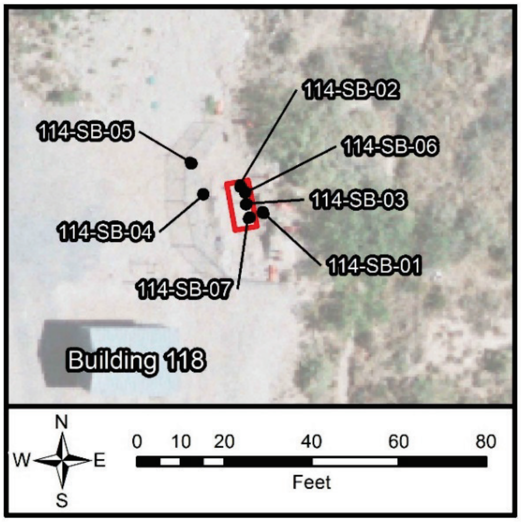
SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-04
SITE COORDINATES (ft.) N: 549397.541 **E:** 1529447.934
GROUND ELEVATION (ft. MSL): 4773.478
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 04/18/2017 – 04/19/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 12 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE: Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	SOIL SAMPLE: TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	LITHOLOGIC DESCRIPTION: USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0–5									
5–10	N/A	5	7	12-14-40-26	100	Soil Chemical	1704181335 1704181336	SW	Color is brown, 7.5 YR 5/4 (damp). Grains are subangular to subrounded. Well graded sand. About 60% marble and limestone with calcite precipitation. Minimal amounts of quartzite.
10–15	N/A	10	12	23-21-49-86	100	Soil Chemical	1704181350 1704181351	SW	Color is pink, 7.5 YR 7/3 (dry). Grains are angular. Well graded sand with gravel. Abour 70% marble with calcite precipitation.
15–20									

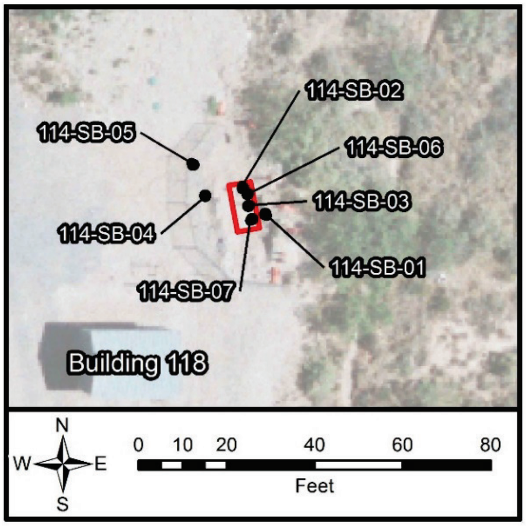
SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-05
SITE COORDINATES (ft.) N: 549405.09 **E:** 1529447.145
GROUND ELEVATION (ft. MSL): 4773.2
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 04/18/2017 – 04/19/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 12 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	5	7	36-52-44-38	100	Soil Chemical	1704181300 1704181301	SW	Color is pink 7.5 YR 7/3 (dry). Grains are subangular to subrounded. Well graded sand with gravel. About 50 % limestone with quartzite and marble.
15	N/A	10	12	36-52-44-38	100	Soil Chemical	1704181313 1704181314	SW	Color is pinkish white 7.5 YR 8/2 (dry). Grains are subangular. Well graded sand with gavel. About 40% marble and limestone, 40% quartzite, with some granite
20									

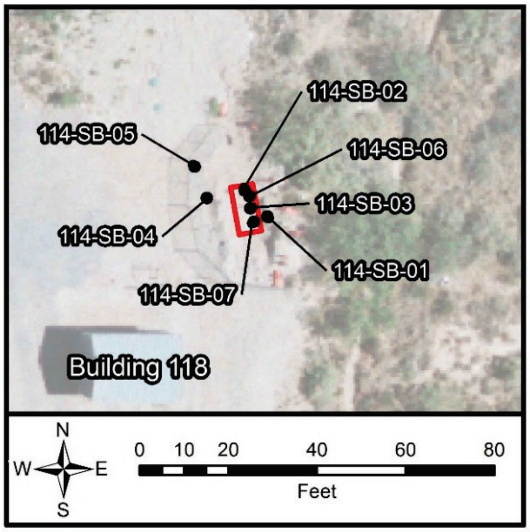
SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-06
SITE COORDINATES (ft.) **N:** 549396.914 **E:** 1529458.117
GROUND ELEVATION (ft. MSL): 4773.896
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 10/31/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 9 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE: Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	SOIL SAMPLE: TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	LITHOLOGIC DESCRIPTION: USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 – 5									
10	N/A	7	9	13-10-16-7	100	Soil Chemical	1710310955 1710310956	SW	Color is light brown, 7.5 YR 6/4. Well graded sand with gravel. Clasts are angular to subangular. Clasts are all dark limestone with caliche precipitate, no other rock types are visible.
15									
20									

SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-07
SITE COORDINATES (ft.) N: 549391.896 **E:** 1529459.237
GROUND ELEVATION (ft. MSL): 4774.07
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 10-31-2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 9 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 – 5									
10	N/A	7	9	50-46-30-17	80	Soil Chemical	1710310900 1710310901	SW	Color is light brown 7.5 YR 6/4 (damp). Well graded gravel with sand. Clasts are angular to subangular dark limestone. About 80% of the clasts have caliche precipitate. Smaller amounts of quartzite and rhyolite are visible.
15									
20									

Appendix D
Analytical Reports

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

May 31, 2017

Carlyn Tufts
NASA_WSTF
P.O. Box 20
Las Cruces, NM 88004
TEL: (575) 524-5452
FAX

RE: 16EC053B

OrderNo.: 1704970

Dear Carlyn Tufts:

Hall Environmental Analysis Laboratory received 40 sample(s) on 4/21/2017 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704180700
Project: 16EC053B **Collection Date:** 4/18/2017 7:00:00 AM
Lab ID: 1704970-001 **Matrix:** AQUEOUS **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7470: MERCURY						Analyst: **MED**	
Mercury	ND	0.00020		mg/L	1	5/2/2017 1:32:54 PM	31514
EPA 6010B: TOTAL RECOVERABLE METALS						Analyst: **MED**	
Arsenic	ND	0.020		mg/L	1	5/2/2017 9:25:54 AM	31501
Barium	0.0054	0.020	J	mg/L	1	5/2/2017 9:25:54 AM	31501
Cadmium	ND	0.0020		mg/L	1	5/2/2017 9:25:54 AM	31501
Chromium	0.0035	0.0060	J	mg/L	1	5/2/2017 9:25:54 AM	31501
Lead	ND	0.0050		mg/L	1	5/2/2017 9:25:54 AM	31501
Selenium	ND	0.050		mg/L	1	5/2/2017 9:25:54 AM	31501
Silver	ND	0.0050		mg/L	1	5/2/2017 9:25:54 AM	31501

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704190720
Project: 16EC053B **Collection Date:** 4/19/2017 7:20:00 AM
Lab ID: 1704970-003 **Matrix:** AQUEOUS **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7470: MERCURY							Analyst: **MED**
Mercury	ND	0.00020		mg/L	1	5/2/2017 1:34:51 PM	31514
EPA 6010B: TOTAL RECOVERABLE METALS							Analyst: **MED**
Arsenic	ND	0.020		mg/L	1	5/2/2017 9:27:40 AM	31501
Barium	0.00082	0.020	J	mg/L	1	5/2/2017 9:27:40 AM	31501
Cadmium	ND	0.0020		mg/L	1	5/2/2017 9:27:40 AM	31501
Chromium	ND	0.0060		mg/L	1	5/2/2017 9:27:40 AM	31501
Lead	ND	0.0050		mg/L	1	5/2/2017 9:27:40 AM	31501
Selenium	ND	0.050		mg/L	1	5/2/2017 9:27:40 AM	31501
Silver	ND	0.0050		mg/L	1	5/2/2017 9:27:40 AM	31501

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-005
Matrix: SOIL
Client Sample ID: 1704181435
Collection Date: 4/18/2017 2:35:00 PM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	0.047	0.031		mg/Kg	1	4/28/2017 11:18:15 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	4.8	2.5		mg/Kg	1	4/26/2017 9:21:50 AM	31405
Barium	73	0.099		mg/Kg	1	4/26/2017 9:21:50 AM	31405
Cadmium	0.64	0.099		mg/Kg	1	4/26/2017 9:21:50 AM	31405
Chromium	12	0.30		mg/Kg	1	4/26/2017 9:21:50 AM	31405
Lead	4.0	0.24		mg/Kg	1	5/1/2017 9:24:13 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:00:10 AM	31405
Silver	0.29	0.25		mg/Kg	1	4/26/2017 9:21:50 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704181437
Project: 16EC053B | **Collection Date:** 4/18/2017 2:37:00 PM
Lab ID: 1704970-007 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	0.041	0.031		mg/Kg	1	4/28/2017 11:19:59 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	5.3	2.4		mg/Kg	1	4/26/2017 9:23:19 AM	31405
Barium	64	0.098		mg/Kg	1	4/26/2017 9:23:19 AM	31405
Cadmium	0.54	0.098		mg/Kg	1	4/26/2017 9:23:19 AM	31405
Chromium	7.9	0.29		mg/Kg	1	4/26/2017 9:23:19 AM	31405
Lead	4.2	0.24		mg/Kg	1	5/1/2017 9:25:26 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:01:34 AM	31405
Silver	0.11	0.24	J	mg/Kg	1	4/26/2017 9:23:19 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704181450
Project: 16EC053B | **Collection Date:** 4/18/2017 2:50:00 PM
Lab ID: 1704970-009 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.031		mg/Kg	1	4/28/2017 11:25:18 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	3.8	5.0	J	mg/Kg	2	4/26/2017 10:07:05 AM	31405
Barium	61	0.20		mg/Kg	2	4/26/2017 10:07:05 AM	31405
Cadmium	ND	0.20		mg/Kg	2	4/26/2017 10:07:05 AM	31405
Chromium	9.0	0.59		mg/Kg	2	4/26/2017 10:07:05 AM	31405
Lead	3.5	1.2		mg/Kg	5	5/1/2017 10:02:18 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:07:05 AM	31405
Silver	ND	0.50		mg/Kg	2	4/26/2017 10:07:05 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **5/31/2017**

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-011
Matrix: SOIL
Client Sample ID: 1704181500
Collection Date: 4/18/2017 3:00:00 PM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.032		mg/Kg	1	4/28/2017 11:27:03 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	7.0	2.5		mg/Kg	1	4/26/2017 9:27:28 AM	31405
Barium	46	0.10		mg/Kg	1	4/26/2017 9:27:28 AM	31405
Cadmium	0.13	0.10		mg/Kg	1	4/26/2017 9:27:28 AM	31405
Chromium	8.5	0.30		mg/Kg	1	4/26/2017 9:27:28 AM	31405
Lead	2.2	0.25		mg/Kg	1	5/1/2017 9:27:55 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:08:26 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:27:28 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-013
Matrix: SOIL
Client Sample ID: 1704181335
Collection Date: 4/18/2017 1:35:00 PM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	0.011	0.031	J	mg/Kg	1	4/28/2017 11:28:49 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	5.4	2.5		mg/Kg	1	4/26/2017 9:28:49 AM	31405
Barium	81	0.10		mg/Kg	1	4/26/2017 9:28:49 AM	31405
Cadmium	ND	0.10		mg/Kg	1	4/26/2017 9:28:49 AM	31405
Chromium	5.7	0.30		mg/Kg	1	4/26/2017 9:28:49 AM	31405
Lead	3.8	0.25		mg/Kg	1	5/1/2017 9:29:10 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:09:50 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:28:49 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704181350
Project: 16EC053B | **Collection Date:** 4/18/2017 1:50:00 PM
Lab ID: 1704970-015 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst: **ELS**	
Mercury	ND	0.033		mg/Kg	1	4/28/2017 11:30:35 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst: **MED**	
Arsenic	6.1	2.4		mg/Kg	1	4/26/2017 9:35:33 AM	31405
Barium	120	0.097		mg/Kg	1	4/26/2017 9:35:33 AM	31405
Cadmium	ND	0.097		mg/Kg	1	4/26/2017 9:35:33 AM	31405
Chromium	8.6	0.29		mg/Kg	1	4/26/2017 9:35:33 AM	31405
Lead	5.6	1.2		mg/Kg	5	5/1/2017 10:06:00 AM	31469
Selenium	ND	4.8		mg/Kg	2	4/26/2017 10:38:07 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:35:33 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704181300
Project: 16EC053B **Collection Date:** 4/18/2017 1:00:00 PM
Lab ID: 1704970-017 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.031		mg/Kg	1	4/28/2017 11:32:21 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	9.9	2.5		mg/Kg	1	4/26/2017 9:36:53 AM	31405
Barium	53	0.099		mg/Kg	1	4/26/2017 9:36:53 AM	31405
Cadmium	ND	0.099		mg/Kg	1	4/26/2017 9:36:53 AM	31405
Chromium	19	0.30		mg/Kg	1	4/26/2017 9:36:53 AM	31405
Lead	1.3	0.25		mg/Kg	1	5/1/2017 9:31:39 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:18:07 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:36:53 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-019 **Matrix:** SOIL

Client Sample ID: 1704181313
Collection Date: 4/18/2017 1:13:00 PM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.033		mg/Kg	1	4/28/2017 11:34:09 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	7.3	2.5		mg/Kg	1	4/26/2017 9:38:14 AM	31405
Barium	40	0.098		mg/Kg	1	4/26/2017 9:38:14 AM	31405
Cadmium	ND	0.098		mg/Kg	1	4/26/2017 9:38:14 AM	31405
Chromium	6.4	0.30		mg/Kg	1	4/26/2017 9:38:14 AM	31405
Lead	3.1	0.24		mg/Kg	1	5/1/2017 9:32:52 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:19:28 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:38:14 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-021 **Matrix:** SOIL

Client Sample ID: 1704191035
Collection Date: 4/19/2017 10:35:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	0.0069	0.033	J	mg/Kg	1	4/28/2017 11:35:48 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	6.1	2.4		mg/Kg	1	4/26/2017 9:39:36 AM	31405
Barium	110	0.098		mg/Kg	1	4/26/2017 9:39:36 AM	31405
Cadmium	0.14	0.098		mg/Kg	1	4/26/2017 9:39:36 AM	31405
Chromium	11	0.29		mg/Kg	1	4/26/2017 9:39:36 AM	31405
Lead	1.5	0.24		mg/Kg	1	5/1/2017 9:37:50 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:20:49 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:39:36 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-023
Matrix: SOIL
Client Sample ID: 1704191050
Collection Date: 4/19/2017 10:50:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.032		mg/Kg	1	4/28/2017 11:37:29 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	14	2.4		mg/Kg	1	4/26/2017 9:40:59 AM	31405
Barium	30	0.096		mg/Kg	1	4/26/2017 9:40:59 AM	31405
Cadmium	0.18	0.096		mg/Kg	1	4/26/2017 9:40:59 AM	31405
Chromium	5.5	0.29		mg/Kg	1	4/26/2017 9:40:59 AM	31405
Lead	2.4	0.25		mg/Kg	1	5/1/2017 9:39:04 AM	31469
Selenium	ND	4.8		mg/Kg	2	4/26/2017 10:22:11 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:40:59 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-025
Matrix: SOIL
Client Sample ID: 1704191052
Collection Date: 4/19/2017 10:52:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst: **ELS**	
Mercury	ND	0.033		mg/Kg	1	4/28/2017 11:39:09 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst: **MED**	
Arsenic	9.6	2.5		mg/Kg	1	4/26/2017 9:42:21 AM	31405
Barium	33	0.10		mg/Kg	1	4/26/2017 9:42:21 AM	31405
Cadmium	ND	0.10		mg/Kg	1	4/26/2017 9:42:21 AM	31405
Chromium	5.5	0.30		mg/Kg	1	4/26/2017 9:42:21 AM	31405
Lead	1.9	0.25		mg/Kg	1	5/1/2017 9:40:17 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:23:31 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:42:21 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704190835
Project: 16EC053B | **Collection Date:** 4/19/2017 8:35:00 AM
Lab ID: 1704970-027 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	0.039	0.032		mg/Kg	1	4/28/2017 11:40:50 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	4.0	2.4		mg/Kg	1	4/26/2017 9:43:45 AM	31405
Barium	68	0.097		mg/Kg	1	4/26/2017 9:43:45 AM	31405
Cadmium	1.1	0.097		mg/Kg	1	4/26/2017 9:43:45 AM	31405
Chromium	9.5	0.29		mg/Kg	1	4/26/2017 9:43:45 AM	31405
Lead	4.8	0.24		mg/Kg	1	5/1/2017 9:41:31 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:24:53 AM	31405
Silver	0.94	0.24		mg/Kg	1	4/26/2017 9:43:45 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-029
Matrix: SOIL
Client Sample ID: 1704190845
Collection Date: 4/19/2017 8:45:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	0.017	0.033	J	mg/Kg	1	4/28/2017 11:46:07 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	4.0	2.5		mg/Kg	1	4/26/2017 9:45:08 AM	31405
Barium	39	0.099		mg/Kg	1	4/26/2017 9:45:08 AM	31405
Cadmium	0.095	0.099	J	mg/Kg	1	4/26/2017 9:45:08 AM	31405
Chromium	7.3	0.30		mg/Kg	1	4/26/2017 9:45:08 AM	31405
Lead	2.4	0.25		mg/Kg	1	5/1/2017 9:42:45 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:26:14 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:45:08 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704190855
Project: 16EC053B | **Collection Date:** 4/19/2017 8:55:00 AM
Lab ID: 1704970-031 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.031		mg/Kg	1	4/28/2017 11:47:49 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	5.7	2.5		mg/Kg	1	4/26/2017 9:46:32 AM	31405
Barium	32	0.099		mg/Kg	1	4/26/2017 9:46:32 AM	31405
Cadmium	0.11	0.099		mg/Kg	1	4/26/2017 9:46:32 AM	31405
Chromium	7.5	0.30		mg/Kg	1	4/26/2017 9:46:32 AM	31405
Lead	3.7	1.2		mg/Kg	5	5/1/2017 10:20:26 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:27:37 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:46:32 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704190915
Project: 16EC053B **Collection Date:** 4/19/2017 9:15:00 AM
Lab ID: 1704970-033 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst: **ELS**	
Mercury	ND	0.031		mg/Kg	1	4/28/2017 11:49:31 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst: **MED**	
Arsenic	12	2.5		mg/Kg	1	4/26/2017 9:47:53 AM	31405
Barium	58	0.099		mg/Kg	1	4/26/2017 9:47:53 AM	31405
Cadmium	0.15	0.099		mg/Kg	1	4/26/2017 9:47:53 AM	31405
Chromium	12	0.30		mg/Kg	1	4/26/2017 9:47:53 AM	31405
Lead	2.4	0.25		mg/Kg	1	5/1/2017 9:45:15 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:36:45 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:47:53 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-035
Matrix: SOIL
Client Sample ID: 1704190935
Collection Date: 4/19/2017 9:35:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.032		mg/Kg	1	4/28/2017 11:51:14 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	5.1	2.4		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Barium	33	0.097		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Cadmium	0.11	0.097		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Chromium	8.3	0.29		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Lead	5.4	0.25		mg/Kg	1	4/28/2017 11:11:00 AM	31468
Selenium	ND	2.4		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:53:21 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-037 **Matrix:** SOIL

Client Sample ID: 1704190750
Collection Date: 4/19/2017 7:50:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst: **ELS**	
Mercury	ND	0.032		mg/Kg	1	4/28/2017 11:56:27 AM	31471
EPA METHOD 6010B: SOIL METALS						Analyst: **MED**	
Arsenic	6.3	2.4		mg/Kg	1	4/26/2017 9:57:28 AM	31405
Barium	39	0.098		mg/Kg	1	4/26/2017 9:57:28 AM	31405
Cadmium	0.073	0.098	J	mg/Kg	1	4/26/2017 9:57:28 AM	31405
Chromium	4.0	0.29		mg/Kg	1	4/26/2017 9:57:28 AM	31405
Lead	3.1	1.2		mg/Kg	5	5/1/2017 10:22:55 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:43:31 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:57:28 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-039
Matrix: SOIL
Client Sample ID: 1704190740
Collection Date: 4/19/2017 7:40:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.033		mg/Kg	1	4/28/2017 12:01:45 PM	31471
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	7.4	2.5		mg/Kg	1	4/26/2017 9:58:49 AM	31405
Barium	39	0.099		mg/Kg	1	4/26/2017 9:58:49 AM	31405
Cadmium	3.8	0.099		mg/Kg	1	4/26/2017 9:58:49 AM	31405
Chromium	12	0.30		mg/Kg	1	4/26/2017 9:58:49 AM	31405
Lead	3.9	0.24		mg/Kg	1	5/1/2017 9:48:59 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:44:52 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:58:49 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-001	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017	11:30 AM
Client Sample ID	1704970-002A / 1704180701	**Sampling Time**	7:01 AM			
Matrix	Water					
Comments						

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/L	0.006	0.01	5/2/2017	JEK	EPA 335.4	

Sample Number	170425031-002	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017	11:30 AM
Client Sample ID	1704970-004A / 1704190721	**Sampling Time**	7:21 AM			
Matrix	Water					
Comments						

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/L	0.006	0.01	5/2/2017	JEK	EPA 335.4	

Sample Number	170425031-003	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017	11:30 AM
Client Sample ID	1704970-006A / 1704181436	**Sampling Time**	2:36 PM			
Matrix	Soil					
Comments						

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	47.1	mg/Kg	0.137	0.237	5/2/2017	JEK	EPA 335.4	E1,H2
%moisture	4.3	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-004	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-008A / 1704181438	**Sampling Time**	2:38 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	60.6	mg/Kg	0.153	0.263	5/2/2017	JEK	EPA 335.4	E1,H2
%moisture	5.1	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-005	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-010A / 1704181451	**Sampling Time**	2:51 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	2.59	mg/Kg	0.154	0.265	5/2/2017	JEK	EPA 335.4	
%moisture	6.0	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-006	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-012A / 1704181501	**Sampling Time**	3:01 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	1.53	mg/Kg	0.126	0.218	5/2/2017	JEK	EPA 335.4	
%moisture	4.2	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-007	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-014A / 1704181336	**Sampling Time**	1:36 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	1.63	mg/Kg	0.156	0.269	5/2/2017	JEK	EPA 335.4	
%moisture	7.1	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-008	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-016A / 1704181351	**Sampling Time**	1:51 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.142	0.245	5/2/2017	JEK	EPA 335.4	
%moisture	3.0	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-009	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-018A / 1704181301	**Sampling Time**	1:01 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.144	0.248	5/2/2017	JEK	EPA 335.4	
%moisture	7.4	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D ALBUQUERQUE, NM 87109	**Project Name:**	1704970
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-010	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-020A / 1704181314	**Sampling Time**	1:14 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.139	0.24	5/2/2017	JEK	EPA 335.4	
%moisture	3.1	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-011	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-022A / 1704191036	**Sampling Time**	10:36 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	0.459	mg/Kg	0.151	0.261	5/2/2017	JEK	EPA 335.4	
%moisture	4.7	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-012	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-024A / 1704191051	**Sampling Time**	10:51 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.142	0.245	5/2/2017	JEK	EPA 335.4	
%moisture	3.4	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-013	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-026A / 1704191053	**Sampling Time**	10:53 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.145	0.25	5/2/2017	JEK	EPA 335.4	
%moisture	3.4	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-014	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-028A / 1704190836	**Sampling Time**	8:36 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	19.6	mg/Kg	0.137	0.237	5/2/2017	JEK	EPA 335.4	
%moisture	4.3	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-015	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-030A / 1704190846	**Sampling Time**	8:46 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	8.63	mg/Kg	0.147	0.254	5/2/2017	JEK	EPA 335.4	
%moisture	3.0	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-016	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-032A / 1704190856	**Sampling Time**	8:56 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	2.41	mg/Kg	0.151	0.26	5/2/2017	JEK	EPA 335.4	
%moisture	4.6	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-017	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-034A / 1704190916	**Sampling Time**	9:16 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	0.848	mg/Kg	0.145	0.25	5/2/2017	JEK	EPA 335.4	
%moisture	4.3	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-018	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-036A / 1704190936	**Sampling Time**	9:36 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.153	0.263	5/2/2017	JEK	EPA 335.4	
%moisture	6.7	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-019	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-038A / 1704190751	**Sampling Time**	7:51 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.140	0.242	5/3/2017	JEK	EPA 335.4	
%moisture	4.1	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-020	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-040A / 1704190741	**Sampling Time**	7:41 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.137	0.236	5/3/2017	JEK	EPA 335.4	
%moisture	5.5	Percent			5/3/2017	JEK	%moisture	

Authorized Signature

Todd Taruscio, Lab Manager

E1	Concentration estimated. Analyte exceeded calibration range.
H2	Initial analysis within holding time, Reanalysis for the required dilution was past holding time.
MCL	EPA's Maximum Contaminant Level
ND	Not Detected
PQL	Practical Quantitation Limit

This report shall not be reproduced except in full, without the written approval of the laboratory.
The results reported relate only to the samples indicated.
Soil/solid results are reported on a dry-weight basis unless otherwise noted.

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Quality Control Data

Lab Control Sample

Parameter	LCS Result	Units	LCS Spike	%Rec	AR %Rec	Prep Date	Analysis Date
Cyanide	0.476	mg/kg	0.5	95.2	90-110	5/3/2017	5/3/2017
Cyanide	0.509	mg/L	0.5	101.8	90-110	5/2/2017	5/2/2017

Matrix Spike

Sample Number	Parameter	Sample Result	MS Result	Units	MS Spike	%Rec	AR %Rec	Prep Date	Analysis Date
170420020-001	Cyanide	ND	0.485	mg/L	0.5	97.0	90-110	5/2/2017	5/2/2017
170425031-019	Cyanide	ND	11.6	mg/kg	12.1	95.9	70-130	5/3/2017	5/3/2017

Matrix Spike Duplicate

Parameter	MSD Result	Units	MSD Spike	%Rec	%RPD	AR %RPD	Prep Date	Analysis Date
Cyanide	0.503	mg/L	0.5	100.6	3.6	0-20	5/2/2017	5/2/2017
Cyanide	11.4	mg/kg	12.1	94.2	1.7	0-25	5/3/2017	5/3/2017

Method Blank

Parameter	Result	Units	PQL	Prep Date	Analysis Date
Cyanide	ND	mg/Kg	0.01	5/3/2017	5/3/2017
Cyanide	ND	mg/L	0.01	5/2/2017	5/2/2017
Cyanide	ND	mg/Kg	0.01	5/1/2017	5/2/2017

AR	Acceptable Range
ND	Not Detected
PQL	Practical Quantitation Limit
RPD	Relative Percentage Difference

Comments:

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **MB-31470** SampType: **MBLK** TestCode: **EPA Method 7471: Mercury**
Client ID: **PBS** Batch ID: **31470** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334268** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	ND	0.033								

Sample ID **LCS-31470** SampType: **LCS** TestCode: **EPA Method 7471: Mercury**
Client ID: **LCSS** Batch ID: **31470** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334269** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.16	0.033	0.1667	0	96.9	80	120			

Sample ID **MB-31471** SampType: **MBLK** TestCode: **EPA Method 7471: Mercury**
Client ID: **PBS** Batch ID: **31471** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334270** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	ND	0.033								

Sample ID **LCS-31471** SampType: **LCS** TestCode: **EPA Method 7471: Mercury**
Client ID: **LCSS** Batch ID: **31471** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334271** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.17	0.033	0.1667	0	99.9	80	120			

Sample ID **1704970-035AMS** SampType: **MS** TestCode: **EPA Method 7471: Mercury**
Client ID: **1704190935** Batch ID: **31470** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334296** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.16	0.031	0.1580	0	104	75	125			

Sample ID **1704970-035AMSD** SampType: **MSD** TestCode: **EPA Method 7471: Mercury**
Client ID: **1704190935** Batch ID: **31470** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334297** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.16	0.033	0.1644	0	99.5	75	125	0.0396	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Client: NASA_WSTF

Project: 16EC053B

Sample ID **1704970-037AMS** SampType: **MS** TestCode: **EPA Method 7471: Mercury**

Client ID: **1704190750** Batch ID: **31471** RunNo: **42436**

Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334299** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.16	0.031	0.1576	0	101	75	125			

Sample ID **1704970-037AMSD** SampType: **MSD** TestCode: **EPA Method 7471: Mercury**

Client ID: **1704190750** Batch ID: **31471** RunNo: **42436**

Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334300** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.17	0.032	0.1637	0	102	75	125	5.01	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **MB-31514** SampType: **MBLK** TestCode: **EPA Method 7470: Mercury**
Client ID: **PBW** Batch ID: **31514** RunNo: **42495**
Prep Date: **5/2/2017** Analysis Date: **5/2/2017** SeqNo: **1336141** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	ND	0.00020								

Sample ID **LCS-31514** SampType: **LCS** TestCode: **EPA Method 7470: Mercury**
Client ID: **LCSW** Batch ID: **31514** RunNo: **42495**
Prep Date: **5/2/2017** Analysis Date: **5/2/2017** SeqNo: **1336142** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.0049	0.00020	0.005000	0	97.3	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **MB-31405** SampType: **MBLK** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **PBS** Batch ID: **31405** RunNo: **42366**
Prep Date: **4/25/2017** Analysis Date: **4/26/2017** SeqNo: **1332023** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	ND	2.5								
Barium	ND	0.10								
Cadmium	ND	0.10								
Chromium	ND	0.30								
Selenium	ND	2.5								
Silver	ND	0.25								

Sample ID **LCS-31405** SampType: **LCS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **LCSS** Batch ID: **31405** RunNo: **42366**
Prep Date: **4/25/2017** Analysis Date: **4/26/2017** SeqNo: **1332024** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	23	2.5	25.00	0	92.1	80	120			
Barium	24	0.10	25.00	0	97.4	80	120			
Cadmium	24	0.10	25.00	0	96.9	80	120			
Chromium	24	0.30	25.00	0	96.9	80	120			
Selenium	23	2.5	25.00	0	90.8	80	120			
Silver	5.1	0.25	5.000	0	102	80	120			

Sample ID **1704970-035AMS** SampType: **MS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31405** RunNo: **42366**
Prep Date: **4/25/2017** Analysis Date: **4/26/2017** SeqNo: **1332071** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	25	2.5	24.73	5.125	80.7	75	125			
Barium	53	0.099	24.73	32.67	83.6	75	125			
Cadmium	19	0.099	24.73	0.1133	77.8	75	125			
Chromium	26	0.30	24.73	8.286	70.1	75	125			S
Selenium	10	2.5	24.73	0	42.0	75	125			S
Silver	3.9	0.25	4.947	0	78.3	75	125			

Sample ID **1704970-035AMSD** SampType: **MSD** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31405** RunNo: **42366**
Prep Date: **4/25/2017** Analysis Date: **4/26/2017** SeqNo: **1332072** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	26	2.5	24.99	5.125	82.3	75	125	2.45	20	
Barium	56	0.10	24.99	32.67	93.1	75	125	4.74	20	
Cadmium	20	0.10	24.99	0.1133	78.1	75	125	1.39	20	
Chromium	27	0.30	24.99	8.286	76.3	75	125	6.52	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **1704970-035AMSD** SampType: **MSD** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31405** RunNo: **42366**
Prep Date: **4/25/2017** Analysis Date: **4/26/2017** SeqNo: **1332072** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	12	2.5	24.99	0	48.2	75	125	14.7	20	S
Silver	3.8	0.25	4.997	0	76.8	75	125	0.856	20	

Sample ID **1704970-035APS** SampType: **PS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31405** RunNo: **42366**
Prep Date: Analysis Date: **4/26/2017** SeqNo: **1332147** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chromium	25	0.29	24.22	8.286	70.9	80	120			S
Selenium	13	2.4	24.22	0	51.8	80	120			S

Sample ID **MB-31468** SampType: **MBLK** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **PBS** Batch ID: **31468** RunNo: **42431**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334198** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	ND	0.25								

Sample ID **LCS-31468** SampType: **LCS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **LCSS** Batch ID: **31468** RunNo: **42431**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334199** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	24	0.25	25.00	0	95.5	80	120			

Sample ID **1704970-035AMS** SampType: **MS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31468** RunNo: **42431**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334204** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	23	0.25	24.95	5.361	68.8	75	125			S

Sample ID **1704970-035AMSD** SampType: **MSD** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31468** RunNo: **42431**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334205** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	22	0.25	24.70	5.361	66.5	75	125	3.29	20	S

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1704970**

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **1704970-035APS** SampType: **PS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31468** RunNo: **42431**
Prep Date: Analysis Date: **4/28/2017** SeqNo: **1334206** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	19	0.25	24.82	5.361	55.3	80	120			S

Sample ID **MB-31469** SampType: **MBLK** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **PBS** Batch ID: **31469** RunNo: **42465**
Prep Date: **4/27/2017** Analysis Date: **5/1/2017** SeqNo: **1335209** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	ND	0.25								

Sample ID **LCS-31469** SampType: **LCS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **LCSS** Batch ID: **31469** RunNo: **42465**
Prep Date: **4/27/2017** Analysis Date: **5/1/2017** SeqNo: **1335210** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	25	0.25	25.00	0	99.2	80	120			

Sample ID **1704970-039AMS** SampType: **MS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190740** Batch ID: **31469** RunNo: **42465**
Prep Date: **4/27/2017** Analysis Date: **5/1/2017** SeqNo: **1335235** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	18	0.24	23.89	3.853	60.0	75	125			S

Sample ID **1704970-039AMSD** SampType: **MSD** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190740** Batch ID: **31469** RunNo: **42465**
Prep Date: **4/27/2017** Analysis Date: **5/1/2017** SeqNo: **1335236** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	20	0.24	24.25	3.853	67.3	75	125	10.4	20	S

Sample ID **1704970-039APS** SampType: **PS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190740** Batch ID: **31469** RunNo: **42465**
Prep Date: Analysis Date: **5/1/2017** SeqNo: **1335264** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	19	0.24	23.91	3.853	65.3	80	120			S

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **MB-31501**	SampType: **MBLK**	TestCode: **EPA 6010B: Total Recoverable Metals**
Client ID: **PBW**	Batch ID: **31501**	RunNo: **42479**
Prep Date: **5/1/2017**	Analysis Date: **5/2/2017**	SeqNo: **1335647** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	ND	0.020								
Barium	ND	0.020								
Cadmium	ND	0.0020								
Chromium	ND	0.0060								
Lead	ND	0.0050								
Selenium	ND	0.050								
Silver	ND	0.0050								

Sample ID **LCS-31501**	SampType: **LCS**	TestCode: **EPA 6010B: Total Recoverable Metals**
Client ID: **LCSW**	Batch ID: **31501**	RunNo: **42479**
Prep Date: **5/1/2017**	Analysis Date: **5/2/2017**	SeqNo: **1335648** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	0.50	0.020	0.5000	0	100	80	120			
Barium	0.49	0.020	0.5000	0	99.0	80	120			
Cadmium	0.50	0.0020	0.5000	0	99.1	80	120			
Chromium	0.49	0.0060	0.5000	0	98.3	80	120			
Lead	0.49	0.0050	0.5000	0	98.7	80	120			
Selenium	0.51	0.050	0.5000	0	103	80	120			
Silver	0.10	0.0050	0.1000	0	102	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: NASA_WSTF Work Order Number: 1704970 RcptNo: 1

Received By: Erin Melendrez 4/21/2017 9:00:00 AM
Completed By: Anne Thorne 4/21/2017 10:20:26 AM Anne Thorne
Reviewed By: 04/21/17

Chain of Custody

		Yes	No	Not Present
1.	Custody seals intact on sample bottles?	☑	☐	☐
2.	Is Chain of Custody complete?	☑	☐	☐
3.	How was the sample delivered?	FedEx		

Log In

		Yes	No	NA
4.	Was an attempt made to cool the samples?	☑	☐	☐
5.	Were all samples received at a temperature of >0° C to 6.0°C	☑	☐	☐
6.	Sample(s) in proper container(s)?	☑	☐	
7.	Sufficient sample volume for indicated test(s)?	☑	☐	
8.	Are samples (except VOA and ONG) properly preserved?	☑	☐	
9.	Was preservative added to bottles?	☐	☑	☐
10.	VOA vials have zero headspace?	☐	☐	No VOA Vials ☑
11.	Were any sample containers received broken?	☐	☑	
12.	Does paperwork match bottle labels? (Note discrepancies on chain of custody)	☑	☐	
13.	Are matrices correctly identified on Chain of Custody?	☑	☐	
14.	Is it clear what analyses were requested?	☑	☐	
15.	Were all holding times able to be met? (If no, notify customer for authorization.)	☑	☐	

# of preserved bottles checked for pH: 2 2
(<2 or >12 unless noted)
Adjusted? ND
Checked by: ENM

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: Date
By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
2	2.9	Good	Yes			

Date 4-20-17

WSTF CHAIN OF CUSTODY RECORD

Laboratory: HEAL PO# 16EC053B

Address shipping questions to:
- ☐ Lori Minnick, 575-524-5119
- ☐ Other ______________, 575-524-________

Send sample receipt confirmation and analytical reports to:
- ☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
- ☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
- ☐ Other

Special Instructions

Return coolers and reusable packaging materials within 14 days as required in statement of work to:

Return Address:
NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytical Requirements: Method / Analytes: Total Metals	Total Cyanide					Charge Number (WSTF Use Only)	Comments
1704180700	114-SB	1	A	X						STFA	1704970-001
1704180701	"	1	A		X						-002
1704190720	"	1	A	X							-003
1704190721	"	1	A		X						-004
1704181435	114-SB-03	1	S	X							7'-8' -005
1704181436	"	1	S		X						" -006
1704181437	"	1	S	X							" -007
1704181438	"	1	S		X						" -008
1704181450	"	1	S	X							10'-12' -009
1704181451	"	1	S		X						" -010
1704181500	"	1	S	X							15'-16' -011

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori W Minnick	4-20-17 / 1100 Hrs	[signature]	04/21/17 0900 2.9°C

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

WSTF CHAIN OF CUSTODY RECORD

Date 4-20-17

Laboratory: WEAL　　PO# 16EC053B

Address shipping questions to:
☐ Lori Minnick, 575-524-5119
☐ Other ______, 575-524-______

Send sample receipt confirmation and analytical reports to:
☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
☐ Other

Special Instructions
Return coolers and reusable packaging materials within 14 days as required in statement of work to:
Return Address:
NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytical Requirements (Method/Analytes): Total Metals	Total Cyanide					Charge Number (WSTF Use Only)	Comments
1704181501	114-SB-03	1	S		X					STFA	15'-16' 1704970-012
1704181335	114-SB-04	1	S	X							5'-7' -013
1704181336	"	1	S		X						" -014
1704181350	"	1	S	X							10'-12' -015
1704181351	"	1	S		X						" -016
1704181300	114-SB-05	1	S	X							5'-7' -017
1704181301	"	1	S		X						" -018
1704181313	"	1	S	X							10'-12' -019
1704181314	"	1	S		X						" -020
1704191035	114-SB-01	1	S	X							5'-7' -021
1704191036	"	1	S		X						" -022

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori Minnick	4-20-17 1100 HRS.	[signature]	04/21/17 0900 2.9°C

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

WSTF CHAIN OF CUSTODY RECORD

Date 4-20-17

Laboratory: HEAL PO# 16EC063B

Address shipping questions to:
☐ Lori Minnick, 575-524-5119
☐ Other ______, 575-524-______

Send sample receipt confirmation and analytical reports to:
☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
☐ Other

Special Instructions
Return coolers and reusable packaging materials within 14 days as required in statement of work to:
Return Address:
NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytical Requirements: Total Metals	Total Cyanide					Charge Number (WSTF Use Only)	Comments
1704191050	114-SB-01	1	S	X						STFA	10'-12' 1704970023
1704191061	"	1	S		X						" -024
1704191052	"	1	S	X							" 025
1704191063	"	1	S		X						" 026
1704190835	114-SB-02	1	S	X							6-8' 027
1704190836	"	1	S		X						" 028
1704190845	114-SB-02	1	S	X							10'-12' 029
1704190846	"	1	S		X						" 030
1704190855	"	1	S	X							15'-17' 031
1704190856	"	1	S		X						" 032
1704190915	"	1	S	X							20'-22' 033

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori W Minnick	4-20-17 / 1100 HRS.	[signature]	04/21/17 0900 2.9°

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

Date 4-20-17

WSTF CHAIN OF CUSTODY RECORD

Laboratory: HEAL PO# 16EC0536

Address shipping questions to:
☑ Lori Minnick, 575-524-5119
☐ Other ______________, 575-524-________

Send sample receipt confirmation and analytical reports to:
☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
☐ Other

Special Instructions

Return coolers and reusable packaging materials within 14 days as required in statement of work to:

Return Address:

NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytes / Method: Total Metals	Total Cyanide					Charge Number (WSTF Use Only)	Comments
1704190916	114-SB-02	1	S		X					STFA	20'-22' 1704970-034
1704190935	"	1	S	X							25'-27' -035
1704190936	"	1	S		X						" -036
1704190937	"	1	S	X							" Matrix Spike for #1704190935 -035
1704190938	"	1	S		X						" Matrix Spike for #1704190936 -036
1704190750	114-SB-03	1	S	X							25'-27' -037
1704190751	"	1	S		X						" -038
1704190740	"	1	S	X							20'-22' -039
1704190741	"	1	S		X						" -040

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori Minnick	4-20-19 / 1100 HRS.	[signature]	04/21/17 0900 2.9°C

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

Continues from Page

T. Kondy + A. Montes present. Weather is warm and cloudy. Rinsate taken off a decon'ed split spoon.

Rinsate 114-SB

Sample #	Analysis	Preserv	Cont.	Lot #	Lab
1704180700	Total Metals	Ice, HNO3	(1) 500 ml poly	060616-2AAW	HALL
—0701	Total Cyanide	Ice, NaOH	(1) 250 ml poly	102416-2AA0	HALL

Soil 114-SB-05 (5-7)

Sample #	Analysis	Preserv	Cont.	Lot #	Lab
1704181300	Total Metals	Ice	(1) 4 oz Jar	012609B	HALL
—1301	Total cyanide	Ice	(1) 4 oz JAR	"	"

114-SB-05 (10-12)

Sample #	Analysis	Preserv	Cont.	Lot #	Lab
1704181313	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
—1314	Total Cyanide	"	"	"	"

~~TK 114-SB-05~~

Sample #	Analysis	Preserv	Cont.	Lot #	Lab
~~70419~~	~~Total Metals~~	~~Ice~~	~~1 4 oz JAR~~	~~012609B~~ ~~060616-2AAW~~	~~HALL~~
~~—~~	~~Total cyanide~~	~~"~~	~~"~~	~~"~~	~~"~~

~~TK~~ Rinsate

Sample #	Analysis	Preserv	Cont.	Lot #	Lab
~~1704190720~~	~~Total Metals~~	~~Ice, HNO3~~	~~(1) 500 ml poly~~	~~060616-2AAW~~	~~HALL~~
—0721	Total cyanide	Ice, NaOH	(1) 500 ml poly	102416-2AA0	HALL

Continued on Page

Signed: T. Kondy Date: 4-18-17

Read and Understood By

Signed: Mike Manny Date: 2/19/18

Project SWMO 22

Notebook No. STF #1

Continues from Page

Soil.

114-SB-04 (5-7)

Sample #	Analyses	Preserv.	Cont.	Lot #	Lab
170418 1335	Total Metals	Ice	(1) 4oz JAR	012609B	HAL6
— 1336	Total cyanide	"	"	"	

114-SB-04 (10-12)

170418 1350	Total Metals	Ice	(1) 4oz JAR	012609B	HAL2
— 1351	Total cyanide	"	"	"	

Continued on Page

Read and Understood By

Signed [signature] Date 4-18-17

Signed [signature] Date 2/19/18

Project SUMO 22 Notebook No. STI #1

Continues from Page

Soil

114-SB-03 (7-8)

Sample #	Analysis	Preserv	Cont.	Lot #	Lab
1704181435	Total Metals	ice	(1) 4 oz JAR	012609B	HALL
-1436	Total cyanide	"	"	"	"
-1437	Total Metals (Dup)	"	"	"	"
-1438	Total cyanide (Dup)	"	"	"	"

114-SB-03 (10-12)

1704181450	Total Metals	ice	(1) 4 oz JAR	012609B	HALL
-1451	Total cyanide	"	"	"	"

114-SB-03 (15-16)

1704181500	Total Metals	ice	1 4 oz JAR	012609B	HALL
-1502	Total cyanide	"	"	"	"

Rinsate

1704190720	Total Metals	ice, HNO3	(1) 500 ml poly	060616-2AAW	HALL
-0721	Total cyanide	ice, NaOH	(1) 250 ml poly	102416-2AAO	HALL

Soil 114-SB-03 (20-22)

1704190740	Total Metals	ice	(1) 4 oz JAR	012609B	HALL
-0741	Total cyanide	"	"	"	"

114-SB-03 (25-27)

1704190750	Total Metals	ice	(1) 4 oz JAR	012609B	HALL
-0751	Total cyanide	"	"	"	"

Continued on Page

Read and Understood By

Signed [signature] Date 4-19-17

Signed [signature] Date 2/19/18

Project SWMO 22

Notebook No. SFI # 1

Continues from Page

Soil

Sample #	Analysis	Preserv	Cont.	Lot #	Loc
		114-SB-02	(6-8)		
170419 0835	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 0836	Total cyanide	"	"	"	"
		114-SB-02	(10-12)		
170419 0845	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 0846	Total cyanide	"	"	"	"
		114-SB-02	(15-17)		
170419 0855	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 0856	Total cyanide	"	"	"	"
		114-SB-02	(20-22)		
170419 0915	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 0916	Total cyanide	"	"	"	"
		114-SB-02	(25-27)		
170419 0935	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 0936	Total cyanide	"	"	"	"
— 0937	Total Metals (MS)	"	"	"	"
— 0938	Total cyanide (MS)	"	"	"	"

Continued on Page

Read and Understood By

Signed [signature] Date 4-19-17 Signed [signature] Date 2/19/18

Project SUMO 22 Notebook No. STI #1
Continues from Page

Sample #	Analysis	Soil Preser	114-SB-01 Cont.	(5-7) Lot #	Lab
170419 1035	Total Metals	ice	(1) 4oz JAR	012609B	HALL
— 1036	Total cyanide	"	"	"	"
			114-SB-01	(10-12)	
170419 1050	Total Metals	ice	(1) 4oz JAR	012609B	HALL
— 1051	Total cyanide	"	"	"	"
— 1052	Total Metals	"	"	"	"
— 1053	Total cyanide	"	"	"	"

Continued on Page

Read and Understood By

Signed [signature] Date 4-19-17 Signed [signature] Date 2/19/18

November 10, 2017 Service Request No:R1710397

Ms. Carlyn Tufts
NASA/WSTF/Navarro
P.O. Box 20
Las Cruces, NM 88004

Laboratory Results for: White Sands Test Facility

Dear Ms.Tufts,

Enclosed are the results of the sample(s) submitted to our laboratory November 02, 2017
For your reference, these analyses have been assigned our service request number **R1710397.**

All analyses were performed according to our laboratory's quality assurance program. The test results meet requirements of the NELAP standards except as noted in the case narrative report. All results are intended to be considered in their entirety, and ALS Environmental is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report. The measurement uncertainty of the results included in this report is within that expected when using the prescribed method(s) for analysis of these samples, and represented by Laboratory Control Sample control limits. Any events, such as QC failures, which may add to the uncertainty are explained in the report narrative.

Please contact me if you have any questions. My extension is 7472. You may also contact me via email at Janice.Jaeger@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Brady Kalkman

Brady Kalkman

For

Janice Jaeger

Project Manager

CC: Michael Narap

ADDRESS 1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
PHONE +1 585 288 5380 | FAX +1 585 288 8475
ALS Group USA, Corp.
dba ALS Environmental

Narrative Documents

ALS Environmental—Rochester Laboratory
1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Phone (585) 288-5380 Fax (585) 288-8475
www.alsglobal.com

1565 Jefferson Rd, Building 300, Rochester, NY 14623 | 585-288-5380 | www.alsglobal.com

ALS Environmental

Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Sample Matrix: Water

Service Request: R1710397
Date Received: 11/2/17

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables, including results of QC samples analyzed from this delivery group. Analytical procedures performed by the lab are validated in accordance with NELAC standards. Any parameters that are not included in the lab's NELAC accreditation are identified on a "Non-Certified Analytes" report in the Miscellaneous Forms Section of this report. Individual analytical results requiring further explanation are flagged with qualifiers and/or discussed below. The flags are explained in the Report Qualifiers and Definitions page in the Miscellaneous Forms section of this report.

Sample Receipt

Five Water, Soil samples were received for analysis at ALS Environmental on 11/02/2017. Any discrepancies noted upon initial sample inspection are noted on the cooler receipt and preservation form included in this data package. The samples were received in good condition and consistent with the accompanying chain of custody form. Samples are refrigerated at ≤6°C upon receipt at the lab except for aqueous samples designated for metals analyses, which are stored at room temperature.

General Chemistry Analyses:

No significant anomalies were noted with this analysis.

Approved by Tamara Hsteg Date 11/10/2017

SAMPLE DETECTION SUMMARY

CLIENT ID: 1710310955 114-SB-06	Lab ID: R1710397-003					
Analyte	**Results**	**Flag**	**MDL**	**PQL**	**Units**	**Method**
Cyanide, Residual	0.025	J	0.015	0.062	mg/Kg	9012B
Cyanide, Total	0.17	BJ	0.02	0.33	mg/Kg	9012B
Total Solids	90.3				Percent	ALS SOP

CLIENT ID: 1710310956 117-SB-06	Lab ID: R1710397-004					
Analyte	**Results**	**Flag**	**MDL**	**PQL**	**Units**	**Method**
Cyanide, Residual	1.36		0.015	0.064	mg/Kg	9012B
Cyanide, Total	2.22		0.02	0.29	mg/Kg	9012B
Total Solids	94.2				Percent	ALS SOP

CLIENT ID: 1710310900 114-SB-07	Lab ID: R1710397-005					
Analyte	**Results**	**Flag**	**MDL**	**PQL**	**Units**	**Method**
Cyanide, Residual	0.055	J	0.015	0.061	mg/Kg	9012B
Cyanide, Total	0.09	BJ	0.02	0.26	mg/Kg	9012B
Total Solids	95.9				Percent	ALS SOP

Sample Receipt Information

ALS Environmental—Rochester Laboratory
1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Phone (585) 288-5380 Fax (585) 288-8475
www.alsglobal.com

Client: NASA/WSTF/Navarro **Service Request:** R1710397
Project: White Sands Test Facility/17EC028

SAMPLE CROSS-REFERENCE

SAMPLE #	CLIENT SAMPLE ID	DATE	TIME
R1710397-001	1710310755 114-SB	10/31/2017	
R1710397-002	1710310756 114-SB	10/31/2017	
R1710397-003	1710310955 114-SB-06	10/31/2017	
R1710397-004	1710310956 117-SB-06	10/31/2017	
R1710397-005	1710310900 114-SB-07	10/31/2017	

WSTF CHAIN OF CUSTODY RECORD

Date ~~10/31/2017~~ 11-1-17

Page 1 of 1

Laboratory: ALS Environmental	PO# 17EC028			Analytical Requirements						Charge Number (WSTF Use Only)	Special Instructions
Address shipping questions to: ☒ Lori Minnick, 575-524-5119 ☒ Mike Narup, 575-524-5483				Method							Return coolers and reusable packaging materials within 14 days as required in statement of work to: Return Address: NASA WSTF Environmental Department 12600 NASA Road; Bldg. 120 Las Cruces, NM 88012 Attn: Lori Minnick
Send sample receipt confirmation and analytical reports to: ☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov ☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov ☒ Mike Narup, michael.j.narup@nasa.gov											
Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytes	Cyanide (335.4/9012B)						Comments
1710310755	114-SB	1	A		X					STFA	
1710310756	"	1	A		X					"	
1710310955	114-SB-06	1	S		X					"	7-9'
1710310956	"	1	S		X					"	"
1710310900	114-SB-07	1	S		X					"	"
1710310901	"	1	S		X					"	" MS for 1710310900 as per Lori Minnick [illegible] 11/2/17

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
[signature]	11-1-17 / 1100Hrs.	[signature]	11-2-17 09:05

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

R1710397 5
NASA/WSTF/Navarro
White Sands Test Facility

WSTF 331B (05/2016)

R1710397 5
NASA/WSTF/Navarro
White Sands Test Facility

ALS

Cooler Receipt and Preservation Check Form

Project/Client NASA Folder Number R1710397.

Cooler received on 11-2-17 by: ME COURIER: ALS UPS FEDEX VELOCITY CLIENT

1	Were **Custody seals** on outside of cooler?	Y N	5a	**Perchlorate** samples have required headspace?	Y N NA
2	**Custody papers** properly completed (ink, signed)?	Y N	5b	Did VOA vials, Alk, or Sulfide have sig* **bubbles**?	Y N NA
3	Did all bottles arrive in good **condition** (unbroken)?	Y N	6	Where did the bottles originate?	ALS/ROC CLIENT
4	Circle: **Wet Ice Dry Ice Gel packs** present?	Y N	7	Soil VOA received as:	Bulk Encore 5035set NA

8. Temperature Readings Date: 11-2-17 Time: 09:15 ID: IR#7 IR#9 From: Temp Blank Sample Bottle

Observed Temp (°C)	4.3	2.5					
Correction Factor (°C)	+1.2	ø					
Corrected Temp (°C)	5.5	2.5					
Temp from:Type of bottle	250 plastic	—					
Within 0-6°C?	Y N	Y N	Y N	Y N	Y N	Y N	Y N
If<0°C, were samples frozen?	Y N	Y N	Y N	Y N	Y N	Y N	Y N

If out of Temperature, note packing/ice condition: _____ Ice melted Poorly Packed (described below) Same Day Rule

&Client Approval to Run Samples: _____ Standing Approval Client aware at drop-off Client notified by: _____

All samples held in storage location: R-002 by ME on 11-2-17 at 09:18
5035 samples placed in storage location: _____ by _____ on _____ at _____

Cooler Breakdown: Date: 11-3-17 Time: 08:45 by: ME

9. Were all bottle labels complete (*i.e.* analysis, preservation, etc.)? YES NO
10. Did all bottle labels and tags agree with custody papers? YES NO
11. Were correct containers used for the tests indicated? YES NO
12. Were 5035 vials acceptable (no extra labels, not leaking)? YES NO N/A
13. Air Samples: Cassettes / Tubes Intact Canisters Pressurized Tedlar® Bags Inflated N/A

pH	Lot of test paper	Reagent	Preserved? Yes	No	Lot Received	Exp	Sample ID	Vol. Added	Lot Added	Final pH
≥12	213916	NaOH	X		181658	07/18				
≤2		HNO_3								
≤2		H_2SO_4								
<4		$NaHSO_4$								
Residual Chlorine (-)		For CN Phenol and 522	X		If +, contact PM to add $Na_2S_2O_3$ (CN), ascorbic (phenol).					
		$Na_2S_2O_3$	-	-						
		ZnAcetate	-	-						
		HCl	**	**						

**Not to be tested before analysis – pH tested and recorded by VOAs on a separate worksheet

Bottle lot numbers: 071017-2AAB

Explain all Discrepancies/ Other Comments:

CLRES	BULK
DO	FLDT
HPROD	HGFB
HTR	LL3541
PH	SUB
SO3	MARRS
ALS	REV

Labels secondary reviewed by: ME

PC Secondary Review: [signature] 11/6/17 *significant air bubbles: VOA > 5-6 mm : WC >1 in. diameter

Miscellaneous Forms

ALS Environmental—Rochester Laboratory
1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623
Phone (585) 288-5380 Fax (585) 288-8475
www.alsglobal.com

ALS Environmental

REPORT QUALIFIERS AND DEFINITIONS

U Analyte was analyzed for but not detected. The sample quantitation limit has been corrected for dilution and for percent moisture, unless otherwise noted in the case narrative.

J Estimated value due to either being a Tentatively Identified Compound (TIC) or that the concentration is between the MRL and the MDL. Concentrations are not verified within the linear range of the calibration. For DoD: concentration >40% difference between two GC columns (pesticides/Arclors).

B Analyte was also detected in the associated method blank at a concentration that may have contributed to the sample result.

E Inorganics- Concentration is estimated due to the serial dilution was outside control limits.

E Organics- Concentration has exceeded the calibration range for that specific analysis.

D Concentration is a result of a dilution, typically a secondary analysis of the sample due to exceeding the calibration range or that a surrogate has been diluted out of the sample and cannot be assessed.

* Indicates that a quality control parameter has exceeded laboratory limits. Under the ñNotesò column of the Form I, this qualifier denotes analysis was performed out of Holding Time.

H Analysis was performed out of hold time for tests that have an ñimmediateò hold time criteria.

Spike was diluted out.

+ Correlation coefficient for MSA is <0.995.

N Inorganics- Matrix spike recovery was outside laboratory limits.

N Organics- Presumptive evidence of a compound (reported as a TIC) based on the MS library search.

S Concentration has been determined using Method of Standard Additions (MSA).

W Post-Digestion Spike recovery is outside control limits and the sample absorbance is <50% of the spike absorbance.

P Concentration >40% (25% for CLP) difference between the two GC columns.

C Confirmed by GC/MS

Q DoD reports: indicates a pesticide/Aroclor is not confirmed (Ó100% Difference between two GC columns).

X See Case Narrative for discussion.

MRL Method Reporting Limit. Also known as:
LOQ Limit of Quantitation (LOQ)
The lowest concentration at which the method analyte may be reliably quantified under the method conditions.

MDL Method Detection Limit. A statistical value derived from a study designed to provide the lowest concentration that will be detected 99% of the time. Values between the MDL and MRL are estimated (see J qualifier).

LOD Limit of Detection. A value at or above the MDL which has been verified to be detectable.

ND Non-Detect. Analyte was not detected at the concentration listed. Same as U qualifier.

ACCREDITED IN ACCORDANCE WITH nelac

Rochester Lab ID # for State Certifications[1]

Connecticut ID # PH0556	Maine ID #NY0032	New Hampshire ID # 294100 A/B
Delaware Accredited	Nebraska Accredited	
DoD ELAP #65817	New Jersey ID # NY004	Pennsylvania ID# 68-786
Florida ID # E87674	New York ID # 10145	Rhode Island ID # 158
Illinois ID #200047	North Carolina #676	Virginia #460167

[1] Analyses were performed according to our laboratoryǿs NELAP-approved quality assurance program and any applicable state or agency requirements. The test results meet requirements of the current NELAP/TNI standards or state or agency requirements, where applicable, except as noted in the case narrative. Since not all analyte/method/matrix combinations are offered for state/NELAC accreditation, this report may contain results which are not accredited. For a specific list of accredited analytes, contact the laboratory or go to http://www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental/Downloads/North-America-Downloads

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028		

Sample Name:	1710310755 114-SB	**Date Collected:**	10/31/17
Lab Code:	R1710397-001	**Date Received:**	11/2/17
Sample Matrix:	Water		

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
Calculation		CWOODS

Sample Name:	1710310756 114-SB	**Date Collected:**	10/31/17
Lab Code:	R1710397-002	**Date Received:**	11/2/17
Sample Matrix:	Water		

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
Calculation		CWOODS

Sample Name:	1710310955 114-SB-06	**Date Collected:**	10/31/17
Lab Code:	R1710397-003	**Date Received:**	11/2/17
Sample Matrix:	Soil		

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
ALS SOP		KWONG
Calculation		CWOODS

Sample Name:	1710310956 117-SB-06	**Date Collected:**	10/31/17
Lab Code:	R1710397-004	**Date Received:**	11/2/17
Sample Matrix:	Soil		

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
ALS SOP		KWONG
Calculation		CWOODS

Analyst Summary report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028		

Sample Name:	1710310900 114-SB-07	**Date Collected:**	10/31/17
Lab Code:	R1710397-005	**Date Received:**	11/2/17
Sample Matrix:	Soil		

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
ALS SOP		KWONG
Calculation		CWOODS

The preparation methods associated with this report are found in these tables unless discussed in the case narrative.

Water/Liquid Matrix

Analytical Method	Preparation Method
200.7	200.2
200.8	200.2
6010C	3005A/3010A
6020A	ILM05.3
9014 Cyanide Reactivity	SW846 Ch7, 7.3.4.2
9034 Sulfide Reactivity	SW846 Ch7, 7.3.4.2
9034 Sulfide Acid Soluble	9030B
9056A Bomb (Halogens)	5050A
9066 Manual Distillation	9065
SM 4500-CN-E Residual Cyanide	SM 4500-CN-G
SM 4500-CN-E WAD Cyanide	SM 4500-CN-I

Solid/Soil/Non-Aqueous Matrix

Analytical Method	Preparation Method
6010C	3050B
6020A	3050B
6010C TCLP (1311) extract	3005A/3010A
6010 SPLP (1312) extract	3005A/3010A
7196A	3060A
7199	3060A
9056A Halogens/Halides	5050
300.0 Anions/ 350.1/ 353.2/ SM 2320B/ SM 5210B/ 9056A Anions	DI extraction

For analytical methods not listed, the preparation method is the same as the analytical method reference.

Sample Results

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General Chemistry

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Water	**Date Received:**	11/02/17 09:05
Sample Name:	1710310755 114-SB	**Basis:**	NA
Lab Code:	R1710397-001		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND U	mg/L	0.0100	-	1	NA	NA	
Cyanide, Residual	9012B	ND U	mg/L	0.0020	0.0020	1	11/10/17 09:56	11/08/17	
Cyanide, Total	9012B	ND U	mg/L	0.010	0.002	1	11/10/17 09:21	11/08/17	

Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Water	**Date Received:**	11/02/17 09:05
Sample Name:	1710310756 114-SB	**Basis:**	NA
Lab Code:	R1710397-002		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND U	mg/L	0.0100	-	1	NA	NA	
Cyanide, Residual	9012B	ND U	mg/L	0.0020	0.0020	1	11/10/17 09:57	11/08/17	
Cyanide, Total	9012B	ND U	mg/L	0.010	0.002	1	11/10/17 09:22	11/08/17	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310955 114-SB-06	**Basis:**	Dry
Lab Code:	R1710397-003		

Inorganic Parameters

Analyte Name	Analysis Method	Result		Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND	U	mg/Kg	1.0	-	1	NA	NA	
Cyanide, Residual	9012B	**0.025**	**J**	mg/Kg	0.062	0.015	1	11/10/17 10:00	11/08/17	
Cyanide, Total	9012B	**0.17**	**BJ**	mg/Kg	0.33	0.02	1	11/10/17 09:41	11/08/17	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310955 114-SB-06	**Basis:**	As Received
Lab Code:	R1710397-003		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Total Solids	ALS SOP	**90.3**	Percent	-	-	1	11/03/17 10:00	NA	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310956 117-SB-06	**Basis:**	Dry
Lab Code:	R1710397-004		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND U	mg/Kg	1.0	-	1	NA	NA	
Cyanide, Residual	9012B	**1.36**	mg/Kg	0.064	0.015	1	11/10/17 10:02	11/08/17	
Cyanide, Total	9012B	**2.22**	mg/Kg	0.29	0.02	1	11/10/17 09:44	11/08/17	

Client:	NASA/WSTF/Navarro		**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028		**Date Collected:**	10/31/17
Sample Matrix:	Soil		**Date Received:**	11/02/17 09:05
Sample Name:	1710310956 117-SB-06		**Basis:**	As Received
Lab Code:	R1710397-004			

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Total Solids	ALS SOP	**94.2**	Percent	-	-	1	11/03/17 10:00	NA	

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310900 114-SB-07	**Basis:**	Dry
Lab Code:	R1710397-005		

Inorganic Parameters

Analyte Name	Analysis Method	Result		Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND	U	mg/Kg	1.0	-	1	NA	NA	
Cyanide, Residual	9012B	**0.055**	**J**	mg/Kg	0.061	0.015	1	11/10/17 10:03	11/08/17	
Cyanide, Total	9012B	**0.09**	**BJ**	mg/Kg	0.26	0.02	1	11/10/17 09:44	11/08/17	

ALS Group USA, Corp.
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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310900 114-SB-07	**Basis:**	As Received
Lab Code:	R1710397-005		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Total Solids	ALS SOP	**95.9**	Percent	-	-	1	11/03/17 10:00	NA	

QC Summary Forms

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Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Sample Matrix: Soil

Service Request: R1710397
Date Collected: NA
Date Received: NA

Sample Name: Method Blank
Lab Code: R1710397-MB1

Basis: Dry

Inorganic Parameters

Analyte Name	Analysis Method	Result		Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Cyanide, Residual	9012B	ND	U	mg/Kg	0.060	0.015	1	11/10/17 09:58	11/08/17	
Cyanide, Total	9012B	**0.04**	**J**	mg/Kg	0.30	0.02	1	11/10/17 09:39	11/08/17	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	R1710397-MB2		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Cyanide, Residual	9012B	ND U	mg/L	0.0020	0.0020	1	11/10/17 09:54	11/08/17	
Cyanide, Total	9012B	ND U	mg/L	0.010	0.002	1	11/10/17 09:15	11/08/17	

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QA/QC Report

Client:	NASA/WSTF/Navarro		**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028		**Date Collected:**	10/31/17
Sample Matrix:	Soil		**Date Received:**	11/02/17
			Date Analyzed:	11/10/17
			Date Extracted:	11/8/17

Duplicate Matrix Spike Summary
Cyanide, Total

Sample Name:	1710310900 114-SB-07		**Units:**	mg/Kg
Lab Code:	R1710397-005		**Basis:**	Dry
Analysis Method:	9012B			
Prep Method:	Method			

		Matrix Spike R1710397-005MS			Duplicate Matrix Spike R1710397-005DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Cyanide, Total	0.09 BJ	3.24	3.09	102	2.91	3.07	92	10-159	11	30

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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QA/QC Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Water	**Date Received:**	11/02/17
		Date Analyzed:	11/10/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	1710310756 114-SB	**Units:**	mg/L
Lab Code:	R1710397-002	**Basis:**	NA

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample R1710397-002DUP Result	Average	RPD	RPD Limit
Cyanide, Residual	9012B	0.0020	0.0020	ND U	ND U	NC	NC	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17
		Date Analyzed:	11/10/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	1710310900 114-SB-07	**Units:**	mg/Kg
Lab Code:	R1710397-005	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample R1710397-005DUP Result	Average	RPD	RPD Limit
Cyanide, Residual	9012B	0.062	0.015	0.055 J	0.049 J	0.0519	11	30

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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QA/QC Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17
		Date Analyzed:	11/03/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	1710310900 114-SB-07	**Units:**	Percent
Lab Code:	R1710397-005	**Basis:**	As Received

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample R1710397-005DUP Result	Average	RPD	RPD Limit
Total Solids	ALS SOP	-		95.9	95.5	95.7	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

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QA/QC Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Analyzed:**	11/10/17
Sample Matrix:	Soil		

Lab Control Sample Summary
General Chemistry Parameters

Units: mg/Kg
Basis: Dry

Lab Control Sample
R1710397-LCS1

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cyanide, Residual	9012B	ND U	5.00	0	0-10
Cyanide, Total	9012B	2.96	3.00	99	85-115

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Analyzed:**	11/10/17
Sample Matrix:	Soil		

Lab Control Sample Summary
General Chemistry Parameters

Units: mg/Kg
Basis: Dry

Lab Control Sample
R1710397-LCS2

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cyanide, Total	9012B	17.5	18.0	97	85-115

Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Sample Matrix: Water

Service Request: R1710397
Date Analyzed: 11/10/17

Lab Control Sample Summary
General Chemistry Parameters

Units:mg/L
Basis:NA

Lab Control Sample
R1710397-LCS3

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cyanide, Residual	9012B	ND U	0.100	0	0-10
Cyanide, Total	9012B	0.0995	0.100	99	85-115

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QA/QC Report

Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Sample Matrix: Water

Service Request: R1710397
Date Analyzed: 11/10/17

Lab Control Sample Summary
General Chemistry Parameters

Units:mg/L
Basis:NA

Lab Control Sample
R1710397-LCS4

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cyanide, Total	9012B	0.585	0.600	98	85-115

~~Soil~~ IK.1

J. Koney + A. Montes present. Weather is cool, cloudy and a few sprinkles. Rinsate taken from decon split spoon -

Rinsate 114-SB

Sample#	Analysis	Preserve	Cont.	Lot #	Lab
1710310755	cyanide	ice, NAOH	(1) 250 ml poly	07107-2AA0	ALS

MN 10/31/17
~~Equipment~~ ~~Field~~ Blank Field Blank

1710310756	cyanide	ice, NAOH	(1) 250 ml poly	07107-2AA0	ALS

Soil
114-SB-06 7-9 FT

1710310955	cyanide	ice	(1) 4 oz JAR	070214	ALS
— 0956	" ~~(Dupl)~~ (Dupl)	"	"	"	"

114-SB-07 7-9 FT

1710310900	cyanide	ice	(1) 4 oz JAR	070214	ALS
— 0901	" (MS)	"	"	"	"

Continued on Page

Signed [signature] Date 10-31-17
Read and Understood By
Signed [signature] Date 10/31/17

Appendix E
Quality Assurance Reports

National Aeronautics and Space Administration

Quality Assurance Report for White Sands Test Facility Septic Tank Soil Analytical Data

May 2021

Revised 2023

NM 8800019434

Report Submitted: May 14, 2021

Report Prepared by:
Stephanie Portillo
Environmental Scientist III
Navarro Research and Engineering, Inc.

1.0 Introduction

The WSTF Septic Tanks (SWMU 21–27) Investigation Work Plan requires the preparation of an investigation report that includes soil analytical data reported. The Quality Assurance Report (QAR) prepared and reviewed by responsible environmental contractor data management personnel provides the following information:

- A summary of notable anomalies.
- A summary of notable data quality issues by analytical method, if any.
- A list of the sample events for which soil samples were collected in April and October 2017.
- The quantity and type of quality control samples collected or prepared in April and October 2017.
- Definitions of data qualifiers used in WSTF analytical data reporting.
- The quantity and type of data qualifiers applied to individual analytical results.
- A list of quality assurance narratives arranged by analytical method.
- A summary table of blank sample detections.

2.0 Data Quality

2.1 Notable Anomalies

At SWMU 22, samples collected during this investigation include investigation soil samples, duplicates, matrix spikes, field blanks and equipment rinsate samples in accordance with the approved IWP. Soil samples, including duplicate and matrix spike samples, were obtained by advancing the auger to just above the sampling interval specified in the SWMUs 21–27 Investigation Report (IR).

In April 2017, NASA installed five soil borings 114-SB-01 through 114-SB-05 (3 to 12 feet [ft] below ground surface [bgs] and 2 to 27 ft bgs) and collected 16 (19 with duplicates and matrix spikes) soil chemical samples. The April 2017 soil samples from soil borings 114-SB-01 through -05 were analyzed at an off-site National Environmental Laboratory Accreditation Program accredited laboratory for total metals using SW-846 Methods 6010B/7471 and total cyanide using SW-846 Method 335.4 instead of using Method 9012B.

Results of the SWMU 22 April 2017 soil samples indicate that nitrate interference may have impacted cyanide results in a similar manner as identified during sludge sample analyses related to the SWMU 22 waste characterization for disposal as described in Section 3.4.10 of the SWMUs 21–27 IR. The samples exhibiting nitrate interference had elevated cyanide concentrations and were observed in samples collected from immediately beneath the former septic tank. Due to these anomalous cyanide results, NASA evaluated the potential for nitrate interference impacts to cyanide analytical results by sampling soils from two additional shallow soil borings, 114-SB-06 and 114-SB-07, installed in October 2017. These samples were analyzed using SW-846 Method 9012B. Soil samples were collected adjacent to the two borings exhibiting the highest cyanide concentrations from soils immediately beneath the fill material. NASA selected an accredited laboratory that could analyze the October 2017 soil samples for total cyanide by SW-846 Method 9012B, using the sulfamic acid preparation modification. In areas where nitrate interference in cyanide analyses is probable, analyses for cyanide using sulfamic acid preparation and Method 9012B yield results that are more representative of subsurface conditions than results of cyanide analyses using Method 335.4.

3.0 Data Tables

Table 1 summarizes the soil sample events in April and October 2017. This report is based on data quality issues related to the sample events listed in Table 1. Table 2 through Table 7 contain information related to the sample events identified in Table 1. As specified by the IWP Section 5. 4, specific quality control samples are utilized to assess the quality of analytical data. Table 2 presents the quantity of quality control samples collected for each analytical method. Table 3 compares the quality control sample percentages collected to the requirements in the IWP. When data quality criteria are not met, data qualifiers are applied to the data. Definitions of data qualifiers used for WSTF chemical analytical data are listed in Table 4. Table 5 and Table 6 present the total number of individual result records and summarize the quantity of field and laboratory data qualifiers assigned to individual analyte result records in the WSTF analytical database. Table 7 provides all quality assurance narratives associated with the sample events in Table 1. Narratives associated with qualified data are identified by bold text in Table 7.

4.0 Usability Assessment

The goal of the usability assessment is to determine the quality of each data point and to identify data that are not acceptable to support project quality objectives. This QAR qualifies as the completed assessment for the April and October 2017 sample events for the Septic Tank Investigation. No data was qualified as being unusable or rejected (R), based on established quality review protocols.

Table 1 – Sample Events for April and October 2017

Location Sample ID	Depth (ft)	Event Date
114-SB-01	5	4/19/2017
	10	
114-SB-02	6	4/19/2017
	10	
	15	
	20	
	25	
114-SB-03	7	4/18/2017
	10	
	15	
	20	4/19/2017
	25	
114-SB-04	5	4/18/2017
	10	
114-SB-05	5	4/18/2017
	10	
114-SB-06	7	10/31/2017
114-SB-07	7	10/31/2017

Table 2 – Quantity of Quality Control Samples

Method	Total Samples	Soil Samples	Equipment Blanks	Field Blanks	Duplicates	Matrix Spike
Total Metals by EPA Method 6010B/7470/7471	**20**	**16**	**2**	**---**	**2**	**1**
Total Cyanide by EPA Method 335. 4	**20**	**16**	**2**	**---**	**2**	**1**
Total Cyanide by EPA Method 9012	**5**	**2**	**1**	**1**	**1**	**---**

Table 3 – Quality Control Sample Percentages

Quality Control Requirement	Requirement %	Samp. Qty.	QC Qty.	QC %
Total Metals Field Blanks (EPA Method 6010B/7470/7471)	10	20	---	**0**
Total Metals Matrix Spikes (EPA Method 6010B/7470/7471)	5	20	1	**5**
Total Metals Duplicates (EPA Method 6010B/7470/7471)	10	20	2	**10**
Total Cyanide Field Blanks (EPA Method 335. 4)	10	20	---	**0**
WhTotal Cyanide Matrix Spikes (EPA Method 335. 4)	5	20	1	**5**
Total Cyanide Duplicates (EPA Method 335. 4)	10	20	2	**10**
Total Cyanide Field Blanks (EPA Method 9012)	10	5	1	**20**
Total Cyanide Matrix Spikes (EPA Method 9012)	5	5	---	**0**
Total Cyanide Duplicates (EPA Method 9012)	10	5	1	**20**

Table 4 – Definitions of Data Qualifiers

Qualifier	Definition
*	User defined qualifier. See quality assurance narrative.
A	The result of an analyte for a laboratory control sample (LCS), initial calibration verification (ICV) or continuing calibration verification (CCV) was outside standard limits.
AD	Relative percent difference for analyst (laboratory) duplicates was outside standard limits.
D	The reported result is from a dilution.
EB	The analyte was detected in the equipment blank.
FB	The analyte was detected in the field blank.
G	The result is an estimated value greater than the upper calibration limit.
i	The result, quantitation limit, and/or detection limit may have been affected by matrix interference.
J	The result is an estimated value less than the quantitation limit, but greater than or equal to the detection limit.
NA	The value/result was either not analyzed for or not applicable.
ND	The analyte was not detected above the detection limit.
Q	The result for a blind control sample was outside standard limits.
QD	The relative percent difference for a field duplicate was outside standard limits.
R	The result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
RB	The analyte was detected in the method blank.
S	The result was determined by the method of standard addition.
SP	The matrix spike recovery and/or the relative percent difference for matrix spike duplicates was outside standard limits.
T	The sample was analyzed outside the specified holding time or temperature.
TB	The analyte was detected in the trip blank.
TIC	The analyte was tentatively identified by a GC/MS library search and the amount reported is an estimated value.

Table 5 – Quantity of Field Based Data Qualifiers Assigned to Individual Result Records

Method	Total Result Records	"FB"	"EB"	"TB"	"Q"	"QD"	"SP"	"R"
Arsenic by EPA Method 6010B	**20**	0	0	0	0	**2**	0	0
Barium by EPA Method 6010B	**20**	0	**2**	0	0	0	0	0
Cadmium by EPA Method 6010B	**20**	0	0	0	0	0	0	0
Chromium by EPA Method 6010B	**20**	0	**1**	0	0	**2**	**1**	0
Lead by EPA Method 6010B	**20**	0	0	0	0	0	**1**	0
Mercury by EPA Method 7470/7471	**20**	0	0	0	0	0	0	0
Selenium by EPA Method 6010B	**20**	0	0	0	0	0	0	0

Method	Total Result Records	"FB"	"EB"	"TB"	"Q"	"QD"	"SP"	"R"
Silver by EPA Method 6010B	**20**	0	0	0	0	**2**	0	0
Total Cyanide by EPA Method 335. 4	**20**	0	0	0	0	**2**	0	0
Total Cyanide by EPA Method 9012	**5**	0	0	0	0	**3**	0	0

Table 6 – Quantity of Laboratory based Data Qualifiers Assigned to Individual Result Records

Method	Total Result Records	"*"	"A"	"AD"	"G"	"RB"	"T"	"D"	"i"	"J"
Arsenic by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**1**
Barium by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**2**
Cadmium by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**2**
Chromium by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**1**
Lead by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	0
Mercury by EPA Method 7470/7471	**20**	0	0	0	0	0	0	0	0	**3**
Selenium by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	0
Silver by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**1**
Total Cyanide by EPA Method 335. 4	**20**	0	0	0	0	0	0	0	0	0
Total Cyanide by EPA Method 9012	**5**	0	0	0	0	**2**	0	0	0	**2**

Table 7 – Quality Assurance Narratives

Location Sample_ID	Event Date	QA Narratives for Various Analytical Methods
114-SB-01-010	19-Apr-17	For Total Metals (soil), field duplicate samples 1704191050 and 1704191052 the relative percent difference for barium was 9. 5%. Upper acceptance limit for relative percent difference is 25%.
114-SB-01-010	19-Apr-17	**For Total Metals (soil), field duplicate samples 1704191050 and 1704191052 the relative percent difference for arsenic was 37. 3%. This value is outside the upper acceptance limit for relative percent difference of 25%.**
114-SB-01-010	19-Apr-17	For Total Metals (soil), field duplicate samples 1704191050 and 1704191052 the relative percent difference for chromium was 0. 0%. Upper acceptance limit for relative percent difference is 25%.
114-SB-01-010	19-Apr-17	For Total Metals (soil), field duplicate samples 1704191050 and 1704191052 the relative percent difference for lead was 23. 3%. Upper acceptance limit for relative percent difference is 25%.
114-SB-01-010	19-Apr-17	For EPA Method 335. 4 (soil), relative percent differences (RPD) for duplicate samples 1704191051 and 1704191053 were within control limits or below the calculable range.
114-SB-02-025	19-Apr-17	**For Total Metals (soil), matrix spike recoveries for sample 1704190937 for chromium, selenium, and lead were outside laboratory control limits low. Affected data are appropriately qualified.**
114-SB-02-025	19-Apr-17	For EPA Method 335. 4 (soil), matrix spike recoveries for sample 1704190938 were within laboratory control limits.
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for barium was 13. 1%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	**For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for chromium was 41. 2%. This value is outside the upper acceptance limit for relative percent difference of 25%.**
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for arsenic was 9. 9%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for cadmium was 16. 9%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	**For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for silver was 90. 0%. This value is outside the upper acceptance limit for relative percent difference of 25%.**

Location Sample_ID	Event Date	QA Narratives for Various Analytical Methods
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for mercury was 13. 6%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for lead was 4. 9%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	**For EPA Method 335. 4 (soil), field duplicate samples 1704181436 and 1704181438 the relative percent difference for cyanide was 25. 9%. This value is outside the upper acceptance limit for relative percent difference of 25%.**
114-SB-03-020	19-Apr-17	For Total Metals (water), barium (0. 00082 mg/L) was detected in the equipment blank (1704190720) below the reporting limit. No data are affected by this equipment blank contamination.
114-SB-03-020	19-Apr-17	For EPA Method 335. 4 (water), there were no detections in the equipment blank.
114-SB-05-005	18-Apr-17	For Total Metals (water), barium (0. 0054 mg/L) and chromium (0. 0035 mg/L) were detected in the equipment blank (1704180700) below the reporting limit. No data are affected by this equipment blank contamination.
114-SB-05-005	18-Apr-17	For EPA Method 335. 4 (water), there were no detections in the equipment blank.
114-SB-06-007	31-Oct-17	For SW-846 Method 9012A (water), there were no detections in the equipment blank.
114-SB-06-007	31-Oct-17	For SW-846 Method 9012A (water), there were no detections in the field blank.
114-SB-06-007	31-Oct-17	**For SW-846 Method 9012A (soil), cyanide, total (0. 04 mg/Kg) was detected in the method blank for analytical batch 302722. Affected data are appropriately qualified.**
114-SB-07-007	31-Oct-17	For SW-846 Method 9012, matrix spike recoveries for sample 1710310901 were within laboratory control limits.
114-SB-07-007	31-Oct-17	**For SW-846 Method 9012A (soil), cyanide, total (0. 04 mg/Kg) was detected in the method blank for analytical batch 302722. Affected data are appropriately qualified.**

Appendix F
Health Risk Statistics

ProUCL Input File SWMU 22: Background

Cr 4-8' BG4	Cr 4-8' SWMU22	As 8-12' BG4	As 8-12' SWMU22
4.07	11.00	2.55	14.00
4.15	9.50	3.09	4.00
4.21	12.00	3.10	3.80
4.76	5.70	3.65	6.10
4.90	19.00	3.73	7.30
5.49		3.90	
5.52		5.00	
6.46		5.30	
7.28		5.40	
7.36		5.70	
8.20		5.80	
9.80		6.60	
		7.60	
		9.90	

Note: The table shows the input file used to perform the background comparisons for arsenic and chromium at SWMU22. "BG4" indicates the column lists background concentrations, and "SWMU22" indicates the column lists investigation data. All units are mg/kg.

ProUCL Input File SWMU 22: UCL95

Arsenic	Barium	Cadmium	d_Cadmium	Chromium	Cyanide	d_Cyanide	Lead
6.10	110.00	0.14	1.00	11.00	0.46	1.00	1.50
14.00	33.00	0.18	1.00	5.50	0.00	0.00	2.40
4.00	68.00	1.10	1.00	9.50	8.60	1.00	4.80
4.00	39.00	0.09	1.00	7.30	2.40	1.00	2.40
5.70	32.00	0.11	1.00	7.50	0.85	1.00	3.70
12.00	58.00	0.15	1.00	12.00	0.00	0.00	2.40
5.10	33.00	0.11	1.00	8.30	2.60	1.00	5.40
5.30	73.00	0.64	1.00	12.00	1.50	1.00	4.20
3.80	61.00	0.13	0.00	9.00	0.00	0.00	3.50
7.00	46.00	0.13	1.00	8.50	0.00	0.00	2.20
7.40	39.00	3.80	1.00	12.00	1.60	1.00	3.90
6.30	39.00	0.07	1.00	4.00	0.00	0.00	3.10
5.40	81.00	0.06	0.00	5.70	0.00	0.00	3.80
6.10	120.00	0.06	0.00	8.60	0.00	0.00	5.60
9.90	53.00	0.06	0.00	19.00	2.22	1.00	1.30
7.30	40.00	0.06	0.00	6.40	0.09	1.00	3.10

Note: The table shows the input file used to calculate the UCL95 of these constituents. All units are mg/kg.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:43:47 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	16	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	3.8	Mean	6.837
Maximum	14	Median	6.1
SD	2.867	Std. Error of Mean	0.717
Coefficient of Variation	0.419	Skewness	1.441

Normal GOF Test

Shapiro Wilk Test Statistic	0.845	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.235	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	8.094	95% Adjusted-CLT UCL (Chen-1995)	8.293
		95% Modified-t UCL (Johnson-1978)	8.137

Gamma GOF Test

A-D Test Statistic	0.558	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.215	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.315	k star (bias corrected MLE)	5.985
Theta hat (MLE)	0.935	Theta star (bias corrected MLE)	1.142
nu hat (MLE)	234.1	nu star (bias corrected)	191.5
MLE Mean (bias corrected)	6.837	MLE Sd (bias corrected)	2.795
		Approximate Chi Square Value (0.05)	160.5
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	157.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	8.159	95% Adjusted Gamma UCL (use when n<50)	8.326

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.157	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.335	Mean of logged Data	1.853
Maximum of Logged Data	2.639	SD of logged Data	0.373

Assuming Lognormal Distribution

95% H-UCL	8.235	90% Chebyshev (MVUE) UCL	8.746
95% Chebyshev (MVUE) UCL	9.625	97.5% Chebyshev (MVUE) UCL	10.85
99% Chebyshev (MVUE) UCL	13.24		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	8.017	95% Jackknife UCL	8.094
95% Standard Bootstrap UCL	7.975	95% Bootstrap-t UCL	8.755
95% Hall's Bootstrap UCL	9.185	95% Percentile Bootstrap UCL	8.075
95% BCA Bootstrap UCL	8.275		
90% Chebyshev(Mean, Sd) UCL	8.988	95% Chebyshev(Mean, Sd) UCL	9.962
97.5% Chebyshev(Mean, Sd) UCL	11.31	99% Chebyshev(Mean, Sd) UCL	13.97

Suggested UCL to Use

95% Adjusted Gamma UCL	8.326

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2018 12:33:04 PM
From File	SWMU22_All_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0.000
Selected Null Hypothesis	Sample 1 Mean >= Sample 2 Mean (Form 2)
Alternative Hypothesis	Sample 1 Mean < the Sample 2 Mean

Sample 1 Data: As 8-12' BG4

Sample 2 Data: As 8-12' SWMU22

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	14	5
Number of Distinct Observations	14	5
Minimum	2.55	3.8
Maximum	9.9	14
Mean	5.094	7.04
Median	5.15	6.1
SD	2.009	4.157
SE of Mean	0.537	1.859

Sample 1 vs Sample 2 Two-Sample t-Test

H0: Mean of Sample 1 - Mean of Sample 2 >= 0

Method	DF	t-Test Value	Critical t (0.05)	P-Value
Pooled (Equal Variance)	17	-1.396	-1.740	0.090
Welch-Satterthwaite (Unequal Varian	4.7	-1.005	-2.015	0.182

Pooled SD: 2.675

Conclusion with Alpha = 0.050

Student t (Pooled) Test: Do Not Reject H0, Conclude Sample 1 >= Sample 2

Welch-Satterthwaite Test: Do Not Reject H0, Conclude Sample 1 >= Sample 2

Background is greater than or equal to Investigation Data; exclude as COPC

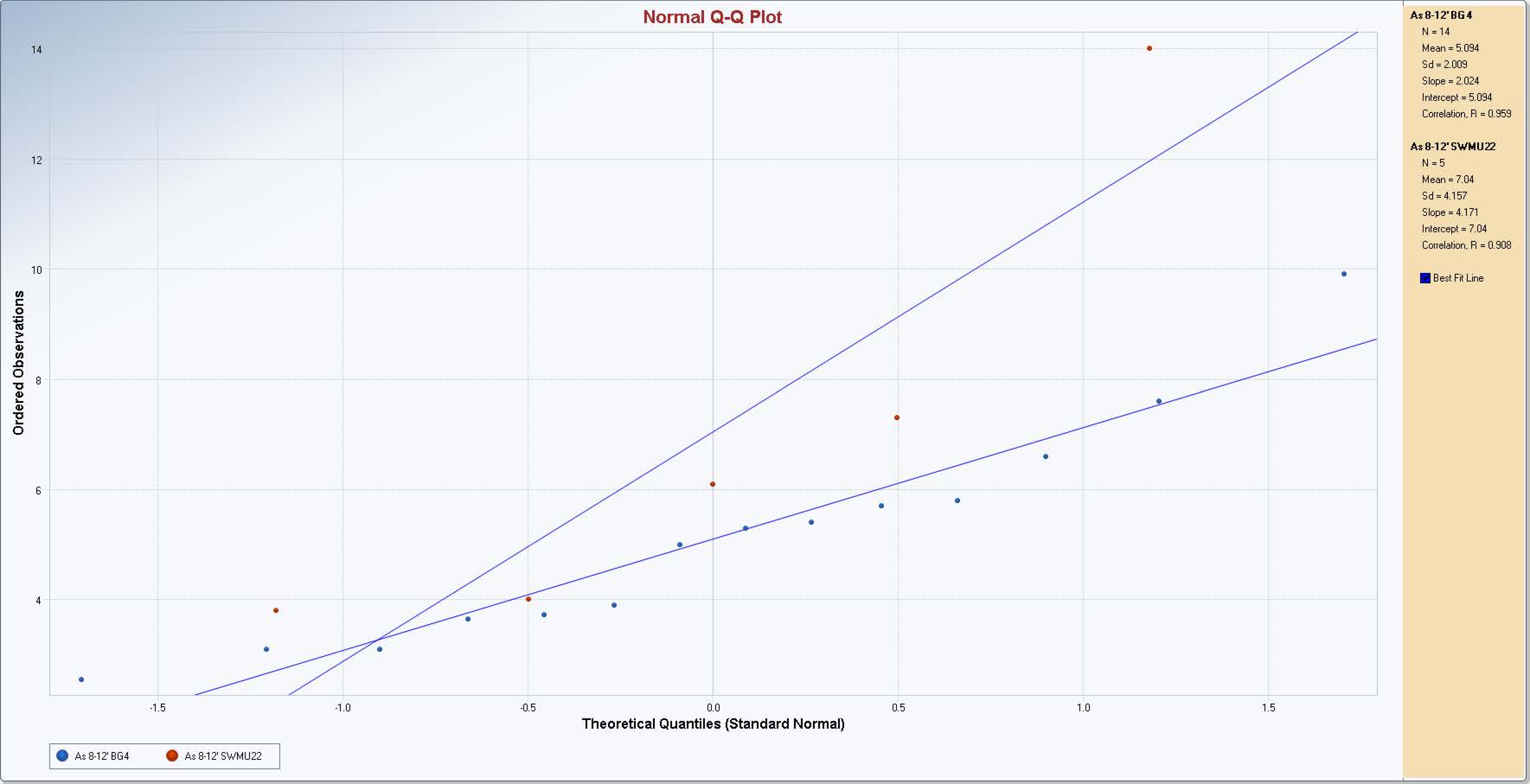
Test of Equality of Variances

Variance of Sample 1	4.038
Variance of Sample 2	17.28

Numerator DF	Denominator DF	F-Test Value	P-Value
4	13	4.280	0.040

Conclusion with Alpha = 0.05

Two variances are not equal


Normal Q-Q Plot
Ordered Observations
Theoretical Quantiles (Standard Normal)
14
12
10
8
6
4
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
As 8-12' BG4
As 8-12' SWMU22
As 8-12' BG4
N = 14
Mean = 5.094
Sd = 2.009
Slope = 2.024
Intercept = 5.094
Correlation, R = 0.959
As 8-12' SWMU22
N = 5
Mean = 7.04
Sd = 4.157
Slope = 4.171
Intercept = 7.04
Correlation, R = 0.908
Best Fit Line

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:45:53 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Barium

General Statistics

Total Number of Observations	16	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	32	Mean	57.81
Maximum	120	Median	49.5
SD	26.97	Std. Error of Mean	6.743
Coefficient of Variation	0.467	Skewness	1.26

Normal GOF Test

Shapiro Wilk Test Statistic	0.847	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.183	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	69.63	95% Adjusted-CLT UCL (Chen-1995)	71.17
		95% Modified-t UCL (Johnson-1978)	69.99

Gamma GOF Test

A-D Test Statistic	0.588	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.194	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.818	k star (bias corrected MLE)	4.769
Theta hat (MLE)	9.937	Theta star (bias corrected MLE)	12.12
nu hat (MLE)	186.2	nu star (bias corrected)	152.6
MLE Mean (bias corrected)	57.81	MLE Sd (bias corrected)	26.47
		Approximate Chi Square Value (0.05)	125
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	122.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	70.55	95% Adjusted Gamma UCL (use when n<50)	72.19

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.184	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.466	Mean of logged Data	3.969
Maximum of Logged Data	4.787	SD of logged Data	0.421

Assuming Lognormal Distribution

95% H-UCL	71.66	90% Chebyshev (MVUE) UCL	76.05
95% Chebyshev (MVUE) UCL	84.46	97.5% Chebyshev (MVUE) UCL	96.13
99% Chebyshev (MVUE) UCL	119.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	68.9	95% Jackknife UCL	69.63
95% Standard Bootstrap UCL	68.39	95% Bootstrap-t UCL	74.38
95% Hall's Bootstrap UCL	75.13	95% Percentile Bootstrap UCL	69
95% BCA Bootstrap UCL	70.19		
90% Chebyshev(Mean, Sd) UCL	78.04	95% Chebyshev(Mean, Sd) UCL	87.2
97.5% Chebyshev(Mean, Sd) UCL	99.92	99% Chebyshev(Mean, Sd) UCL	124.9

Suggested UCL to Use

95% Student's-t UCL	69.63

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:46:51 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cadmium

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
Number of Detects	11	Number of Non-Detects	5
Number of Distinct Detects	10	Number of Distinct Non-Detects	5
Minimum Detect	0.073	Minimum Non-Detect	0.0614
Maximum Detect	3.8	Maximum Non-Detect	0.126
Variance Detects	1.232	Percent Non-Detects	31.25%
Mean Detects	0.593	SD Detects	1.11
Median Detects	0.14	CV Detects	1.87
Skewness Detects	2.885	Kurtosis Detects	8.668
Mean of Logged Detects	-1.456	SD of Logged Detects	1.239

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.529	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.373	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.428	KM Standard Error of Mean	0.239
KM SD	0.911	95% KM (BCA) UCL	0.858
95% KM (t) UCL	0.847	95% KM (Percentile Bootstrap) UCL	0.843
95% KM (z) UCL	0.821	95% KM Bootstrap t UCL	2.412
90% KM Chebyshev UCL	1.145	95% KM Chebyshev UCL	1.469
97.5% KM Chebyshev UCL	1.92	99% KM Chebyshev UCL	2.805

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.489	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.77	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.37	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.267	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.653	k star (bias corrected MLE)	0.536
Theta hat (MLE)	0.909	Theta star (bias corrected MLE)	1.108
nu hat (MLE)	14.37	nu star (bias corrected)	11.78
Mean (detects)	0.593		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.411
Maximum	3.8	Median	0.11
SD	0.948	CV	2.306
k hat (MLE)	0.421	k star (bias corrected MLE)	0.383
Theta hat (MLE)	0.977	Theta star (bias corrected MLE)	1.072
nu hat (MLE)	13.46	nu star (bias corrected)	12.27
Adjusted Level of Significance (β)	0.0335		
Approximate Chi Square Value (12.27, α)	5.406	Adjusted Chi Square Value (12.27, β)	4.897
95% Gamma Approximate UCL (use when n>=50)	0.933	95% Gamma Adjusted UCL (use when n<50)	1.03

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.428	SD (KM)	0.911
Variance (KM)	0.83	SE of Mean (KM)	0.239
k hat (KM)	0.221	k star (KM)	0.221
nu hat (KM)	7.074	nu star (KM)	7.081
theta hat (KM)	1.937	theta star (KM)	1.935
80% gamma percentile (KM)	0.593	90% gamma percentile (KM)	1.294
95% gamma percentile (KM)	2.147	99% gamma percentile (KM)	4.461

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.08, α)	2.215	Adjusted Chi Square Value (7.08, β)	1.919
95% Gamma Approximate KM-UCL (use when n>=50)	1.369	95% Gamma Adjusted KM-UCL (use when n<50)	1.581

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.799	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.31	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.414	Mean in Log Scale	-2.25
SD in Original Scale	0.947	SD in Log Scale	1.595
95% t UCL (assumes normality of ROS data)	0.829	95% Percentile Bootstrap UCL	0.858
95% BCA Bootstrap UCL	1.059	95% Bootstrap t UCL	2.295
95% H-UCL (Log ROS)	1.737		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.859	KM Geo Mean	0.156
KM SD (logged)	1.151	95% Critical H Value (KM-Log)	2.943
KM Standard Error of Mean (logged)	0.302	95% H-UCL (KM -Log)	0.724
KM SD (logged)	1.151	95% Critical H Value (KM-Log)	2.943
KM Standard Error of Mean (logged)	0.302		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.42	Mean in Log Scale	-2.041
SD in Original Scale	0.944	SD in Log Scale	1.361
95% t UCL (Assumes normality)	0.834	95% H-Stat UCL	1.045

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	1.469

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:47:52 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chromium

General Statistics

Total Number of Observations	16	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	4	Mean	9.144
Maximum	19	Median	8.55
SD	3.576	Std. Error of Mean	0.894
Coefficient of Variation	0.391	Skewness	1.293

Normal GOF Test

Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.15	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10.71	95% Adjusted-CLT UCL (Chen-1995)	10.92
		95% Modified-t UCL (Johnson-1978)	10.76

Gamma GOF Test

A-D Test Statistic	0.237	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.12	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.215	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.675	k star (bias corrected MLE)	6.278
Theta hat (MLE)	1.191	Theta star (bias corrected MLE)	1.456
nu hat (MLE)	245.6	nu star (bias corrected)	200.9
MLE Mean (bias corrected)	9.144	MLE Sd (bias corrected)	3.649
		Approximate Chi Square Value (0.05)	169.1
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	165.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	10.86	95% Adjusted Gamma UCL (use when n<50)	11.08

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.98	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.386	Mean of logged Data	2.147
Maximum of Logged Data	2.944	SD of logged Data	0.376

Assuming Lognormal Distribution

95% H-UCL	11.08	90% Chebyshev (MVUE) UCL	11.77
95% Chebyshev (MVUE) UCL	12.96	97.5% Chebyshev (MVUE) UCL	14.61
99% Chebyshev (MVUE) UCL	17.85		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	10.61	95% Jackknife UCL	10.71
95% Standard Bootstrap UCL	10.54	95% Bootstrap-t UCL	11.17
95% Hall's Bootstrap UCL	11.8	95% Percentile Bootstrap UCL	10.63
95% BCA Bootstrap UCL	10.84		
90% Chebyshev(Mean, Sd) UCL	11.83	95% Chebyshev(Mean, Sd) UCL	13.04
97.5% Chebyshev(Mean, Sd) UCL	14.73	99% Chebyshev(Mean, Sd) UCL	18.04

Suggested UCL to Use

95% Student's-t UCL	10.71

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2018 11:14:26 AM
From File	SWMU22_All_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0.000
Selected Null Hypothesis	Sample 1 Mean >= Sample 2 Mean (Form 2)
Alternative Hypothesis	Sample 1 Mean < the Sample 2 Mean

Sample 1 Data: Cr 4-8' BG4

Sample 2 Data: Cr 4-8' SWMU22

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	12	5
Number of Distinct Observations	12	5
Minimum	4.07	5.7
Maximum	9.8	19
Mean	6.017	11.44
Median	5.505	11
SD	1.823	4.857
SE of Mean	0.526	2.172

Sample 1 vs Sample 2 Two-Sample t-Test

H0: Mean of Sample 1 - Mean of Sample 2 >= 0

Method	DF	t-Test Value	Critical t (0.05)	P-Value
Pooled (Equal Variance)	15	-3.449	-1.753	0.002
Welch-Satterthwaite (Unequal Varian	4.5	-2.426	-2.132	0.033

Pooled SD: 2.955

Conclusion with Alpha = 0.050

Student t (Pooled) Test: Reject H0, Conclude Sample 1 < Sample 2

Welch-Satterthwaite Test: Reject H0, Conclude Sample 1 < Sample 2

Background is less than Investigation data; include as COPC

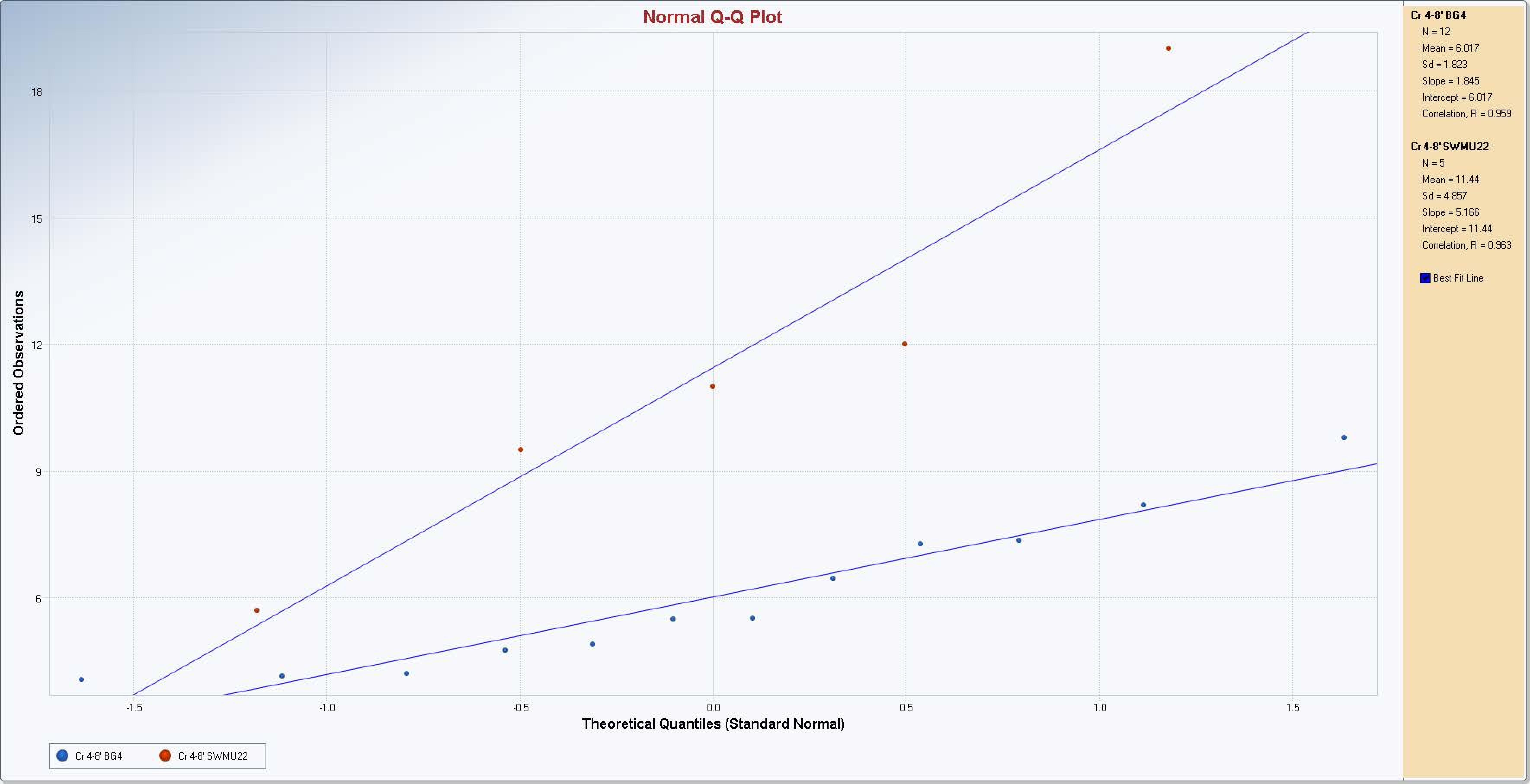
Test of Equality of Variances

Variance of Sample 1	3.324
Variance of Sample 2	23.59

Numerator DF	Denominator DF	F-Test Value	P-Value
4	11	7.097	0.009

Conclusion with Alpha = 0.05

Two variances are not equal


Normal Q-Q Plot
Ordered Observations
Theoretical Quantiles (Standard Normal)
18
15
12
9
6
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Cr 4-8' BG4
N = 12
Mean = 6.017
Sd = 1.823
Slope = 1.845
Intercept = 6.017
Correlation, R = 0.959
Cr 4-8' SWMU22
N = 5
Mean = 11.44
Sd = 4.857
Slope = 5.166
Intercept = 11.44
Correlation, R = 0.963
Best Fit Line
Cr 4-8' BG4
Cr 4-8' SWMU22

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:48:54 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cyanide

General Statistics

Total Number of Observations	16	Number of Distinct Observations	10
Number of Detects	9	Number of Non-Detects	7
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	0.09	Minimum Non-Detect	0
Maximum Detect	8.6	Maximum Non-Detect	0
Variance Detects	6.41	Percent Non-Detects	43.75%
Mean Detects	2.258	SD Detects	2.532
Median Detects	1.6	CV Detects	1.121
Skewness Detects	2.333	Kurtosis Detects	6.216

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.721	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.335	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.27	KM Standard Error of Mean	0.56
KM SD	2.112	95% KM (BCA) UCL	2.454
95% KM (t) UCL	2.252	95% KM (Percentile Bootstrap) UCL	2.251
95% KM (z) UCL	2.191	95% KM Bootstrap t UCL	3.198
90% KM Chebyshev UCL	2.95	95% KM Chebyshev UCL	3.711
97.5% KM Chebyshev UCL	4.767	99% KM Chebyshev UCL	6.842

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.312	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.206	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.287	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.031	k star (bias corrected MLE)	0.761
Theta hat (MLE)	2.19	Theta star (bias corrected MLE)	2.965
nu hat (MLE)	18.56	nu star (bias corrected)	13.71
Mean (detects)	2.258		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.27	SD (KM)	2.112
Variance (KM)	4.46	SE of Mean (KM)	0.56
k hat (KM)	0.362	k star (KM)	0.336
nu hat (KM)	11.57	nu star (KM)	10.74
theta hat (KM)	3.512	theta star (KM)	3.785
80% gamma percentile (KM)	1.996	90% gamma percentile (KM)	3.691
95% gamma percentile (KM)	5.601	99% gamma percentile (KM)	10.5

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0335
Approximate Chi Square Value (10.74, α)	4.407	Adjusted Chi Square Value (10.74, β)	3.955
95% Gamma Approximate KM-UCL (use when n>=50)	3.094	95% Gamma Adjusted KM-UCL (use when n<50)	3.447

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	N/A	KM Geo Mean	N/A
KM SD (logged)	N/A	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	N/A	95% H-UCL (KM -Log)	N/A
KM SD (logged)	N/A	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	N/A		

DL/2 Statistics

Mean in Original Scale	1.27	SD in Original Scale	2.181
95% t UCL (Assumes normality)	2.226		

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

ı Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	3.447

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:49:58 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	16	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	1.3	Mean	3.331
Maximum	5.6	Median	3.3
SD	1.278	Std. Error of Mean	0.32
Coefficient of Variation	0.384	Skewness	0.229

Normal GOF Test

Shapiro Wilk Test Statistic	0.965	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.142	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.892	95% Adjusted-CLT UCL (Chen-1995)	3.876
		95% Modified-t UCL (Johnson-1978)	3.895

Gamma GOF Test

A-D Test Statistic	0.245	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.123	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.624	k star (bias corrected MLE)	5.423
Theta hat (MLE)	0.503	Theta star (bias corrected MLE)	0.614
nu hat (MLE)	212	nu star (bias corrected)	173.5
MLE Mean (bias corrected)	3.331	MLE Sd (bias corrected)	1.43
		Approximate Chi Square Value (0.05)	144.1
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	141

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.013	95% Adjusted Gamma UCL (use when n<50)	4.099

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.13	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.262	Mean of logged Data	1.126
Maximum of Logged Data	1.723	SD of logged Data	0.422

Assuming Lognormal Distribution

95% H-UCL	4.181	90% Chebyshev (MVUE) UCL	4.437
95% Chebyshev (MVUE) UCL	4.929	97.5% Chebyshev (MVUE) UCL	5.612
99% Chebyshev (MVUE) UCL	6.954		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.857	95% Jackknife UCL	3.892
95% Standard Bootstrap UCL	3.837	95% Bootstrap-t UCL	3.944
95% Hall's Bootstrap UCL	3.896	95% Percentile Bootstrap UCL	3.831
95% BCA Bootstrap UCL	3.844		
90% Chebyshev(Mean, Sd) UCL	4.29	95% Chebyshev(Mean, Sd) UCL	4.724
97.5% Chebyshev(Mean, Sd) UCL	5.327	99% Chebyshev(Mean, Sd) UCL	6.511

Suggested UCL to Use

95% Student's-t UCL	3.892

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix G
Ecological Checklist

NEW MEXICO ENVIRONMENT DEPARTMENT
SITE ASSESSMENT CHECKLIST

I. SITE LOCATION

1. Site

Name:	Building 114 septic tank
US EPA I.D. Number:	SWMU 22
Location:	NASA
County:	Dona Ana
City:	NA
State:	New Mexico

2. Latitude: 32°30'06.35"N Longitude: 106°36'35.69"W

3. Attach site maps, including a topographical map, a diagram which illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps which illustrate known release areas, sampling locations, and any other important features, if available.

   See septic tank investigation report to which this checklist is attached.

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft).
   Less than 1/10th of an acre.

2. Provide an approximate breakdown of the land uses on the site:

95	% Heavy Industrial		% Light Industrial		% Urban
	% Residential		% Rural		% Agricultural[b]
	% Recreational[a]	5	% Undisturbed		% Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, etc.):

[b]For agricultural areas, please list the crops and/or livestock which are present:

[c]For areas designated as "other", please describe the usage of the area:

3. Provide an approximate breakdown of the land uses in the area surrounding the site.
Indicate the radius (in miles) of the area described: 0.10 mile

	% Heavy Industrial	65	% Light Industrial		% Urban
	% Residential		% Rural		% Agricultural[b]
	% Recreational[a]	35	% Undisturbed		% Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, golf course, etc.):
NA

[b]For agricultural areas, please list the crops and/or livestock which are present:
NA

[c]For areas designated as "other", please describe the usage of the area:
NA

4. Describe reasonable and likely future land and/or water use(s) at the site.

Approximately 60 foot (ft) X 20 ft area associated with a previously existing septic tank that serviced buildings 114 and 119 at the NASA facility.

5. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).

According to long-term WSTF personnel, the Building 114 septic tank was installed in 1963, originally to service domestic wastewater originating from Building 114 and the temporary trailer. Building 119 was constructed in the mid-1990s and connected to the Building 114 sanitary sewer lines that led to the septic system. The only evidence discovered of potentially hazardous constituents discharged to the septic tank was reported by a long-term WSTF employee who stated that between approximately 1963 and 1985, there had been waste *"plate-maker"* machine chemicals and waste electrostatic printing chemicals discharged to the septic tank. These waste potentially contain silver and cyanide.

6. If any movement of soil has taken place at the site, describe the degree of the disturbance. Indicate the likely source of any disturbances (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) and estimate when these events occurred.

The Building 114 septic tank was removed in November 2016. Soil disturbance occurred from the surface to a depth of approximately 6 feet below ground surface (ft bgs).

7. Describe the current uses of the site. Include information on recent (previous 5 years) disturbances or chemical releases that have occurred. For each chemical release, provide information on the form of the chemical released and the causes or mechanism of the release.

   Gravel parking lot adjacent to Building 114. Waste "plate-maker" and electrostatic printing chemical discharges ceased in 1985. Subsequent to 1985, only hand washing wastes were discharged to the septic tank.

8. Identify the location or suspected location of chemical releases at the site. Provide an estimate of the distance between these locations and the areas identified in Section III.

   Suspected releases occurred at the base of the septic tank, approximately 6 feet below ground.

9. Identify the suspected contaminants of concern (COCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc.).

   Reported maximum concentrations of identified COPCs in subsurface soils follow: Cadmium (3.8 milligrams per kilogram [mg/kg]) ; total Chromium (19 mg/kg); Cyanide (8.6 mg/kg) , and; Silver (0.94 mg/kg).
   These constituent concentrations are compared with Ecological Screening Levels (ESL) listed in the RA Guidance Volume II Attachment C for plants (Table 1, attached), deer mouse and horned lark. Due to the small size of SWMU 22 (1/10th of an acre), comparisons to Tier I ESLs for the kit fox, red-tailed hawk, and pronghorn antelope were not performed. The maximum total Chromium concentration exceeds the Tier 1 ESL for plants and the horned lark. The maximum Cyanide concentration exceeds the Tier I ESL for the horned lark.

10. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.

    Subsurface soil over 5 ft below ground surface (bgs).

11. Indicate the approximate depth to groundwater (in feet below ground surface [bgs]).

    The depth to groundwater in the nearest monitoring well (NASA-4) as measured during November 2017 was approximately 137 feet below ground.

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.).

    Groundwater flow is to the west.

III. HABITAT EVALUATION

III.A Wetland Habitats

Are any wetland[1] areas such as marshes or swamps on or adjacent to the site?

☐ Yes ☒ No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location), and clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination that wetland areas are or are not present.

____

____

____

If no wetland areas are present, proceed to Section III.B.

Wetland Area Questions

☐ Onsite ☐ Offsite

Name or Designation: ______________________________

1. Indicate the approximate area of the wetland (acres or ft^2): Click or tap here to enter text.

2. Identify the type(s) of vegetation present in the wetland.

☐ Submergent (i.e., underwater) vegetation
☐ Emergent (i.e., rooted in the water, but rising above it) vegetation
☐ Floating vegetation
☐ Scrub/shrub
☐ Wooded
☐Other (Please describe): __________________________

[1] Wetlands are defined in 40 CFR §232.2 as "Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

3. Estimate the vegetation density of the wetland area.

☐Dense (i.e., greater than 75% vegetation)
☐Moderate (i.e., 25% to 75% vegetation)
☐Sparse (i.e., less than 25% vegetation)

4. Is standing water present? ☐Yes ☐No

If yes, is the water primarily: ☐Fresh or ☐Brackish
Indicate the approximate area of the standing water (ft^2): ____________________
Indicate the approximate depth of the standing water, if known (ft. or in.): __________

5. If known, indicate the source of the water in the wetland.

☐Stream/River/Creek/Lake/Pond
☐Flooding
☐Groundwater
☐Surface runoff

6. Is there a discharge from the facility to the wetland? ☐Yes ☐No If yes, please describe:

____
____
____

7. Is there a discharge from the wetland? ☐Yes ☐No
If yes, indicate the type of aquatic feature the wetland discharges into:
☐Surface stream/River (Name: ______________________________
☐Lake/Pond (Name: ______________________________
☐Groundwater
☐Not sure

Wetland Area Questions (Continued)

8. Does the area show evidence of flooding? ☐Yes ☐No
If yes, indicate which of the following are present (mark all that apply):

☐Standing water
☐Water-saturated soils
☐Water marks
☐Buttressing
☐Debris lines
☐Mud cracks
☐Other (Please describe): ______________________________

9. Animals observed in the wetland area or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

____
____
____

III.B Aquatic Habitats

III.B.1 Non-Flowing Aquatic Features

Are any non-flowing aquatic features (such as ponds or lakes) located at or adjacent to the site?

☐Yes ☒ No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.B.2.

Non-Flowing Aquatic Feature Questions

☐ Onsite ☐ Offsite

Name or Designation: ______________________________

1. Indicate the type of aquatic feature present:

   ☐Natural (e.g., pond or lake)
   ☐Man-made (e.g., impoundment, lagoon, canal, etc.)

2. Estimate the approximate size of the water body (in acres or sq. ft.): ______________
3. If known, indicate the depth of the water body (in ft. or in.): ______________

4. Indicate the general composition of the bottom substrate. Mark all sources that apply from the following list.

   ☐Bedrock Sand ☐Concrete
   ☐Boulder (>10 in.) ☐Silt Debris
   ☐Cobble (2.5 - 10 in.) ☐Clay Detritus
   ☐Gravel (0.1 - 2.5 in.) ☐Muck (fine/black)
   ☐Other (Please specify): ______________________________

Non-Flowing Aquatic Feature Questions (Continued)

5. Indicate the source(s) of the water in the aquatic feature. Mark all sources that apply from the following list.

   ☐River/Stream/Creek
   ☐Groundwater
   ☐Industrial Discharge
   ☐Surface Runoff
   ☐Other (Please specify): ____________________

6. Is there a discharge from the facility to the aquatic feature? Yes ☐ No ☐
   If yes, describe the origin of each discharge and its migration path:

   ____
   ____
   ____

7. Does the aquatic feature discharge to the surrounding environment? Yes ☐ No ☐
   If yes, indicate the features from the following list into which the aquatic feature discharges, and indicate whether the discharge occurs onsite or offsite:

☐River/Stream/Creek	☐onsite	☐ offsite
☐Groundwater	☐onsite	☐ offsite
☐Wetland	☐onsite	☐ offsite
☐Impoundment	☐onsite	☐ offsite

   ☐Other (Please specify): ____________________

8. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Fish
   ☐Mammals
   ☐Reptiles (e.g., snakes, turtles)
   ☐Amphibians (e.g., frogs, salamanders)
   ☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

   Specify species, if known:

   ____

III.B.2 Flowing Aquatic Features

Are any flowing aquatic features (such as streams or rivers) located at or adjacent to the site?

☐Yes ☒No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the flowing aquatic features. If more than one flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map

If no, proceed to Section III.C.

Flowing Aquatic Feature Questions

☐Onsite ☐Offsite

Name or Designation: ______________________________

1. Indicate the type of flowing aquatic feature present.

☐River
☐Stream
☐Creek
☐Brook
☐Dry wash
☐Arroyo
☐Intermittent stream
☐Artificially created (ditch, etc.)
☐Other (Please specify): ______________________________

2. Indicate the general composition of the bottom substrate.

☐Bedrock Sand	☐Concrete
☐Boulder (>10 in.)	☐Silt Debris
☐Cobble (2.5 - 10 in.)	☐Clay Detritus
☐Gravel (0.1 - 2.5 in.)	☐Muck (fine/black)

☐Other (Please specify): ______________________________

3. Describe the condition of the bank (e.g., height, slope, extent of vegetative cover) of the aquatic feature.

____
____
____

4. Is there a discharge from the facility to the aquatic feature? ☐Yes ☐No
If yes, describe the origin of each discharge and its migration path:

____
____
____

5. Indicate the discharge point of the water body. Specify name, if known.

____
____
____

Flowing Aquatic Feature Questions (Continued)

6. If the flowing aquatic feature is a dry wash or arroyo, answer the following questions.

☐Check here if feature is not a dry wash or arroyo

If known, specify the average number of days in a year in which flowing water is present in the feature: ____.

Is standing water or mud present? Check all that apply.

☐Standing water

☐Mud

☐Neither standing water or mud

Does the area show evidence of recent flow (e.g., flood debris clinging to vegetation)?

☐Yes

☐No

☐Not sure

7. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☐Birds

☐Fish

☐Mammals

☐Reptiles (e.g., snakes, turtles)

☐Amphibians (e.g., frogs, salamanders)

☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

____

____

____

III.C Terrestrial Habitats
III.C.1 Wooded

Are any wooded areas on or adjacent to the site? ☐Yes ☒No

> If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.2.

Wooded Area Questions

☐On-site ☐Off-site

Name or Designation: ______________________________

1. Estimate the approximate size of the water body (in acres or sq. ft.): ______________
2. Indicate the dominant type of vegetation in the wooded area.

   ☐Evergreen
   ☐Deciduous
   ☐Mixed
   Dominant plant species, if known: ______________________________

3. Estimate the vegetation density of the wooded area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☐Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at chest height.

   ☐0-6 inches
   ☐6-12 inches
   ☐>12 inches
   ☐No single size range is predominant

5. Animals observed in the wooded area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   ____
   ____
   ____

III.C.2 Shrub/Scrub

Are any shrub/scrub areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.3.

Shrub/Scrub Area Questions

☒On-Site ☒Off-Site

Name or Designation: Mixed Chihuahuan Desert Scrub

1. Estimate the approx. size of the shrub/scrub (in acres or sq. ft.): See 2 below
2. Indicate the dominant type of shrub/scrub vegetation present, if known.

   SWMU 22 is located within a surrounding environment of largely undeveloped Chihuahuan desert scrub habitat typical of the Jornada del Muerto Basin of southern Dona Ana County, NM. Thousands of acres of mixed desert scrub, playa lakebeds, bare ground, and desert grasslands define this portion the basin Chihuahuan desert habitat. Specific species dominant adjacent to this site include honey mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), and mariola (*Parthenium incanum*). The area at the previously existing septic tank is currently a gravel parking lot. The area leading to the north is fairly recently disturbed desert comprised of bare ground, gravel, and annual plants (primarily sunflowers ([*Asteracea* spp]).

3. Estimate the vegetation density of the shrub/scrub area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☒Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the scrub/shrub vegetation.

   ☒0-2 feet
   ☐2-5 feet
   ☐>5 feet

5. Animals observed in the shrub/scrub area or suspected to be present based on indirect evidence or file material:
   ☒Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   A single rock dove (*Columba livia*) was observed inside building 114. A red tailed hawk *(Buteo jamaicensis*) was observed perched on a power pole at 145 yards northwest of the SWMU. No other birds were detected during the site visit.

III.C.3 Grassland

Are any grassland areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the grassland area on the attached site map and answer the following questions. If more than one grassland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual grassland area. Distinguish between grassland areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.4.

Grassland Area Questions

☐On-Site ☐Off-Site

Name or Designation: ____

1. Estimate the approximate size of the grassland area (in acres or sq. ft.): ____________

2. Indicate the dominant plant type, if known.

   ____
   ____
   ____

3. Estimate the vegetation density of the grassland area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☐Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the dominant plant type (in ft. or in.). ______

5. Animals observed in the grassland area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   ____

III.C.4 Desert

Are any desert areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the desert area on the attached site map and answer the following questions. If more than one desert area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual desert area. Distinguish between desert areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.5.

Desert Area Questions

☒On-Site ☒Off-Site

Name or Designation: Chihuahuan Desert

1. Estimate the approximate size of the desert area (in acres or sq. ft.): See section III.C.2

2. Describe the desert area (e.g., presence or absence of vegetation, vegetation types, presence/size of rocks, sand, etc.)
   See section III.C.2 above

3. Animals observed in the desert area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known: Please See section III.C.2 above

III.C.5 Other

1. Are there any other terrestrial communities or habitats on or adjacent to the site which were not previously described?
☐Yes ☒No

If yes, indicate the "other" area(s) on the attached site map and describe the area(s) below. Distinguish between onsite and offsite areas. If no, proceed to Section III.D.

No

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas[2] exist adjacent to or within 0.5 miles of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*

No

2. Are any areas on or near (i.e., within 0.5 miles) the site which are owned or used by local tribes? If yes, describe. *Contact the Tribal Liaison in the Office of the Secretary (505)827-2855 to obtain this information.*

No

4. Does the site serve or potentially serve as a habitat, foraging area, or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*

Yes, the State Endangered night-blooming cereus (*Peniocereus greggii*) is known to exist in scattered populations around White Sands Test Facility (WSTF). Multiple surveys have been conducted for decades on this rare plant throughout WSTF. None of these plants were observed at or near SWMU 22. Current conditions at this SWMU do not provide good habitat for this rare cactus. Surrounding desert habitat may provide. adequate habitat.

[2] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to **Table 1** at the end of this document for examples of sensitive environments.

5. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.

   Yes, literally dozens of species of migratory birds may stop by on their way past SWMU 22. It is not likely that many individuals would ever stay for extended periods of time directly on this site since it a gravel parking lot, Nearby buildings and power poles provide elevated perch sites that are used for resting and roosting by birds.

6. Is the site used by any ecologically[3], recreationally, or commercially important species? If yes, explain.

   No

IV. EXPOSURE PATHWAY EVALUATION

1. Do existing data provide sufficient information on the nature, rate, and extent of contamination at the site?

   ☒Yes
   ☐No
   ☐Uncertain

   Please provide an explanation for your answer:

   See septic tank investigation report to which this checklist is attached.

2. Do existing data provide sufficient information on the nature, rate, and extent of contamination in offsite affected areas?

   ☒Yes
   ☐No
   ☐Uncertain
   ☐No offsite contamination

   Please provide an explanation for your answer:

   See septic tank investigation report to which this checklist is attached.

[3] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms and whose function as such would not be replaced by more tolerant species; or perform a critical ecological function (such as organic matter decomposition) and whose functions will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area <u>if they serve as a food source for other species</u>, but do <u>not</u> include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc.).

3. Do existing data address potential migration pathways of contaminants at the site?

   ☒Yes
   ☐No
   ☐Uncertain

   Please provide an explanation for your answer:

   See septic tank investigation report to which this checklist is attached.

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

   ☒Yes
   ☐No
   ☐Uncertain
   ☐No offsite contamination

   Please provide an explanation for your answer:

   See septic tank investigation report to which this checklist is attached.

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within 0.5 miles) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available.

   No

6. Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 5 feet below ground surface (bgs). If yes, explain.

   The septic tank investigation report to which this checklist is attached.

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.

   No

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.

   No

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions:

What is the approximate distance from the contaminated area to the nearest watercourse or arroyo?

☐0 feet (i.e., contamination has reached a watercourse or arroyo)
☐1-10 feet
☐11-20 feet
☐21-50 feet
☐51-100 feet
☐101-200 feet
☐> 200 feet
☐> 500 feet
☒> 1000 feet

What is the slope of the ground in the contaminated area?
☒0-10%
☐10-30%
☐> 30%

What is the approximate amount of ground and canopy vegetative cover in the contaminated area?
☒< 25%
☐25-75%
☐> 75%

Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?
☒Yes
☐No
☐Do not know

Do any structures, pavement, or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

☐Yes
☒No
☐Do not know

10. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.

    No

11. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?

    No

12. Could receptors be impacted by external irradiation at the site? Are gamma emitting radionuclides present at the site? Is the radionuclide contamination buried or at the surface?

    No

PHOTOGRAPHIC DOCUMENTATION

During the site visit(s), photographs should be taken to document the current conditions at the site and to support the information entered in the checklist. For example, photographs may be used to document the following: The nature, quality, and distribution of vegetation at the site

- Receptors or evidence of receptors
- Potentially important ecological features, such as ponds and drainage ditches
- Potential exposure pathways
- Any evidence of contamination or impact

The following space may be used to record photo subjects.

SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.

SWMU 22 is limited in size at less than 1/10 of an acre. The site occurs adjacent to numerous buildings within a large gravel capped parking lot and within 180 feet of a paved roadway. No ecologically important habitats or organisms exist at, or adjacent to, the site. As noted above State Endangered night blooming cereus are known from desert habitats around the NASA facility, none are known to occur at the site or within close proximity.

Concentrations of detected constituents are compared with Tier I ESLs for plants and deer mouse. Due to the limited size of the site, impacts to the kit fox, red-tailed hawk, and pronghorn antelope were not evaluated. The maximum total chromium concentration exceeds the Tier 1 ESL for plants.

Checklist Completed by: Doug Burkett

Affiliation: Burkett Ecological Services

Author Assisted by:

Date:

Comparison of Tier I Ecological Screening Levels for Selected Species And Maximum Constituent Concentrations

Table 1 - Plants

Constituents	Maximum Concentration 0'-10' bgs (mg/kg)	Tier I ESL[1] Plants (mg/kg)	Screening Level Hazard Indices
Cadmium	1.10E+00	3.20E+01	3.44E-02
Chromium, total	**1.90E+01**	3.50E-01	5.43E+01
Cyanide	8.60E+00	NE	--
Silver	9.40E-01	5.60E+02	1.68E-03
Screening Level Hazard Quotient (SLHQ)			**5.43E+01**

Bold font indicates exceedance of ESL.

[1]ESLs from NMED Risk Assessment Guidance Volume II (March, 2017) Attachment C.

ESL = Ecological Screening Level

SLHQ = Screening Level Hazard Quotient (sum of hazard indices).

Table 2 - Deer Mouse

Constituents	Maximum Concentration 0'-10' bgs (mg/kg)	Tier I ESL[1] Deer Mouse (mg/kg)	Screening Level Hazard Indices
Cadmium	1.10E+00	7.00E+00	1.57E-01
Chromium, total	1.90E+01	2.18E+01	8.72E-01
Cyanide	8.60E+00	6.24E+02	1.38E-02
Silver	9.40E-01	5.47E+01	1.72E-02
SLHQ			**1.06E+00**

Bold font indicates exceedance of ESL.

[1]ESLs from NMED Risk Assessment Guidance Volume II (March, 2017) Attachment C.

ESL = Ecological Screening Level

SLHQ = Screening Level Hazard Quotient (sum of hazard indices).

National Aeronautics and Space Administration

Revised WSTF Septic Tanks (SWMUs 21-27) Investigation Report

February 2018

Revised July 2019

Revised May 2021

Revised June 2023

NM8800019434

Revised WSTF Septic Tanks (SWMUs 21-27) Investigation Report

February 2018

Revised July 2019

Revised May 2021

Revised June 2023

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

_______________________________ _______________________________

Timothy J. Davis
Chief, Environmental Office

Date

National Aeronautics and Space Administration

Johnson Space Center
White Sands Test Facility
12600 NASA Road
Las Cruces, NM 88012
www.nasa.gov/centers/wstf

www.nasa.gov

Executive Summary

The National Aeronautics and Space Administration (NASA) is required by the New Mexico Environment Department (NMED)-issued Hazardous Waste Permit (Permit; NMED, 2016) to determine the nature, extent, and potential migration pathways of contaminant releases from solid waste management units (SWMUs) at the Johnson Space Center (JSC) White Sands Test Facility (WSTF). This investigation report (IR) addresses applicable Permit and NMED regulatory requirements, describes the investigation activities, summarizes investigation results, provides an interpretation of the results, and presents conclusions and recommendations for all septic tanks located at WSTF. Seven WSTF septic tanks are identified in the Permit as SWMUs as follows:

- SWMU 21 – 100 Area Septic Tank at Guard Shack (Building 116)
- SWMU 22 – 100 Area Septic Tank at Building 114
- SWMU 23 – 200 Area Septic Tanks at Building 272 (Tanks A and B)
- SWMU 24 – 300 Area Septic Tank at Main Parking Lot
- SWMU 25 – 300 Area Septic Tank at Building 320
- SWMU 26 – 300 Area Septic Tank at Building 364
- SWMU 27 – 400 Area Septic Tank at Main Parking Lot

A Historical Information Summary (HIS; NASA, 2013a) was developed for the SWMU septic tanks listed above, as well as these additional eight known septic tanks at WSTF:

- 100 Area Septic Tank at Building 117 (WSTF Forward Guard Gate)
- 250 Area Septic Tank (Area of Interest)
- 200 Area Septic Tank at Building 272 (Tank C)
- 400 Area Septic Tank at Building 463
- 400 Area Septic Tank at Building 447
- 600 Area Septic Tank at Building 650
- 800 Area Septic Tank at Buildings 802/803
- Second Tracking and Data Relay Satellite System Ground Terminal (STGT) Facility Septic Tank

NASA recommended in the *WSTF Septic Tanks (SWMU 21-27) Investigation Work Plan* (IWP; NASA, 2013a) that a soils investigation not be conducted at SWMUs 21 and 23-27 because there was no evidence or documentation that these units ever received hazardous waste or hazardous constituents. NMED approved the IWP with a modification requiring NASA to examine all WSTF septic tanks for leaks during removal (NMED, 2013b). If evidence of any leaks/spills were observed during removal, NASA was required to inform NMED within 24 hours and potentially perform additional investigation(s). The tanks were removed and no evidence of leaks or spills was observed, thus no investigation was required at these tank locations. The only evidence located during HIS research of hazardous constituents discharged to any of the above listed septic tanks was at the 100 Area Septic Tank at Building 114 (SWMU 22). From research performed during preparation of the HIS, it was determined that silver and cyanide were possible contaminants of potential concern (COPCs) within SWMU 22 (NASA, 2013a).

This IR primarily describes the SWMU 22 investigation activities, summarizes investigation results, presents conclusions, and provides recommendations based on the findings. The report also summarizes the removal of and current status of all WSTF septic tanks.

During initial investigation activities, NASA discovered an unexpected configuration of the SWMU 22 septic tank. This septic tank was found to consist of only a single chamber and it contained no free liquids. A discharge pipe from the tank was not immediately recognized and NASA concluded that the bottom of the tank was compromised. This observed unexpected configuration of the Building 114 septic tank required modifications to the planned NMED-approved IWP.

To remedy this issue, NASA proposed modifying the soil investigation by removing borings originally identified in the leach field area for the SWMU 22 septic tank and installing five soil borings as described in the *Summary of SWMU 22 Sewage Sludge Analytical Results and Proposed SWMU 22 Soil Investigation Methodology Deviations* (Deviations; NASA, 2014a). NMED approved this document on May 6, 2014 (NMED, 2014a). Further field investigation revealed that the tank did have a discharge line, but this piping terminated abruptly approximately 60 feet (ft) north of the tank. No leach field was found and there was no evidence of wastewater in the discharge pipe or discharge of wastewater at its termination point. NASA compared the liquid wastewater marks inside the tank to the height of the tank discharge pipe and concluded that the septage within the septic tank was never discharged to the pipe.

During the investigation, two soil borings were installed downgradient from the Building 114 septic tank location, two were installed within the septic tank footprint, and one was installed upgradient of the septic tank location in accordance with the approved investigation modification. In addition to the planned five soil borings, and due to potential nitrate/nitrite interference with cyanide analyses, two additional soil borings were completed to 7 ft below ground surface (bgs) within the footprint of the SWMU 22 septic tank. One soil sample per additional boring was collected at 7 ft bgs and analyzed by Method 9012B, with a sulfamic acid pretreatment to avoid nitrate/nitrite interference. These samples replaced the original samples collected at that depth.

A total of seven soil boring locations with eighteen total soil samples and nine quality assurance/quality control (QA/QC) samples (three duplicates, three equipment blanks, one field blank, and two matrix spikes) were collected. As part of the data quality objectives (DQOs) performance acceptance criteria, soil chemical analytical data were reviewed and evaluated in accordance with the IWP (NASA, 2013a), and the *Summary of SWMU 22 Sewage Sludge Analytical Results and Proposed SWMU 22 Investigation Methodology Deviations* (Deviations; NASA, 2014a), incorporating Attachment 15 of the Permit (NMED, 2016). All soil chemical results were validated and determined to be appropriate for use to meet the investigation goals and to support risk screen evaluations for all receptor populations. Data validation identified that a high bias exists for cyanide concentrations due to nitrate interference. NASA included all chemical data in the risk screen evaluation while understanding that use of the high biased cyanide results generates risk and hazard values that are inherently conservative.

Initially, the IWP stated the following: “If COPC concentrations in vadose zone soils exceed the appropriate risk-based cleanup levels…. for direct exposure routes under the construction worker scenario (construction soil screening levels, CSSL), then a RCRA Corrective Measures Study will be performed to determine the appropriate soil remediation.” However, based upon recent NMED communications, residential exposure scenarios must be evaluated to qualify for Corrective Action Complete without controls (CAC). For the purposes of this report, the RSSLs were used as the basis to determine whether or not to continue investigation and/or corrective actions. NASA utilized NMED’s March 2019 *Risk Assessment Guidance for Site Investigations and Remediation* (RA Guidance; NMED, 2019) to determine remaining risk and hazard associated with existing site conditions under all exposure scenarios (residential, construction worker, soil-to-groundwater, and ecological).

Human health risk and hazard screenings were performed using both RSSLs and CSSLs, as well as risk-based and maximum contaminant level (MCL)-based SSLs protective of groundwater with a dilution attenuation factor (DAF) of 20 in accordance the RA Guidance and Attachment 15 of the Permit. Populations of WSTF background concentrations for metals were compared to SWMU 22 investigative data populations to identify COPCs for each exposure scenario. Based on results of comparison of WSTF background and SWMU 22 populations, identified COPCs for residential, construction worker, and ecological receptor exposure scenarios included cadmium, chromium, cyanide, and silver. Identified COPCs for the soil-to-groundwater exposure scenario also include arsenic, barium, and lead, due to the lack of WSTF soil background data at depths deeper than 12 ft bgs to compare to investigation data.

Results of health risk and hazard screening indicated that there were no SWMU 22 COPC concentrations above residential or construction worker soil screening levels (SSLs) and risk/hazard targets. For the soil-to-groundwater exposure scenario, two COPCs exceeded soil leachate SSLs: arsenic and cyanide. Evaluation of the soil chemical data indicate concentrations of arsenic and cyanide generally decrease with depth. Based on the observed decrease with depth of the two COPCs, the lack of a continuing source of liquid to vertically mobilize contaminants in the soil, the regional arid climate, and depth to groundwater, NASA concludes that the soil-to-groundwater pathway is incomplete.

Ecological risk screening indicated that identified total chromium and cyanide concentrations in site soils exceed Tier I Ecological Screening Levels for plants. However, non-burrowing animals and plant roots are not expected to come in contact with soils associated with SWMU 22 due to the depth of releases (> 5 ft bgs). No ecologically important habitats or organisms exist at, or adjacent to, the site, and evidence of deep-rooted flora and animal burrows was not observed within the SWMU 22 footprint and surrounding areas.

NASA concludes that there is no source of contamination in the SWMU 22 soil that would adversely impact human and ecological receptors or the environment.

Based on closure activities completed at SWMUs 21 and 23-27 and findings of research conducted during preparation of the HIS (NASA, 2013a), NASA recommends that no further action be performed at the septic tanks comprising SWMUs 21 and 23-27. Based on the investigation and risk screen evaluation results for SWMU 22, NASA also recommends that no further action be performed. NASA recommends that SWMUs 21-27 be considered for a corrective action complete status determination. NASA will consult with the NMED prior to preparation and submittal of a Class 3 Permit Modification in accordance with 40 CFR 270.42(c) that will include all supporting site history and investigation information for each SWMU.

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List of Acronyms

amsl	Above Mean Sea Level
bgs	Below Ground Surface
BTV	Background Threshold Value
CAC	Corrective Action Complete
CFR	Code of Federal Regulations
CLC POTW	City of Las Cruces Publicly Owned Treatment Works
COPC	Contaminant of Potential Concern
CSSL	Construction Soil Screening Level
DAF	Dilution Attenuation Factor
DP	Discharge Permit
DQO	Data Quality Objective
EPA	Environment Protection Agency
ESL	Ecological Screening Level
ft	Feet/foot
HI	Hazard Index
HIS	Historical Information Summary
HSA	Hollow Stem Auger
HWMU	Hazardous Waste Management Unit
IDW	Investigation-Derived Waste
in.	Inch(es)
IR	Investigation Report
IWP	Investigation Work Plan
JSC	Johnson Space Center
LWP	NMED Liquid Waste Program
MCL	Maximum Contaminant Level
mg/kg	Milligram per kilogram
mi	Mile(s)
MSDS	Material Safety Data Sheet
NASA	National Aeronautics and Space Administration
NMED	New Mexico Environment Department
NMGW	NMED Groundwater and Surface Water
OSHA	Occupational Safety and Health Administration
Permit	NMED Hazardous Waste Permit
PPE	Personal Protective Equipment
QA	Quality Assurance
QC	Quality Control
QAR	Quality Assurance Report
RA	Risk Assessment
RA Guidance	NMED Risk Assessment Guidance for Site Investigations and Remediation
RSSL	Residential Soil Screening Levels
RPD	Relative Percent Difference
SAM	San Andres Mountains
SCEM	Site Conceptual Exposure Model
SHP	Safety and Health Plan
SJDMB	Southern Jornada del Muerto Basin
SLHQ	Screening Level Hazard Quotient
SSL	Soil Screening Levels

STGT	Second Tracking and Data Relay Satellite System Ground Terminal
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
UCL95	95% Upper Confidence Level
USDA	United States Department of Agriculture
WSTF	White Sands Test Facility

1.0 Introduction

The National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) White Sands Test Facility (WSTF; Environmental Protection Agency [EPA] Identification Number NM8800019434) has supported testing of space flight equipment and hazardous materials since 1964. The facility contains five closed hazardous waste management units (HWMUs) that are under post-closure care and 37 solid waste management units (SWMUs) within the 100, 200, 300, 400, and 600 Areas. Post-closure care requirements are specified by the NASA WSTF Hazardous Waste Permit (Permit) issued by the New Mexico Environment Department (NMED) in 2009 (NMED, 2016). Specific regulatory requirements are discussed in Section 1.1.

This investigation was primarily conducted at SWMU 22, the 100 Area Septic Tank at Building 114 (hereafter referred to as the Building 114 septic tank or SWMU 22). However, the WSTF Permit identifies seven additional septic tanks as SWMUs. WSTF septic tanks are described in Section 1.3 of this report. A Historical Information Summary (HIS; NASA, 2013) was prepared for the SWMU septic tanks identified in the Permit and eight additional known septic tanks at WSTF. The only evidence located during HIS research of hazardous constituents discharged to any of the above listed septic tanks was at the Building 114 septic tank (NASA, 2013a).

There was no evidence that hazardous waste or hazardous constituents were discharged to the septic tanks at SWMUs 21 and 23-27; therefore, NASA recommended in the investigation work plan (IWP; NASA, 2013a) that soil investigations not be performed at these locations. NMED approved the IWP with modifications on November 8, 2013. In accordance with the NMED-approved IWP, a soil investigation was not conducted for SWMU 21, SWMUs 23-27, and the additional eight septic tanks at or adjacent to WSTF. However, a variety of field activities were performed at these septic tanks and at SWMU 22. This investigation report (IR) summarizes all field activities associated with septic tank identification and removal, and provides the current status of all septic tanks at WSTF. As required by the WSTF Permit, this IR summarizes SWMU 22 soil investigation field activities, presents the analytical results from soil samples collected during the SWMU 22 investigation, and provides interpretation of results and recommendations based on the results.

1.1 Regulatory Requirements

The Permit issued by NMED (NMED, 2016) requires the preparation of IWPs to assess the potential impact of any historical releases of hazardous waste or hazardous constituents that may have occurred at WSTF as part of the Resource Conservation and Recovery Act (RCRA) corrective action process (CAP). The CAP consists of investigation, characterization, and, if necessary, cleanup. The principal components of the CAP are:

- RCRA Facility Assessment
- RCRA Facility Investigation (RFI)
- Interim Corrective Measures (if necessary)
- Corrective Measures Study (if necessary)
- Corrective Measures Implementation (if necessary)

NASA is currently implementing interim corrective measures to address groundwater contamination and is conducting RCRA Facility Investigations (RFIs) for specific HWMUs, SWMUs, and any other areas of concern or areas of interest at WSTF. Attachment 16 of the Permit required submittal of an IWP for SWMUs 21-27 by June 30, 2013. The *NASA WSTF Septic Tanks (SWMU 21-27) Investigation Work Plan* was prepared in accordance with Permit Section VII.H and was submitted to NMED on June 27, 2013 (NASA, 2013a). NMED approved the IWP on November 8, 2013 with a modification requiring NASA to examine all WSTF septic tanks for leaks during removal (NMED, 2013b). If evidence of any leaks/spills were observed during removal, NASA was required to inform NMED within 24 hours and potentially perform additional investigation(s).

During investigation field activities, conditions at SWMU 22 required modifications to the planned soil boring investigation. NASA submitted the *Summary of SWMU 22 Sewage Sludge Analytical Results and Proposed SWMU 22 Soil Investigation Methodology Deviations* (Deviations) on March 4, 2014. On May 6, 2014, NMED approved the proposed investigation modifications (NMED, 2014).

1.2 Facility Location and Description

The NASA JSC WSTF is located at 12600 NASA Road in central Doña Ana County, New Mexico. The site is approximately 17 miles (mi) northeast of Las Cruces, New Mexico and 65 mi north of El Paso, Texas (Figure 1.1). The site was strategically constructed in a remote location adjacent to the San Andres Mountains (SAM). The Department of the Army owns the land occupied by WSTF, and NASA uses the land under a land use agreement (Department of Defense, 1976). Access to the site is provided by a paved road that intersects U.S. highway 70, 1 mi west of Organ, New Mexico.

1.3 SWMU 22 and Septic Tank Areas Location and Description

Eight WSTF septic tanks identified as SWMUs in the Permit. NASA identified an additional eight septic tanks in the HIS, for a total of 16 (Figure 1.2). Three septic tanks were located in the 100 Area, three were located in the 200 Area, one was located in the 250 Area, three were located in the 300 Area, three were located in the 400 Area, one was located in the 600 Area, one was located in the 800 Area, and one was located at the Second Tracking and Data Relay Satellite System Ground Terminal (STGT) Facility. A description of each tank is provided below.

Eight WSTF septic tanks are identified in the Permit as SWMUs:

- SWMU 21 – 100 Area Septic Tank at Guard Shack (Building 116)
- SWMU 22 – 100 Area Septic Tank at Building 114
- SWMU 23 – 200 Area Septic Tanks at Building 272 (Tanks A and B)
- SWMU 24 – 300 Area Septic Tank at Main Parking Lot
- SWMU 25 – 300 Area Septic Tank at Building 320
- SWMU 26 – 300 Area Septic Tank at Building 364
- SWMU 27 – 400 Area Septic Tank at Main Parking Lot

The eight additional known septic tanks at WSTF not identified as SWMUs are:

- 100 Area Septic Tank at Building 117 (WSTF Forward Guard Gate)
- 250 Area Septic Tank (Area of Interest identified in the 200 Area investigation)
- 200 Area Septic Tank at Building 272 (Tank C)
- 400 Area Septic Tank at Building 463
- 400 Area Septic Tank at Building 447

- 600 Area Septic Tank at Building 650
- 800 Area Septic Tank at Buildings 802/803
- STGT Facility Septic Tank

Locations of the WSTF industrial areas and septic tanks are provided on Figure 1.2. Access to the WSTF site is provided by NASA Road. Access to the 200, 300, 400, and 800 industrial areas are provided via Apollo Boulevard, the main access road through WSTF. Building 650 can be accessed from NASA Road to the Well Road, and STGT is reached via NASA Road to the STGT Access Road (Figure 1.2).

1.4 Purpose and Method of Investigation

The primary purpose of this investigation was to determine if historical activities as described in the HIS (NASA, 2013a) resulted in contamination of the soil beneath and adjacent to the SWMU 22 septic tank. If any staining or discoloration was discovered during the excavations of any of the other septic tanks included as part of this investigation, then the IWP would have been revised to include additional soil boring locations as part of the investigation. Soils were collected using a Central Mine Equipment CME-75 hollow stem auger (HSA) drill rig with a split spoon sampler. In total, seven boring locations, including four soil samples located within the footprint of the SWMU 22 septic tank. Samples were collected from the footprint of the SWMU 22 septic tank rather than the leach field after it was determined that the bottom of the septic tank had been compromised and no wastewater had been discharged to the leach field (NASA, 2014a).

During the investigation, NASA complied with all applicable internal site procedures regarding health and safety, investigation activities, soil sampling, data management, and quality assurance (QA)/quality control (QC), as well as external federal (Occupational Safety and Health Administration [OSHA]) and state (NMED) regulations. Sludge and soil samples were shipped to the contracted analytical laboratory, and resulting analytical reports were delivered to NASA. Analytical results from sludge and soil samples were evaluated and compared with appropriate regulatory criteria to determine if corrective actions are required.

Additionally, NASA conducted a health risk assessment to evaluate COPCs as a part of this investigation even though the requirement for a health risk assessment was not included in the IWP. The results of this assessment are provided in Section 7.0.

1.5 Type of Results

The type of results presented in this report include the following:

- Pre-investigation SWMU 22 septic tank sludge sampling results summary.
- Septic tank abandonment forms.
- SWMU 22 soil boring lithologic logs containing borehole identification information, descriptions of soil types, soil sampling locations, and the total depth drilled for each soil boring.
- SWMU 22 soil investigation results, including soil analytical data summaries and contract laboratory analytical data reports for soil samples collected from SWMU 22 soil borings.

2.0 Background

Prior to performing the investigation, a HIS was prepared and submitted to NMED in conjunction with the IWP (NASA, 2013a). The HIS contained detailed background research regarding the operational histories for each septic tank at WSTF. Research included review of WSTF environmental records (correspondence, discharge plans, analytical data, memoranda, reports, test preparation sheets, discrepancy reports, liquid waste applications and permits, maintenance records, WSTF utility drawings, photographs, etc.) and interviews with current and former long-term WSTF personnel. A summary of historical information, previous investigations, and contaminants of potential concern (COPCs) for SWMU 22 is included in this report. The HIS provides detailed operational history and details for each of the septic tanks (NASA, 2013a).

2.1 Historical Use

WSTF was designed as a hazardous testing facility with separate disposal systems for wastewater characterized as hazardous waste and non-hazardous wastewater. Septic tank systems were used at various locations at WSTF for non-hazardous wastewater. The Building 114 (SWMU 22), 250 Area, and the STGT septic tanks were installed prior to completion of sewage lagoons at WSTF. Other septic tanks were installed in WSTF industrial areas (300 and 400 Area main septic tanks [SWMUs 24 and 27]), or added as new buildings were constructed (Building 320 [SWMU 25], Building 364 [SWMU 26], Building 447, and Building 463). Remote working areas far from the sewage lagoons or areas where gravity feed to the sewage lagoons could not be completed also required septic tanks (Building 116 [SWMU 21], Building 117, Building 272 [SWMU 23 tanks and Tank C], Building 650, and Buildings 802/803). The historical use of each septic tank and associated buildings at WSTF was researched to determine if any hazardous constituents were discharged to any septic system. The only evidence discovered during HIS research of hazardous constituents discharged to any septic system at WSTF was at SWMU 22, the Building 114 septic tank. Between 1963 and the mid-to-late 1980s, Building 114 was used as a print reproduction facility at which electrostatic and photographic plate-maker processes were used. Machines were used to make master copies of forms or documents for reproduction on an offset press. Spent chemicals were historically discharged to the Building 114 septic tank (SWMU 22) via the bathroom sink (NASA, 2013a). COPCs are discussed below:

- Silver was identified as a COPC after septic tank HIS research discovered silver-bearing waste was discharged to a sink in Building 114 that drained to the septic tank. The septage in the tank and soil under the tank and within the leach field was sampled for RCRA metals using EPA SW-846 Methods 1311/6010C/7470A.
- Cyanide was also identified as a COPC after septic tank HIS research discovered waste containing cyanide salts was discharged to a sink in Building 114 that drained to the septic tank. The septage in the tank and soil under the tank and within the leach field was sampled for cyanide using EPA SW-846 Method 9012B.

2.2 Current Structures Near SWMU 22

The Building 114 septic tank was located in the 100 Area (Figure 1.2). The tank was referred to as "Building 114," since it was originally installed to service Building 114, which is currently unoccupied and used for storage. Adjacent to the SWMU 22 septic tank site to the northeast is a cleared soil area where equipment is stored (Figure 1.2). Close to Building 114 to the south is Building 119 (Figure 1.2), which was constructed in the mid-1990s and is currently used for communications. The original Building 114 septic tank was taken out of service and removed, and a new septic tank was installed on September 10, 2013 for use by employees working in Building 119 (NASA, 2017a). This septic tank was installed instead of connecting to the City of Las Cruces sewer system due to logistical constrains from underground utilities located close to the area. Underground utilities surrounding SWMU 22 can be seen in Figure 2.1.

2.3 Previous Investigations

No previous investigation or remediation activities have been conducted for SWMUs 21-27 or the eight additional septic tanks identified at WSTF.

2.4 Nature and Extent of Contamination

Information regarding the history of operations, historical waste management practices, and COPCs for the Building 114 septic tank were presented in the HIS (NASA, 2013a). A brief summary of historical information for the Building 114 septic tank is presented in this section. No evidence of hazardous waste or hazardous constituents being discharged to the septic tanks associated with SWMUs 21 and 23-27 was identified during research performed for the HIS.

Releases of hazardous constituents possibly discharged to the Building 114 septic tank included small amounts of spent process wastes from photographic and electrostatic plate-maker machines. Three different plate-maker machines were used historically at WSTF to make master copies of forms for reproduction on an offset press. The manufacturer of the plate-maker machines provided Material Safety Data Sheets (MSDS's) for the chemicals they believed were used in the machines utilized at WSTF. These MSDSs were provided in Appendix D of the HIS (NASA, 2013a).

Both photographic and electrostatic plate-making processes were used at WSTF. Residual chemicals from the photographic process were historically discharged to the Building 114 septic tank. Two different versions of the photographic process were used at Building 114, the first from 1963 until approximately 1974 and the second from approximately 1973 to the mid to late 1980s. As part of the reproduction process, these photographic chemicals were diluted with water before use in the machines. When the chemicals were spent, the contents of the machines were emptied into the bathroom sink in Building 114. Both machines were emptied approximately every two months, depending on how much the plate-maker was used, with a total discharge of approximately three gallons of waste each time (NASA, 2013a). These process waste discharges to the Building 114 septic tank ceased in 1985, when NASA began containerizing wastes from the reproduction facility.

Based on information collected during HIS research, it is believed that the photographic process plate-maker machines used the silver salt diffusion transfer reversal process to produce master copies of forms and documents. In the diffusion transfer reversal process, non-developed silver halide of an image-wise exposed photographic silver halide emulsion layer material is transformed with a silver halide solvent into soluble silver complex compounds. These are allowed to diffuse into an image-receiving element and are reduced with a developing agent. This is done generally in the presence of physical development nuclei to form a reversed silver image.

Based on process knowledge and information gained from interviews performed during preparation of the HIS, NASA determined that a silver-bearing waste stream was most likely discharged to SWMU 22. The waste stream consisted of silver salts dissolved in water (NASA, 2013a). The amount of silver present in the waste stream was dependent on usage. Waste streams generated from commercial industrial photographic and imaging processing are known to contain up to 12,000 parts per million of silver (EPA, 1999). Sampling of a similar photographic process at WSTF with similar amounts of waste yielded up to 200 parts per million of silver (NASA, 2013a).

Based on information obtained during HIS research, an electrostatic plate-maker machine was used at WSTF in addition to the photographic process plate-maker machines. It is unknown when use of this machine began at WSTF; however, use of the machine ended approximately in 1973. This machine contained approximately four quarts of liquid, which consisted of two types of hydrocarbons and a water-soluble cyanide chemical. Appendix D of the HIS provides the MSDSs for these chemicals. Chemicals were added to the machine as needed during use. It is believed that spent solutions containing these compounds were infrequently generated as part of the process. Though undocumented, these solutions could have been discharged to the Building 114 septic tank.

Based on an evaluation of the discharges as described above, it was determined that silver was discharged to the Building 114 septic tank and may have subsequently been discharged to the soil. In addition, cyanide salts may have been released to the environment at SWMU 22. Therefore, silver and cyanide have been designated as the COPCs for this investigation.

NASA also evaluated information regarding the use of two types of hydrocarbons in the electrostatic plate-maker machine while developing the NMED-approved IWP. The two hydrocarbon-based solutions used in the electrostatic plate-maker machine included the electrostatic dispersant that contains isoparaffinic hydrocarbons and exhibits a flash point of 105 °F and the ITEK Premium Plate Toner that contains isoparaffinic hydrocarbons and exhibits a flash point of 102 °F to 128 °F. Interviews with former workers at Building 114 indicate that these solutions were replenished and/or replaced infrequently on an as-needed basis once the solution was "spent." The solution became spent when the volatile hydrocarbon fraction of these solutions had evaporated to a point where the solution was no longer effective. Due to the limited potential for these two spent solutions to contain significant amounts of hydrocarbons, the high potential of these hydrocarbons to volatilize once exposed to ambient conditions within the septic tank, and the amount of time since these solutions were potentially discharged, NASA did not suspect that the spent hydrocarbon solution appreciably impacted soils and groundwater beneath the former septic tank. Silver and cyanide were the sole COPCs identified in the IWP, which was subsequently approved by the NMED. NASA does not consider the lack of volatile organic constituent analyses of subsurface soils to constitute a significant data gap. There was no evidence that any other hazardous waste or hazardous constituents were disposed of at any of the other septic tanks at WSTF (NASA, 2013a).

3.0 Scope of Activities

3.1 Summary of Activities

This section provides a brief overview of the various activities performed at the WSTF septic tanks. Prior to beginning investigation fieldwork at the septic tanks, NASA prepared for implementing the IWP by performing the following:

- An evaluation of each septic tank to determine whether to retain or remove the tank.
- Field verification of the location of each septic tank identified for abandonment to confirm accessibility for excavation equipment (to avoid intercepting underground utilities).
- Pre-task safety training attended by all project personnel.

NASA then performed preparatory fieldwork at the septic tanks to facilitate investigation fieldwork, including the following:

- Collection of sludge samples from the Building 114 septic tank (SWMU 22).
- Preparation and shipment of investigation sludge samples (including QA/QC field samples) to the contracted analytical laboratory.
- Laboratory analysis, analytical reporting, and data processing through the WSTF data management system.

- Resampling of sludge in SWMU 22 with associated samples preparation, shipment, laboratory analysis, analytical reporting, and data processing.
- Removal of the SWMU 22 septic tank and backfilling with clean fill.
- Removal of any remaining septage within the remaining septic tanks scheduled for abandonment.
- Recording of daily field activities in field logbooks and field data on required forms.
- Safety and health briefings conducted daily at the work site for pre-investigation activities

NASA then completed the primary investigation tasks that consisted of the following:

- Excavation and removal of the septic tanks scheduled for abandonment. The 100 Area septic tanks at Building 117 (WSTF Forward Guard Gate) and the new replacement tank at Building 119 was retained. Abandonment Forms were completed and submitted to NMED following excavation and removal of each tank.
- Field check of SWMU 22 soil boring locations to confirm accessibility by drilling equipment, site clearance to drill (to avoid intercepting underground utilities), and pre-task safety training attended by all project personnel.
- Recording of daily field activities in field logbooks and field data on required forms.
- Safety and health briefings conducted daily at the investigation site.
- Installation of soil borings and collection of soil chemical samples for COPCs at SWMU 22.
- Preparation and shipment of investigation soil samples (including QA/QC field samples) to the contracted analytical laboratory.
- Laboratory analysis, analytical reporting, and data processing through the WSTF data management system.
- Finalization of SWMU 22 soil analytical data for interpretation and presentation in this IR.

3.2 Data Quality Objectives

The Data Quality Objectives (DQOs) of the project are used to establish performance or acceptance criteria. These criteria are used to develop the sampling framework. The DQOs consist of the problem statement, information inputs, the spatial extent of the investigation, and the performance or acceptance criteria (the decision rule).

3.2.1 Problem Statement and Objective

The problem statement is: Confirm that soil beneath and downgradient of the SWMU 22 septic tank and leach field does not contain hazardous constituents at concentrations above regulatory limits as a result of present or past operations. The objective of this investigation is to compare any residual contamination present at SWMU 22 to appropriate regulatory criteria to make this decision.

3.2.2 Information Inputs

Primary decision inputs are analytical data generated from septic tank vadose zone soil sampling performed during this investigation. COPCs were identified based on the history of the Building 114 septic tank.

3.2.3 Spatial Extent of Investigation

The horizontal boundaries of the study represent the known extent of the SWMU 22. The vertical boundary of the study is limited to the uppermost vadose zone (to 27 feet [ft] below ground surface [bgs]) beneath SWMU 22 and surrounding (upgradient and downgradient), as approved in the IWP (NASA, 2013a) and investigation methodology deviation document (NASA, 2014a).

3.2.4 Decision Rule

In accordance with the NMED *Risk Assessment Guidance for Site Investigations and Remediation* (RA Guidance; NMED, 2019), validated analytical results from soil samples collected during the investigation will be compared to all applicable soil screening levels (SSLs) including human health risk and hazard screenings using both residential soil screening levels (RSSLs) and construction soil screening levels (CSSLs) as well as risk-based and maximum contaminant level (MCL)-based SSLs protective of groundwater for identified complete exposure pathways. In addition to comparison to complete exposure pathways, investigation data will also be compared to RSSLs to evaluate the investigation site for a potential "corrective action complete" determination, per requirements listed in the NMED RA Guidance (NMED, 2019).

If COPC concentrations in vadose zone soils exceed the appropriate NMED SSLs, then further investigation or a RCRA Corrective Measures Study may be required to determine the appropriate course of action. Otherwise, consider a no further action and corrective action complete determination.

3.3 Site Conceptual Exposure Model

A preliminary site conceptual exposure model (SCEM) was presented in the IWP (NASA, 2013a) for this investigation (Figure 3.1) to evaluate possible exposure to hazardous constituents or COPCs at SWMU 22. Components of the SCEM are the source(s) of contamination, the release mechanism, the exposure pathway, the potential receptor(s), and fate and transport of potential contamination. Although multiple exposures were evaluated as a part of this investigation, the construction worker scenario is the only plausible setting given the nature of WSTF operations and history.

3.3.1 Contamination Source(s)

The SWMU 22 septic tank and soil below and adjacent to the tank are considered the primary sources for the conceptual model. Exposed subsurface soil outside of the septic tank that may have come in contact with septage is a potential secondary source.

3.3.2 Release Mechanisms

1. Hydraulic Pressure. This release mechanism is most applicable to the septic tank because of its poor integrity. Hazardous constituents may have leaked from the tank to the soils beneath the source. Under this release mechanism, the mass of the hazardous substances is pulled by gravity toward the subsurface strata through the path of least resistance.

2. Leaching. This release mechanism refers to the movement of soluble chemicals via infiltration into subsurface soils. This release mechanism could be viewed as the combined mechanisms of gravitational force, hydraulic pressure, and solubility. Leaching also serves as a migration pathway that transports wastewater to other media or locations.

3. Digging. This mechanism refers to human activities that may intercept soils that have accumulated wastes as a result of infiltration, leaching, or runoff. Construction activities that entail soil or sediment excavation are examples of this release mechanism.

3.3.3 Exposure Pathways and Exposure Scenarios

Four potential exposure pathways are identified: 1) ingestion of groundwater; 2) incidental ingestion of soil; 3) inhalation of contaminants or particulate emissions (dust); and 4) dermal contact with soil.

The migration to groundwater pathway for any historical contamination from potential discharges or spills or residual soil contamination could result in groundwater contamination from SWMU 22. The groundwater underlying much of WSTF is known to be contaminated, and its future use and potential risk to receptors are part of ongoing site-wide evaluation and corrective actions. The only water supply wells for the site are located several miles to the west of the investigation area and are monitored regularly for the presence of any site-source contaminants. There is no complete groundwater exposure pathway. However, the NMED RA guidance requires that every investigation with potential soil contamination evaluate the soil-to-groundwater scenario (NMED, 2019).

There are no current or future residential land use scenarios anticipated in the vicinity of SWMU 22. The area is within a controlled test site located on the U.S. Army White Sands Missile Range. There are no encroaching residential areas. Therefore, there are no complete exposure pathways identified for residential land use scenarios.

If there is any residual soil contamination at SWMU 22, then a construction worker may encounter contaminated material when working in the areas in the future. Therefore, inadvertent ingestion of, inhalation of, or dermal contact with contaminated soil may be considered complete exposure pathways for this evaluation.

Identified exposure scenarios include the construction worker (for 0 to 10 ft bgs soils) and the soil-go-groundwater scenario (all depths bgs soils). NASA also evaluated the residential exposure scenario (for 0 to 10 ft bgs soils) to determine the long-term disposition of the SWMU 22 area.

3.3.4 Potential Receptors

There are no immediate plans for construction or facility expansion in the SWMU 22 area; however, a potential exposure scenario at SWMU 22 exists for unanticipated future growth or construction activities. Potential receptors under this scenario are workers conducting excavation or construction activities in the SWMU 22 area. Groundwater beneath SWMU 22 is also a potential receptor of contaminants leaching from potentially contaminated soils.

3.3.5 Fate and Transport

There are three general categories of processes affecting contaminant fate and transport: hydrodynamic; abiotic; and, biotic processes. Hydrodynamic processes include advection, dispersion, and preferential flow. Abiotic processes include adsorption, volatilization, ion exchange, hydrolysis, precipitation or dissolution, cosolvation, redox processes, and colloid transport. Biotic processes include metabolism and/or cometabolism by microorganisms.

At SWMU 22, the most likely mechanisms for transport of wastes or COPC(s) into the vadose zone would be any of the hydrodynamic processes as a result of leaching due to operation of the septic tank. Because septage comprises the majority of the discharge load to the septic tank, biotic as well as abiotic processes are also occurring. Subsurface analytical data was required to determine the presence and concentration of COPC(s) in the vadose zone.

3.4 Surface Conditions

3.4.1 Site Topography

WSTF topography is characteristic of the Bolson subsection, Mexican Highland section of the Basin and Range physiographic province of the southwestern United States, formed as a result of late Tertiary extensional tectonism. The WSTF industrial area is located on the piedmont slope west of the SAM, one of the most prominent north-south mountain ranges in southern New Mexico. The SAM extends from San Augustine Pass (6 mi south of WSTF) to Mockingbird Gap (75 mi north). The WSTF 100 Area is located between Bear Canyon to the northeast and Loman Canyon to the southeast. Foothills on the western pediment of the SAM at WSTF consist of thin layers of alluvium covering fractured Paleozoic and Cretaceous carbonate and clastic (shale, siltstone, and sandstone) and Tertiary volcanic bedrock (NASA, 1996). The elevation at the septic tank at Building 114 (SWMU 22) is 4,770 ft above mean sea level (amsl; Figure 3.2).

3.4.2 Soils

Soils at WSTF are typically characterized by the U.S. Department of Agriculture (USDA) Soil Classification (USDA, 1999) Nickel-Tencee Association (60% Nickel gravelly fine sandy loam and 25% Tencee very gravelly loam). The alluvium is classified as the piedmont slope facies of the Camp Rice Formation, which forms part of the Quaternary Santa Fe Group (Seager, 1981).

3.4.3 Water Bodies

Gardner Spring is the only major natural water body located in the vicinity of septic tank at Building. 114 (SWMU 22; Figure 3.3). Gardner Spring consists of a small intermittent surface seep located approximately 1 mi northeast of the 100 Area. With heavy mountain-front rainfall, the Gardner Spring Arroyo carries rainwater southwest and west toward the Southern Jornada del Muerto Basin (SJDMB). This rainwater infiltrates the sand and gravels of the arroyo floor and recharges local groundwater. The nearest natural water body of significant size is the ephemeral Isaacs Lake, located approximately 8 mi to the southwest of the 100 Area. Isaacs Lake is located at the lowest topographic point of the SJDMB, at an elevation of 4,285 ft amsl.

3.4.4 Vegetation

Vegetation at WSTF includes a combination of woody shrubs and grasses characteristic of the Chihuahuan Desert Shrub Biotic Community. These shrubs include Louisiana White Sage, Creosote bush, Honey Mesquite, Tarbush, Broom Snakeweed, and Lotebush. Common grasses include Alkali Sacaton, Side-Oats Grama, Fluff Grass, Tobosa Grass, and Purple Three Awn. The facility receives little use by wildlife species because it has been physically altered by human disturbance (NASA, 1996).

3.4.5 Erosional Features

The drainage pattern forming off the SAM east of the 100 Area consists of a network of arroyos cut through alluvial fans. These arroyos trend west to southwest from the mountains towards the SJDMB and consist of larger, deeper, more prominent drainages to subtle arroyos, generally hidden from sight within the low profile topography and vegetation (NASA, 1996; Figure 3.2).

3.4.6 Pre-Investigation Activities

Pre-investigation activities were conducted to provide site characterization data for planning for tank removal and disposal and site investigation details. These pre-investigation activities included determining which WSTF septic tanks to abandon or retain, installing a replacement septic tank for SWMU 22, assessing the condition/contents of the SWMU 22 septic tank system, and SWMU 22 sludge sampling to characterize the sludge for disposal.

3.4.7 WSTF Septic Tank Abandon or Retain Determinations

As part of planning and construction of the WSTF sanitary sewer system to connect to the City of Las Cruces Publicly Owned Treatment Works (CLC POTW), NASA evaluated all septic tank sites to determine which septic tank systems should be abandoned and whether any septic systems should be retained. NASA evaluated each septic tank at WSTF for current usage, anticipated future use, and ease of connection to the CLC POTW. The final status of each septic tank is provided in Table 3.1. For septic tanks scheduled for abandonment, the sites were evaluated to ensure fieldwork could be performed as planned. Sites were assessed for ease of access for excavation equipment and overhead and underground utilities to ensure safety. In addition, all project personnel attended pre-task safety training.

3.4.8 WSTF Septic Tank System Retention/Installation

NASA determined that the septic tank for Building 117 (Figure 1.2) would be retained due to the remoteness of the area and impracticality of connecting the WSTF Forward Guard Gate facilities to the CLC POTW. An application for the Building 117 septic system was submitted to the NMED Ground Water Quality Bureau (GWQB) on March 29, 2006 (NASA, 2006a). The NMED GWQB approved the application on May 12, 2006 (NMED, 2006) and provided temporary permission to discharge from the tank under the condition that an application be submitted to renew and modify Discharge Permit (DP) -392 to include all septic tank leach fields within the 100, 200, and 600 Areas. NASA complied with the condition of approval by filing an application to renew and modify DP-392 on November 20, 2006 (NASA, 2006b). The application identified the required septic tanks, including the Building 117 tank, and the six existing wastewater lagoons already permitted under DP-392. NMED took no final action on the application because NASA began planning to divert wastewater discharged to the lagoons and most septic tanks to the CLC POTW. Once it was determined that the tank would be retained, NASA filed a separate application with the NMED to permit the Building 117 tank through the Liquid Waste Program (LWP) on May 31, 2017 (NASA, 2017a). NMED LWP personnel inspected the tank, approved the application, and permitted the tank on July 10, 2017 (NMED, 2017b).

Building 119 is adjacent to Building 114 in the WSTF 100 Area and facilities within both buildings historically discharged septage to the Building 114 septic tank (SWMU 22). The location of Building 119 made it impractical for NASA to provide sanitary sewer service to the CLC POTW. Instead, a replacement septic tank was installed for Building 119 prior to removing and investigating SWMU 22. NASA submitted the *Application for Permit to Replace Septic Tank* for Buildings 114 and 119 to the NMED LWP on August 19, 2013 (NASA, 2013b). NMED LWP approved the permit to construct the new septic tank on August 30, 2013 (NMED, 2013a). The replacement septic tank was installed adjacent to SWMU 22 (Figure 1.2) to service Buildings 114 and 119 Area on September 10, 2013.

3.4.9 SWMU 22 Tank System Assessment

An initial measurement of the contents of the Building 114 septic tank was performed on August 13, 2013 prior to the tank being taken out of service. At that time, the tank contained 3 inches (in.) of sewage sludge, and 28 in. of liquid wastewater. An initial visual inspection of the inside of the tank was performed on November 13, 2013 by partially removing the tank cover. Discharges to the tank had ceased after installation of new tank for Building 119 facilities on September 10, 2013. It was expected the Building 114 tank would contain free liquid (wastewater), as was found in the initial inspection. However, in November, there was no free liquid in the SWMU 22 tank.

After the initial inspection, NASA questioned the integrity of the Building 114 septic tank to hold liquid waste. An effluent pipe was not initially observed in the tank (NASA, 2014a), but after completely removing the tank cover a discharge pipe was found. The discharge pipe was found to extend approximately 60 feet to the northeast of the tank. Extensive investigation was conducted, but no wastewater emitters or traditional leach field were located. No evidence of wastewater was observed in the pipe and there was no evidence of wastewater discharge at the effluent pipe termination point. Lack of staining and fluid fill lines near the effluent port in the tank also indicated that wastewater never flowed out the discharge pipe. The investigation methodology was modified because field observations indicated discharges at SWMU 22 occurred at the tank itself, not at a leach field (NASA, 2014a). The investigation was modified to determine if contaminants of concern seeped from the SWMU 22 septic tank downgradient or into the vadose zone alluvium below the tank (NASA, 2014a). During excavation and tank removal, no visible seepage or moisture was detected outside of the septic tank excavation. Soil staining was only visible on the first few inches of alluvium below the contact with clean fill sediment within the footprint of the tank. Appendix A contains photographs of the SWMU 22 septic tank, outlet pipe, and fill line.

3.4.10 SWMU 22 Sludge Sampling

On December 11, 2013, NASA performed sludge sampling at SWMU 22 to characterize the waste (sludge and tank) for disposal. Sampling consisted of collecting one sludge sample and duplicate sample from the center of the tank with a shovel that had initially been triple rinsed with deionized water and then air dried. Samples were analyzed for toxicity characteristic leaching procedure (TCLP) Metals by EPA Method 6010C/4770A and cyanide by EPA Method 9012B. Cyanide results were inconsistent between the sample and duplicate sample, with a 172.5% relative difference (4.87 mg/kg and 65.9 mg/kg). NASA's allowable percent difference is 25% (NASA, 2014a).

NASA compared the highest analytical results from sludge sampling to NMED's CSSLs to determine if the sludge or tank would be classified as hazardous or nonhazardous. No constituent exceeded any CSSL, including cyanide (with a CSSL of 186 mg/kg), and NASA preliminarily classified the sludge and tank as nonhazardous, However, due to the large percent difference between the sample cyanide result and the duplicate cyanide result, NASA proposed to resample the tank sludge prior to March 31, 2014. If the additional sampling results indicated that cyanide was present above the CSSL, then NASA would submit a new removal plan for the SWMU 22 tank, based on the sludge and tank waste being classified as hazardous waste (NASA, 2014a). NMED approved the results and NASA's proposed actions on May 6, 2014 (NMED, 2014a).

On March 12, 2014, NASA resampled the Building 114 septic tank sludge. A sample and duplicate sample were obtained from both the northwest and southeast corners of the tank (NASA, 2014b). Cyanide sample results between samples and duplicates still exceeded 25%. At the northwest corner of the septic tank, cyanide results in sludge sample and duplicate were 16.2 mg/kg and 30.6 mg/kg (61.5% relative difference). At the southeast corner of the septic tank, cyanide results in the sludge sample and duplicate were 1.81 mg/kg and 3.93 mg/kg (73.9% relative difference; NASA, 2014b).

NASA concluded that the SWMU 22 sludge and tank were nonhazardous waste, based on all cyanide results compared with the CSSL (186 mg/kg) and proposed disposing of the tank as planned in the original septic tanks removal plan that was included as Appendix A of the IWP (NASA, 2013a). NMED approved the second SWMU 22 sludge sampling results on June 26, 2014 (NMED, 2014b).

NMED released revised SSLs in December 2014 that decreased the cyanide CSSL from 186 mg/kg to 12.1 mg/kg (NMED, 2014c). When the previous cyanide results from SWMU 22 sludge samples were compared to the new regulatory criteria, the potential for the sludge and tank waste to be characterized as hazardous waste arose. NASA evaluated the cyanide results from previous sampling and determined that the cyanide concentrations in SWMU 22 sludge may have been impacted by nitrate/nitrite interference during analysis using SW-486 Method 9012B (NASA, 2015a). Method 9012B states that “high results may be obtained for samples that contain nitrate and/or nitrite…The possibility of interference of nitrate and nitrite is eliminated by pretreatment with sulfamic acid just before distillation” (EPA, 2004).

NASA resampled the SWMU 22 sludge on June 16, 2015 from the center of the tank. Results were 0.79 mg/kg and 0.17 mg/kg (129.2% relative difference). The laboratory was instructed to perform pretreatment with sulfamic acid prior to distillation to eliminate nitrate/nitrite interference; however, the laboratory did not perform the sulfamic acid pretreatment. An additional SWMU 22 tank cyanide resampling event was conducted on March 9, 2016 from the northwest corner of the tank. Sulfamic acid pretreatment was requested by NASA and conducted by the contracted laboratory. Total cyanide results were 0.09 mg/kg and 10.3 mg/kg. A final set of sludge samples was collected and analyzed for cyanide by Method 9012B with sulfamic acid pretreatment on June 9, 2016. Results were 1.53 mg/kg and 6 mg/kg.

NASA compared all of the cyanide results of sludge samples pretreated with sulfamic acid (to avoid nitrate/nitrite interference) to the NMED CSSLs for cyanide from the December 2014 RA guidance (NMED, 2014c). NMED soil screening levels were considered guidance for determining if cyanide was present in such a quantity that it may be considered reactive. It was assumed that cyanide present at or below the NMED soil screening levels is not reactive. This rationale was accepted by the NMED in a May 6, 2014 approval (NMED, 2014a) of NASA’s March 4, 2014 Summary of SWMU 22 Sewage Sludge Analytical Results and Proposed SWMU 22 Soil Investigation Methodology Deviations (NASA, 2014a). All SWMU 22 total cyanide results were below the 2014 NMED CSSL of 12.1 mg/kg. After receipt of these results, NASA re-characterized the SWMU 22 septic tank and sludge as nonhazardous waste. The tank and sludge were removed in accordance with the revised removal strategy identified in the Summary of SWMU 22 Sewage Sludge Analytical Results (NASA, 2014a). Sewage sludge was removed and disposed of by a licensed septage pumper. The SWMU 22 septic tank was removed on November 9, 2016 and disposed of as solid waste in accordance with the NMED-approved IWP (NASA, 2013a).

4.0 Field Investigation Results

Planned investigation activities for the Building 114 septic tank were described in the IWP (NASA, 2013a) and the approved Deviations (NASA, 2014a; NMED, 2014a), and were developed based on project DQOs and other requirements of the Permit (NMED, 2016). These activities were adhered to as closely as possible during the investigation. Deviations from the planned investigation methodology are identified in Section 4.10 of this report. The following sections describe the field activities conducted for the septic tanks investigation from January 2015 to October 2017.

4.1 Field Data Collection

Contractor Environmental Department personnel including geologists, compliance personnel, and sampling technicians recorded day-to-day accounts of field activities in field logbooks, and any investigation data collected were recorded either in logbooks or on project-required forms. Investigation documentation included, but was not limited to the following:

- Field logbooks
- Daily tailgate safety meeting forms
- Lithologic logging forms
- GPS data for soil boring locations
- Survey forms including maps
- Sample documentation
- Internal and external chain-of-custody forms
- Sample shipment forms

4.2 Septic Tank Decommissioning and Removal

NASA evaluated each septic tank at WSTF to determine whether to remove or retain the tank. The results of the assessment are summarized in Table 3.1, which provides the final status of each WSTF septic tank. After determining that a septic tank was to be removed, NASA inspected the tank to determine if residual septage was present, and if so, coordinated its removal. Following waste removal, NASA excavated and removed the septic tanks and coordinated their disposal at an approved off-site facility (Table 3.1). All tanks were excavated, pumped, and removed in accordance with the septic tanks removal plan (Appendix A of the IWP; NASA, 2013a). Appendix B contains the required liquid waste system abandonment forms submitted the NMED LWP. As required by the NMED approval with modifications, NASA closely observed all septic tanks during removal. No evidence of leakage, spills, unauthorized discharges to the environment, or unexpected system configurations were observed during excavation or removal of any septic tank identified in the Permit as SWMUs 21 and 23-27. Tank excavations were backfilled with clean fill per the approved IWP. The clean fill was sourced from the WSTF borrow pit and, in some cases, stockpiled soil from recent excavations for new sewer lines in the area. The borrow pit is located east-northeast of the 100 Area upgradient of any site where use of or releases of hazardous constituents occurred. The borrow pit and surrounding area were undisturbed by other site activities and only used for excavation of materials for use in construction projects at WSTF. Likewise, the sewer line excavations from which fill material was obtained are not located near any area where WSTF industrial activities occurred. The fill consisted of clean native soil but was not sampled or certified. After backfilling operations, the ground surface was smoothed to grade and left to revegetate naturally. The following sections summarize the findings of septic tank assessments and describe the removal and disposal process for each SWMU and non-SWMU septic tank.

4.2.1 SWMU 21 – 100 Area Septic Tank at Guard Shack (Building 116)

The 100 Area septic tank at the WSTF original guard shack (at Building 116; SWMU 21) was pumped, excavated, and removed on July 17, 2017. NASA submitted the liquid waste system abandonment form to NMED LWP as required on August 8, 2017 (NASA, 2017b).

4.2.2 SWMU 22 – 100 Area Septic Tank at Building 114

Final SWMU 22 sludge sampling results indicated silver and cyanide concentrations were below the NMED CSSLs. The sewage sludge and the septic tank carcass were characterized as nonhazardous waste and tank removal SWMU 22 was conducted in accordance with the original septic tank removal plan (Appendix A of the IWP [NASA, 2013a]) that was approved by the NMED HWB (NMED, 2013b) and the NMED LWP (NMED, 2013c). Minimal water was added to the SWMU 22 tank during sewage sludge removal by a licensed subcontractor. The tank was pumped and removed on November 9, 2016. NASA submitted the required liquid waste system abandonment form to NMED LWP on November 15, 2016, (NASA, 2016e).

4.2.3 SWMU 23 – 200 Area Septic Tanks at Building 272 (Tanks A&B)

The 200 Area septic tanks (A&B) at Building 272 (SWMU 23) were both pumped, excavated, and removed on December 16, 2015. NASA submitted the liquid waste system abandonment form to NMED LWP as required on February 4, 2016 (NASA, 2016b).

4.2.4 SWMU 24 – 300 Area Septic Tank at Main Parking Lot

The 300 Area main septic tank (SWMU 24) was pumped, excavated, and removed on March 4, 2016. NASA submitted the liquid waste system abandonment form to NMED LWP as required on April 28, 2016 (NASA, 2016d).

4.2.5 SWMU 25 – 300 Area Septic Tank at Building 320

The 300 Area septic tank at Building 320 (SWMU 25) was pumped, excavated, and removed on February 10, 2016. NASA submitted the liquid waste system abandonment form to NMED LWP as required on March 30, 2016 (NASA, 2016c).

4.2.6 SWMU 26 – 300 Area Septic Tank at Building 364

The 300 Area septic tank at Building 364 (SWMU 26) was pumped, excavated, and removed on May 20, 2015. The liquid waste system abandonment form was submitted to NMED LWP as required on July 6, 2015 (NASA, 2015c).

4.2.7 SWMU 27 – 400 Area Septic Tank at Main Parking Lot

The 400 Area main septic tank (SWMU 27) was pumped, excavated, and removed on March 8, 2016. NASA submitted the NMED LWP liquid waste system abandonment form as required on April 28, 2016 (NASA, 2016d).

4.2.8 100 Area Septic Tank at Building 117 (WSTF Forward Guard Gate)

As discussed in Section 3.4.8, the 100 Area septic tank at Building 117 was retained for use at WSTF. The tank was inspected by the NMED LWP and Permit Number 002090 was issued for the on-going operation of this septic system (NMED, 2017b).

4.2.9 250 Area Septic Tank (Area of Interest)

Despite a thorough field inspection, the 250 Area septic tank (area of interest) was not located during this investigation. It was determined that the septic tank had been removed in the past without documentation, or had biodegraded. According to research performed during preparation of the HIS, the tank was intended to be temporary and was constructed mostly of redwood and "orangeburg drain pipe," which reportedly biodegrade over time. The HIS also contained a photograph from June 1977 showing an open pit surrounded by bollard posts in the area where the septic tank was reported to be located (NASA, 2013a; Appendix A). The tank may have been removed at that time.

4.2.10 200 Area Septic Tank at Building 272 (Tank C)

The 200 Area septic tank at Building 272 (Tank C) was pumped, excavated, and removed on December 16, 2015. NASA submitted the liquid waste system abandonment form to NMED LWP as required on February 4, 2016 (NASA, 2016b).

4.2.11 400 Area Septic Tank at Building 447

The 400 Area septic tank at Building 447 was pumped, excavated, and removed on February 18, 2016., NASA submitted the liquid waste system abandonment form to NMED LWP as required on March 30, 2016 (NASA, 2016c).

4.2.12 400 Area Septic Tank at Building T463

The 400 Area septic tank at Building T463 was pumped, excavated, and removed on January 28, 2015. NASA submitted the liquid waste system abandonment form to NMED LWP as required on March 16, 2015 (NASA, 2015b).

4.2.13 600 Area Septic Tank at Building 650

The 600 Area septic tank at Building 650 was pumped, excavated, and removed on February 17, 2016. NASA submitted the liquid waste system abandonment form was submitted to NMED LWP as required on March 30, 2016 (NASA, 2016c).

4.2.14 800 Area Septic Tank at Building 802/803

The 800 Area septic tank at Buildings 802/803 was pumped, excavated, and removed on June 21, 2017. NASA submitted the liquid waste abandonment form to NMED LWP as required on August 8, 2017 (NASA, 2017b).

4.2.15 STGT Septic Tank

The STGT septic tank was pumped, excavated, and removed on July 19, 2017. NASA submitted the liquid waste program abandonment form to NMED LWP as required on August 8, 2017 (NASA, 2017b).

4.3 Drilling Program

4.3.1 Overview of Drilling Program

Off-site contractors were used during drilling for this project with oversight by WSTF personnel. Initial soil boring locations (Figure 2.1) were presented in the IWP (NASA, 2013a). These locations were later changed within the Deviations (NASA, 2014a) and approved by NMED on May 6, 2014. All soil borings were completed in accordance with the Deviations (NASA, 2014a) except where noted in this report.

Seven soil borings were installed at or adjacent to the location of the Building 114 septic tank. Three shallow soil borings and two deeper borings were installed in April 2017. One boring upgradient and two borings downgradient were installed to 12 ft bgs. Two borings were drilled within the excavation area (footprint) of the septic tank to 27 ft bgs. Due to anomalous analytical results for samples collected from these borings at 6 to 8 ft bgs (the base of the former septic tank), two additional shallow borings were installed to 9 ft bgs in October 2017 within the excavation area. Appendix C contains lithologic logs of the soil borings installed during this investigation.

4.3.2 Building 114 Septic Tank (SWMU 22) Soil Boring Locations

Subsurface drilling and sampling activities were performed at the Building 114 septic tank on April 18, 2017 and April 19, 2017 by Terracon Consultants, Inc. of El Paso, TX, under the supervision of WSTF contractor Environmental Department personnel.

A truck mounted Central Mine Equipment CME-75 HSA drilling rig was used to drill the soil borings and to collect soil samples. Soil borings were advanced using a carbide-tipped bit and 5-ft length x 8.75-in. diameter steel augers. Original soil boring locations were presented in the IWP (NASA, 2013a) and approved by NMED (NMED, 2013b). Initially, five soil borings were planned for installation within the leach field, one boring was planned upgradient and one boring was planned downgradient of the leach field. Three potential supplemental borings were also originally proposed if any evidence of contamination was noted at the tank site: two within the tank footprint and one downgradient of the tank. However, during pre-investigation sludge sampling activities at the Building 114 septic tank, it was discovered that the tank bottom was compromised. The available evidence indicated that the septage had not reached the leach field. With NMED's approval (NMED, 2014a), NASA modified the planned soil investigation to include the installation of two borings within the footprint of the SWMU 22 septic tank, one boring downgradient of the tank, and one boring upgradient of the tank (NASA, 2014a). Soil borings were installed in the following order: upgradient soil boring 114-SB-01 to 12 ft bgs; downgradient soil borings 114-SB-04 and 114-SB-05 to 12 ft bgs; and, SWMU 22 soil borings (in footprint) 114-SB-02 and 114-SB-03 to 27 ft bgs.

On October 31, 2017, two additional soil borings were completed to 9 ft bgs within the footprint of the SWMU 22 tank due to anomalous cyanide results from soil samples collected at the 6 to 8 ft bgs interval in borings 114-SB-02 and 114-SB-03. Terracon Consultants also completed the additional borings, designated as 114-SB-07 and 114-SB-06, with WSTF contractor Environmental Department personnel supervision.

4.4 Soil Sampling

Soil sample depths were originally proposed in the IWP (NASA, 2013a), but were later changed in the Deviations (NASA, 2014a), which NMED approved on May 6, 2014. Both approved documents were used in conjunction with Permit Section 17.2.2.b.i. (NMED, 2016) to guide soil sampling operations in the field. The following sections describe the sampling activities performed during investigation fieldwork at SWMU 22.

4.4.1 Chemical Sampling and Analysis

At SWMU 22, samples collected during this investigation include investigation soil samples, duplicates, matrix spikes, and equipment rinsate samples. Soil samples, including duplicate and matrix spike samples, were obtained by advancing the auger to just above the sampling interval specified in the Deviations (NASA, 2014a). A 3-in. split spoon sampler was utilized to collect soil samples across the interval specified in the Deviations (NASA, 2014a).

At the Building 114 septic tank location, NASA collected soil samples for chemical analyses of total metals content and cyanide content. In April 2017, NASA installed the five soil borings 114-SB-01 through 114-SB-05 (three to 12 ft bgs and two to 27 ft bgs) and collected 16 (19 with duplicates and matrix spikes) soil chemical samples. The April 2017 soil samples from soil borings 114-SB-01 through -05 were analyzed at an off-site National Environmental Laboratory Accreditation Program accredited laboratory for total metals using SW-846 Methods 6010B/7471 and total cyanide using SW-846 Method 335.4 instead of using Method 9012B, as requested. Results of cyanide analyses of the April 2017 soil samples indicate that nitrate interference may have impacted cyanide results in the same manner as previously identified during sludge sample analyses as described in Section 3.4.10. The elevated cyanide concentrations were observed in samples collected from immediately beneath the former septic tank.

NASA evaluated the potential for nitrate interference impacts to cyanide analytical results by sampling soils from two additional shallow soil borings, 114-SB-06 and 114-SB-07, installed in October 2017 and analyzing these samples using SW-846 Method 9012B. Soil samples were collected adjacent to the two borings exhibiting the highest cyanide concentrations from soils immediately beneath the fill material. NASA selected an accredited laboratory that could analyze the October 2017 soil samples for total cyanide by SW-846 Method 9012B, using the sulfamic acid preparation modification. In areas where nitrate interference in cyanide analyses is probable, analyses for cyanide using sulfamic acid preparation and Method 9012B yield results that are more representative of subsurface conditions than results of cyanide analyses using Method 335.4.

4.4.2 SWMU 22 Shallow Boring Soil Sampling

At the Building 114 septic tank location, shallow soil samples were collected using a 3-in. split spoon sampler at designated intervals within borings updgradient boring 114-SB-01 and downgradient borings 114-SB-04 and 114-SB-05. In addition to soil chemical samples collected from the three shallow borings, NASA collected equipment rinsate samples from the 3-in. split spoon sampler prior to soil sampling on April 18 and 19, 2017. Soil chemical samples and related quality control samples were collected at:

- 114-SB-01: 5 to 7 ft bgs; 10 to 12 ft bgs (with duplicates)
- 114-SB-04: 5 to 7 ft bgs; 10 to 12 ft bgs
- 114-SB-05: 5 to 7 ft bgs; 10 to 12 ft bgs

Analytical results from cyanide samples collected in April 2017 from the 6 to 8 ft bgs interval within soil boring 114-SB-02 and the 7 to 8 ft bgs interval within soil boring 114-SB-03 may have been impacted by nitrate/nitrite interference. As a result, replacement samples were collected from the 7 to 9 ft bgs interval within additional shallow soil 114-SB-07 and 114-SB-06, installed in October 2017. During installation of these soil borings, fill material was identified from the ground surface to a depth of 7 ft bgs, therefore the selected sample interval for both boreholes was immediately beneath the fill material, from 7 to 9 ft bgs. The sampling interval lies directly beneath the clean fill sand that was used to fill in the excavation following excavation and removal of the septic tank. NASA collected equipment rinsate samples from the 3-in. split spoon sampler prior to soil sampling on October 31, 2017. A field blank was also collected at this sampling event. Soil chemical samples were collected as follows:

- 114-SB-06: 7 to 9 ft bgs
- 114-SB-07: 7 to 9 ft bgs

4.4.3 SWMU 22 Deep Boring Soil Sampling

At the Building 114 septic tank location, deep soil samples were collected using a 3-in. split spoon sampler at designated intervals within borings 114-SB-02 and 114-SB-03, both of which lay within the excavation area of the septic tank. Shallow soil samples were collected upgradient and downgradient from SWMU 22. NASA collected equipment rinsate samples from the 3-in. split spoon sampler prior to soil sampling on April 18 and 19, 2017. Soil chemicals and quality control samples were collected at the following locations:

- 114-SB-02: 6 to 8 ft bgs; 10 to 12 ft bgs; 15 to 17 ft bgs; 20 to 22 ft bgs; 25 to 27 ft bgs (with matrix spike).
- 114-SB-03: 7 to 8 ft bgs (with duplicates); 10 to 12 ft bgs; 15 to 17 ft bgs; 20 to 22 ft bgs; 25 to 27 ft bgs.

Photographs of the sampling event are included in Appendix A.

4.5 Subsurface Conditions

4.5.1 Man-made Structures

The complex network of underground electrical, gas, communication, and water lines in the vicinity of the Building 114 septic tank is shown in Figure 2.1.

4.5.2 Geology and Hydrogeology

Soils observed in this investigation were evaluated using the Munsell soil color system (Munsell, 2009) and consisted of pinkish white (5 YR 7/2) to light yellowish brown (10 YR 6/4) sand with gravel (Unified Soil Classification System group SW). No other soil investigations were conducted at the remaining septic tank SWMU sites. The alluvium in the area primarily consisted of well graded sand with gravel and significant amounts of silt.

4.6 Soil Boring Abandonment

Following the completion of the two deep and five shallow soil borings for the Building 114 septic tank (114-SB-01, 114-SB-02, 114-SB-03, 114-SB-04, 114-SB-05, 114-SB-06, 114-SB-07), each boring was filled with a Portland Type I/II cement-bentonite grout containing approximately 5% bentonite by weight from total depth of the borehole to 2 ft bgs. The grout was allowed to set, covered by 2 ft of cement, and staked with a brass cap. The brass caps were surveyed by WSTF personnel with Trimble®,[1] TSC3 Global Positioning System surveying equipment and stamped with the boring number and coordinates. The coordinates and the elevation were recorded in the applicable project documentation.

4.7 Safety and Health Measures

Field activities were conducted in accordance with requirements of OSHA Standards for Hazardous Waste Operations and Emergency Response (HAZWOPER; 29 CFR 1910.120[a]-[o]), EPA standards, the WSTF environmental contractor's Safety and Health Plan (SHP), and the IWP (NASA, 2015b). The SHP addressed safety and health issues pertaining to work activities, including known and reasonably anticipated hazards associated with project scope of work as well as contingencies for unexpected conditions. Requirements of the SHP applied to prime and sub-tier contractors as well as personnel requesting access to controlled areas of the investigation site.

Project field personnel were current in HAZWOPER training required under 29 CFR 1910.120(e). Safety professionals, or other designees, inspected subcontractor equipment prior to the commencement of work. There were no significant health and safety concerns identified. Beyond the federal, state, and site required health and safety measures listed above, key field personnel attended a safety presentation before commencement of field activities outlining possible hazards that may arise.

4.8 Decontamination Procedures

Decontamination procedures were performed by personnel who have completed the Occupational Safety and Health Administration (OSHA) standards for HAZWOPER 29 Code of Federal Regulations (CFR) 1910.120[a-o] 40-hour training personnel wearing appropriate personal protective equipment (PPE). The decontamination of heavy equipment was performed under the supervision of WSTF contractor

[1] Trimble is a registered trademark of Trimble, Inc. Corporation.

Environmental Department personnel. All decontamination was performed in accordance with the project specific Field Decontamination Plan.

Decontamination during sewage sludge sampling activities included rinsing reusable sampling equipment with purified deionized water prior to initiating sample collection. Following sampling activities, reusable sampling equipment was decontaminated using a 2% bleach solution and cleaned using a non-phosphate detergent at the project site. Decontamination water was properly contained until sample results were received and the final characterization of the water was performed.

Heavy equipment used for the soil borings at the Building 114 septic tank included an HSA drilling rig that was decontaminated at the large decontamination pad next to Building 637 with a high pressure heated water wash prior to drilling the soil borings. The split spoon barrel used for sampling was decontaminated first by washing the sampler with a non-phosphate detergent wash such as Alconox®[2] and rinsed with water between sampling events. Nitrile gloves were donned for collection and handling of soil samples for chemical analysis and replaced for every sample interval. Following the drilling of the soil borings the HSA drilling rig and related equipment was decontaminated before being taken off site.

4.9 Investigation-Derived Waste Management

As required in Permit Attachment 20 (Section 20.2.13), an Investigation-Derived Waste (IDW) Management Plan was provided with the IWP in Attachment B (NASA, 2013a). The HIS associated with this investigation (NASA, 2013a) determined that limited amounts of silver and possibly cyanide bearing waste streams were discharged to the septic tank associated with SWMU 22 prior to 1985. No evidence of discharge of listed hazardous wastes to SWMU 22 or any other WSTF septic tank was found during the HIS research process. The IDW Management Plan addressed waste generated from removal and investigation activities at SWMU 22. Hazardous waste was not generated during the removal of septic tanks associated with SWMUs 21 and 23-27. The non-hazardous sewage sludge and septage from SWMUs 21 and 23-27 was removed and disposed of by a licensed septage pumper. The septic tanks associated with SWMUs 21 and 23-27 were removed and disposed of as solid waste in accordance with the NMED-approved IWP (NASA, 2013a).

The IDW Management Plan provided with the IWP included a description of the potential wastes that would be generated from SWMU 22 as well as procedures for waste management, characterization, and disposition. IDW generated during the SWMU 22 project was managed per the IDW Management Plan. Generated wastes included: concrete septic tank, septage, environmental media (soil); used non-dedicated sampling equipment; PPE; plastic sheeting; miscellaneous debris contaminated by IDW; and water and soap used for equipment decontamination.

Waste initially generated during SWMU 22 sewage sludge sampling was managed as hazardous waste in accordance with the requirements of 20.4.1.300 NMAC and 40 CFR 262.34(C) (2012) with hazardous waste codes D003 for cyanide reactivity and D011 for silver toxicity. Additional waste characterization was performed after receiving the sewage sludge results, and it was determined that the sewage sludge, IDW contact waste, and decontamination water could be managed as non-hazardous solid waste. IDW contact waste (i.e., gloves and wipes) from sampling events was bagged, disinfected with a 2% bleach solution as a best management practice, and disposed of in an onsite solid waste dumpster. Aqueous waste, such as decontamination water, was discharged to the WSTF sewage lagoons and sanitary sewer throughout the project. Sewage sludge from SWMU 22 was characterized as non-hazardous and removed by a licensed subcontractor septage pumper. The SWMU 22 septic tank carcass was also characterized as

[2] Alconox is a registered trademark of Alconox, Inc.

non-hazardous solid waste, and was removed by an on-site contractor who disposed of the concrete as solid waste at an appropriate disposal facility.

Environmental media generated during the SWMU 22 soil investigation consisted of two 55-gallon drums of drill cuttings from soil boring installation. The drill cuttings were initially characterized as hazardous waste with D003 (cyanide reactivity) and D011 (silver toxicity) waste codes, which correspond to the COCs for the project. Contaminated media may be considered hazardous waste if the media exhibits a characteristic of hazardous waste or was contaminated with listed hazardous waste. No listed hazardous waste constituents were identified during the investigation. The SWMU 22 soil investigation results indicated that the drill cuttings were non-hazardous because the soil was not reactive (D003) and did not contain silver above the D011 toxicity characteristic concentration. EPA guidance (1998) states that because the determination of characteristic hazardous waste can be made through relatively straightforward analytical testing, no formal "contained-in" determination by EPA or an authorized state is required. The EPA also states in the same document that generators of contaminated media may make independent determinations as to whether the media exhibits a characteristic of hazardous waste. Using the soil investigation results and EPA guidance, NASA determined that the environmental media was not characteristic hazardous waste, and it was returned to the immediate project area adjacent to the SWMU 22 tank location in accordance with the NMED-approved IWP Management Plan for the project (NASA, 2013a). Debris (i.e., wipes and gloves) from the soil investigation were re-characterized as non-hazardous waste and disposed of as solid waste in an on-site dumpster. Soil investigation decontamination fluids were also determined to be non-hazardous and were discharged to the sanitary sewer.

4.10 Deviations

During the course of this investigation, deviations from the approved IWP arose while still meeting required DQOs. Notable deviations implemented during the investigation are described below.

4.10.1 SWMU 22 Leach Field Borings

It was stated in the IWP that soil borings would be identified with Global Positioning System surveying equipment and samples would be collected to confirm that the soil below the leach field did not contain hazardous constituents. Following the inspection of the Building 114 septic tank, it was discovered that there was no leach field associated with the tank and that the bottom of the septic tank was compromised. As a result, the SWMU 22 soil investigation was modified to exclude soil borings within the proposed leach field, and instead focused on soil within the footprint of the Building 114 septic tank (NASA 2014a).

4.10.2 Soil Boring Depths and Locations

Three borings were proposed within the original IWP, two of which would be drilled within the leach field of the 100 Area septic tank at Building 114 (SWMU 22) and one soil boring would be drilled downgradient of the leach field. Following the discovery that wastewater was never discharged to the leach field and that the Building 114 septic tank had been compromised, new soil borings were proposed as a deviation in 2014 (NASA 2014a). This document proposed two borings within the footprint of the septic tank at base of the tank and every 5-ft interval thereafter to a total depth of 10 ft below the base of the tank. One soil boring would be installed upgradient and two would be installed downgradient from the SWMU 22 excavation site. Soil samples were proposed at 5 and 10 ft bgs.

The WSTF Hazardous Waste Permit (NMED, 2016) states that samples must be collected "Twenty feet below the base of the disposal units if contamination is not detected." As a result, soil samples were collected at intervals of 0, 5, 10, 15, and 20 ft below the base of the SMWU 22 excavation, which was estimated to be between 6 to 7 ft bgs according to measurements conducted with the HSA drilling rig.

4.10.3 Field Blanks

Collection of field blanks for the SWMU 22 soil investigation were not proposed in IWP, however, field blanks were collected in conjunction with the October 31, 2017 soil sampling event.

4.10.4 Risk Screening

The IWP states, "If COPC concentrations in vadose zone soils exceed the appropriate risk-based clean up levels… for direct exposure routes under the construction worker scenario, then a RCRA Corrective Measures Study will be performed to determine appropriate soil remediation. Otherwise, consider a no further action determination" (NASA, 2013a). Utilizing current NMED RA guidance (NMED, 2019), the comparison of COPC concentrations to SSLs would be inadequate to fully characterize potential risk and recommend no further action. NASA performed the more thorough risk screening in accordance with NMED RA guidance (NMED, 2019). A complete description of risk screening is provided in Section 7.0.

5.0 Regulatory Criteria

Soil was the media of concern in this investigation. The IWP stated the investigation results would be compared to the NMED CSSLs (NASA, 2013a). Based upon recent NMED communications, residential exposure scenarios must be evaluated to qualify for Corrective Action Complete without controls (CAC). For the purposes of this report, the RSSLs were used as the basis to determine whether or not to continue investigation and/or corrective actions. NASA performed human health and ecological risk screening in accordance with the RA Guidance (NMED, 2019), comparing detected constituent concentrations to SSLs for each identified exposure scenario listed in Section 3.2.3. NMED RSSLs applicable for this investigation are those for silver and cyanide.

6.0 Investigation Results

This section provides the soil chemical analytical results from sampling performed at the Building 114 septic tank. In accordance with the IWP, field and laboratory quality control samples were collected in order to produce data of known and sufficient quality to meet project objectives. This included field rinsate (equipment) blanks, field duplicate samples, matrix spike samples, and laboratory method blanks. Analytical data were validated upon review and verified usable in order to meet the project DQOs. The soil sample analytical results are summarized below and compared to applicable regulatory criteria. No contaminants were detected in any equipment blank samples.

6.1 Soil Chemical Results

Soil chemical sampling parameters are provided in Table 6.1. All collected soil samples were analyzed for total metals content using SW-846 Methods 6010B and 7471 (mercury). Soil samples from borings 114-SB-01, -02, -03, -04, and -05 were analyzed for cyanide using SW-846 Method 335.4, while samples from borings 114-SB-06, and -07 were analyzed for cyanide using SW-846 Method 9012B. Appendix D provides the analytical reports submitted by the contractor analytical laboratories. A Quality Assurance Report (QAR) was completed on the April and October 2017 sample events and is provided as Appendix E.

6.1.1 Data Quality

The QAR (Appendix E) did not identify negative quality issues with metals analyses using EPA Methods 6010B and 7471 or with the cyanide analyses using EPA Method 335.4 and SW-846 Method 9012B, making these data usable for the purposes of this investigation and the risk screen evaluation. However, cyanide analysis by SW-846 Methods 335.4 did exhibit elevated concentrations beneath the former septic tank due to nitrate interference, as discussed in Sections 3.4.10 and 4.4.1, and these samples exhibit high biased concentrations due to this interference. For the cyanide analyses using SW-846 Method 9012B, the primary and duplicate samples collected from soil boring 114-SB-06 exhibit a relative percent difference (RPD) of approximately 170%, exceeding the established RPD precision maximum of 20% for soil stated in WSTF Permit Attachment 17, Section 17.3.3.b, Field Duplicates. The NASA data validation indicates the elevated RPD is not due to laboratory error or other data validation issues, and these data suggest the difference is attributable to heterogeneity between the samples. For the purposes of this investigation and risk screen evaluation, the higher, more conservative concentration from the duplicate sample was used.

As part of the data validation, NASA assigns flags for method blank contamination "RB" based on the associated sample concentration as follows: (a) if the concentration in the associated samples is not over ten (10) times the identified concentration in the method blank, the "RB" flag is assigned to that sample indicating the sample concentration may be biased high, and; (b) If the concentration in the associated sample is over ten (10) times the identified method blank concentration, the "RB" flag is not assigned, since the identified blank concentration is not anticipated to affect the total sample concentration. For the 114-SB-06 samples, the associated method blank concentration is 0.04 mg/kg. The primary sample cyanide concentration was 0.17 mg/kg (less than 10 times 0.04 mg/kg) and was flagged "RB," and the duplicate sample cyanide concentration was 2.22 mg/kg (more than 10 times 0.04 mg/kg) and was not flagged.

Use of both the high biased cyanide data from the EPA Method 335.4 and the higher concentration duplicate sample results from boring 114-SB-06 constitute a conservative approach in evaluation of the investigation and associated risk screen evaluation.

6.1.2 Results of Soil Samples

Sample locations and a summary of all detections for both the April and October 2017 samples are provided in Table 6.2. The April 2017 samples were analyzed for cyanide by EPA Method 335.4; arsenic, barium, cadmium, chromium, lead, selenium, and silver by EPA Method 6010B; and mercury by EPA Method 7471. The October 2017 samples were analyzed for cyanide by EPA Method 9012B. A map of these locations and associated analytical results is provided in Figure 2.1.

Silver and cyanide were reported at concentrations above laboratory detection limits in soil samples collected during the Building 114 septic tank investigation. Silver was detected in only three samples analyzed for the investigation at only two locations. The detection was in soil boring 14-SB-03 at a depth of 7 to 8 ft bgs at concentrations of 0.29 mg/kg and 0.11 mg/kg. The duplicate result was accompanied by a "J" quality flag, indicating the reported concentration of silver was an estimated value below the practical quantitation limit, but above or equal to the method detection limit. The other detection of silver was in a sample collected from boring 114-SB-02 at a depth of 6 to 8 ft bgs and at a concentration of 0.94 mg/kg. Reported concentrations of silver did not exceed either the NMED Residential or Construction Worker SSL and did not exceed the NMED soil-to-groundwater soil leachate SSL.

In the April 2017 sampling event, cyanide was detected in 10 of 20 samples (including duplicates) analyzed. Three results for cyanide exceeded the RSSL: borings 114-SB-02 at a depth of 6 to 8 ft bgs (19.6 mg/kg) and 114-SB-03 at a depth of 7 to 8 ft bgs (47.3 mg/kg and 60.6 mg/kg in the duplicate).

As previously described, NASA believed that the elevated concentrations of cyanide in several borings sampled in April 2017 may have resulted from nitrate/nitrite interference during the analytical process. In order to further evaluate the potential for anomalous detections of cyanide, two additional borings were installed within the Building 114 septic tank excavation: 114-SB-06 and 114-SB-07. Additional soil samples were collected from these borings in October 2017: 114-SB-06 at a depth of 7 to 9 ft bgs and at 114-SB-07 at a depth of 7 to 9 ft bgs including a duplicate. The sampling interval was selected because the interface between native alluvium and backfill material was observed at approximately 7 ft bgs in April 2017.

The subcontracted analytical laboratory was directed to utilize sulfamic acid as part of the pretreatment process to reduce nitrate interference as provided for in the EPA guidance for Method 9012B. The total cyanide concentrations in the primary and duplicate soil samples collected from a depth of 7 to 9 ft bgs in boring 14-SB-06 were 0.17 mg/kg (primary) and 2.22 mg/kg (duplicate). The primary sample result was accompanied by the “J”, “RB”, and “QD” quality flags; a “J” flag indicates the reported concentration of cyanide was an estimated value below the practical quantitation limit, but above or equal to the method detection limit; the “RB” flag indicates the analyte was detected in the method blank, and: the “QD” flag indicates the relative percent difference for a field duplicate was outside standard limits. The duplicate sample concentration was flagged “QD”. The cyanide concentration in the sample collected from a depth of 7-9 ft bgs in boring 114-SB-07 was 0.09 mg/kg, and was also flagged “J”, “RB”, and “QD”.

6.2 Determination of Constituents of Potential Concern for Risk Screening

The information presented in NMED’s RA Guidance (NMED, 2019) was used for determination of site COPCs for the SWMU 22 human health risk and hazard screening evaluation. The HIS was used to determine what COPCs would likely be present, and appropriate analytical methods were chosen. As previously stated, silver and cyanide were the COPCs identified in the IWP. To search for these COPCs, soil samples were analyzed for metals and cyanide. Any analyte detected in SWMU 22 soil samples was initially considered to be a potential COPC. The list of potential COPCs was then evaluated in accordance with the RA Guidance to determine final COPCs.

The NMED RA guidance includes several receptor scenarios to determine if sites meet or exceed the recommended target risk from carcinogenic compounds and the target hazard (Hazard Index [HI]) from non-carcinogenic compounds. These exposure scenarios assess impacts from soil depth intervals deemed appropriate for each receptor scenario. SWMU 22 analytical data was separated by depth and evaluated per receptor scenario.

As described previously, analytical data generated during this investigation consisted of samples collected from soils from approximately 5 ft bgs to depths of up to 27 ft bgs. The exposure scenarios evaluated as part of the risk screening included residential (0 ft to10 ft bgs soils), construction worker (0 ft to10 ft bgs soils), soil-to-groundwater (soils from all depths), and burrowing ecological (0 ft to10 ft bgs soils).

Analyzed constituents for SWMU 22 included arsenic, barium, cadmium, total chromium, cyanide, lead, mercury, selenium, and silver. Selenium was the only constituent not detected at concentrations greater than laboratory detection limits, so was not carried forward as a COPC through the risk screening process.

6.2.1 QA/QC Duplicate Samples

Sample locations where duplicate samples were collected and analyzed for quality control purposes resulted in duplicate data points for these locations. The results of the primary and duplicate sample analyses were compared, and the most conservative value was selected and carried forward through the risk screening process.

6.2.2 Background versus Maximum Detected Concentration

NASA compared maximum detected analyte concentrations with the NMED approved background threshold values (BTV) as documented in the *Response to Notice of Disapproval for the Soil Background Study Investigation Report* (NASA, 2015d). The background study established BTVs for five distinct soil types present at the WSTF facility. SWMU 22 soils are characterized as Area 4 soils, therefore the Area 4 BTVs were used for comparison purposes.

The Area 4 BTVs included a background value for arsenic, barium, chromium, lead, and mercury, but did not establish background values for cadmium, cyanide, or silver. Cadmium, cyanide, and silver were carried through the risk screening process. For the remaining metals, maximum SWMU 22 constituent concentrations collected from soil interval 4 to 8 ft bgs and 8 to 12 ft bgs were compared to the approved 4 to 8 ft bgs and 8 to 12 ft bgs BTVs. The maximum concentration of chromium (1.90E+01 mg/kg) for 4 to 8 ft bgs and arsenic (1.40E+01 mg/kg) for 8 to 12 ft bgs exceeded the Area 4 corresponding BTVs (1.17E+01 mg/kg and 1.19E+01 mg/kg, respectively; Table 6.1 and Table 6.2). For constituents with maximum concentrations exceeding the respective BTV, the RA Guidance requires a population-to-population comparison be completed.

6.2.3 Background Population-To-Population Comparison

Arsenic and chromium, which exhibited maximum concentrations greater than the corresponding BTVs, were then evaluated using a two-sample hypothesis test. This test compared the distribution of the site data to the distribution of background data, also known as a population-to-population comparison. The EPA's ProUCL Version 5.1 statistical software was used for hypothesis testing (EPA, 2015). ProUCL was also used to determine the most appropriate test (parametric or nonparametric) based on the distribution of the data. Additionally, ProUCL was used to generate a Q-Q plot of the background and site data sets, and this graph was reviewed to support this determination. The ProUCL-generated statistical worksheets of the arsenic and chromium population-to-population comparisons and Q-Q plots are provided in Appendix F.

Results of the background population-to-population comparison for arsenic indicate the identified concentrations of arsenic are representative of background concentrations, so arsenic was eliminated as a COPC for the Residential and Construction Worker exposure scenarios. However, arsenic was not eliminated as a COPC for the soil-to-groundwater exposure scenario as BTVs are not established for soils deeper than 12 ft bgs. NASA observed that arsenic concentrations in samples collected from 0 to 10 ft bgs ranged from 3.8 to 14 mg/kg and in samples collected from depths greater than 10 ft bgs ranged from 5.1 to 12 mg/kg, possibly indicating that arsenic concentrations in deep soils at SWMU 22 may be indicative of background. Results of the background population-to-population comparison for chromium indicate the identified concentrations of chromium are greater than background concentrations, so chromium was retained as a COPC for all exposure scenarios.

6.2.4 SWMU 22 COPCs

The COPCs identified following background comparisons for SWMU 22 were cadmium, chromium, cyanide, and silver for the residential and construction worker exposure scenarios. For the soil-to-groundwater exposure scenario, additional COPCs were added due to lack of background data deeper than 12 ft bgs (cadmium, chromium, cyanide, and silver plus arsenic, barium, lead, and mercury added).

7.0 Risk and Hazard Screening

NASA completed a human health and ecological risk screening in accordance with NMED RA Guidance (NMED, 2019). Risk screening efforts included evaluation of residential, construction worker, soil-to-groundwater, and burrowing ecological exposure scenarios. Screening was not conducted for industrial and ecological non-burrowing scenarios because the Building 114 septic tank was buried approximately 5 ft bgs with no discharge to a leach field. Any potential discharge to the environment occurred deeper than 1 ft bgs, which resulted in no exposure for industrial and non-burrowing ecological receptors.

Risks and hazards were evaluated in a stepwise approach. For human health risk/hazards, maximum concentrations of COPCs were compared to NMED SSLs using equations from the guidance as described below. Then risks and hazards were summed to obtain the combined site risk and/or hazard for each exposure scenario. If there were no cancer risk or non-cancer hazard target exceedances for individual or combined COPCs, then no further risk or hazard screening was necessary for that scenario.

For residential and construction worker exposure scenarios, NMED established cancer and non-cancer SSLs based on toxicity (NMED, 2019). For COPCs with a cancer SSL, the maximum concentration was divided by the SSL, then multiplied by 10^{-5} to establish the individual COPC risk. The risk target was 1E-05. For COPCs with a non-cancer SSL, the maximum concentration was divided by the SSL, then multiplied by 1 to establish the HI. The hazard target was 1. COPCs could have both cancer and non-cancer SSLs (NMED, 2019).

For the soil-to-groundwater exposure scenario, the NMED has established a target soil leachate SSL for use with initial risk/hazard screening using a DAF of 20 (NMED, 2019). The maximum concentration at any depth was used to compare directly to the soil leachate SSL. For COPCs that exceeded the soil leachate SSL using the maximum concentration, the EPA software ProUCL was used to calculate the UCL95 concentration for the soil-to-groundwater scenario. The UCL95 concentrations for individual COPCs were then compared directly with the individual target soil leachate SSLs.

ProUCL-generated calculated statistical outputs for determination of the UCL95 values (for soils both 0 to 10 ft bgs for residential and construction worker scenarios and all results, all depths for the soil-to-groundwater scenario) are provided in Appendix F. UCL95 concentration values were not calculated for all COPC analytes because the total number of detections was insufficient (< 5) to perform valid statistical analyses. Therefore, the maximum concentration of these COPCs was carried through the UCL95 screening process.

7.1 SWMU 22 Residential Exposure Scenario

The residential receptor screening levels are based upon child and adult receptors. This receptor scenario is expected to be a conservative scenario and assumes that exposures occur 24 hours per day, 350 days per year over a 26-year exposure duration. In accordance with NMED RA Guidance (2019), risk and HIs were evaluated for COPCs having cancer and non-cancer RSSLs. As stated, risks and hazards were evaluated in a stepwise approach, initially calculated based on maximum concentrations. The residential exposure scenario includes exposure to soils from the ground surface to a depth of 10 ft (0 ft to 10 ft bgs).

Table 7.1 presents the results of the residential cancer risk screening based on maximum SWMU 22 concentrations for cadmium and chromium. Table 7.2 contains the results of residential non-cancer hazard screening based on maximum SWMU 22 cadmium, chromium, cyanide, and silver concentrations. Risk screening indicated the residential combined cancer risk was 1.97E-06, which did not exceed the target cancer risk of 1E-05. For non-cancer screening, the combined HI for SWMU 22 was 7.93E-01, which did not exceed the target HI of 1.

7.2 SWMU 22 Construction Worker Scenario

As stated in the RA Guidance (NMED, 2019), a construction worker is assumed to be a receptor that is exposed to contaminated soil during the workday for the duration of a single on-site construction project. If multiple construction projects are anticipated, it is assumed that different workers will be employed for each project. The construction worker exposure scenario includes exposure to soils from the ground surface to a depth of 10 ft (0 to 10 ft bgs).

Table 7.3 presents the results of the construction worker cancer risk screening based on maximum cadmium and chromium concentrations. Table 7.4 contains the results of the construction worker non-cancer hazard screening based on maximum cadmium, chromium, cyanide, and silver concentrations. Health risk screening indicated the construction worker combined cancer risk was 4.09E-07, which did not exceed the target cancer risk of 1E-05. Hazard screening indicated the construction worker combined non-cancer HI was 8.74E-01, which did not exceed the target HI of 1.

7.3 SWMU 22 Soil-to-Groundwater Scenario

Table 7.5 presents the results of the point comparison screening based on maximum COPC concentrations. Direct comparisons of maximum COPC concentrations to target soil leachate SSLs indicated that two COPCs exceeded soil leachate SSLs for the soil-to-groundwater exposure scenario. These COPCs were arsenic and cyanide.

Since maximum COPC screening resulted in exceeding two target soil leachate SSLs, the UCL95 concentrations for each COPC were calculated and compared directly to target SL-SSLs. Table 7.6 presents the results of the screening based on calculated UCL95 COPC concentrations. The UCL95 concentration value was not calculated for two of the eight COPC analytes (mercury and silver), because the total number of detections was insufficient (< 5) to perform valid statistical analyses. Therefore, the maximum concentration of these analytes was carried through the UCL95 screening process. The direct point comparisons indicated that calculated UCL95 concentrations for arsenic and cyanide exceeded target soil leachate screening SSL. Arsenic was eliminated as a COPC for the upper exposure intervals based on comparison with established BTVs. Detected arsenic concentrations at depths below 10 ft bgs may represent background conditions.

Investigation analytical results for cyanide and arsenic generally exhibit decreasing concentrations with increasing depth. Two graphs of sample concentrations versus depth are provided as Figure 7.1 for arsenic and Figure 7.2 for cyanide. Both figures demonstrate concentrations decrease with increasing depth.

7.4 Ecological Screening

A complete Tier I ecological risk evaluation, including the ecological site assessment checklist provided in Volume II of the RA Guidance (NMED, 2019) was completed for SWMU 22, and is provided in Appendix G. The COPC total chromium was identified at concentrations exceeding the Tier I ecological screening level (ESL) for plants at SWMU 22. Total chromium is known to bioaccumulate through trophic processes and, over long-term processes, could potentially be detrimental to plants and animals that persist within the site.

Vegetation and native soils within SWMU 22 are extremely limited. SWMU 22 is located within a surrounding environment of largely undeveloped Chihuahuan desert scrub habitat typical of the SJDMB of southern Dona Ana County, New Mexico. Thousands of acres of mixed desert scrub, playa lakebeds, bare ground, and desert grasslands define this portion the basin Chihuahuan desert habitat. Specific species dominant adjacent to this site include honey mesquite (Prosopis glandulosa), four-wing saltbush (Atriplex canescens), and mariola (Parthenium incanum).

SWMU 22 is limited in size at less than 1/10 of an acre. The site occurs adjacent to numerous buildings within a large gravel capped parking lot and within 180 ft of a paved roadway. No ecologically important habitats or organisms exist at, or adjacent to, the site. State endangered night blooming cereus are known to exist in desert habitats at or near WSTF, but none are known to occur at the site or within close proximity. The area at the previously existing septic tank is currently a gravel parking lot. The area leading to the north and east is fairly recently disturbed desert comprised of bare ground, gravel, and annual plants (primarily sunflowers [Asteracea spp]). Some invertebrates and small vertebrates may persist at or near SWMU 22. However, non-burrowing animals and plant roots are not expected to come in contact with soils associated with SWMU 22 due to the depth of releases (> 5 ft bgs). Evidence of deep-rooted flora and animal burrows was not observed within the SWMU 22 footprint and surrounding areas.

The RA Guidance (Volume II) states that selection of species for risk evaluation is based on the size of the site. SWMU 22 is approximately 1/10 acre, and the RA Guidance recommends evaluation of risk for plants, the deer mouse, and the horned lark. The results of the soil investigation identified elevated COPC concentrations at the site at depths greater than 5 ft bgs, so the exposure pathways to plant species and the deer mouse are considered complete. The exposure pathway for the horned lark is incomplete due to the depth of elevated COPC concentrations of over 1 ft bgs, and evaluation of site risk for this species is not warranted. The kit fox, red-tailed hawk, and pronghorn antelope were not evaluated as the RA Guidance states that impacts to these species from small sites is minimal. The minimum size of sites that require evaluation for the kit fox is 276 acres, for the red-tailed hawk is 177 acres, and for the pronghorn antelope is 342 acres, making the evaluation unnecessary.

The maximum identified COPC concentrations reported for investigation soil samples were evaluated using Tier I ESLs for plants (Appendix G, Table 1), and the deer mouse (Appendix G, Table 2) to determine the HIs for site COPCs, and the Screening Level Hazard Quotient (SLHQ; sum of HIs) for each receptor population. The maximum total chromium concentration (1.90E+01 mg/kg) exceeds Tier I ESLs for plants (3.50E-01 mg/kg), and the SLHQ for plants exceeds the NMED target hazard of 1. Based on the site inspection, deep-rooted plants were not identified at the site. Coupling this with the small size of the site, NASA identified no adverse impact to the overall plant community. The SLHQ for the deer mouse is essentially equal to the NMED target risk/hazard of 1, indicating no adverse risk.

8.0 Conclusions

Silver was detected in two soil samples collected at the 100 Area Septic Tank at Building 114 (SWMU 22) including one duplicate, and cyanide was detected in 13 of the 23 sample locations including duplicates collected as a part of this investigation.

NASA compared the concentrations of metals and cyanide in soil samples collected at SWMU 22 to NMED SSLs and conducted ecological and health risk screenings. Results of the cumulative human health and hazard screening at SWMU 22 are summarized in Table 8.1. Final individual risk/hazards can be reviewed in Table 7.1, Table 7.2, Table 7.3, and Table 7.4. Neither residential or construction worker exposure scenarios resulted in individual or cumulative carcinogenic risks or cumulative hazards greater than the targets. As a result, for residential and construction worker scenarios, NASA concludes that there are no adverse human health impacts at SWMU 22.

However, for the soil-to-groundwater exposure scenario, both the maximum and UCL95 concentrations of arsenic and cyanide exceeded soil leachate SSLs. NASA believes that arsenic concentrations are likely consistent with WSTF background concentration populations, but without sufficient background data to compare to, the metals were included in the risk screening process. Both arsenic and cyanide concentrations were observed to decrease with increasing depth as shown on Table 6.2, Figure 7.1, and Figure 7.2. Additionally, the source of liquid that previously mobilized COPCs downward to groundwater has been removed with removal of the septic tank.

Results of the ecological risk screening for SWMU 22 indicated total chromium concentrations exceeded ESLs for plants, and the corresponding SLHQ for plants exceeds the NMED target of 1. However, SWMU 22 occupies approximately 1/10 of an acre, and deep-rooted plants are not present within the boundary of site. For these reasons, NASA did not identify adverse risk to the overall plant community. Evaluation of the COPC concentrations and the effect on the deer mouse receptor population did not identify adverse risk.

9.0 Recommendations

Based on findings of research conducted during preparation of the HIS (NASA, 2013a), NASA recommends that no further action be performed at the septic tanks comprising SWMUs 21 and 23-27. Further, NASA recommends that the septic tanks comprising SWMUs 21 and 23-27 be considered for a corrective action complete status determination. NASA understands that prior to submittal of a Class 3 Permit Modification, the NMED should be consulted to discuss groundwater contamination and remediation, and ongoing source area investigations at WSTF. NASA will consult with the NMED prior to preparation and submittal of a Class 3 Permit Modification in accordance with 40 CFR 270.42(c) that will include all supporting site history and investigation information for each SWMU.

Results of the investigation indicate the soil-to-groundwater exposure pathway is incomplete due to: (a) generally decreasing arsenic and cyanide concentrations with depth based on soil chemical concentration data for SWMU 22 presented in Section 6.0 and Table 6.2; (b) the lack of a continuing source of liquid to vertically mobilize contaminants in the soil; (c) the regional arid climate, and (d) depth to groundwater of over 100 ft below ground. Therefore, further investigation of the soil-to-groundwater pathway at SWMU 22 is not warranted.

Based on results of the risk screen evaluation for human and ecological receptors, no adverse risk from COPCs remaining at the site was identified. NASA recommends that SWMU 22 be considered for a corrective action complete status. NASA will consult with the NMED prior to preparation and submittal of a Class 3 Permit Modification in accordance with 40 CFR 270.42(c). When submitted, a petition for corrective action complete and the Class 3 Permit Modification will include all supporting site history and investigation information.

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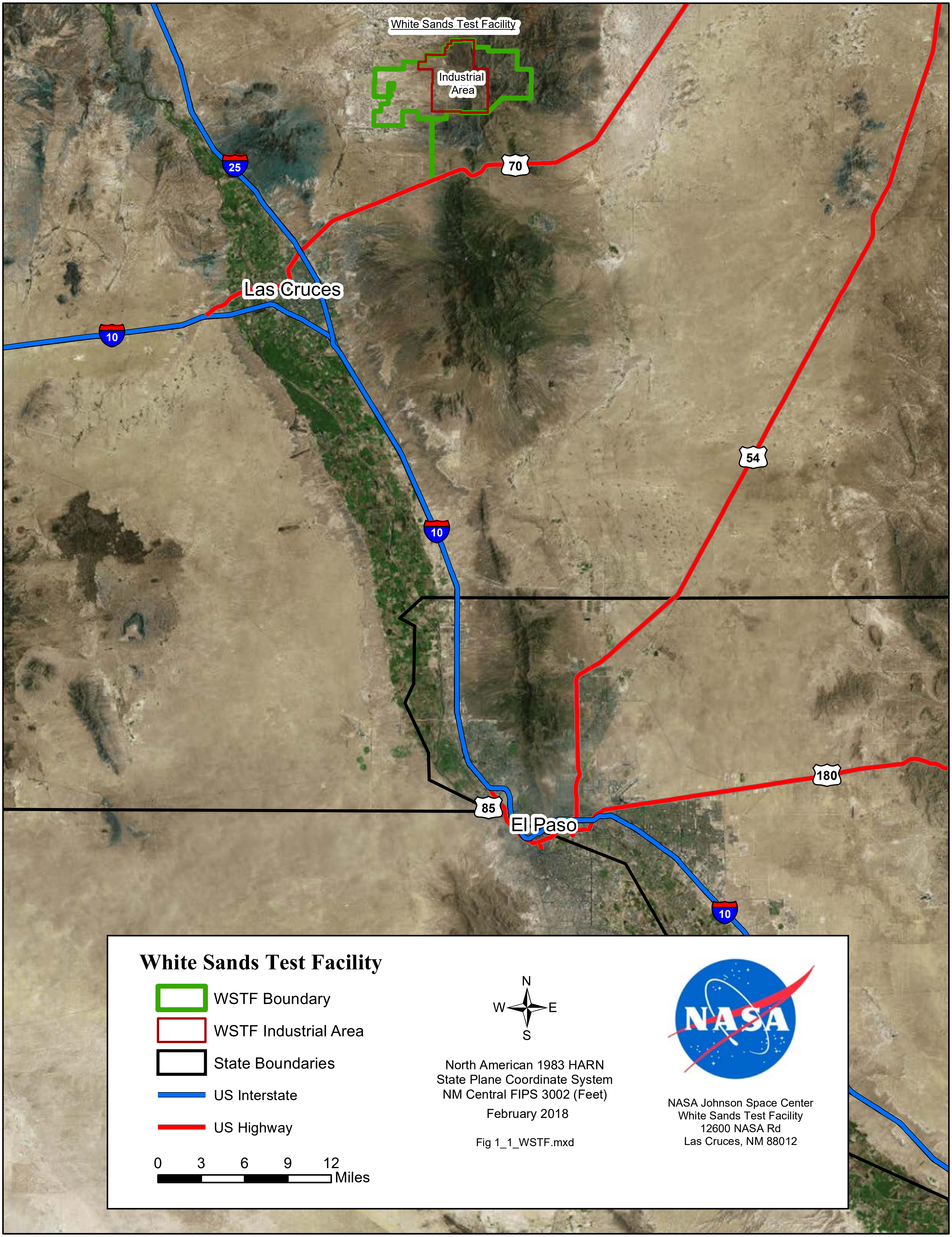
Figures

Figure 1.1 **WSTF Location Map**

(SEE NEXT PAGE)


White Sands Test Facility
Industrial Area
Las Cruces
El Paso
25
10
70
54
180
85
White Sands Test Facility
WSTF Boundary
WSTF Industrial Area
State Boundaries
US Interstate
US Highway
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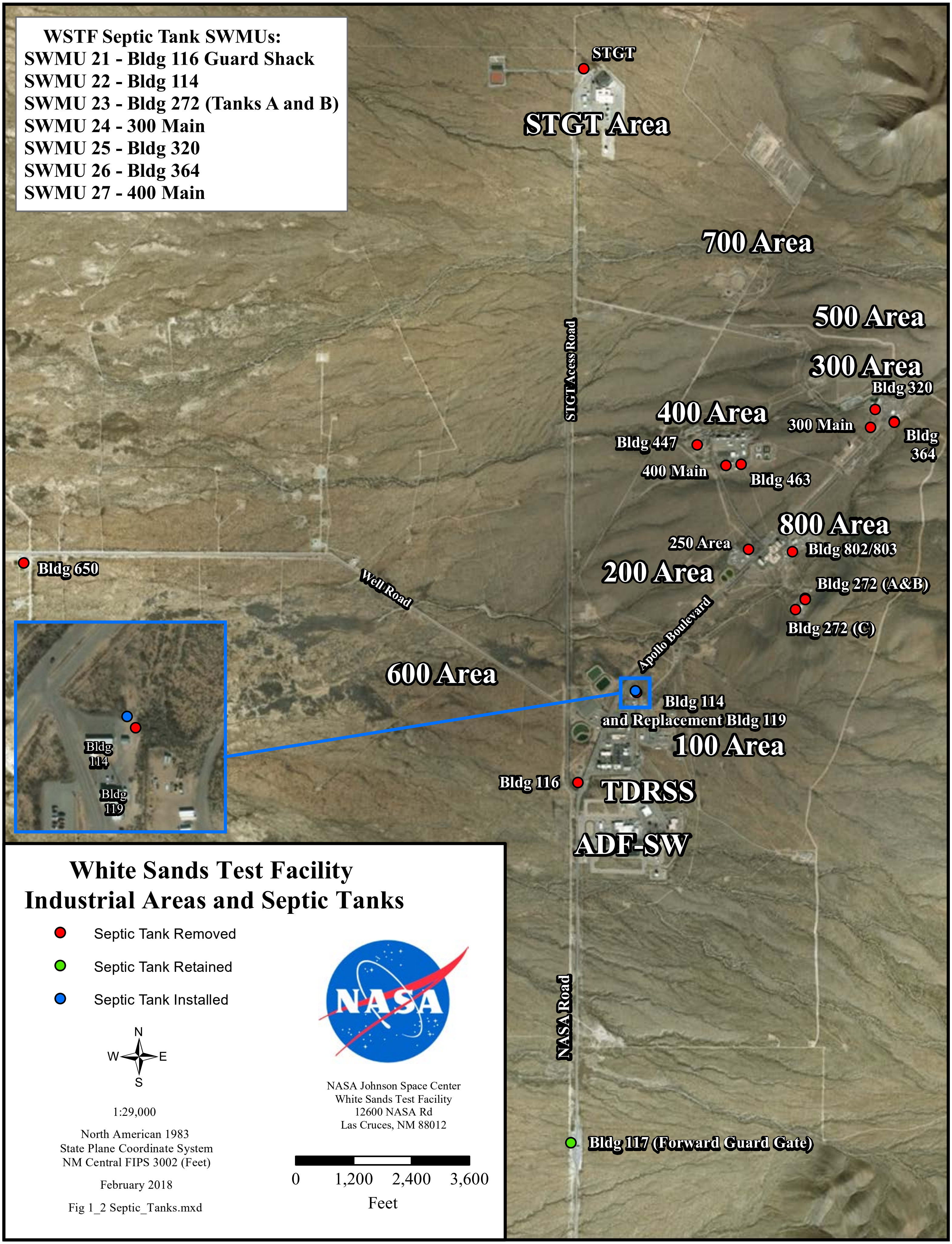
North American 1983 HARN
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
February 2018
Fig 1_1_WSTF.mxd
NASA
NASA Johnson Space Center
White Sands Test Facility
12600 NASA Rd
Las Cruces, NM 88012

Figure 1.2 WSTF Industrial Areas and Septic Tank Locations

(SEE NEXT PAGE)


WSTF Septic Tank SWMUs:
SWMU 21 - Bldg 116 Guard Shack
SWMU 22 - Bldg 114
SWMU 23 - Bldg 272 (Tanks A and B)
SWMU 24 - 300 Main
SWMU 25 - Bldg 320
SWMU 26 - Bldg 364
SWMU 27 - 400 Main
STGT
STGT Area
700 Area
500 Area
300 Area
Bldg 320
300 Main
Bldg 364
400 Area
Bldg 447
400 Main
Bldg 463
STGT Acess Road
800 Area
250 Area
Bldg 802/803
200 Area
Bldg 272 (A&B)
Bldg 272 (C)
Bldg 650
Well Road
Apollo Boulevard
600 Area
Bldg 114
and Replacement Bldg 119
100 Area
Bldg 114
Bldg 119
Bldg 116
TDRSS
ADF-SW
NASA Road
Bldg 117 (Forward Guard Gate)
White Sands Test Facility
Industrial Areas and Septic Tanks
Septic Tank Removed
Septic Tank Retained
Septic Tank Installed
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W
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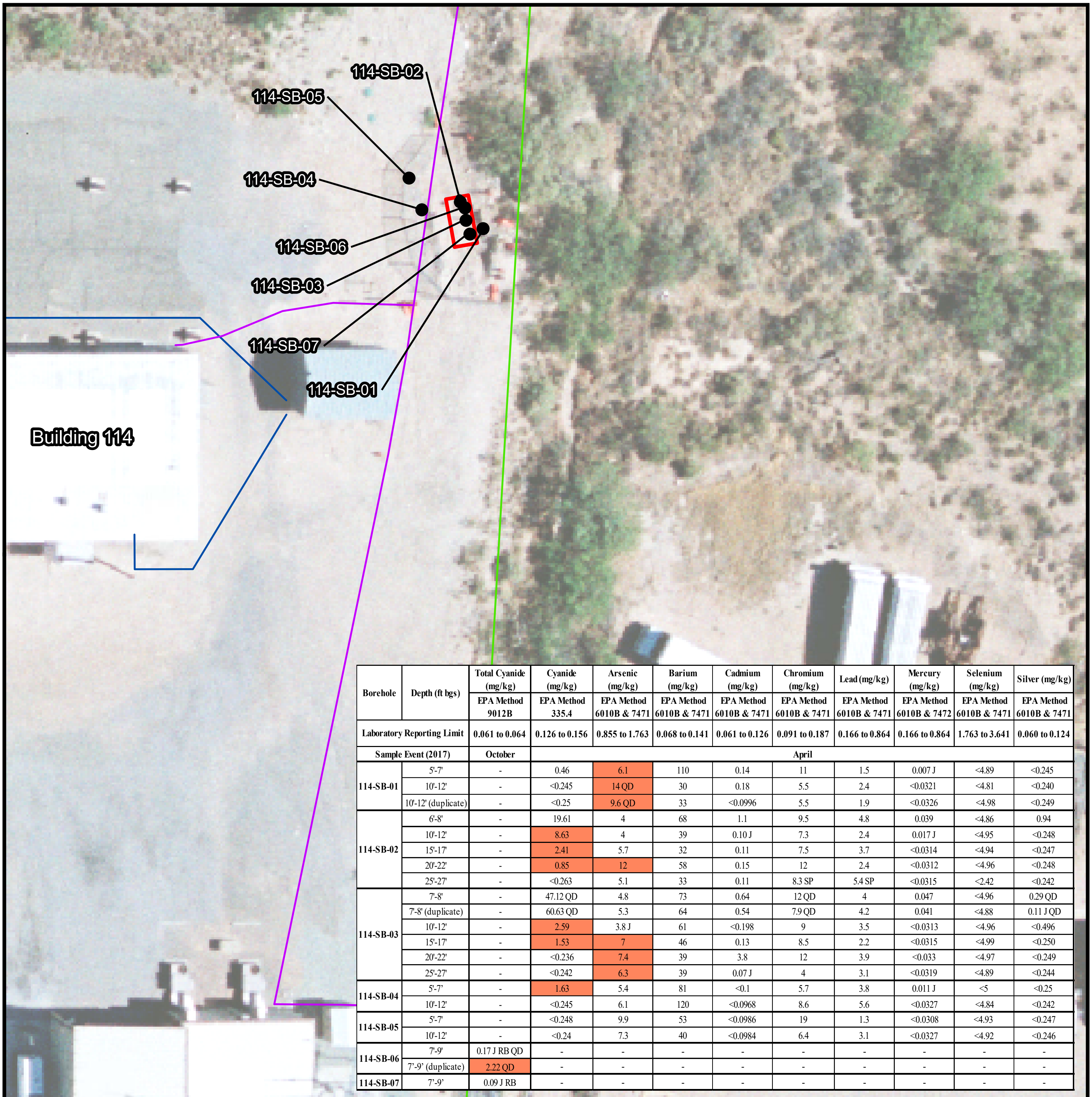
North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
February 2018
Fig 1_2 Septic_Tanks.mxd
NASA
NASA Johnson Space Center
White Sands Test Facility
12600 NASA Rd
Las Cruces, NM 88012
0
1,200
2,400
3,600
Feet

Figure 2.1 Building 114 Septic Tank Soil Boring Locations and Utilities

(SEE NEXT PAGE)



Borehole	Depth (ft bgs)	Total Cyanide (mg/kg)	Cyanide (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)
		EPA Method 9012B	EPA Method 335.4	EPA Method 6010B & 7471	EPA Method 6010B & 7471	EPA Method 6010B & 7471	EPA Method 6010B & 7471	EPA Method 6010B & 7471	EPA Method 6010B & 7472	EPA Method 6010B & 7471	EPA Method 6010B & 7471
Laboratory Reporting Limit		0.061 to 0.064	0.126 to 0.156	0.855 to 1.763	0.068 to 0.141	0.061 to 0.126	0.091 to 0.187	0.166 to 0.864	0.166 to 0.864	1.763 to 3.641	0.060 to 0.124
Sample Event (2017)		October	April								
114-SB-01	5'-7'	-	0.46	6.1	110	0.14	11	1.5	0.007 J	<4.89	<0.245
	10'-12'	-	<0.245	14 QD	30	0.18	5.5	2.4	<0.0321	<4.81	<0.240
	10'-12' (duplicate)	-	<0.25	9.6 QD	33	<0.0996	5.5	1.9	<0.0326	<4.98	<0.249
114-SB-02	6'-8'	-	19.61	4	68	1.1	9.5	4.8	0.039	<4.86	0.94
	10'-12'	-	8.63	4	39	0.10 J	7.3	2.4	0.017 J	<4.95	<0.248
	15'-17'	-	2.41	5.7	32	0.11	7.5	3.7	<0.0314	<4.94	<0.247
	20'-22'	-	0.85	12	58	0.15	12	2.4	<0.0312	<4.96	<0.248
	25'-27'	-	<0.263	5.1	33	0.11	8.3 SP	5.4 SP	<0.0315	<2.42	<0.242
114-SB-03	7'-8'	-	47.12 QD	4.8	73	0.64	12 QD	4	0.047	<4.96	0.29 QD
	7'-8' (duplicate)	-	60.63 QD	5.3	64	0.54	7.9 QD	4.2	0.041	<4.88	0.11 J QD
	10'-12'	-	2.59	3.8 J	61	<0.198	9	3.5	<0.0313	<4.96	<0.496
	15'-17'	-	1.53	7	46	0.13	8.5	2.2	<0.0315	<4.99	<0.250
	20'-22'	-	<0.236	7.4	39	3.8	12	3.9	<0.033	<4.97	<0.249
	25'-27'	-	<0.242	6.3	39	0.07 J	4	3.1	<0.0319	<4.89	<0.244
114-SB-04	5'-7’	-	1.63	5.4	81	<0.1	5.7	3.8	0.011 J	<5	<0.25
	10'-12'	-	<0.245	6.1	120	<0.0968	8.6	5.6	<0.0327	<4.84	<0.242
114-SB-05	5'-7'	-	<0.248	9.9	53	<0.0986	19	1.3	<0.0308	<4.93	<0.247
	10'-12'	-	<0.24	7.3	40	<0.0984	6.4	3.1	<0.0327	<4.92	<0.246
114-SB-06	7'-9'	0.17 J RB QD	-	-	-	-	-	-	-	-	-
	7’-9’ (duplicate)	2.22 QD	-	-	-	-	-	-	-	-	-
114-SB-07	7’-9’	0.09 J RB	-	-	-	-	-	-	-	-	-

Building 114 Septic Tank
Soil Boring Locations and Utilities

- Building 114 Septic Tank Soil Borings
- Telephone Lines
- Fiber Optic Lines
- Water Lines
- Building 114 Septic Tank Footprint

Feet
0 10 20 30 60

N
W E
S

1:355
Original Size: 8.5"x11"
North American 1983
State Plane Coordinate System
NM Centr002 (Feet)
May 2021
Fig 2_1 Bldg_114_Soil_Borings0051121.mxd

NASA Johnson Space Center
White Sands Test Facility
12600 NASA Rd
Las Cruces, NM 88012

Figure 3.1 Site Conceptual Exposure Model

(SEE NEXT PAGE)

Building 114 Septic Tank (SWMU 22) Site Conceptual Exposure Model

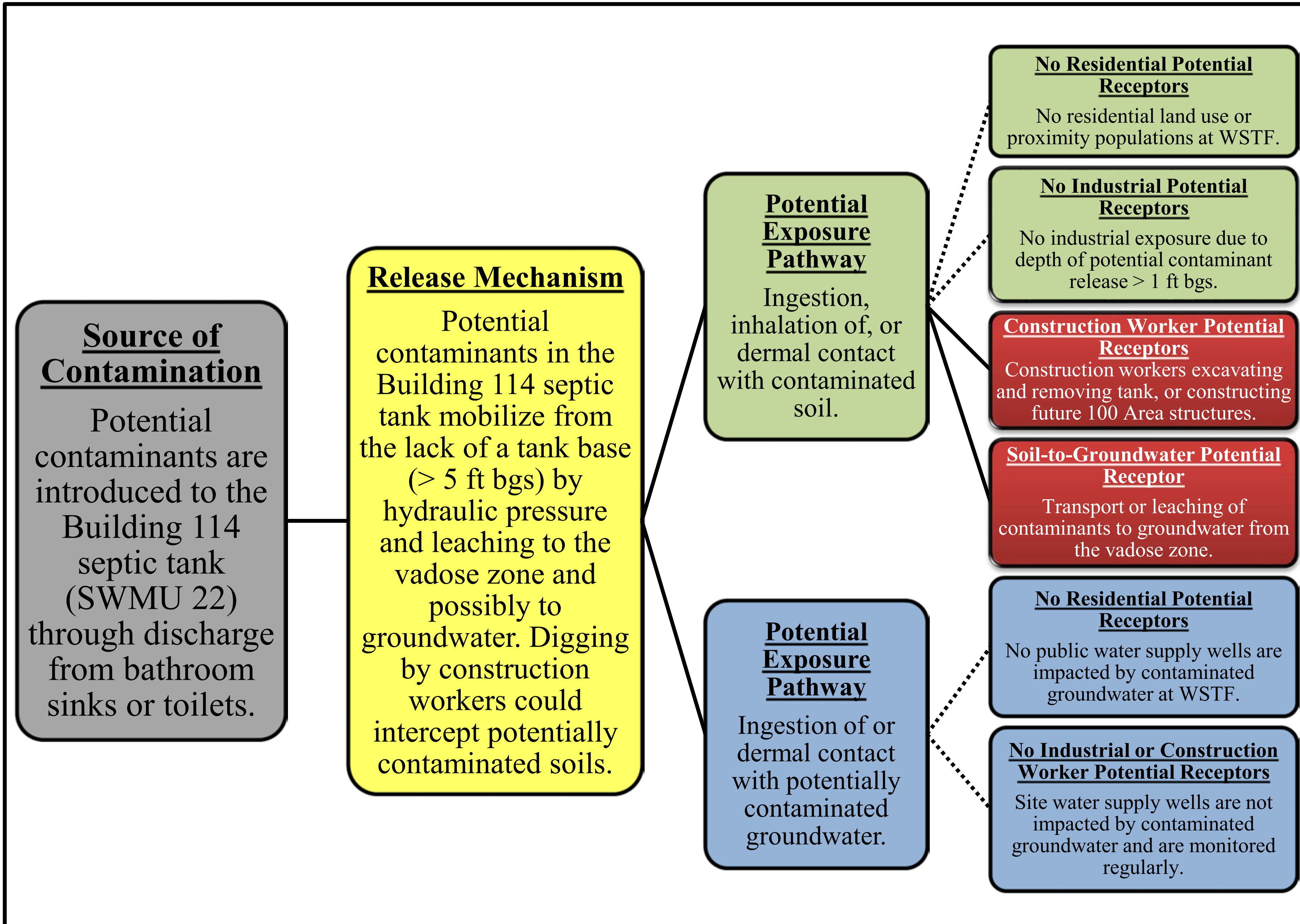
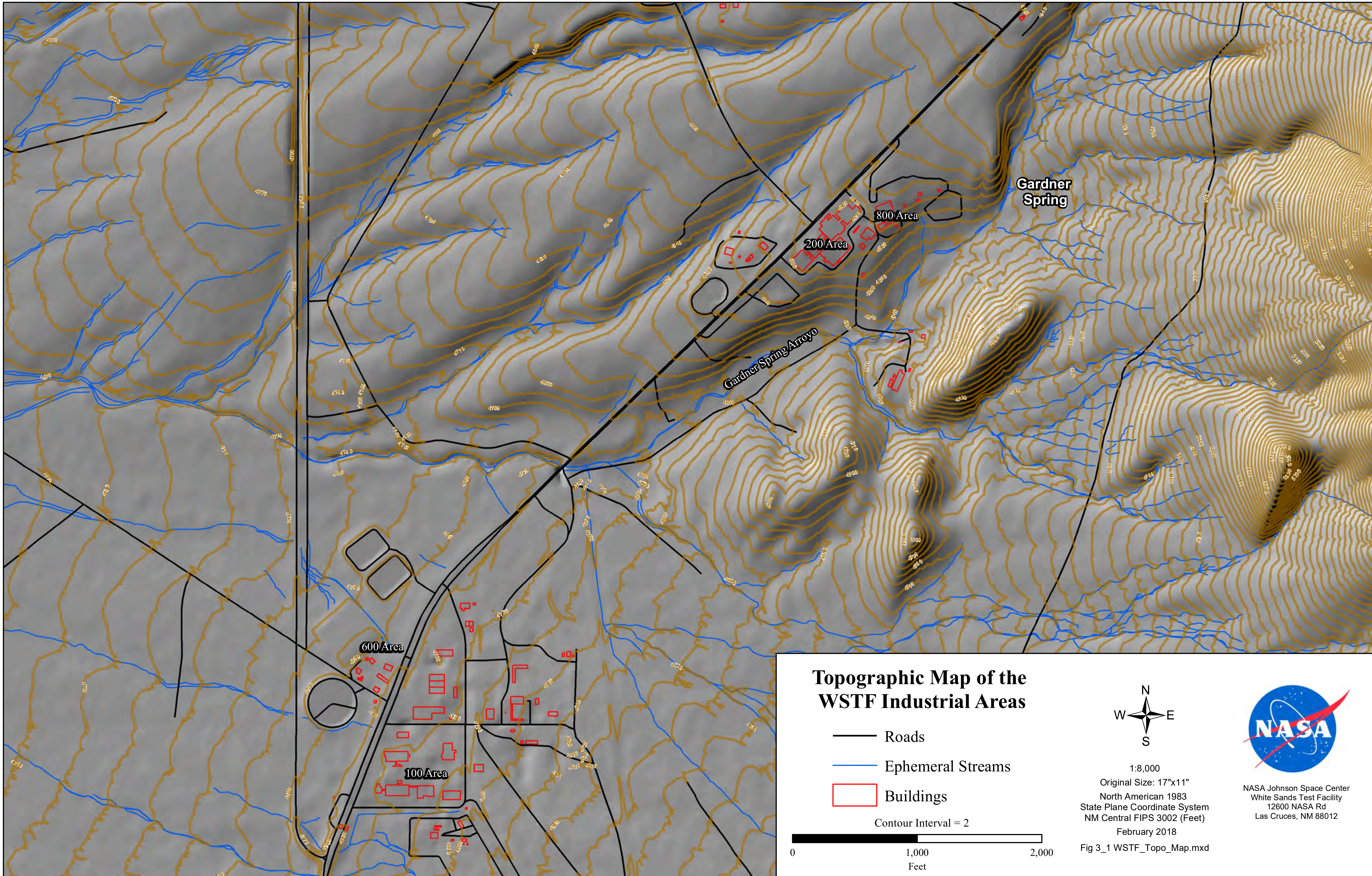


Figure 3.2 **Topographic Map of WSTF Industrial Areas**

(SEE NEXT PAGE)


Gardner Spring
800 Area
200 Area
Gardner Spring Arroyo
600 Area
100 Area
Topographic Map of the WSTF Industrial Areas
Roads
Ephemeral Streams
Buildings
Contour Interval = 2
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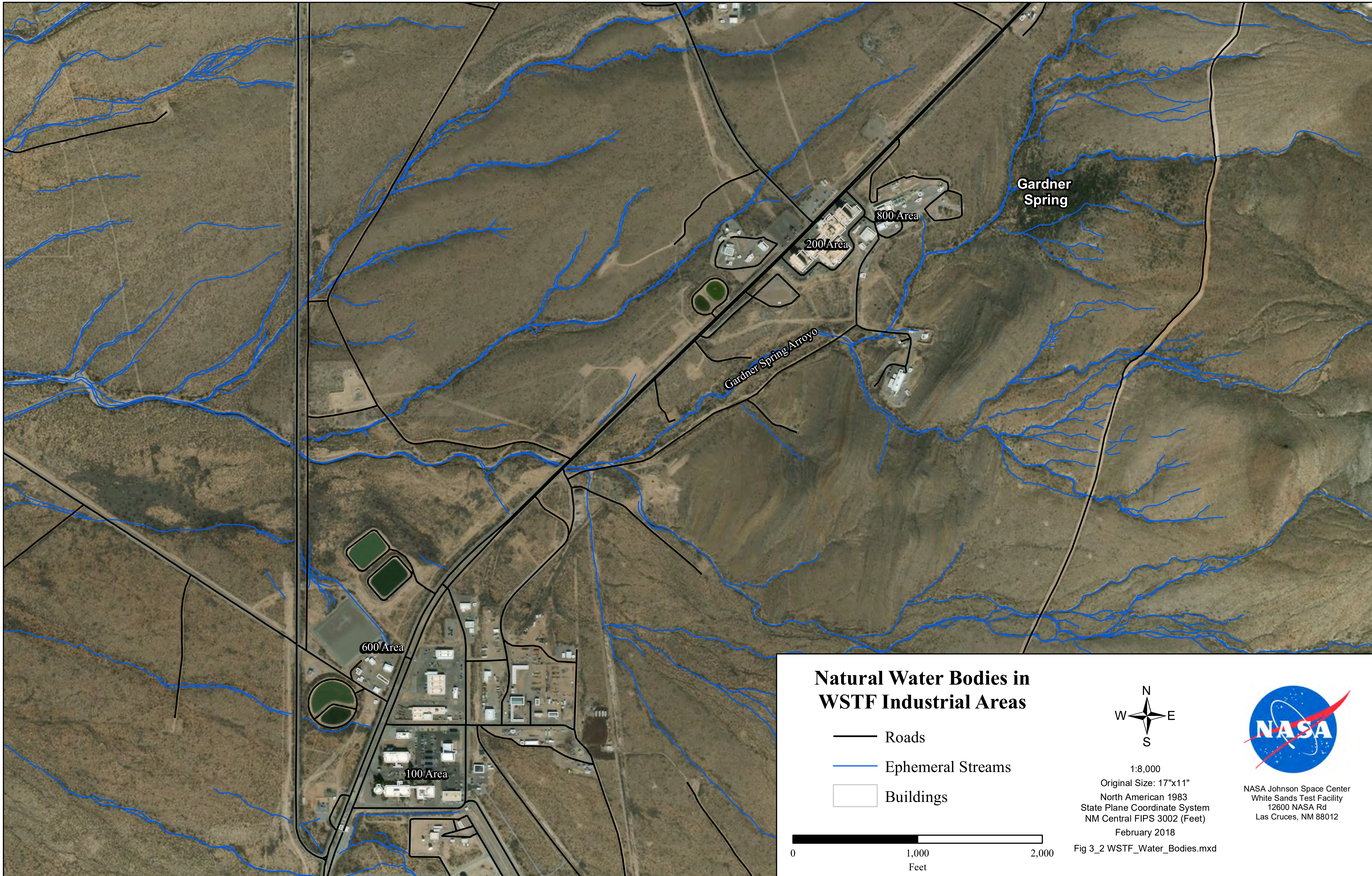
Original Size: 17"x11"
North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
February 2018
Fig 3_1 WSTF_Topo_Map.mxd
NASA Johnson Space Center
White Sands Test Facility
12600 NASA Rd
Las Cruces, NM 88012

Figure 3.3 Natural Water Bodies in WSTF Industrial Area

(SEE NEXT PAGE)



Gardner Spring
800 Area
200 Area
Gardner Spring Arroyo
600 Area
100 Area
Natural Water Bodies in WSTF Industrial Areas
Roads
Ephemeral Streams
Buildings
N
W
E
S
1:8,000
Original Size: 17"x11"
North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
February 2018
Fig 3_2 WSTF_Water_Bodies.mxd
0
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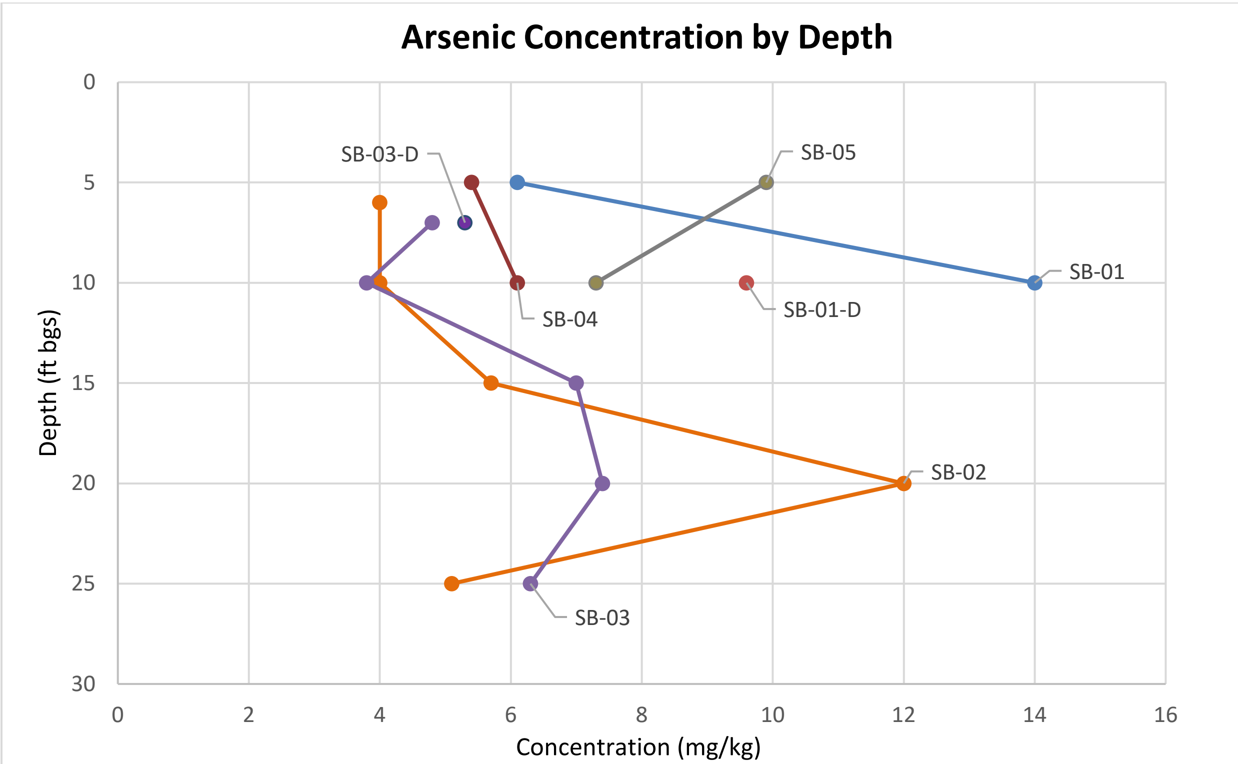
2,000
Feet
NASA Johnson Space Center
White Sands Test Facility
12600 NASA Rd
Las Cruces, NM 88012

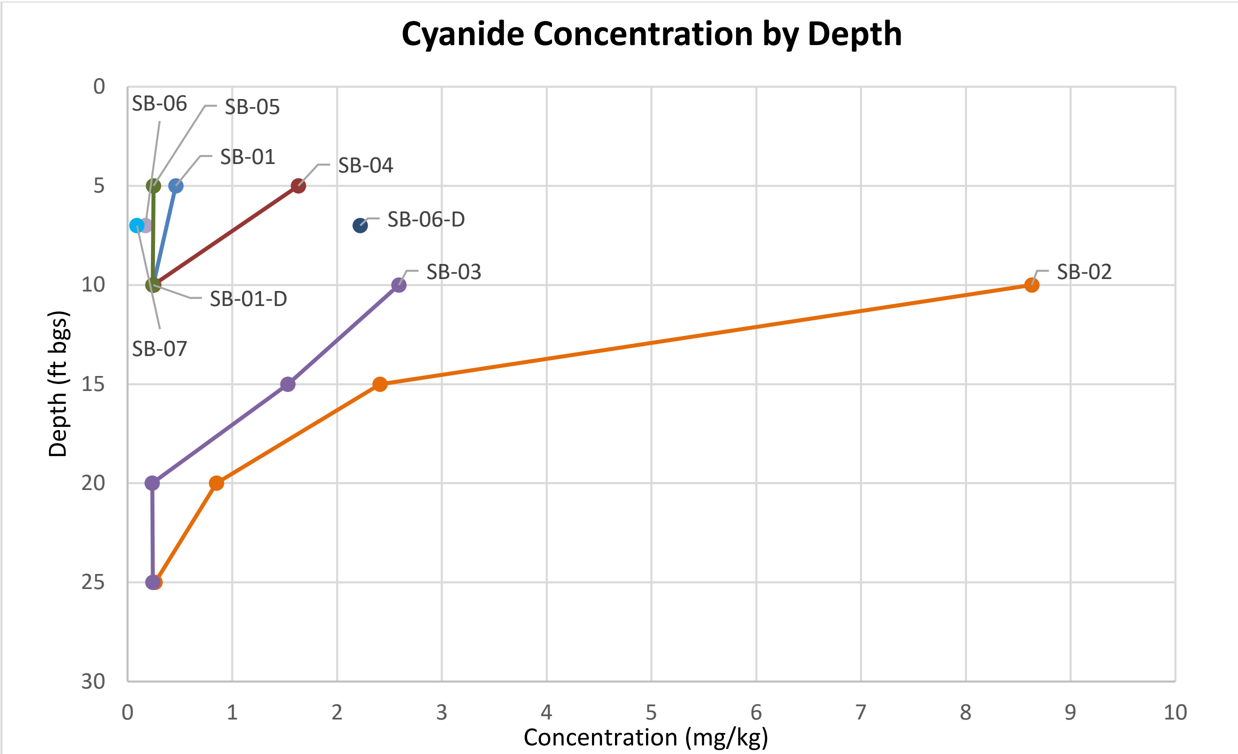
Figure 7.1 **Arsenic Sample Concentrations Versus Depth**



Notes:

1. Each plot line represents data from one soil boring, i.e., SB-03 includes all primary sample data collected from soil boring 114-SB-03.
2. "D" at the end of a boring label represents duplicate samples.

Figure 7.2 Cyanide Sample Concentrations Versus Depth



Notes:

1. Each plot line represents data from one soil boring, i.e., SB-03 includes all primary sample data collected from soil boring 114-SB-03.
2. “D” at the end of a boring label represents duplicate samples.

Tables

Table 3.1 Final Status of WSTF Septic Tanks

Area	SWMU	Location	Size/ Gal	Design Flow Rate	Install Date	Permit Number	Leach field Area (ft²)	Excav. Date	Disposal Location	Final Status	Comments
100	21	Bldg. 116-Guard Gate	500	200 gpd	1966	NA	1,250	07/17/17	Foothills Clean Fill Landfill	Removed	Installed during original facility construction. No leaching observed.
100	22	Bldg. 114	1,200	600 gpd	1963	DA 130309	NR	11/09/16	WSMR Landfill	Removed	Installed during original facility construction. No leaching observed.
100	NA	Bldg. 119	1,200	100 gpd	Sep-13	DA 130309	300	NA	NA	Retain	Installed due to challenges connecting to main sewer line.
200	NA	Bldg. 250 Area	NR	NR	1963 or 1964	NA	NR	NA	NA	Does not exist	Installed during original facility construction and ended use following Apollo Program. Two shallow soil vapor points from Phase I 200 Investigation showed very little VOCs.
200	23	Bldg. 272 (Tanks A & B)	1,200	600 gpd (each)	Dec-91	LC 910939	1,500	12/16/15	Foothills Clean Fill Landfill	Removed	Designed in series: Tank A for septage and Tank B for cooling water. No leaching observed.
200	23	Bldg. 272 (Tank C)	900	200 gpd	2004	DP-392	480	12/16/15	Foothills Clean Fill Landfill	Removed	No leaching observed.
300	24	300 - Main Parking Lot Location	5,800	680 gpd	1963	NA	11,000	03/04/16	WSMR Landfill	Removed	Installed during original facility construction. No leaching observed.
300	25	Bldg. 320	1,200	200 gpd	Aug-93	LC 930858	1,500	02/10/16	Foothills Clean Fill Landfill	Removed	Registered in Lockheed's name. No leaching observed.
300	26	Bldg. 364	1,200	300 gpd	Dec-91?/ Jan-92	LC 910918	1,500	05/20/15	Foothills Clean Fill Landfill	Removed	No leaching observed.

Area	SWMU	Location	Size/ Gal	Design Flow Rate	Install Date	Permit Number	Leach field Area (ft²)	Excav. Date	Disposal Location	Final Status	Comments
400	27	400 - South Main Parking Lot	5,800	780 gpd	1964	NA	11,000	03/08/16	WSMR Landfill	Removed	Installed during original facility construction; 1967 document describes tank capacity as 6,200 gallons. No leaching observed.
400	NA	Bldg. T463	1,200	400 gpd	Jun-92	LC 920527	1,500	01/28/15	Foothills Clean Fill Landfill	Removed	Listed in Sept 1996 as "Temporarily out of service awaiting future building"; WSTF TPS shows building T463 was removed 4/14/1994. No leaching observed.
400	NA	Bldg. 447	750	100 gpd	Apr-90	LC 900333	300	02/18/16	Foothills Clean Fill Landfill	Removed	Steam Team Support Building. No leaching observed.
800	NA	Bldgs 802 & 803	1,500	600 gpd	Apr-87	LC 870401	900	06/21/17	WSMR Landfill	Removed	Registered under Lockheed by Johnny's Septic Tank Company. No leaching observed.
600	NA	Bldg. 650 Plume-Front Area	1,200	40 gpd	Apr-01	DA 010359	1,500	02/17/16	Foothills Clean Fill Landfill	Removed	Remote area for emergency use only; originally permitted with "Honeywell" as the owner. No leaching observed.
NA	NA	Bldg. 117-Forward Guard Gate	900	80 gpd	Feb-06	LWP 002090	232	NA	NA	Retain	Remote area.
NA	NA	STGT	1,200	600 gpd	10/19/89	LC 890939	530	07/19/17	WSMR Landfill	Removed	Installed after the initial STGT lagoon failed to hold water for temporary use until the lagoon was completed. 1989-1991

NA = Not applicable
NR = No record drawings found

Table 6.1 Contaminants of Potential Concern

Parameter	Analytical Method	Quantity	Container and Preservative Requirements	Holding Times
Total Metals (Subsurface soils)	SW-846 Methods 6010B/7471	19 Total: (16 samples, two duplicates, one matrix spike)	1 each 4 oz. wide mouth sample jar; Preservation – Ice (≤6 C)	6 months, except mercury (28 days)
Cyanide (Subsurface soils)	SW-846 Method 335.4	19 Total: (16 samples, two duplicates, one matrix spike)	1 each 4 oz. wide mouth sample jar; Preservation - Ice (≤6 °C)	14 days
Cyanide (Subsurface soils)	SW-846 Method 9012B	4 Total: (two samples, one duplicate, one matrix spike)	1 each 4 oz. wide mouth sample jar; Preservation - Ice (≤6 °C)	14 days

Table 6.2 100 Area Septic Tank at Building 114 (SWMU 22) Soil Borings Sample Locations and Detections

Laboratory Reporting Limit		0.126 to 0.156	0.855 to 1.763	0.068 to 0.141	0.061 to 0.126	0.091 to 0.187	0.166 to 0.864	0.166 to 0.864	1.763 to 3.641	0.060 to 0.124
Borehole	**Depth (ft bgs)**	**Cyanide (mg/kg)**	**Arsenic (mg/kg)**	**Barium (mg/kg)**	**Cadmium (mg/kg)**	**Chromium (mg/kg)**	**Lead (mg/kg)**	**Mercury (mg/kg)**	**Selenium (mg/kg)**	**Silver (mg/kg)**
April 2017 Results Investigation Samples Analyzed for Metals by EPA Method 6010B/7471[1] and Cyanide by EPA Method 335.4										
114-SB-01	5'-7'	0.46	6.1	110	0.14	11.0	1.5	0.007 J	<4.89	<0.245
	10'-12'	<0.245	14.0 QD	30	0.18	5.5	2.4	<0.0321	<4.81	<0.240
	10'-12' (duplicate)	<0.25	9.6 QD	33	<0.0996	5.5	1.9	<0.0326	<4.98	<0.249
114-SB-02	6'-8'	19.6[2]	4.0	68	1.10	9.5	4.8	0.039	<4.86	0.94
	10'-12'	8.63	4.0	39	0.10 J	7.3	2.4	0.017 J	<4.95	<0.248
	15'-17'	2.41	5.7	32	0.11	7.5	3.7	<0.0314	<4.94	<0.247
	20'-22'	0.85	12.0	58	0.15	12.0	2.4	<0.0312	<4.96	<0.248
	25'-27'	<0.263	5.1	33	0.11	8.3 SP	5.4 SP	<0.0315	<2.42	<0.242
114-SB-03	7'-8'	47.1 QD[3]	4.8	73	0.64	12.0 QD	4	0.047	<4.96	0.29 QD
	7'-8' (duplicate)	60.6 QD[4]	5.3	64	0.54	7.9 QD	4.2	0.041	<4.88	0.11 J QD
	10'-12'	2.59	3.8 J	61	<0.198	9.0	3.5	<0.0313	<4.96	<0.496
	15'-17'	1.53	7.0	46	0.13	8.5	2.2	<0.0315	<4.99	<0.250
	20'-22'	<0.236	7.4	39	3.80	12.0	3.9	<0.033	<4.97	<0.249
	25'-27'	<0.242	6.3	39	0.07 J	4.0	3.1	<0.0319	<4.89	<0.244
114-SB-04	5'-7’	1.63	5.4	81	<0.1	5.7	3.8	0.011 J	<5	<0.25
	10'-12'	<0.245	6.1	120	<0.0968	8.6	5.6	<0.0327	<4.84	<0.242
114-SB-05	5'-7'	<0.248	9.9	53	<0.0986	19.0	1.3	<0.0308	<4.93	<0.247
	10'-12'	<0.24	7.3	40	<0.0984	6.4	3.1	<0.0327	<4.92	<0.246

Laboratory Reporting Limit		0.126 to 0.156	0.855 to 1.763	0.068 to 0.141	0.061 to 0.126	0.091 to 0.187	0.166 to 0.864	0.166 to 0.864	1.763 to 3.641	0.060 to 0.124
Borehole	**Depth (ft bgs)**	**Cyanide (mg/kg)**	**Arsenic (mg/kg)**	**Barium (mg/kg)**	**Cadmium (mg/kg)**	**Chromium (mg/kg)**	**Lead (mg/kg)**	**Mercury (mg/kg)**	**Selenium (mg/kg)**	**Silver (mg/kg)**
October 2017 Results Investigation Samples Analyzed for Cyanide by EPA Method 9012B										
114-SB-06	7'-9'	0.17 J RB QD	NA	NA	NA	NA	NA	NA	NA	NA
	7'-9' (duplicate)	2.22 QD	NA	NA	NA	NA	NA	NA	NA	NA
114-SB-07	7'-9'	0.09 J RB QD	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1 = Arsenic, barium, cadmium, chromium, lead, selenium and silver analyzed by SW-846 Method 6010B, and mercury analyzed by SW-846 Method 7471. The April 2017 cyanide samples analyzed using SW-846 Method 335.4, and the October 2017 cyanide samples analyzed using SW-846 Method 9012B.
2 = Soil sample from 114-SB-02, 6'-8' bgs, is replaced by soil sample from 114-SB-07, 7'-9' bgs.
3 = Soil sample from 114-SB-03, 7'-8' bgs, is replaced by soil sample from 114-SB-06, 7'-9' bgs.
4 = Duplicate soil sample from 114-SB-03, 7'-8' bgs, is replaced by duplicate soil sample from 114-SB-06, 7'-9' bgs.
Analyte concentrations exceeding the NMED soil-to-groundwater SL-SSL are listed in red font color in this table and Figure 2.1.
J = Indicates the result is an estimated value less than the quantitation limit, but greater than or equal to the detection limit.
RB = The analyte was detected in the method blank.
QD = The relative percent difference for a field duplicate was outside standard limits.
NA = Not applicable/not analyzed.
Samples reported as less than (<) a concentration were not detected above the laboratory detection limit.
Boreholes 114-SB-02, 114-SB-03, 114-SB-06, and 114-SB-07 depths begin at the tank base, which is determined by color differences between clean fill sediment and native alluvium.

Table 7.1 SWMU 22 Risk Screening Maximum Concentration Evaluation - Residential Carcinogens

Carcinogens	Maximum Concentration 0'-10' bgs (mg/kg)	Residential SSL[1,2] (mg/kg)	Residential Risk (Conc/RSSL)x10^{-5}
Cadmium	1.10E+00	8.59E+04	1.28E-10
Chromium, total	1.90E+01	9.66E+01	1.97E-06
Site Residential Risk Sum			1.97E-06

Bold font indicates exceedance of SSL, Risk or Hazard Index.

[1]RSSLs are included for conservative risk. There are no complete residential pathways for SWMU 22.

[2]SSLs from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

RSSL = Residential Soil Screening Level

SSL = Soil Screening Level

Table 7.2 SWMU 22 Hazard Screening Maximum Concentration Evaluation - Residential Noncarcinogens

Noncarcinogens	Maximum Concentration 0'-10' bgs (mg/kg)	Residential SSL[1,2] (mg/kg)	Residential HI (Conc/RSSL)x1
Cadmium	1.10E+00	7.05E+01	1.56E-02
Chromium, total	1.90E+01	4.52E+04	4.21E-04
Cyanide	8.60E+00	1.11E+01	7.75E01
Silver	9.40E-01	3.91E+02	2.40E-03
Site Residential HI Sum			7.93E-01

Bold font indicates exceedance of SSL, Risk or Hazard Index.

[1]RSSLs are included for conservative risk. There are no complete residential pathways for SWMU 22.

[2]SSLs from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

HI = Hazard Index

RSSL = Residential Soil Screening Level

SSL = Soil Screening Level

Table 7.3 SWMU 22 Risk Screening Maximum Concentration Evaluation - Construction Worker Carcinogens

Carcinogens	Maximum Concentration 0'-10' bgs (mg/kg)	Construction Worker SSL[1] (mg/kg)	Construction Worker Risk (Conc/CSSL)x10^{-5}
Cadmium	1.10E+00	3.61E+03	3.05E-09
Chromium, total	1.90E+01	4.68E+02	4.06E-07
Site Construction Worker Risk Sum			4.09E-07

Bold font indicates exceedance of SSL, Risk or Hazard Index.

[1]SSLs from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

CSSL = Construction Worker Soil Screening Level

SSL = Soil Screening Level

Table 7.4 SWMU 22 Hazard Screening Maximum Concentration Evaluation - Construction Worker Noncarcinogens

Noncarcinogens	Maximum Concentration 0'-10' bgs (mg/kg)	Construction Worker SSL[1] (mg/kg)	Construction Worker HI (Conc/CSSL)x1
Cadmium	1.10E+00	7.21E+01	1.53E-02
Chromium, total	1.90E+01	1.34E+02	1.42E-01
Cyanide	8.60E+00	1.20E+01	7.17E-01
Silver	9.40E-01	1.77E+03	5.31E-04
Site Construction Worker HI Sum			8.74E-01

Bold font indicates exceedance of SSL, Risk or Hazard Index.

[1]SSLs from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

CSSL = Construction Worker Soil Screening Level

HI = Hazard Index

SSL = Soil Screening Level

Table 7.5 SWMU 22 Risk Screening Maximum Concentration Comparison with Soil Leachate SSL

COPC	Maximum Concentration All Depths bgs (mg/kg)	Cw, DAF 20 (mg/kg)
Arsenic	**1.40E+01**	5.83E+00
Barium	1.20E+02	2.70E+03
Cadmium	3.80E+00	9.39E+00
Chromium, total	1.90E+01	2.05E+05
Cyanide	**8.60E+00**	7.13E-01
Lead	5.60E+00	2.70E+02
Mercury	4.70E-02	2.09E+00
Silver	9.40E-01	1.38E+01

Bold font indicates exceedance of soil leachate SSL from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

SSL = Soil Screening Level

Table 7.6 SWMU 22 Risk Screening UCL95 Concentration Comparison with Soil Leachate SSL

COPC	UCL95 Concentration All Depths bgs (mg/kg)	Cw, DAF 20 (mg/kg)
Arsenic	**8.33E+00**	5.83E+00
Barium	6.96E+01	2.70E+03
Cadmium	1.49E+00	9.39E+00
Chromium, total	1.07E+01	2.05E+05
Cyanide	**3.45E+00**	7.13E-01
Lead	3.89E+00	2.70E+02
Mercury[1]	4.70E-02	2.09E+00
Silver[1]	9.40E-01	1.38E+01

Bold font indicates exceedance of soil leachate SSL from NMED Risk Assessment Guidance (NMED, 2019), Table A-1 unless otherwise indicated.

1 = Maximum concentration retained. Insufficient detections to support statistical analyses and calculation of UCL95 concentration

SSL = Soil Screening Level

Table 8.1 Summary of SWMU 22 Cumulative Risk/Hazards

Exposure Scenario	Site Risk, HI, or Ratio	Target	Exceeds Target?
Residential cancer[1]	1.97E-06	1.00E-05	No
Residential non-cancer[1]	7.93E-01	1	No
Construction Worker cancer[1]	4.09E-07	1.00E-05	No
Construction Worker non-cancer[1]	8.74E-01	1	No

Bold font indicates exceedance of cumulative target.
[1]Indicates maximum concentrations were used for cumulative risk/HI/ratio.

Appendix A
Photographic Documentation

Picture showing open pit at location of 250 Area septic tank. This may represent removal of the tank in June 1977.

Figure A.2 **SWMU 22 – Prior to Excavation (View to the northeast)**

Building 114 septic tank (SWMU 22) showing surface vent pipe.

Figure A.3 SWMU 22 – Excavating Septic Tank (View to the southwest)

This photograph shows the Building 114 (SWMU 22) septic tank during excavation.

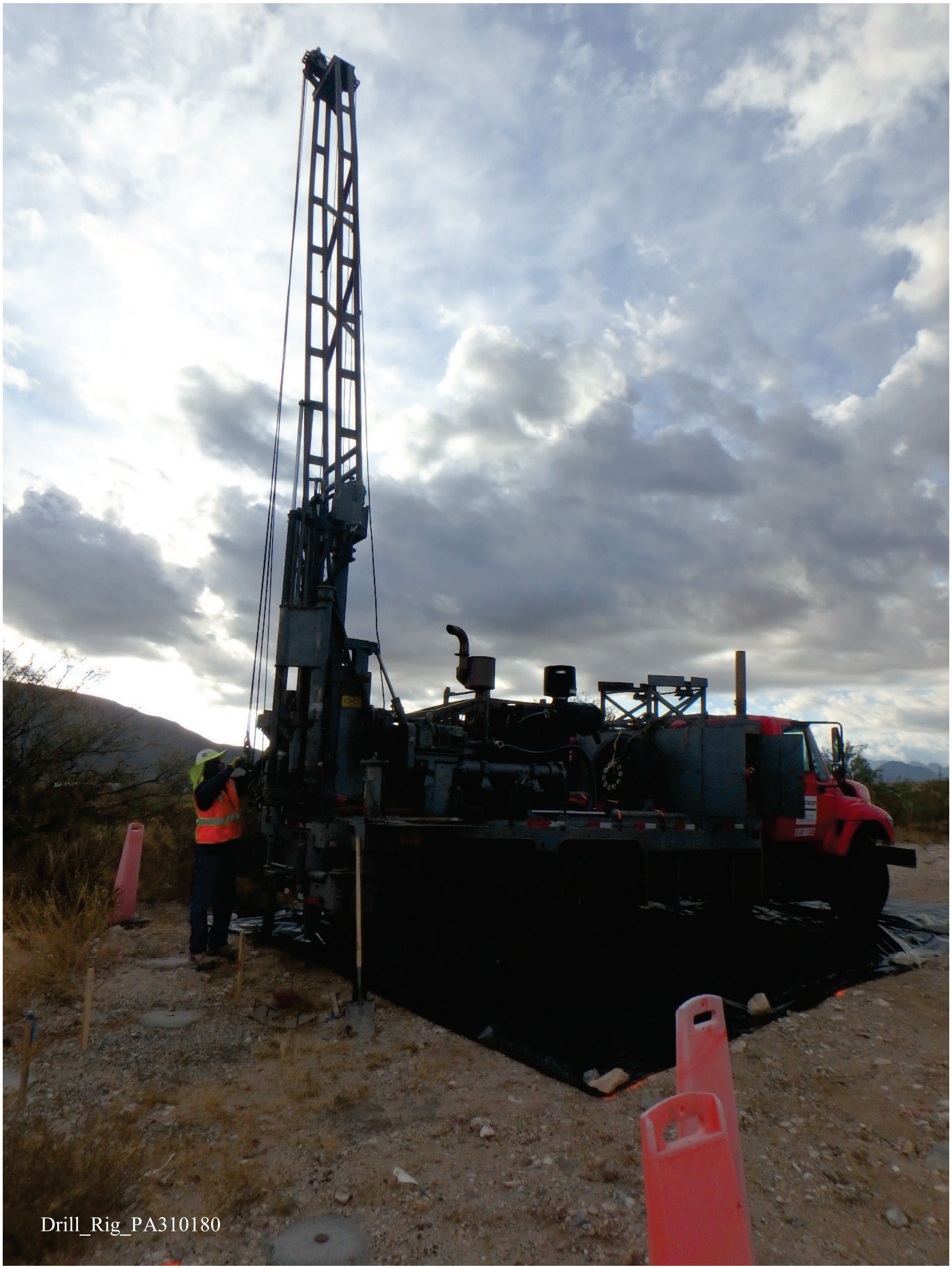
Figure A.4 **SWMU 22 – Inlet Pipe (View to the northeast)**

Photograph showing the inlet pipe (from Building 114 to the septic tank) for SWMU 22.

Figure A.5 **SWMU 22 – Outlet Pipe (view to the southwest)**

The vertical pipe is the vent. At the bottom of the vertical pipe, a dark area shows the entry to the discharge pipe from the septic tank (with no evidence of discharge within the pipe).

Building 114 (SWMU 22) septic tank. The surface vent can be seen with the tank top at the upper left of the photo. This photo was taken prior to removal of the tank. The tank contained no bottom.



Drill rig (CME-75 Hollow Stem Auger) at SWMU 22.

Soil sample is from boring 114-SB-07 at 7 to 9 ft bgs and was typical of the soil encountered during the drilling investigation. Soil is shown here within a stainless steel bowl.

Appendix B
NMED Liquid Waste Abandonment Forms
(chronological order by year)

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

March 16, 2015

Reply to Attn of: RE-15-029

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
1170 N. Solano Dr., Suite M
Las Cruces, NM 88001

Subject: NASA WSTF On-Site Liquid Waste System Abandonment Form for Building T463 Septic Tank

Enclosed is the On-Site Liquid Waste System Abandonment Form for the NASA WSTF Building T463 septic tank. The tank was removed in accordance with the NASA WSTF Septic Tanks Removal Plan on January 28, 2015. The remaining building sewer line was capped in accordance with Uniform Plumbing Code requirements and the excavation was backfilled with clean-fill. NASA also requests cancellation of the NMED Permit No. LC 92057 that is associated with this tank.

If you have any questions or comments, please contact Michael Jones of my staff at 575–524–5604.

Timothy J. Davis
Chief, Environmental Office

Enclosure

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 920527

System Owner's Name: NASA Johnson Space Center White Sands Test Facility

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

✓ ~~Connected to Sewer Lines or Plugged~~/Capped based on UPC Requirements

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [x] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

✓ System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

This septic tank was located at the former location of Building T463. It was removed in accordance with the WSTF Septic Tanks Removal Plan on January 28, 2015.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	N/C - Not Compliant
N/I - Not Inspected	N/V - Not Verified
N/A - Not Applicable	

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National Aeronautics and
Space Administration

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Lyndon B. Johnson Space Center
White Sands Test Facility
Post Office Box 20
Las Cruces, NM 88004-0020

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1. Article Addressed to: Mr. Michael Montoya Liquid Waste Program New Mexico Enviromental Dept. 1170 North Solano Dr, Suite M Las Cruces, NM 88001	D. Is delivery address different from item 1? ☐ Yes If YES, enter delivery address below: ☐ No 3. Service Type ☑ Certified Mail ☐ Express Mail ☐ Registered ☑ Return Receipt for Merchandise ☐ Insured Mail ☐ C.O.D. 4. Restricted Delivery? (*Extra Fee*) ☐ Yes
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National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

July 6, 2015

Reply to Attn of: RE-15-072

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
1170 N. Solano Dr., Suite M
Las Cruces, NM 88001

Subject: NASA WSTF On-Site Liquid Waste System Abandonment Form for Building 364 Septic Tank

Enclosed is the On-Site Liquid Waste System Abandonment Form for the NASA WSTF Building 364 septic tank. The tank was removed in accordance with the NASA WSTF Septic Tanks Removal Plan on May 20, 2015. The tank excavation was backfilled with clean-fill. The building sewer line had been previously rerouted from the tank during sanitary sewer construction. NASA requests cancellation of NMED Liquid Waste Permit No. LC 910918 that is associated with this tank, and a copy of the completed and signed abandonment form after the NMED takes action on this submittal.

If you have any questions or comments, please contact Michael Jones of my staff at 575–524–5604.

Timothy J. Davis
Chief, Environmental Office

Enclosure

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 910918

System Owner's Name: NASA Johnson Space Center White Sands Test Facility

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

✓ Connected to Sewer Lines o~~r Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

☒ Septic Tank ☐ Sec./Tert. Treatment Unit ☐ Holding Tank
☐ Seepage Pit ☐ Other: ☐ Cesspool

ABANDONMENT PROCEDURE:

✓ System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

Septic tank is located near WSTF Building 364. It was removed in accordance with the WSTF Septic Tanks Removal Plan on May 20, 2015.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

NMED ACTION TAKEN:

☐ Abandonment **Approved**
☐ Abandonment **Approved w/conditions** (See Comments/Violations)
☐ Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

☐ Granted ☐ Not Granted

NMED Inspector Date

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1. Article Addressed to:

Mr. Michael Montoya
Liquid Waste Program
New Mexico Enviromental Dept.
1170 North Solano Dr, Suite M
Las Cruces, NM 88001

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X
☐ Agent
☐ Addressee

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National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

February 4, 2016

Reply to Attn of: RE-16-019

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms for WSTF Building 272 Septic Tanks A, B, and C

Enclosed are the On-Site Liquid Waste System Abandonment Forms for WSTF Building 272 septic tanks A, B, and C. The tanks were removed in accordance the WSTF Septic Tanks Removal Plan on December 16, 2015. The building sewer lines were rerouted to the WSTF sanitary sewer system and the tank excavations have been backfilled with clean fill. NASA also requests cancellation of Liquid Waste Permit No. LC 910939 that is associated with Building 272 septic tanks A & B. Septic tank C does not have an associated Liquid Waste Program permit number. This tank was installed with the permission of the NMED Ground Water Pollution Prevention Section (now Ground Water Quality Bureau) following a March 11, 2005 letter from NASA that requested to permit the tank under existing groundwater discharge permit number DP-392.

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

for

Timothy J. Davis
Chief, Environmental Office

Enclosure (2)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 910939 (Building 272 Tanks A&B)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:
[X] Septic Tank [ ] Sec./Tert. Treatment Unit [ ] Holding Tank
[ ] Seepage Pit [ ] Other: [ ] Cesspool

ABANDONMENT PROCEDURE:
Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
Building 272 septic tanks A&B were installed in series in December 1991. The tanks were removed in accordance with the WSTF Septic Tanks Removal Plan on December 16, 2015.

ABANDONMENT PERFORMED BY:
Company Name: JACOBS Engineering Group, Inc.
Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:
[ ] Abandonment **Approved**
[ ] Abandonment **Approved w/conditions** (See Comments/Violations)
[ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:
[ ] Granted [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (Building 272 Tank C)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [x] Septic Tank
- [ ] Sec./Tert. Treatment Unit
- [ ] Holding Tank
- [ ] Seepage Pit
- [ ] Other:
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

There is no liquid waste permit for Building 272 septic tank C. The tank was installed with NMED permission in 2005 per a request to install letter under DP-392. The tank was removed with Building 272 septic tanks A and B on December 16, 2015 in accordance with the WSTF Septic Tanks Removal Plan.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

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NA - Not Applicable	

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Las Cruces, NM 88004-0020

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1. Article Addressed to:

Mr. Michael Montoya
Liquid Waste Program
New Mexico Enviromental Dept.
2301 Entrada Del Sol
Las Cruces, NM 88001

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A. Signature ☐ Agent ☐ Addressee

B. Received by (*Printed Name*) Nohemi Mendoza

C. Date of Delivery 2-8-16

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If YES, enter delivery address below: ☐ No

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4. Restricted Delivery? (*Extra Fee*) ☐ Yes

2. Article Number (*Transfer from service label*) 7011 2970 0004 4020 1288

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National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

March 30, 2016

Reply to Attn of: RE-16-049

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms for Septic Tanks Near WSTF Buildings 320, 447, and 650

Enclosed are the On-Site Liquid Waste System Abandonment Forms for septic tanks formerly located near WSTF Buildings 320, 447, and 650. These septic tanks were removed in accordance with the WSTF Septic Tanks Removal Plan during February 2016. The Building 320 tank was removed on February 10, the Building 650 tank was removed on February 17, and the Building 447 tank was removed on February 18. Building sewer lines previously connected to each tank were rerouted to the WSTF sanitary sewer system and the tank excavations have been backfilled with clean fill. NASA also requests cancellation of associated Liquid Waste Permits LC930858 (Building 320), LC900333 (Building 447), and DA010359 (Building 650).

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

Timothy J. Davis
Chief, Environmental Office

Enclosure (3)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC930858

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The WSTF Building 320 septic tank was installed in August 1993. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on February 10, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC900333

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The WSTF Building 447 septic tank was installed in April 1990. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on February 18, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

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NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: DA010359

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:
- [X] Septic Tank
- [ ] Sec./Tert. Treatment Unit
- [ ] Holding Tank
- [ ] Seepage Pit
- [ ] Other:
- [ ] Cesspool

ABANDONMENT PROCEDURE:
Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
The WSTF Building 650 septic tank was installed in April 2001. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on February 17, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:
- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:
- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements
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NA - Not Applicable
NC - Not Compliant
NV - Not Verified

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1. Article Addressed to:

Mr. Michael Montoya
Liquid Waste Program
New Mexico Enviromental Dept.
2301 Entrada Del Sol
Las Cruces, NM 88001

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X [signature]
☐ Agent
☐ Addressee

B. Received by (*Printed Name*) Michael Montoya

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National Aeronautics and
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Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

April 28, 2016

Reply to Attn of: RE-16-066

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms for WSTF 300 Area and 400 Area Main Septic Tanks

Enclosed are the On-Site Liquid Waste System Abandonment Forms for the WSTF 300 Area and 400 Area Main septic tanks. These septic tanks were removed in accordance with the WSTF Septic Tanks Removal Plan on March 4 and March 8, 2016, respectively. The influent sewer lines previously connected to each tank were rerouted to the WSTF sanitary sewer system and the tank excavations have been backfilled with clean fill.

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

Timothy J. Davis
Chief, Environmental Office

Enclosure (2)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (300 Area Main Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:
- [X] Septic Tank
- [ ] Sec./Tert. Treatment Unit
- [ ] Holding Tank
- [ ] Seepage Pit
- [ ] Other:
- [ ] Cesspool

ABANDONMENT PROCEDURE:
Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
The 300 Area Main septic tank was installed in 1963 during WSTF site construction.
The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on
March 4, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:
- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:
- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (400 Area Main Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:
- [X] Septic Tank
- [ ] Sec./Tert. Treatment Unit
- [ ] Holding Tank
- [ ] Seepage Pit
- [ ] Other:
- [ ] Cesspool

ABANDONMENT PROCEDURE:
Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
The 400 Area Main septic tank was installed in 1964 during WSTF site construction.
The tank was removed in accordance with the WSTF Septic Tanks Removal Plan
on March 8, 2016.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:
- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:
- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

November 15, 2016

Reply to Attn of: RE-16-150

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms for WSTF Building 114 Septic Tank

The On-Site Liquid Waste System Abandonment Form for the WSTF Building 114 septic tank is enclosed. The septic tank was removed in accordance with the WSTF Septic Tanks Removal Plan on November 9, 2016, and the tank excavation was backfilled with clean fill. The influent sewer line connected to the tank was previously rerouted to a new septic tank that was installed on September 10, 2013 (Permit No. DA130309).

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

Timothy J. Davis
Chief, Environmental Office

Enclosure (1)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (Building 114 Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Sec./Tert. Treatment Unit
- [ ] Holding Tank
- [ ] Seepage Pit
- [ ] Other:
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The Building 114 septic tank was installed in 1963 during WSTF site construction. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on November 9, 2016. The building sewer line was connected to a new septic tank (Permit No. DA130309).

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

New Mexico Environment Department
Environmental Health Bureau

Application for Liquid Waste Permit or Registration

☐ Conventional-New ☐ Conventional Modification ☒ Registration ☐ ATS/ADS - New ☐ ATS/ADS Modification ☐ Commercial ☐ Amendment

Section 1 General Information

NMED USE — Liquid Waste Processing Number: 002090 | Field Office ID: | Application Date:

Name (Property Legal owner, Inc., LLC, partnership, DBA, full legal name): National Aeronotical and Space Administration (NASA)

Facility Name:	Phone:	E-mail address(es):
Johnson Space Center White Sands Test Facility	575-524-5024	timothy.j.davis@nasa.gov

System Location: Physical Address, County - (if needed, attach directions): 12600 NASA Road (Dona Ana County)

Mailing Address (Invoices, permits, official correspondence): NASA JSC-WSTF, Attn: Timothy J. Davis Chief, Environmental Office, P.O. Box 20

City:	State:	Zip Code:	City:	State:	Zip Code:
Las Cruces	NM	88012	Las Cruces	NM	88004

Uniform Property Code:	Date of Record:	Lot Size (0.01 acres):	Total No. LW Systems on Property:	Total Design Flow on Property:
	1960	60,000	2	180 gpd

Subdivision:	Subdivision Plat Date:	Unit/Phase:	Block	Lot/Tract	Township	Range	Section
N/A	N/A	N/A	N/A	N/A	T21S	R03E	14

Water Supply Source: ☒ Onsite ☐ Offsite | ☐ Private ☐ Shared ☒ Public

No. Connections: 75

OSE Well Permit No. LRG-6369

Private or Shared Water Well Location (long., lat. or physical address, city, state): N/A

Public Water System Name: NASA JSC White Sands Test Facility - FF

Irrigation well, flood irrigation area on lot? ☐ YES NO ☒

Enter all LW permit nos. for lot: DA130309 (Blds. 114 and 119)

Section 2 Installer Information

No person shall construct, install or modify an onsite liquid waste system unless that person holds a valid and appropriate classification of contractor's license issued by New Mexico CID.

Installer Name:	Phone:	Installer Company Name:
Johnny's Septic Tank Co.	575-526-5442	Johnny's Septic Tank Co.

☐ Corp., Inc. ☐ LLC ☐ Sole Prop. ☐ LP, LLP, GP

Mailing Address (street / PO Box, City, State, Zip): 2155 Dona Ana Road

E-mail address:

CID License Classification: ☐ MM-1 ☐ MM-98 ☐ MS-1 ☒ MS-3 ☐ Homeowner

CID License No.: 25764

I am a licensed contractor by the State of New Mexico Regulation Licensing Department, Construction Industries Division (CID). I will either personally install the work myself or authorize my employee(s), ____________________ (named here) to provide the services and labor for this permit application under my direct supervision.

Section 3 Authentication / Verification

By signing below, I attest that the information in this application is correct and true to the best of my knowledge. I understand the issuing of this permit does not relieve me from the responsibility of complying with all applicable provisions of the New Mexico Plumbing Code and the New Mexico Liquid Waste Disposal and Treatment Regulations. Obtaining this permit does not relieve me from the responsibility of obtaining any permit required by state, city or county regulation or ordinance or other requirements of state or federal law.

☐ CID Licensed Contractor
☐ Qualified Homeowner
☒ Authorized Rep (Registrations Only)

Printed Name: Timothy J. Davis; John J. Villegas

Signature: [signed] for T. Davis / J. Villegas

Date Signed: 5/31/17

NMED USE ONLY

NMED PERMIT TO CONSTRUCT

NMED PERMIT TO CONSTRUCT NO:

A permit for construction of the Liquid Waste system described herein is hereby: ☐ Granted ☐ Granted with Conditions ☐ Denied ☐ Cancelled

Conditions, Reasons for Cancellation or Denial:

NMED Inspector Name Printed: | NMED Inspector Signature: | Date:

NMED LIQUID WASTE FEES

☐ Conventional-New $100	☐ Conventional Modification $50	☐ Registration $100	☐ ATS/ADS – New $150	☐ ATS/ADS Modification $75	☒ Commercial $150	☐ Variance $50

Total Fee Paid | Date Paid | Payment Received By

FINAL INSPECTION OF LW SYSTEM

☒ Final Inspection Conducted by NMED | Final Inspection Date: 6/21/17 | NMED Inspector Name Printed: Michael Montoya

☐ Contractor photo inspection authorized: | Photo inspection date: | Date photos and Completed Form Received by NMED:

NMED PERMIT TO OPERATE

NMED PERMIT TO OPERATE NO:

A permit for operation of the Liquid Waste system described herein is hereby: ☒ Granted ☐ Granted with Conditions ☐ Denied ☐ Cancelled

Conditions, Reasons for Cancellation of Denial:

NMED Inspector Name Printed: Michael Montoya | NMED Inspector Signature: [signed] | Date: 6-21-17

D WM NM

New Mexico Environment Department
Environmental Health Bureau

Application for Liquid Waste Permit or Registration

If your lot has more than one LW system, you must fill out a separate application for each system. The site plan drawing must show all liquid waste systems located on your lot. Existing permitted systems must be identified with their LW Permit #. New, modified or unpermitted systems must be clearly labelled on the site plan. NMED agents are not authorized to amend or complete any portion of this application.

Liquid Waste Processing Number: 00 2090

Treatment & Disposal System Design

Section 1 Design Flow, Hydrology, and Soil Description

A. Wastewater Sources & Design Flow Calculations

Facility		Units (enter number)	(Q) Flow, calculated: gpd
☐Single Family Residence		Bedrooms:	Total flow:
☐Multiple Family Units	No. Units:	Calculation Sheet Attached: ☐YES NO☐	Total flow:
☐Commercial / Institution (type): ☐Other:		Method of Design Flow Calculation: ☐ Table 201.1 ☐ PE (Calc. Sheet) ☐Water Meter Data Attached	Total flow:
☐Cluster ■Other (type): 4 employees x 20 gpd		No. of Units: 1 (Bldg. 117)	Total flow: 80 gpd
Total Flow for this LW System: *(see page 1 for total flow to property)*		Q	80 gpd

B. Hydrology Data

Depth from ground surface to:	Feet
Seasonal High Water table	175 ft
Bedrock, caliche, tight clay	< 20 ft
Gravel, cobbles, highly permeable soil	<20 ft
Test Hole / Soil Borings Used: ☐ YES NO ■	
Soil Classification Methodology used: ☐Jar Test ☐Laboratory: ■ Hand Sampling ☐Other: ☐Sieve	

C. Soil Description

Type	AR
☐Type Ia: Coarse Sand (or up to 30% gravel)	1.25
☐Type Ib: Medium Sand, Loamy Sand	2.0
■Type II: Sandy Loam, Fine Sand, Loam	2.0
☐Type III: Silt, Silt Loam, Clay Loam, Silty Clay Loam, Sandy Clay Loam	2.0
☐Type IV: Sandy Clay, Silty Clay, Clay	5.0

Section 2. Treatment Unit and Pump Design:

1	Primary Treatment Unit ■Septic Tank(s)	No. Septic Tank(s): 1	Manufacturer: Johnny's Septic Tank Co.		Series / Model / Certification No.: NM97-9-265A	Capacity (gallons): 900	Burial Depth: 5 ft.
2 PUMP	☐Pump Tank	Manufacturer:			Series / Model:	Capacity (gallons):	Burial Depth:
	☐Pump ☐Dual Pump	Manufacturer:			Series / Model:	Pump Curve Attch'd: ☐YES NO☐	Effluent Pump: ☐YES NO☐
3 ATS	☐Secondary ☐Tertiary	☐Standard ☐Conditional ☐Experimental	☐Required ☐Voluntary	Manufacturer:	Series / Model:	Capacity (gallons):	Burial Depth:
	☐ Disinfection	☐UV ☐Ozone ☐Chlorine	☐Required ☐Voluntary	Manufacturer:	Series / Model:	Notes:	

Section 3 Disposal System Design, Components and Calculations

A. Minimum Required absorption area, calculated (Multiply Design Flow (Q) times Application Rate (AR)): Q 100 X AR 2 = Min. Sq. Ft. Required: 200

B. Design Components: ☐Distribution Box ☐Tee ☐ Drop Box ☐Alternating Drainfield Valve ☐ Other:

CONVENTIONAL DISPOSAL

☐Pipe & Gravel	Trench Width:	Depth Gravel Below Pipe:	Total Linear Feet:	No. of Trenches:	Trench Depth:	Length, each trench:	Trench Spacing (ft):	Proposed Sq. Ft:
■Chamber ☐Synthetic Agg. ☐Other:	Mfr. Model No & Sizing Credit (sf/ft. or unit): Gravelless Quick 4 Infiltrators		Total Linear Feet: 45	No. of Units: 3	Trench Depth: 4 ft	Length, each trench: Unknown	Trench Spacing (ft): N/A	Proposed Sq. Ft: 231.6
☐Seepage Pit ☐Absorption Bed	Dimensions (L x W):		Depth below invert:	Proposed Sq. Ft.:	Trench Depth:	Notes:		

Section 4 Alternative Disposal System (ADS) Design, Components and Calculations

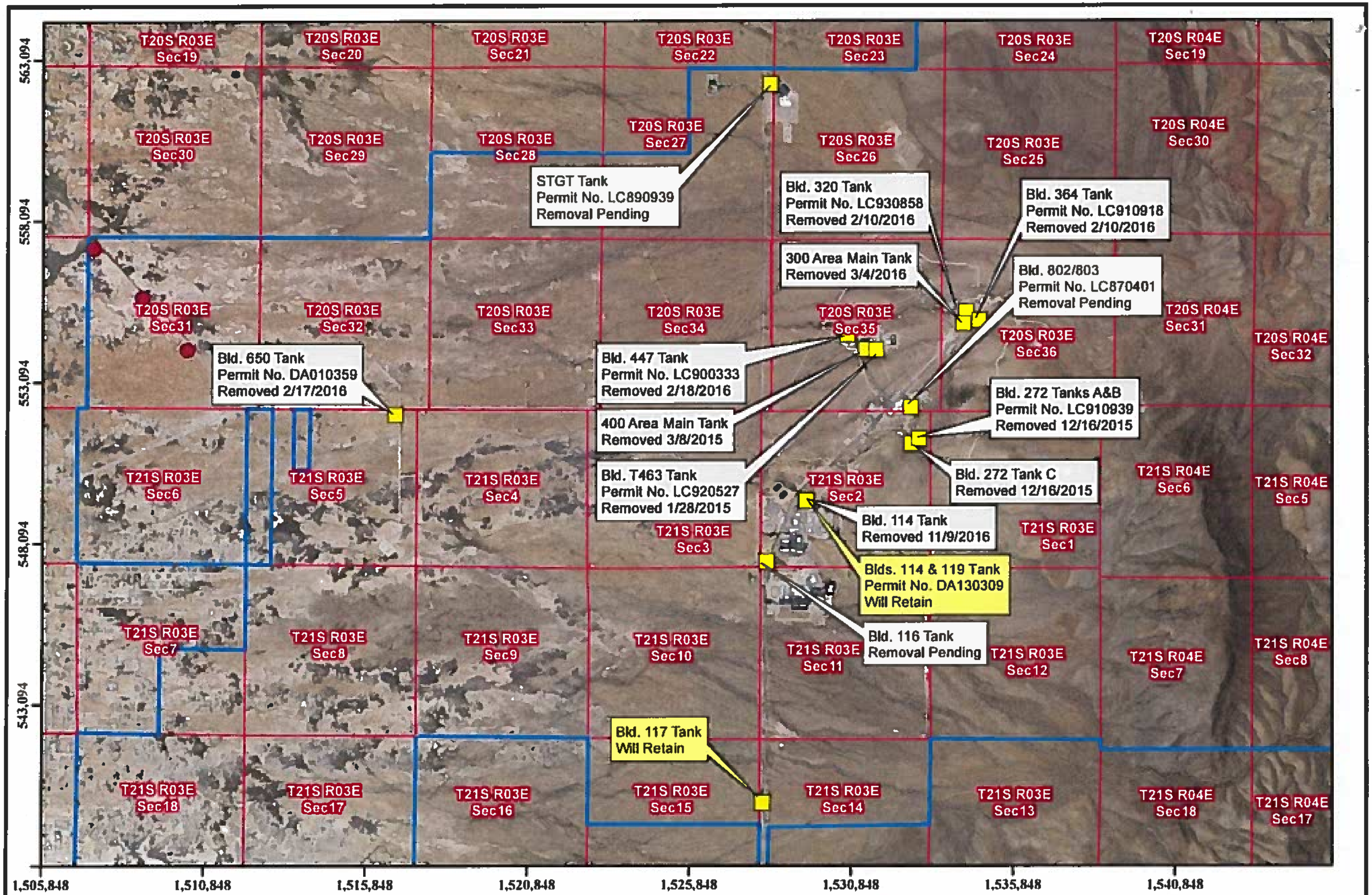
For all ADS's – calculation sheets & site plan drawings (plan view with cross section views) must be submitted with this permit application.

Alternative Disposal System

Discharging	☐Wisconsin Mound	☐Elevated System	☐Unlined ET Bed	☐Effluent Irrigation Re-use	☐Sand-Lined Trench Sand ASTM Specs Attached? ☐YES NO ☐	☐Bottomless Sand Filters Sand ASTM Specs Attached? ☐YES NO ☐
	☐LPD	☐LPP	☐Graywater	☐Drip Irrigation		
	☐Split Flow (complete holding tank section & septic tank & conventional disposal section)			☐Wetland	☐Other (description):	
Non-Discharging	☐Holding Tank / No. of Tank(s):	Manufacturer:	NM Certification No.:	Capacity:	Burial Depth:	High Water Alarm at 80%? ☐YES NO ☐
	☐Lined ET Bed Sand ASTM Specs Attached? ☐YES NO ☐	Liner Material & Thickness (mils):	Dimensions (L x W) & sq. ft.:	☐Lined Lagoon	Liner Material & Thickness (mils):	Dimensions (L x W) & sq. ft.:
	☐Vault	☐Privy (outhouse)	☐Other (description):			

Section 5 Setbacks / Site Plan & Attachments (check those that apply)

■ YES NO ☐	1. Does proposed system meet all setbacks required per 20.7.3.302 NMAC (see setback Table 302.1)?
■ YES NO ☐	2. Site plan attached w/ all structures shown, LW systems, wells & waters w/ 200' all setbacks clearly shown per 402.A.1 NMAC?
■ N/A ☐ YES NO ☐	3. If ATS or ADS, all requirements under section 403 are submitted, including calculations and drawings?
Supporting Documents Included:	☐Survey ☐Plat ☐Floorplan ☐Warranty Deed ☐Tax Bill ☐Other:



Application for Liquid Waste System Registration
White Sands Test Facility
Building 117

0 1,500 3,000 6,000 Feet

Coordinate System
NMSP, Central Zone, Feet, NAD83

NASA Johnson Space Center
White Sands Test Facility
Las Cruces, New Mexico

Location Map

Production Well
Septic Tank Location
PLSS Section
WSTF Boundary

N W E S

MAY 2017

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

March 29, 2006

Reply to Attn of: RA-E06-006

New Mexico Environment Department
Attn: Ms. Christina Kelso
Ground Water Pollution Prevention Section
Harold Runnels Building
P. O. Box 26110
Santa Fe, NM 87502

Subject: NASA White Sands Test Facility (WSTF) Discharge Plan DP-392 Permit Amendment Request to Install a New Septic Tank System and Leachfield

Per Liquid Waste Regulations promulgated at 20.7.3 NMAC, NASA is proposing to install a new septic tank and leachfield system with the concurrence of the New Mexico Environment Department (NMED) through the provisions of 20.6.2 NMAC. The septic tank system is designed to accommodate four employees who will be working on a daily basis at the new forward guard station along the existing access road to the facility. The new guard station will be on the east side of the road approximately 1.3 miles from the existing main gate. The Liquid Waste Permit form with sizing criteria, plans, and specifications is enclosed. The wastewater disposal program at WSTF is currently permitted under Discharge Plan DP-392, and this Permit can be amended to incorporate septic systems at the renewal date (expires May 24, 2007).

The proposed system will have a single, 900-gallon septic tank and high capacity infiltrators to be installed by Johnny's Septic Tank of Las Cruces (Construction Industries Division License No. 25764). The infiltrators will have 231.6 square feet of leachfield absorption area using the commercial gravelless design listed by NMED on the Liquid Waste Permit Application.

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

To the extent that information has been submitted electronically, I acknowledge that NMED will rely solely on the electronic information as accurate and complete information and that it is this data that will be used for compliance and enforcement purposes pursuant to the provisions set forth in the NASA WSTF Final Project Agreement. If you have any questions or comments concerning this submittal, please call me at 505–524–5733.

Original Signed By:

Radel Bunker-Farrah
Environmental Program Manager

Enclosure
bcc:
HTSI Team/P. H. Pache

RA/RBunker-Farrah:btm:3/29/06:5733

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NM ENVIRONMENT DEPARTMENT

APPLICATION FOR A LIQUID WASTE PERMIT

NMED Permit Number:__________

NMED Inspection Required ___ No ___ Yes, Call __________ for Appointment   Date NMED Received:__________

Date Accepted as Complete:__________

SYSTEM OWNER'S NAME: Last, First, MI. Home Phone: Business Phone:
NASA (contractor is Sandoval Construction) 524-6878

MAILING ADDRESS: Street/PO Box, City, State, Zip Code

SYSTEM LOCATION: Street Address/ Location - give directions to site County:
Nasa Site - please see attached location map

SUBDIVISION BLOCK LOT UNIFORM PROPERTY CODE

TOWNSHIP RANGE SECTION QTR QTR QTR LATITUDE LONGITUDE

INSTALLER'S NAME & FIRM: PHONE:
Johnny's Septic Tank Co. 505-526-5442

MAILING ADDRESS: Street/PO Box, City State, Zip Code
2155 Dona Ana Rd Las Cruces, NM 88007

CID License No./ Certification MM-1 MM-98 MS-1 MS-3 Homeowner

I. PERMIT APPLICATION (Instructions on back of pink copy)

A. Proposed Liquid Waste System is for: X New construction
___ Replacement of an existing system ___ Modification to an existing system

B. Manufactured Housing (mobile) ___ Yes X No

C. Proposed System is: X Conventional ___ Mound ___ Holding Tank
___ Evapotranspiration ___ Other, Describe: __________

II. WASTEWATER SOURCES & DESIGN FLOWS IN GALLONS PER DAY (gpd)

A. Proposed liquid waste system use and design flow:
___ Single family residence with ___ no. of bedrooms _____ gpd
___ Multiple family units; ___ no. of units; ___ no. bedrooms per unit _____ gpd
X Other (type) Guard Station Flow sizing units 4 80 gpd

B. Are there other sewage sources on this property? ___ Yes ___ No N/A gpd

TOTAL WASTEWATER FLOW ON PROPERTY = N/A GPD

III. SITE INFORMATION

A. Lot Size: N/A Acres (nearest 0.01 acre)   Date of Record: N/A (Plat Date or Subdivision Date)

B. Depth from Ground Surface to:
Seasonal High Water Table >100 feet
Bedrock, Caliche, Tight Clay <20 feet
Gravel, Cobbles, Highly permeable soil <20 feet

C. Soil Description: (NMED may require both texture description and percolation rate)
Texture:
___ Coarse sand or gravel; (give percolation rate below)
___ Sand; (give percolation rate below) ___ Fine Sand
X Sandy Loam; ___ Loam; ___ Silty Loam;
___ Clay Loam; ___ Clay;
___ Other; (describe)__________

Soil Percolation Rate: __________ min/inch (attach percolation test record)

D. Domestic Water Source: ___ On-site X Off-site;
___ Private X Public ___ Shared
Irrigation Well or Flood Irrigated Area on the lot. ___ Yes ___ No

IV. SYSTEM DESIGN

A. Treatment Unit:
X Septic Tank Capacity 900 Gallons
Manufacturer: Johnny's Septic Certification No.: NM97-9-265A
___ Other (specify):__________

B. Disposal System: X Trench ___ Bed ___ Seepage Pit ___ Mound
___ Evapotraspiration ___ Other, specify: __________
Materials: ___ Pipe and gravel X Gravelless (specify) Infiltrators

C. Minimum required absorption area 231.6 square feet
Trench or Bed width 3 ft. Gravel depth below distribution pipe Infiltrators ft.
Total Trench or Bed length 45 ft. Number of trenches: 3
Number of gravelless units 2 quik 4's

D. Depth from ground surface to bottom of absorption area >< 4 ft.

#22

V. SITE PLAN: Diagram the lot and liquid waste system. Show setbacks to the objects listed below within 200 feet of system and the direction of groundwater flow. Give distances from:

Treatment Unit to:		Disposal System to:
>5 ft.	Property line	>8 ft.
>5 ft.	Property line	>8 ft.
>5 ft.	Buildings	>8 ft.
>5 ft.	Structures	>8 ft.
>200 ft.	Wells	>200 ft.
N/A ft.	Irrigation	N/A ft.
N/A ft.	Arroyos	N/A ft.
N/A ft.	Surface water	N/A ft.

Please see attached

VI. The foregoing information is correct and true to the best of my knowledge. I understand that the issuing of this permit does not relieve me from the responsibility of complying with all applicable provisions of the New Mexico Plumbing Code and the New Mexico Liquid Waste Disposal Regulations. Obtaining this permit does not relieve me from the responsibility of obtaining any permit required by state, city or county regulation or ordinance or other requirements of state or federal law.

Signature ____________ Date 2-23-06

____ Owner __X__ Contractor ____ Other ____________

VII. NMED PERMIT A permit for construction of the liquid waste disposal system described herein is hereby:

____ Granted ____ Granted subject to conditions ____ Denied

____ Conditions ____ Reasons for Denial:

____

____

____

NMED Representative ____________ Date ____________

NOTE: This permit may be canceled for failure to meet any condition specified; failure to complete the system within one year; for providing inaccurate or incomplete information; or for failure to notify NMED that the system is completed.

If you have questions call: ____________

NMED Inspection History	NMED Representative	Date

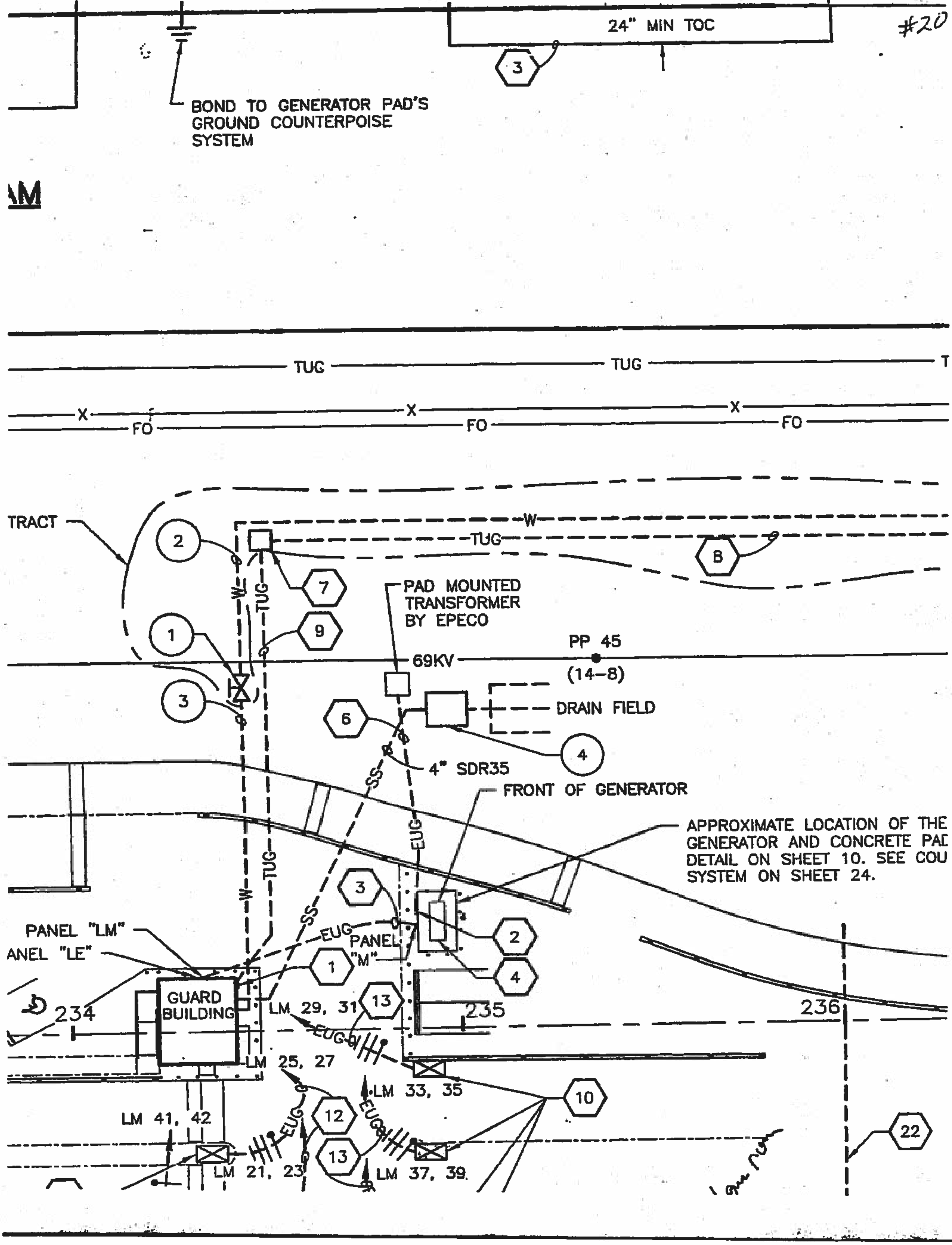
VIII. NMED FINAL APPROVAL:

The system described above ____ was ____ was not inspected.

NMED Representative ____________ Date ____________

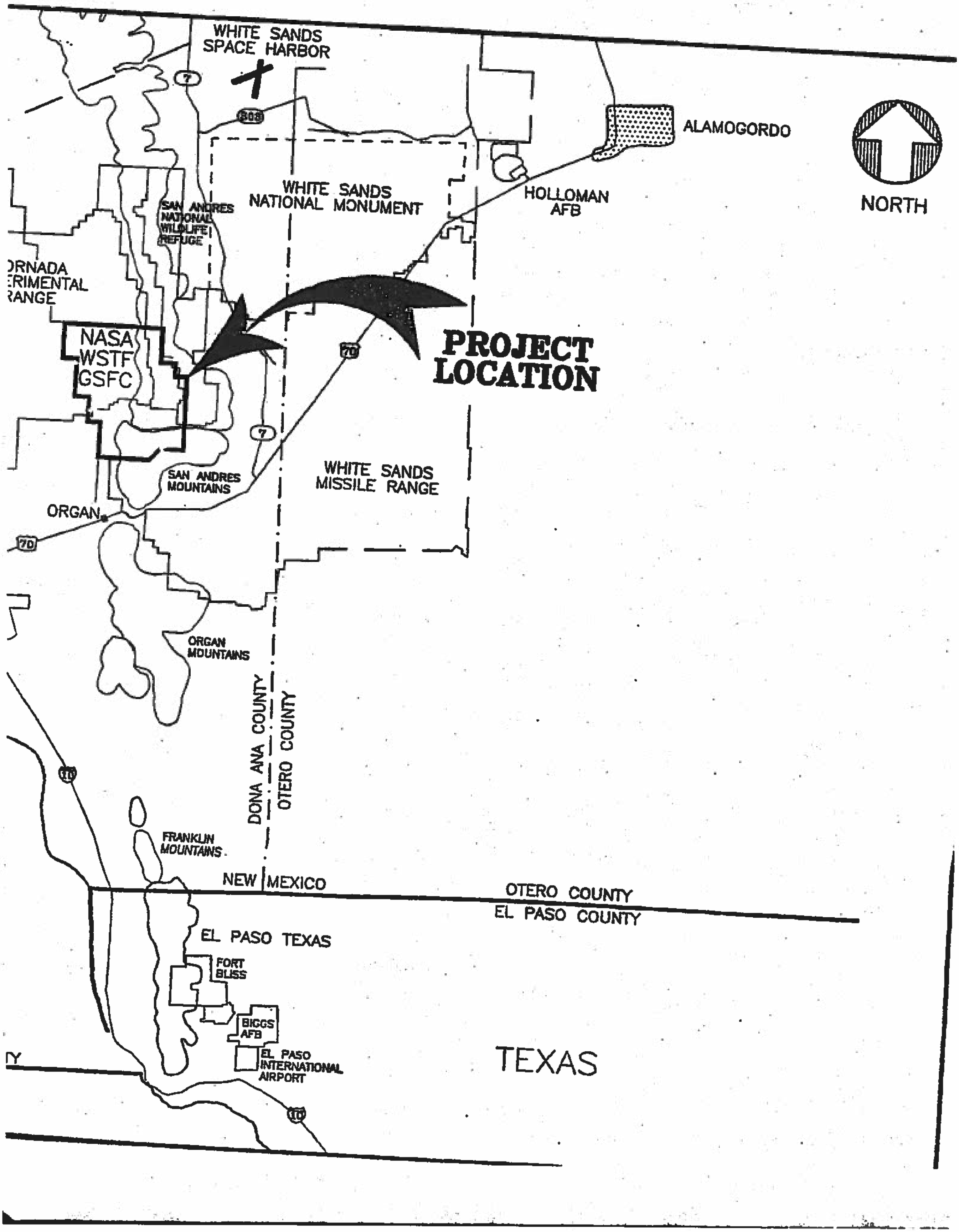
#20

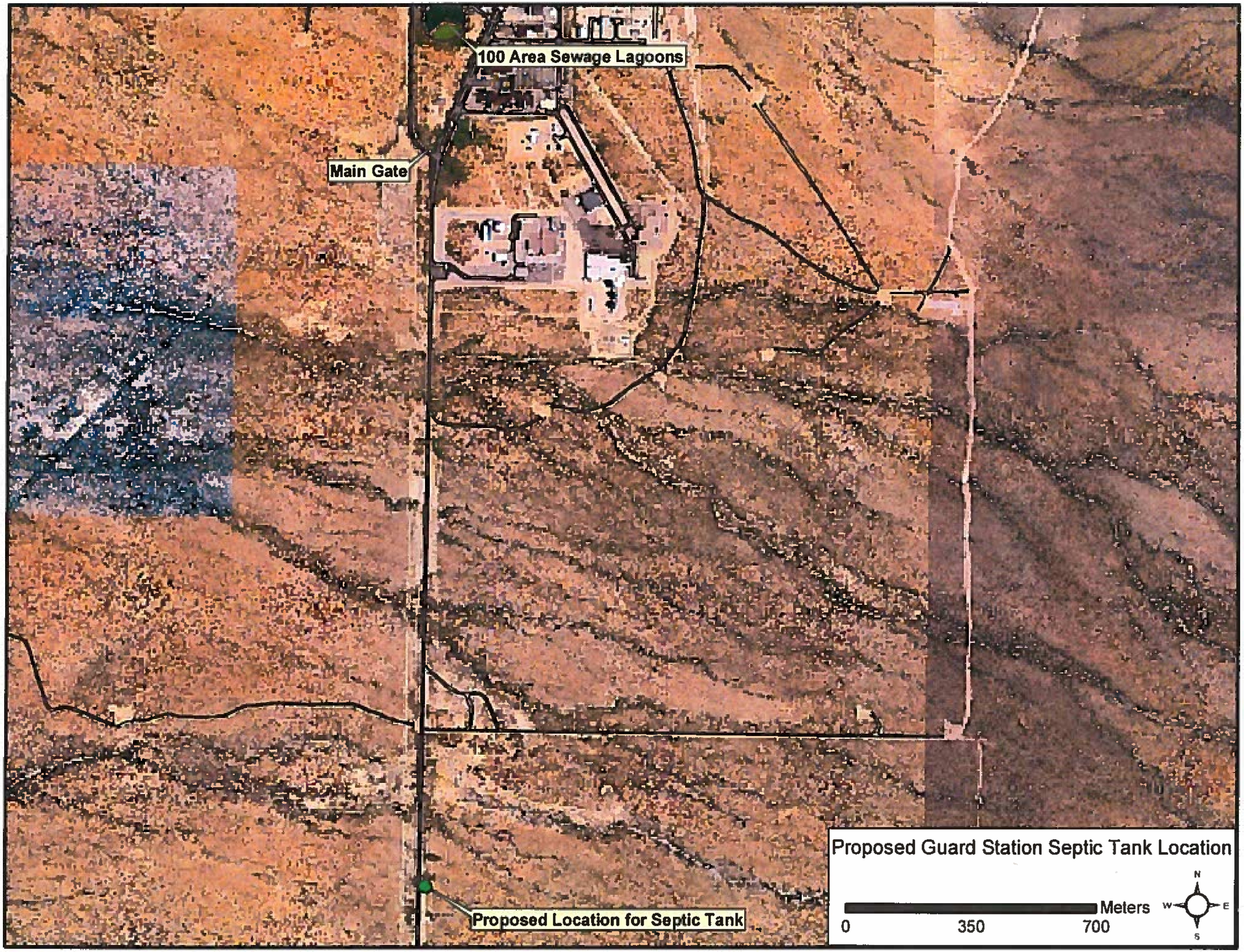
#20



24" MIN TOC
3
BOND TO GENERATOR PAD'S
GROUND COUNTERPOISE
SYSTEM
AM
TUG
TUG
X
FO
TRACT
2
W
TUG
7
B
1
9
PAD MOUNTED
TRANSFORMER
BY EPECO
69KV
PP 45
(14-8)
3
6
DRAIN FIELD
4
4" SDR35
SS
FRONT OF GENERATOR
EUG
APPROXIMATE LOCATION OF THE
GENERATOR AND CONCRETE PAD
DETAIL ON SHEET 10. SEE COU
SYSTEM ON SHEET 24.
3
PANEL "LM"
PANEL "LE"
PANEL "M"
2
1
4
GUARD
BUILDING
234
LM 29, 31
13
235
236
LM 25, 27
LM 33, 35
10
LM 41, 42
12
22
LM 21, 23
13
LM 37, 39

#20


WHITE SANDS
SPACE HARBOR
7
ALAMOGORDO
NORTH
WHITE SANDS
NATIONAL MONUMENT
HOLLOMAN
AFB
SAN ANDRES
NATIONAL
WILDLIFE
REFUGE
RNADA
ERIMENTAL
RANGE
NASA
WSTF
GSFC
PROJECT
LOCATION
70
7
SAN ANDRES
MOUNTAINS
WHITE SANDS
MISSILE RANGE
ORGAN
70
ORGAN
MOUNTAINS
DONA ANA COUNTY
OTERO COUNTY
10
FRANKLIN
MOUNTAINS
NEW MEXICO
OTERO COUNTY
EL PASO COUNTY
EL PASO TEXAS
FORT
BLISS
BIGGS
AFB
EL PASO
INTERNATIONAL
AIRPORT
TEXAS
10


100 Area Sewage Lagoons
Main Gate
Proposed Location for Septic Tank
Proposed Guard Station Septic Tank Location
Meters
0
350
700
N
W
E
S

State of New Mexico
ENVIRONMENT DEPARTMENT
Ground Water Quality Bureau
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502-6110
Telephone (505) 827-2918
Fax (505) 827-2965

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

FAX TRANSMISSION

DATE: May 12, 2006 **PAGES, incl. cover** 5
TO: Timothy Davis
COMPANY: NASA JSC White Sands Test Facility
FAX: (505) 524-5798
PHONE: (505) 524-5024

FROM: Christina Kelso, Environmental Scientist CK
FAX: (505) 827-2965
PHONE: (505) 827-2782

COMMENTS: Attached are copies of the Temporary Permission letters the New Mexico Environment Department Ground Water Quality Bureau issued to NASA today to discharge air conditioning condenser cooler water at the Second Tracking and Data Relay Station Ground Terminal (DP-584), and to install and discharge from a septic tank leachfield at the 100, 200 and 600 Areas (DP-392). If you have any questions, let me know. The invoices will be sent under separate cover.

State of New Mexico
ENVIRONMENT DEPARTMENT
Ground Water Quality Bureau
Harold Runnels Building
1190 St. Francis Drive, P.O. Box 26110
Santa Fe, New Mexico 87502-6110
Telephone (505) 827-2918
Fax (505) 827-2965

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

May 12, 2006

Radel Bunker-Farrah, Environmental Program Manager
NASA JSC White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

RE: Temporary Permission to Install and Discharge from a Septic Tank Leachfield, NASA - White Sands Test Facility, 100, 200, and 600 Areas, DP-392

Dear Ms. Bunker-Farrah:

The New Mexico Environment Department has reviewed your request, dated April 6, 2006, to discharge up to 80 gallons per day of domestic wastewater to a new septic tank leachfield system that will be installed at a new guard station. The guard station will be located approximately 1.3 miles south from the 100 Area main gate. The system consists of a 900-gallon septic tank and 231.6 square foot leachfield. The 100, 200, and 600 Areas domestic wastewater lagoons are permitted under Discharge Permit DP-392. Ground water beneath the site is at a depth of approximately 175 feet and has a total dissolved solids concentrations of approximately 600 milligrams per liter. The proposed discharge location is approximately 12 miles northeast from Las Cruces in Section 14, T21S, R3E, Dona Ana County.

Temporary permission to discharge is hereby granted pursuant to Section 20.6.2.3106.B NMAC for the above referenced discharge for 120 days from the date of this letter. This approval is contingent on your discharging as described in your April 6, 2006 request and upon the following condition:

1. Submit an application to renew and modify DP-392 to include all septic tank leachfields located at the 100, 200, and 600 Areas into the Discharge Permit.

This approval does not relieve you of your responsibility to comply with any other applicable federal, state, and/or local laws and regulations, such as zoning requirements and nuisance ordinances. Also, this approval does not relieve you of liability should your operation result in actual pollution of surface or ground waters.

If you have any questions, please contact Christina Kelso of the Ground Water Pollution Prevention Section at (505) 827-2782.

Sincerely,

George Schuman for W. Olson

William C. Olson, Chief
Ground Water Quality Bureau

WO:CK/ck

cc: Ken Smith, District Manager, NMED District 3
NMED Las Cruces Field Office
Dave Cobrain, NMED HWB
Timothy Davis, Environmental Scientist, NASA JSC White Sands Test Facility, P.O. Box 20, Las Cruces, NM 88004-0020

National Aeronautics and
Space Administration

White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

May 31, 2017

Reply to Attn of: RE-17-063

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: Application for Liquid Waste System Registration

NASA is requesting to register an existing septic tank located at the White Sands Test Facility (WSTF) by filing the application provided in Enclosure 1. The septic tank was installed in 2006 during construction of a forward guard gate at WSTF (Building 117). A map identifying the location of the Building 117 septic tank is provided in Enclosure 2. The tank and leach field were constructed in accordance with an application (Enclosure 3) approved by the NMED Groundwater Quality Bureau (GWQB) on May 12, 2006 for temporary permission to install and discharge from the tank (Enclosure 4). NASA complied with the NMED GWQB condition of approval by filing an application to renew and modify Discharge Plan (DP)-392 to include septic tank leach fields in the 100, 200, and 600 Areas. The application was submitted to the NMED GWQB on November 20, 2006, and identified the required septic tanks, including the Building 117 tank, and the six existing wastewater impoundments already permitted under DP-392. No final action was taken on the application because NASA began planning to divert wastewater discharged to the lagoons and most septic tanks to the City of Las Cruces wastewater treatment system. Construction of an on-site sanitary sewer system was completed, and NASA started diverting wastewater effluent to the City of Las Cruces wastewater treatment system on July 9, 2015.

NASA initiated closure of the six lagoon cells associated with DP-392 after connection to the City of Las Cruces wastewater treatment system was completed and discharges to the wastewater lagoons ceased. NASA also began decommissioning and removing septic tanks located throughout the facility, as identified in the WSTF Septic Tanks Investigation Work Plan and Removal Plan. The location of these tanks, their removal status, and LWP permit number (if applicable) are identified in the provided location map (Enclosure 2). The WSTF Septic Tanks Investigation Work Plan and Removal Plan was acknowledged as received by the NMED Liquid Waste Program (LWP) through a letter dated December 5, 2013. NASA has submitted the required Onsite Liquid Waste System Abandonment forms for the tanks that have been removed, and is currently planning the removal of the remaining three decommissioned septic tanks.

The majority of wastewater flow at the facility has been diverted to the City of Las Cruces wastewater treatment system, with the exception of wastewater from WSTF Buildings 114/119 and WSTF Building 117. It was not practical to connect these buildings to the on-site sanitary sewer system. A new septic tank was installed at Buildings 114/119 on September 10, 2013, in accordance with NMED LWP permit number DA130309. NASA is requesting to register the septic tank at Building 117 to ensure discharges from this tank are recognized under a NMED LWP permit once DP-392 is terminated.

Please contact Amanda Skarsgard, Environmental Project Manager, at 575-524-5460 if you have any questions concerning this submittal.

Sincerely,

for

Timothy J. Davis
Chief, Environmental Office

John J. Villegas
Chief, Facility Engineering Office

4 Enclosures

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

July 5, 2017

Reply to Attn of: RE-17-078

New Mexico Environment Department
Las Cruces Field Office
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: Liquid Waste Permit Application Fee for the NASA White Sands Test Facility – Permit Number 2090

Enclosure 1 contains NMED Liquid Waste Program Invoice Number 1008993 dated June 8, 2017 requesting payment of the application fee for liquid waste permit number 2090. Check #44977 in the amount of one hundred and fifty dollars ($150.00) is provided in Enclosure 2.

If you have any questions or comments, please contact Amanda Skarsgard of my staff at 575-524-5460.

Amanda Skarsgard for

Timothy J. Davis
Chief, Environmental Office

2 Enclosures

New Mexico Environment Department Environmental Health Bureau

Inspection Report

A. Basic Information

LWP 002090

Site Name: NASA WSTF Permit #: ~~AP-320~~ DP-392

Site address/County: Dona Ana

Responsible Party: JR Hennesey

B. System Documentation

Design flow: 80 Gallons per day

Advanced treatment system

Describe system: ____

Risers/lids? Yes ___ No ___ Are lids secure? Yes ___ No ___ Signs? Yes ___ No ___ Fencing? Yes ___ No ___

Describe the disposal system: ____

Conventional Septic Tanks

Number of tanks: 1 Series: Yes No Parallel: Yes No 900 gal

Are there risers/lids? Yes ✓ No ___ Are risers secure? Yes ✓ No ___

Describe the disposal system: Chamber System

GPS of tank: N 32 29.054 W 106 36. 855 elev. 4760

Holding Tanks

Number of tanks: ____ Series: Yes No Parallel: Yes No

Are there risers/lids? Yes ___ No ___ Are lids secure? Yes ___ No ___ High water alarm? Yes ___ No ___

Impoundments (Lagoons)

Signs? Yes ___ No ___ Fencing? Yes ___ No ___ Number of lagoons: ____

Approximate freeboard: ____ Type of liner: ____

Condition of liner: ____

C. Other Information (If Applicable)

1. Lift station: Yes No
2. Surge Tank/Timer Dosed System: Yes No
3. Water supply well present: Yes No Appear to meet setback requirements: Yes No
4. Water supply meter present? Yes No

   Location: ____

   Meter reading during time of inspection: ____

   Collect sample and test for nitrate
5. Effluent water meter present? Yes No

   Location: ____

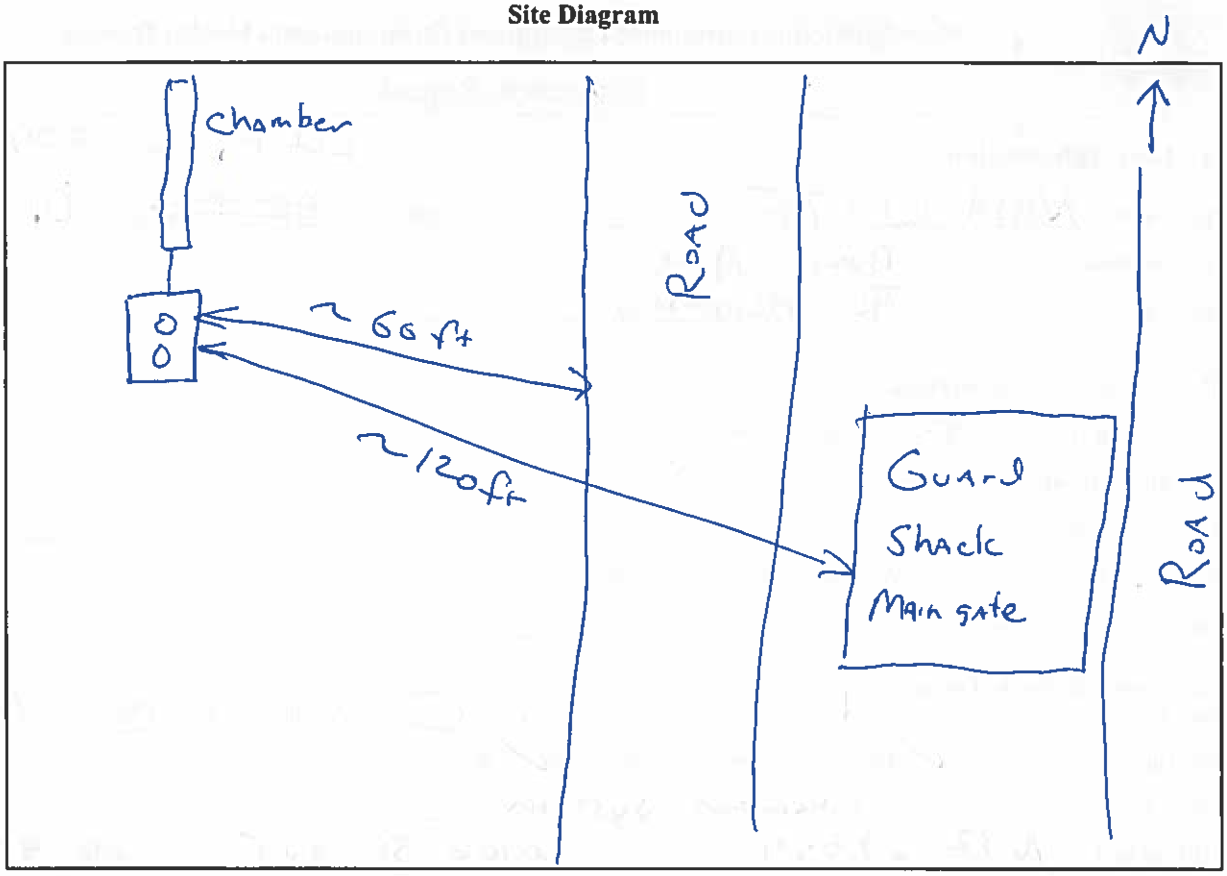
   Meter reading during time of inspection: ____
6. Monitoring Well(s) Present? Yes No

   Location from source component: ____

   Location from source component: ____

   Location from source component: ____

Site Diagram



D. Operational Status

1. Does site diagram match site plan as described on permit? Yes No
2. Does the system appear to be functioning and as described on permit? Yes No
3. Power is on to all components and electrical components appear to be functional? Yes No
4. System un-locatable, but appears to be functional? Yes No
5. Evidence of failure or previous failure? Yes No

E. NMED Evaluator

Inspector Name: Michael Montoya

Signature: [signature]

Date: 6/21/17

Final Approval

[✓] Granted

[ ] Granted with conditions (See Below)

[ ] Not Granted

Comments/Conditions: ______

NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH BUREAU

2301 Entrada Del Sol
Las Cruces, NM 88001
Phone (575) 288-2050 Fax (575) 526-6162
www.env.nm.gov

SUSANA MARTINEZ
Governor

JOHN SANCHEZ
Lt. Governor

BUTCH TONGATE
Secretary

J.C. BORREGO
Deputy Secretary

July 10, 2017

National Aeronotical and Space Administration (NASA)
NASA JSC-WSTF, ATTN: Timothy Davis, Environmental Office PO Box 20
Las Cruces, NM 88004

Subject: Notice of Action Taken, Permit #002090 has been *Granted* for the on-going Operation of the Liquid Waste Treatment & Disposal System (Septic System)

Dear National Aeronotical and Space Administration (NASA),

Your septic system has received final approval to Operate by the New Mexico Environment Department's (NMED's) Environmental Health Bureau. This is a permit for the ongoing operation of the septic system as described in your liquid waste permit application. Please review the following requirements:

Standard Requirements for Operating Your Liquid Waste System

1. The system owner is responsible for regular maintenance of their liquid waste system. This includes regular pumping of the septic tank to remove the build-up of solids, fats, oils and grease. The EPA recommends that you have your septic system inspected at least every 3 years by a professional and have your tank pumped every 3 to 5 years. The frequency of pumping may increase depending upon the number of people living in the home, water used and the amount of solids.
2. There is an effluent filter on your septic tank which keeps solids in your septic tank. Without this filter, solids will end up in your disposal system and decrease the life of your disposal system by causing clogging and premature failure. This filter will need to be cleaned regularly. It is recommended that you clean this filter semi-annually, but more often if needed.
3. What goes down your drain can have a major impact on how well your septic system works. Do not put the following down your drain because they can clog your system: Dental floss, feminine hygiene products, condoms, diapers, cotton swabs, cigarette butts, coffee grounds, cat litter, paper towels and flushable wipes. Household chemicals, gasoline, oil, pesticides, antifreeze, and paint can stress or destroy the biological treatment taking place in the system or might contaminate surface waters or groundwater.
4. Know the location of your septic tank and disposal system. Do not drive or park over any part of your system. Compaction of the soil above your disposal system will inhibit oxygen transfer to the bacteria that are treating your wastewater.
5. If you plan on adding a bedroom or a guest house to this system, you must submit a

modification permit to your local field office. If you plan on sub-dividing your lot, you should contact your local field office to determine whether you need to submit a modification permit or whether you can amend your permit.

6. Plant only grass over and near your septic disposal system and avoid over-irragtion of this area as damage and over-saturation may result. Roots from nearby trees or shrubs may clog or damage your disposal system. Plant choice is an important consideration to avoid root intrusion or damage to your liquid waste system.

7. Keep roof drains, basement sump pump drains, and other rainwater away from your disposal field. Flooding the disposal field with excessive water slows down or stops treatment processes and can cause plumbing fixtures to back up. Be aware that leaky toilets can lead to over-saturation and failure of your disposal system.

8. If you are a homeowner, you may occasionally empty waste from one personal RV into the on-site liquid waste system serving the residence, provided that the RV is not used as a permanent living quarters. The hose must be disconnected after discharge.

9. Prior to the transfer of a property with an established on-site liquid waste system, the property owner is required to have the system evaluated by a qualified Third Party Evaluator.

10. If you permit to Operate was "Granted with Conditions" you will receive a separate Permit Conditions Letter.

If you have any questions or comments, you may contact me at the address and telephone number stated above.

Sincerely,

Michael Montoya, Environmental Health Inspector
Environmental Health Bureau
New Mexico Environment Department

New Mexico Environment Department
Environmental Health Bureau

On-site Liquid Waste System

Permit to Operate

Owner Name: National Aeronotical and Space Administration (NASA)

Installer Name: Johnny's Septic Tank Co., Inc.

System Location:

System Type: Commercial

Permit Number: 002090

The New Mexico Environment Department may cancel this permit for failure to meet any of the following: failure to complete the system within one year, for providing inaccurate or incomplete information, or failure to notify NMED to schedule an inspection within a minimum of 2 working days prior to the inspection.

Date Issued: June 21, 2017

Authorizing Official
NMED

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020

August 8, 2017

Reply to Attn of: RE-17-098

Mr. Michael Montoya
New Mexico Environment Department
Liquid Waste Program
2301 Entrada Del Sol
Las Cruces, NM 88001

Subject: On-Site Liquid Waste System Abandonment Forms

Enclosed are the On-Site Liquid Waste System Abandonment Forms for septic tanks formerly located near White Sands Test Facility (WSTF) Building 116, Buildings 802/803, and the Second Tracking and Data Relay Satellite System Ground Terminal (STGT) guard station. These septic tanks were removed in accordance with the WSTF Septic Tanks Removal Plan during June and July 2017. The Building 116 tank was removed on July 17, 2017, the Buildings 802/803 tank was removed on June 21, 2017, and the STGT guard station tank was removed on July 19, 2017. The sewer service lines for Buildings 802/803 and the STGT guard station were rerouted to the WSTF sanitary sewer system, while the building sewer line to Building 116 was capped. The tank excavations were backfilled with clean fill. NASA also requests cancellation of associated Liquid Waste Permits LC 870401 (Buildings 802/803) and LC 890939 (STGT guard station). The Building 116 septic tank was installed in 1966 and was never permitted.

Please contact Amanda Skarsgard of my staff at 575–524–5460 if you have any questions or comments concerning this submittal.

AS for

Timothy J. Davis
Chief, Environmental Office

Enclosure (3)

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: N/A (Building 116 Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
No ~~Connected to Sewer Lines or~~ Plugged/Capped based on UPC Requirements

ON-SITE LIQUID WASTE SYSTEM TYPE:

[X] Septic Tank	[ ] Sec./Tert. Treatment Unit	[ ] Holding Tank
[ ] Seepage Pit	[ ] Other:	[ ] Cesspool

ABANDONMENT PROCEDURE:

Yes	System Pumped
N/A	Bottom of System Opened or Ruptured or Unit Collapsed
N/A	System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A	Top Cover Removed or Collapsed
N/A	System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A	System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
The Building 116 septic tank was installed in 1966 during WSTF site construction. The tank was removed in accordance with the WSTF Septic Tanks Removal Plan on July 17, 2017. The building sewer line was capped.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:
[ ] Abandonment **Approved**
[ ] Abandonment **Approved w/conditions** (See Comments/Violations)
[ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:
[ ] Granted [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 870401 (Blds. 802/803 Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:
Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

- [X] Septic Tank
- [ ] Seepage Pit
- [ ] Sec./Tert. Treatment Unit
- [ ] Other:
- [ ] Holding Tank
- [ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:
The Building 803 septic tank was installed in 1987. The tank was removed
in accordance with the WSTF Septic Tanks Removal Plan on June 21, 2017.
The building sewer line was connected to the WSTF sanitary sewer system.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

- [ ] Abandonment **Approved**
- [ ] Abandonment **Approved w/conditions** (See Comments/Violations)
- [ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

- [ ] Granted
- [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

STATE OF NEW MEXICO
ENVIRONMENT DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION
ON-SITE LIQUID WASTE SYSTEM ABANDONMENT

NMED Permit No.: LC 890939 (STGT Septic Tank)

System Owner's Name: NASA Johnson Space Center White Sands Test Facility (WSTF)

Address: 12600 NASA Road
Las Cruces, New Mexico 88012

BUILDING SEWER:

Yes Connected to Sewer Lines ~~or Plugged/Capped based on UPC Requirements~~

ON-SITE LIQUID WASTE SYSTEM TYPE:

[X] Septic Tank	[ ] Sec./Tert. Treatment Unit	[ ] Holding Tank
[ ] Seepage Pit	[ ] Other:	[ ] Cesspool

ABANDONMENT PROCEDURE:

Yes System Pumped
N/A Bottom of System Opened or Ruptured or Unit Collapsed
N/A System filled with Earth, Sand, Gravel, Concrete, or Other Approved Material
N/A Top Cover Removed or Collapsed
N/A System Filled to the Top of Sidewalls or above the Level of any Outlet Pipe
N/A System Filled Level with Top of Ground Surface

COMMENTS/VIOLATIONS:

The STGT guard shack septic tank was installed in 1989. The tank was removed
in accordance with the WSTF Septic Tanks Removal Plan on July 19, 2017.
The building sewer line was connected to the WSTF sanitary sewer system.

ABANDONMENT PERFORMED BY:

Company Name: JACOBS Engineering Group, Inc.

Address: 12600 NASA Road
Las Cruces, NM 88012

NMED ACTION TAKEN:

[ ] Abandonment **Approved**
[ ] Abandonment **Approved w/conditions** (See Comments/Violations)
[ ] Abandonment **Not Approved** (See Comments/Violations)

FINAL APPROVAL:

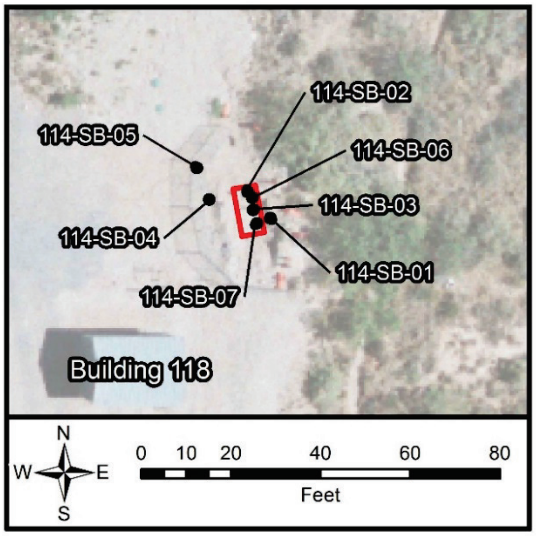
[ ] Granted [ ] Not Granted

NMED Inspector Date

OK - If Abandoned and meets Requirements	NC - Not Compliant
NI - Not Inspected	NV - Not Verified
NA - Not Applicable	

Appendix C
Lithologic Logs

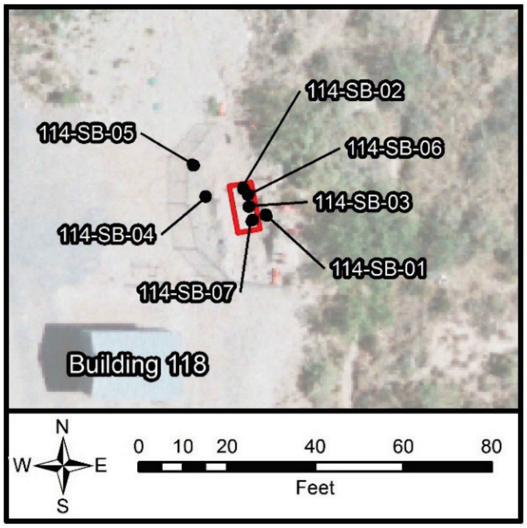
SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-01
SITE COORDINATES (ft.) N: 549392.072 **E:** 1529462.222
GROUND ELEVATION (ft. MSL): 4774.617
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 04/18/2017 - 04/19/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 12 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	5	7	16-27-29-22	100	Soil Chemical	1704191035 1704191036	ML	Color is pink 7.5 YR 7/4 (dry). Grains are subrounded sandy silt with gravel. Almost all clasts are marble or limestone with minimal quartzite. Large color variation between the top of the sample and the bottom of the sample.
15	N/A	10	12	102-106-54-60	70	Soil Chemical	1704191050 1704191051 1704191052 1704191053	SW	10' to 11' is light brown. Color is light brown 7.5 YR 6/3 bottom of sample is light grey, 7.5 YR 7/1. Well graded sand with gravel. Subangular clasts. 90% quartzite concentrated in the 11' to 12' section.
20									

SOIL BORING LITHOLOGIC LOG



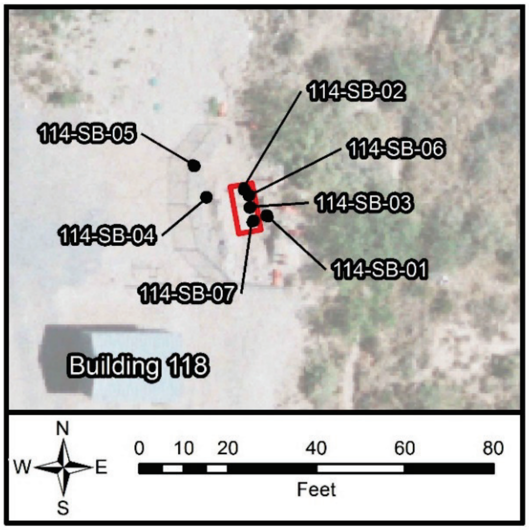
SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-02
SITE COORDINATES (ft.) N: 549398.445 **E:** 1529457.245
GROUND ELEVATION (ft. MSL): 4773.68
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 04/18/2017 - 04/19/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 27 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE: Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	SOIL SAMPLE: TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	LITHOLOGIC DESCRIPTION: USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	6	8	3-24 110-82	100	Soil Chemical	1704190835 1704190836	SW	Color is pinkish white 7.5 YR 7/2 (dry). Grains are subangular to subrounded. Well graded sand with gravel. 10% cemented alluvium, 50% limestone and marble with calcite precipitate.
15	N/A	10	12	21-19- 22-41	100	Soil Chemical	1704190845 1704190846	SW	Color is pink, 7.5 YR 7/3 (dry). Grains are angular to subangular. Well graded sand with gravel. Mix of limestone and quartzite with small amounts of marble.

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
20	N/A	15	17	28-45 -32-22	100	Soil Chemical	1704190855 1704190856	SW	Color is pink, 7.5 YR 7/4 (dry). Grains are angular to subangular . Well graded sand with gravel. Mix of marble, limestone and quartzite with calcite precipitation.
20 25	N/A	20	22	51-100- Augered	100	Soil Chemical	1704190915 1704190916	GW	Color is pink, 7.5 YR 7/4 (dry). Grains are angular. Well graded gravel with sand. About 80% of the large gravel pieces are quartzite. More than likely drilled through a large cobble of quartzite.
30	N/A	25	27	22-24- 26-22	100	Soil Chemical	1704190935 1704190936 1704190937 1704190938	ML	Color is reddish yellow 7.5 YR 6/6 (dry). Grains are subrounded. Sandy silt with gravel. Mostly clumps of silt and sand with some limestone.

NOTE: == indicates split-spoon refusal

SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-03

SITE COORDINATES (ft.) N: 549394.007 **E:** 1529458.349

GROUND ELEVATION (ft. MSL): 4773.982

COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)

STATE: New Mexico **COUNTY:** Doña Ana

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Split Spoon Sampler

DRILLING CONTR./DRILLER: Terracon

DATE STARTED: DATE COMPLETED: 04/18/2017 – 04/19/2017

FIELD REPS.: M. Narup

TOTAL DEPTH: 27 ft.

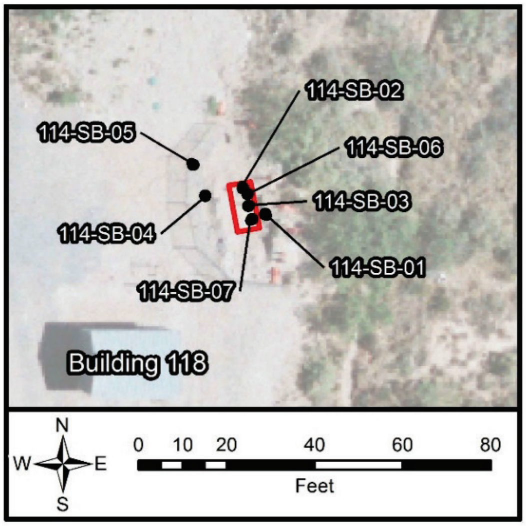
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	5	7	5-3-2-3	100	Soil Chemical	1704181435 1704181436 1704181437 1704181438	SW	Color is pale brown 10 YR 6/3 (dry). Grains are subangular. Well graded sand with gravel. About 50% marble and 30% quartzite.
15	N/A	10	12	18-27-29-32	100	Soil Chemical	1704181450 1704181451	SW	Color is light yellowish brown 10 YR 6/4 (dry). Grains are subangular to angular. Well graded sand with gravel. About 50% limestone and 40% quartzite.

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
20	N/A	15	17	20-18-37-100	100	Soil Chemical	1704181500 1704181501	SW	Color is light brown 7.5 YR 6/4 (dry). Grains are subangular to subrounded. Well graded sand with gravel. About 35% limestone with calcite precipitation and 20% quartzite.
20 25	N/A	20	22	9-58-70-83	100	Soil Chemical	1704190740 1704190741	GW	Color is light brown 7.5 YR 6/4 (dry). Grains are subrounded. Well graded gravel with sand. 70% limestone and marble with calcite precipitation.
30	N/A	25	27	11-32-38-35	100	Soil Chemical	1704190750 1704190751	SW	Color is light yellowish brown, 10 YR 6/4 (dry). Grains are subrounded. Well graded sand with gravel. About 40% quartzite and 40% limestone and marble.

NOTE: == indicates split-spoon refusal

SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-04

SITE COORDINATES (ft.) N: 549397.541 **E:** 1529447.934

GROUND ELEVATION (ft. MSL): 4773.478

COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)

STATE: New Mexico **COUNTY:** Doña Ana

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Split Spoon Sampler

DRILLING CONTR./DRILLER: Terracon

DATE STARTED: DATE COMPLETED: 04/18/2017 – 04/19/2017

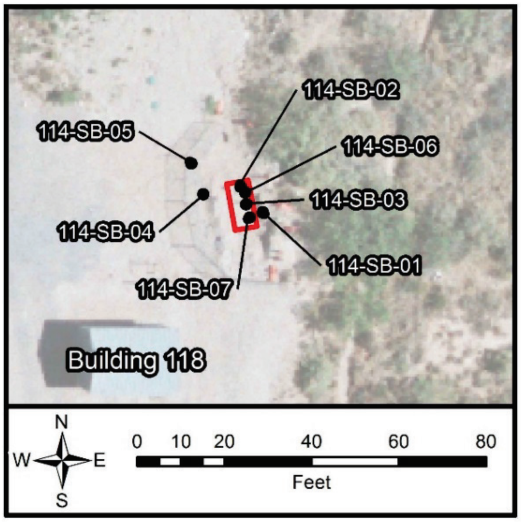
FIELD REPS.: M. Narup

TOTAL DEPTH: 12 ft.

COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE: Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	SOIL SAMPLE: TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	LITHOLOGIC DESCRIPTION: USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	5	7	12-14-40-26	100	Soil Chemical	1704181335 1704181336	SW	Color is brown, 7.5 YR 5/4 (damp). Grains are subangular to subrounded. Well graded sand. About 60% marble and limestone with calcite precipitation. Minimal amounts of quartzite.
15	N/A	10	12	23-21-49-86	100	Soil Chemical	1704181350 1704181351	SW	Color is pink, 7.5 YR 7/3 (dry). Grains are angular. Well graded sand with gravel. Abour 70% marble with calcite precipitation.
20									

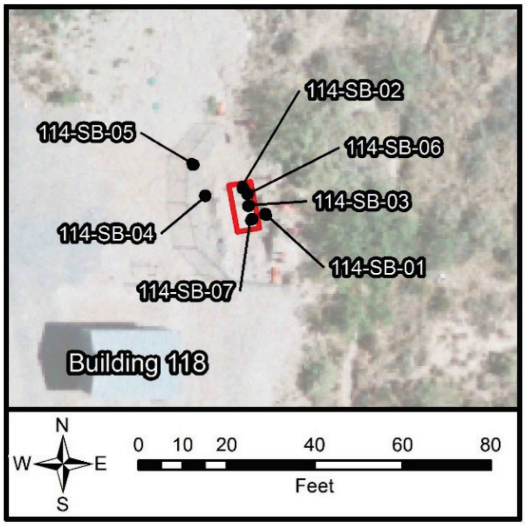
SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-05
SITE COORDINATES (ft.) N: 549405.09 **E:** 1529447.145
GROUND ELEVATION (ft. MSL): 4773.2
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 04/18/2017 – 04/19/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 12 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	5	7	36-52-44-38	100	Soil Chemical	1704181300 1704181301	SW	Color is pink 7.5 YR 7/3 (dry). Grains are subangular to subrounded. Well graded sand with gravel. About 50 % limestone with quartzite and marble.
15	N/A	10	12	36-52-44-38	100	Soil Chemical	1704181313 1704181314	SW	Color is pinkish white 7.5 YR 8/2 (dry). Grains are subangular. Well graded sand with gavel. About 40% marble and limestone, 40% quartzite, with some granite
20									

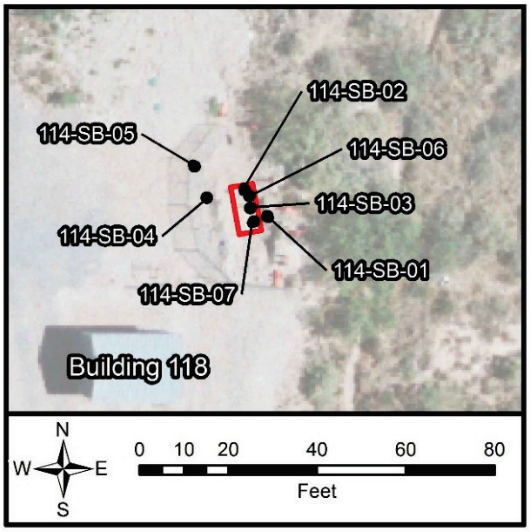
SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-06
SITE COORDINATES (ft.) **N:** 549396.914 **E:** 1529458.117
GROUND ELEVATION (ft. MSL): 4773.896
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 10/31/2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 9 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE				SOIL SAMPLE		LITHOLOGIC DESCRIPTION	
		Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	7	9	13-10-16-7	100	Soil Chemical	1710310955 1710310956	SW	Color is light brown, 7.5 YR 6/4. Well graded sand with gravel. Clasts are angular to subangular. Clasts are all dark limestone with caliche precipitate, no other rock types are visible.
15									
20									

SOIL BORING LITHOLOGIC LOG



SITE ID: NASA-WSTF **LOCATION ID:** 114-SB-07
SITE COORDINATES (ft.) N: 549391.896 **E:** 1529459.237
GROUND ELEVATION (ft. MSL): 4774.07
COORDINATE SYSTEM: North American 1983
State Plane Coordinate System
NM Central FIPS 3002 (Feet)
STATE: New Mexico **COUNTY:** Doña Ana
DRILLING METHOD: Hollow Stem Auger
SAMPLING METHOD: Split Spoon Sampler
DRILLING CONTR./DRILLER: Terracon
DATE STARTED: DATE COMPLETED: 10-31-2017
FIELD REPS.: M. Narup
TOTAL DEPTH: 9 ft.
COMMENTS:

DEPTH (ft. bgs)	PID (ppm)	SOIL CORE Sample Depth (ft) From	To	Blow Counts per 6" Core	% Core Rec.	SOIL SAMPLE TYPE (Soil Grab, Soil Gas, Soil Chemical, Soil Geotechnical, Hex. Chrom.)	WSTF 10-DIGIT SAMPLE NUMBER(S) (yrmmddtttt)	LITHOLOGIC DESCRIPTION USCS Group	Color, sorting/grading, consistency/density, grain size proportions (%), rounding/shape, consolidation/cementation, moisture content, distinguishing features
0 5									
10	N/A	7	9	50-46-30-17	80	Soil Chemical	1710310900 1710310901	SW	Color is light brown 7.5 YR 6/4 (damp). Well graded gravel with sand. Clasts are angular to subangular dark limestone. About 80% of the clasts have caliche precipitate. Smaller amounts of quartzite and rhyolite are visible.
15									
20									

Appendix D
Analytical Reports

HALL
ENVIRONMENTAL
ANALYSIS
LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

May 31, 2017

Carlyn Tufts
NASA_WSTF
P.O. Box 20
Las Cruces, NM 88004
TEL: (575) 524-5452
FAX

RE: 16EC053B OrderNo.: 1704970

Dear Carlyn Tufts:

Hall Environmental Analysis Laboratory received 40 sample(s) on 4/21/2017 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results, it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifiers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy Freeman
Laboratory Manager
4901 Hawkins NE
Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-001
Matrix: AQUEOUS
Client Sample ID: 1704180700
Collection Date: 4/18/2017 7:00:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7470: MERCURY						Analyst:	**MED**
Mercury	ND	0.00020		mg/L	1	5/2/2017 1:32:54 PM	31514
EPA 6010B: TOTAL RECOVERABLE METALS						Analyst:	**MED**
Arsenic	ND	0.020		mg/L	1	5/2/2017 9:25:54 AM	31501
Barium	0.0054	0.020	J	mg/L	1	5/2/2017 9:25:54 AM	31501
Cadmium	ND	0.0020		mg/L	1	5/2/2017 9:25:54 AM	31501
Chromium	0.0035	0.0060	J	mg/L	1	5/2/2017 9:25:54 AM	31501
Lead	ND	0.0050		mg/L	1	5/2/2017 9:25:54 AM	31501
Selenium	ND	0.050		mg/L	1	5/2/2017 9:25:54 AM	31501
Silver	ND	0.0050		mg/L	1	5/2/2017 9:25:54 AM	31501

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-003 **Matrix:** AQUEOUS

Client Sample ID: 1704190720
Collection Date: 4/19/2017 7:20:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7470: MERCURY						Analyst:	**MED**
Mercury	ND	0.00020		mg/L	1	5/2/2017 1:34:51 PM	31514
EPA 6010B: TOTAL RECOVERABLE METALS						Analyst:	**MED**
Arsenic	ND	0.020		mg/L	1	5/2/2017 9:27:40 AM	31501
Barium	0.00082	0.020	J	mg/L	1	5/2/2017 9:27:40 AM	31501
Cadmium	ND	0.0020		mg/L	1	5/2/2017 9:27:40 AM	31501
Chromium	ND	0.0060		mg/L	1	5/2/2017 9:27:40 AM	31501
Lead	ND	0.0050		mg/L	1	5/2/2017 9:27:40 AM	31501
Selenium	ND	0.050		mg/L	1	5/2/2017 9:27:40 AM	31501
Silver	ND	0.0050		mg/L	1	5/2/2017 9:27:40 AM	31501

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: **5/31/2017**

CLIENT: NASA_WSTF | **Client Sample ID:** 1704181435
Project: 16EC053B | **Collection Date:** 4/18/2017 2:35:00 PM
Lab ID: 1704970-005 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	0.047	0.031		mg/Kg	1	4/28/2017 11:18:15 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	4.8	2.5		mg/Kg	1	4/26/2017 9:21:50 AM	31405
Barium	73	0.099		mg/Kg	1	4/26/2017 9:21:50 AM	31405
Cadmium	0.64	0.099		mg/Kg	1	4/26/2017 9:21:50 AM	31405
Chromium	12	0.30		mg/Kg	1	4/26/2017 9:21:50 AM	31405
Lead	4.0	0.24		mg/Kg	1	5/1/2017 9:24:13 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:00:10 AM	31405
Silver	0.29	0.25		mg/Kg	1	4/26/2017 9:21:50 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704181437
Project: 16EC053B | **Collection Date:** 4/18/2017 2:37:00 PM
Lab ID: 1704970-007 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	0.041	0.031		mg/Kg	1	4/28/2017 11:19:59 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	5.3	2.4		mg/Kg	1	4/26/2017 9:23:19 AM	31405
Barium	64	0.098		mg/Kg	1	4/26/2017 9:23:19 AM	31405
Cadmium	0.54	0.098		mg/Kg	1	4/26/2017 9:23:19 AM	31405
Chromium	7.9	0.29		mg/Kg	1	4/26/2017 9:23:19 AM	31405
Lead	4.2	0.24		mg/Kg	1	5/1/2017 9:25:26 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:01:34 AM	31405
Silver	0.11	0.24	J	mg/Kg	1	4/26/2017 9:23:19 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704181450
Project: 16EC053B **Collection Date:** 4/18/2017 2:50:00 PM
Lab ID: 1704970-009 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.031		mg/Kg	1	4/28/2017 11:25:18 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	3.8	5.0	J	mg/Kg	2	4/26/2017 10:07:05 AM	31405
Barium	61	0.20		mg/Kg	2	4/26/2017 10:07:05 AM	31405
Cadmium	ND	0.20		mg/Kg	2	4/26/2017 10:07:05 AM	31405
Chromium	9.0	0.59		mg/Kg	2	4/26/2017 10:07:05 AM	31405
Lead	3.5	1.2		mg/Kg	5	5/1/2017 10:02:18 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:07:05 AM	31405
Silver	ND	0.50		mg/Kg	2	4/26/2017 10:07:05 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-011
Matrix: SOIL

Client Sample ID: 1704181500
Collection Date: 4/18/2017 3:00:00 PM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.032		mg/Kg	1	4/28/2017 11:27:03 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	7.0	2.5		mg/Kg	1	4/26/2017 9:27:28 AM	31405
Barium	46	0.10		mg/Kg	1	4/26/2017 9:27:28 AM	31405
Cadmium	0.13	0.10		mg/Kg	1	4/26/2017 9:27:28 AM	31405
Chromium	8.5	0.30		mg/Kg	1	4/26/2017 9:27:28 AM	31405
Lead	2.2	0.25		mg/Kg	1	5/1/2017 9:27:55 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:08:26 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:27:28 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704181335
Project: 16EC053B **Collection Date:** 4/18/2017 1:35:00 PM
Lab ID: 1704970-013 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	0.011	0.031	J	mg/Kg	1	4/28/2017 11:28:49 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	5.4	2.5		mg/Kg	1	4/26/2017 9:28:49 AM	31405
Barium	81	0.10		mg/Kg	1	4/26/2017 9:28:49 AM	31405
Cadmium	ND	0.10		mg/Kg	1	4/26/2017 9:28:49 AM	31405
Chromium	5.7	0.30		mg/Kg	1	4/26/2017 9:28:49 AM	31405
Lead	3.8	0.25		mg/Kg	1	5/1/2017 9:29:10 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:09:50 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:28:49 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704181350
Project: 16EC053B **Collection Date:** 4/18/2017 1:50:00 PM
Lab ID: 1704970-015 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.033		mg/Kg	1	4/28/2017 11:30:35 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	6.1	2.4		mg/Kg	1	4/26/2017 9:35:33 AM	31405
Barium	120	0.097		mg/Kg	1	4/26/2017 9:35:33 AM	31405
Cadmium	ND	0.097		mg/Kg	1	4/26/2017 9:35:33 AM	31405
Chromium	8.6	0.29		mg/Kg	1	4/26/2017 9:35:33 AM	31405
Lead	5.6	1.2		mg/Kg	5	5/1/2017 10:06:00 AM	31469
Selenium	ND	4.8		mg/Kg	2	4/26/2017 10:38:07 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:35:33 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704181300
Project: 16EC053B **Collection Date:** 4/18/2017 1:00:00 PM
Lab ID: 1704970-017 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	ND	0.031		mg/Kg	1	4/28/2017 11:32:21 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	9.9	2.5		mg/Kg	1	4/26/2017 9:36:53 AM	31405
Barium	53	0.099		mg/Kg	1	4/26/2017 9:36:53 AM	31405
Cadmium	ND	0.099		mg/Kg	1	4/26/2017 9:36:53 AM	31405
Chromium	19	0.30		mg/Kg	1	4/26/2017 9:36:53 AM	31405
Lead	1.3	0.25		mg/Kg	1	5/1/2017 9:31:39 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:18:07 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:36:53 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-019
Matrix: SOIL

Client Sample ID: 1704181313
Collection Date: 4/18/2017 1:13:00 PM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.033		mg/Kg	1	4/28/2017 11:34:09 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	7.3	2.5		mg/Kg	1	4/26/2017 9:38:14 AM	31405
Barium	40	0.098		mg/Kg	1	4/26/2017 9:38:14 AM	31405
Cadmium	ND	0.098		mg/Kg	1	4/26/2017 9:38:14 AM	31405
Chromium	6.4	0.30		mg/Kg	1	4/26/2017 9:38:14 AM	31405
Lead	3.1	0.24		mg/Kg	1	5/1/2017 9:32:52 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:19:28 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:38:14 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704191035
Project: 16EC053B **Collection Date:** 4/19/2017 10:35:00 AM
Lab ID: 1704970-021 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	0.0069	0.033	J	mg/Kg	1	4/28/2017 11:35:48 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	6.1	2.4		mg/Kg	1	4/26/2017 9:39:36 AM	31405
Barium	110	0.098		mg/Kg	1	4/26/2017 9:39:36 AM	31405
Cadmium	0.14	0.098		mg/Kg	1	4/26/2017 9:39:36 AM	31405
Chromium	11	0.29		mg/Kg	1	4/26/2017 9:39:36 AM	31405
Lead	1.5	0.24		mg/Kg	1	5/1/2017 9:37:50 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:20:49 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:39:36 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-023
Matrix: SOIL
Client Sample ID: 1704191050
Collection Date: 4/19/2017 10:50:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	ND	0.032		mg/Kg	1	4/28/2017 11:37:29 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	14	2.4		mg/Kg	1	4/26/2017 9:40:59 AM	31405
Barium	30	0.096		mg/Kg	1	4/26/2017 9:40:59 AM	31405
Cadmium	0.18	0.096		mg/Kg	1	4/26/2017 9:40:59 AM	31405
Chromium	5.5	0.29		mg/Kg	1	4/26/2017 9:40:59 AM	31405
Lead	2.4	0.25		mg/Kg	1	5/1/2017 9:39:04 AM	31469
Selenium	ND	4.8		mg/Kg	2	4/26/2017 10:22:11 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:40:59 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-025

Matrix: SOIL

Client Sample ID: 1704191052
Collection Date: 4/19/2017 10:52:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.033		mg/Kg	1	4/28/2017 11:39:09 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	9.6	2.5		mg/Kg	1	4/26/2017 9:42:21 AM	31405
Barium	33	0.10		mg/Kg	1	4/26/2017 9:42:21 AM	31405
Cadmium	ND	0.10		mg/Kg	1	4/26/2017 9:42:21 AM	31405
Chromium	5.5	0.30		mg/Kg	1	4/26/2017 9:42:21 AM	31405
Lead	1.9	0.25		mg/Kg	1	5/1/2017 9:40:17 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:23:31 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:42:21 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704190835
Project: 16EC053B | **Collection Date:** 4/19/2017 8:35:00 AM
Lab ID: 1704970-027 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	0.039	0.032		mg/Kg	1	4/28/2017 11:40:50 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	4.0	2.4		mg/Kg	1	4/26/2017 9:43:45 AM	31405
Barium	68	0.097		mg/Kg	1	4/26/2017 9:43:45 AM	31405
Cadmium	1.1	0.097		mg/Kg	1	4/26/2017 9:43:45 AM	31405
Chromium	9.5	0.29		mg/Kg	1	4/26/2017 9:43:45 AM	31405
Lead	4.8	0.24		mg/Kg	1	5/1/2017 9:41:31 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:24:53 AM	31405
Silver	0.94	0.24		mg/Kg	1	4/26/2017 9:43:45 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704190845
Project: 16EC053B **Collection Date:** 4/19/2017 8:45:00 AM
Lab ID: 1704970-029 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	0.017	0.033	J	mg/Kg	1	4/28/2017 11:46:07 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	4.0	2.5		mg/Kg	1	4/26/2017 9:45:08 AM	31405
Barium	39	0.099		mg/Kg	1	4/26/2017 9:45:08 AM	31405
Cadmium	0.095	0.099	J	mg/Kg	1	4/26/2017 9:45:08 AM	31405
Chromium	7.3	0.30		mg/Kg	1	4/26/2017 9:45:08 AM	31405
Lead	2.4	0.25		mg/Kg	1	5/1/2017 9:42:45 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:26:14 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:45:08 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:				
	*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704190855
Project: 16EC053B | **Collection Date:** 4/19/2017 8:55:00 AM
Lab ID: 1704970-031 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.031		mg/Kg	1	4/28/2017 11:47:49 AM	31470
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	5.7	2.5		mg/Kg	1	4/26/2017 9:46:32 AM	31405
Barium	32	0.099		mg/Kg	1	4/26/2017 9:46:32 AM	31405
Cadmium	0.11	0.099		mg/Kg	1	4/26/2017 9:46:32 AM	31405
Chromium	7.5	0.30		mg/Kg	1	4/26/2017 9:46:32 AM	31405
Lead	3.7	1.2		mg/Kg	5	5/1/2017 10:20:26 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:27:37 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:46:32 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704190915
Project: 16EC053B **Collection Date:** 4/19/2017 9:15:00 AM
Lab ID: 1704970-033 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	ND	0.031		mg/Kg	1	4/28/2017 11:49:31 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	12	2.5		mg/Kg	1	4/26/2017 9:47:53 AM	31405
Barium	58	0.099		mg/Kg	1	4/26/2017 9:47:53 AM	31405
Cadmium	0.15	0.099		mg/Kg	1	4/26/2017 9:47:53 AM	31405
Chromium	12	0.30		mg/Kg	1	4/26/2017 9:47:53 AM	31405
Lead	2.4	0.25		mg/Kg	1	5/1/2017 9:45:15 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:36:45 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:47:53 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF **Client Sample ID:** 1704190935
Project: 16EC053B **Collection Date:** 4/19/2017 9:35:00 AM
Lab ID: 1704970-035 **Matrix:** SOIL **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	ND	0.032		mg/Kg	1	4/28/2017 11:51:14 AM	31470
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	5.1	2.4		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Barium	33	0.097		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Cadmium	0.11	0.097		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Chromium	8.3	0.29		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Lead	5.4	0.25		mg/Kg	1	4/28/2017 11:11:00 AM	31468
Selenium	ND	2.4		mg/Kg	1	4/26/2017 9:53:21 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:53:21 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF
Project: 16EC053B
Lab ID: 1704970-037
Matrix: SOIL
Client Sample ID: 1704190750
Collection Date: 4/19/2017 7:50:00 AM
Received Date: 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY							Analyst: **ELS**
Mercury	ND	0.032		mg/Kg	1	4/28/2017 11:56:27 AM	31471
EPA METHOD 6010B: SOIL METALS							Analyst: **MED**
Arsenic	6.3	2.4		mg/Kg	1	4/26/2017 9:57:28 AM	31405
Barium	39	0.098		mg/Kg	1	4/26/2017 9:57:28 AM	31405
Cadmium	0.073	0.098	J	mg/Kg	1	4/26/2017 9:57:28 AM	31405
Chromium	4.0	0.29		mg/Kg	1	4/26/2017 9:57:28 AM	31405
Lead	3.1	1.2		mg/Kg	5	5/1/2017 10:22:55 AM	31469
Selenium	ND	4.9		mg/Kg	2	4/26/2017 10:43:31 AM	31405
Silver	ND	0.24		mg/Kg	1	4/26/2017 9:57:28 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

CLIENT: NASA_WSTF | **Client Sample ID:** 1704190740
Project: 16EC053B | **Collection Date:** 4/19/2017 7:40:00 AM
Lab ID: 1704970-039 | **Matrix:** SOIL | **Received Date:** 4/21/2017 9:00:00 AM

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed	Batch
EPA METHOD 7471: MERCURY						Analyst:	**ELS**
Mercury	ND	0.033		mg/Kg	1	4/28/2017 12:01:45 PM	31471
EPA METHOD 6010B: SOIL METALS						Analyst:	**MED**
Arsenic	7.4	2.5		mg/Kg	1	4/26/2017 9:58:49 AM	31405
Barium	39	0.099		mg/Kg	1	4/26/2017 9:58:49 AM	31405
Cadmium	3.8	0.099		mg/Kg	1	4/26/2017 9:58:49 AM	31405
Chromium	12	0.30		mg/Kg	1	4/26/2017 9:58:49 AM	31405
Lead	3.9	0.24		mg/Kg	1	5/1/2017 9:48:59 AM	31469
Selenium	ND	5.0		mg/Kg	2	4/26/2017 10:44:52 AM	31405
Silver	ND	0.25		mg/Kg	1	4/26/2017 9:58:49 AM	31405

Refer to the QC Summary report and sample login checklist for flagged QC data and preservation information.

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-001	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-002A / 1704180701	**Sampling Time**	7:01 AM		
Matrix	Water				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/L	0.006	0.01	5/2/2017	JEK	EPA 335.4	

Sample Number	170425031-002	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-004A / 1704190721	**Sampling Time**	7:21 AM		
Matrix	Water				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/L	0.006	0.01	5/2/2017	JEK	EPA 335.4	

Sample Number	170425031-003	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-006A / 1704181436	**Sampling Time**	2:36 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	47.1	mg/Kg	0.137	0.237	5/2/2017	JEK	EPA 335.4	E1,H2
%moisture	4.3	Percent			5/3/2017	JEK	%moisture	

Certifications held by Anatek Labs ID: EPA:ID00013; AZ:0701; FL(NELAP):E87893; ID:ID00013; MT:CERT0028; NM: ID00013;NV:ID00013; OR:ID200001-002; WA:C595
Certifications held by Anatek Labs WA: EPA:WA00169; ID:WA00169; WA:C585; MT:Cert0095; FL(NELAP): E871099

Anatek Labs, Inc.

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504 E Sprague Ste. D • Spokane WA 99202 • (509) 838-3999 • Fax (509) 838-4433 • email spokane@anateklabs.com

Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-004	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-008A / 1704181438	**Sampling Time**	2:38 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	60.6	mg/Kg	0.153	0.263	5/2/2017	JEK	EPA 335.4	E1,H2
%moisture	5.1	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-005	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-010A / 1704181451	**Sampling Time**	2:51 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	2.59	mg/Kg	0.154	0.265	5/2/2017	JEK	EPA 335.4	
%moisture	6.0	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-006	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-012A / 1704181501	**Sampling Time**	3:01 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	1.53	mg/Kg	0.126	0.218	5/2/2017	JEK	EPA 335.4	
%moisture	4.2	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-007	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-014A / 1704181336	**Sampling Time**	1:36 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	1.63	mg/Kg	0.156	0.269	5/2/2017	JEK	EPA 335.4	
%moisture	7.1	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-008	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-016A / 1704181351	**Sampling Time**	1:51 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.142	0.245	5/2/2017	JEK	EPA 335.4	
%moisture	3.0	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-009	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-018A / 1704181301	**Sampling Time**	1:01 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.144	0.248	5/2/2017	JEK	EPA 335.4	
%moisture	7.4	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-010	**Sampling Date**	4/18/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-020A / 1704181314	**Sampling Time**	1:14 PM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.139	0.24	5/2/2017	JEK	EPA 335.4	
%moisture	3.1	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-011	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-022A / 1704191036	**Sampling Time**	10:36 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	0.459	mg/Kg	0.151	0.261	5/2/2017	JEK	EPA 335.4	
%moisture	4.7	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-012	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-024A / 1704191051	**Sampling Time**	10:51 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.142	0.245	5/2/2017	JEK	EPA 335.4	
%moisture	3.4	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-013	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-026A / 1704191053	**Sampling Time**	10:53 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.145	0.25	5/2/2017	JEK	EPA 335.4	
%moisture	3.4	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-014	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-028A / 1704190836	**Sampling Time**	8:36 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	19.6	mg/Kg	0.137	0.237	5/2/2017	JEK	EPA 335.4	
%moisture	4.3	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-015	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017 11:30 AM
Client Sample ID	1704970-030A / 1704190846	**Sampling Time**	8:46 AM		
Matrix	Soil				
Comments					

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	8.63	mg/Kg	0.147	0.254	5/2/2017	JEK	EPA 335.4	
%moisture	3.0	Percent			5/3/2017	JEK	%moisture	

Certifications held by Anatek Labs ID: EPA:ID00013; AZ:0701; FL(NELAP):E87893; ID:ID00013; MT:CERT0028; NM: ID00013;NV:ID00013; OR:ID200001-002; WA:C595
Certifications held by Anatek Labs WA: EPA:WA00169; ID:WA00169; WA:C585; MT:Cert0095; FL(NELAP): E871099

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-016	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017	11:30 AM
Client Sample ID	1704970-032A / 1704190856	**Sampling Time**	8:56 AM			
Matrix	Soil					
Comments						

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	2.41	mg/Kg	0.151	0.26	5/2/2017	JEK	EPA 335.4	
%moisture	4.6	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-017	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017	11:30 AM
Client Sample ID	1704970-034A / 1704190916	**Sampling Time**	9:16 AM			
Matrix	Soil					
Comments						

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	0.848	mg/Kg	0.145	0.25	5/2/2017	JEK	EPA 335.4	
%moisture	4.3	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-018	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017	11:30 AM
Client Sample ID	1704970-036A / 1704190936	**Sampling Time**	9:36 AM			
Matrix	Soil					
Comments						

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.153	0.263	5/2/2017	JEK	EPA 335.4	
%moisture	6.7	Percent			5/3/2017	JEK	%moisture	

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Sample Number	170425031-019	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017	11:30 AM
Client Sample ID	1704970-038A / 1704190751	**Sampling Time**	7:51 AM			
Matrix	Soil					
Comments						

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.140	0.242	5/3/2017	JEK	EPA 335.4	
%moisture	4.1	Percent			5/3/2017	JEK	%moisture	

Sample Number	170425031-020	**Sampling Date**	4/19/2017	**Date/Time Received**	4/25/2017	11:30 AM
Client Sample ID	1704970-040A / 1704190741	**Sampling Time**	7:41 AM			
Matrix	Soil					
Comments						

Parameter	Result	Units	MDL	PQL	Analysis Date	Analyst	Method	Qualifier
Cyanide	ND	mg/Kg	0.137	0.236	5/3/2017	JEK	EPA 335.4	
%moisture	5.5	Percent			5/3/2017	JEK	%moisture	

Authorized Signature

Todd Taruscio, Lab Manager

E1	Concentration estimated. Analyte exceeded calibration range.
H2	Initial analysis within holding time, Reanalysis for the required dilution was past holding time.
MCL	EPA's Maximum Contaminant Level
ND	Not Detected
PQL	Practical Quantitation Limit

This report shall not be reproduced except in full, without the written approval of the laboratory.
The results reported relate only to the samples indicated.
Soil/solid results are reported on a dry-weight basis unless otherwise noted.

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Client:	HALL ENVIRONMENTAL ANALYSIS LAB	**Batch #:**	170425031
Address:	4901 HAWKINS NE SUITE D	**Project Name:**	1704970
	ALBUQUERQUE, NM 87109		
Attn:	ANDY FREEMAN		

Analytical Results Report

Quality Control Data

Lab Control Sample

Parameter	LCS Result	Units	LCS Spike	%Rec	AR %Rec	Prep Date	Analysis Date
Cyanide	0.476	mg/kg	0.5	95.2	90-110	5/3/2017	5/3/2017
Cyanide	0.509	mg/L	0.5	101.8	90-110	5/2/2017	5/2/2017

Matrix Spike

Sample Number	Parameter	Sample Result	MS Result	Units	MS Spike	%Rec	AR %Rec	Prep Date	Analysis Date
170420020-001	Cyanide	ND	0.485	mg/L	0.5	97.0	90-110	5/2/2017	5/2/2017
170425031-019	Cyanide	ND	11.6	mg/kg	12.1	95.9	70-130	5/3/2017	5/3/2017

Matrix Spike Duplicate

Parameter	MSD Result	Units	MSD Spike	%Rec	%RPD	AR %RPD	Prep Date	Analysis Date
Cyanide	0.503	mg/L	0.5	100.6	3.6	0-20	5/2/2017	5/2/2017
Cyanide	11.4	mg/kg	12.1	94.2	1.7	0-25	5/3/2017	5/3/2017

Method Blank

Parameter	Result	Units	PQL	Prep Date	Analysis Date
Cyanide	ND	mg/Kg	0.01	5/3/2017	5/3/2017
Cyanide	ND	mg/L	0.01	5/2/2017	5/2/2017
Cyanide	ND	mg/Kg	0.01	5/1/2017	5/2/2017

AR	Acceptable Range
ND	Not Detected
PQL	Practical Quantitation Limit
RPD	Relative Percentage Difference

Comments:

Certifications held by Anatek Labs ID: EPA:ID00013; AZ:0701; FL(NELAP):E87893; ID:ID00013; MT:CERT0028; NM: ID00013;NV:ID00013; OR:ID200001-002; WA:C595
Certifications held by Anatek Labs WA: EPA:WA00169; ID:WA00169; WA:C585; MT:Cert0095; FL(NELAP): E871099

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1704970**

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **MB-31470** SampType: **MBLK** TestCode: **EPA Method 7471: Mercury**
Client ID: **PBS** Batch ID: **31470** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334268** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	ND	0.033								

Sample ID **LCS-31470** SampType: **LCS** TestCode: **EPA Method 7471: Mercury**
Client ID: **LCSS** Batch ID: **31470** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334269** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.16	0.033	0.1667	0	96.9	80	120			

Sample ID **MB-31471** SampType: **MBLK** TestCode: **EPA Method 7471: Mercury**
Client ID: **PBS** Batch ID: **31471** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334270** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	ND	0.033								

Sample ID **LCS-31471** SampType: **LCS** TestCode: **EPA Method 7471: Mercury**
Client ID: **LCSS** Batch ID: **31471** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334271** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.17	0.033	0.1667	0	99.9	80	120			

Sample ID **1704970-035AMS** SampType: **MS** TestCode: **EPA Method 7471: Mercury**
Client ID: **1704190935** Batch ID: **31470** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334296** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.16	0.031	0.1580	0	104	75	125			

Sample ID **1704970-035AMSD** SampType: **MSD** TestCode: **EPA Method 7471: Mercury**
Client ID: **1704190935** Batch ID: **31470** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334297** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.16	0.033	0.1644	0	99.5	75	125	0.0396	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **1704970-037AMS** SampType: **MS** TestCode: **EPA Method 7471: Mercury**
Client ID: **1704190750** Batch ID: **31471** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334299** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.16	0.031	0.1576	0	101	75	125			

Sample ID **1704970-037AMSD** SampType: **MSD** TestCode: **EPA Method 7471: Mercury**
Client ID: **1704190750** Batch ID: **31471** RunNo: **42436**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334300** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.17	0.032	0.1637	0	102	75	125	5.01	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **MB-31514**	SampType: **MBLK**	TestCode: **EPA Method 7470: Mercury**
Client ID: **PBW**	Batch ID: **31514**	RunNo: **42495**
Prep Date: **5/2/2017**	Analysis Date: **5/2/2017**	SeqNo: **1336141** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	ND	0.00020								

Sample ID **LCS-31514**	SampType: **LCS**	TestCode: **EPA Method 7470: Mercury**
Client ID: **LCSW**	Batch ID: **31514**	RunNo: **42495**
Prep Date: **5/2/2017**	Analysis Date: **5/2/2017**	SeqNo: **1336142** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Mercury	0.0049	0.00020	0.005000	0	97.3	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **MB-31405**	SampType: **MBLK**	TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **PBS**	Batch ID: **31405**	RunNo: **42366**
Prep Date: **4/25/2017**	Analysis Date: **4/26/2017**	SeqNo: **1332023** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	ND	2.5								
Barium	ND	0.10								
Cadmium	ND	0.10								
Chromium	ND	0.30								
Selenium	ND	2.5								
Silver	ND	0.25								

Sample ID **LCS-31405**	SampType: **LCS**	TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **LCSS**	Batch ID: **31405**	RunNo: **42366**
Prep Date: **4/25/2017**	Analysis Date: **4/26/2017**	SeqNo: **1332024** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	23	2.5	25.00	0	92.1	80	120			
Barium	24	0.10	25.00	0	97.4	80	120			
Cadmium	24	0.10	25.00	0	96.9	80	120			
Chromium	24	0.30	25.00	0	96.9	80	120			
Selenium	23	2.5	25.00	0	90.8	80	120			
Silver	5.1	0.25	5.000	0	102	80	120			

Sample ID **1704970-035AMS**	SampType: **MS**	TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935**	Batch ID: **31405**	RunNo: **42366**
Prep Date: **4/25/2017**	Analysis Date: **4/26/2017**	SeqNo: **1332071** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	25	2.5	24.73	5.125	80.7	75	125			
Barium	53	0.099	24.73	32.67	83.6	75	125			
Cadmium	19	0.099	24.73	0.1133	77.8	75	125			
Chromium	26	0.30	24.73	8.286	70.1	75	125			S
Selenium	10	2.5	24.73	0	42.0	75	125			S
Silver	3.9	0.25	4.947	0	78.3	75	125			

Sample ID **1704970-035AMSD**	SampType: **MSD**	TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935**	Batch ID: **31405**	RunNo: **42366**
Prep Date: **4/25/2017**	Analysis Date: **4/26/2017**	SeqNo: **1332072** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	26	2.5	24.99	5.125	82.3	75	125	2.45	20	
Barium	56	0.10	24.99	32.67	93.1	75	125	4.74	20	
Cadmium	20	0.10	24.99	0.1133	78.1	75	125	1.39	20	
Chromium	27	0.30	24.99	8.286	76.3	75	125	6.52	20	

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

WO#: **1704970**

Hall Environmental Analysis Laboratory, Inc.

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID **1704970-035AMSD** SampType: **MSD** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31405** RunNo: **42366**
Prep Date: **4/25/2017** Analysis Date: **4/26/2017** SeqNo: **1332072** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Selenium	12	2.5	24.99	0	48.2	75	125	14.7	20	S
Silver	3.8	0.25	4.997	0	76.8	75	125	0.856	20	

Sample ID **1704970-035APS** SampType: **PS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31405** RunNo: **42366**
Prep Date: Analysis Date: **4/26/2017** SeqNo: **1332147** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Chromium	25	0.29	24.22	8.286	70.9	80	120			S
Selenium	13	2.4	24.22	0	51.8	80	120			S

Sample ID **MB-31468** SampType: **MBLK** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **PBS** Batch ID: **31468** RunNo: **42431**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334198** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	ND	0.25								

Sample ID **LCS-31468** SampType: **LCS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **LCSS** Batch ID: **31468** RunNo: **42431**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334199** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	24	0.25	25.00	0	95.5	80	120			

Sample ID **1704970-035AMS** SampType: **MS** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31468** RunNo: **42431**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334204** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	23	0.25	24.95	5.361	68.8	75	125			S

Sample ID **1704970-035AMSD** SampType: **MSD** TestCode: **EPA Method 6010B: Soil Metals**
Client ID: **1704190935** Batch ID: **31468** RunNo: **42431**
Prep Date: **4/27/2017** Analysis Date: **4/28/2017** SeqNo: **1334205** Units: **mg/Kg**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Lead	22	0.25	24.70	5.361	66.5	75	125	3.29	20	S

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1704970**

01-Jun-17

Client: NASA_WSTF
Project: 16EC053B

Sample ID	1704970-035APS	SampType: PS	TestCode: EPA Method 6010B: Soil Metals							
Client ID: 1704190935		Batch ID: 31468	RunNo: 42431							
Prep Date:		Analysis Date: 4/28/2017	SeqNo: 1334206	Units: mg/Kg						
Analyte	**Result**	**PQL**	**SPK value**	**SPK Ref Val**	**%REC**	**LowLimit**	**HighLimit**	**%RPD**	**RPDLimit**	**Qual**
Lead	19	0.25	24.82	5.361	55.3	80	120			S

Sample ID	MB-31469	SampType: MBLK	TestCode: EPA Method 6010B: Soil Metals							
Client ID: PBS		Batch ID: 31469	RunNo: 42465							
Prep Date: 4/27/2017		Analysis Date: 5/1/2017	SeqNo: 1335209	Units: mg/Kg						
Analyte	**Result**	**PQL**	**SPK value**	**SPK Ref Val**	**%REC**	**LowLimit**	**HighLimit**	**%RPD**	**RPDLimit**	**Qual**
Lead	ND	0.25								

Sample ID	LCS-31469	SampType: LCS	TestCode: EPA Method 6010B: Soil Metals							
Client ID: LCSS		Batch ID: 31469	RunNo: 42465							
Prep Date: 4/27/2017		Analysis Date: 5/1/2017	SeqNo: 1335210	Units: mg/Kg						
Analyte	**Result**	**PQL**	**SPK value**	**SPK Ref Val**	**%REC**	**LowLimit**	**HighLimit**	**%RPD**	**RPDLimit**	**Qual**
Lead	25	0.25	25.00	0	99.2	80	120			

Sample ID	1704970-039AMS	SampType: MS	TestCode: EPA Method 6010B: Soil Metals							
Client ID: 1704190740		Batch ID: 31469	RunNo: 42465							
Prep Date: 4/27/2017		Analysis Date: 5/1/2017	SeqNo: 1335235	Units: mg/Kg						
Analyte	**Result**	**PQL**	**SPK value**	**SPK Ref Val**	**%REC**	**LowLimit**	**HighLimit**	**%RPD**	**RPDLimit**	**Qual**
Lead	18	0.24	23.89	3.853	60.0	75	125			S

Sample ID	1704970-039AMSD	SampType: MSD	TestCode: EPA Method 6010B: Soil Metals							
Client ID: 1704190740		Batch ID: 31469	RunNo: 42465							
Prep Date: 4/27/2017		Analysis Date: 5/1/2017	SeqNo: 1335236	Units: mg/Kg						
Analyte	**Result**	**PQL**	**SPK value**	**SPK Ref Val**	**%REC**	**LowLimit**	**HighLimit**	**%RPD**	**RPDLimit**	**Qual**
Lead	20	0.24	24.25	3.853	67.3	75	125	10.4	20	S

Sample ID	1704970-039APS	SampType: PS	TestCode: EPA Method 6010B: Soil Metals							
Client ID: 1704190740		Batch ID: 31469	RunNo: 42465							
Prep Date:		Analysis Date: 5/1/2017	SeqNo: 1335264	Units: mg/Kg						
Analyte	**Result**	**PQL**	**SPK value**	**SPK Ref Val**	**%REC**	**LowLimit**	**HighLimit**	**%RPD**	**RPDLimit**	**Qual**
Lead	19	0.24	23.91	3.853	65.3	80	120			S

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

QC SUMMARY REPORT

Hall Environmental Analysis Laboratory, Inc.

WO#: **1704970**

01-Jun-17

Client: NASA_WSTF

Project: 16EC053B

Sample ID **MB-31501**	SampType: **MBLK**	TestCode: **EPA 6010B: Total Recoverable Metals**
Client ID: **PBW**	Batch ID: **31501**	RunNo: **42479**
Prep Date: **5/1/2017**	Analysis Date: **5/2/2017**	SeqNo: **1335647** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	ND	0.020								
Barium	ND	0.020								
Cadmium	ND	0.0020								
Chromium	ND	0.0060								
Lead	ND	0.0050								
Selenium	ND	0.050								
Silver	ND	0.0050								

Sample ID **LCS-31501**	SampType: **LCS**	TestCode: **EPA 6010B: Total Recoverable Metals**
Client ID: **LCSW**	Batch ID: **31501**	RunNo: **42479**
Prep Date: **5/1/2017**	Analysis Date: **5/2/2017**	SeqNo: **1335648** Units: **mg/L**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	%RPD	RPDLimit	Qual
Arsenic	0.50	0.020	0.5000	0	100	80	120			
Barium	0.49	0.020	0.5000	0	99.0	80	120			
Cadmium	0.50	0.0020	0.5000	0	99.1	80	120			
Chromium	0.49	0.0060	0.5000	0	98.3	80	120			
Lead	0.49	0.0050	0.5000	0	98.7	80	120			
Selenium	0.51	0.050	0.5000	0	103	80	120			
Silver	0.10	0.0050	0.1000	0	102	80	120			

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory
4901 Hawkins NE
Albuquerque, NM 87109
TEL: 505-345-3975 FAX: 505-345-4107
Website: www.hallenvironmental.com

Sample Log-In Check List

Client Name: NASA_WSTF   Work Order Number: 1704970   RcptNo: 1

Received By: **Erin Melendrez** 4/21/2017 9:00:00 AM

Completed By: **Anne Thorne** 4/21/2017 10:20:26 AM

Reviewed By: 04/21/17

Chain of Custody

1. Custody seals intact on sample bottles? Yes ☑ No ☐ Not Present ☐
2. Is Chain of Custody complete? Yes ☑ No ☐ Not Present ☐
3. How was the sample delivered? FedEx

Log In

4. Was an attempt made to cool the samples? Yes ☑ No ☐ NA ☐
5. Were all samples received at a temperature of >0° C to 6.0°C Yes ☑ No ☐ NA ☐
6. Sample(s) in proper container(s)? Yes ☑ No ☐
7. Sufficient sample volume for indicated test(s)? Yes ☑ No ☐
8. Are samples (except VOA and ONG) properly preserved? Yes ☑ No ☐
9. Was preservative added to bottles? Yes ☐ No ☑ NA ☐
10. VOA vials have zero headspace? Yes ☐ No ☐ No VOA Vials ☑
11. Were any sample containers received broken? Yes ☐ No ☑
12. Does paperwork match bottle labels? Yes ☑ No ☐
    (Note discrepancies on chain of custody)
13. Are matrices correctly identified on Chain of Custody? Yes ☑ No ☐
14. Is it clear what analyses were requested? Yes ☑ No ☐
15. Were all holding times able to be met? Yes ☑ No ☐
    (If no, notify customer for authorization.)

# of preserved bottles checked for pH: 2 2
(<2 or >12 unless noted)
Adjusted? ND
Checked by: ENM

Special Handling (if applicable)

16. Was client notified of all discrepancies with this order? Yes ☐ No ☐ NA ☑

Person Notified: Date
By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:
Client Instructions:

17. Additional remarks:

18. **Cooler Information**

Cooler No	Temp °C	Condition	Seal Intact	Seal No	Seal Date	Signed By
2	2.9	Good	Yes			

WSTF CHAIN OF CUSTODY RECORD

Date 4-20-17

Laboratory: HEAL PO# 16EC053B

Address shipping questions to:
☐ Lori Minnick, 575-524-5119
☐ Other ______________, 575-524-________

Send sample receipt confirmation and analytical reports to:
☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
☐ Other

Special Instructions

Return coolers and reusable packaging materials within 14 days as required in statement of work to:

Return Address:
NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytical Requirements: Total Metals	Total Cyanide					Charge Number (WSTF Use Only)	Comments
1704180700	114-SB	1	A	X						STFA	1704970-001
1704180701	"	1	A		X						-002
1704190720	"	1	A	X							-003
1704190721	"	1	A		X						-004
1704181435	114-SB-03	1	S	X							7'-8' -005
1704181436	"	1	S		X						" -006
1704181437	"	1	S	X							" -007
1704181438	"	1	S		X						" -008
1704181450	"	1	S	X							10'-12' -009
1704181451	"	1	S		X						" -010
1704181500	"	1	S	X							15'-16' -011

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori W Minnick	4-20-17 / 1100 Hrs	[signature]	04/21/17 0900 2.9°C

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

Date 4-20-17

WSTF CHAIN OF CUSTODY RECORD

Laboratory: HEAL PO# 16EC053B

Address shipping questions to:
☐ Lori Minnick, 575-524-5119
☐ Other ____________, 575-524-________

Send sample receipt confirmation and analytical reports to:
☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
☐ Other

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Return coolers and reusable packaging materials within 14 days as required in statement of work to:
Return Address:
NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytical Requirements: Total Metals	Total Cyanide					Charge Number (WSTF Use Only)	Comments
1704181501	114-SB-03	1	S		X					STFA	15'-16' 1704970-012
1704181335	114-SB-04	1	S	X							5'-7' -013
1704181336	"	1	S		X						" -014
1704181350	"	1	S	X							10'-12' -015
1704181351	"	1	S		X						" -016
1704181300	114-SB-05	1	S	X							5'-7' -017
1704181301	"	1	S		X						" -018
1704181313	"	1	S	X							10'-12' -019
1704181314	"	1	S		X						" -020
1704191035	114-SB-01	1	S	X							5'-7' -021
1704191036	"	1	S		X						" -022

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori Minnick	4-20-17 / 1100 HRS.	[signature]	04/21/17 0900 2.9°C

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

WSTF CHAIN OF CUSTODY RECORD

Date 4-20-17

Laboratory: HEAL PO# 16EC063B

Address shipping questions to:
☐ Lori Minnick, 575-524-5119
☐ Other ______________, 575-524-________

Send sample receipt confirmation and analytical reports to:
☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
☐ Other

Special Instructions

Return coolers and reusable packaging materials within 14 days as required in statement of work to:

Return Address:
NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytical Requirements (Method / Analytes): Total Metals	Total Cyanide					Charge Number (WSTF Use Only)	Comments	
1704191050	114-SB-01	1	S	X						STFA	10'-12'	1704970023
1704191061	"	1	S		X						"	-024
1704191052	"	1	S	X							"	-025
1704191053	"	1	S		X						"	-026
1704190835	114-SB-02	1	S	X							6'-8'	-027
1704190836	"	1	S		X						"	-028
1704190845	114-SB-02	1	S	X							10'-12'	-029
1704190846	"	1	S		X						"	-030
1704190855	"	1	S	X							15'-17'	-031
1704190856	"	1	S		X						"	-032
1704190915	"	1	S	X							20'-22'	-033

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori W Minnick	4-20-17 / 1100 HRS.	[signature]	04/21/17 0900 2.9°

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

WSTF CHAIN OF CUSTODY RECORD

Date 4-20-17

Laboratory: HEAL   PO# 16EC0536

Address shipping questions to:
☑ Lori Minnick, 575-524-5119
☐ Other ____________, 575-524-________

Send sample receipt confirmation and analytical reports to:
☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
☐ Other

Special Instructions

Return coolers and reusable packaging materials within 14 days as required in statement of work to:

Return Address:

NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytical Requirements: Total Metals	Total Cyanide					Charge Number (WSTF Use Only)	Comments
1704190916	114-SB-02	1	S		X					STFA	20'-22' 1704970-034
1704190935	"	1	S	X							25'-27' -035
1704190936	"	1	S		X						" -036
1704190937	"	1	S	X							" Matrix Spike for #1704190935 -035
1704190938	"	1	S		X						" Matrix Spike for #1704190936 -036
1704190750	114-SB-03	1	S	X							25'-27' -037
1704190751	"	1	S		X						" -038
1704190740	"	1	S	X							20'-22' -039
1704190741	"	1	S		X						" -040

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori Minnick	4-20-19 / 1100 HRS.	[signature]	04/21/17 0900 2.9°C

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

T.Kondy + A. Montes present. Weather is warm and cloudy. Rinsate taken off a decond split spoon.

Rinsate 114-SB

Sample #	Analysis	Preserv	Cont.	Lot #	Lab
1704180700	Total Metals	Ice, HNO3	(1) 500 ml poly	060616-2AAU	HALL
— 0701	Total Cyanide	Ice, NaOH	(1) 250 ml poly	102416-2AAO	HALL
	Soil	114-SB-05		(5-7)	
1704181300	Total Metals	Ice	(1) 4 oz Jar	012609B	HALL
— 1301	Total cyanide	Ice	(1) 4 oz JAR	"	"
		114-SB-05		(10-12)	
1704181313	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 1314	Total Cyanide	"	"	"	"
	TK	114-SB-05			
~~70419~~	~~Total Metals~~	~~Ice~~	~~1 4oz JAR~~	~~012609B~~ ~~060616-2AAU~~	~~HALL~~
~~—~~	~~Total cyanide~~	~~"~~	~~"~~	~~"~~	~~"~~
	TK Rinsate				
~~1704190720~~	~~Total Metals~~	~~Ice, HNO3~~	~~(1) 500 ml poly~~	~~060616-2AAU~~	~~HALL~~
~~— 0721~~	~~Total cyanide~~	~~Ice, NaOH~~	~~(1) 500 ml poly~~	~~102416-2AAO~~	~~HALL~~

Continued on Page

Signed: T. Kondy Date: 4-18-17

Read and Understood By

Signed: Mike [signature] Date: 2/19/18

Project SWMO 22 Notebook No. STF #1
Continues from Page

Soil

114-SB-04 (5-7)

Sample #	Analyses	Preserv.	Cont.	Lot #	Lab
170418 1335	Total Metals	Ice	(1) 4oz JAR	012609B	HAL6
— 1336	Total cyanide	"	"	"	

114-SB-04 (10-12)

170418 1350	Total Metals	Ice	(1) 4oz JAR	012609B	HAL2
— 1351	Total cyanide	"	"	"	

Continued on Page

Signed [signature] Date 4-18-17 Read and Understood By Signed [signature] Date 2/19/18

Sample #	Analysis	Preserv	Cont.	Lot #	Lab
		Soil 114-SB-03	(7-8)		
1704181435	Total Metals	ice	(1) 4 oz JAR	012609B	HALL
-1436	Total cyanide	''	''	''	''
-1437	Total Metals (Dup)	''	''	''	''
-1438	Total Cyanide (Dup)	''	''	''	''
		114-SB-03	(10-12)		
1704181450	Total Metals	ice	(1) 4 oz JAR	012609B	HALL
-1451	Total cyanide	''	''	''	''
		114-SB-03	(15-16)		
1704181500	Total Metals	ice	1 4 oz JAR	012609B	HALL
-1502	Total cyanide	''	''	''	''
		Rinsate			
1704190720	Total Metals	ice, HNO_3	(1) 500 ml poly	060616-2AAW	HALL
-0721	Total cyanide	ice, NaOH	(1) 250 ml poly	102416-2AAO	HALL
		Soil 114-SB-03	(20-22)		
1704190740	Total Metals	ice	(1) 4 oz JAR	012609B	HALL
-0741	Total cyanide	''	''	''	''
		114-SB-03	(25-27)		
1704190750	Total Metals	ice	(1) 4 oz JAR	012609B	HALL
-0751	Total cyanide	''	''	''	''

Continued on Page

Signed [signature] Date 4-19-17

Read and Understood By

Signed Mike Marum Date 2/19/18

Soil

Sample #	Analysis	Preserv	Cont.	Lot #	Loc
		114-SB-02	(6-8)		
170419 0835	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 0836	Total cyanide	"	"	"	"
		114-SB-02	(10-12)		
170419 0845	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 0846	Total cyanide	"	"	"	"
		114-SB-02	(15-17)		
170419 0855	Total Metals	Ice	(1) 4 oz JAR	012609B	HAL
— 0856	Total cyanide	"	"	"	"
		114-SB-02	(20-22)		
170419 0915	Total Metals	Ice	(1) 4 oz JAR	012609B	HALL
— 0916	Total cyanide	"	"	"	"
		114-SB-02	(25-27)		
170419 0935	Total Metals	Ice	(1) 4 oz JAR	012609B	HAL
— 0936	Total cyanide	"	"	"	"
— 0937	Total Metals (MS)	"	"	"	"
— 0938	Total cyanide (MS)	"	"	"	"

Continued on Page

Signed [signature] Date 4-19-17

Read and Understood By

Signed [signature] Date 2/19/18

Project SUMO 22 Notebook No. STI #1

Continues from Page

Sample #	Analysis	Soil Preser	114-SB-01 (5-7) Cont.	Lot #	Lab
170419 1035	Total Metals	ice	(1) 4oz JAR	012609B	HALL
— 1036	Total cyanide	"	"	"	"
		114-SB-01 (10-12)			
170419 1050	Total Metals	ice	(1) 4oz JAR	012609B	HALL
— 1051	Total cyanide	"	"	"	"
— 1052	Total Metals	"	"	"	"
— 1053	Total cyanide	"	"	"	"

Continued on Page

Read and Understood By

Signed [signature] Date 4-19-17 Signed [signature] Date 2/19/18

November 10, 2017 Service Request No:R1710397

Ms. Carlyn Tufts
NASA/WSTF/Navarro
P.O. Box 20
Las Cruces, NM 88004

Laboratory Results for: White Sands Test Facility

Dear Ms.Tufts,

Enclosed are the results of the sample(s) submitted to our laboratory November 02, 2017
For your reference, these analyses have been assigned our service request number **R1710397.**

All analyses were performed according to our laboratory's quality assurance program. The test results meet requirements of the NELAP standards except as noted in the case narrative report. All results are intended to be considered in their entirety, and ALS Environmental is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report. The measurement uncertainty of the results included in this report is within that expected when using the prescribed method(s) for analysis of these samples, and represented by Laboratory Control Sample control limits. Any events, such as QC failures, which may add to the uncertainty are explained in the report narrative.

Please contact me if you have any questions. My extension is 7472. You may also contact me via email at Janice.Jaeger@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Brady Kalkman

Brady Kalkman

For

Janice Jaeger

Project Manager

CC: Michael Narap

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Narrative Documents

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ALS Environmental

Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Sample Matrix: Water

Service Request: R1710397
Date Received: 11/2/17

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables, including results of QC samples analyzed from this delivery group. Analytical procedures performed by the lab are validated in accordance with NELAC standards. Any parameters that are not included in the lab's NELAC accreditation are identified on a "Non-Certified Analytes" report in the Miscellaneous Forms Section of this report. Individual analytical results requiring further explanation are flagged with qualifiers and/or discussed below. The flags are explained in the Report Qualifiers and Definitions page in the Miscellaneous Forms section of this report.

Sample Receipt

Five Water, Soil samples were received for analysis at ALS Environmental on 11/02/2017. Any discrepancies noted upon initial sample inspection are noted on the cooler receipt and preservation form included in this data package. The samples were received in good condition and consistent with the accompanying chain of custody form. Samples are refrigerated at ≤6°C upon receipt at the lab except for aqueous samples designated for metals analyses, which are stored at room temperature.

General Chemistry Analyses:

No significant anomalies were noted with this analysis.

Approved by [signature] Date 11/10/2017

SAMPLE DETECTION SUMMARY

CLIENT ID: 1710310955 114-SB-06	Lab ID: R1710397-003					
Analyte	**Results**	**Flag**	**MDL**	**PQL**	**Units**	**Method**
Cyanide, Residual	0.025	J	0.015	0.062	mg/Kg	9012B
Cyanide, Total	0.17	BJ	0.02	0.33	mg/Kg	9012B
Total Solids	90.3				Percent	ALS SOP

CLIENT ID: 1710310956 117-SB-06	Lab ID: R1710397-004					
Analyte	**Results**	**Flag**	**MDL**	**PQL**	**Units**	**Method**
Cyanide, Residual	1.36		0.015	0.064	mg/Kg	9012B
Cyanide, Total	2.22		0.02	0.29	mg/Kg	9012B
Total Solids	94.2				Percent	ALS SOP

CLIENT ID: 1710310900 114-SB-07	Lab ID: R1710397-005					
Analyte	**Results**	**Flag**	**MDL**	**PQL**	**Units**	**Method**
Cyanide, Residual	0.055	J	0.015	0.061	mg/Kg	9012B
Cyanide, Total	0.09	BJ	0.02	0.26	mg/Kg	9012B
Total Solids	95.9				Percent	ALS SOP

Sample Receipt Information

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Client: NASA/WSTF/Navarro **Service Request:** R1710397
Project: White Sands Test Facility/17EC028

SAMPLE CROSS-REFERENCE

SAMPLE #	CLIENT SAMPLE ID	DATE	TIME
R1710397-001	1710310755 114-SB	10/31/2017	
R1710397-002	1710310756 114-SB	10/31/2017	
R1710397-003	1710310955 114-SB-06	10/31/2017	
R1710397-004	1710310956 117-SB-06	10/31/2017	
R1710397-005	1710310900 114-SB-07	10/31/2017	

Date ~~10/31/2017~~ 11-1-17

WSTF CHAIN OF CUSTODY RECORD

Page 1 of 1

Laboratory: ALS Environmental PO# 17EC028

Address shipping questions to:
☒ Lori Minnick, 575-524-5119
☒ Mike Narup, 575-524-5483

Send sample receipt confirmation and analytical reports to:
☒ Carlyn Tufts, carlyn.a.tufts@nasa.gov
☒ Shelly Hernandez, shelly.j.hernandez@nasa.gov
☒ Mike Narup, michael.j.narup@nasa.gov

Special Instructions
Return coolers and reusable packaging materials within 14 days as required in statement of work to:
Return Address:
NASA WSTF Environmental Department
12600 NASA Road; Bldg. 120
Las Cruces, NM 88012
Attn: Lori Minnick

Sample Number	Sample Location	# of Containers	Sample Matrix*	Analytical Requirements: Method / Analytes	Cyanide (335.4/9012B)					Charge Number (WSTF Use Only)	Comments
1710310755	114-SB	1	A		X					STFA	
1710310756	"	1	A		X					"	
1710310955	114-SB-06	1	S		X					"	7-9'
1710310956	"	1	S		X					"	"
1710310900	114-SB-07	1	S		X					"	"
1710310901	"	1	S		X					"	" MS for 1710310900 as per Lori Minnick [initials] 11/2/17

Relinquished By:	Date/Time:	Accepted By:	Date/Time:
Lori W Minnick	11-1-17 / 1100 Hrs.	[signature]	11-2-17 09:05

* Sample Matrix: A – Aqueous; G – Gaseous; S – Solid

R1710397 5
NASA/WSTF/Navarro
White Sands Test Facility

WSTF 331B (05/2016)

ALS

Cooler Receipt and Preservation Check Form

Project/Client NASA Folder Number R1710397

Cooler received on 11-2-17 by: ME COURIER: ALS UPS FEDEX VELOCITY CLIENT

1	Were **Custody seals** on outside of cooler?	Y N	5a	**Perchlorate** samples have required headspace?	Y N NA
2	**Custody papers** properly completed (ink, signed)?	Y N	5b	Did VOA vials, Alk, or Sulfide have sig* **bubbles**?	Y N NA
3	Did all bottles arrive in good **condition** (unbroken)?	Y N	6	Where did the bottles originate?	ALS/ROC CLIENT
4	Circle: Wet Ice Dry Ice Gel packs present?	Y N	7	Soil VOA received as: Bulk Encore 5035set NA	

8. Temperature Readings Date: 11-2-17 Time: 09:15 ID: IR#7 IR#9 From: Temp Blank Sample Bottle

Observed Temp (°C)	4.3	2.5					
Correction Factor (°C)	+1.2	Ø					
Corrected Temp (°C)	5.5	2.5					
Temp from:Type of bottle	250 plastic	—					
Within 0-6°C?	Y N	Y N	Y N	Y N	Y N	Y N	Y N
If <0°C, were samples frozen?	Y N	Y N	Y N	Y N	Y N	Y N	Y N

If out of Temperature, note packing/ice condition: ________ Ice melted Poorly Packed (described below) Same Day Rule

&Client Approval to Run Samples: ______ Standing Approval Client aware at drop-off Client notified by: ________

All samples held in storage location: R-002 by ME on 11-2-17 at 09:18
5035 samples placed in storage location: ______ by ______ on ______ at ______

Cooler Breakdown: Date: 11-3-17 Time: 08:45 by: ME

9. Were all bottle labels complete (*i.e.* analysis, preservation, etc.)? YES NO
10. Did all bottle labels and tags agree with custody papers? YES NO
11. Were correct containers used for the tests indicated? YES NO
12. Were 5035 vials acceptable (no extra labels, not leaking)? YES NO N/A
13. Air Samples: Cassettes / Tubes Intact Canisters Pressurized Tedlar® Bags Inflated N/A

pH	Lot of test paper	Reagent	Preserved? Yes	Preserved? No	Lot Received	Exp	Sample ID	Vol. Added	Lot Added	Final pH
≥12	213916	NaOH	X		181658	07/18				
≤2		HNO_3								
≤2		H_2SO_4								
<4		$NaHSO_4$								
Residual Chlorine (-)		For CN Phenol and 522	X		If +, contact PM to add $Na_2S_2O_3$ (CN), ascorbic (phenol).					
		$Na_2S_2O_3$	-	-						
		ZnAcetate	-	-						
		HCl	**	**						

**Not to be tested before analysis – pH tested and recorded by VOAs on a separate worksheet

Bottle lot numbers: 071017-2AAB

Explain all Discrepancies/ Other Comments:

CLRES	BULK
DO	FLDT
HPROD	HGFB
HTR	LL3541
PH	SUB
SO3	MARRS
ALS	REV

Labels secondary reviewed by: ME

PC Secondary Review: [signature] 11/6/17

*significant air bubbles: VOA > 5-6 mm : WC >1 in. diameter

Miscellaneous Forms

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REPORT QUALIFIERS AND DEFINITIONS

U Analyte was analyzed for but not detected. The sample quantitation limit has been corrected for dilution and for percent moisture, unless otherwise noted in the case narrative.

J Estimated value due to either being a Tentatively Identified Compound (TIC) or that the concentration is between the MRL and the MDL. Concentrations are not verified within the linear range of the calibration. For DoD: concentration >40% difference between two GC columns (pesticides/Arclors).

B Analyte was also detected in the associated method blank at a concentration that may have contributed to the sample result.

E Inorganics- Concentration is estimated due to the serial dilution was outside control limits.

E Organics- Concentration has exceeded the calibration range for that specific analysis.

D Concentration is a result of a dilution, typically a secondary analysis of the sample due to exceeding the calibration range or that a surrogate has been diluted out of the sample and cannot be assessed.

* Indicates that a quality control parameter has exceeded laboratory limits. Under the "Notes" column of the Form I, this qualifier denotes analysis was performed out of Holding Time.

H Analysis was performed out of hold time for tests that have an "immediate" hold time criteria.

Spike was diluted out.

+ Correlation coefficient for MSA is <0.995.

N Inorganics- Matrix spike recovery was outside laboratory limits.

N Organics- Presumptive evidence of a compound (reported as a TIC) based on the MS library search.

S Concentration has been determined using Method of Standard Additions (MSA).

W Post-Digestion Spike recovery is outside control limits and the sample absorbance is <50% of the spike absorbance.

P Concentration >40% (25% for CLP) difference between the two GC columns.

C Confirmed by GC/MS

Q DoD reports: indicates a pesticide/Aroclor is not confirmed (≥100% Difference between two GC columns).

X See Case Narrative for discussion.

MRL Method Reporting Limit. Also known as:
LOQ Limit of Quantitation (LOQ)
The lowest concentration at which the method analyte may be reliably quantified under the method conditions.

MDL Method Detection Limit. A statistical value derived from a study designed to provide the lowest concentration that will be detected 99% of the time. Values between the MDL and MRL are estimated (see J qualifier).

LOD Limit of Detection. A value at or above the MDL which has been verified to be detectable.

ND Non-Detect. Analyte was not detected at the concentration listed. Same as U qualifier.

Rochester Lab ID # for State Certifications[1]

Connecticut ID # PH0556	Maine ID #NY0032	New Hampshire ID # 294100 A/B
Delaware Accredited	Nebraska Accredited	
DoD ELAP #65817	New Jersey ID # NY004	Pennsylvania ID# 68-786
Florida ID # E87674	New York ID # 10145	Rhode Island ID # 158
Illinois ID #200047	North Carolina #676	Virginia #460167

[1] Analyses were performed according to our laboratory's NELAP-approved quality assurance program and any applicable state or agency requirements. The test results meet requirements of the current NELAP/TNI standards or state or agency requirements, where applicable, except as noted in the case narrative. Since not all analyte/method/matrix combinations are offered for state/NELAC accreditation, this report may contain results which are not accredited. For a specific list of accredited analytes, contact the laboratory or go to http://www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental/Downloads/North-America-Downloads

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Service Request: R1710397

Sample Name: 1710310755 114-SB
Lab Code: R1710397-001
Sample Matrix: Water
Date Collected: 10/31/17
Date Received: 11/2/17

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
Calculation		CWOODS

Sample Name: 1710310756 114-SB
Lab Code: R1710397-002
Sample Matrix: Water
Date Collected: 10/31/17
Date Received: 11/2/17

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
Calculation		CWOODS

Sample Name: 1710310955 114-SB-06
Lab Code: R1710397-003
Sample Matrix: Soil
Date Collected: 10/31/17
Date Received: 11/2/17

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
ALS SOP		KWONG
Calculation		CWOODS

Sample Name: 1710310956 117-SB-06
Lab Code: R1710397-004
Sample Matrix: Soil
Date Collected: 10/31/17
Date Received: 11/2/17

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
ALS SOP		KWONG
Calculation		CWOODS

Analyst Summary report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028		

Sample Name:	1710310900 114-SB-07	**Date Collected:**	10/31/17
Lab Code:	R1710397-005	**Date Received:**	11/2/17
Sample Matrix:	Soil		

Analysis Method	Extracted/Digested By	Analyzed By
9012B	MROGERSON	GNITAJOUPPI
ALS SOP		KWONG
Calculation		CWOODS

The preparation methods associated with this report are found in these tables unless discussed in the case narrative.

Water/Liquid Matrix

Analytical Method	Preparation Method
200.7	200.2
200.8	200.2
6010C	3005A/3010A
6020A	ILM05.3
9014 Cyanide Reactivity	SW846 Ch7, 7.3.4.2
9034 Sulfide Reactivity	SW846 Ch7, 7.3.4.2
9034 Sulfide Acid Soluble	9030B
9056A Bomb (Halogens)	5050A
9066 Manual Distillation	9065
SM 4500-CN-E Residual Cyanide	SM 4500-CN-G
SM 4500-CN-E WAD Cyanide	SM 4500-CN-I

Solid/Soil/Non-Aqueous Matrix

Analytical Method	Preparation Method
6010C	3050B
6020A	3050B
6010C TCLP (1311) extract	3005A/3010A
6010 SPLP (1312) extract	3005A/3010A
7196A	3060A
7199	3060A
9056A Halogens/Halides	5050
300.0 Anions/ 350.1/ 353.2/ SM 2320B/ SM 5210B/ 9056A Anions	DI extraction

For analytical methods not listed, the preparation method is the same as the analytical method reference.

Sample Results

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Analytical Report

Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Sample Matrix: Water

Service Request: R1710397
Date Collected: 10/31/17
Date Received: 11/02/17 09:05

Sample Name: 1710310755 114-SB
Lab Code: R1710397-001

Basis: NA

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND U	mg/L	0.0100	-	1	NA	NA	
Cyanide, Residual	9012B	ND U	mg/L	0.0020	0.0020	1	11/10/17 09:56	11/08/17	
Cyanide, Total	9012B	ND U	mg/L	0.010	0.002	1	11/10/17 09:21	11/08/17	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Water	**Date Received:**	11/02/17 09:05
Sample Name:	1710310756 114-SB	**Basis:**	NA
Lab Code:	R1710397-002		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND U	mg/L	0.0100	-	1	NA	NA	
Cyanide, Residual	9012B	ND U	mg/L	0.0020	0.0020	1	11/10/17 09:57	11/08/17	
Cyanide, Total	9012B	ND U	mg/L	0.010	0.002	1	11/10/17 09:22	11/08/17	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310955 114-SB-06	**Basis:**	Dry
Lab Code:	R1710397-003		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND U	mg/Kg	1.0	-	1	NA	NA	
Cyanide, Residual	9012B	**0.025 J**	mg/Kg	0.062	0.015	1	11/10/17 10:00	11/08/17	
Cyanide, Total	9012B	**0.17 BJ**	mg/Kg	0.33	0.02	1	11/10/17 09:41	11/08/17	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310955 114-SB-06	**Basis:**	As Received
Lab Code:	R1710397-003		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Total Solids	ALS SOP	**90.3**	Percent	-	-	1	11/03/17 10:00	NA	

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310956 117-SB-06	**Basis:**	Dry
Lab Code:	R1710397-004		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND U	mg/Kg	1.0	-	1	NA	NA	
Cyanide, Residual	9012B	**1.36**	mg/Kg	0.064	0.015	1	11/10/17 10:02	11/08/17	
Cyanide, Total	9012B	**2.22**	mg/Kg	0.29	0.02	1	11/10/17 09:44	11/08/17	

Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310956 117-SB-06	**Basis:**	As Received
Lab Code:	R1710397-004		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Total Solids	ALS SOP	**94.2**	Percent	-	-	1	11/03/17 10:00	NA	

Client: NASA/WSTF/Navarro | **Service Request:** R1710397
Project: White Sands Test Facility/17EC028 | **Date Collected:** 10/31/17
Sample Matrix: Soil | **Date Received:** 11/02/17 09:05

Sample Name: 1710310900 114-SB-07 | **Basis:** Dry
Lab Code: R1710397-005

Inorganic Parameters

Analyte Name	Analysis Method	Result		Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Amenable Cyanide	Calculation	ND	U	mg/Kg	1.0	-	1	NA	NA	
Cyanide, Residual	9012B	**0.055**	**J**	mg/Kg	0.061	0.015	1	11/10/17 10:03	11/08/17	
Cyanide, Total	9012B	**0.09**	**BJ**	mg/Kg	0.26	0.02	1	11/10/17 09:44	11/08/17	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17 09:05
Sample Name:	1710310900 114-SB-07	**Basis:**	As Received
Lab Code:	R1710397-005		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Total Solids	ALS SOP	**95.9**	Percent	-	-	1	11/03/17 10:00	NA	

QC Summary Forms

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	Dry
Lab Code:	R1710397-MB1		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Cyanide, Residual	9012B	ND U	mg/Kg	0.060	0.015	1	11/10/17 09:58	11/08/17	
Cyanide, Total	9012B	**0.04 J**	mg/Kg	0.30	0.02	1	11/10/17 09:39	11/08/17	

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Analytical Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
Sample Name:	Method Blank	**Basis:**	NA
Lab Code:	R1710397-MB2		

Inorganic Parameters

Analyte Name	Analysis Method	Result	Units	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
Cyanide, Residual	9012B	ND U	mg/L	0.0020	0.0020	1	11/10/17 09:54	11/08/17	
Cyanide, Total	9012B	ND U	mg/L	0.010	0.002	1	11/10/17 09:15	11/08/17	

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17
		Date Analyzed:	11/10/17
		Date Extracted:	11/8/17

Duplicate Matrix Spike Summary
Cyanide, Total

Sample Name:	1710310900 114-SB-07	**Units:**	mg/Kg
Lab Code:	R1710397-005	**Basis:**	Dry
Analysis Method:	9012B		
Prep Method:	Method		

		Matrix Spike R1710397-005MS			**Duplicate Matrix Spike** R1710397-005DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Cyanide, Total	0.09 BJ	3.24	3.09	102	2.91	3.07	92	10-159	11	30

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Water	**Date Received:**	11/02/17
		Date Analyzed:	11/10/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	1710310756 114-SB	**Units:**	mg/L
Lab Code:	R1710397-002	**Basis:**	NA

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample R1710397-002DUP Result	Average	RPD	RPD Limit
Cyanide, Residual	9012B	0.0020	0.0020	ND U	ND U	NC	NC	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17
		Date Analyzed:	11/10/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	1710310900 114-SB-07	**Units:**	mg/Kg
Lab Code:	R1710397-005	**Basis:**	Dry

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample R1710397-005DUP Result	Average	RPD	RPD Limit
Cyanide, Residual	9012B	0.062	0.015	0.055 J	0.049 J	0.0519	11	30

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project	White Sands Test Facility/17EC028	**Date Collected:**	10/31/17
Sample Matrix:	Soil	**Date Received:**	11/02/17
		Date Analyzed:	11/03/17

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	1710310900 114-SB-07	**Units:**	Percent
Lab Code:	R1710397-005	**Basis:**	As Received

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample R1710397-005DUP Result	Average	RPD	RPD Limit
Total Solids	ALS SOP	-		95.9	95.5	95.7	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Analyzed:**	11/10/17
Sample Matrix:	Soil		

Lab Control Sample Summary
General Chemistry Parameters

Units: mg/Kg
Basis: Dry

Lab Control Sample
R1710397-LCS1

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cyanide, Residual	9012B	ND U	5.00	0	0-10
Cyanide, Total	9012B	2.96	3.00	99	85-115

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Sample Matrix: Soil

Service Request: R1710397
Date Analyzed: 11/10/17

Lab Control Sample Summary
General Chemistry Parameters

Units: mg/Kg
Basis: Dry

Lab Control Sample
R1710397-LCS2

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cyanide, Total	9012B	17.5	18.0	97	85-115

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	NASA/WSTF/Navarro	**Service Request:**	R1710397
Project:	White Sands Test Facility/17EC028	**Date Analyzed:**	11/10/17
Sample Matrix:	Water		

Lab Control Sample Summary
General Chemistry Parameters

Units:mg/L
Basis:NA

Lab Control Sample
R1710397-LCS3

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cyanide, Residual	9012B	ND U	0.100	0	0-10
Cyanide, Total	9012B	0.0995	0.100	99	85-115

Client: NASA/WSTF/Navarro
Project: White Sands Test Facility/17EC028
Sample Matrix: Water

Service Request: R1710397
Date Analyzed: 11/10/17

Lab Control Sample Summary
General Chemistry Parameters

Units:mg/L
Basis:NA

Lab Control Sample
R1710397-LCS4

Analyte Name	Analytical Method	Result	Spike Amount	% Rec	% Rec Limits
Cyanide, Total	9012B	0.585	0.600	98	85-115

~~Soil~~ TK-1

T. Koney + A. Montes present. Weather is cool, cloudy and a few sprinkles. Rinsate taken from decon split spoon -

Rinsate 114-SB

Sample #	Analysis	Preserve	Cont.	Lot #	Lab
171031 0755	cyanide	ice, NAOH	(1) 250 ml poly	07107-2AA0	ALS

MN 10/31/17
~~Equipment~~ ~~Field~~ Blank Field Blank

171031 0756	cyanide	ice, NAOH	(1) 250 ml poly	07107-2AA0	ALS

Soil
114-SB-06 7-9 FT

171031 0955	cyanide	ice	(1) 4 oz JAR	070214	ALS
— 0956	" ~~Dup~~ (Dupl)	"	"	"	"

114-SB-07 7-9 FT

171031 0900	cyanide	ice	(1) 4 oz JAR	070214	ALS
— 0901	" (MS)	"	"	"	"

Continued on Page

T. Koney Signed 10-31-17 Date
Read and Understood By Michael Naranjo Signed 10/31/17 Date

Appendix E
Quality Assurance Reports

National Aeronautics and Space Administration

Quality Assurance Report for White Sands Test Facility Septic Tank Soil Analytical Data

May 2021

Revised 2023

NM 8800019434

Report Submitted: May 14, 2021

Report Prepared by:
Stephanie Portillo
Environmental Scientist III
Navarro Research and Engineering, Inc.

1.0 Introduction

The WSTF Septic Tanks (SWMU 21–27) Investigation Work Plan requires the preparation of an investigation report that includes soil analytical data reported. The Quality Assurance Report (QAR) prepared and reviewed by responsible environmental contractor data management personnel provides the following information:

- A summary of notable anomalies.
- A summary of notable data quality issues by analytical method, if any.
- A list of the sample events for which soil samples were collected in April and October 2017.
- The quantity and type of quality control samples collected or prepared in April and October 2017.
- Definitions of data qualifiers used in WSTF analytical data reporting.
- The quantity and type of data qualifiers applied to individual analytical results.
- A list of quality assurance narratives arranged by analytical method.
- A summary table of blank sample detections.

2.0 Data Quality

2.1 Notable Anomalies

At SWMU 22, samples collected during this investigation include investigation soil samples, duplicates, matrix spikes, field blanks and equipment rinsate samples in accordance with the approved IWP. Soil samples, including duplicate and matrix spike samples, were obtained by advancing the auger to just above the sampling interval specified in the SWMUs 21–27 Investigation Report (IR).

In April 2017, NASA installed five soil borings 114-SB-01 through 114-SB-05 (3 to 12 feet [ft] below ground surface [bgs] and 2 to 27 ft bgs) and collected 16 (19 with duplicates and matrix spikes) soil chemical samples. The April 2017 soil samples from soil borings 114-SB-01 through -05 were analyzed at an off-site National Environmental Laboratory Accreditation Program accredited laboratory for total metals using SW-846 Methods 6010B/7471 and total cyanide using SW-846 Method 335.4 instead of using Method 9012B.

Results of the SWMU 22 April 2017 soil samples indicate that nitrate interference may have impacted cyanide results in a similar manner as identified during sludge sample analyses related to the SWMU 22 waste characterization for disposal as described in Section 3.4.10 of the SWMUs 21–27 IR. The samples exhibiting nitrate interference had elevated cyanide concentrations and were observed in samples collected from immediately beneath the former septic tank. Due to these anomalous cyanide results, NASA evaluated the potential for nitrate interference impacts to cyanide analytical results by sampling soils from two additional shallow soil borings, 114-SB-06 and 114-SB-07, installed in October 2017. These samples were analyzed using SW-846 Method 9012B. Soil samples were collected adjacent to the two borings exhibiting the highest cyanide concentrations from soils immediately beneath the fill material. NASA selected an accredited laboratory that could analyze the October 2017 soil samples for total cyanide by SW-846 Method 9012B, using the sulfamic acid preparation modification. In areas where nitrate interference in cyanide analyses is probable, analyses for cyanide using sulfamic acid preparation and Method 9012B yield results that are more representative of subsurface conditions than results of cyanide analyses using Method 335.4.

3.0 Data Tables

Table 1 summarizes the soil sample events in April and October 2017. This report is based on data quality issues related to the sample events listed in Table 1. Table 2 through Table 7 contain information related to the sample events identified in Table 1. As specified by the IWP Section 5. 4, specific quality control samples are utilized to assess the quality of analytical data. Table 2 presents the quantity of quality control samples collected for each analytical method. Table 3 compares the quality control sample percentages collected to the requirements in the IWP. When data quality criteria are not met, data qualifiers are applied to the data. Definitions of data qualifiers used for WSTF chemical analytical data are listed in Table 4. Table 5 and Table 6 present the total number of individual result records and summarize the quantity of field and laboratory data qualifiers assigned to individual analyte result records in the WSTF analytical database. Table 7 provides all quality assurance narratives associated with the sample events in Table 1. Narratives associated with qualified data are identified by bold text in Table 7.

4.0 Usability Assessment

The goal of the usability assessment is to determine the quality of each data point and to identify data that are not acceptable to support project quality objectives. This QAR qualifies as the completed assessment for the April and October 2017 sample events for the Septic Tank Investigation. No data was qualified as being unusable or rejected (R), based on established quality review protocols.

Table 1 – Sample Events for April and October 2017

Location Sample ID	Depth (ft)	Event Date
114-SB-01	5	4/19/2017
	10	
114-SB-02	6	4/19/2017
	10	
	15	
	20	
	25	
114-SB-03	7	4/18/2017
	10	
	15	
	20	4/19/2017
	25	
114-SB-04	5	4/18/2017
	10	
114-SB-05	5	4/18/2017
	10	
114-SB-06	7	10/31/2017
114-SB-07	7	10/31/2017

Table 2 – Quantity of Quality Control Samples

Method	Total Samples	Soil Samples	Equipment Blanks	Field Blanks	Duplicates	Matrix Spike
Total Metals by EPA Method 6010B/7470/7471	**20**	**16**	**2**	---	**2**	**1**
Total Cyanide by EPA Method 335. 4	**20**	**16**	**2**	---	**2**	**1**
Total Cyanide by EPA Method 9012	**5**	**2**	**1**	**1**	**1**	---

Table 3 – Quality Control Sample Percentages

Quality Control Requirement	Requirement %	Samp. Qty.	QC Qty.	QC %
Total Metals Field Blanks (EPA Method 6010B/7470/7471)	10	20	---	**0**
Total Metals Matrix Spikes (EPA Method 6010B/7470/7471)	5	20	1	**5**
Total Metals Duplicates (EPA Method 6010B/7470/7471)	10	20	2	**10**
Total Cyanide Field Blanks (EPA Method 335. 4)	10	20	---	**0**
WhTotal Cyanide Matrix Spikes (EPA Method 335. 4)	5	20	1	**5**
Total Cyanide Duplicates (EPA Method 335. 4)	10	20	2	**10**
Total Cyanide Field Blanks (EPA Method 9012)	10	5	1	**20**
Total Cyanide Matrix Spikes (EPA Method 9012)	5	5	---	**0**
Total Cyanide Duplicates (EPA Method 9012)	10	5	1	**20**

Table 4 – Definitions of Data Qualifiers

Qualifier	Definition
*	User defined qualifier. See quality assurance narrative.
A	The result of an analyte for a laboratory control sample (LCS), initial calibration verification (ICV) or continuing calibration verification (CCV) was outside standard limits.
AD	Relative percent difference for analyst (laboratory) duplicates was outside standard limits.
D	The reported result is from a dilution.
EB	The analyte was detected in the equipment blank.
FB	The analyte was detected in the field blank.
G	The result is an estimated value greater than the upper calibration limit.
i	The result, quantitation limit, and/or detection limit may have been affected by matrix interference.
J	The result is an estimated value less than the quantitation limit, but greater than or equal to the detection limit.
NA	The value/result was either not analyzed for or not applicable.
ND	The analyte was not detected above the detection limit.
Q	The result for a blind control sample was outside standard limits.
QD	The relative percent difference for a field duplicate was outside standard limits.
R	The result is rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
RB	The analyte was detected in the method blank.
S	The result was determined by the method of standard addition.
SP	The matrix spike recovery and/or the relative percent difference for matrix spike duplicates was outside standard limits.
T	The sample was analyzed outside the specified holding time or temperature.
TB	The analyte was detected in the trip blank.
TIC	The analyte was tentatively identified by a GC/MS library search and the amount reported is an estimated value.

Table 5 – Quantity of Field Based Data Qualifiers Assigned to Individual Result Records

Method	Total Result Records	"FB"	"EB"	"TB"	"Q"	"QD"	"SP"	"R"
Arsenic by EPA Method 6010B	**20**	0	0	0	0	**2**	0	0
Barium by EPA Method 6010B	**20**	0	**2**	0	0	0	0	0
Cadmium by EPA Method 6010B	**20**	0	0	0	0	0	0	0
Chromium by EPA Method 6010B	**20**	0	**1**	0	0	**2**	**1**	0
Lead by EPA Method 6010B	**20**	0	0	0	0	0	**1**	0
Mercury by EPA Method 7470/7471	**20**	0	0	0	0	0	0	0
Selenium by EPA Method 6010B	**20**	0	0	0	0	0	0	0

Method	Total Result Records	"FB"	"EB"	"TB"	"Q"	"QD"	"SP"	"R"
Silver by EPA Method 6010B	**20**	0	0	0	0	**2**	0	0
Total Cyanide by EPA Method 335. 4	**20**	0	0	0	0	**2**	0	0
Total Cyanide by EPA Method 9012	**5**	0	0	0	0	**3**	0	0

Table 6 – Quantity of Laboratory based Data Qualifiers Assigned to Individual Result Records

Method	Total Result Records	"*"	"A"	"AD"	"G"	"RB"	"T"	"D"	"i"	"J"
Arsenic by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**1**
Barium by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**2**
Cadmium by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**2**
Chromium by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**1**
Lead by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	0
Mercury by EPA Method 7470/7471	**20**	0	0	0	0	0	0	0	0	**3**
Selenium by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	0
Silver by EPA Method 6010B	**20**	0	0	0	0	0	0	0	0	**1**
Total Cyanide by EPA Method 335. 4	**20**	0	0	0	0	0	0	0	0	0
Total Cyanide by EPA Method 9012	**5**	0	0	0	0	**2**	0	0	0	**2**

Table 7 – Quality Assurance Narratives

Location Sample_ID	Event Date	~~EPA Method TO-15~~QA Narratives for Various Analytical Methods
114-SB-01-010	19-Apr-17	For Total Metals (soil), field duplicate samples 1704191050 and 1704191052 the relative percent difference for barium was 9. 5%. Upper acceptance limit for relative percent difference is 25%.
114-SB-01-010	19-Apr-17	**For Total Metals (soil), field duplicate samples 1704191050 and 1704191052 the relative percent difference for arsenic was 37. 3%. This value is outside the upper acceptance limit for relative percent difference of 25%.**
114-SB-01-010	19-Apr-17	For Total Metals (soil), field duplicate samples 1704191050 and 1704191052 the relative percent difference for chromium was 0. 0%. Upper acceptance limit for relative percent difference is 25%.
114-SB-01-010	19-Apr-17	For Total Metals (soil), field duplicate samples 1704191050 and 1704191052 the relative percent difference for lead was 23. 3%. Upper acceptance limit for relative percent difference is 25%.
114-SB-01-010	19-Apr-17	For EPA Method 335. 4 (soil), relative percent differences (RPD) for duplicate samples 1704191051 and 1704191053 were within control limits or below the calculable range.
114-SB-02-025	19-Apr-17	**For Total Metals (soil), matrix spike recoveries for sample 1704190937 for chromium, selenium, and lead were outside laboratory control limits low. Affected data are appropriately qualified.**
114-SB-02-025	19-Apr-17	For EPA Method 335. 4 (soil), matrix spike recoveries for sample 1704190938 were within laboratory control limits.
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for barium was 13. 1%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	**For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for chromium was 41. 2%. This value is outside the upper acceptance limit for relative percent difference of 25%.**
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for arsenic was 9. 9%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for cadmium was 16. 9%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	**For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for silver was 90. 0%. This value is outside the upper acceptance limit for relative percent difference of 25%.**

Location Sample_ID	Event Date	~~EPA Method TO-15~~QA Narratives for Various Analytical Methods
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for mercury was 13. 6%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	For Total Metals (soil), field duplicate samples 1704181435 and 1704181437 the relative percent difference for lead was 4. 9%. Upper acceptance limit for relative percent difference is 25%.
114-SB-03-007	18-Apr-17	**For EPA Method 335. 4 (soil), field duplicate samples 1704181436 and 1704181438 the relative percent difference for cyanide was 25. 9%. This value is outside the upper acceptance limit for relative percent difference of 25%.**
114-SB-03-020	19-Apr-17	For Total Metals (water), barium (0. 00082 mg/L) was detected in the equipment blank (1704190720) below the reporting limit. No data are affected by this equipment blank contamination.
114-SB-03-020	19-Apr-17	For EPA Method 335. 4 (water), there were no detections in the equipment blank.
114-SB-05-005	18-Apr-17	For Total Metals (water), barium (0. 0054 mg/L) and chromium (0. 0035 mg/L) were detected in the equipment blank (1704180700) below the reporting limit. No data are affected by this equipment blank contamination.
114-SB-05-005	18-Apr-17	For EPA Method 335. 4 (water), there were no detections in the equipment blank.
114-SB-06-007	31-Oct-17	For SW-846 Method 9012A (water), there were no detections in the equipment blank.
114-SB-06-007	31-Oct-17	For SW-846 Method 9012A (water), there were no detections in the field blank.
114-SB-06-007	31-Oct-17	**For SW-846 Method 9012A (soil), cyanide, total (0. 04 mg/Kg) was detected in the method blank for analytical batch 302722. Affected data are appropriately qualified.**
114-SB-07-007	31-Oct-17	For SW-846 Method 9012, matrix spike recoveries for sample 1710310901 were within laboratory control limits.
114-SB-07-007	31-Oct-17	**For SW-846 Method 9012A (soil), cyanide, total (0. 04 mg/Kg) was detected in the method blank for analytical batch 302722. Affected data are appropriately qualified.**

Appendix F
Health Risk Statistics

ProUCL Input File SWMU 22: Background

Cr 4-8' BG4	Cr 4-8' SWMU22	As 8-12' BG4	As 8-12' SWMU22
4.07	11.00	2.55	14.00
4.15	9.50	3.09	4.00
4.21	12.00	3.10	3.80
4.76	5.70	3.65	6.10
4.90	19.00	3.73	7.30
5.49		3.90	
5.52		5.00	
6.46		5.30	
7.28		5.40	
7.36		5.70	
8.20		5.80	
9.80		6.60	
		7.60	
		9.90	

Note: The table shows the input file used to perform the background comparisons for arsenic and chromium at SWMU22. "BG4" indicates the column lists background concentrations, and "SWMU22" indicates the column lists investigation data. All units are mg/kg.

ProUCL Input File SWMU 22: UCL95

Arsenic	Barium	Cadmium	d_Cadmium	Chromium	Cyanide	d_Cyanide	Lead
6.10	110.00	0.14	1.00	11.00	0.46	1.00	1.50
14.00	33.00	0.18	1.00	5.50	0.00	0.00	2.40
4.00	68.00	1.10	1.00	9.50	8.60	1.00	4.80
4.00	39.00	0.09	1.00	7.30	2.40	1.00	2.40
5.70	32.00	0.11	1.00	7.50	0.85	1.00	3.70
12.00	58.00	0.15	1.00	12.00	0.00	0.00	2.40
5.10	33.00	0.11	1.00	8.30	2.60	1.00	5.40
5.30	73.00	0.64	1.00	12.00	1.50	1.00	4.20
3.80	61.00	0.13	0.00	9.00	0.00	0.00	3.50
7.00	46.00	0.13	1.00	8.50	0.00	0.00	2.20
7.40	39.00	3.80	1.00	12.00	1.60	1.00	3.90
6.30	39.00	0.07	1.00	4.00	0.00	0.00	3.10
5.40	81.00	0.06	0.00	5.70	0.00	0.00	3.80
6.10	120.00	0.06	0.00	8.60	0.00	0.00	5.60
9.90	53.00	0.06	0.00	19.00	2.22	1.00	1.30
7.30	40.00	0.06	0.00	6.40	0.09	1.00	3.10

Note: The table shows the input file used to calculate the UCL95 of these constituents. All units are mg/kg.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:43:47 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	16	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	3.8	Mean	6.837
Maximum	14	Median	6.1
SD	2.867	Std. Error of Mean	0.717
Coefficient of Variation	0.419	Skewness	1.441

Normal GOF Test

Shapiro Wilk Test Statistic	0.845	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.235	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	8.094	95% Adjusted-CLT UCL (Chen-1995)	8.293
		95% Modified-t UCL (Johnson-1978)	8.137

Gamma GOF Test

A-D Test Statistic	0.558	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.215	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.315	k star (bias corrected MLE)	5.985
Theta hat (MLE)	0.935	Theta star (bias corrected MLE)	1.142
nu hat (MLE)	234.1	nu star (bias corrected)	191.5
MLE Mean (bias corrected)	6.837	MLE Sd (bias corrected)	2.795
		Approximate Chi Square Value (0.05)	160.5
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	157.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	8.159	95% Adjusted Gamma UCL (use when n<50)	8.326

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.157	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.335	Mean of logged Data	1.853
Maximum of Logged Data	2.639	SD of logged Data	0.373

Assuming Lognormal Distribution

95% H-UCL	8.235	90% Chebyshev (MVUE) UCL	8.746
95% Chebyshev (MVUE) UCL	9.625	97.5% Chebyshev (MVUE) UCL	10.85
99% Chebyshev (MVUE) UCL	13.24		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	8.017	95% Jackknife UCL	8.094
95% Standard Bootstrap UCL	7.975	95% Bootstrap-t UCL	8.755
95% Hall's Bootstrap UCL	9.185	95% Percentile Bootstrap UCL	8.075
95% BCA Bootstrap UCL	8.275		
90% Chebyshev(Mean, Sd) UCL	8.988	95% Chebyshev(Mean, Sd) UCL	9.962
97.5% Chebyshev(Mean, Sd) UCL	11.31	99% Chebyshev(Mean, Sd) UCL	13.97

Suggested UCL to Use

95% Adjusted Gamma UCL	8.326

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2018 12:33:04 PM
From File	SWMU22_All_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0.000
Selected Null Hypothesis	Sample 1 Mean >= Sample 2 Mean (Form 2)
Alternative Hypothesis	Sample 1 Mean < the Sample 2 Mean

Sample 1 Data: As 8-12' BG4

Sample 2 Data: As 8-12' SWMU22

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	14	5
Number of Distinct Observations	14	5
Minimum	2.55	3.8
Maximum	9.9	14
Mean	5.094	7.04
Median	5.15	6.1
SD	2.009	4.157
SE of Mean	0.537	1.859

Sample 1 vs Sample 2 Two-Sample t-Test

H0: Mean of Sample 1 - Mean of Sample 2 >= 0

Method	DF	t-Test Value	Critical t (0.05)	P-Value
Pooled (Equal Variance)	17	-1.396	-1.740	0.090
Welch-Satterthwaite (Unequal Varian	4.7	-1.005	-2.015	0.182

Pooled SD: 2.675

Conclusion with Alpha = 0.050

Student t (Pooled) Test: Do Not Reject H0, Conclude Sample 1 >= Sample 2

Welch-Satterthwaite Test: Do Not Reject H0, Conclude Sample 1 >= Sample 2

Background is greater than or equal to Investigation Data; exclude as COPC

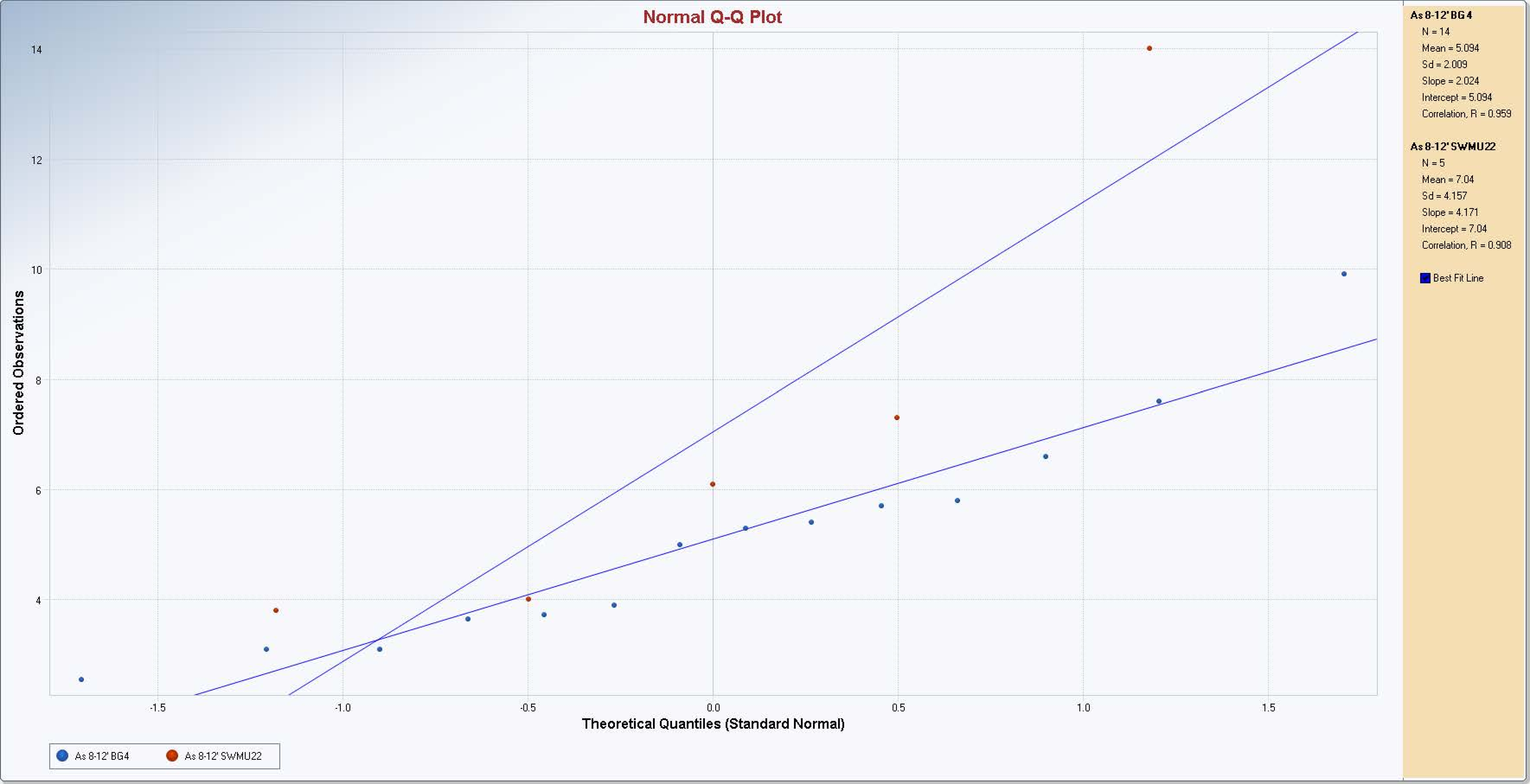
Test of Equality of Variances

Variance of Sample 1	4.038
Variance of Sample 2	17.28

Numerator DF	Denominator DF	F-Test Value	P-Value
4	13	4.280	0.040

Conclusion with Alpha = 0.05

Two variances are not equal



Normal Q-Q Plot
Ordered Observations
Theoretical Quantiles (Standard Normal)
14
12
10
8
6
4
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
As 8-12' BG4
As 8-12' SWMU22
As 8-12' BG4
N = 14
Mean = 5.094
Sd = 2.009
Slope = 2.024
Intercept = 5.094
Correlation, R = 0.959
As 8-12' SWMU22
N = 5
Mean = 7.04
Sd = 4.157
Slope = 4.171
Intercept = 7.04
Correlation, R = 0.908
Best Fit Line

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:45:53 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Barium

General Statistics

Total Number of Observations	16	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	32	Mean	57.81
Maximum	120	Median	49.5
SD	26.97	Std. Error of Mean	6.743
Coefficient of Variation	0.467	Skewness	1.26

Normal GOF Test

Shapiro Wilk Test Statistic	0.847	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.183	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	69.63	95% Adjusted-CLT UCL (Chen-1995)	71.17
		95% Modified-t UCL (Johnson-1978)	69.99

Gamma GOF Test

A-D Test Statistic	0.588	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.194	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.818	k star (bias corrected MLE)	4.769
Theta hat (MLE)	9.937	Theta star (bias corrected MLE)	12.12
nu hat (MLE)	186.2	nu star (bias corrected)	152.6
MLE Mean (bias corrected)	57.81	MLE Sd (bias corrected)	26.47
		Approximate Chi Square Value (0.05)	125
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	122.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	70.55	95% Adjusted Gamma UCL (use when n<50)	72.19

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.918	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.184	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.466	Mean of logged Data	3.969
Maximum of Logged Data	4.787	SD of logged Data	0.421

Assuming Lognormal Distribution

95% H-UCL	71.66	90% Chebyshev (MVUE) UCL	76.05
95% Chebyshev (MVUE) UCL	84.46	97.5% Chebyshev (MVUE) UCL	96.13
99% Chebyshev (MVUE) UCL	119.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	68.9	95% Jackknife UCL	69.63
95% Standard Bootstrap UCL	68.39	95% Bootstrap-t UCL	74.38
95% Hall's Bootstrap UCL	75.13	95% Percentile Bootstrap UCL	69
95% BCA Bootstrap UCL	70.19		
90% Chebyshev(Mean, Sd) UCL	78.04	95% Chebyshev(Mean, Sd) UCL	87.2
97.5% Chebyshev(Mean, Sd) UCL	99.92	99% Chebyshev(Mean, Sd) UCL	124.9

Suggested UCL to Use

95% Student's-t UCL	69.63

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:46:51 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cadmium

General Statistics

Total Number of Observations	16	Number of Distinct Observations	15
Number of Detects	11	Number of Non-Detects	5
Number of Distinct Detects	10	Number of Distinct Non-Detects	5
Minimum Detect	0.073	Minimum Non-Detect	0.0614
Maximum Detect	3.8	Maximum Non-Detect	0.126
Variance Detects	1.232	Percent Non-Detects	31.25%
Mean Detects	0.593	SD Detects	1.11
Median Detects	0.14	CV Detects	1.87
Skewness Detects	2.885	Kurtosis Detects	8.668
Mean of Logged Detects	-1.456	SD of Logged Detects	1.239

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.529	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.373	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.428	KM Standard Error of Mean	0.239
KM SD	0.911	95% KM (BCA) UCL	0.858
95% KM (t) UCL	0.847	95% KM (Percentile Bootstrap) UCL	0.843
95% KM (z) UCL	0.821	95% KM Bootstrap t UCL	2.412
90% KM Chebyshev UCL	1.145	95% KM Chebyshev UCL	1.469
97.5% KM Chebyshev UCL	1.92	99% KM Chebyshev UCL	2.805

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.489	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.77	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.37	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.267	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.653	k star (bias corrected MLE)	0.536
Theta hat (MLE)	0.909	Theta star (bias corrected MLE)	1.108
nu hat (MLE)	14.37	nu star (bias corrected)	11.78
Mean (detects)	0.593		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.411
Maximum	3.8	Median	0.11
SD	0.948	CV	2.306
k hat (MLE)	0.421	k star (bias corrected MLE)	0.383
Theta hat (MLE)	0.977	Theta star (bias corrected MLE)	1.072
nu hat (MLE)	13.46	nu star (bias corrected)	12.27
Adjusted Level of Significance (β)	0.0335		
Approximate Chi Square Value (12.27, α)	5.406	Adjusted Chi Square Value (12.27, β)	4.897
95% Gamma Approximate UCL (use when n>=50)	0.933	95% Gamma Adjusted UCL (use when n<50)	1.03

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.428	SD (KM)	0.911
Variance (KM)	0.83	SE of Mean (KM)	0.239
k hat (KM)	0.221	k star (KM)	0.221
nu hat (KM)	7.074	nu star (KM)	7.081
theta hat (KM)	1.937	theta star (KM)	1.935
80% gamma percentile (KM)	0.593	90% gamma percentile (KM)	1.294
95% gamma percentile (KM)	2.147	99% gamma percentile (KM)	4.461

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.08, α)	2.215	Adjusted Chi Square Value (7.08, β)	1.919
95% Gamma Approximate KM-UCL (use when n>=50)	1.369	95% Gamma Adjusted KM-UCL (use when n<50)	1.581

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.799	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.31	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.251	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.414	Mean in Log Scale	-2.25
SD in Original Scale	0.947	SD in Log Scale	1.595
95% t UCL (assumes normality of ROS data)	0.829	95% Percentile Bootstrap UCL	0.858
95% BCA Bootstrap UCL	1.059	95% Bootstrap t UCL	2.295
95% H-UCL (Log ROS)	1.737		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.859	KM Geo Mean	0.156
KM SD (logged)	1.151	95% Critical H Value (KM-Log)	2.943
KM Standard Error of Mean (logged)	0.302	95% H-UCL (KM -Log)	0.724
KM SD (logged)	1.151	95% Critical H Value (KM-Log)	2.943
KM Standard Error of Mean (logged)	0.302		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.42	Mean in Log Scale	-2.041
SD in Original Scale	0.944	SD in Log Scale	1.361
95% t UCL (Assumes normality)	0.834	95% H-Stat UCL	1.045

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	1.469

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:47:52 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Chromium

General Statistics

Total Number of Observations	16	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	4	Mean	9.144
Maximum	19	Median	8.55
SD	3.576	Std. Error of Mean	0.894
Coefficient of Variation	0.391	Skewness	1.293

Normal GOF Test

Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.15	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	10.71	95% Adjusted-CLT UCL (Chen-1995)	10.92
		95% Modified-t UCL (Johnson-1978)	10.76

Gamma GOF Test

A-D Test Statistic	0.237	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.12	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.215	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.675	k star (bias corrected MLE)	6.278
Theta hat (MLE)	1.191	Theta star (bias corrected MLE)	1.456
nu hat (MLE)	245.6	nu star (bias corrected)	200.9
MLE Mean (bias corrected)	9.144	MLE Sd (bias corrected)	3.649
		Approximate Chi Square Value (0.05)	169.1
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	165.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	10.86	95% Adjusted Gamma UCL (use when n<50)	11.08

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.98	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.386	Mean of logged Data	2.147
Maximum of Logged Data	2.944	SD of logged Data	0.376

Assuming Lognormal Distribution

95% H-UCL	11.08	90% Chebyshev (MVUE) UCL	11.77
95% Chebyshev (MVUE) UCL	12.96	97.5% Chebyshev (MVUE) UCL	14.61
99% Chebyshev (MVUE) UCL	17.85		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	10.61	95% Jackknife UCL	10.71
95% Standard Bootstrap UCL	10.54	95% Bootstrap-t UCL	11.17
95% Hall's Bootstrap UCL	11.8	95% Percentile Bootstrap UCL	10.63
95% BCA Bootstrap UCL	10.84		
90% Chebyshev(Mean, Sd) UCL	11.83	95% Chebyshev(Mean, Sd) UCL	13.04
97.5% Chebyshev(Mean, Sd) UCL	14.73	99% Chebyshev(Mean, Sd) UCL	18.04

Suggested UCL to Use

95% Student's-t UCL	10.71

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

t-Test Sample 1 vs Sample 2 Comparison for Uncensored Full Data Sets without NDs

User Selected Options	
Date/Time of Computation	ProUCL 5.12/8/2018 11:14:26 AM
From File	SWMU22_All_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Substantial Difference (S)	0.000
Selected Null Hypothesis	Sample 1 Mean >= Sample 2 Mean (Form 2)
Alternative Hypothesis	Sample 1 Mean < the Sample 2 Mean

Sample 1 Data: Cr 4-8' BG4

Sample 2 Data: Cr 4-8' SWMU22

Raw Statistics

	Sample 1	Sample 2
Number of Valid Observations	12	5
Number of Distinct Observations	12	5
Minimum	4.07	5.7
Maximum	9.8	19
Mean	6.017	11.44
Median	5.505	11
SD	1.823	4.857
SE of Mean	0.526	2.172

Sample 1 vs Sample 2 Two-Sample t-Test

H0: Mean of Sample 1 - Mean of Sample 2 >= 0

Method	DF	t-Test Value	Critical t (0.05)	P-Value
Pooled (Equal Variance)	15	-3.449	-1.753	0.002
Welch-Satterthwaite (Unequal Varian	4.5	-2.426	-2.132	0.033

Pooled SD: 2.955

Conclusion with Alpha = 0.050

Student t (Pooled) Test: Reject H0, Conclude Sample 1 < Sample 2

Welch-Satterthwaite Test: Reject H0, Conclude Sample 1 < Sample 2

Background is less than Investigation data; include as COPC

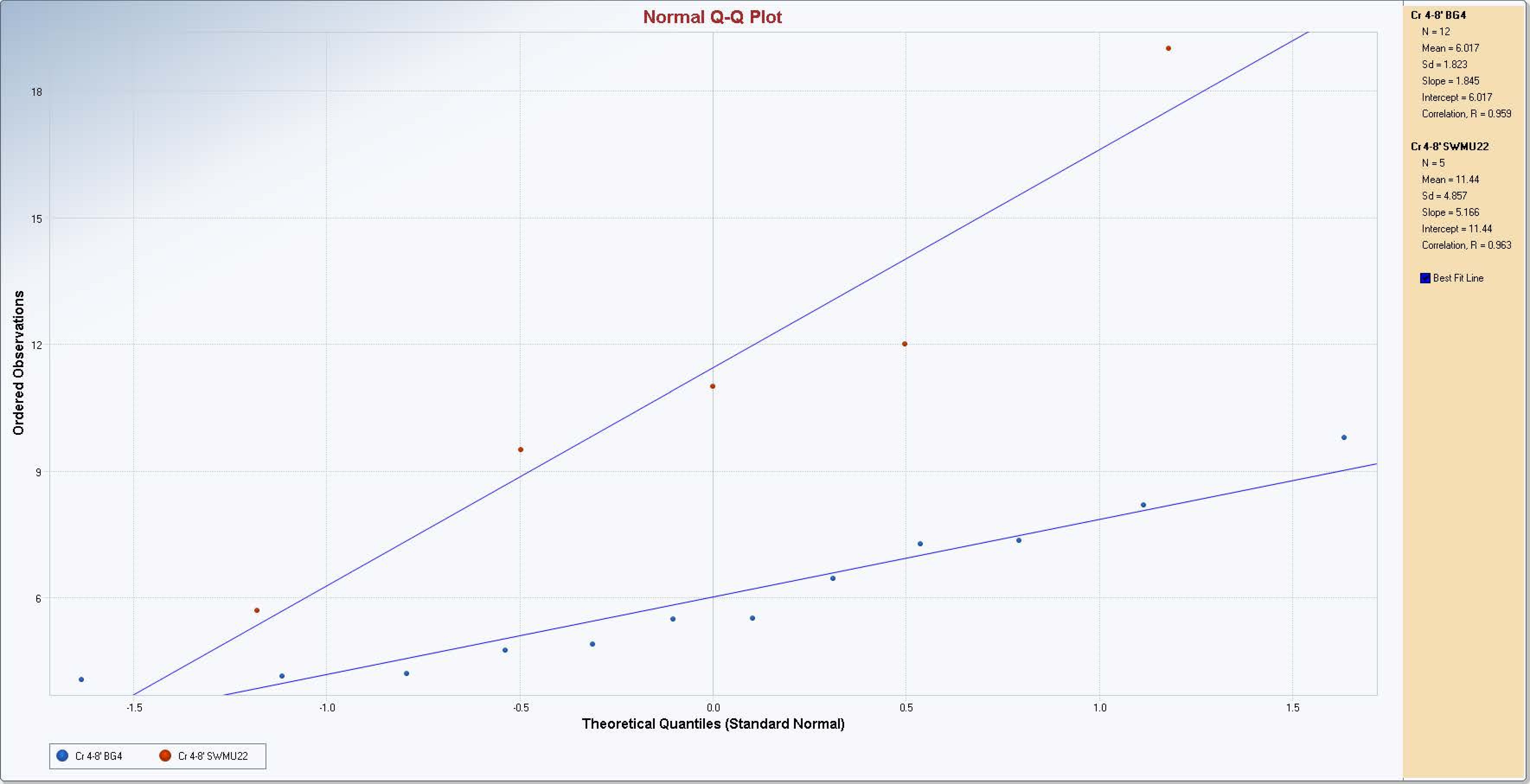
Test of Equality of Variances

Variance of Sample 1	3.324
Variance of Sample 2	23.59

Numerator DF	Denominator DF	F-Test Value	P-Value
4	11	7.097	0.009

Conclusion with Alpha = 0.05

Two variances are not equal



Normal Q-Q Plot
Ordered Observations
Theoretical Quantiles (Standard Normal)
18
15
12
9
6
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
Cr 4-8' BG4
Cr 4-8' SWMU22
Cr 4-8' BG4
N = 12
Mean = 6.017
Sd = 1.823
Slope = 1.845
Intercept = 6.017
Correlation, R = 0.959
Cr 4-8' SWMU22
N = 5
Mean = 11.44
Sd = 4.857
Slope = 5.166
Intercept = 11.44
Correlation, R = 0.963
Best Fit Line

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:48:54 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cyanide

General Statistics

Total Number of Observations	16	Number of Distinct Observations	10
Number of Detects	9	Number of Non-Detects	7
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	0.09	Minimum Non-Detect	0
Maximum Detect	8.6	Maximum Non-Detect	0
Variance Detects	6.41	Percent Non-Detects	43.75%
Mean Detects	2.258	SD Detects	2.532
Median Detects	1.6	CV Detects	1.121
Skewness Detects	2.333	Kurtosis Detects	6.216

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.721	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.335	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.27	KM Standard Error of Mean	0.56
KM SD	2.112	95% KM (BCA) UCL	2.454
95% KM (t) UCL	2.252	95% KM (Percentile Bootstrap) UCL	2.251
95% KM (z) UCL	2.191	95% KM Bootstrap t UCL	3.198
90% KM Chebyshev UCL	2.95	95% KM Chebyshev UCL	3.711
97.5% KM Chebyshev UCL	4.767	99% KM Chebyshev UCL	6.842

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.312	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.206	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.287	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.031	k star (bias corrected MLE)	0.761
Theta hat (MLE)	2.19	Theta star (bias corrected MLE)	2.965
nu hat (MLE)	18.56	nu star (bias corrected)	13.71
Mean (detects)	2.258		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.27	SD (KM)	2.112
Variance (KM)	4.46	SE of Mean (KM)	0.56
k hat (KM)	0.362	k star (KM)	0.336
nu hat (KM)	11.57	nu star (KM)	10.74
theta hat (KM)	3.512	theta star (KM)	3.785
80% gamma percentile (KM)	1.996	90% gamma percentile (KM)	3.691
95% gamma percentile (KM)	5.601	99% gamma percentile (KM)	10.5

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance (β)	0.0335
Approximate Chi Square Value (10.74, α)	4.407	Adjusted Chi Square Value (10.74, β)	3.955
95% Gamma Approximate KM-UCL (use when n>=50)	3.094	95% Gamma Adjusted KM-UCL (use when n<50)	3.447

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	N/A	KM Geo Mean	N/A
KM SD (logged)	N/A	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	N/A	95% H-UCL (KM -Log)	N/A
KM SD (logged)	N/A	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	N/A		

DL/2 Statistics

Mean in Original Scale	1.27	SD in Original Scale	2.181
95% t UCL (Assumes normality)	2.226		

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

ı Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)	3.447

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.12/11/2018 8:49:58 AM
From File	UCL95_Input_SWMU22.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	16	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	1.3	Mean	3.331
Maximum	5.6	Median	3.3
SD	1.278	Std. Error of Mean	0.32
Coefficient of Variation	0.384	Skewness	0.229

Normal GOF Test

Shapiro Wilk Test Statistic	0.965	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.142	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.213	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	3.892	95% Adjusted-CLT UCL (Chen-1995)	3.876
		95% Modified-t UCL (Johnson-1978)	3.895

Gamma GOF Test

A-D Test Statistic	0.245	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.123	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.624	k star (bias corrected MLE)	5.423
Theta hat (MLE)	0.503	Theta star (bias corrected MLE)	0.614
nu hat (MLE)	212	nu star (bias corrected)	173.5
MLE Mean (bias corrected)	3.331	MLE Sd (bias corrected)	1.43
		Approximate Chi Square Value (0.05)	144.1
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	141

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.013	95% Adjusted Gamma UCL (use when n<50)	4.099

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.13	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.213	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.262	Mean of logged Data	1.126
Maximum of Logged Data	1.723	SD of logged Data	0.422

Assuming Lognormal Distribution

95% H-UCL	4.181	90% Chebyshev (MVUE) UCL	4.437
95% Chebyshev (MVUE) UCL	4.929	97.5% Chebyshev (MVUE) UCL	5.612
99% Chebyshev (MVUE) UCL	6.954		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	3.857	95% Jackknife UCL	3.892
95% Standard Bootstrap UCL	3.837	95% Bootstrap-t UCL	3.944
95% Hall's Bootstrap UCL	3.896	95% Percentile Bootstrap UCL	3.831
95% BCA Bootstrap UCL	3.844		
90% Chebyshev(Mean, Sd) UCL	4.29	95% Chebyshev(Mean, Sd) UCL	4.724
97.5% Chebyshev(Mean, Sd) UCL	5.327	99% Chebyshev(Mean, Sd) UCL	6.511

Suggested UCL to Use

95% Student's-t UCL	3.892

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix G
Ecological Checklist

NEW MEXICO ENVIRONMENT DEPARTMENT
SITE ASSESSMENT CHECKLIST

I. SITE LOCATION

1. Site

Name:	Building 114 septic tank
US EPA I.D. Number:	SWMU 22
Location:	NASA
County:	Dona Ana
City:	NA
State:	New Mexico

2. Latitude: 32°30'06.35"N Longitude: 106°36'35.69"W

3. Attach site maps, including a topographical map, a diagram which illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps which illustrate known release areas, sampling locations, and any other important features, if available.

   See septic tank investigation report to which this checklist is attached.

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft).
   Less than 1/10th of an acre.

2. Provide an approximate breakdown of the land uses on the site:

95 % Heavy Industrial	___ % Light Industrial	___ % Urban
___ % Residential	___ % Rural	___ % Agricultural[b]
___ % Recreational[a]	5 % Undisturbed	___ % Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, etc.):

____

[b]For agricultural areas, please list the crops and/or livestock which are present:

____

[c]For areas designated as "other", please describe the usage of the area:

____

3. Provide an approximate breakdown of the land uses in the area surrounding the site. Indicate the radius (in miles) of the area described: 0.10 mile

	% Heavy Industrial	65	% Light Industrial		% Urban
	% Residential		% Rural		% Agricultural[b]
	% Recreational[a]	35	% Undisturbed		% Other[c]

[a]For recreational areas, please describe the usage of the area (e.g., park, playing field, golf course, etc.):
NA

[b]For agricultural areas, please list the crops and/or livestock which are present:
NA

[c]For areas designated as "other", please describe the usage of the area:
NA

4. Describe reasonable and likely future land and/or water use(s) at the site.

Approximately 60 foot (ft) X 20 ft area associated with a previously existing septic tank that serviced buildings 114 and 119 at the NASA facility.

5. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).

According to long-term WSTF personnel, the Building 114 septic tank was installed in 1963, originally to service domestic wastewater originating from Building 114 and the temporary trailer. Building 119 was constructed in the mid-1990s and connected to the Building 114 sanitary sewer lines that led to the septic system. The only evidence discovered of potentially hazardous constituents discharged to the septic tank was reported by a long-term WSTF employee who stated that between approximately 1963 and 1985, there had been waste *"plate-maker"* machine chemicals and waste electrostatic printing chemicals discharged to the septic tank. These waste potentially contain silver and cyanide.

6. If any movement of soil has taken place at the site, describe the degree of the disturbance. Indicate the likely source of any disturbances (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) and estimate when these events occurred.

The Building 114 septic tank was removed in November 2016. Soil disturbance occurred from the surface to a depth of approximately 6 feet below ground surface (ft bgs).

7. Describe the current uses of the site. Include information on recent (previous 5 years) disturbances or chemical releases that have occurred. For each chemical release, provide information on the form of the chemical released and the causes or mechanism of the release.

Gravel parking lot adjacent to Building 114. Waste “plate-maker” and electrostatic printing chemical discharges ceased in 1985. Subsequent to 1985, only hand washing wastes were discharged to the septic tank.

8. Identify the location or suspected location of chemical releases at the site. Provide an estimate of the distance between these locations and the areas identified in Section III.

Suspected releases occurred at the base of the septic tank, approximately 6 feet below ground.

9. Identify the suspected contaminants of concern (COCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc.).

Reported maximum concentrations of identified COPCs in subsurface soils follow: Cadmium (3.8 milligrams per kilogram [mg/kg]) ; total Chromium (19 mg/kg); Cyanide (8.6 mg/kg) , and; Silver (0.94 mg/kg).
These constituent concentrations are compared with Ecological Screening Levels (ESL) listed in the RA Guidance Volume II Attachment C for plants (Table 1, attached), deer mouse and horned lark. Due to the small size of SWMU 22 ($1/10^{th}$ of an acre), comparisons to Tier I ESLs for the kit fox, red-tailed hawk, and pronghorn antelope were not performed. The maximum total Chromium concentration exceeds the Tier 1 ESL for plants and the horned lark. The maximum Cyanide concentration exceeds the Tier I ESL for the horned lark.

10. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.

Subsurface soil over 5 ft below ground surface (bgs).

11. Indicate the approximate depth to groundwater (in feet below ground surface [bgs]).

The depth to groundwater in the nearest monitoring well (NASA-4) as measured during November 2017 was approximately 137 feet below ground.

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.).

Groundwater flow is to the west.

III. HABITAT EVALUATION

III.A Wetland Habitats

Are any wetland[1] areas such as marshes or swamps on or adjacent to the site?

☐ Yes ☒ No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location), and clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination that wetland areas are or are not present.

____

____

____

If no wetland areas are present, proceed to Section III.B.

Wetland Area Questions

☐ Onsite ☐ Offsite

Name or Designation: ____

1. Indicate the approximate area of the wetland (acres or ft^2): Click or tap here to enter text.

2. Identify the type(s) of vegetation present in the wetland.

☐ Submergent (i.e., underwater) vegetation
☐ Emergent (i.e., rooted in the water, but rising above it) vegetation
☐ Floating vegetation
☐ Scrub/shrub
☐ Wooded
☐Other (Please describe): ___________________________________

[1] Wetlands are defined in 40 CFR §232.2 as "Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

3. Estimate the vegetation density of the wetland area.

☐Dense (i.e., greater than 75% vegetation)
☐Moderate (i.e., 25% to 75% vegetation)
☐Sparse (i.e., less than 25% vegetation)

4. Is standing water present? ☐Yes ☐No

If yes, is the water primarily: ☐Fresh or ☐Brackish
Indicate the approximate area of the standing water (ft^2): ____________________
Indicate the approximate depth of the standing water, if known (ft. or in.): __________

5. If known, indicate the source of the water in the wetland.

☐Stream/River/Creek/Lake/Pond
☐Flooding
☐Groundwater
☐Surface runoff

6. Is there a discharge from the facility to the wetland? ☐Yes ☐No If yes, please describe:

____
____
____

7. Is there a discharge from the wetland? ☐Yes ☐No
If yes, indicate the type of aquatic feature the wetland discharges into:
☐Surface stream/River (Name: ____________________
☐Lake/Pond (Name: ____________________
☐Groundwater
☐Not sure

Wetland Area Questions (Continued)

8. Does the area show evidence of flooding? ☐Yes ☐No
If yes, indicate which of the following are present (mark all that apply):

☐Standing water
☐Water-saturated soils
☐Water marks
☐Buttressing
☐Debris lines
☐Mud cracks
☐Other (Please describe): ______________________________

9. Animals observed in the wetland area or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

____
____
____

III.B Aquatic Habitats

III.B.1 Non-Flowing Aquatic Features

Are any non-flowing aquatic features (such as ponds or lakes) located at or adjacent to the site?

☐Yes ☒ No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.B.2.

Non-Flowing Aquatic Feature Questions

☐ Onsite ☐ Offsite

Name or Designation: ______________________________

1. Indicate the type of aquatic feature present:

   ☐Natural (e.g., pond or lake)
   ☐Man-made (e.g., impoundment, lagoon, canal, etc.)

2. Estimate the approximate size of the water body (in acres or sq. ft.): ____________
3. If known, indicate the depth of the water body (in ft. or in.): ____________

4. Indicate the general composition of the bottom substrate. Mark all sources that apply from the following list.

☐Bedrock Sand	☐Concrete
☐Boulder (>10 in.)	☐Silt Debris
☐Cobble (2.5 - 10 in.)	☐Clay Detritus
☐Gravel (0.1 - 2.5 in.)	☐Muck (fine/black)

☐Other (Please specify): ______________________________

Non-Flowing Aquatic Feature Questions (Continued)

5. Indicate the source(s) of the water in the aquatic feature. Mark all sources that apply from the following list.

☐River/Stream/Creek
☐Groundwater
☐Industrial Discharge
☐Surface Runoff
☐Other (Please specify): ______________________________

6. Is there a discharge from the facility to the aquatic feature? Yes ☐ No ☐
If yes, describe the origin of each discharge and its migration path:

____
____
____

7. Does the aquatic feature discharge to the surrounding environment? Yes ☐ No ☐
If yes, indicate the features from the following list into which the aquatic feature discharges, and indicate whether the discharge occurs onsite or offsite:

☐River/Stream/Creek	☐onsite	☐ offsite
☐Groundwater	☐onsite	☐ offsite
☐Wetland	☐onsite	☐ offsite
☐Impoundment	☐onsite	☐ offsite

☐Other (Please specify): ______________________________

8. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:

____

III.B.2 Flowing Aquatic Features

Are any flowing aquatic features (such as streams or rivers) located at or adjacent to the site?

☐Yes ☒No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the flowing aquatic features. If more than one flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations, and clearly identify each area on the site map

If no, proceed to Section III.C.

Flowing Aquatic Feature Questions

☐Onsite ☐Offsite

Name or Designation: ______________________________

1. Indicate the type of flowing aquatic feature present.

   ☐River
   ☐Stream
   ☐Creek
   ☐Brook
   ☐Dry wash
   ☐Arroyo
   ☐Intermittent stream
   ☐Artificially created (ditch, etc.)
   ☐Other (Please specify): ______________________________

2. Indicate the general composition of the bottom substrate.

   ☐Bedrock Sand ☐Concrete
   ☐Boulder (>10 in.) ☐Silt Debris
   ☐Cobble (2.5 - 10 in.) ☐Clay Detritus
   ☐Gravel (0.1 - 2.5 in.) ☐Muck (fine/black)
   ☐Other (Please specify): ______________________________

3. Describe the condition of the bank (e.g., height, slope, extent of vegetative cover) of the aquatic feature.

   ____
   ____
   ____

4. Is there a discharge from the facility to the aquatic feature? ☐Yes ☐No
   If yes, describe the origin of each discharge and its migration path:

   ____
   ____
   ____

5. Indicate the discharge point of the water body. Specify name, if known.

   ____
   ____
   ____

Flowing Aquatic Feature Questions (Continued)

6. If the flowing aquatic feature is a dry wash or arroyo, answer the following questions.
☐Check here if feature is not a dry wash or arroyo
If known, specify the average number of days in a year in which flowing water is present in the feature: ____.

Is standing water or mud present? Check all that apply.
☐Standing water
☐Mud
☐Neither standing water or mud

Does the area show evidence of recent flow (e.g., flood debris clinging to vegetation)?
☐Yes
☐No
☐Not sure

7. Animals observed in the vicinity of the aquatic feature or suspected to be present based on indirect evidence or file material:

☐Birds
☐Fish
☐Mammals
☐Reptiles (e.g., snakes, turtles)
☐Amphibians (e.g., frogs, salamanders)
☐Sediment-dwelling invertebrates (e.g., mussels, crayfish, insect nymphs)

Specify species, if known:
____
____
____

III.C Terrestrial Habitats
III.C.1 Wooded

Are any wooded areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.2.

Wooded Area Questions

☐On-site ☐Off-site

Name or Designation: ______________________________

1. Estimate the approximate size of the water body (in acres or sq. ft.): ____________
2. Indicate the dominant type of vegetation in the wooded area.

   ☐Evergreen
   ☐Deciduous
   ☐Mixed
   Dominant plant species, if known: ______________________________

3. Estimate the vegetation density of the wooded area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☐Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at chest height.

   ☐0-6 inches
   ☐6-12 inches
   ☐>12 inches
   ☐No single size range is predominant

5. Animals observed in the wooded area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   ____
   ____
   ____

III.C.2 Shrub/Scrub

Are any shrub/scrub areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.3.

Shrub/Scrub Area Questions

☒On-Site ☒Off-Site

Name or Designation: Mixed Chihuahuan Desert Scrub

1. Estimate the approx. size of the shrub/scrub (in acres or sq. ft.): See 2 below
2. Indicate the dominant type of shrub/scrub vegetation present, if known.

   SWMU 22 is located within a surrounding environment of largely undeveloped Chihuahuan desert scrub habitat typical of the Jornada del Muerto Basin of southern Dona Ana County, NM. Thousands of acres of mixed desert scrub, playa lakebeds, bare ground, and desert grasslands define this portion the basin Chihuahuan desert habitat. Specific species dominant adjacent to this site include honey mesquite (*Prosopis glandulosa*), four-wing saltbush (*Atriplex canescens*), and mariola (*Parthenium incanum*). The area at the previously existing septic tank is currently a gravel parking lot. The area leading to the north is fairly recently disturbed desert comprised of bare ground, gravel, and annual plants (primarily sunflowers ([*Asteracea* spp]).

3. Estimate the vegetation density of the shrub/scrub area.

   ☐Dense (i.e., greater than 75% vegetation)
   ☐Moderate (i.e., 25% to 75% vegetation)
   ☒Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the scrub/shrub vegetation.

   ☒0-2 feet
   ☐2-5 feet
   ☐>5 feet

5. Animals observed in the shrub/scrub area or suspected to be present based on indirect evidence or file material:
   ☒Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known:

   A single rock dove (*Columba livia*) was observed inside building 114. A red tailed hawk *(Buteo jamaicensis*) was observed perched on a power pole at 145 yards northwest of the SWMU. No other birds were detected during the site visit.

III.C.3 Grassland

Are any grassland areas on or adjacent to the site? ☐Yes ☒No

If yes, indicate the grassland area on the attached site map and answer the following questions. If more than one grassland area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual grassland area. Distinguish between grassland areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.4.

Grassland Area Questions

☐On-Site ☐Off-Site

Name or Designation: ______________________________

1. Estimate the approximate size of the grassland area (in acres or sq. ft.): ____________

2. Indicate the dominant plant type, if known.

____
____
____

3. Estimate the vegetation density of the grassland area.

☐Dense (i.e., greater than 75% vegetation)
☐Moderate (i.e., 25% to 75% vegetation)
☐Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the dominant plant type (in ft. or in.). ______

5. Animals observed in the grassland area or suspected to be present based on indirect evidence or file material:

☐Birds
☐Mammals
☐Reptiles (e.g., snakes, lizards)
☐Amphibians (e.g., toads, salamanders)

Specify species, if known:

____

III.C.4 Desert

Are any desert areas on or adjacent to the site? ☒Yes ☐No

If yes, indicate the desert area on the attached site map and answer the following questions. If more than one desert area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual desert area. Distinguish between desert areas by using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.C.5.

Desert Area Questions

☒On-Site ☒Off-Site

Name or Designation: Chihuahuan Desert

1. Estimate the approximate size of the desert area (in acres or sq. ft.): See section III.C.2

2. Describe the desert area (e.g., presence or absence of vegetation, vegetation types, presence/size of rocks, sand, etc.)
   See section III.C.2 above

3. Animals observed in the desert area or suspected to be present based on indirect evidence or file material:

   ☐Birds
   ☐Mammals
   ☐Reptiles (e.g., snakes, lizards)
   ☐Amphibians (e.g., toads, salamanders)

   Specify species, if known: Please See section III.C.2 above

III.C.5 Other

1. Are there any other terrestrial communities or habitats on or adjacent to the site which were not previously described?
☐Yes ☒No

If yes, indicate the "other" area(s) on the attached site map and describe the area(s) below. Distinguish between onsite and offsite areas. If no, proceed to Section III.D.

No

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas[2] exist adjacent to or within 0.5 miles of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*

No

2. Are any areas on or near (i.e., within 0.5 miles) the site which are owned or used by local tribes? If yes, describe. *Contact the Tribal Liaison in the Office of the Secretary (505)827-2855 to obtain this information.*

No

4. Does the site serve or potentially serve as a habitat, foraging area, or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and appropriate State of New Mexico division.*

Yes, the State Endangered night-blooming cereus (*Peniocereus greggii*) is known to exist in scattered populations around White Sands Test Facility (WSTF). Multiple surveys have been conducted for decades on this rare plant throughout WSTF. None of these plants were observed at or near SWMU 22. Current conditions at this SWMU do not provide good habitat for this rare cactus. Surrounding desert habitat may provide. adequate habitat.

[2] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to **Table 1** at the end of this document for examples of sensitive environments.

5. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.

Yes, literally dozens of species of migratory birds may stop by on their way past SWMU 22. It is not likely that many individuals would ever stay for extended periods of time directly on this site since it a gravel parking lot, Nearby buildings and power poles provide elevated perch sites that are used for resting and roosting by birds.

6. Is the site used by any ecologically[3], recreationally, or commercially important species? If yes, explain.

No

IV. EXPOSURE PATHWAY EVALUATION

1. Do existing data provide sufficient information on the nature, rate, and extent of contamination at the site?

☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:

See septic tank investigation report to which this checklist is attached.

2. Do existing data provide sufficient information on the nature, rate, and extent of contamination in offsite affected areas?

☒Yes
☐No
☐Uncertain
☐No offsite contamination

Please provide an explanation for your answer:

See septic tank investigation report to which this checklist is attached.

---

[3] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms and whose function as such would not be replaced by more tolerant species; or perform a critical ecological function (such as organic matter decomposition) and whose functions will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area <u>if they serve as a food source for other species</u>, but do <u>not</u> include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc.).

3. Do existing data address potential migration pathways of contaminants at the site?

☒Yes
☐No
☐Uncertain

Please provide an explanation for your answer:

See septic tank investigation report to which this checklist is attached.

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

☒Yes
☐No
☐Uncertain
☐No offsite contamination

Please provide an explanation for your answer:

See septic tank investigation report to which this checklist is attached.

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within 0.5 miles) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available.

No

6. Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 5 feet below ground surface (bgs). If yes, explain.

The septic tank investigation report to which this checklist is attached.

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.

No

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.

No

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions:

What is the approximate distance from the contaminated area to the nearest watercourse or arroyo?

☐0 feet (i.e., contamination has reached a watercourse or arroyo)
☐1-10 feet
☐11-20 feet
☐21-50 feet
☐51-100 feet
☐101-200 feet
☐> 200 feet
☐> 500 feet
☒> 1000 feet

What is the slope of the ground in the contaminated area?
☒0-10%
☐10-30%
☐> 30%

What is the approximate amount of ground and canopy vegetative cover in the contaminated area?
☒< 25%
☐25-75%
☐> 75%

Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?
☒Yes
☐No
☐Do not know

Do any structures, pavement, or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

☐Yes
☒No
☐Do not know

10. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.

    No

11. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?

    No

12. Could receptors be impacted by external irradiation at the site? Are gamma emitting radionuclides present at the site? Is the radionuclide contamination buried or at the surface?

    No

PHOTOGRAPHIC DOCUMENTATION

During the site visit(s), photographs should be taken to document the current conditions at the site and to support the information entered in the checklist. For example, photographs may be used to document the following: ▯ The nature, quality, and distribution of vegetation at the site

- Receptors or evidence of receptors
- Potentially important ecological features, such as ponds and drainage ditches
- Potential exposure pathways
- Any evidence of contamination or impact

The following space may be used to record photo subjects.

SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.

SWMU 22 is limited in size at less than 1/10 of an acre. The site occurs adjacent to numerous buildings within a large gravel capped parking lot and within 180 feet of a paved roadway. No ecologically important habitats or organisms exist at, or adjacent to, the site. As noted above State Endangered night blooming cereus are known from desert habitats around the NASA facility, none are known to occur at the site or within close proximity.

Concentrations of detected constituents are compared with Tier I ESLs for plants and deer mouse. Due to the limited size of the site, impacts to the kit fox, red-tailed hawk, and pronghorn antelope were not evaluated. The maximum total chromium concentration exceeds the Tier 1 ESL for plants.

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Date:

Comparison of Tier I Ecological Screening Levels for Selected Species And Maximum Constituent Concentrations

Table 1 - Plants

Constituents	Maximum Concentration 0'-10' bgs (mg/kg)	Tier I ESL[1] Plants (mg/kg)	Screening Level Hazard Indices
Cadmium	1.10E+00	3.20E+01	3.44E-02
Chromium, total	**1.90E+01**	3.50E-01	5.43E+01
Cyanide	8.60E+00	NE	--
Silver	9.40E-01	5.60E+02	1.68E-03
Screening Level Hazard Quotient (SLHQ)			**5.43E+01**

Bold font indicates exceedance of ESL.

[1]ESLs from NMED Risk Assessment Guidance Volume II (March, 2017) Attachment C.

ESL = Ecological Screening Level

SLHQ = Screening Level Hazard Quotient (sum of hazard indices).

Table 2 - Deer Mouse

Constituents	Maximum Concentration 0'-10' bgs (mg/kg)	Tier I ESL[1] Deer Mouse (mg/kg)	Screening Level Hazard Indices
Cadmium	1.10E+00	7.00E+00	1.57E-01
Chromium, total	1.90E+01	2.18E+01	8.72E-01
Cyanide	8.60E+00	6.24E+02	1.38E-02
Silver	9.40E-01	5.47E+01	1.72E-02
SLHQ			**1.06E+00**

Bold font indicates exceedance of ESL.

[1]ESLs from NMED Risk Assessment Guidance Volume II (March, 2017) Attachment C.

ESL = Ecological Screening Level

SLHQ = Screening Level Hazard Quotient (sum of hazard indices).