HGL
HydroGeoLogic, Inc
Exceeding Expectations

Corporate Headquarters

Via Federal Express

17 March 2005

Mr. Cornelius Amindyas
Project Manager
State of New Mexico Environment Department
Hazardous Waste Bureau
5500 San Antonio NE
Albuquerque, New Mexico 87109

Re: Response to Notice of Deficiency
Supplemental RFI Work Plan, SWMUs 101, 104, 105, 108, 109, 113B, 115, 116, 165, 177, 179, and 181, July 2005
Holloman Air Force Base
EPA ID# NM6572124422

Dear Mr. Amindyas:

Per the direction of and on behalf of Holloman Air Force Base, HGL is pleased to provide you with this response to the New Mexico Environment Department Notice of Deficiency dated 17 January 2006. The response incorporates discussions between the Air Force, HGL, and NMED during meetings in Albuquerque on 21 February and at Holloman Air Force Base on 22-23 February.

As we intend to commence field work in accordance with these responses during the week of 17 April, NMED's feedback/concurrence with regard to their acceptability would be greatly appreciated.

Please call Dan Holmquist of Holloman Air Force Base at (505) 572-5395 should you have any questions or comments.

Sincerely,

Kenneth J. Cottrell, C.P.G., P.G.
Senior Project Manager

Enclosure

1155 Herndon Parkway, Suite 900, Herndon, VA 20170-5545
Phone: (703) 478-5186 Fax: (703) 471-4180
www.hgl.com

DISTRIBUTION

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HQ ACC/A7VRO

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HQ AFCEE/ICC

Mr. Daniel Holmquist (w/2 enc.)
Remedial Project Manager, Holloman AFB

Mr. Stanley Scott, Project Manager
HQ ACC/A7VR

Mr. Dave Strasser, CHMM
NMED HWB

RESPONSE TO NOTICE OF DEFICIENCY SUPPLEMENTAL RFI WORK PLAN, SWMUS 101, 104, 105, 108, 109, 113B, 115, 116, 165, 177, 179, AND 181, JULY 2005

HOLLOMAN AIR FORCE BASE ALAMOGORDO, NEW MEXICO

Air Force Center for Environmental Excellence
Brooks City-Base, Texas

March 2006

RESPONSE TO COMMENTS
SUPPLEMENTAL RCRA FACILITY INVESTIGATION WORK PLAN
SOLID WASTE MANAGEMENT UNITS 101, 104, 105, 108, 109, 113B, 115, 116, 165, 177, 179, AND 181
HOLLOMAN AIR FORCE BASE
JULY 2005

Responses to Comments from Mr. James P. Bearzi

General Work Plan Deficiencies

Comment 1 *Although the NMED agreed to review this multiple-site Work Plan as submitted, the Permittee is required to submit individual (stand-alone) investigation reports for each site (i.e., LF-10, LF-19, LF-21, LF-22, LF-23, LF-29, DP-30/SD-33, and SS-39). The individual reports may either be bound into one document or submitted separately.*

Response 1 **The landfill sites (LF-10, LF-19, LF-21, LF-22, LF-23, and LF-29) will be bound into one document. DP-30/SD-33 and SS-39 will be submitted individually, as discussed at our meeting with Mr. Dave Strasser at NMED on 21 February.**

Comment 2 *The Permittee is required to submit trenching plans for all landfills for NMED approval after the geophysical surveys are conducted at each site and the results are interpreted (except LF-29, due to the potential presence of unexploded ordnance). This shall include LF-10, where trenching was not proposed. These plans must show the locations and depths of all trenches and provide the rationale for their selection. Trenching must be performed at the landfills to characterize their contents, regardless of the results of the geophysical surveys. If potentially hazardous materials are encountered, the NMED must be notified within 24 hours. Any potentially hazardous materials encountered during the trenching must be removed and disposed of in accordance with appropriate regulations and the subject work plan. Soil samples must be collected just below any potentially hazardous materials and at the water table below the material. Analytical parameters and the number of samples are to be determined after consultation with the NMED and will be dependent on the type(s) and quantities of potentially hazardous material found.*

Response 2 **Geophysical surveying activities were proposed as part of the Supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan of July 2005 in an effort to**

delineate landfill boundaries and anomalies, and to identify potential areas for trenching activities at landfills LF-19, LF-21, LF-22, and LF-23. The Air Force will address LF-10 as a separate response, which is forthcoming. Geophysical surveys have been completed at each site and the soil gas survey has been completed as scoped in the Work Plan at LF-10. Based on these results, trenching plans for LF-19, LF-21, LF-22, and LF-23 have been prepared and incorporated into a soil gas and geophysical survey technical memorandum that discusses the activities performed and associated survey results. The trenching plans discuss proposed trench locations and justification for designated locations, sampling and proposed analytical requirements, and contingency activities if hazardous constituents are encountered during trenching activities. The soil gas and geophysical survey technical memorandum included in this Comment Response Letter as Attachment A.

Comment 3 *The Permittee is required to analyze all ground water samples at all sites where ground water samples were collected for Total Dissolved Solids (TDS).*

Response 3 **Agreed.**

Comment 4 *Appendix J, Quality Assurance Project Plan (QAPP) Addendum, Page 1-1, Section 1.0, Introduction, 3rd Paragraph, 2nd Sentence. This sentence states, "This QAPP Addendum, in conjunction with the RFI Field Sampling Plan (FSP) presented as Appendix A of the project Work Plan, constitutes the RFI Sampling and Analysis Plan (SAP)." Appendix A of the subject Work Plan is "Records Search." An Appendix for the FSP is not apparent. Therefore, the Permittee is required to submit the FSP for NMED review.*

Response 4 **As discussed at the 21 February meeting with NMED, information provided within a Field Sampling Plan is included in Section 3.0 (Investigative Approach) of the July 2005 Supplemental RCRA Facility Investigation Work Plan. Section 3.0 describes the investigative approach for each site and field methodologies used to conduct the investigation. The sentence "This QAPP Addendum, in conjunction with the RFI Field Sampling Plan (FSP) presented as Appendix A of the project Work Plan, constitutes the RFI Sampling and Analysis Plan (SAP)" has been removed. A copy of the revised page is included as Attachment B of this Comment Response Letter.**

Comment 5 *Appendix J, Quality Assurance Project Plan (QAPP) Addendum, Page 5-1, Section 5.0, Quality Control Objectives. This Section indicates that the project method analyte lists and method sensitivity requirements are presented in the Basewide QAPP. The Permittee is required to submit the project analyte lists with the method detection limits (MDLs) for each analyte that are reflective of the proposed work and the requirements of this Notice.*

Response 5 **Project analyte lists with MDLs for each analyte reflective of the work are attached to this Comment Response Letter as Attachment C.**

Comment 6 *Figures 1.2, 2.1, 2.6, 2.7, 2.8, 2.9, 2.10, 2.12, 2.13, 2.15, 2.16, 2.18, 2.19, 2.21, 2.22, 2.24, 2.25, 2.26, 2.27, 2.29, 2.30, 2.31, 2.33, 2.34, 2.35, 2.36, 2.37, and 3.1. NMED requires that site figures include a coordinate system (i.e., UTM, latitude/longitude) and the boundaries of the site(s) shown on the figures. GPS coordinates (+/-3 ft accuracy) of site boundaries are acceptable. The Permittee is required to revise and resubmit these figures.*

Response 6 **The work plan figures have been revised to incorporate NMED comments and updated to reflect geophysical survey results. The revised figures are provided herein as Attachment D. In addition, Table 2.30 has been added which includes Northings, Eastings, and elevations for all wells included in the Work Plan. This table and associated replacement page 2-33 are included in Attachment E.**

Site-Specific Deficiencies

Comment 7 *LF-10 (SWMUs 101 and 109). The Work Plan proposes that passive soil gas samples will be collected at 100-foot intervals for VOC analysis. The Permittee must collect these samples at 50-foot intervals to provide sufficient coverage.*

Response 7 **A passive EMFLUX soil gas survey of LF-10 was conducted in September and October 2005 as scoped in the Work Plan at 100-foot intervals. The sampling methodology and survey results are included in a Soil Gas and Geophysical Survey Technical Memorandum attached to this comment response letter as Attachment A. As discussed at our meeting with NMED on February 21-23, the distribution of positive detections and overall low concentrations of contaminants in soil gas do not suggest hot spots or data gaps that could be better defined using a 50-foot interval. As such, the Permittee requests NMED concurrence that**

additional soil gas sampling at a 50-foot interval is not necessary. However, based on the results, additional soil gas sampling is proposed for LF-10. The additional samples will be collected to assess a portion of the landfill determined to extend beyond the current boundaries of the soil gas survey. A sampling plan discussing the collection of the additional soil gas samples is included in the technical memorandum (Attachment A).

Comment 8 *LF-29 (SWMU 104). The Work Plan does not propose a passive soil gas survey for this site. The Permittee is required to conduct a passive soil gas survey at this site in accordance with the methodologies specified in Section 3.6.3, Passive Soil Gas Surveys. Gas samples are to be analyzed for VOCs at 50-foot intervals. In addition, all soil samples collected at this site must be analyzed for perchlorate in addition to the proposed analyses for VOCs, SVOCs, RCRA Metals, TPH, and explosives. Ground water samples from monitoring wells MW-29-01, MW-29-05, MW-29-07, and MW-29-08 must also be analyzed for perchlorae and TDS.*

Response 8 **A LF-29 soil gas sampling plan is included within Section 5 of the attached Soil Gas and Geophysical Survey Technical Memorandum (Attachment A). As discussed at our meeting, we propose to perform soil gas sampling at 50-foot intervals proximal to significant geophysical anomalies, and at 100-foot intervals elsewhere, in order to reduce the amount of intrusive work at the site, given the UXO avoidance procedures that must be employed at LF-29.**

LF-29 soil analytical requirements will be expanded to include perchlorate. Groundwater analytical requirements for samples obtained from monitoring wells MW-29-01, MW-29-05, MW-29-07, and MW-29-08 will be expanded to include perchlorate and total dissolved solid (TDS) analyses. The additional analyses will be conducted in accordance with the Quality Assurance Project Plan (QAPP) Addendum submitted as Appendix J in the July 2005 Supplemental RFI Work Plan.

DP-30/SD-33 (SWMU 113B)

Comment 9a *The Work Plan proposes that waste samples are to be analyzed using TCLP methodology. The Permittee is required to analyze all waste samples for total levels of contaminants. This will include analysis for VOCs, SVOCs, Target Analyte List (not RCRA) Metals, TPH,*

herbicides, pesticides, and PCBs. TCLP can be used to characterize any excavated waste for disposal purposes.

Response 9a **As clarified at our meeting on 21 February, all samples taken from within the waste material will be analyzed for TCLP to characterize it for disposal. Samples taken from below the waste and the perimeter of the waste area will be analyzed for VOCs, SVOCs, TAL Metals, TPH, herbicides, pesticides, and PCBs to demonstrate compliance with NMED SSLs. A map showing sample locations is provided on Figure 3.1, included as Attachment D. The replacement page 3-8 is included as Attachment F to this Response to Comments Letter.**

Comment 9b *The Work Plan proposes biennial (every two years) ground water monitoring at this site. Based on analysis of ground water flow velocity estimates, the Permittee is required to conduct ground water monitoring at this site semi-annually (twice a year). The Permittee is required to submit a semi-annual ground water monitoring plan for NMED approval that includes the installation of an additional ground water monitoring well immediately downgradient (south of) borings SB30&33-02 and SB30&33-07, as shown on Figure 2.27. Ground water must be analyzed for VOCs, TAL Metals, and TDS.*

Response 9b **Agreed. The proposed location of the new well is shown on Figure 3.1, which is included as Attachment D. Groundwater will be sampled semi-annually and analyzed for VOCs, TAL metals, and TDS.**

SS-39 (SWMUs 165, 177, 179, and 181)

Response 10a *The Work Plan indicates that contaminants of potential concern (COPCs) from fuels used at this site include unsymmetrical dimethylhydrazine (UDMH) and aniline, which are both RCRA toxic hazardous constituents (U098 and U012, respectively) as listed in Appendix VIII to 40 CFR 261. There is no evidence that these constituents have ever been analyzed for in soil or ground water at this site. Therefore, the Permittee must submit a work plan for NMED approval to analyze all ground water samples collected at this site for these constituents. In addition, this work plan must include the collection of new soil samples to be analyzed for UDMH, aniline, and RCRA Metals. These samples must be collected from the following former boring locations: HA-39-01 (the oxidizer spill drainpipe outlet), HA-39-02 (the propellant spill drainpipe discharge box), and SB-39-01*

and SB-39-02 (the building 1176 drainage trough discharge sumps). Soil samples must be collected from 2 – 4 feet below ground surface (bgs) and 8 – 10 feet bgs.

Response 10a

Groundwater at SS-39 will be analyzed for UDMH and RCRA Metals. As confirmed during our site walk with NMED on 23 February, soil samples will be collected from the following former boring locations HA-39-01, HA-39-02, SB-39-01, and SB-39-02 and analyzed for UDMH, aniline, and RCRA Metals. Two additional sample locations were identified during the site walk. A sample will be obtained from the southwest corner of Building 1176 downgradient of where the Building 1176 southwest drainage trough changes direction. A sediment sample will be taken from beneath the grate at SWMU 167, the concrete Collection Basin. These samples will be analyzed for UDMH, aniline, and RCRA metals. These borings have been added to Figure 3.1, which is included herein as Attachment D. In addition, the QAPP has been updated to include UDMH and aniline. The updated QAPP pages are included in Attachment B.

Comment 10b

Additional investigation requirements for site SS-39 were described in NMED correspondence dated February 9, 2005. These requirements included, among other things, the installation of ground water monitoring wells downgradient of the source area no more than 200 feet apart. The locations of the proposed wells, as shown on Figure 3.1, do not satisfy this requirement. The February 9, 2005 correspondence also required that ground water be analyzed for VOCs, SVOCs, RCRA Metals, and perchlorate. The Work Plan only proposes analysis of VOCs and perchlorate. NMED agrees that SVOCs are not COPCs (with the exception of aniline) and, therefore, do not have to be analyzed for. However, metals are COPCs, as evidenced by concentrations of cadmium, chromium, arsenic, and lead in various soil samples in excess of residential, industrial, and construction worker soil screening levels established by the NMED. Therefore, the Permittee is required to analyze all ground water samples for RCRA Metals and TDS, as well as VOCs and perchlorate. In addition, the February 9, 2005, NMED correspondence required that samples from the existing and proposed monitoring wells be collected on a quarterly or semi-annual basis over a two-year period. The Work Plan only proposes biennial sampling. Based on ground water flow velocity estimates, the Permittee is required to collect samples on a semi-annual basis (i.e., twice a year) over a minimum of a two-year period.

Based on the above, the Permittee is required to submit a work plan for NMED approval for the installation of three (3) additional monitoring wells at the approximate locations shown on the attached copy of Figure 3.1. The work plan must include analysis of ground water from all wells sampled for VOCs, RCRA Metals, UDMH, aniline, perchlorate and TDS on a semi-annual basis for a minimum of two years. It is possible that the analytical parameters may be adjusted over time.

Response 10b **Three additional groundwater monitoring wells will be installed in accordance with NMED comments; their locations are provided on the updated Figure 3.1 (Attachment D). As discussed during our site walk, the high water table will necessitate completing the wells with well screens below the water table to allow for proper surface seals. Groundwater was encountered using a hand auger during the site walk at 3 to 6 inches below grade. It is believed that groundwater quality in these wells will be more reflective of Lost River water quality, especially in times of heavy precipitation and regional runoff. The groundwater analytical list presented in Section 3.5.2 has been revised to include RCRA metals and TDS analyses and groundwater monitoring increased from biennial sampling to semi-annual monitoring for a period of two years, recognizing the possibility that analytical parameters may be adjusted over time. This page is provided as Attachment E.**

Comment 10c *Page 2.31, Section 2.2.9, SS-39, 5th Paragraph, 2nd Sentence. This sentence indicates that the Remedial Investigation (RI) ground water analytical results are provided in Table 2.33. The Work Plan does not contain a Table 2.33. NMED assumes that this refers to Table 2.24. The Permittee must confirm this or provide written clarification.*

Response 10c **NMED is correct. SS-39 Remedial Investigation (RI) groundwater analytical results are provided in Table 2.24 and not in Table 2.33. The Table 2.33 callout in the text has been corrected to specify Table 2.24. The corrected page is included as Attachment G.**

Comment 10d *Table 2.25, Last Page. This table shows "Result" columns for borings 179-BPH01, 179-BPH02, and 179-BPH03; however, all the results are shown as "NA," meaning "not analyzed." In addition, these three borings are not shown on any of the SS-39 figures provided in the Work Plan. The Permittee must explain why these borings were included on the table if all results were "NA" and to resubmit a figure showing the locations of these borings and a tabulation of any results.*

Response 10d **Borings 179-BPH01, 179-BPH02, and 179-BPH03 were included on Table 2.25 to summarize as much historical data as possible to facilitate the development of a comprehensive Site Conceptual Model. Based upon further review of the RFI (Radian, 1994), borings 179-BPH01, 179-BPH02, and 179-BPH03 were determined to represent surface soil samples submitted for pH analysis. The pH results were not included within the RFI report and associated appendices (Administrative Record numbers 810-812). As discussed at our 21 February meeting, these borings have been removed from Table 2.25 and the replacement page has been included in Attachment H.**

Comment 10e *Figure 2.30. The Permittee is required to revise and resubmit this figure to depict the locations and boundaries of all four SWMUs related to this site. This revision must include the approximate location of SWMU 165, the building 1176 pond.*

Response 10e **SWMU's 177, 179, and 181 have been added to Figure 2.30. A copy of the revised figure is attached (Attachment D). As stated in the RFI report (Radian, 1994) and discussed at our February meetings, SWMU 165 has never been located. In the Records Search (CH2MHill, 1983) the pond was described as being approximately 50 feet long and 30 feet wide. The RI (Radian, 1992b) stated "Previous reports indicate that SWMU 165 is located between Building 1176 and Lost River; however, no evidence of the Pond was found at the reported location or at any location in the vicinity of Building 1176." No evidence of the Pond was observed during our site walk of 23 February. Consequently, the location of SWMU 165 is not depicted on the revised Figure 2.30.**

Comment 10f *Figures 2.37 and 3.1. These figures show TCE concentrations in the ground water. However, the unit of measurement for these concentrations is not provided. In addition, the location of DPT boring SS3911 is not shown. The Permittee is required to revise and resubmit these figures showing the unit of measurement (i.e., µg/L) for TCE concentrations, the location of boring SS3911, and the corresponding TCE concentrations.*

Response 10f **Figures 2.37 and 3.1 have been revised in accordance with NMED's comments and are included as Attachment D.**

Comment 10g *Appendix H.8, SS-39 Boring/Drilling Logs. Boring/drilling logs are not provided for the following borings: SB-39-01, SB-39-02, 179-A01, 179-A02, 179-A03, 179-A04, and 179-A05. The Permittee is required to submit copies of these logs.*

Response 10g **Boring logs SB-39-01 and SB-39-02 are included as Attachment H. HGL reviewed the Holloman AFB Administrative Record and was unable to locate boring logs for borings 179-A01, 179-A02, 179-A03, 179-A04, and 179-A05. Documents reviewed by HGL included the borings' corresponding RFI (Radian, 1994 and AR# 810), and associated appendices (Radian, 1994 and AR #'s 811 and 812).**

SUPPLEMENTAL RCRA FACILITY INVESTIGATION ADDENDUM – PASSIVE SOIL GAS AND GEOPHYSICAL SURVEY RESULTS

TECHNICAL MEMORANDUM

Prepared for
Air Force Center for Environmental Excellence
Brooks City-Base, Texas

March 2006

SUPPLEMENTAL RCRA FACILITY INVESTIGATION ADDENDUM - PASSIVE SOIL GAS AND GEOPHYSICAL SURVEY RESULTS

TECHNICAL MEMORANDUM

Prepared for

Air Force Center for Environmental Excellence
3300 Sidney Brooks
Brooks City-Base, Texas 78235-5344

Prepared by

HydroGeoLogic, Inc.
1155 Herndon Parkway, Suite 900
Herndon, Virginia 20170-5545

Contract No. F41624-03-D-8602
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March 2006

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LIST OF ACRONYMS, SYMBOLS AND ABBREVIATIONS

AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
bgs	below ground surface
DP	Disposal Pit
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
GPS	Global Positioning System
HGL	HydroGeoLogic, Inc.
MOBSS	Mobile Bare Base Squadron
ng	nanograms
NMED	New Mexico Environment Department
PCE	tetrachloroethene
PID	photoionization detector
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SWMU	Solid Waste Management Unit
SOPs	Standard Operating Procedures
TAL	Target Analyte List
TCE	trichloroethene
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbons
VOC	Volatile Organic Compound

SUPPLEMENTAL RCRA FACILITY INVESTIGATION ADDENDUM - PASSIVE SOIL GAS AND GEOPHYSICAL SURVEY RESULTS TECHNICAL MEMORANDUM

1.0 INTRODUCTION

This technical memorandum presents the results of a soil gas survey and several geophysical surveys conducted at Holloman Air Force Base (AFB), New Mexico, as part of a supplemental Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). The surveys were performed on behalf of Holloman AFB to satisfy New Mexico Environment Department (NMED) requirements under contract to Air Force Center for Environmental Excellence (AFCEE), Contract No. F41624-03-D-8602, Task Order 0037. Specifically, the surveys were conducted to provide additional data on the landfills to optimize supplemental RFI sampling activities proposed in the July 2005 Supplemental RCRA Facility Investigation Work Plan. The following Environmental Restoration Program (ERP) / Solid Waste Management Units (SWMUs) sites were investigated:

- DP-30/SD-33 (SWMU 113B) – Grease Trap/Cooking Grease Disposal Pits;
- LF-10 (SWMUs 101 and 109) – Old Main Base Landfill;
- LF-19 (SWMU 105) – Golf Course Landfill;
- LF-21 (SWMU 116) – West Area Landfill No. 2;
- LF-22 (SWMU 115) – West Area Landfill No. 1;
- LF-23 (SWMU 108) – MOBSS Landfill; and
- LF-29 (SWMU 104) – Former Army Landfill.

Field activities are summarized on Table 1.1 and discussed in the Sections 3 and 4. Background information on the Base and investigated sites is included as Section 2. Soil gas sampling methodology and sampling results are included in Section 3. Geophysical survey results are presented in Section 4. Additional field activities, based on soil gas sampling results, geophysical survey results and NMED comments on the July 2005 Supplemental RCRA Facility Investigation Work Plan are included in Section 5. Photographs of the survey activities and ERP/SWMU sites are included in Attachment A. Supplemental data and analytical results have been included as Attachments B through E provided on the attached CD-ROM.

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2.0 BACKGROUND

2.1 INSTALLATION LOCATION

Holloman AFB is situated in south central New Mexico, in Otero County. A facility location map is provided as Figure 2.1. Holloman AFB has a population of 6,000 and occupies approximately 50,000 acres of the northeast quarter of Section 1 Township 17 South, Range 8 East. A facility layout map of Holloman AFB showing the location of the seven ERP/SWMU sites is provided as Figure 2.2.

2.2 INSTALLATION HISTORY

Holloman AFB, formerly Alamogordo Army Airfield, began as a temporary facility during World War II. Construction of the temporary airfield was initiated on 6 February 1942. Prior to 1942 the property occupied by Holloman AFB was undeveloped rangeland. Over time, Holloman AFB's status, mission, and Command have periodically changed. In 1992, Holloman AFB was realigned under the Air Combat Command.

2.3 ERP/SWMU SPECIFIC WASTE HISTORY

2.3.1 DP-30/SD-33 (SWMU 113B) – Grease Trap/Cooking Grease Disposal Pits

DP-30, grease trap disposal pits, was active from 1972 to 1979 and consisted of shallow trenches that were reportedly dug and received wastes from base grease traps, oil/water separators, and grit from the wastewater treatment system. One interviewee indicated that quantities of various pesticides (diazinon, malathion, pyrethrum) were also disposed at the location. The disposal of pesticides at DP-30 was not verified. Six trenches were identified at DP-30 during a 1991 RI visual inspection of the site.

Cooking grease disposal trenches (SD-33) are located immediately south of DP-30. Bioenvironmental engineering personnel later identified these trenches as the disposal site for cooking greases from base kitchens. Three trenches were identified at SD-33 during a 1991 RI visual inspection of the site.

2.3.2 LF-10 (SWMUs 101 and 109) – Old Main Base Landfill

LF-10 was a former base sanitary landfill that operated between 1942 and 1958. Based on a 1982 records search, the landfill encompassed approximately 22 acres just north of the existing residential housing area and east of the civil engineering complex. The landfill reportedly received base domestic solid waste and one interviewee indicated that some drums containing waste oils and solvents may have been historically disposed at the landfill. A base incinerator had also been located in this area in the past and ash from this operation was reportedly buried in the landfill.

2.3.3 LF-19 (SWMU 105) – Golf Course Landfill

Based on the 1982 records search, the Golf Course landfill is located due south of the golf course and approximately 800 feet north of the southern base boundary. The landfill

reportedly operated for approximately 10 years, from 1968 to 1978. The landfill was used primarily to dispose of golf course grass clippings; however, some unused rodenticides were reportedly disposed at the site as well.

2.3.4 LF-21 (SWMU 116) – West Area Landfill No.2

The 1983 Records Search indicated that LF-21 covered an area of 1 to 2 acres and was active from the early 1970's (assumed) until 1977. Bioenvironmental Engineering records indicated that waste materials contained at the site included paper bags, food, cans, boxes, boards, and tree limbs. One interviewee also indicated that some 55 gallon drums were observed during the active period of the landfill. Disposal operations were stopped after the site was identified as an unapproved landfill site.

2.3.5 LF-22 (SWMU 115) – West Area Landfill No.1

The 1982 Records Search stated that LF-22 is located in an arroyo near the Solar Observatory, Building 910. The landfill reportedly covered a 2 to 3 acre area and was active as a landfill between 1974 and 1978. A December 28, 1978 memo in the bioenvironmental engineer's pollution file described the landfill site and indicated that items such as plastic sheeting, boxes and empty cans were disposed at the site. Disposal operations were stopped after the location was identified as an unapproved landfill site. During the records search, one interviewee indicated that some 55 gallon drums were observed at the site during the active period of the landfill.

2.3.6 LF-23 (SWMU 108) – MOBSS Landfill

The 4449th MOBSS Landfill is located west of the Solar Observatory (Building 910) and received waste disposal items from 1976 to 1979. Cans of diazinon, dibromochloromethane, and 55-gallon drums of unknown contents were observed at the site during the records search. According to facility records, LF-23 is relatively small, encompassing an area less than 0.5 acres. However, visual inspection of LF-23 prior to geophysical surveying activities identified the presence of similar debris extending from LF-23 northward for several hundred feet. Consequently, the geophysical survey described herein was extended to encompass approximately 2.5 acres.

2.3.7 LF-29 (SWMU 104) – Former Army Landfill

LF-29 was active from the early 1950's to 1975, reportedly receiving spent munitions and missiles. No known hazardous waste materials are known to have been disposed at the site. Based on a Visual Site Inspection, the landfill was identified as being north of Test Group Headquarters Area. Based on an RI conducted at the sites, a small berm extending 400 feet in a north-south direction and 350 feet in an east-west direction bounds the landfill on all four sides.

3.0 SOIL GAS SURVEY

The soil gas survey was conducted on LF-10 (SWMUs 101 and 109), the Old Main Base Landfill, between September 28 and October 5, 2005 as proposed in the July 2005 work plan (HGL, 2005). The soil gas survey was performed using the EMFLUX® passive Soil Gas Method, a verified Environmental Protection Agency (EPA) technology method under the EPA Technology Verification Program. The method is described fully in EPA Publication EPA/600/R-98/096. A copy of the publication and EPA verification statement is included in Attachment B (CD-ROM).

A total of 107 soil gas samples were collected during the survey, equating to 1 sample per 0.2 acres. Sample locations were located on a 100 foot by 100 foot grid covering the entire landfill, encompassing approximately 22 acres, as inferred from historic subsurface soil sampling results (HGL, 2005b). A 100 foot sample spacing was considered reasonable given the method's high performance during an pilot study of an EPA soil gas test site using a 200 foot sample spacing in order to evaluate a volatile organic compound (VOC) groundwater plume approximately 30 to 50 feet below ground surface (bgs). A copy of the pilot study's formal evaluation's executive summary is included in Attachment B.

Several sample locations were relocated or removed from the survey due to presence of surface obstructions (e.g., buildings, vehicles, and an electrical substation) and subsurface utilities. The southern boundary of the survey was defined by the northern extent of several recyclable debris (e.g., concrete, asphalt, soil, gravel) stockpiles and an electrical substation. In addition, several sample locations were repositioned away from features that might dilute soil gas sample concentrations such as groundwater monitoring wells; subsurface utility vaults; and pavement fractures, joints, and underlying pavement cavities. Soil gas sample locations are depicted on Figure 3.1.

3.1 FIELD SAMPLING ACTIVITIES

Passive EMFLUX® soil gas samplers were installed at LF-10 on September 28, 29, and 30, 2005. At each sample location, a stainless steel slide hammer or gas-powered one-man auger was used to complete a soil boring to a maximum depth of 4 feet or until refusal was encountered. An electric hand-held drill fitted with a 1¼-inch drill bit was used to core a hole through concrete or asphalt pavement when present. Soil borings are not a general requirement of the EMFLUX® passive Soil Gas Method; however, the likely presence of caliche beneath portions of LF-10 was considered to be a potential barrier for the vertical migration of generated soil gas. Consequently, soil borings were drilled at all soil gas sample locations to allow vertical migration of subsurface soil vapors to occur more freely (O'Neil, 2005).

Once a soil boring was completed to the maximum depth of 4 feet below ground surface (bgs) or refusal was encountered, an EMFLUX® sampler was installed at the sample location in accordance with laboratory provided instructions. A copy of the installation instructions is included in Attachment B (CD-ROM). After installation, the samplers were covered with

soil for gravel- and soil-covered areas, or concrete at paved locations. Copies of the field sample data sheets and sampler deployment forms are included in Attachment C (CD-ROM).

The passive soil gas samplers were allowed to sit undisturbed for approximately 72 hours in accordance with laboratory recommendations and retrieved from the subsurface on October 1, 2 and 3, 2005. Once removed from the subsurface, the samplers were inspected for defects and appropriately labeled. Once a sample had been retrieved, the associated sample boring was resurfaced to grade with like material (i.e., soil or concrete). During the sample retrieval process, 9 of the 107 soil gas samplers were found to have been disturbed or entirely removed from the subsurface by Base children. New samplers were installed at the nine locations on October 2, 2005 and allowed to sit for 72 hours. The 9 samplers were retrieved from the subsurface on October 5, 2005.

The collected samples were labeled with a 12 digit identification tag, consisting of a 4 digit prefix identifying LF-10 and an 8 digit suffix identifying the sample location's grid coordinate based on northings and eastings For example, a soil gas sample obtained from grid coordinate North 100, East 100 was labeled "LF10-N100E100". Associated chain-of-custody forms have been included in Attachment C.

3.2 SOIL GAS SURVEY RESULTS

The 107 soil gas samples were submitted for 40 target volatile organic compounds (VOCs) using gas chromatography/mass spectrometry instrumentation following modified EPA Method 8260B procedures. . In addition, four trip blanks, provided by the laboratory, were also submitted for VOC analysis in accordance with the supplemental RFI work plan (HGL, 2005b).

Table 3.1 summarizes positive soil gas analytical results obtained from the survey. Twelve VOCs (chloroform, benzene, ethylbenzene, n-butylbenzene, naphthalene, tetrachloroethene [PCE], toluene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, trichloroethene [TCE], and xylenes) were detected in the soil gas samples. 1,2,4-Trimethylbenzene was detected in every soil gas sample collected including trip blanks during the survey. Toluene and M&P xylenes were detected in many of the samples including one or more of the trip blanks. Because the three VOCs were positively detected in the trip blanks, all three VOCs were considered indicative of blank contamination.

The nine remaining VOCs were detected sporadically across LF-10. Concentration maps for chloroform, TCE, PCE, 1,3,5-trimethylbenzene, n-butylbenzene, and naphthalene are included as Figures 3.2 through 3.7, respectively. With the exception of a few sample locations VOC detections of these six compounds were low and at unique locations (i.e., detected concentrations of one VOC were not co-located with another VOC).. Several of the VOCs (i.e., chloroform [Figure 3.2], n-butylbenzene [Figure 3.6] and naphthalene [Figure 3.7]), when detected, were generally detected in several adjacent sample locations across LF-10, suggesting localized areas of potential contamination. The remaining VOCs were detected at discrete sample locations, suggesting a distinct area of contamination.

The majority of the VOCs detected in the soil gas samples were detected in the central, western, and southern portions of LF-10. Chloroform was detected primarily in the central to south-central portion of the landfill, ranging from 14 nanograms (ng) to 56 ng. TCE, at 14 ng and 606 ng, was detected in two samples located along the survey's southern boundary while PCE, ranging from 14 ng to 103 ngs, was detected sporadically across LF-10. Sample LF10-N100E200 contained PCE (62 ng) and TCE (14 ng). 1,3,5-Trimethylbenzene (25 ng to 79 ng) and n-butylbenzene (27 ng to 49 ng) were detected at relatively similar concentrations throughout the central portion of the landfill. Naphthalene was detected primarily in the western north-central portion of the landfill (ranging from 26 ng to 143 ng) and along the survey's south-central boundary (34 ng to 65 ng).

No VOCs were positively detected along the survey's eastern and northern borders. The lack of VOC detections along the northern and eastern survey boundaries suggests the soil gas survey has extended beyond the influence of the landfill, if the landfill contents are a source of soil gas VOC detections.

A copy of the soil gas survey laboratory report is included in Attachment C (CD-ROM). A complete copy of the soil gas analytical results is included within the laboratory report.

3.3 SOIL GAS SURVEY CONCLUSIONS

Based on soil gas survey results, both halogenated and fuel-related VOCs are present in the soil gas of LF-10. Nine VOCs were detected in the soil gas samples; however, three of the VOCs, 1,2,4-trimethylbenzene, toluene, and xylenes, were detected in the trip blanks, suggesting that their detections were the result of blank contamination.

The six remaining VOCs were detected sporadically across LF-10, and with the exception of a few sample locations, were not detected in the same samples. Halogenated VOCs were detected primarily in the central, southern, and western portions of the landfill. Fuel-related VOCs were detected across LF-10 but primarily within the central portion of the landfill.

For the most part, no VOCs were detected within 200 feet of the northern and eastern survey boundaries. Several VOCs were detected along the western and southern survey boundaries and are currently unbounded.

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4.0 GEOPHYSICAL SURVEYING

Geophysical surveying activities were conducted at the Holloman AFB in September and October 2005. An electromagnetic and magnetic geophysical survey was conducted on ERP/SWMU sites LF-10, LF-19, LF-21, LF-22, and LF-23, an electromagnetic survey was conducted on site DP-30/SD-33, and a magnetic survey was conducted on LF-29 (Table 1.1). The geophysical surveys were conducted to delineate landfill and disposal pit boundaries and determine the presence of any geophysical anomalies that will be targeted for further investigation during the FY2006 supplemental RFI.

4.1 GEOPHYSICAL SURVEYING ACTIVITIES

4.1.1 Terrain Conductivity Surveying

A Geonics Limited Model EM-31 Mark2 terrain conductivity instrument was utilized to measure lateral soil conductivity changes at all seven ERP/SWMU sites. Due to the high naturally conductive soils encountered at Holloman AFB, the metal-detection (in-phase) component of the electromagnetic survey was adversely and significantly compromised and could not be used as proposed in the RFI work plan. Consequently, the electromagnetic survey strategy was modified to utilize only the quadrature (conductivity) component of the electromagnetic method. A magnetometer was used to detect buried metallic debris as described in the next section.

The EM-31 Mark2 system operates on magnetic induction and Maxwell's Law, whereby an electromagnetic field is transmitted through the soil and the associated electrical field current is ultimately picked up by the receiver and correlated directly to soil conductivity. The Mark2's fixed intercoil spacing of 3.66 meters (12 feet) produces an ellipsoidal electromagnetic field that is approximately 20 feet wide and 40 feet high and typically penetrates subsurface soils to a depth of 20 feet and laterally 10 feet. However, the highly conductive soils present beneath Holloman AFB most likely lessened the effective signal penetration depth to approximately 10 feet.

At DP-30/SD-33, LF-23, and LF-29, the electromagnetic survey was conducted on a 10-foot line spacing. At LF-19, LF-21, and LF-22, the electromagnetic surveys were conducted utilizing a 20-foot line spacing while at LF-10, a 50-foot line spacing was utilized. A 2 reading per second sampling rate was employed for all seven electromagnetic surveys, which translates to a station spacing of every 1.5 feet along each line.

4.1.2 Magnetometer Surveying

Geometrics, Inc. Model G-858 and Model G-856 total-field magnetometers were utilized for magnetic surveying at the six landfill sites. Magnetic surveying of DP-30/SD-33 was not conducted because the unit reportedly only received grease. The G-858 magnetometer was utilized for surveying activities. The G-856 unit was employed strictly as a site-specific fixed based station, recording changes in the Earth's daily (diurnal) magnetic field when magnetic

surveys were being conducted. Readings from the fixed base station surveys were subsequently removed from each day's total-field magnetic survey, yielding true residual data.

Calibration testing of the G-858 magnetometer at LF-10 and LF-19 sites indicated that a 2-meter line spacing provided 100 percent survey coverage. Therefore, a 2-meter line spacing was employed at all six sites. A 10 reading per second sampling rate, translating to a station spacing of 0.3 feet, was selected for the magnetic surveys.

The G-858 unit was configured as a vertical dual-sensor gradiometer at LF-10 in order to minimize the effects of cultural "noise" associated with the myriad surface metallic observed at the site (e.g., rebar, buildings, vehicles, surficial debris). A single-sensor total-field configuration was utilized at the other sites. Because LF-29 contained numerous occurrences of scattered surface metal debris, a horizontal dual-sensor non-gradiometer configuration was utilized to achieve a 1-meter line spacing so that all causative bodies would be surveyed at the landfill.

4.1.3 Global Positioning

A Trimble ApGPS 132, a high-performance Global Positioning System (GPS) receiver, was utilized to provide precision guidance of the survey lines during the magnetometer and terrain conductivity surveys. GPS surveys typically have an accuracy of ± ½ meter.

4.2 GEOPHYSICAL SURVEY DATA PROCESSING

No post-survey data processing was performed on the EM-31 data. Post-survey processing of the magnetic data included: global dropout removal, global duplicate time removal, global spike removal, custom range despiking, GPS offset, removal of diurnal magnetic field, and heading error removal. A detailed description of the post-survey processing activities is included in the geophysical survey report included as Attachment D (CD-ROM).

4.3 GEOPHYSICAL SURVEY RESULTS

The geophysical survey results are provided as color contours as Figures 4.1 through 4.12. A copy of the geophysical survey report is attached as Attachment D (CD-ROM).

4.3.1 DP-30/SD-33 (SWMU 113B) – Grease Trap/Cooking Grease Disposal Pits

Prior to conducting field activities, a visual site inspection of DP-30 and SD-33 was conducted. The area encompassing the two sites was relatively flat and sparsely to moderately vegetated with shrubs. Minor amounts of scrap metal were observed sporadically across the site.

Access to the DP-30 and SD-33 were provided by unpaved service roads. No other site improvements were noted at the two sites. Photographs of the DP-30/SD-33 area are included in Attachment A.

4.3.1.1 Terrain Conductivity Survey Results

A terrain conductivity survey was conducted at DP-30, SD-33, and the surrounding area, encompassing approximately 4 acres (Figure 4.1). Based on the waste reportedly disposed at the two units, metallic and magnetic susceptible debris were not anticipated at the sites. Consequently, a magnetic survey of the DP-30/SD-33 area was not performed.

Low conductivity anomalies (blue areas), consistent of oil and grease contamination, were identified within the surveyed area. The locations of the anomalies correspond to the approximate locations of DP-30 and SD-33; however, the sizes of the anomalies suggest the two sites may be larger than previously determined. The inferred boundaries, based on the conductivity results, of the waste units are depicted on Figure 4.1.

The SD-33 anomaly is an inverted "L" shaped anomaly approximately 100 feet long and ranges in width from 40 to 80 feet. The anomaly appears to be comprised of multiple linear and several oblong shape anomalies, possibly reflecting former disposal trenches and pits. The DP-30 anomaly is more amorphous in shape with less differentiation within the anomaly, and extends approximately 240 feet long and ranges in width from approximately 100 to 160 feet.

4.3.1.2 Geophysical Survey Conclusions

Terrain conductivity surveying of the DP-30/SD-33 area has positively identified the former waste disposal units. The conductivity survey identified both sites as low conductivity anomalies, which is consistent of oil and grease contamination when compared to the naturally high conductive soils at Holloman AFB. Based on the survey results, the units may be larger than historically documented. Linear trending and oblong features comprising the SD-33 conductivity anomaly suggest former disposal trench and pit locations. The conductivity survey was unable to differential individual waste disposal pits within DP-30.

4.3.2 LF-10 (SWMUs 101 and 109) – Old Main Base Landfill

An electromagnetic and magnetic survey, encompassing approximately 24 acres, was conducted at LF-10 (SWMUs 101 and 109) to delineate the extent of the landfill and identify areas within the landfill containing significant metallic anomalies. The geophysical surveys were extended beyond the inferred limits of the landfill established during previous studies in an effort to confirm the landfill boundaries.

LF-10 is bounded to the north by Arkansas Avenue, to the south by an electrical substation and undeveloped lands used for the stockpiling of recyclable construction debris, to the east by an arroyo, and to the west by Creosote Avenue and Arkansas Avenue. Since the closure of the landfill, the northern and central portion of LF-10 has been improved with the construction of a one-story building (Building 121), a concrete paved parking lot, and a chain-link fence. Several other structures including a guard house and an open air pavilion are present as well. The area between the chain-link fence and the paved parking lot is covered in gravel and used for vehicle, equipment, material, and minor debris storage. Several shallow northwest to

southeast trending depressions were observed within the Building 121 compound, deforming the concrete-paved vehicle parking lot. The remaining portion of the landfill is undeveloped and unpaved. Miscellaneous debris (i.e., metal, ceramics, silverware, glass, clothing, wood pallets, tires, cut timber, and concrete rubble) were observed scattered across the surface or immediately below the surface of the landfill's undeveloped sections.

4.3.2.1 Terrain Conductivity Survey Results

The terrain conductivity survey was performed in an effort to identify the boundaries of the landfill (Figure 4.2). Based on the survey results, a high conductive anomaly is present along the eastern edge of the terrain conductivity survey. The anomaly corresponds to the adjacent arroyo and is most likely attributable to water-saturated gypsum soils located within the arroyo drainage channel. This conclusion is supported by the fact that higher conductivity readings were recorded as the topography dropped into the arroyo. In addition, water saturated soils were encountered approximately 0.5 to 2 feet below ground surface (bgs) in many of the soil borings completed in this area during the soil gas survey.

Several additional high conductive anomalies were also identified around the Building 121 complex. These anomalies corresponded to identified onsite surface structures including fence lines, lightning poles, and subsurface utility access ports. A moderately conductive anomaly is present in the southwestern portion of the survey boundary. This anomaly corresponds to an overall topographic low spot at the site and most likely attributable to the presence of highly conductive soils, as observed within the arroyo.

Several negative conductive anomalies were identified within the concrete-paved vehicle parking lot. The low conductive anomalies most likely represent rebar within the concrete pavement or possible voids spaces between the pavement and the underlying soils as observed during the visual site inspection.

4.3.2.2 Magnetic Survey Results

Excluding onsite metallic or magnetically susceptible structures, large discrete magnetic anomalies were not identified beneath LF-10 (Figure 4.3). Rather, LF-10 is underlain by numerous northwest-southeast trending linear magnetic anomalies which likely represent former disposal trenches, consistent with common historic Department of Defense trench/fill landfill practices. The magnetic highs and lows within the linear anomalies were not robust; however, a sufficient amount of metal must be present for the linear anomalies to be detected during the gradiometer magnetic survey. These anomalies cross the entire LF-10 area, extending from a buried gas line near Creosote Avenue to the arroyo's western and from Building 121 to the area covered with the stockpiled recyclable construction debris and electrical substation. The linear anomalies generally disappear beneath the developed sections of the landfill. The disappearance of the magnetic anomalies is most likely the result of soils and waste being reworked during the construction of the Building 121 complex or due to signal interferences from metallic or magnetically susceptible objects present around the Building 121 complex. The shallow depressions pockmarking the Building 121 parking lot

trend in the same direction as the magnetic anomalies indicating the former disposal trenches are still present beneath the Building 121 complex.

In addition to the linear magnetic anomalies, scattered magnetic anomalies were observed along the western and northern survey boundaries and within the arroyo. Within the arroyo, the magnetic anomalies were indicative of surficial metal debris. Along the northern and western survey boundaries, the magnetic anomalies were also indicative of surficial debris and metallic and magnetically susceptible objects.

4.3.2.3 LF-10 Geophysical Survey Conclusions

Geophysical surveying at LF-10 appears to have delineated the extent of the former landfill. Magnetic surveying, due to the metallic and magnetically susceptible materials within the landfill, allowed the identification of the former disposal trenches. Based on the aerial distribution of the former disposal trenches, the maximum extent of the landfill was inferred. The revised landfill boundaries are depicted by the green dashed line on Figures 4.2 and 4.3.

4.3.3 LF-19 (SWMU 105) - Golf Course Landfill

Visual inspection of the survey area was conducted at the time of the geophysical survey. Based on facility records, LF-19 encompasses two landfills. The larger landfill is located on the moderately to heavily vegetated southern facing slope of the Holloman AFB golf course. The upper portion of the slope is covered with large trees surrounding a barbwire enclosed cactus garden. Stockpiles of sand and soil used for golf course maintenance, and a pile of slashed vegetation were observed covering the northern landfill. Sections of drainage culvert piping, stored on the ground, were located in the southeastern portion of the northern landfill.

The southern landfill was separated from the northern portion by a shallow, dry drainage swale flanked on both sides by moderately sized shrubs. The topography of the southern landfill was relatively flat. The entire area south of the drainage swale was occupied by several unpaved service roads situated between northeast to southwest trending shallow mounds of soil. A few scattered pieces of metallic debris were observed on the surface of the shallow soil mounds. Site photographs are included in Appendix A.

4.3.3.1 Terrain Conductivity Survey Results

The results of the terrain conductivity survey are shown on Figure 4.4. Three very, localized high conductivity anomalies and one low conductivity anomaly were identified in the northern portion of the survey. These anomalies correspond to the barbwire fence present around the cactus garden.

Three large high conductivity anomalies where identified in the southwestern and southern portions of the survey area. Two of these anomalies overlap the previously defined northern and southern landfill boundaries of LF-19. The third anomaly was located between the northern and southern landfills. The conductivity anomalies are relatively amorphous in shape, and were not consistent with soil mound trends. In addition, the boundaries of the high

conductivity anomalies exhibited diffuse borders, indicating that the anomalies reflected either highly conductive saturated soils or buried non-magnetic waste. Based on site records, LF-19 reportedly received exclusively grass clippings.

4.3.3.2 Magnetic Survey Results

The LF-19 magnetic survey identified several magnetic anomalies. Excluding the anomalies associated with onsite monitoring wells and the barbwire fence, discrete magnetic anomalies were observed primarily in the southeast corner of the northern landfill and in the eastern portion of the southern landfill. Two of the anomalies corresponded to the corrugated drain pipe located on the surface. The other anomalies were identified in areas containing metallic or magnetically susceptible surficial debris.

4.3.3.3 LF-19 Geophysical Survey Conclusions

Geophysical surveying of LF-19 confirmed the absence of subsurface metallic anomalies. Magnetic surveying identified a few discrete magnetic anomalies associated with areas containing metallic or magnetically susceptible surficial debris. The lack of magnetic anomalies within the two landfills supports Base records indicating that LF-19 received almost exclusively non-metallic waste. Terrain conductivity results do not imply the presence of a landfill.

4.3.4 LF-21 (SWMU 116) – West Area Landfill No.2

Based on available facility documents, Forty-Niner Avenue, formerly bounding the landfill on the east, was relocated westward in 2005. The remaining portion of LF-21 (SWMU 116) was visually inspected immediately prior to geophysical surveying activities.

The topography of the site is relatively flat with minor variations present across the unit. The landfill is moderately vegetated with trees and shrubs growing primarily in small groupings. Debris consisting of asphalt, concrete, metal piping, wiring, sheet metal, and a wood door was observed scattered in small piles throughout the entire unit. One large green, metallic storage box and several former military foxholes were also observed, indicating the site has been used for training activities in the past. Based on the presence of surficial debris, the geophysical survey was extended to the west and south beyond the previously defined limits of LF-21, encompassing a total of 5 acres.

4.3.4.1 Terrain Conductivity Survey Results

LF-21 soils were identified as being moderately to highly conductive during the terrain conductivity survey (Figure 4.6). Conductivities were generally higher along the southeastern, southern, western, and northwestern portions of the survey area. No distinct conductivity patterns suggestive of landfill boundaries were discerned from the survey data.

Several high conductive anomalies were identified, two within the southeastern portion, near Forty-Niner Avenue; two in the north-central portion of the survey area, adjacent to Observatory Road; and one associated with a green metal shed. With the exception of the

green metal shed anomaly, the remaining high conductivity anomalies exhibited diffuse borders suggesting either saturated soil conditions or buried non-metallic debris. Several small, localized low conductivity anomalies were detected onsite. These anomalies typically occurred in the northeastern corner of the survey area.

4.3.4.2 Magnetic Survey Results

Magnetic surveying of LF-21 identified multiple magnetic anomalies that generally occurred within four distinct groupings across the survey area (Figure 4.7). The largest magnetic anomaly grouping occurred in the southeast portion of the landfill in an area littered with surficial metal debris. However, based on the visual inspection of the site, surficial metal debris was observed scattered in piles across the entire survey area.

Two of the magnetic groupings occurred in areas correspond to two of the high conductivity anomalies, one in the southeast corner of the survey area and one in the north-central portion of the survey. A third metal grouping was identified in the immediate vicinity of the low conductivity anomaly.

4.3.4.3 LF-21 (SWMU 116) Geophysical Survey Conclusions

Forty-Niner Avenue was relocated in 2005 and currently dissects the landfill into two. Consequently, the small portion of the previously defined unit boundary now beneath and east of Forty-Niner Avenue was not included in the geophysical survey. Neither the terrain conductivity nor the magnetic surveys indicate the presence of one large distinct landfill; however, based on historical documents, LF-21 reportedly received waste consisting of paper bags, food, cans, boxes, boards, and tree limbs, therefore, landfill material may be present with or without the presence of magnetic anomalies. Several conductivity anomalies were identified but exhibited diffuse boundaries suggesting either the presence of highly conductive soils or buried non-metallic waste. Terrain conductivity results do not imply the presence of a landfill.

4.3.5 LF-22 (SWMU 115) - West Area Landfill No.1

A visual inspection of LF-22 (SWMU 115) was conducted immediately prior to geophysical surveying activities. The unit was observed to be a construction debris rubble pile within a former drainage swale. Several trees bordered the debris laden drainage swale. The area surrounding the debris pipe was flat, sparsely vegetated with small shrubs, and contained minor amounts of surficial metallic debris.

4.3.5.1 Terrain Conductivity Survey Results

One large low conductivity anomaly was identified at LF-22 (Figure 4.8). The anomaly is roughly oblong in shape and is approximately 400 feet long and averages roughly 80 feet in width. The anomaly corresponds to the concrete debris laden drainage swale observed on site. No other anomalies were identified from the survey data.

4.3.5.2 Magnetic Survey Results

Numerous magnetic anomalies were identified at LF-22 (Figure 4.9). The majority of the magnetic anomalies correspond with the low conductivity anomaly (i.e., the concrete debris laden drainage channel). Few metallic objects were observed within and around the concrete rubble. This suggests metallic or magnetically susceptible items may be buried beneath the concrete rubble.

The remaining anomalies outside of the concrete rubble pile appear to be associated with onsite structures (i.e., fencing and monitoring wells) and surficial metal debris scattered across the survey area.

4.3.5.3 LF-22 (SWMU 115) - Geophysical Survey Conclusions

According to base records, LF-22 received waste in the form of plastic sheeting, boxes, and empty cans. Geophysical surveying identified one conductivity anomaly and multiple magnetic anomalies. The conductivity anomaly and most of the magnetic anomalies were associated with a concrete rubble pile located within a drainage swale. Based on the geophysical survey results, the previously established LF-22 landfill boundaries were modified to reflect the shape of the rubble pile as shown on Figures 4.8 and 4.9. Very little metallic or magnetically susceptible items were observed within the concrete rubble, indicating metallic and/or magnetically susceptible debris may be present beneath the concrete rubble pile.

4.3.6 LF-23 (SWMU 108) - MOBSS Landfill

The geophysical survey of LF-23 (SWMU 108) consisted of a terrain conductivity survey and magnetic survey. LF-23 was observed to be comprised primarily of concrete rubble placed on the northwestern slope of a former borrow pit. In addition, pipes, cables, a former utility vault, several rusted cans, asphalt, and gravel were observed at LF-23 intermixed with the concrete rubble. According to facility records, the unit was approximately 0.5 acres in size; however, during the visual inspection of the landfill, concrete debris was observed north of the landfill's defined boundary. Consequently, the geophysical survey was extended northward to encompass approximately 2.5 acres. Photographs of LF-23 are included in Attachment A.

4.3.6.1 Terrain Conductivity Survey Results

Two conductivity anomalies were identified at LF-23 (Figure 4.10). One was associated with the chain-link fence located along the survey's northern boundary. The second was located along the western edge of the survey within the former barrow pit. Given the diffused condition of the anomaly's borders and water observed ponded on the borrow pit soils during the geophysical survey, the anomaly is most likely attributable to highly conductive saturated soils. No conductive anomalies were observed within the concrete disposal areas of LF-23.

4.3.6.2 Magnetic Survey Results

Magnetic anomalies were observed at LF-23 (Figure 4.11). The anomalies were associated with onsite surface structures and the concrete debris observed along the northwestern slope of the former barrow pit.

4.3.6.3 LF-23 Geophysical Survey Conclusions

Based on the geophysical survey results and visual observations, LF-23 appears to be little more than a concrete debris pile located along the northeastern slope of a former borrow pit. Terrain conductivity anomalies are likely related to saturated soils. Magnetic anomalies were observed throughout the concrete rubble pile but generally clustered in small groupings. Debris observed included concrete rubble, piping, cables, asphalt, gravel, a concrete utility vault, several rusted cans of a black viscous material, and several open, approximately 30-gallon drums. Based on the association between the magnetic anomalies and the presence of the concrete rubble, the boundaries of LF-23 were modified to reflect the rubble pile. The modified landfill boundaries are depicted on Figures 4.10 and 4.11.

4.3.7 LF-29 (SWMU 104) - Former Army Landfill

A magnetic survey was conducted at LF-29 (SWMU 104), an area encompassing approximately 5 acres (Figure 4.12). LF-29 is a rectangular-shaped unit surrounded by a soil berm on all four sides. The floor of LF-29 is relatively flat and moderately vegetated. Metallic and non-metallic aircraft debris is present across the entire area.

4.3.7.1 Magnetic Survey Results

Several magnetic anomalies were identified at LF-29, primarily within the central and central-northern portion of the landfill. LF-29 is littered with both metallic and nonmetallic debris, Six distinct magnetic anomalies were identified at the site; however, the surface of LF-29 is littered with metallic and non-metallic debris. The identified metallic anomalies may be attributable to the surficial debris.

4.3.7.2 Conclusions

The landfill is bounded on all four sides by a soil berm. Magnetic surveying within the bermed area identified six large magnetic anomalies. It is unknown whether the anomalies represent debris buried beneath the surficial debris.

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5.0 PROPOSED ADDITIONAL ACTIVITIES

Based on a review of the July 2005 Supplemental RCRA Facility Investigation Work Plan, NMED requires trenching to be conducted at LF-10, and the submission of site-specific trenching plans for LF-10, LF-19, LF-21, LF-22, and LF-23 prior to initiating supplemental RFI activities (NMED, 2006). NMED also requires additional soil gas survey at LF-29 and LF-10.

Site-specific trenching plans are presented in the following subsections. Additional soil gas sampling activities are also discussed for LF-10 and LF-29.

5.1 INVESTIGATION APPROACH

5.1.1 Soil Gas Sampling

Based on a NMED Notice of Deficiency (NOD) letter (NMED, 2006); NMED requires a soil gas survey of LF-29 based on a 50 foot grid spacing. In addition, NMED requires the soil gas survey proposed at LF-10 be conducted on a 50 foot grid spacing rather than the proposed 100 foot grid spacing.

The soil gas survey of LF-10 was compiled utilizing a 100 foot grid spacing at a density of one sample per 0.2 acres as proposed in the RFI workplan in October 2005 (Section 3). The LF-10 soil gas survey identified low VOC concentrations sporadically across the entire landfill. If the VOCs detected in the soil gas samples are indicative of the landfill material, then the soil gas sampling results generally indicate minor VOC impacts. As discussed at meetings with NMED in February 2006, the distribution of positive detections and overall low concentrations of contaminants do not suggest data gaps or hot spots that could be better defined using a 50-foot interval.

Additional soil gas samples at LF-10 are proposed, however, to extend the previous soil gas survey boundaries southward and westward. The boundaries of the September-October 2005 soil gas survey were based on the inferred limits of the landfill material as defined by previous investigations. Magnetic data collected in during the geophysical survey of LF-10 indicate landfill material extends beyond the inferred landfill limits to the south and west. The additional soil gas samples are proposed to complete the landfill's soil gas survey.

As discussed in February meetings with NMED, soil gas surveying at LF-29 proposed to employ a combination of 50-foot intervals in areas of geophysical anomalies and 100-foot intervals elsewhere because of UXO concerns, as described in Section 5.7.1.

The soil gas survey at LF-29 and the additional soil gas samples at LF-10 will be collected utilizing the passive EMFLUX® sampling method. Sampling activities will be conducted in the same manner as discussed in Section 3 of this technical memorandum. Detailed discussions of the proposed activities are presented below in Sections 5.2 (LF-10) and 5.7 (LF-29).

5.1.2 Trenching

Prior to initiating trenching activities, the surface conditions of proposed trench locations will be documented in the field logbook. Observations including, but not limited to, the type of surficial waste (if any) including the presence of metallic and magnetically susceptible debris, the presence of vegetation, soil staining, and recent anthropogenic features will be recorded.

After documenting the surficial conditions of the proposed trench locations, trenching activities will be initiated. Trenching activities will be conducted in accordance with the July 2005 Supplemental RCRA Facility Investigation Work Plan (HGL, 2005b) unless otherwise noted in Sections 5.2 through 5.6 of this technical memorandum. Holloman AFB SOPs are included in the July 2005 work plan as Appendix I.

Trenches will extend into the subsurface until the source of the magnetic or conductivity anomaly is uncovered. If waste material is present, the associated trench will be advanced vertically until the base of the waste material, the top of the water table, or the maximum extent of the excavating equipment is achieved, in general whichever occurs first. If waste material is observed to extend below the top of the water table, spot locations within a trench may be extended several feet below the water table to determine the base of the landfill waste if the nature of the waste is heterogeneous. If waste is not encountered in a trench, the trench will be advanced to a maximum depth of 7 feet bgs. None of the trenches will extend horizontally longer than 30 feet.

Soil, excavated during trench advancement, will be stockpiled adjacent to the respective trenches. The stockpiled soil will be used to backfill the trench upon completion of the trench and trench characterization activities. Non-hazardous debris encountered during trenching will be placed back in the trench but will not be allowed within three feet of the surface. Backfill and compaction of the backfill material will be conducted in accordance with Holloman AFB SOPs and specifications; since trenching is forseen in only undeveloped areas, compaction and the import of fill will likely not be required. If potentially hazardous material is encountered within a trench, the hazardous material will be segregated from the non-hazardous material and stockpiled on plastic sheeting away from trenching activities and trenching will cease. The stockpiled, potentially hazardous material will be covered with plastic sheeting to prevent infiltration of precipitation and the generation of dust from the stockpile.

5.1.2.1 Trench Soil Sampling

During the horizontal and vertical advancement of a trench, soil characterization will be conducted via the excavator bucket to examine and field screen the landfill soils. Soils will be characterized using the Unified Soil Classification System and physically described (e.g., color, moisture content, and particle size percentages). In addition, bedding structures, former disposal trench sidewalls, and descriptions of the waste material (if present) will also be documented.

As proposed in the July 2005 Supplemental RCRA Facility Investigation work plan (HGL, 2005), soil samples will be collected for laboratory analysis only if hazardous materials

are encountered during trenching activities. Hazardous materials, for this work, will be considered to include unusual solids or fluids leaking from containers (e.g., drums, buckets, etc.), or free phase hydrocarbons.

In the January 17, 2006 NMED NOD letter, NMED requires soil samples to be collected directly beneath the waste material and at the soil water table interface if potentially hazardous materials are encountered. In addition, NMED requires NMED notification and consultation if hazardous materials are encountered to determine appropriate soil sample analytical requirements. Sampling methods and analyses will be conducted in accordance with the July 2005 QAPP (HGL, 2005a).

5.2 LF-10

5.2.1 Soil Gas Sampling

VOCs were positively detected in samples collected from the soil gas survey's western and southern boundaries and are unbounded by non-detect samples. Based on the LF-10 magnetic survey results, the soil gas survey's southwestern and southern boundaries lie within the former landfill boundary. Consequently, to accomplish the soil gas survey's main objective, to assess soil gas quality across LF-10, as well as evaluate the extent of VOC impacts in the southern portion of the landfill, additional soil gas sampling is proposed.

The proposed 27 additional soil gas samples will be collected by extending the 100 foot sampling grid westward and southward to include the remaining unsampled portion of the landfill and to delineate current unbounded VOC detections. The locations of the proposed additional soil gas samples are presented on Figure 5.1. Minor deviations of the proposed locations may occur based on site features. Soil gas samples will then be collected and analyzed in the same manner as the September and October 2005 sampling event.

5.2.2 Site-Specific Trenching Approach

Future activities associated with LF-10 will be addressed by the Air Force in a forthcoming letter.

5.3 LF-19

5.3.1 Site-Specific Trenching Approach

Geophysical survey results indicate limited to no metallic or magnetically susceptible debris is present within the LF-19 landfill. This is consistent with the LF-19 waste history. Magnetic anomalies detected during the geophysical surveys correspond primarily to known areas littered with magnetic susceptible surficial debris and observed metallic or magnetically susceptible objects (i.e., barbwire fencing, monitoring wells, and corrugated pipes). Conductivity surveying identified several high conductivity anomalies that exhibit characteristics indicative of saturated or high conductivity soils rather than buried waste. Based on the survey results, three trenches are proposed for LF-19. The proposed trench locations are shown on Figure 5.2.

Groundwater beneath LF-19 has historically been measured to range between 7 to 11 feet bgs (HGL, 2005b).

5.4 LF-21

5.4.1 Site-Specific Trenching Approach

Based on the magnetic survey of LF-21, distinct magnetic anomalies are present throughout the survey area but generally correspond to four distinct anomaly groupings. The largest grouping encompasses the entire southern portion of the landfill, an area littered with surficial debris. Three of the magnetic anomaly groupings correspond to high and low conductivity anomalies. Two of the magnetic and one corresponding conductivity anomaly lie outside the defined boundaries of the landfill indicating either the landfill is larger than previously determined or the anomalies represent surficial debris.

Within the landfill, as previously defined, five trenches are proposed due to the well-defined but scattered presence of detected magnetic anomalies. The five trenches will be considered spot trenches and completed adjacent to the magnetic anomalies and associated conductivity anomalies. Outside the previously defined landfill boundaries, two trenches are proposed in the western portion of the landfill adjacent to identified magnetic anomalies. These two trenches will be completed as spot trenches to determine the presence or absence of waste material in an effort to fully delineate LF-21. The locations of the proposed trenches and associated magnetic anomalies are presented on Figure 5.3.

Groundwater beneath LF-21 has historically been measured to range between 6.5 to 9 feet bgs (HGL, 2005b).

5.5 LF-22

5.5.1 Site-Specific Trenching Approach

Although LF-22 encompasses less than one acre, based on geophysical survey results, three trenches have been proposed due to the length of the LF-22. The three trenches will be located within the landfill and located near identified magnetic anomalies. The trenches will be completed adjacent to identified magnetic anomalies as shown on Figure 5.4.

Based on the geophysical survey and visual site inspection, LF-22 is comprised of concrete rubble located within a drainage swale. Waste material may be present beneath the concrete rubble. Therefore, trenching will consist of removing the concrete rubble on the surface and vertically advancing the trenches until the source of the magnetically susceptible anomaly is identified or the absence of buried magnetically susceptible debris is verified.

Groundwater beneath LF-22 has historically been measured to range between 11 and 12 feet bgs (HGL, 2005b).

5.6 LF-23

5.6.1 Site-Specific Trenching Approach

Based on the geophysical survey and visual site inspection, LF-23 is composed of construction and demolition rubble located along the eastern slope of the borrow pit. Geophysical survey results determined the landfill encompasses approximately 2.1 acres, extending over 850 feet in length and 50 to 190 feet in width. Based on the length of the landfill, three trenches are proposed and located in areas containing magnetic anomalies. Waste disposal at LF-23 may have advanced the landfill slope westward; therefore, the proposed trenches will trend in an east-west direction, perpendicular to the former borrow pit's slope. Trenching will consist of removing the rubble overburden and vertically advancing the trenches until the source of the magnetically susceptible anomaly is identified or the absence of buried magnetically susceptible debris is verified. In addition, a fourth trench will be completed adjacent to several metallic drums observed on site during the geophysical survey. The locations of the proposed trenches are depicted on Figure 5.5.

Groundwater beneath LF-23 has historically been measured to range between 4 and 9 feet bgs.

5.7 LF-29

5.7.1 Soil Gas Sampling

In the January 17, 2006 NMED NOD, NMED requires the completion of a soil gas survey at LF-29 utilizing a 50-foot grid spacing (NMED, 2006). However, as discussed during our meetings with NMED on 21-23 February, we propose to perform soil gas surveying at 50-foot spacing in areas proximal to significant geophysical anomalies, and at 100-foot intervals elsewhere, in order to reduce the amount of intrusive work at the site, given the UXO avoidance procedures that must be employed at LF-29. The locations of the proposed soil gas samples are depicted on Figure 5.6.

5.7.2 LF-29 Soil Boring Sampling

The July 2005 Supplemental RCRA Facility Investigation Work Plan specified that soil borings will be completed adjacent to identified magnetic anomalies and sampled (HGL, 2005b). NMED concurred in Comment 2 of their NOD letter that trenching at LF-29 would not be required. A total of seven magnetic anomalies were identified within the landfill. Therefore, to minimize soil disturbance due to potential MECs, the soil gas sample closest to each magnetic anomaly will be converted into a soil boring. In addition, soil gas sample locations where soil gas samples contain positively detected VOCs, excluding VOCs considered to be indicative of blank contamination, will also be converted into soil borings and sampled.

The soil borings will be completed to a maximum depth of 20 feet bgs, until groundwater is encountered or refusal occurs. During borehole advancement, soil samples will be collected continuously for characterization and field screening using a photoionization detector in

accordance with the July 2005 work plan (HGL, 2005b). One subsurface soil sample per boring will be collected from the most likely contaminated soil interval, based on field screening and visual inspection results. If field screening and a visual inspection of the soil samples fail to indicate contamination, a soil sample collected at the top of the water table will be submitted for laboratory analysis. The collected soil samples will be submitted for VOCs, SVOCS, RCRA metals, TPH, explosives and perchlorate, in accordance with the work plan and NMED comments (NMED, 2006). Analytical requirements will be consistent with the project QAPP (HGL, 2005a).

6.0 REFERENCES

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FIGURES