DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

DEC 12 2019

Colonel David S. Miller
Commander
377th Air Base Wing
2000 Wyoming Blvd SE
Kirtland AFB NM 87117

Mr. Dave Cobrain
Hazardous Waste Bureau (HWB)
New Mexico Environment Department (NMED)
2905 Rodeo Park Drive East, Building 1
Santa Fe NM 87505-6303

Dear Mr. Cobrain

Attached, please find the *Quarterly Monitoring Report for July – September 2019, Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111, Kirtland Air Force Base, New Mexico,* dated December 2019. This report summarizes vadose zone activities, groundwater monitoring, and interim measure activities associated with the distal plume capture and treatment system at ST 106/SS-111.

If you have any questions or concerns, please contact Mr. Scott Clark at commercial line (505) 846-9017 or email scott.clark@us.af.mil; or Mr. Sheen Kottkamp at commercial line (505) 846-7674 or email sheen.kottkamp.1@us.af.mil.

Sincerely

DAVID S. MILLER, Colonel, USAF
Commander

Attachment:
Quarterly Monitoring Report for July – September 2019, Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111, Kirtland Air Force Base, New Mexico, dated December 2019; 2 Hard Copies/2 CDs

cc:
NMED-OOTS (Pruett), letter
NMED-OOTS (McQuillan), letter and CD
NMED GWQB (Hunter), letter and CD
NMED Resource Protection Division (Stringer), letter and CD
EPA Region 6 (King, Ellinger), letter and CD
COA (Ziegler), letter and CD
ABCWUA (Agnew), letter and CD
SAF-IEE (Lynnes), electronic only
AFCEC/CZ (Renaghan, Clark, Kottkamp, Segura, Fitzner), electronic only
USACE-ABQ District Office (Moayyad, Phaneuf, Dreeland, Cordova, Kunkel), electronic only
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KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

QUARTERLY MONITORING REPORT – JULY-SEPTEMBER 2019 BULK FUELS FACILITY SOLID WASTE MANAGEMENT UNIT ST-106/SS-111 KIRTLAND AIR FORCE BASE, NEW MEXICO

DECEMBER 2019

377 MSG/CEI
2050 Wyoming Boulevard SE
Kirtland Air Force Base, New Mexico 87117-5270

KIRTLAND AIR FORCE BASE
ALBUQUERQUE, NEW MEXICO

Quarterly Monitoring Report – July–September 2019
Bulk Fuels Facility
Solid Waste Management Unit ST-106/SS-111
Kirtland Air Force Base, New Mexico

December 2019

Prepared for
Kirtland Air Force Base
2050 Wyoming Boulevard SE
Kirtland Air Force Base, New Mexico 87117-5270

Prepared by
EA Engineering, Science, and Technology, Inc., PBC
320 Gold Avenue Southwest, Suite 1300
Albuquerque, New Mexico 87102
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14. ABSTRACT

This Quarterly Report describes activities performed from July 1 through September 30, 2019 and the progress of the Resource Conservation and Recovery Act interim measures for soil and groundwater remediation at Solid Waste Management Unit ST-106/SS-111, the Bulk Fuels Facility Site, at Kirtland Air Force Base, New Mexico. During the quarter, soil vapor (bioventing pilot test), groundwater, drinking water from supply wells, and the groundwater treatment system (GWTS) samples were collected and analyzed for contaminants of concern (notably ethylene dibromide [EDB]) and other relevant field and laboratory parameters. The GWTS extracted and treated 65,771,100 gallons of groundwater through a granular activated carbon filtration system and discharged the treated effluent to the Tijeras Arroyo Golf Course main pond and injection well KAFB-7 in the third quarter (Q3) 2019. The GWTS was running 98 percent of the time and removed approximately 2,978 milligrams of EDB in Q3 2019.

15. SUBJECT TERMS

Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111, ethylene dibromide, EDB, interim measures, RCRA, groundwater sampling, groundwater treatment system operation, granular activated carbon, ethylene dibromide

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DAVID S. MILLER, Colonel, U.S. Air Force
Commander, 377th Air Base Wing

12 Dec 19
Date

This document has been approved for public release.

Athana Zuch
KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

12/9/19
Date

PREFACE

This Quarterly Monitoring Report – July–September 2019 has been prepared by EA Engineering, Science, and Technology, Inc., PBC (EA) for Kirtland Air Force Base under the U.S. Army Corps of Engineers Contract Number W912DR-12-D-0006, Delivery Order DM01 and pertains to the Base Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS 111, located in Albuquerque, New Mexico.

This report contains data collected by EA itself as well as from other entities/sources that are not under EA's direct control (collectively "non-EA Data"). All non-EA data reported herein are displayed in the form they were received from their source entity, and EA assumes no liability for the accuracy of any non-EA data in this report.

This report was prepared in accordance with applicable federal, state, and local laws and regulations, including the New Mexico Hazardous Waste Act, New Mexico Statutes Annotated 1978, New Mexico Hazardous Waste Management Regulations, Resource Conservation and Recovery Act, and regulatory correspondence between the New Mexico Environment Department Hazardous Waste Bureau and the U.S. Air Force, dated March 25 and May 20, 2016.

Monitoring of groundwater, drinking water, and operation of the groundwater treatment system was conducted from July 1 through September 30, 2019.

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	microgram(s) per liter
µS/cm	microSiemens per centimeter
%	percent
AFB	Air Force Base
ARV	air relief valve
BFF	Bulk Fuels Facility
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CFR	Code of Federal Regulations
DO	dissolved oxygen
DoD	Department of Defense
DP	discharge permit
EA	EA Engineering, Science, and Technology, Inc., PBC
EDB	ethylene dibromide (1,2-dibromoethane)
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
ft	foot (feet)
GAC	granular activated carbon
gpm	gallon(s) per minute
GWM	groundwater monitoring
GWTS	groundwater treatment system
ID	identification
IDW	investigation-derived waste
LNAPL	light non-aqueous phase liquid
MCL	maximum contaminant level
mg	milligram(s)
mg/L	milligram(s) per liter
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
No.	number
O&M	operation and maintenance
ORP	oxidation-reduction potential
psi	pound(s) per square inch
PSL	project screening level

Q1	first quarter of the year, January 1 through March 31
Q2	second quarter of the year, April 1 through June 30
Q3	third quarter of the year, July 1 through September 30
Q4	fourth quarter of the year, October 1 through December 31
QAPjP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
REI	reference elevation interval
SE	Southeast
SMTP	simple mail transfer protocol
SVM	soil vapor monitoring
SWMU	Solid Waste Management Unit
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VA	Veterans Affairs

EXECUTIVE SUMMARY

The investigation and remediation of the Kirtland Air Force Base (AFB) Bulk Fuels Facility (BFF) release (Solid Waste Management Unit [SWMU] ST-106/SS 111) are being implemented pursuant to the Resource Conservation and Recovery Act (RCRA) corrective action provisions in Part 6 of Kirtland AFB's Hazardous Waste Treatment Facility Operating Permit (Permit Number NM9570024423 [RCRA Permit]) (New Mexico Environment Department [NMED], 2010). This report for the third quarter (Q3) of calendar year 2019 summarizes the activities performed from July 1 through September 30, 2019. These activities are part of ongoing monitoring for the Phase 2 RCRA Facility Investigation and to support the evaluation of the dissolved-phase ethylene dibromide (EDB) groundwater pump and treat interim measure and *in situ* biodegradation pilot study.

This Executive Summary describes the following Q3 2019 groundwater monitoring (GWM), interim measure, and pilot activities performed at the BFF between July and September 2019:

- Continuation of the bioventing pilot test for wet respirometry evaluation
- Sampling of the GWM network
- Monthly sampling of the drinking water supply wells located in the vicinity of the plume containing dissolved-phase benzene (south of Ridgecrest Drive Southeast [SE]) and dissolved-phase EDB
- Operation and maintenance of the groundwater treatment system (GWTS) to remove EDB from groundwater extracted from the dissolved-phase distal portion of the plume, which is the Target Capture Zone for the groundwater interim measure
- Projected activities in the fourth quarter (Q4) 2019.

ES-1 Vadose Zone Monitoring

The bioventing pilot testing includes short-duration "dry" and "wet" respiration tests (approximately 3 weeks), followed by a longer-term (2 years in duration) bioventing pilot test. Data collected from the short-duration respiration test will be used to refine the design and details of the long-term test. Results of the bioventing test will be used to evaluate the feasibility of this technology in the upcoming Corrective Measures Evaluation.

In Q3 2019, the bioventing pilot test continued. The wet respirometry test was completed and post-wet respirometry vapor samples were collected on July 5, 2019. A bioventing report will be submitted in January 2020 as requested by NMED in a letter dated February 25, 2019 (NMED, 2019). The bioventing report will include data collected up to Q4 2019. Data collected after Q4 2019 will be provided in the relevant quarterly monitoring reports.

ES-2 Groundwater Monitoring Network Gauging and Sampling

In Q3 2019, 64 Kirtland BFF GWM wells (Figure 3-1) were sampled. Depths to groundwater were measured in 162 GWM wells. Findings from the Q3 2019 sampling and gauging event include:

- Groundwater levels showed an overall average increase across the GWM network of 0.17 feet (ft) since quarter 2 (Q2) 2019.

- Light non-aqueous phase liquid was detected and measured in five wells (KAFB-106014, KAFB-106059, KAFB-106076, KAFB-106079, and KAFB-106154-484; located south of Ridgecrest Drive SE) during gauging (Figure 3-5).

- Fifteen recently installed wells were sampled in Q3 2019 (Figure 3-1).

The U.S. Geological Survey (USGS) monitors 14 sentinel wells between the Kirtland AFB BFF EDB plume and the Albuquerque Bernalillo County Water Utility Authority and Veterans Affairs Medical Center water supply wells as a means of providing independent observation of water quality in the vicinity of these water supply wells. Samples are collected from these sentinel wells quarterly. Q3 2019 samples were collected during the time period of July 15–18, 2019. The USGS transmittal letter, including the Q3 2019 data results, are provided in Appendix E-5.

ES-3 Drinking Water Supply Well Monitoring

Four drinking water supply wells (KAFB-003, KAFB-015, KAFB-016, and ST106-VA-2) are located in the vicinity of the dissolved-phase EDB plume. These wells were sampled monthly from July to September in Q3 2019 and analyzed for EDB and benzene, toluene, ethylbenzene, and total xylenes (BTEX). No EDB or BTEX concentrations were detected in groundwater samples collected from these four drinking water supply wells (Figure 4-1).

ES-4 Groundwater Treatment System Operation

The GWTS consists of two treatment trains. Each treatment train is comprised of a lead granular activated carbon (GAC) vessel followed by a polishing GAC vessel. The GWTS ran for 98 percent of the time from July 1 to September 30, 2019, and 65,771,100 gallons of groundwater was treated during this period. Of the treated water, 56,808,500 gallons was discharged to the Tijeras Arroyo Golf Course main pond, and 8,962,600 gallons was discharged to gravity-fed injection well KAFB-7. Concentrations of EDB and BTEX were non-detect in all mid-GAC and effluent monthly samples collected from either train during Q3 2019. Dissolved manganese was detected at an estimated (J-flag by the laboratory) concentration that was below the project screening level (PSL) concentration in effluent monthly samples collected from Train 1 in August 2019. Dissolved iron and manganese were detected at an estimated concentration that was below the PSL concentrations in mid-GAC and effluent monthly samples, respectively, collected from Train 2 in August 2019.

Although the EDB detections were at estimated concentrations (J-flag by the laboratory) and well below actionable levels (defined as 90 percent of the maximum contaminant level), the detected concentrations of EDB prompted a GAC changeout in both trains in order to continue conservative operations of the GWTS. The GAC was changed out for Train 1 on June 11, 2019, and for Train 2 on July 9, 2019. EDB effluent concentrations for both trains have been below the detection limit since the GAC changeout in Train 1. During Q3 2019, a calculated 2,978 milligrams (mg) of EDB was captured in the lead GAC vessels. Of this total, 22 mg was removed by Train 1, and 2,956 mg was removed by Train 2.

During Q3 2019, some short-term, unscheduled shutdowns occurred due to maintenance activities, electrical fluctuations, and vault leak detections from rainwater intrusion. None of these events resulted in long-term shutdowns and only one involved the full extraction well system. On July 9, 2019, there was a scheduled 36-hour shutdown of Train 2 when the carbon in the Train 2 GAC Tank A was changed out.

Train 1 could not be kept online overnight due to a failure of the Train 1 influent tank (TK-110) level transducer that required running Train 1 manually while GWTS personnel were present. Thus, during the Train 2 GAC Tank A changeout, the entire system was offline for approximately 16 hours between July 9 and 10, 2019.

ES-5 Projected Activities

Planned activities for Q4 2019 include:

- Continue the long-term bioventing pilot test. A report summarizing the available results of the bioventing pilot tests will be submitted to NMED by January 31, 2020.
- Sample the soil vapor monitoring points.
- Sample the Q4 2019 designated wells and measure depth to water in the GWM network beginning in October 2019.
- Sample drinking water supply wells for organic compounds on a monthly basis.
- Operate the GWTS and extraction wells KAFB-106228, KAFB-106233, KAFB-106234, and KAFB-106239 with discharge to the Golf Course main pond and injection well KAFB-7.

1. INTRODUCTION

The investigation and remediation of the Kirtland Air Force Base (AFB) Bulk Fuels Facility (BFF) release (Solid Waste Management Unit [SWMU] ST-106/SS 111) are being implemented pursuant to the Resource Conservation and Recovery Act (RCRA) corrective action provisions in Part 6 of Kirtland AFB's Hazardous Waste Treatment Facility Operating Permit (Permit Number [No.] NM9570024423 [RCRA Permit]) (New Mexico Environment Department [NMED], 2010). This Quarterly Report for the third quarter (Q3) of calendar year 2019 summarizes the activities performed from July 1 through September 30, 2019. The reporting schedule is provided in the Work Plan for BFF Expansion of the Dissolved-Phase Plume Groundwater Treatment System (GWTS) Design (Kirtland AFB, 2017a). This Q3 2019 Quarterly Report presents non-cumulative data for Q3 2019. Key regulatory correspondence for Q3 2019 is provided in Appendix A.

The BFF site is located within the northwestern portion of Kirtland AFB, on the southern end of the city of Albuquerque, as shown on the site location map (Figure 1-1). The Phase I RCRA Facility Investigation (Kirtland AFB, 2018a) provides a detailed site description, history, and conceptual site model. Vadose zone and groundwater investigation and remediation activities are required to address the potential impact of fuels that were released from leaking pipelines at the former fuel off-loading rack.

Groundwater monitoring (GWM) and interim measures for SWMU ST-106/SS-111 were conducted concurrently. The Q3 2019 monitoring program was performed in accordance with multiple work plans: (1) bioventing pilot test (Kirtland AFB, 2018b), (2) GWM (NMED, 2017a, 2018a; Kirtland AFB, 2017a, 2017b), and (3) drinking water supply wells (NMED, 2018b; Kirtland AFB, 2017c). GWTS operations, sampling, and treated effluent discharge were performed under the Operation and Maintenance (O&M) Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c).

2. VADOSE ZONE MONITORING

This section describes the vadose zone monitoring activities conducted during Q3 2019. Section 2.1 provides a brief overview of the bioventing pilot project activities completed in Q3 2019. No soil vapor monitoring (SVM) activities were performed during Q3 2019 (Section 2.2).

2.1 Bioventing Pilot Test

The bioventing pilot test is being performed in accordance with the Bioventing Respiration Test Procedure (Kirtland AFB, 2018d) and the approval conditions requested by NMED in a letter dated February 25, 2019 (NMED, 2019). The bioventing pilot testing includes short-duration "dry" and "moist" respiration tests (approximately 3 weeks), followed by a longer-term (2 years in duration) bioventing pilot test. Data collected from the short-duration respiration test will be used to refine the design and details of the long-term test. Results of the bioventing test will be used to evaluate the feasibility of this technology in the upcoming Corrective Measures Evaluation.

The bioventing pilot test design utilizes existing soil vapor extraction wells and existing SVM wells for air injection and two new SVM well clusters at KAFB-106V1 and KAFB-106V2 (completed under a separate work plan [Kirtland AFB, 2017c]) for observation. Well locations are shown on Figure 2-1. Pilot testing will use a rotary vane pump for the respiration testing and a regenerative blower for the longer-term bioventing test.

Bioventing equipment was installed in March 2019. Baseline analytical samples and respirometry readings were collected in April. The dry respiration field test was performed from April to May, and the wet respiration field test was initiated in May. In Q3 2019, the wet respiration field test was completed and post-wet respirometry vapor sampling was conducted on July 5, 2019. Post-wet respirometry samples were collected from each of the nested wells within KAFB-106V1 and KAFB-106V2 on July 5, 2019. Analytical samples were collected using 6-liter Summa cannisters and were analyzed by Eurofins Air Toxics for benzene, toluene, ethylbenzene, and total xylenes (BTEX)/total petroleum hydrocarbons (TPH)-gasoline range organics by U.S. Environmental Protection Agency (EPA) Method TO-3, volatile organic compounds by EPA Method TO-15 Select Ion Monitoring, and fixed gases/C1-C5 hydrocarbon compounds by ASTM International D1945. Data and results from the wet and dry respiration tests are included in Appendix B.

A bioventing report will be submitted in January 2020 as requested by NMED in a letter dated February 25, 2019 (NMED, 2019). The bioventing report will include data collected up to fourth quarter (Q4) 2019. Data collected after Q4 2019 will be provided in the relevant quarterly monitoring reports.

2.2 Vadose Zone Soil Vapor Data Collection

No SVM activities were performed during Q3 2019. The SVM program is performed semiannually in the second quarter (Q2) and Q4 of each year (NMED, 2018b). Appendices C and D remain in this report as placeholders; information will be included in these appendices following the semiannual sampling events. The next semiannual SVM event will be performed in Q4 2019.

3. GROUNDWATER MONITORING NETWORK GAUGING AND SAMPLING

At the end of Q3 2019, the BFF GWM well network was comprised of 167 GWM wells (Figure 3-1, Table 3-1) and 64 of these wells were sampled in Q3 in accordance with the sampling requirements (Table 3-2).

Throughout this report, GWM wells, and their associated groundwater data, are described based on reference elevation intervals (REIs). REIs are below ground surface elevations that divide the GWM network into data sets comprised of wells that are screened across their respective elevations, allowing for a vertical evaluation of groundwater parameters and contaminant locations. Currently, wells are assigned to three REIs (4857, 4838, and 4814). A detailed explanation of how the REIs are defined is presented in the Q4 2016 Quarterly and Annual Report (Kirtland AFB, 2017e).

In previous reports, GWM wells were assigned designations based either on their location related to the groundwater gradient and their spatial relationship to the dissolved-phase ethylene dibromide (EDB) plume or simply on their location (i.e., source area, etc.). In response to the changing regional groundwater gradient (Q2 2018 Quarterly Monitoring Report [Kirtland AFB, 2018e]), well designations are no longer used in figures and analytical results tables. The former well designations and current monitoring well objectives are provided in Table 3-1 along with the current sampling regime by quarter. A detailed description of the former well designations and the frequency of samples collected by designation is provided in the 2018 Q4 Quarterly and Annual Report (Kirtland AFB, 2019a).

In this report, sample results from GWM wells are discussed based on their location (north or south) in relation to Ridgecrest Drive Southeast (SE). The plume containing dissolved-phase benzene is located south of Ridgecrest Drive SE, while the distal section of the EDB plume (Target Capture Zone for the groundwater interim measure) is primarily located north of Ridgecrest Drive SE.

GWM activities included measuring the depths to groundwater and light non-aqueous phase liquid (LNAPL) (Table 3-3 and Figures 3-2 through 3-5) and measuring field parameters in wells sampled with low-flow sampling pumps. Field parameter measurements are not part of the passive sampling methodology, as discussed in more detail in the Q4 2017 Quarterly and Annual Report (Kirtland AFB, 2018f). Groundwater samples were collected and submitted for laboratory analysis from 64 wells in Q3 2019 (Tables 3-4 through 3-6 and Figures 3-6 and 3-7).

Appendices pertinent to GWM are listed below:

- Appendix E-1 Daily Quality Control Reports – Groundwater Sampling
- Appendix E-2 Groundwater and LNAPL Measurements
- Appendix E-3 Groundwater Purge Logs and Sample Collection Logs
- Appendix E-4 Groundwater Sample Chain-of-Custody Forms
- Appendix E-5 U.S. Geological Survey Sentinel Well Data
- Appendix F-1 Data Quality Evaluation Report – Groundwater Samples
- Appendix F-2 Data Packages – Groundwater Samples
- Appendix F-3 EPA Data Verification and Validation Figures.

3.1 New Groundwater Monitoring Activities

After four quarters of baseline sampling, newly added wells will be assigned an objective and moved into their relevant sampling regime in the following quarter (Table 3-7), in accordance with the Work Plan for

Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling (Kirtland AFB, 2017c). For wells KAFB-106S2, KAFB-106S3, KAFB-106S4, and KAFB-106S5, baseline sampling will be completed in Q4 2019. For wells KAFB-106S1, KAFB-106S7, KAFB-106S8, KAFB-106S9, and KAFB-106247, baseline sampling will be completed in the first quarter (Q1) 2020.

Six data gap wells were installed in Q2 and Q3 2018. For wells KAFB-106241-428, KAFB-106242-418, and KAFB-106243-425, baseline sampling was completed in Q3 2019. For wells KAFB-106240-449, KAFB-106244-445, and KAFB-106245-460, baseline sampling will be completed in Q4 2019.

3.2 Groundwater and Light Non-Aqueous Phase Liquid Gauging

Depth to water was measured in 162 of the 167 GWM wells between July 8 and 10, 2019 (Figures 3-2 through 3-4; Table 3-3), using two Solinst Model 122 oil-water interface probes and a Geotech interface probe in accordance with the approved work plan (Kirtland AFB, 2017a). Section 3.2.1 describes the difference between the number of wells gauged and the number in the monitoring network. Each well was also checked for the presence of LNAPL (Figure 3-5). Of the 86 GWM wells in REI 4857 gauged in Q3 2019, 33 wells had screens that intersected the current water table while the remaining wells had submerged well screens (Figure 3-2). Screen submergence in REI 4857 wells that were gauged in Q3 2019 ranged from 0.46 to 23.65 feet (ft) (KAFB-106025) (Table 3-3).

The interface probe was checked for proper operation and cable integrity prior to each use and was decontaminated after gauging each well. If LNAPL was detected using the interface probe, a plastic bailer was used to confirm the presence and thickness of the LNAPL. Additionally, during Bennett pump sampling, every well was checked for the presence of LNAPL. Depths to LNAPL and groundwater were recorded in the field on well gauging forms (Appendix E-2).

Depth to water in the GWM wells was gauged by two field teams. One team used two dedicated Solinst Model 122 oil-water interface probes (Serial Nos. 253053 and 253056, which is dedicated to measuring water levels in wells that have historically met hazardous waste criteria) and the other used a dedicated Geotech interface probe (Serial No. 0001). Depth to water measurement differences between the three interface probes were identified by measuring depth to water with each interface probe in three GWM wells south of the source area (KAFB-106027, KAFB-106044, and KAFB-106045) (Appendix E-2). The measurement difference between the two Solinst probes is approximately 0.01 ft. During the 3-day gauging period, barometric pressure changes can cause water levels in a given well to vary by up to 0.15 ft, even after diurnal variations are taken into account (Kirtland AFB, 2016b). The difference of 0.01 ft measured between the two Solinst probes is minimal as compared to the naturally occurring changes that could exist between measurements taken over the 3-day gauging period. Based on this, corrections were not made to water level measurements taken with these interface probes in Q3 2019. The measurement difference between the Geotech probe and the two Solinst probes was approximately 0.10 ft, 66 percent (%) of natural groundwater level fluctuations. Therefore, depth to water measurements taken using the Geotech probe were adjusted down by 0.10 ft.

Groundwater elevations from each REI were used to create potentiometric surface maps (Figures 3-2 through 3-4). Horizontal groundwater gradients within the monitoring network are dominated by a radial flow pattern toward depressions in the water table, which are primarily attributable to groundwater extraction. Prior to and during Q3 2019 gauging, groundwater extraction wells KAFB-106233, KAFB-106234, and KAFB-106239 were mostly inactive due to the granular activated carbon (GAC) changeout that occurred during the same time period (Section 5.3). As a result, the horizontal groundwater gradient observed in Q3 2019 is primarily flat, trending east toward production well KAFB-003 in the northern extent of the network and with a radial flow pattern in the middle section of the network toward a

depression around extraction well KAFB-106228, which was pumping during gauging (Figures 3-2 through 3-4).

LNAPL was measured in KAFB-106014, KAFB-106059, KAFB-106076, KAFB-106079, and KAFB-106154-484 in Q3 2019 at thicknesses of 0.06, 0.21, 0.01, 0.15, and 0.21 ft, respectively (Table 3-3 and Figure 3-5). All five wells with LNAPL are located south of Ridgecrest Drive SE on-Base. KAFB-106014, KAFB-106059, KAFB-106076, and KAFB-106079 had measurable LNAPL present in Q2 2019.

3.2.1 Gauging Deviations

Water level measurements were not obtained from five wells in Q3 2019. Depth to water in wells KAFB-106063 and KAFB-106064 could not be measured due to the presence of dedicated downhole equipment related to the Environmental Security Technology Certification Program pilot test project for EDB *in situ* biodegradation. An interface probe was deployed in KAFB-106211; however, there was no water column to measure. This well will be added to the sampling network once the water level rises enough to allow for passive sampling. Depth to water was not measured in monitoring wells KAFB-106026 and KAFB-106230 due to a nearby homeowner who has made threats to field staff in the past; this is not a deviation as the wells were removed from gauging requirements following the incident, but is noted herein to explain the difference between the number of wells gauged and the number in the monitoring network. These wells will be gauged in the future with a security officer present. It is anticipated that these measures will be in place for the Q4 2019 GWM event.

3.3 Groundwater Sampling

Quarterly groundwater samples were collected from 64 wells in the GWM network between July 15 and August 13, 2019 using portable low-flow pump systems or passive sampling methods (Table 3-2). Well locations are shown on Figure 3-1. Groundwater samples collected for the Q3 2019 monitoring event were analyzed for EDB, while select wells, including newly installed wells, were additionally analyzed for BTEX, anions, alkalinity, and metals (Table 3-2). Groundwater samples were analyzed by Eurofins Lancaster Laboratories Environmental, LLC located in Lancaster, Pennsylvania, which maintains current Department of Defense (DoD) Environmental Laboratory Accreditation Program certification. The groundwater purge and sampling forms are provided in Appendix E-3 and the chain-of-custody forms are provided in Appendix E-4.

For low-flow sampling, well water was purged continuously at a flow rate between 0.5 and 1 liter per minute, while field parameters (turbidity, temperature, dissolved oxygen [DO], specific conductivity, pH, and oxidation reduction potential [ORP]) were measured and recorded every 5 minutes. Samples were collected after parameters stabilized for three consecutive readings within 10% of one another, or after 1 hour of purging. Field parameters were recorded on the field forms (Appendix E-3). Wells without a dedicated low-flow pump sampling system were designated, based on historical analytical data, as either clean, intermediate, or hazardous. Decontaminated non-dedicated tubing and portable low-flow pumps were used to sample wells designated as clean. The entire sampling assembly was decontaminated following use at each well. Dedicated tubing specific to a given well was used for wells designated as intermediate or hazardous.

Field parameters are not collected as part of the passive sampling methodology, as discussed in more detail in the Q4 2017 Quarterly and Annual Report (Kirtland AFB, 2018f). Field parameters were measured only from wells that were sampled using the low-flow methodology.

3.3.1 Sampling Deviations

Well KAFB-106211 will be added to the GWM network once the water level rises enough to allow for passive sampling.

3.4 Data Review and Usability Results

The Q3 2019 groundwater analytical data underwent EPA 100% Level 3 data validation by an independent third-party subcontractor, Environmental Data Services, Inc., Virginia Beach, Virginia, following data verification. Data verification is performed on a data set to ensure method, procedural, and contractual compliance with project-specific requirements and is typically performed by the contractor responsible for data collection. Data validation is an analyte- and sample-specific process that extends the evaluation of analytical data beyond the data verification process to determine the analytical quality of a specific data set.

Data verification and data validation are sequential steps in a data review process that can be performed by either the contractor collecting the data or an independent third-party subcontractor. For this project, verification is performed by the contractor to ensure compliance with the project Quality Assurance Project Plan (QAPjP), Appendix D of the Work Plan for BFF Expansion of the Dissolved-Phase Plume GWTS and associated QAPjP (Kirtland AFB, 2017a) and is performed during or at the completion of field or laboratory data collection activities. EPA Stage 3 data validation is conducted by Environmental Data Services, Inc. and incorporates the data verification process and further evaluates data quality based on analytical method-specific quality control criteria and DoD Quality Systems Manual requirements as documented in the project QAPjP. Further details regarding EPA data verification and validation processes are documented in Figures 2 and 4 of the Guidance on Environmental Data Verification and Data Validation (EPA, 2002) that are provided in Appendix F-3.

Subsequent to performing data validation, the data qualifiers were uploaded to the EQuIS® project database. Data were further assessed for accuracy, precision, representativeness, comparability, completeness, and sensitivity and determined to achieve the project data quality objectives in Q3 2019. All groundwater data presented and discussed in this report are final validated data. The Environmental Resources Program Information Management System data deliverable is scheduled for submittal on November 9, 2019. The Data Quality Evaluation Report for groundwater samples collected in Q3 2019 is provided in Appendix F-1, and the final laboratory data reports are included in Appendix F-2.

3.5 Project Screening Levels

The project screening levels (PSLs) were selected to satisfy the requirements of the Kirtland AFB RCRA Permit (NMED, 2010) as the lower of:

- New Mexico Water Quality Control Commission (NMWQCC) standards per the New Mexico Administrative Code, Title 20.6.2.3103, Standards for Groundwater of 10,000 milligrams per liter (mg/L) Total Dissolved Solids Concentration or Less (New Mexico Administrative Code, 2018). For metals, the NMWQCC standard applies to dissolved metals and total mercury.

- EPA National Primary Drinking Water Regulations, maximum contaminant levels (MCLs) and secondary MCLs, and Title 40 Code of Federal Regulations (CFR) Part 141, 143 (EPA, 2019).

If no MCL or NMWQCC standard existed for an analyte, the PSL used was the EPA Tapwater Regional Screening Level (EPA, 2019).

The analytical method utilized to analyze for total nitrate/nitrite nitrogen concentrations (Method 353.2) cannot identify individual nitrate and nitrite concentrations without modification. Typically, in highly oxidizing and near neutral aquifers, nitrate is the primary nitrogen species found in groundwater (Langmuir, 1997). Previous studies in the Albuquerque Basin have used total nitrate/nitrite nitrogen concentrations as equivalent to nitrate nitrogen concentrations (Longmire, 2016; Anderholm et al., 1995). Therefore, total nitrate/nitrite nitrogen concentrations were compared to the 10 mg/L MCL for nitrate in this report.

Groundwater MCLs or PSLs for all analytes are provided in the groundwater analytical data tables included in this report.

3.6 Groundwater Quality Data

Groundwater samples collected for the Q3 2019 monitoring event were analyzed for EDB, while select wells were also analyzed for BTEX, total metals (arsenic, lead, calcium, magnesium, potassium, and sodium), dissolved metals (iron and manganese), anions (bromide, chloride, sulfate, and nitrate/nitrite nitrogen), and alkalinity (Table 3-2). Alkalinity, sulfate, dissolved iron, and dissolved manganese concentrations provide direct and indirect evidence of anaerobic conditions and thus are important indicators of bioremediation (Section 3.6.5). Contaminant concentrations were compared to their respective MCLs or PSLs and are discussed in the following sections. The analytical results for field duplicate samples are presented in the tables and were used to assess field and laboratory analytical precision. However, field duplicate results are not discussed in this text for comparison purposes unless otherwise noted and duplicate data are not provided on figures. The results for the duplicate sample analyses are included in the Data Quality Evaluation Report (Appendix F-1).

Analytical data for both organic and inorganic compounds for the newly added wells are provided in Table 3-4. Data for organic compounds for GWM wells are provided in Table 3-5 and inorganic compounds in Table 3-6. The status of baseline sampling of newly added wells is provided in Table 3-7. Historical EDB results for the previous three quarters are provided in Table 3-8. Concentrations for various compounds are depicted on figures as listed below:

- EDB on Figure 3-6
- BTEX on Figure 3-7

3.6.1 Organic Compounds Analytical Results

3.6.1.1 EDB Analytical Results

Groundwater samples from 64 wells were analyzed for EDB in Q3 2019. This includes 36 wells located north of Ridgecrest Drive SE and 28 wells located south of Ridgecrest Drive SE. EDB analytical results are presented in Tables 3-4 and 3-5, and on Figure 3-6.

- There were no EDB exceedances and one EDB detection from wells north of Ridgecrest Drive SE. In KAFB-106041 (REI 4857), EDB was detected at 0.032 micrograms per liter (µg/L), below the 0.05 µg/L MCL.

- There were 11 EDB exceedances from wells that are south of Ridgecrest Drive SE, seven of which were on-Base in the immediate vicinity of or within the BFF. The highest EDB

concentration south of Ridgecrest Drive SE was detected in the groundwater sample collected from newly added well KAFB-106S1-447 (480 µg/L [in the BFF, REI 4857]).

3.6.1.2 BTEX Analytical Results

A total of 24 wells were sampled for BTEX in Q3 2019 and are located south of Ridgecrest Drive SE. BTEX analytical results are presented in Tables 3-4 and 3-5, and on Figure 3-7; concentrations of BTEX compounds are contoured in the Q2 and Q4 reports as specified in the Work Plan (Kirtland AFB, 2017a). There were no exceedances of BTEX compounds in GWM wells located near drinking water supply wells in Q3 2019. BTEX was detected in areas consistent with previous benzene plume designations.

- Benzene exceeded the 5.0 µg/L MCL in samples from eight GWM wells, located in REI 4857. The highest benzene concentration was detected in KAFB-106S2-451 (6,000 µg/L) in the source area.

- Toluene exceeded the 1,000 µg/L PSL in samples from five GWM wells, located in REI 4857. The highest toluene concentration was detected in KAFB-106S8-451 (8,400 µg/L) in the source area.

- Ethylbenzene exceeded the 700 µg/L PSL in the sample from one GWM well. Ethylbenzene was detected at a concentration of 1,400 µg/L in KAFB-106S5-446, which is a newly added well in REI 4857.

- Xylenes (total) exceeded the 620 µg/L PSL in samples from five GWM wells, located in REI 4857. The highest total xylene concentration was detected in wells KAFB-106S8-451 and KAFB-106S1-447, both located in the source area, at a concentration of 2,000 µg/L.

3.6.2 Inorganic Compounds Analytical Results

Inorganic compounds include total alkalinity, nitrate/nitrite nitrogen, sulfate, bromide, and dissolved iron and manganese. A total of 23 wells were sampled for inorganic compounds in Q3 2019; four of these wells are located north of Ridgecrest Drive SE, and 19 are located south of Ridgecrest Drive SE. Inorganic analytical results are presented in Tables 3-4 and 3-6. Inorganic sampling is conducted to assess geochemical aquifer conditions. Inorganic sample results are evaluated and discussed in the Q2 and Q4 reports when sufficient data is collected to evaluate geochemical aquifer conditions.

3.6.3 Sampling Results for U.S. Geological Survey Sentinel Wells

The U.S. Geological Survey (USGS) monitors 14 sentinel wells between the Kirtland AFB BFF EDB plume and the Albuquerque Bernalillo County Water Utility Authority water supply wells as a means of providing independent observation of water quality in the vicinity of the Albuquerque Bernalillo County Water Utility Authority water supply wells. Samples are collected from these sentinel wells quarterly. For Q3 2019, these samples were collected using dual membrane samplers during the time period of July 15-18, 2019. The samples were analyzed for volatile organic compounds and EDB by the USGS National Water Quality Laboratory using Method O-4127-96 (Connor et al., 1998). The USGS transmittal letter including the Q3 2019 data results is provided in Appendix E-5.

3.6.4 Field Parameters

Field parameters were collected from 10 wells located south of Ridgecrest Drive SE that were sampled using the low-flow sampling method. Field parameter data are provided on sample collection logs in Appendix E-3.

3.6.5 Bioremediation Indicators

Bioremediation indicators are not assessed in Q1 and Q3 due to the limited data set.

3.7 Groundwater Monitoring Well Network Operation and Maintenance

The GWM well network was inspected to ensure that the condition of all protective covers and wellheads met the intended requirements for performance and security. During the inspection period, cleaning and maintenance were performed and all GWM wells were determined to be fully serviceable.

Monitoring wells KAFB-106001, KAFB-106008, and KAFB-106079 were disinfected on September 17, 12, and 13, 2019, respectively. These monitoring wells were brushed and swabbed, then bailed of fines prior to disinfection. A chlorine and water solution were added to each well in accordance with the NMED approved well disinfection standard operating procedure, provided as Appendix R to the O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c). The well screens were then swabbed to mix the chlorinated water into the surrounding formation. The chlorine was left to sit overnight then purged to remove the chlorinated water. The amount of sediment as measured using an Imhoff cone, free chlorine measurements, and gallons purged were recorded in the field and are included in Appendix E-1.
As of the end of Q3 2019, EA Engineering, Science, and Technology, Inc., PBC had removed 88 dedicated Bennett pumps from the GWM well network as part of a transition to passive sampling for the monitoring program. No dedicated Bennett pumps were removed during Q3 2019. Although several wells are sampled using portable Bennett pumps, ongoing issues with this sampling system continue to arise due to corrosion of components and mechanical failure due to aging parts.

4. DRINKING WATER SUPPLY WELL MONITORING

Three drinking water supply wells (KAFB-003, KAFB-015, and KAFB-016) provide drinking water to on-Base employees and tenants of Maxwell Housing, which is located off-Base. One drinking water supply well (ST106-VA-2) provides drinking water to Veterans Affairs (VA) Medical Center patients, employees, and visitors. These drinking water wells are community water systems that are regulated by the NMED Drinking Water Bureau in accordance with the Safe Drinking Water Act.

As part of the monitoring associated with the BFF site, these wells are sampled monthly and analyzed for EDB and BTEX due to their proximity to the BFF plume containing dissolved-phase EDB and benzene.

4.1 Drinking Water Supply Well Sampling and Analysis Procedures

Drinking water supply wells KAFB-003, KAFB-015, KAFB-016, and ST106-VA-2 were sampled in July, August, and September 2019. Field measurements, sample collection, packaging, shipping, and analyses were performed in accordance with the Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling Work Plan and associated QAPjP (Kirtland AFB, 2017c). Field DO, pH, ORP, conductivity, and temperature measurements were measured using an YSI Professional Plus multiparameter water quality probe; turbidity was measured using a Hach 2100Q or Geotech Portable Turbidity Meter. Instrument calibrations were performed at the start of each day of the sampling event to ensure accurate readings.

The sample port at each drinking water well head was opened for 60 seconds prior to sampling to purge any entrained sediment. Following filling, the sample containers were immediately sealed, checked for headspace bubbles, labeled, and put into an iced cooler. Daily quality control reports are presented in Appendix G-1. Completed sample collection logs and chain-of-custody forms are presented in Appendix G-2. Drinking water supply samples were collected and submitted for the following analyses:

- EDB using EPA Method 504.1
- BTEX using EPA Method 524.2.

Samples were submitted to TestAmerica Laboratories in Savannah, Georgia, for analytical testing. Analytical results were validated by Environmental Data Services, Inc. The Data Quality Evaluation Reports are included in Appendix H-1. The TestAmerica Laboratories Analytical Reports for July, August, and September 2019 are included in Appendix H-2.

4.2 Data Review and Usability

The Q3 2019 drinking water analytical data underwent a 100% Level 3 data validation performed by Environmental Data Services, Inc., Virginia Beach, Virginia, following data verification. The data verification and validation steps are discussed in detail in Section 3.4.

All data were valid based on necessary criteria, and no data were qualified as rejected. The technical data completeness was 100%. The data met data quality objectives and were deemed to be appropriate for use in project decision-making. The quality control parameter and data quality indicator (precision, bias [accuracy], representativeness, comparability, completeness, and sensitivity) evaluation results are provided in the Data Quality Evaluation Report and Data Validation Report presented in Appendix H-1. Final validated data are presented in Table 4-1.

4.3 Drinking Water Supply Well Water Quality for Q3 2019

All four wells continue to show no detectable concentrations of EDB or BTEX in the drinking water that is supplied to Kirtland AFB employees and tenants and VA Medical Center patients, employees, and visitors. Analytical results for July, August, and September 2019 are presented in Table 4-1, Figure 4-1, and Appendix H-2. Analytical data were compared to drinking water MCLs and Secondary MCLs. The MCLs for drinking water supply wells are established in the EPA National Primary Drinking Water Regulations, MCLs and Secondary MCLs, Title 40 CFR Parts 141 and 143 (EPA, 2019).

5. GROUNDWATER TREATMENT SYSTEM OPERATION AND PERFORMANCE

This section presents Q3 2019 operations, performance metrics, system expansion activities, maintenance activities of the GWTS, and plume capture evaluation.

Appendices pertinent to GWTS operation and performance are:

- Appendix I-1 GWTS Plant O&M Documentation
- Appendix I-2 New Mexico 811 Line Locate Tickets
- Appendix I-3 GWTS Performance Sample Collection Logs
- Appendix I-4 Data Quality Evaluation Report – GWTS Samples
- Appendix I-5 Data Packages – GWTS Samples

5.1 Groundwater Treatment System Operation

The GWTS is part of the interim measure performed pursuant to the corrective action provisions in the Kirtland AFB RCRA Permit. The purpose of the interim measure is to collapse and treat the dissolved-phase EDB plume that currently extends 1,750 ft to the northeast of Ridgecrest Drive SE (Target Capture Zone). Prior to interim measure groundwater extraction, the EDB plume extended 4,000 ft northeast of Ridgecrest Drive SE (Kirtland AFB, 2015), indicating a significant reduction in the extent of the plume. The GWTS was operated during Q3 2019 to treat groundwater extracted from the distal portion of the plume north of Ridgecrest Drive SE, and is comprised of:

- Four extraction wells (KAFB-106228, KAFB-106233, KAFB-106234, and KAFB-106239)
- Conveyance piping
- A dual train 800-gallon per minute (gpm) maximum capacity carbon treatment system located within the GWTS building
- Effluent conveyance lines discharging to either the Tijeras Arroyo Golf Course main pond or gravity-fed injection well KAFB-7 (Figure 5-1).

In addition to the operational procedures outlined in the O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c), the GWTS is also subject to the terms of Class V Underground Injection Well Discharge Permit (DP) No. 1839 (NMED, 2017b) for injecting treated groundwater to KAFB-7. The DP became effective on April 28, 2017. The requirements associated with the conditions of the DP and the location of reporting requirements in this report are summarized in Table 5-1.

5.1.1 Groundwater Treatment System Treatment Volumes and Percentage Run Time

During Q3 2019, the GWTS treated 65,771,100 gallons of groundwater; 56,808,500 gallons was discharged to Golf Course main pond, and 8,962,600 gallons was discharged to injection well KAFB-7. During Q3 2019, Trains 1 and 2 treated 39,144,500 and 26,626,600 gallons, respectively. Table 5-2 provides a cumulative summary of groundwater quantities extracted, treated, and discharged.

For the purpose of run time evaluation, GWTS operation is defined as the time when groundwater was being pumped from at least one extraction well and was subsequently treated and discharged. Table 5-3

provides a monthly and quarterly summary of the extraction well performance, including individual extraction well run times.

From July 1 through September 30, 2019, the GWTS was operational 98% of the time (Table 5-3), which was similar to Q2 2019. Planned and unplanned system shutdowns affecting GWTS overall run time during Q3 2019 are described in Sections 5.3.1 and 5.3.3.

5.1.2 Extraction Well Performance Metrics

The following subsection provides a summary of the performance metrics for the four extraction wells. Quarterly injection well performance data required for DP reporting compliance are provided in Table 5-4. Average operational extraction flow rates do not include flow rates during downtime. Well performance figures are provided in Appendix I-1.

5.1.2.1 Quarterly Extraction Rates

During Q3 2019, all four extraction wells were operated based on Golf Course main pond capacity with the following priority: KAFB-106234 is the highest priority because it is the closest to Albuquerque Bernalillo County Water Utility Authority water supply wells and, therefore, provides hydraulic control for protection of the water supply, followed by KAFB-106228 and KAFB-106239, which effectively capture EDB from the Target Capture Zone, with KAFB-106233 as the lowest priority since it is currently capturing little to no EDB concentrations due to a reduction in the size of the plume.

Water was extracted from KAFB-106228 during Q3 2019 at an average operational flow rate of 144.1 gpm with a run time of 95% (Table 5-3).

Water was extracted from KAFB-106233 during Q3 2019 at an average operational flow rate of 164.2 gpm with a run time of 88% (Table 5-3).

Water was extracted from KAFB-106234 during Q3 2019 at an average operational flow rate of 174.2 gpm with a run time of 94% (Table 5-3).

Water was extracted from KAFB-106239 during Q3 2019 at an average operational flow rate of 73.5 gpm with a run time of 80% (Table 5-3).

5.2 Groundwater Treatment System Performance Monitoring and Ethylene Dibromide Removal

GWTS performance monitoring is performed in conformance with the most recently approved Work Plan (Kirtland AFB, 2017a) as well as Appendix L of the O&M Plan, Sampling and Analysis Plan, and any subsequent revisions. DP-1839 provides additional sampling criteria. Table 2 of DP-1839 provides a list of the constituents of concern that are most frequently monitored at the GWTS (NMED, 2017b). Q3 2019 GWTS analytical performance metrics and EDB mass removal are discussed in the following sections.

5.2.1 Quarterly Sampling and Analysis

Water samples from Train 1 and Train 2 were collected monthly from the untreated influent (GWTS-BFF-INF1 and GWTS-BFF-INF2), from a port located after the lead GAC vessel (GWTS-BFF-GAC1 and GWTS-BFF-GAC2) but before the final GAC vessel, and from the treated effluent (GWTS-BFF-EFF1 and GWTS-BFF-EFF2) in Q3 2019. These samples were analyzed for EDB, BTEX, and dissolved metals (iron and manganese). In previous reports, the samples collected between the two GAC vessels were referred to as post-GAC samples, but will hereafter be referred to as mid-GAC samples to clarify that they are not effluent samples. EDB concentrations and mass removal for Q3 2019 are summarized in Table 5-5. Sample results and effluent discharge limits are provided in Table 5-6 for Train 1, Table 5-7 for Train 2, Table 5-8 for the Train 1 GAC Tank B changeout, and Table 5-9 for the Train 2 GAC Tank A changeout.

In addition to above mentioned samples, samples were collected from both Train 1 and Train 2 to satisfy annual influent and effluent sampling requirements as provided in Table 3 of the DP. The samples were analyzed for semivolatile organic compounds, anions (chloride, sulfate, nitrate, and nitrite), and total phenol, in addition to the routine monthly analytes. Annual samples were collected in July 2019 from the GWTS influent and effluent. Results for the annual samples are provided in Table 5-10. Influent and effluent samples collected for annual analysis had detectable anions (chloride, sulfate, and nitrite-nitrates) at concentrations below the respective PSLs (Table 5-10) from both treatment trains. Volatile organic compounds, semivolatile organic compounds, and phenols were not detected in any of the samples collected. Results for the annual samples collected from both trains in July 2019 are provided in Table 5-10 and indicate no significant changes in the concentrations of the contaminants of concern since the 2018 annual samples were collected (Kirtland AFB, 2018g). GWTS performance sample collection logs are provided in Appendix I-3.

In Q3 2019, an estimated 2,978 milligrams (mg) of EDB was captured in the lead GAC vessels. Of this total, 22 mg was removed by Train 1 and 2,956 mg was removed by Train 2. Quantities of mass were calculated by taking the sum of each monthly influent concentration multiplied by the respective total weekly treated volume (Table 5-5).

Concentrations of EDB in the influent samples of Train 1 were not detected throughout Q3 2019 (Table 5-6). Concentrations of EDB in the influent samples of Train 2 were detected at concentrations of estimated values of 0.028 J µg/L in July 2019, 0.031 J µg/L in August 2019, and 0.029 µg/L in September 2019, respectively (Table 5-7). The J-qualifier denotes that the analyte was positively identified, but at a low enough concentration that the associated numerical value is estimated. BTEX was not detected in any influent samples collected from either train during Q3 2019. Dissolved iron was not detected in any monthly influent samples collected from either Train 1 or Train 2 (Tables 5-6 and 5-7). Dissolved manganese was detected below the PSL in the August and September monthly influent samples collected from Train 2, but was not detected in any monthly influent samples collected from Train 1 (Tables 5-6 and 5-7).

Concentrations of EDB were not detected in any monthly mid-GAC and effluent samples from either Train 1 or Train 2 throughout Q3 2019 (Table 5-6 and 5-7). Concentrations of BTEX were non-detect in all mid-GAC and effluent monthly samples collected from either train during Q3 2019. Dissolved manganese was detected at an estimated concentration in effluent monthly samples collected from Train 1 in August 2019. Dissolved iron and manganese were detected at estimated concentrations in mid-GAC and effluent monthly samples, respectively, collected from Train 2 in August 2019.

5.2.2 Data Validation

The GWTS analytical data from Q3 2019 GWTS underwent EPA Stage 3 data validation by Environmental Data Services, Inc., Virginia Beach, Virginia, following data verification. The data verification and validation steps are discussed in detail in Section 3.4.

Upon completion of the verification and validation process, the data were assessed for accuracy, precision, representativeness, comparability, completeness, and sensitivity to determine if the project data quality objectives were achieved and deemed usable for their intended purpose. The data validation results are included in the Data Quality Evaluation Report provided in Appendix I-4 and the final laboratory data reports included in Appendix I-5.

5.3 Groundwater Treatment System Maintenance and Expansion Activities

Maintenance activities at the GWTS were performed in accordance with the O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c). Maintenance activities performed at the GWTS in Q3 2019 are provided in the following sections.

5.3.1 Routine Maintenance Activities

Routine maintenance is any activity described as such in the GWTS O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c). A summary of routine maintenance activities is provided below.

During Q3 2019, the Train 1 effluent bag filters were changed on August 9, 2019. The Train 1 influent bag filters were not changed. The Train 2 influent and effluent bag filters were changed on September 3, 2019. The differential pressure along the lead GAC vessel on Train 1 was 3.2 pounds per square inch (psi) on July 1, 2019; and, on September 30, 2019, the differential pressure was 1.7 psi (Appendix I-1). On July 1, 2019, the differential pressure along the lead GAC vessel of Train 2 was 9.1 psi. The differential pressure in the lead GAC of Train 2 was 5.6 psi as of September 30, 2019, showing a decrease in lead GAC vessel differential pressure throughout the quarter after a GAC changeout event performed on July 9, 2019.

The influent Wye-strainers were cleaned 17 times for both Train 1 and Train 2 throughout Q3 2019. Wye-strainers were cleaned to maintain equalization of the influent tanks and prevent cavitation at the influent pump intakes. The Wye-strainers accumulate biologic materials coming in with the influent.

The GWTS routine maintenance schedule is provided in Table 5-11 and non-routine maintenance activities that were performed during Q3 2019 are discussed in Section 5.3.3 and in Table 5-12.

The GWTS was shut down at various times throughout Q3 2019 for routine maintenance and equipment repairs including Golf Course main pond maintenance activities, rain events, and electrical disruptions. The GWTS was not shut down for longer than a 24-hour period even during the GAC changeout (Appendix I-1).

5.3.2 Conveyance Line Security and Administrative Controls

Kirtland AFB is registered as a line-owner with New Mexico 811 for the off-Base portion of the conveyance lines. U.S. Air Force permits are required for all on-Base excavation projects. During Q3 2019, Kirtland AFB responded to 16 off-Base tickets requested through New Mexico 811 (Appendix I-2). There were no conveyance line breaches and all off-Base conveyance lines remained intact.

5.3.3 Non-Routine Maintenance Activities

Non-routine maintenance activities are defined as maintenance items that fall outside of the scope of the GWTS O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c) but need to be addressed in order to maintain consistent GWTS operation. A summary of shutdowns associated with non-routine maintenance activities occurring during Q3 2019 is provided on Table 5-12. Major non-routine maintenance performed in Q3 2019 is listed below.

On July 1, 2019, the Train 1 influent tank (TK-110) water level transducer failed, resulting in incorrect water level measurements within the tank. As Train 1 could, therefore, not run automatically with failed readings of the influent tank water level, Train 1 was only run manually, while GWTS personnel were present, and was thus only run for 8-10 hours per day until the water level transducer was replaced on July 11, 2019.

The GWTS O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c) requires GAC changeout when the effluent concentration of EDB reaches 90% of the 0.05 µg/L MCL to ensure that effluent from the GWTS continues to meet the MCL. On April 4, 2019, EDB was detected in the Train 2 mid-GAC sample port at an estimated concentration of 0.018 J µg/L (Kirtland AFB, 2019b). Although the Train 2 effluent sample remained non-detect and, therefore, is not considered the actionable level provided in the GWTS O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c), on July 9, 2019, the carbon media in the Train 2 GAC Tank A was removed and replaced (changed out) with fresh media to continue conservative operation of the GWTS. This changeout follows the changeout of the Train 1 GAC Tank B that occurred on June 11, 2019. This is considered non-routine maintenance because the changeout was conducted well before the effluent met actionable levels.

The carbon media used in the GAC vessels is virgin coconut carbon as it is the most efficient at capturing EDB. Virgin coconut carbon is made from converting coconuts into carbon, where the carbon is activated, trucked to the GWTS, and slurried into the GAC vessel undergoing a changeout. The spent carbon removed during the changeout is trucked to a carbon reactivation facility where it undergoes a thermal process to remove the EDB, whereby the reactivated carbon is restored to 95% and can be reused. Transportation manifests and reactivation documentation for the spent carbon are provided in Appendix I-1.

Following the changeout, the carbon was allowed to soak up clean water for a period of 24 hours as is required in the O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c). On July 10, 2019, the Train 2 GAC Tank A was backwashed to remove carbon fines leftover from the changeout. Train 2 GAC Tank A was changed from lead tank to lag in order to capture EDB from the Train 2 influent. Following changeover, the Train 2 influent, mid-GAC, and effluent ports were sampled. Samples were collected for EDB, BTEX, and dissolved iron and manganese as required by the GWTS O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c) whenever significant process changes occur.

Train 1 weekly sampling, following the June 2019 sampling, continued to occur on July 2 and 12, 2019 in accordance with the O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c). Train 2 Daily sampling occurred from July 11 to 17, 2019, and weekly Train 2 sampling occurred on July 18 and 25, 2019, and on August 1 and 8, 2019. Routine monthly sampling will continue for both trains (Tables 5-6 and 5-7). Concentrations of EDB, BTEX, and dissolved iron were not detected in either Train 1 weekly mid-GAC or effluent samples (Table 5-8). Dissolved manganese was detected in both remaining Train 1 weekly effluent samples at estimated concentrations 0.0039 J mg/L on July 2, 2019, and 0.0014 J mg/L on July 12, 2019, below the PSL of 0.2 mg/L. Dissolved manganese was not detected in either Train 1 mid-GAC samples. Concentrations of EDB and BTEX were not detected in any Train 2 mid-GAC or

effluent samples (Table 5-9). Dissolved manganese was detected in seven of the 11 Train 2 effluent samples collected between July 11 and August 8, 2019 at estimated concentrations between 0.0016 J mg/L and 0.0083 J mg/L, and was detected in the Train 2 mid-GAC sample on July 12, 2019 at an estimated concentration of 0.0011 J mg/L. These detections were below the PSL of 0.2 mg/L. Dissolved iron was detected in Train 2 effluent samples at estimated concentrations of 0.154 J mg/L and 0.168 J mg/L on July 13 and 14, 2019, respectively, and was detected in Train 2 mid-GAC samples at a concentration of 0.431 mg/L and estimated concentration of 0.0453 J mg/L on July 14 and August 8, 2019, respectively, all below the PSL of 1 mg/L. Iron and manganese were not detected in the September monthly sampling event.

On May 23, 2019, the simple mail transfer protocol (SMTP) of the GWTS control system began failing to send emails to GWTS personnel in response to system alarms. Various attempts were made to resolve this issue, including several visits by an instrumentation and controls subcontractor. Until the system was repaired, GWTS personnel remotely accessed the human machine interface and monitored the alarms page regularly. Troubleshooting of the human machine interface indicated an issue preventing emails from being sent out through the SMTP service. The human machine interface was replaced on July 11, 2019, returning full function to SMTP service.

After severe electrical storms, digital values of the operations of KAFB-106233 and KAFB-106234 were disrupted and began reading incorrectly, both at the human machine interface and at the well control house. On July 9, 2019, analog output card 1769-IF41 in the well control house was replaced at "Slot 4" on July 9, 2019, and at "Slot 5" on July 31, 2019. Digital values returned to normal.

Due to concerns about the effect of sodium hypochlorite on the GAC media prior to changeout, namely the possibility that it was oxidizing the GAC and reducing adsorption onto the media, sodium hypochlorite injections were temporarily ceased, and a temporary shutdown of the Miox sodium hypochlorite generator was completed on May 14, 2019. On July 22, 2019, the sodium hypochlorite generator was reinstated, and injections resumed ongoing operations.

On August 12, 2019, the air relief valve (ARV) in the KAFB-106233/234 Louisiana Vault failed. During a routine shutdown to changeover discharge locations between the Tijeras Arroyo Golf Course main pond and injection well KAFB-7, the ARV in the Louisiana Vault opened to relieve pressure in the line but was stuck open due to an excess of rust build-up. This resulted in the vault to fill with water. Approximately 40 gallons of water flowed onto the ground within Kirtland AFB property where the vault is located. GWTS personnel responded quickly and stopped the release.

The ARV was rebuilt with a rebuild kit and rust was removed to return the ARV to proper functioning order. A few gallons of water from the KAFB-106233/234 Louisiana Vault seeped through a shared conduit line located between it and the adjacent KAFB-106228 Louisiana Vault. The seeping water caused leak sensor in the KAFB-106228 Louisiana Vault's electrical junction box to trip. Once the leak detector was drained, the leak detect alarm was deactivated, and KAFB-106228 was restarted. During this time, Train 2 was offline for approximately 23 hours; however, Train 1 was operated during that time.

On August 20, 2019, a faulty pressure transducer in the KAFB-106228 well vault was repaired after discovery of discontinuity in the pressure transducer's electrical line that ran between the KAFB-106228 Louisiana Vault and the GWTS.

On August 29, 2019, the Train 2 influent skid pump P-212A i-ALERT® Condition Monitor failed due to power loss from a low battery in the i-ALERT® unit. The failed unit reported dangerous levels of vibration in the skid pump motor. As a result, KAFB-106239 was shut down and left offline for approximately 17 hours while the Train 2 skid pump (P-212B) continued to operate. The failure was

determined to be caused from a low battery in the i-ALERT® unit and both P-212A and KAFB-106239 were restarted. A new i-ALERT® device was received and installed on September 6, 2019.

KAFB-106239 was disinfected on July 23, 2019, and then, from September 9 to 16, 2019, underwent a well rehabilitation (including a chlorine bleach disinfection) and a change in the set depth in accordance with the O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c). Disinfection was performed in accordance with the Standard Operating Procedure provided as Appendix R to the O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c) approved by NMED on August 6, 2018 (NMED, 2018c). The analytical sampling suites for pre-treatment and post-treatment groundwater samples were approved by NMED on November 16, 2018 (NMED, 2018d). On September 16 and 17, 2019, KAFB-106228 was taken offline for a change in the set depth in accordance with the O&M Plan (NMED, 2016; Kirtland AFB, 2016a, 2017d, 2018c). Disinfection of this well was not deemed necessary based on operational parameters (no reduction in flow).

Pre- and post-treatment samples of all Q3 2019 monitoring and extraction well disinfections were analyzed for bromate and chlorite (Method E300.1) and for perchlorate (Method E331.0). These samples are collected to verify that the disinfectants were flushed from the well. Bromate and chlorite were not detected in any pre- or post-treatment samples. Perchlorate was detected at concentrations ranging from 0.1 to 0.17 µg/L, below the PSL of 14 µg/L, in all samples, except the post-treatment samples of KAFB-106008 and KAFB-106079, which had detection concentrations of 32 and 25 µg/L, respectively (Table I-1-5). Additional water will be pumped from these wells to reduce the perchlorate concentrations. These wells will be resampled for perchlorate in Q4 2019 following the additional pumping. Groundwater from the Middle Rio Grande Basin has naturally occurring perchlorate concentrations ranging from 0.12 to 1.8 µg/L (Plummer et al., 2006).

Two Eaton Model 50 Duplex Basket Strainers were received on September 18, 2019, and installation is pending.

On September 24, 2019, the leaking nipple and ball valve assembly leading to the ARV in the KAFB-106228 well vault was replaced.

5.3.4 Effluent Conveyance Line Integrity

Effluent line testing was not performed during Q3 2019. Final retesting of the segment between the changeover valve and KAFB-7 will be performed after permanent valves are installed at KAFB-7.

6. INVESTIGATION-DERIVED WASTE

During Q3 2019, both hazardous and non-hazardous investigation-derived waste (IDW) were generated. Non-hazardous IDW consisted strictly of liquids that were sourced from GWM operations. Liquid hazardous waste was generated during well rehabilitation activities performed during the quarter. There was no drilling solid or liquid IDW waste generated or disposed of during Q3 2019.

In addition to the IDW generated specifically during Q3 2019, additional non-hazardous IDW generated during Q2 2019 and Q4 2018 was managed during Q3 2019. This section discusses the details of waste generated and managed during the quarter.

6.1 Non-Hazardous Investigation-Derived Waste

Non-hazardous IDW liquids comprised the entirety of waste volume generated during the quarter. This waste was generated from both the quarterly GWM sampling event and well rehabilitation activities. Appendices J-1, J-2, and J-3 provide specific information regarding the non-hazardous liquid IDW waste generated and disposed of during Q3 2019.

6.1.1 Groundwater Monitoring Liquid Investigation-Derived Waste

Non-hazardous IDW purge water collected during sampling of the GWM wells was placed in 55-gallon plastic (poly) drums. The drums were sealed with matching plastic lids with steel, locking-ring collars, labeled with vinyl non-hazardous waste labels, and transferred to the designated non-hazardous IDW yard located on Kirtland AFB. Small volumes of IDW water, typically generated from the sampling of drinking water wells, were placed in labeled, 5-gallon plastic buckets (pails) with sealing lids.

Eligibility for discharge of non-hazardous liquid IDW to the GWTS was determined by comparing historical, well-specific data from the previous two quarters to the acceptance criteria of the GWTS. Liquid IDW from monitoring wells that had historically met the GWTS acceptance criteria was discharged to the facility without further review. Liquid IDW sourced from wells with historical data from the previous two quarters that exceeded the GWTS acceptance criteria was held for further evaluation.

For Q3 2019, 1,526 gallons of non-hazardous water was generated. Of this total volume, 1,441 gallons of IDW was processed through the GWTS. The water was sourced from GWM well purge and development activities as well as small volumes from GWM equipment decontamination. In all cases, the water met the GWTS acceptance criteria. All IDW water processed through the GWTS was discharged to the Tijeras Arroyo Golf Course main pond (Table J-1-1). A total of 85 gallons of non-hazardous salt/brine water obtained from GWTS maintenance activities was disposed of off Kirtland AFB. The liquids were transported and disposed of by Advanced Chemical Transport in Albuquerque, New Mexico under Manifest No. D249465 (Appendix J-1).

Any liquid IDW that is collected, but not yet processed through the GWTS, is temporarily accumulated in the "Pending Disposal" area of the IDW yard. Typically, this category includes non-hazardous purge water collected during the quarter that meets GWTS acceptance criteria, but was held due to GWTS discharge limitations, O&M activities, or pending disposal approvals. By the end of Q3 2019, no GWM water was being held in the "Pending Disposal" category (Table J-1-2).

Any liquid IDW that is collected, but held pending receipt and evaluation of analytical data, is placed in the "Pending Analysis" area of the IDW yard. The total volume of waste in this area at the end of Q3 2019 was 5 gallons consisting of meter calibration fluid (Table J-1-3).

6.1.2 Non-Hazardous Drilling Liquid Investigation-Derived Waste

There was no liquid IDW generated or disposed from drilling activities during Q3 2019 (Table J-1-4).

6.1.3 Non-Hazardous Well Drilling Liquid Investigation-Derived Waste Pending Disposal

There was no well drilling liquid IDW held as "Pending Disposal" at the end of Q3 2019.

6.1.4 Non-Hazardous Solid Waste

This section discusses solid treatment plant waste, which is not considered IDW. However, it is provided herein to consolidate the discussion of waste generation and disposal.

During Q3 2019, maintenance operations at the GWTS generated no non-hazardous solid waste that required disposal during the quarter (Table J-2-1).

Additional non-hazardous, routine, and disposable solid wastes were generated during GWM activities. These included single-use dual membrane samplers, disposable in-line filters, nitrile gloves, and paper trash. These items were disposed of as municipal solid waste and volumes were not tracked.

6.1.5 Non-Hazardous Well Drilling Solid Investigation-Derived Waste

During Q3 2019, there was no non-hazardous, non-liquid IDW (soil or mud) managed and disposed of during the quarter (Table J-2-2a). There was no soil or mud waste generated from well drilling activities held as "Pending Disposal" at the end of Q3 2019.

6.1.6 Special Waste Well Drilling Solid Investigation-Derived Waste

Special waste is defined as petroleum-contaminated soil that has TPH concentration greater than 100 milligrams per kilogram (Subparagraph [i] of Paragraph [13] of Subsection S of 20.9.2.7 New Mexico Administrative Code [2011]). No special waste was generated or disposed of during Q3 2019 (Table J-2-2b). No special waste was held in "Pending Disposal" areas of the IDW yard at the end of Q3 2019.

6.2 Hazardous Investigation-Derived Waste

Hazardous or suspected hazardous IDW is accumulated in one of two RCRA less than 90-day accumulation areas associated with the Kirtland BFF Project. Hazardous waste generated from routine GWM sampling or well maintenance activities (purge or well development water) is placed in the Kirtland AFB BFF RCRA less than 90-day accumulation area. Hazardous or suspected hazardous waste generated during drilling activities are held in the Kirtland AFB Zia Park temporary RCRA less than 90-day accumulation area.

Prior to the start of each quarterly GWM sampling event, a preliminary evaluation is made to identify monitoring wells that are anticipated to generate characteristically hazardous liquid IDW for initial waste segregation purposes. Based on historical analytical data available for each well, the water is suspected to

be characteristically hazardous if the concentration of benzene exceeded 500 µg/L (per 40 CFR Part 261.24) in either of the previous two sampling events. Liquid IDW from these wells is managed as a potentially characteristically hazardous waste pending confirmation from laboratory analytical results. The hazardous waste classification code for benzene is D018.

All liquid hazardous waste (purge or well development water) is placed in 55-gallon steel drums with steel tops and locking rings (UN designation 1A2/Y1.2/100/**). All waste containers are properly labeled, sealed, and placed on secondary containment pallets located within the BFF less than 90-day accumulation area. The accumulation area and waste containers are inspected on a weekly basis by trained personnel as required under 40 CFR 262.34.

Solid hazardous wastes are held in either 55-gallon, steel drums with steel tops and locking rings or, if volume requires, 20-yard capacity roll-off bins. Bin doors are sealed with an expanding foam to minimize the potential of leaks and the bins are double lined with 10-millimeter plastic liners. Bins have either integrated hard cover tops with ratcheting straps or have removable, heavy-duty vinyl covers that are secured to the bin using heavy-duty rubber straps to protect the contents from weather or access by local fauna. All drums are placed on secondary containment pallets. Roll-off bins are placed on secondary containment composed of plastic sheeting with rolled edges.

Upon receipt of analytical data, the IDW remains in the less than 90-day accumulation area if confirmed to be a hazardous waste. If the IDW is determined to not meet hazardous criteria based on analytical data, the non-hazardous waste is transferred to the "Pending Disposal" area of the non-hazardous IDW yard.

All hazardous waste must be removed from Kirtland AFB and properly disposed of off-Base within the required 90-day accumulation time limit. Hazardous waste is transported off Kirtland AFB after it is properly profiled, manifested, and approved for transport by the Kirtland AFB Hazardous Waste Management Group. Waste is transported by a licensed hazardous waste hauler to a permitted treatment, storage, and disposal facility.

When possible, liquid hazardous waste may be consolidated. This is typically done to combine small volumes of waste generated when using passive sampling methodologies as well as to reduce the total number of drums that require offsite disposal. Appendix J-3 provides specific information regarding the hazardous liquid waste disposed of during Q3 2019.

6.2.1 Hazardous Investigation-Derived Waste Volume Q3 2019

During Q3 2019, hazardous purge water was generated from GWM activities. A total of seven drums of suspected hazardous waste from GWM activities was held in the BFF less than 90-day area. One drum, Q3 Consolidated, contained 3.5 gallons of suspected hazardous waste generated from passive sampling activities. Analytical results from the consolidated drum indicated that the waste did not meet hazardous waste criteria. The waste was subsequently classified as non-hazardous and moved to the non-hazardous waste IDW yard. After technical review, the waste was allowed to be discharged to the GWTS (discharge reported in Table J-1-1).

Six drums of hazardous waste were generated from well redevelopment activities at wells KAFB-106008 and KAFB-106079. Generator knowledge gained from years of data from these wells allowed for classification of this waste as hazardous without further requirements for additional sampling and analysis. A total of 240 gallons of hazardous waste was held in six drums in the BFF less than 90-day accumulation yard at the end of Q3 2019 (Table J-3-1). This waste is currently pending disposal.

There was no liquid hazardous waste disposed of during Q3 2019.

No solid hazardous waste was generated, accumulated, or disposed of during Q3 2019 from any BFF site activities.

7. PROJECTED ACTIVITIES

Q4 2019 will comprise the period between October 1 and December 31, 2019. Planned Q4 2019 activities are summarized below.

Vadose Zone Characterization and Monitoring

- Continue bioventing pilot study
- Perform semiannual SVM in Q4 2019.

Groundwater Monitoring

- Perform and report on quarterly GWM in Q4 2019
- Report quarterly monitoring of USGS sentinel wells (by USGS).

Drinking Water Supply Well Monitoring

- Perform drinking water supply well monitoring monthly for organic compound analysis for the four wells sampled.

Groundwater Treatment System Operation

- Continue operating the GWTS and extraction wells KAFB-106228, KAFB-106233, KAFB-106234, and KAFB-106239
- Perform GWTS well disinfection as required
- Complete performance assessment of the GWTS extraction system

Reporting

A quarterly and annual report will be prepared to detail the activities conducted during the quarter, and to summarize the activities, GWM data, and performance assessment for the entire year. The report will include the semiannual sampling data collected for the full GWM network as well as the vadose zone. The report will provide results of the performance assessment to evaluate the effectiveness of the interim measures.

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