NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6313
Phone (505) 476-6000 Fax (505) 476-6030
www.env.nm.gov

Michelle Lujan Grisham
Governor

Howie C. Morales
Lt. Governor

James C. Kenney
Cabinet Secretary

Jennifer J. Pruett
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

August 17, 2020

Colonel David S. Miller
Base Commander
377 ABW/CC
2000 Wyoming Blvd SE
Kirtland AFB, NM 87117

Lt. Colonel Wayne J. Acosta
Civil Engineer Office
377 Civil Engineering Division
2050 Wyoming Blvd SE, Suite 116
Kirtland AFB, NM 87117

RE: DISAPPROVAL
SOURCE ZONE CHARACTERIZATION REPORT FOR THE BULK FUELS FACILITY SOLID WASTE MANAGEMENT UNIT ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO
EPA ID # NM9570024423
HWB-KAFB-19-012

Dear Colonel Miller and Lt. Colonel Acosta:

The New Mexico Environment Department (NMED) is in receipt of the U.S. Air Force (Permittee) Kirtland Air Force Base (Facility) *Source Zone Characterization Report for the Bulk Fuels Facility Solid Waste Management Unit ST-106/SS-111* (Report), dated October 2019. NMED has reviewed the Report and hereby issues this Disapproval.

Upon examination of the Report and associated documents, NMED discovered issues with data collection, data analyses, data quality, data presentation, and data interpretation. Therefore, NMED was unable to evaluate the validity of the conclusions presented by the Permittee in the Report. NMED's comments are attached. General topics and several examples of NMED's comments were discussed during a NMED/KAFB conference call on June 18, 2020.

The Permittee must submit a revised Report that corrects the deficiencies noted in this Disapproval. The revised Report must be accompanied by a response letter (also included as an appendix) that details where the comments were addressed and cross-references NMED' s

numbered comments. The Permittee must submit a complete electronic redline-strikeout version of the revised Report that shows where all changes were made to the Report. In addition, all PDF versions of documents must be provided in a searchable format. The revised Report must be submitted no later than **December 31, 2020**.

If you have any questions regarding this letter, please contact me at (505) 476-6035.

Sincerely,

Kevin Pierard

Digitally signed by Kevin Pierard
Date: 2020.08.17 15:20:12 -06'00'

Kevin M. Pierard, Chief
Hazardous Waste Bureau

Attachment: NMED Comments

cc: D. Cobrain, NMED HWB
R. Murphy, NMED HWB
L. Andres, NMED HWB
B. Wear, NMED HWB
L. King, EPA Region 6 (6LCRRC)
S. Kottkamp, KAFB
K. Lynnes, KAFB

File: KAFB 2020 and Reading

Attachment 1

GENERAL COMMENTS

1. **Quality Control of document submittals.**

   NMED Comment: Quality control issues identified by NMED in documents previously submitted by the Permittee have also been identified in this Report. Examples include the lack of proper numbering of pages and tables, inconsistencies in the titles of related documents, and the lack of labeling of site features on figures. The Permittee must review its quality control procedures and address these issues to assist NMED in expediting document reviews and to assist the public in better understanding the documents that are submitted by the Permittee. This general topic and several examples of the following general comments were discussed during the NMED/KAFB conference call on June 18, 2020.

2. **Document titles and reporting for remaining scopes of work which were included in the Work Plan.**

   NMED Comment: Several scopes of work were included in the approved Work Plan but not all were addressed in this Report:

   a. The NMED approved June 2017 *Work Plan for Vadose Zone Coring, Vapor Monitoring, and Water Supply Sampling, Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111* (Work Plan) provides:
      i. the technical approach for the continuous coring for subsurface sample collection, installation of soil vapor monitoring wells for future pilot testing at two of the coring locations, dual-completion of soil vapor/groundwater monitoring wells in eight of the coring locations;
      ii. soil vapor network monitoring and maintenance;
      iii. sampling of the newly installed groundwater monitoring wells and water supply wells; and
      iv. details for the air-lift enhanced bioremediation pilot test.

      The *Source Zone Characterization Report for the Bulk Fuels Facility Solid Waste Management Unit ST-106/SS-111*, dated October 2019, (Report) presents the results of item i and elements of items of ii and iii above: no information on item iv was provided. The Permittee is advised that, in order to avoid confusion, all future work plans must be written for one specific scope of work. No revision necessary.

   b. The title of the Report does not match the name of the relevant scope of work in the Work Plan. This letter pertains solely to the vadose zone coring and associated well installation activities as described in the Report. In order to maintain a clear administrative record, the names of all future documents and scopes of work must not

change during the Resource Conservation and Recovery Act (RCRA) corrective action process (i.e., work plans through reports); however, the revised Report must retain its current title to avoid further confusion. No revision necessary. This issue was discussed during the NMED/KAFB conference call on June 18, 2020.

c. Future submittals that report on the activities performed under the Work Plan, must reference the Work Plan in the cover letter and executive summary of the document. Additionally, all future document titles and cover pages must include all major scope activities incorporated within that document, including those presented in appendices. No revision necessary. This issue was discussed during the NMED/KAFB conference call on June 18, 2020.

d. Report revision required. The workplan for the source zone characterization contained multiple scopes of work for various aspects of the study. The Report must clarify where the information regarding the other scopes of work presented in the Work Plan can be found (e.g., data associated with groundwater well gauging and sampling, drinking water and irrigation supply well sampling, and soil vapor monitoring data). The Work Plan discusses data collection for various scopes of work:

- **i.** Section 3.1.5, pages 3-6, 2nd paragraph of the Work Plan states: "Semiannual monitoring of the SVM network was approved...and will include sampling of the entire 284 SVMP network...".
- **ii.** Section 6.2 Project Data Types and Records, page 6-1, 1st paragraph, line 1 of the Work Plan states: "Field data will be collected.....in support of field activities associated with the BFF vadose zone treatability studies including coring, long term SVM, well drilling and installation, drinking water supply...[and]...irrigation well sampling."
- **iii.** Section 6.2.3 Chemical Analytical Data: page 6-2,1st paragraph, line 1 of the Work Plan states: "Chemical analytical data will include sample results from soil, soil vapor, and groundwater samples generated by the lab subcontractors."

The revised report must include a section describing the status of the remaining scopes of work included in the approved Work Plan. Include the date the work was performed and the specific document(s) where the information was reported.

3. Historic high and low water levels at the site

NMED Comment: Report revision required. The historic groundwater levels and present groundwater levels referenced by the Permittee in the Report are not consistently or clearly described in the text. For example:

a. The Work Plan states in Section 3.1.1, page 3-3, 1st paragraph, line 2: "The bottom of the designated coring interval extends approximately 10-20 feet (ft) below the lowest historic water level (2009) to ensure that the deepest vertical LNAPL migration is evaluated.

b. In the Report, Section 5.3, page 5-10, 3rd paragraph, 1st line states: "The highest LNAPL saturation percentage of the collected cores came from KAFB-106S9 at a depth of 484 feet below ground surface (ft bgs)). This is very close to the former lowest ground water elevation from 2009 (approximately 500 ft bgs)."

c. Section 7, page 7-2, 2nd paragraph, 3rd bullet, 2nd line: "...at a depth that coincides with the former lowest groundwater elevation from 2009 (approximately 500 ft bgs)."

d. The approved Work Plan states: "Coring intervals will begin at least ten (10) feet above the 1970s high water mark, which is equivalent to the 1960s high water mark."

Please revise the Report to provide a discussion of groundwater elevation changes over time at the site that includes the dates (month/year) of both the historical high and historical low water levels. Present the historic water levels in both depth below ground surface (ft bgs) and elevation relative to mean sea level (ft amsl) to the nearest 0.01 foot.

4. Laboratory data, laboratory qualifiers, and data presentation

NMED Comment: Report revision required. Quality Assurance (QA) and Quality Control (QC) of laboratory data:

a. The 2010 KAFB Hazardous Waste Facility Permit (Permit), Section 6.5.18, Laboratory Analyses Requirements for all Environmental Media, states "All analytical data (including non-detects, estimated values, and detects) shall be included in the electronic copy of the Investigation Report or other report in Microsoft™ Excel format with any qualifiers as attached from the analytical laboratory." The majority of the laboratory results for soil sampling at the facility presented in Table 5-1 were analyzed by Test America Laboratory. The associated laboratory reports are included as Appendix G-1, however, there are over 50 PDF laboratory reports, each consisting of 600 to 1,200+ individual pages. This format is inconsistent with the Permit requirements which makes it difficult to find specific data and information (e.g., a specific soil sample from a specific boring, at a specific depth, or specific data quality issues for samples associated with a particular laboratory report). The Permittee must revise the Report to provide a Microsoft™ Excel spreadsheet that includes the laboratory data in a searchable format.

This spreadsheet must include a specific field which indicates the laboratory report file name for each sample.

b. Permit, Section 6.5.18.2, Laboratory Deliverables, states "[l]aboratory analytical data packages shall be prepared in accordance with United States Environmental Protection Agency (EPA)-established Level III or IV analytical support protocols" and "[t]he Permittee shall present summary tables of these data and Level II QC results to the Department in reports or other documents...Raw analytical data, including calibration curves, instrument calibration data, data calculation work sheets, and other laboratory supporting data for samples from this project, shall be compiled and kept on file at the Facility for reference." The Permittee must revise Appendix G-1, Laboratory Data Packages- Soil Samples, Test America, Inc., to present Level II laboratory report data packages instead of Level IV laboratory report data packages.

c. The December 2017 *Quality Assurance Project Plan for Bulk Fuels Facility Vadose Zone Treatability Studies Solid Waste Management Unit St-106/Ss-111, Revision 1,* (QAPP) was included as an appendix to the Work Plan. Section 4.2 of the QAPP states that data will be validated and flagged with the following data qualifiers: J+, J-, U, UJ, and R. Laboratory case narratives outline numerous concerns resulting in a variety of laboratory data qualifiers which are not included on Table 5-1 or mentioned in text of the Report. For example, the case narrative for associated soil sample V-V2-131218-117 identified three laboratory qualifiers (i.e. J, D, and Q) for the ethylene dibromide (EDB) results for that sample, however, Table 5-1 of the Report shows only a J qualifier. In another example, the case narrative of the laboratory report for total petroleum hydrocarbon (TPH) gasoline range organics (GRO) results for P-V2-121218-080 and P-V2-121218-103 indicates that these samples have been reported with "Q" laboratory data qualifiers which indicate that "One or more quality control criteria failed", however, Table 5-1 of the Report shows only a J qualifier. Please revise the Report to include all laboratory-assigned data qualifiers, including dilution, with footnotes that adequately define the qualifier codes. Data qualifiers must be presented in Table 5-1, and elsewhere in the Report as appropriate.

d. Section 6.5.18.3.1 of the Permit, Laboratory Analyses Requirements for all Environmental Media, states that "[a] full review and discussion of QC data and all data qualifiers shall be submitted with Investigation Reports...". Section 4.2 of the QAPP, Analytical Data Verification and Validation, states "data review findings will be summarized and documented in task-specific data reports, completion reports or with each quarterly monitoring report." The Permittee must include a new section in the

revised Report that discusses all data quality concerns and how these concerns may affect the data quality.

e. Table 5-1 indicates that several results are J-coded as a result of the laboratory having to dilute numerous samples prior to analysis due to high contaminant concentrations (e.g.: V-V2-131218-159). The Permittee is reminded that per 6.5.18 of the Permit "[t]he Department will not accept J-coded (estimated) results for samples requiring dilution prior to laboratory analysis." Please revise the Report to indicate that samples diluted prior to analysis will be not be used as decision level data but may be used qualitatively.

f. Laboratory reports indicate that some samples were analyzed outside of the holding time. As a result, the laboratory reports document data validation concerns for these samples. This important information is not included in the Report. The Permittee must revise Table 5-1 to note which samples exceeded holding times and include the applicable laboratory qualifiers on the revised table. Additionally, the Permittee must include an explanation of the issue causing the analysis outside of the holding time and the effect it may have on the data quality, an explanation of any steps taken to resolve the matter, and the results of those efforts in the revised Report. See Comment 4.c above regarding laboratory qualifiers.

g. Table 5-1 only presents analytical results under the column heading for the limit of detection (LOD). The LOD is the lowest analyte concentration at which an analyte can be detected, however, precision and accuracy are not achieved. The limit of quantitation (LOQ) is the lowest concentration at which an analyte can be reliably detected with precision and accuracy. Section 4.3.2, Project-Required Reporting Limits – Sensitivity, in the QAPP of the approved Work Plan indicates that LOQs will be calculated. Laboratory reports show that data is presented with the detection limit (DL), LOD, and LOQ for all analyses performed. Table 5-1 only includes LOD and is therefore not acceptable as presented for the purposes of data reporting. The Permittee must revise the Report to add columns to Table 5-1 to report the DL, LOD, and LOQ for each analysis presented.

SPECIFIC COMMENTS

5. Notice Page

Permittee Statement: "Physical and chemical characterization was performed on residual LNAPL samples."

NMED Comment: NMED Comment: Report revision required. The results of chemical characterization of residual LNAPL from samples collected in 2011 for the Phase I RCRA

Facility Investigation Report, Bulk Fuels Facility Release, Solid Waste Management Unit ST-106/SS-111 are presented in the Report rather than from samples collected as part of the field work implemented under the Work Plan. Please revise the statement for accuracy and revise Table 5-5 to include chemical characterization data performed on residual LNAPL samples collected as part of the field activities covered in this Report or provide an explanation in the revised Report justifying why these data were not collected. The purpose of collecting samples in 2018 was to allow for evaluation of the changing chemical composition of LNAPL in groundwater over time and to calculate new values for the effective solubility of benzene and EDB for estimating the current extent of LNAPL in groundwater. This is important information to obtain due to rising water levels.

6. **Executive Summary, page ES-1**

Permittee Statement: "The results of this investigation indicate that the presence of fuel has been significantly reduced in the vadose zone by remedial actions and natural processes."

NMED Comment: Report revision required. The Report does not include historical data from source area characterization to compare to the 2018 and 2019 soil, soil vapor, light non-aqueous phase liquid (LNAPL), and groundwater data presented in this Report that would support this statement. The Permittee must include the historical data and provide a discussion to support this statement or remove it from the narrative.

7. **Executive Summary, page ES-1**

Permittee Statement: "LNAPL saturation in vadose zone samples was highest in the source area and none of the samples were found to contain mobile LNAPL. This demonstrates that there is no drainage of LNAPL that could cause continued LNAPL head in the source area that would be required to drive migration."

NMED Comment: Report revision required. Analysis of multiple geophysical and lithologic logs at the site indicate it is likely that a discontinuous clay layer in the source area may have altered the pathway for the migration of fuels related contamination to groundwater. This potential migration pathway is likely to contain hydrocarbon saturated soils that, while not mobile under current conditions, would likely serve as a significant source of dissolved phase petroleum hydrocarbon contamination as groundwater levels continue to rise and come into contact with them. The lithologic cross sections and the discussion on the site hydrogeology presented in the Report do not address this issue. Revise the Report to address this possibility by identifying the top and bottom surfaces of both the upper and lower clay units beneath the site using cross sections and isopach maps.

8. Section 2 Facility History and Project Background, page 2-1

NMED Comment: Report revision required. The Permittee must revise the Report to include a comprehensive general overview of the site history per reporting requirements outlined in Permit Section 6.2.4.3, Investigation Reports, item number 5, Background Information.

9. Section 3 Scope of Activities, page 3-2

NMED Comment: Report revision required. Laboratory reports included in Appendix G-4 (DBSA Soil Testing Laboratory) include results for Fraction Organic Carbon (FOC). Revise the Report to add an additional bullet to the list on this page that states that FOC testing was conducted and provide the purpose of the tests. Include a table that summarizes the analytical results for FOC, as this is valuable information for use in valuating risk.

10. Section 4.2.1 Groundwater Monitoring Wells, page 4-4

NMED Comment: Report revision required. The Permittee does not discuss well development, gauging, or sampling performed on new groundwater monitoring wells after well installation was complete. This information is essential for a comprehensive characterization of the source area. Revise the Report to include this information in accordance with Permit Sections 6.2.4.3 (Investigation Reports) and 6.5.17.10.8 (Well and Piezometer Completion Reports), see Comment 58, below.

11. Section 5.1 Subsurface Lithology, page 5-1

Permittee Statement: "Soil descriptions from the lithologic logs created during coring activities were used to create detailed geologic models of the subsurface."

NMED Comment: Report revision required. It appears that an incomplete data set was used to generate the model. Cross sections, fence diagrams, and models must be generated using lithologic, soil vapor, and water level data from all the available boreholes and monitoring locations. Failing to do so creates an incomplete picture of subsurface site conditions and may lead to erroneous conclusions regarding the nature and extent of contaminants. Please revise the figures to incorporate both the data collected during the vadose zone coring project and previously collected data.

12. Section 5.1 Subsurface Lithology, page 5-1

Permittee Statements: "Data supplied to this module are based on Unified Soil Classification System (USCS) classifications logged during drilling that were simplified into nine categories reflecting observed grain-size distribution and inferred permeability."

and

"The data used to construct the model are provided in Appendix J."

NMED Comment: Report revision required. The table provided in Appendix J, EVS Model Data does not appear to include most of the model inputs described in the Report. The column headers are not aligned with the data columns and the only units provided (feet and ppb) are both included in a single column. Revise the Report to define all of the parameters in the table and provide appropriate units for each column. NMED notes that Table 5-2, Soil Grain Size Distribution and Classification, contains only eight rather than nine grain-size distribution categories. Please resolve this discrepancy.

Additionally, please revise Appendix J to include the complete data set, data sources, and data quality assurance evaluation used to create the model presented in the Report. This information must include calibrated targets and estimated parameters, parameter distributions and sources of variability, and how each parameter is used in the model. Also include information on model boundary/source conditions, vadose zone and aquifer material properties, and contaminant transport properties. Identify all model assumptions and uncertainties and present the results of the uncertainty and sensitivity analyses in the revised report.

13. Section 5.1 Subsurface Lithology, page 5-1

Permittee Statement: "The subsurface in the area of the Source Zone Characterization project is shown on a west-to-east transect (A-A') and a north-to-south transect (B-B') (Figures 5-1 and 5-2)."

NMED Comments: Report revision required.

a. The Permittee must revise the Report to include a brief discussion of the regional geology and how it is expressed locally at the site.

b. Figures 5-1 and 5-2 contain errors. Please revise the report to correct the following errors:
   - **i.** The X-axis on Figure 5-2 should read "1,474,500" rather than "1,475,500".
   - **ii.** The inset aerial photograph in the Key incorrectly shows the scale of the axes as 2:1 while the scale of the photograph is shown as 1:1.

c. The Permittee must include copies of the field lithologic logs and well completion diagrams as an appendix to the Report.

14. Section 5.1.1 Field Screening, page 5-2

Permittee Statement: "The heated headspace values observed below the water table were indicative of the relative presence of hydrocarbons and were used to guide sample collection. In general, elevated heated headspace values (greater than 100 milligrams per kilogram) were observed predominately in the saturated zone (Table 4-1)."

NMED Comment: Report revision required. The Permittee's summary of heated headspace field screening lacks the necessary level of detail given its use in guiding sample collection for laboratory analyses. Please revise the discussion to provide a more complete summary of the heated headspace field screening results, including the increasing and decreasing trend in heated headspace readings followed by another increase at depth in heated headspace readings, which correspond to historical water levels at the Site. Additionally, PIDs typically give a response in units of parts per million by volume (ppmv). In heated headspace screening, the concentration in the headspace, measured in ppmv, does not equal the soil or water concentration, measured in mg/kg or mg/L. Correct the units in the revised report.

15. Section 5.2.1 Analytical Results for Organic Compounds, Vadose Zone, page 5-2:

Permittee Statement: "Concentrations of TPH, BTEX, and EDB are below the laboratory reporting limit in the vadose zone in all other boreholes (Figures 5-3 through 5-5, Table 5-1)."

NMED Comment: Report revision required. Soil coring was to be completed within set temperature parameters (≤ 20° Celsius) regardless of whether collection of a soil sample was planned for any given interval. On November 2, 2018 the Permittee requested via electronic mail a variance from meeting the temperature requirement for samples collected above 450 ft bgs for borings KAFB-106S2, KAFB-106S3, KAFB-106S6, KAFB-106S7, KAFB-106S8, and for samples above 400 ft bgs for boring KAFB-106S1. NMED approved the request on November 5, 2018 without comment. The Permittee's presentation of the analytical results for organic compounds in Section 5.2.1 fails to address their inability to meet the Work Plan requirement for completing sonic coring within set temperature parameters (≤ 20° Celsius). The Report must be revised to include a description of the process for measuring the core temperature and a discussion on the uncertainties associated with the temperature measurements. The Permittee must discuss the impact of elevated core temperatures on PID readings, sample integrity, and representativeness of the laboratory analytical results. The Permittee must include temperature data in appropriate tables. For example, Table 4-1 and Table 5-1 must have a column that displays the core temperature for each PID result or analytical sample. Lab analytical samples must be flagged for any sample that was collected above ≤ 20°Celsius. This issue was discussed during the NMED/KAFB conference call on June 18, 2020.

16. 5.2.1 Analytical Results for Organic Compounds, page 5-2

Permittee Statement: "For the purposes of this report, only results for the primary contaminants of concern BTEX, EDB, and TPH are discussed."

NMED Comment: Report revision required. Clarify why analyses for 61 other constituents is not discussed in the Report. Revise the Report to include a discussion of the other constituents listed in Table 5-1 and provide an explanation for excluding certain analytes.

17. 5.2.1 Vadose Zone Summary, page 5-2

Permittee Statement: "Concentrations of BTEX, TPH, and EDB were elevated in the samples collected from KAFB-106V1 and KAFB-106V2 (Figures 5-3 through 5-5, Table 5-1)."

NMED Comment: Report revision required. The Permittee's subsequent discussion addresses only KAFB-106V1. The Vadose Zone Summary must also include a discussion of organic compound trends in well KAFB-106V2. A discussion of the physical and interstitial properties of the stratigraphic intervals that control the migration and occurrence of the organic compounds in the vadose zone must be included in the revised report.

18. 5.2.1 Vadose Zone Summary, page 5-2

Permittee Statement: "The clay unit at these wells [KAFB-106V1 and KAFB-106V2] is very stiff to hard and contained up to 40 percent (%) silt."

NMED Comment: Report revision required. The source of the data for Permittee's statement must be included. The boring lithologic log for KAFB-106V1 indicates a maximum silt content of 10% in the clay layer. The boring lithologic log for KAFB-106V2 indicates a maximum silt content of 40% in the clay layer. Analytical data in Table 5-2 Soil Grain Size Distribution and Classification does not provide particle size distribution data for the clay layer at any of the boring locations. None of the analytical data presented in the Report includes measurements of sample stiffness or hardness. If the source of the data in the Permittee's statement is from the field borehole lithologic logs, the data must be reported in Section 5.1, Subsurface Lithology, rather than in Section 5.2, Laboratory Analytical Results. Please revise the Report for accuracy.

19. 5.2.1 Vadose Zone Summary, page 5-2

Permittee Statement: "Concentrations of BTEX, TPH, and EDB decrease significantly below the clay to the total depth of KAFB-106V1 at 285 ft bgs. Concentrations of TPH, BTEX, and EDB are below the laboratory reporting limit within the vadose zone in all other boreholes."

NMED Comment: Report revision required. The Permittee's statement is not supported by the data reported in Table 5.1. The table indicates elevated total petroleum hydrocarbons-

diesel range organics (TPH DRO) and TPH GRO concentrations starting at a depth of 459' bgs in well KAFB-106S1. Concentrations for both analytes increase with depth to over 3000 milligram per kilogram (mg/kg) at a depth of 489' bgs. Depth to water (DTW) for KAFB-106S1 is recorded at 492' bgs in the boring log header and well construction diagram. Based on a DTW of 492' bgs, the elevated concentrations are within the vadose zone and both screened intervals of the well are above the water table.

NMED notes that the reported DTW at KAFB-106S1 is substantially greater than at any other ground water monitoring well. For instance, at nearby well KAFB-106S8, DTW is approximately 476' bgs. The anomalous DTW measurement at KAFB-106S1 must be corrected or explained. The Permittee must review the water level data and all related analytical data for all boreholes and revise the Report for accuracy.

20. 5.2.1 Saturated Zone Summary, page 5-3

Permittee Statement: "In wells located off-Base, toluene was the only constituent detected in KAFB-106S5 (farthest from source area) at concentrations of 0.00091 milligrams per kilogram (mg/kg) (417 ft bgs) and 0.00094 mg/kg (467 ft bgs)."

NMED Comment: Report revision required. The Permittee must identify the off-base wells. Additionally, Table 5-1 indicates that TPH DRO was detected at 5.6 mg/kg at a depth of 467 ft bgs at boring KAFB-106S5. Please revise the statement for accuracy.

21. 5.2.2 Light Non-Aqueous Phase Liquid Saturation, Mobility, and Effective Solubility, page 5-4

Permittee Statement: "The highest LNAPL saturation from the vadose zone sample was observed in KAFB-106V1 at a depth of 122 ft bgs...".

NMED Comment: Report revision required. No percentage is provided to compare with the ranges of LNAPL saturation results stated in the previous paragraphs. The Permittee must add the value for percent pore volume for KAFB-106V1 at 122 ft bgs to this sentence.

22. 5.2.2 Light Non-Aqueous Phase Liquid Saturation, Mobility, and Effective Solubility, page 5-4

Permittee Statement: "The percentage of LNAPL saturation decreases away from the source area (KAFB-106V1 and KAFB- 106V2). The highest LNAPL saturation in the saturated zone was found in KAFB-106S9 at a depth of 484 ft bgs (Table 5-4). The lowest LNAPL saturations KAFB-106S5 and KAFB-106S7, which are the farthest wells from the source area..."

NMED Comment: Report revision required. The Permittee must add the percentages of LNAPL saturation to this sentence for comparison purposes and reference the table that presents this information.

23. 5.2.2 Light Non-Aqueous Phase Liquid Saturation, Mobility, and Effective Solubility, page 5-4

Permittee Statement: "Soil grain distribution and classification was analyzed on 16 soil samples (six vadose zone and 10 saturated zone), along with 14 interstitial analyses of soil samples (six vadose zone and eight saturated zone)."

NMED Comment: Report revision required. NMED identified multiple problems with the data and discussion for Section 5.2.2 that make it difficult to evaluate the information presented by the Permittee. The tables and associated discussions must be revised for accuracy and the section rewritten. This issue was discussed during the NMED/KAFB conference call on June 18, 2020.

a. Table 5-3, Lithology and Interstitial Properties of Selected Core Samples, indicates that interstitial properties (total porosity, air filled porosity, pore fluid water saturation, and pore fluid LNAPL saturation) were determined for 16 rather than 14 samples. Resolve the discrepancy.

b. The sample depth column for Table 5-2 reports a depth range for some samples and a single depth for other samples. Explain the difference in the reported sampling intervals and explain how a representative particle size distribution for a 2-foot-long core sample was determined for samples where only a single depth is given. Explain why sample sizes listed in Table 5-4 range from 1/10 foot to 2 feet.

c. A description of the rationale for selecting discreet samples from core samples and at least two examples of the process must be provided in the discussion in Section 5.2.2. Compare the rationale for selecting a discreet sample from cores that fluoresced under ultraviolet (UV) light to cores that did not fluoresce.

d. Table 5-2 reports particle size distribution data and a corresponding United Soil Classification System (USCS) name. Sample GUV-S9-171018-473 is given a USCS classification of well graded sand. The particle size distribution data reports the sample as having 56.67 weight percent (wt.%) gravel 4.0 wt% coarse sand, 17.29 wt% medium sand, 18.97 wt% fine sand, and 3.07 wt% silt/clay. According to the USCS code the sample should be classified as a sandy gravel rather than a well graded sand. All such discrepancies in Tables 5-2 must be identified and corrected.

e. Issues were identified with the PTS Laboratories Physical Properties Data presented in Appendix G-2. For example, PTS File No: 48218 includes two samples, identified on some pages of the data sheets as GUV-S9-171018-473 and GUV-S9-181018-484 and on

other pages as GUV-S9-171018-473 and GUV-S9-181018-474. Review the PTS lab data for accuracy. The Report must be revised to remove data, discussions, conclusions, and recommendations that are based on lab data that fails to meet data quality objectives.

f. NMED has identified discrepancies in the lithologic descriptions for samples reported in Tables 5-2, 5-3, and 5-4. For example, sample GUV-S5-231018-488 is described in Table 5-3 as a well graded sand with gravel while in Table 5-4 it is described as coarse sand. Aside from the descriptions being different, a well graded sand should contain a range of sand sizes rather than coarse sand only. All such discrepancies in Tables 5-2, 5-3, and 5-4 must be identified and the Report revised accordingly. The following are examples of some of the discrepancies identified:

- **i.** The PTS Laboratories sieve analysis results in Appendix G-2 report that sample GUV-S4-041118-486 is classified as a medium sand. Table 5-4 lists the soil type for the sample as fine sand. Resolve the discrepancy.
- **ii.** The PTS Laboratories sieve analysis results in Appendix G-2 report that sample GUV-S2-161118-489 is classified as fine sand. Table 5-4 lists the soil type for the sample as fine sand. Table 5-2 lists the sample as well graded gravel with sand. Resolve the discrepancy.
- **iii.** The PTS Laboratories sieve analysis results in Appendix G-2 report that sample GUV-S3-211118-494 is classified as gravel. Table 5-4 lists the soil type for the sample as gravel. Table 5-2 lists the sample as clay. Resolve the discrepancy.
- **iv.** The PTS Laboratories sieve analysis results in Appendix G-2 report that sample GUV-V1-161219-164 is 91 wt% fine sand. Table 5-2 lists the sample as clay. Resolve the discrepancy.

g. Appendix G-2 appears to contain duplicate Chain of Custody Record forms for individual samples. Remove the duplicate forms from Appendix G-2 or provide an explanation for retaining them.

h. Sample GUV-S7-220119-492 is attributed to coring location KAFB-106S7 in table 5-3, but it is attributed to coring location KAFB-105S7 in Table 5-4. Resolve the discrepancy.

i. The PTS Laboratories Chain of Custody Record for sample GUV-S5-231018-488 indicates that grain size distribution data was one of the analyses requested. Grain size distribution data for the sample is not presented in Table 5-2 of the Report and the footnotes for Table 5-3 indicate that the lithology description for the sample was obtained from logs. Explain why the log description was used rather than the laboratory analysis. Also, the PTS Laboratories data sheets for grain size distribution, interstitial properties, and fluid properties for the sample could not be located in Appendix G-2. All

of the laboratory data for the sample must be provided in the revised Report or the sample must be excluded from the Report.

j. The Permittee states in Section 3 that the intensity of core sample response to UV light provided an approximation of the relative amount of LNAPL present in the soil and that this was used to select sample locations for further laboratory LNAPL analysis. The photo of core sample GUV-V2-131218 at a depth of 214-215 ft bgs appears to display the most intense response to UV light of any of the samples evaluated yet the Permittee did not select the sample for LNAPL analysis. Provide justification for not conducting LNAPL analysis on this sample.

24. 5.2.2 Light Non-Aqueous Phase Liquid Saturation, Mobility, and Effective Solubility, page 5-4

Permittee Statement: "For the purpose of assessing the location of LNAPL in the saturated zone, the more conservative effective solubility concentration of 1.43 milligrams per liter (mg/L) benzene is used as a line of evidence of potential LNAPL occurrence."

and

"Using the effective solubility concentration of 1.43 mg/L, the location of submerged LNAPL was approximated by locating this concentration isocontour on the benzene concentration map. Figure 5-7 shows the approximate location of LNAPL as superimposed on the [second quarter of 2019 sampling event] Q2 2019 benzene isocontour map (reference elevation interval 4857)."

NMED Comment: Report revision required. Figure 5-7, LNAPL-Filled Porosity from Continuous Coring, depicts the outline of the dissolved benzene plume where concentrations exceed the EPA maximum contaminant level (MCL) of 5 ug/L in groundwater rather than the contour for the effective solubility concentration of benzene 1.43 mg/L. Also depicted in the figure is an outline of the estimated extent of LNAPL/residual LNAPL in groundwater. The Permittee must clarify in the legend of Figure 5-7 if this contour is equivalent to the effective solubility of benzene (1.43 mg/L), if it is not, revise Figure 5-7 to show the isocontour for 1.43 mg/L benzene. Furthermore, it is not clear what data was used to create the LNAPL outline. The Permittee's statement refers to using the effective solubility concentration of 1.43 mg/L to construct the LNAPL isocontour however, the well identification numbers and analytical data used to construct the contour have not been provided. The Permittee must also revise the legend of Figure 5-7 to indicate the source of the data used to create the LNAPL isocontour and provide a table that identifies the wells, date of collection, and concentration data used to create the LNAPL isocontour.

25. 5.2.2 Light Non-Aqueous Phase Liquid Saturation, Mobility, and Effective Solubility, page 5-5 and 5-7

Permittee Statement: "Figure 5-7 indicates that the BTEX plume biodegrades within a relatively short distance (less than 500 ft) from the residual source and is fully attenuated before it reaches Ridgecrest Drive."

and

"Based on these data, it does not appear that biodegradation of EDB or BTEX can occur at significant rates at these sample locations [KAFB-106S7, KAFB-106S8, KAFB-106247]."

NMED Comment: Report revision required. The Permittee must revise the Report to include lines of evidence to demonstrate that biodegradation is the mechanism by which the BTEX plume is attenuated and resolve the discrepancy between the two conclusions presented in the statements above regarding biodegradation of the BTEX plume.

26. 5.2.2 Light Non-Aqueous Phase Liquid Saturation, Mobility, and Effective Solubility, page 5-4

Permittee Statement: "LNAPL samples collected from KAFB-106006 (alias KAFB-1066) and KAFB-106076 (alias KAFB-10676) in 2011 were used to calculate the effective solubility of BTEX in both samples (Kirtland AFB, 2018a). Solubility values from NMED guidance (NMED, 2019f) were used to calculate the molar fractions for each constituent. The effective solubility of BTEX (average of ortho-, meta-, and para-xylenes) in KAFB-106006 was calculated to be 6.44, 17.25, 1.03, and 1.37 milligrams per liter (mg/L), respectively. The effective solubility of BTEX in KAFB- 106076 was calculated to be 1.43, 6.89, 0.78, and 0.94 mg/L, respectively (Table 5-5)."

NMED Comment: Report revision required. This issue was discussed during the NMED/KAFB conference call on June 18, 2020.

a. The Permittee states that the solubility in water and effective solubility values for benzene are taken from the 2018 *Phase I RCRA Facility Investigation Report, Bulk Fuels Facility Release, Solid Waste Management Unit ST-106/SS-111* (2018 RFI), a document that has not been approved by NMED. The 2018 RFI, page 5-4, lines 24-27, reports the following values for benzene: solubility in water=1,780 mg/L; effective solubility= 1.494 mg/L at KAFB-106006; and effective solubility=6.408 mg/L at KAFB-106076. These values are different than what is presented in the discussion and in Table 5-5. Resolve the discrepancy.

b. NMED notes that the 2018 RFI, page 5-4, lines 28-31, states "It is important to note that additional LNAPL samples may yield additional effective solubilities for benzene that could be higher or lower than those yielded by the two collected LNAPL samples. The original composition of the LNAPL, and the degree of degradation, will both affect the mole fraction of benzene in each sample. These effective solubilities represent only one line of evidence indicating where residual LNAPL remains in the saturated zone." This statement identifies important uncertainties regarding the use of LNAPL samples from 2011 to calculate the effective solubility of benzene and, in turn, to estimate the current extent of LNAPL/residual LNAPL in water. The Permittee must revise the Report to identify the uncertainties associated with using LNAPL samples from 2011.

27. 5.2.2 Light Non-Aqueous Phase Liquid Saturation, Mobility, and Effective Solubility, page 5-5

Permittee Statement: "...exceeded the benzene standard of 5 µg/L ranging from 0.2 to 26,000 µg/L...Figure 5-6."

NMED Comment: Report revision required. The Permittee must add additional text to this section describing how many wells were sampled and where the wells with the highest concentrations are located.

28. Section 5.2.4 Microbial Analysis pages 5-7 and 5-8

Permittee Statement: "In general, concentrations of bacteria associated with potential EDB degradation in soil samples collected in 2018 were moderate... Concentrations of various well-studied reductase enzymes (including ethylene dichloride reductase) were not detected in any samples, and enzymes associated with aerobic cometabolic degradation of EDB during aerobic metabolism of BTEX (phenol hydroxylase and two toluene monooxygenases) were detected in significant numbers in five samples (collected from KAFB-106S1, KAFB-106S2, KAFB-106S3, KAFB-106S4, and KAFB-106S9)."

NMED Comment: Report revision required. Provide information or context on what constitutes "moderate" concentrations of bacteria or "significant number" of enzymes associated with aerobic cometabolic degradation of EDB during aerobic metabolism of BTEX. Revise the Report to include a table and discussions that provide a quantitative comparison of the data presented in the Report to an appropriate standard. Incorporate information on sample depth relative to the water table, lithology, and location relative to the submerged LNAPL plume.

29. Section 5.2.5 Moisture Content, page 5-8

Permittee Statement: "The results of the moisture analyses are shown in Tables 5-7 and 5-8 and in Appendix G-4."

a. **NMED Comment:** Report revision required. Table 5-7, Summary of Soil Analytical Moisture Content, lists the USCS lithology classification for each sample. It is unclear how the soil data in the USCS column corresponds to the data in the other columns. Revise the table to clearly attribute the appropriate soil type to each individual sample. The issues identified with the reporting of PTS Laboratories soil data in Tables 5-2, 5-3, and 5-4 also affects Table 5-7. Please revise all Tables containing USCS data to consistently report accurate USCS classifications for the samples.

b. **NMED Comment:** Report revision required. Table 5-7 reports percent moisture content and percent LNAPL for soil samples but provides no information as to what the percentage values refer to, such as percent pore volume or percent bulk volume. Revise Table 5-7 to indicate what the percentage values refer to.

30. Section 5.2.5 Moisture Content, page 5-8

Permittee Statement: "Moisture analyses were performed by American Society for Testing and Materials (ASTM) International D2216 (ASTM International, 2005) for geotechnical, TPH, EDB, and [volatile organic compounds] VOC analyses."

NMED Comment: Report revision required. ASTM International Test D2216 is a test for determination of the water (moisture) content by mass of soil, rock, and similar materials, not a test method used for geotechnical, TPH, EDB, and VOC analyses. Please revise the statement for accuracy.

31. Section 5.2.5 Moisture Content, page 5-8

Permittee Statement: "The moisture content ranged from 1.3 to 33.8 wt.% for the analyzed samples. The moisture content results and corresponding USCS classification for the samples are summarized in Table 5-7."

NMED Comment: Report revision required. Table 5-7 reports percent moisture content and percent LNAPL for soil samples but does not provide information as to what the percentage values refer to, such as percent pore volume or percent bulk volume. Please revise Table 5-7 accordingly.

32. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-9

Permittee Statement: "The vapor plume model was interpolated using a kriging method assuming a very low horizontal to vertical anisotropy (3 to 1). The very low anisotropy range (typical is 30 to 1) was selected because of the gravity dominated flow of the release. A lower value was not used because it resulted in isolated plumes with no constraint in between borehole locations, which is not considered reasonable."

NMED Comment: Report revision required. Model assumptions such horizontal to vertical anisotropy and gravity dominated flow must be based on empirical data acquired from the site. Please revise the Report to provide justification for the anisotropy ratio and for the modeling assumption that gravity dominated flow is consistent throughout the vadose zone. Discuss differences in anisotropy that may exist between the alluvial piedmont deposits and the Upper Santa Fe Group deposits.

33. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-9

Permittee Statement: "The vapor plume was then illustrated using an arbitrary iso-shell value of l00,000 micrograms per cubic meter. Model results are presented on Figures 5-8 through 5-14 and are discussed below."

NMED Comment: Report revision required. The term "iso-shell" must be defined. Based on the color bar representing BTEX concentrations in soil vapor and the depictions of the BTEX vapor plume in Figures 5-8 through 5-14, it appears that the Permittee used an "iso-shell" value of 10,000 micrograms per cubic meter rather than 100,000 micrograms per cubic meter as a cutoff value to define the boundary of the BTEX plume. Revise the figures and discussion to resolve the discrepancy.

34. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-9

Permittee Statement: "Subsurface geology (sands and gravels) was the dominant control for the downward migration of the release."

NMED Comment: Report revision required. The dominant control for the downward migration of the release was the continuous, extended release of fuel to the subsurface which provided the hydraulic head necessary to drive migration. The dominant control for the contaminant migration pathway was the subsurface geology. Please revise the statement for accuracy.

35. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-9

Permittee Statement: "The lack of significant soil vapor hydrocarbon results directly above these shallow clay units laterally from the source area suggests that LNAPL maintained a

near vertical migration pathway through higher permeable areas around, as well as through the clays. This indicates that LNAPL migration was dominated by gravity drainage rather than horizontal migration along low permeability (i.e., clay or silt) zones."

a. **NMED Comment:** Report revision required. The Permittee makes a comparison of a physical process (gravity drainage) relative to horizontal migration. It is not clear how gravity drainage, migration direction, and permeability relate to one another in this example or why gravity drainage is considered the dominant factor for LNAPL migration. Revise the statement for clarity.

b. **NMED Comment:** Report revision required. In the discussion of downward migration of the contaminant plume the Permittee refers to shallow clay layers and deeper clay layers but provides no information on the different characteristics of the shallow versus deep clay layers to support the conclusions presented in the discussion. The Permittee must differentiate between the shallow and deeper clay layers by including in the discussion, at a minimum, information on the depositional environment, bed geometry and thickness, lateral continuity, and physical and interstitial properties.

36. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-10

Permittee Statement: "At that point, mobile LNAPL migrated northward on the groundwater in response to LNAPL head resulting from continued loading from the ongoing release (Figure 5-10)."

NMED Comment: Report revision required. Figure 5-10 does not clearly depict LNAPL. Revise Figure 5-10 to clearly depict LNAPL.

37. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-10

Permittee Statement: "Figure 5-11 shows the residual LNAPL (smear zone) to be approximately 40 ft thick in the source area (KAFB-106S9) and thins to approximately 25 ft thick toward the south (KAFB-106S1) and less than 10 ft thick to the north (KAFB-106S5)."

NMED Comment: Report revision required. Figure 5-11 must be modified to include a north arrow. Also, the figure depicts multiple isolated LNAPL bodies below the water table without explanation. Revise the Report to add a north arrow to all figures and include a discussion on the significance of the isolated LNAPL bodies depicted in Figure 5-11. Clarify whether all the LNAPL bodies are included in the estimation of the LNAPL smear zone thickness.

38. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-10

Permittee Statement: "Laboratory results during coring operations indicate elevated concentrations of adsorbed hydrocarbons at elevations that most likely relate to the local groundwater elevation steps."

NMED Comment: Report revision required. Provide lines of evidence to support the statement. Revise the discussion and provide a table that describes the number and depths of the elevation steps, the source of the data, the related laboratory results, and corresponding lithologies.

39. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-10

Permittee Statement: "Partitioning of benzene from residual LNAPL where the vadose zone source intersected the groundwater table serves as a continuing source of dissolved contamination."

NMED Comment: Report revision required. This statement must differentiate between past, current, and predicted vadose zone / groundwater table intersection. Please revise the statement for clarity and address submerged LNAPL in the discussion of continuing sources of dissolved contamination.

40. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-10

Permittee Statement: "The dissolved phase benzene plume is shown in map view on Figure 5-12."

NMED Comment: Report revision required. The referenced figure must include clear contaminant contour lines. Also, please clarify if this figure represents soil vapor or groundwater data. The Legend and Notes contradict each other. Revise figure 5-12 for clarity.

41. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-10

Permittee Statement: "The soil vapor plume in the vadose zone is shown on Figure 5-13."

NMED Comment: Report revision required. Figure 5-13 depicts a lone pocket of BTEX vapor to the west of KAFB-106S3 with no associated monitoring points to identify the source of these data. It is difficult to estimate the concentration of this pocket of BTEX soil vapor with the scale provided in the Legend of the figure. Discuss this anomaly, including its concentration and depth in the text of the revised Report.

42. 5.3 Light Non-Aqueous Phase Liquid and Fuel Hydrocarbon Spatial Distribution, page 5-10

Permittee Statement: "Figure 5-14 shows that the highest dissolved phase benzene concentrations are located where the soil vapor plume intersects the groundwater plume, demonstrating that the soil vapor and dissolved vapor data are in alignment."

NMED Comment: Report revision required. Figure 5-14 does not clearly illustrate this concept as data points appear to be omitted from the figure. Please revise the figure to clearly depict the relationship between the soil vapor plume and groundwater plume.

43. Section 6 Investigation Derived Waste, page 6-1

Permittee Statement: "Information regarding investigation-derived waste accumulation and storage, utilization of the Kirtland AFB groundwater treatment system, and other investigation-derived waste processes are described in more detail in the following reports generated for the BFF..."

NMED Comment: The Report contains no information on how the IDW was containerized, transported, characterized, stored, or disposed of. Appendices F-1 through F-4 contain tables but no descriptions of procedures. The Permittee may not refer to separate documents and must include all IDW information relevant to this scope of work as an appendix in the revised Report.

44. Section 7 Summary and Conclusions, page 7-1

Permittee Statement: "The source zone characterization included coring at 11 locations to assess the horizontal and vertical extent of LNAPL at the Site... the collection of over 3,600 linear ft of core, chemical analysis of 87 soil samples, UV fluorescence of 30 cores... Soil core samples were collected to obtain contaminant concentration and soil and LNAPL properties data."

NMED Comment: Report revision required. Please provide the results of these data on cross sections or fence diagrams so that a direct comparison can be made of the lithology and the locations of samples, LNAPL, and UV detections found through field screening and laboratory analyses.

45. Section 7 Summary and Conclusions, page 7-1

Permittee Statement: "Continuous cores were collected next to existing boreholes using sonic drilling to provide higher resolution lithologic data in the source area. The logs from the new cores were then compared to the logs from the existing boreholes."

NMED Comment: Report revision required. The cross sections in the Report do not reflect this higher resolution data and are presented in a different style than those presented in the Work Plan. Please revise the Report to present the data in a format that allows a comparison of the data from the new cores to the data from the pre-existing boreholes.

46. Section 7 Summary and Conclusions, page 7-1

Permittee Statement: "The SVM wells were installed as observation wells for the bioventing pilot study that initiated in 2018."

NMED Comment: Report revision required. Please cite and reference the specific documents in which the information related to the bioventing pilot study was submitted to NMED.

47. Section 7 Summary and Conclusions, page 7-1

Permittee Statement: "Soil samples were collected from drill cuttings and soil cores and then submitted to an analytical laboratory for TPH GRO/DRO/MRO, VOC, and EDB analysis."

NMED Comment: Report revision required. Please identify which soil samples were collected from drill cuttings and sent to analytical laboratories for analysis. Samples collected for investigation derived waste (IDW) analyses may be excluded.

48. Section 7 Summary and Conclusions, page 7-1

Permittee Statement: "Evaluation of the data collected from LNAPL testing provided the following conclusions:"

NMED Comment: Report revision required. This statement appears to be a typographical error. Concentrations of TPH, BTEX, and EDB rather than LNAPL are discussed in the bulleted paragraphs that follow. LNAPL is discussed in a separate section on page 7-2. Please revise the Report to correct the discrepancy.

49. Section 7 Summary and Conclusions, page 7-1

Permittee Statement: "These concentrations increased with depth until a clay unit that was encountered at a depth of approximately 265 ft bgs. Below this clay unit, concentrations decrease significantly (Figures 5-3 through 5-5)."

NMED Comment: Report revision required. Figures 5-3 through 5-5 do not depict lithology and the cross sections provided in Figures 5-1 and 5-2 are insufficient for correlating this information. Please revise the Report to provide adequate cross sections that depict the information presented in the discussion.

50. Section 7 Summary and Conclusions, page 7-2

Permittee statement: "The highest LNAPL saturation from the vadose zone is in KAFB-106V1 at a depth of 122 ft bgs (Table 5-4). The highest LNAPL saturation in the saturated zone was observed in KAFB-106S9 at a depth of 484 ft bgs (Table 5-4). The lowest LNAPL saturations are in wells KAFB-106S5 and KAFB-106S7, which are located off-Base, farthest from the source area (Table 5-4)."

NMED Comment: The revised report must include a figure and/or cross section that illustrates this statement. The figure must clearly depict lithology, LNAPL saturation, current and former groundwater levels, and clearly identify relevant boring locations. See Comment 14.

51. Section 7 Summary and Conclusions, page 7-2

Permittee Statement: "The LNAPL migrated as far north as Bullhead Park, and this was observed in the residual saturation data."

NMED Comment: Report revision required. Bullhead Park is not identified on any of the figures presented in the Report. Please revise the Report to ensure all geographical features and locations referenced in the text of the Report are identified on all relevant figures.

52. Section 7 Summary and Conclusions, page 7-2

Permittee Statement: "The highest LNAPL saturation from the vadose zone is in KAFB-106V1 at a depth of 122 ft bgs (Table 5-4). The highest LNAPL saturation in the saturated zone was observed in KAFB-106S9 at a depth of 484 ft bgs (Table 5-4). The lowest LNAPL saturations are in wells KAFB-106S5 and KAFB-106S7, which are located off-Base, farthest from the source area (Table 5-4)."

NMED Comment: Report revision required. Please revise the Report to add a figure that clearly depicts the spatial context of LNAPL saturation within the site and identify all relevant boring identification numbers, sample depths, groundwater depths at the times of investigation, and historical low and high groundwater depths.

53. Section 7 Summary and Conclusions, pages 7-2 and 7-3

Permittee Statements: "No microbial genes responsible for reductive dehalogenation were found in samples collected."

"No Dehalococcoides, the only bacteria known to be capable of complete reductive dehalogenation to ethane, were found in any of the samples."

and

"Abiotic attenuation of EDB with respect to iron-bearing minerals is not anticipated to be significant."

NMED Comment: Report revision required. Please revise the Report to discuss the presence or absence of bacteria and/or minerals that could have affected the degradation of site-specific contaminants of concern. This will serve to simplify Sections 5.2.3, Mineralogy and Magnetic Susceptibility and 5.2.4, Microbial Analysis, for the general public and stakeholders.

54. Section 7 Summary and Conclusions, page 7-3

Permittee Statement: "In general, soil moisture was less than 5% in vadose zone samples (Table 5-7)."

NMED Comment: Report revision required. According to Table 5-7, soil moisture in vadose zone samples were greater than 10% in many samples, and greater than 15% in approximately one dozen samples, while soil moisture was significantly lower, on average, in the saturated zone. The Permittee must revise the Report to correct this statement and explain why soil moisture levels are higher in the vadose zone relative to the saturated zone, particularly in the area where SVE systems have been operated (KAFB-106V1 and KAFB-106V2).

55. Section 7 Summary and Conclusions, page 7-3

Permittee Statement: "The clays do not appear to have significantly affected lateral migration of the LNAPL. LNAPL migration was primarily by gravity drainage rather than horizontal migration along low permeability (i.e., clay or silt) zones."

NMED Comment: Report revision required. The conclusion that clays do not appear to have significantly affected lateral migration of the LNAPL minimizes the importance of the impact of the clays at the site. The vapor and LNAPL plumes depicted in Figures 5-8 through 5-14 indicate that the clay layer identified at approximately 265 ft bgs caused lateral migration of the contaminant plume. The statement must be revised for clarity.

56. Section 7 Summary and Conclusions, page 7-3

Permittee Statement: "Average gravel LNAPL saturations were 2.57 and 0.9% relative to pore volume and total volume, respectively. For the medium sand samples from the saturated zone, LNAPL saturation ranged from 0.04 to 4.9% pore volume and from 0.02 to 2.0% total volume, respectively. The coarse sand sample from the saturated zone had a LNAPL saturation of 0.08% pore volume and 0.03% total volume. Average LNAPL saturation relative to pore volume and total volume for the three fine sand samples averaged 2.4 and 1.0%, respectively".

NMED Comment: Report revision required. The statement must be revised for accuracy once the issues identified by NMED related to the classification of soil types have been resolved.

57. Section 8 References, page 8-1

NMED Comment: Monitoring well completion reports are listed as individual references but were not submitted to NMED as individual documents. The reports were submitted as appendices in other documents and the title and cover pages of those documents did not identify the presence of the monitoring well completion reports. The Permittee must revise the Report to cite the document, section, and page numbers in which each of the monitoring well completion reports is presented. Additionally, the Permittee must revise the Report to include all of the well completion reports for the well installations associated with this scope of work as an appendix.

58. Section 8 References, page 8-1

NMED Comment: Report revision required. The document "NMED. 2019b. *Approval to Not Install KAFB-106S6 and Relocate KAFB-106247* by Mr. Dennis McQuillan, Chief Scientist. January 25." is not included in Appendix A, Regulatory Correspondence. Please revise the Report to include the reference in Appendix A.

59. Figures 5-1 Cross Section A-A' and 5-2, Cross Section B-B'

NMED Comment: Report revision required.

a. Figures 5-1 and 5-2 are not true cross sections or fence diagrams. They appear to be an interpolation of subsurface geology across the site. Some of the wells used to create the figures are offset too far from the transects to accurately depict subsurface geology. Please revise Figure 5-1 and 5-2 with more reasonable cross section lines. The Permittee must also depict the actual elevation/depth to water on the figure.

b. The cross-sections presented in Figures 5-1 and 5-2 are inadequate in depicting the subsurface conditions across the site, particularly in the source area, because they are inconsistent with much of the lithologic data previously obtained at the site. Revise the Report to include cross sections that appropriately incorporate existing lithologic and geophysical data from other nearby wells in the area and include depth to water and historic high and low water levels. The cross sections must also depict key stratigraphic surfaces such as the top of the ancestral Rio Grande sediments and the top and bottom of the fine grained, low permeability intervals that occur between 250-300 feet bgs. Multiple straight line transects must be presented rather than a single transect with multiple directional changes. The cross sections must be presented in a large enough

format to allow the details to be discernable. This issue was discussed during the NMED/KAFB conference call on June 18, 2020.

60. Figures 5-3 BTEX Concentrations In Soil, 5-4, EDB Concentrations In Soil, and 5-5, TPH Concentrations In Soil

NMED Comment: Report revision required. Soil screening levels are not included on Figures 5-3, 5-4, and 5-5. Please revise these figures to include the soil screening levels used for each contaminant of concern and reference which screening levels were used (e.g., NMED, EPA, etc.) in the "Notes" section of the figures.

61. Figure 5-5 TPH Concentrations in Soil

NMED Comment: Report revision required. There is no unit of measurement for the TPH data in the figure. Please revise Figure 5-5 to indicate a unit of measurement for TPH concentration data.

62. Figure 5-6 Benzene Concentrations in Groundwater Reference Elevation Interval 4857, Q2 2019

NMED Comment: Report revision required. The "Notes" section of Figure 5-6 refers to two abbreviations, MVS and REI, that are not defined in the Report. Please revise the Report to define the abbreviations. Additionally, the title of the figure refers to Reference Elevation Interval 4857. This term is not defined in the Report. Revise the Report to provide an explanation of the term and the significance of the associated value. Add a figure similar to Figure 3-2, Reference Elevation Capture and Containment Intervals, of the Q2 2019 Quarterly Report to provide a point of reference for understanding the concept of reference elevations.

63. Figure 5-6 Benzene Concentrations in Groundwater Reference Elevation Interval 4857, Q2 2019

NMED Comment: Report revision required. A large portion of the figure depicts wells north of Ridgecrest Drive which were not sampled for benzene. Please provide an explanation in the relevant section of the revised Report as to why these wells were not sampled for benzene. In addition, provide the date when benzene was last detected north of Ridgecrest Drive, the wells in which it was last detected, and which wells currently provide evidence of lateral containment of the benzene plume. These wells must be easily identifiable in the revised Report.

64. Figure 5-7 LNAPL-Filled Porosity from Continuous Coring

NMED Comments: Report revision required. The legend indicates that the ≥5 µg/L isocontour for benzene is shown rather than the effective solubility concentration for benzene of 1.43 mg/L. The Permittee must depict the effective solubility concentration for benzene of 1.43 mg/L on Figure 5-7. Furthermore, the legend indicates that the green shaded area of the figure depicts the estimated extent of LNAPL/Residual LNAPL in groundwater while the title block of the figure indicates that the figure presents LNAPL filled porosity from continuous coring. Revise the Figure 5-7 to resolve the discrepancy. Finally, while Figure 5-7 shows wells that contain free phase LNAPL on groundwater, it is difficult to compare this with the submerged LNAPL in soil porosity that is also presented in the figure. Please revise Figure 5-7 to include contours for confirmed free phase LNAPL.

65. **Figure 5-8 EVS Model 3-Dimensional Views South to North and East to West**
Figure 5-9 EVS Model 3-Dimensionalview Showing Clays at 265 Feet Depth
Figure 5-10 EVS Model of Historical Groundwater Elevations Relative to the Vadose Zone Plume and the Dissolved Benzene Plume in Groundwater
Figure 5-11 3-Dimensional View Showing Estimated Location of LNAPL in the Saturated Zone

NMED Comment: Report revision required. NMED has identified the following issues with Figures 5-8 through 5-11:

a. Revise all figures to include a North arrow.

b. Revise the figures to include well identification numbers and pertinent site features (e.g.: source area, former loading racks, former and current above ground storage tanks, any visible KAFB boundaries, Ridgecrest Drive).

c. The plume depiction does not appear to match the data because there are several red and yellow soil vapor monitoring well (SVMW) points with elevated contaminant concentrations that are not incorporated into the plume. Explain this discrepancy and identify anomalous data on the figures in the revised Report.

d. Revise the Report to enable the reader to cross reference the lithologic data points for the intricate edges of the clay lenses with the other data presented in the report.

66. Figure 5-8 EVS Model 3-Dimensional Views South to North and East to West
Figure 5-10 EVS Model of Historical Groundwater Elevations Relative to the Vadose Zone Plume and the Dissolved Benzene Plume in Groundwater

NMED Comment: Report revision required. It is difficult to interpret what represents BTEX in soil vapor and what represents dissolved benzene in groundwater because the same color scale is used for both data sets. Please revise Figures 5-8 and 5-10 to utilize contrasting color scales for BTEX concentrations in soil vapor and dissolved benzene concentrations in groundwater.

67. Figure 5-10 EVS Model of Historical Groundwater Elevations Relative to the Vadose Zone Plume and the Dissolved Benzene Plume in Groundwater

NMED Comment: Report revision required. The figure is difficult to interpret because it is unclear if LNAPL thickness is represented and it is difficult to determine the compass orientation. Revise the figure to include well identification numbers and a north arrow for the purpose of orienting the features depicted in the figure. Also, the figure should be representative of the statements made in Section 5-3.

68. Figure 5-9 EVS Model 3-Dimensionalview Showing Clays at 265 Feet Depth
Figure 5-10 EVS Model of Historical Groundwater Elevations Relative to the Vadose Zone Plume and the Dissolved Benzene Plume in Groundwater
Figure 5-11 3-Dimensional View Showing Estimated Location Of LNAPL in the Saturated Zone

NMED Comment: Report revision required. The explanation of "Depth" in the legends is inaccurate. For example, on Figure 5-9, the legend states "(250) = Depth 100 feet below ground surface". Please revise the figures to accurately indicate depth.

69. Figure 5-8 EVS Model 3-Dimensional Views South to North and East to West
Figure 5-11 3-Dimensional View Showing Estimated Location of LNAPL in the Saturated Zone

NMED Comment: Report revision required. Both figures appear to be missing key soil vapor data from Q2 2019. For example, Q2 2019 soil vapor data from soil vapor monitoring point SVMW-09-266 shows a BTEX concentration of 3,398,000 parts per billion (ppb), which is not included in the figure. Please revise the figures to clearly depict all relevant Q2 2019 soil vapor data. Also, ensure that all monitoring points are labeled on all figures.

70. Figure 5-11 3-Dimensional View Showing Estimated Location of LNAPL in the Saturated Zone

NMED Comment: Report revision required. Figure 5-11 is very difficult to read and interpret. There is no information on the figure which allows the reader to place the information presented within a spatial context for the BFFS:

a. The figure depicts multiple isolated LNAPL bodies below the water table without explanation. Please revise the Report to include a discussion of the significance of the isolated LNAPL bodies depicted on Figure 5-11 and clarify whether all of the LNAPL bodies are included in the estimation of the LNAPL smear zone thickness.

b. It is difficult to correlate high levels of BTEX in soil vapor (<10,000 µg/m^3) in the representation of the subsurface of site. Add well identification numbers to the figure.

c. The legend indicates that "LNAPL in Groundwater" is depicted in the figure as a concentration ranging from 1,000 to 19,068 mg/kg. LNAPL is not usually presented as a concentration. Additionally, it is difficult to identify LNAPL in the figure. Please explain the presentation of LNAPL in units of mg/kg and revise Figure 5-11 so that LNAPL is readily identified.

d. Indicate which quarterly measurements (e.g., Q2 2019) were used to generate the depiction of LNAPL shown in the figure.

e. The area of interest on this figure is the submerged LNAPL in the saturated zone; however, the part of the figure in which the submerged LNAPL is illustrated is only a small portion of the total area available in the figure. Revise the Report to provide an additional figure focusing on the area of submerged LNAPL in the saturated zone which includes a way to identify the location beneath the BFFS site, appropriate scale indicators, and well identification numbers.

71. Figure 5-12 Dissolved Benzene in the Saturated Zone

NMED Comment: Report revision required. NMED has identified multiple issues with this figure:

a. It is difficult to interpret concentration data without clear contaminant contour lines. Please revise the figure to include contour lines.

b. It is unclear what data were used to create this plume image. If the data for all groundwater monitoring wells sampled during Q2 2019 were included, these wells must be identified in the figure. If not, the Permittee must justify that the limited data set is representative of the site conditions. The Permittee must clarify and provide an explanation in the appropriate section of the revised Report.

c. The legend shows a color scale for dissolved benzene in groundwater but the notes reference Q2 2019 soil vapor data. Please resolve the discrepancy.

72. Figure 5-13 Total BTEX in Soil Vapor in the Vadose Zone

NMED Comment: Report revision required. NMED has identified the following issues with the figure:

a. The area of interest is very small compared to size of the background aerial photograph, and therefore approximately 80% of figure is non-relevant imagery of the surrounding area. Please revise the figure scale to clearly depict area of interest.

b. It is unclear what data was used to create the figure. Revise the figure to identify the wells from which data was used to create the figure.

c. It is unclear what subsurface sampling elevations were used to create the depiction of the soil vapor plume. Revise the figure to indicate the subsurface elevations represented on the figure.

d. The color gradient scale in the legend is very subtle in its differentiation between values over several orders of magnitude; furthermore, the colors in the legend do not match the colors in the figure. Revise the figure using a more detailed color gradient that matches the colors used in the figure and add contaminant contour lines.

e. The figure depicts an isolated pocket of elevated BTEX vapor to the west of KAFB-106S3 with no associated soil vapor wells or data points in the vicinity to identify the source of the data used to create the figure. Also, it is difficult to estimate the concentration of this pocket of BTEX soil vapor using the scale provided in the legend of the figure. The Permittee must discuss this pocket of BTEX in the relevant portions of the Report and add associated data points to the revised Figure.

73. Figure 5-14 Total BTEX in Soil Vapor in the Vadose Zone, and Dissolved Benzene in the Saturated Zone

NMED Comment: Report revision required. NMED has identified multiple issues with the figure:

a. It is not clear to which depth/elevations the depicted soil vapor data correspond. Please revise the figure to add depths/elevations.

b. The figure portrays groundwater data and soil vapor data with the same color scheme making it difficult to precisely interpret the data presented on the figure. Revise the figure with different color schemes for each data set depicted on the figure.

c. The color gradient panel for BTEX in soil vapor does not match the color presented on the figure. Revise the figure to use a color scale that matches both the key and the data.

d. It is unclear which data were used to create Figure 5-14. Wells KAFB-106V1 and KAFB-106V2 are not included on Figure 5-14. Revise the figure notes to explain which data sets were used to create Figure 5-14 and include all data points in the revised figure.

e. A large portion of Figure 5-14 depicts non-relevant surrounding satellite imagery. Revise the scale of the figure to provide greater detail for the area of interest.

74. Table 3-1 Coring Intervals and Soil Sample Locations

NMED Comment: Report revision required. Many different types of soil samples were collected for this field effort. Revise Table 3-1 to include any samples that may have been collected with drilling methods other than sonic (e.g., air rotary casing hammer). Additionally, please revise Table 3-1 to indicate which types of samples were collected at the depths presented on the revised table.

75. Table 4-1 Photoionization Detector Field Screening Data

NMED Comment: Report revision required. The depth for KAFB-106S8 is incorrectly expressed as a PID reading of 70.4 ppm rather than a depth of 450 ft bgs. Please revise the table to correct the error.

76. Table 4-1 Photoionization Detector Field Screening Data

NMED Comment: Report revision required. Table 3-3 of the Work Plan, along with Table 3-1 and Table 4-1 of the Report indicate that KAFB-106247, the 'background' boring, was only sampled at 5 of the 10 proposed sample intervals defined by the Work Plan. In Section 4.3 (Deviations from Work Plan) of the revised Report, please explain why laboratory samples for KAFB-106247 were not collected according to the approved Work Plan.

77. Table 5-1 Analytical Results for Total Petroleum Hydrocarbons and Volatile Organic Compounds in Soil

NMED Comment: Report revision required. All laboratory results are presented in Table 5-1 with the LOD only. Add a column to Table 5-1 to report the DL, LOD, and LOQ for each analysis presented. See General Comment 4.g.

78. Table 5-1 Analytical Results for Total Petroleum Hydrocarbons and Volatile Organic Compounds in Soil

NMED Comment: The table footnotes refer to "RSL = regional screening level". The regional screening levels (RSLs) are not included in Table 5-1. Revise Table 5-1 to include a column for the appropriate screening levels used for the Report and reference the screening levels correctly in the table footnotes (e.g., NMED, NMWQCC, EPA, etc).

79. Table 5-2, Soil Grain Size Distribution and Classification

NMED Comment: Report revision required. The USCS Classification appears to be based on the lithologic logs rather than the particle size distribution presented in the table. See Comment 25. The Permittee must also include a table which compares the lithologic log descriptions to the laboratory particle size distribution in the revised Report.

80. Table 5-3 Lithology and Interstitial Properties of Selected Core Samples

NMED Comment: Report revision required. Table 5-3 presents data quantifying porosity, permeability, and saturation of cores based on lithology and analyses of individual cores. In the relevant section of the Report, the Permittee must discuss fluid losses that may have occurred to cores during retrieval of the cores from boreholes during the drilling process and how this may affect sample integrity, data representativeness, and the representativeness of estimates of soil moisture in the vadose and saturated zones.

81. Table 5-4 Summary of LNAPL Saturation and Mobility for Select Core Samples

NMED Comment: Report revision required. Please revise the table to add a footnote explaining how LNAPL Saturation (%TV) was calculated for this table.

82. Table 5-7 Summary of Soil Analytical Moisture Content

NMED Comment: Report revision required. Table 5-7 contains inconsistencies, errors, and omissions. The Permittee must correct the following in the revised report:

a. Add a footnote to indicate what impact fluid loss, due to core retrieval and sample shipping and handling, may have had on soil moisture content in samples.

b. The manner in which the LNAPL data is presented is unclear. For example, the result of 7.2% LNAPL at 122 ft bgs could belong to either V1 or V2, or both, and the result of 2.1% LNAPL at 490 ft bgs could belong to either S5 or S9. Provide clarification on which borings and sample depths correspond to the percentages of LNAPL.

c. The manner in which the lithologic data is presented is misleading. It is not accurate to assume that lithologies remain consistent at any given depth across the area of investigation. Some cells in the "USCS" column of the table have more than one lithology listed, some are separated by dashes, slashes, and or/spaces and some are presented in different colored fonts. For example, at the depth of 360 ft bgs there are two readings for soil moisture (for S3 and S5), and the USCS is presented as "SW-SP/SM" on the left side of the cell and "SW" on the right side of the cell. It is unclear which lithology is associated with S3 and which is associated with S5. Furthermore, the color coding of the font to represent different laboratories that performed analyses does not always correlate with the order of presentation of the data at any given depth. Revise Table 5-7 to accurately present soil moisture data and lithology at the site.

d. The Permittee must add the DBS lab results for KAFB-106247 at 490 ft bgs.

e. The Permittee must add the PTS laboratory results for KAFB-106S5 at 488 ft bgs and KAFB-106S7 at 492 ft bgs.

f. The result for S9 at 342 ft bgs is presented as 14%, whereas the TA laboratory results present the value as 16.3%. Correct this discrepancy in the revised Report.

g. Adjust the font color for results for V1 at 158 ft bgs to blue to indicate that the analysis was performed by PTS laboratory.

h. Data in the Table is presented with inconsistent significant figures. The Permittee must use consistent significant figures in all data presented in the revised report.

83. Table 5-8, Table 5-8

NMED Comment: The results for percent moisture for five of the 22 samples presented do not match the results for percent moisture presented on Table 5-7. Please correct these discrepancies in the revised Report.

84. APPENDIX C - TEMPERATURE LOGS

NMED Comment: The Core Temperature Log indicates many instances where intervals of core were dropped from the core barrel into the borehole during the process of bringing the core to the surface. In some cases, the partial sections of disturbed core were retrieved by the driller. The driller also reports the addition of water to the borehole during drilling. The driller's comments must be addressed in Section 4.3, Deviations from Work Plan. The impact on sample integrity of dropped and/or lost core, and data representativeness must be addressed in the appropriate sections and tables of the Report. Revise the Report accordingly.