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CERTIFIED MAIL - RETURN RECEIPT REQUESTED

March 10, 2015

Colonel Tom D. Miller
Base Commander
377 ABW/CC
2000 Wyoming Blvd. SE
Kirtland AFB, NM 87117-5606

John Pike
Director, Environmental Management Services
377 MSG
2050 Wyoming Blvd. SE, Suite 116
Kirtland AFB, NM 87117-5270

**RE: EDB INTERIM MEASURE IMPLEMENTATION PLAN,
BULK FUELS FACILITY SPILL
SOLID WASTE MANAGEMENT UNITS ST-106 AND SS-111
KIRTLAND AIR FORCE BASE
EPA ID# NM9570024423, HWB-KAFB-15-MISC**

Dear Messrs. Colonel Miller and Pike:

The New Mexico Environment Department (NMED) is in receipt of the Kirtland Air Force Base (the Permittee) *EDB Interim Measure Implementation Plan*, submitted on February 26, 2015. The Implementation Plan was submitted in response to the Notice of Violation (NOV), Interim Groundwater Extraction and Additional Characterization, that NMED issued to the Permittee on January 15, 2015. The Implementation Plan includes:

- A schedule for completion of all actions in the August 1, 2014 Groundwater Extraction Pilot Implementation and Additional Plume Characterization Work Plan, and October 9, 2014 Addendum.
- An aquifer pilot test work plan for the hydraulic testing of extraction well KAFB-106228. The work plan proposes step-drawdown and constant-rate testing of extraction well KAFB-106228, using 14 monitoring wells as aquifer test observation points and 6 monitoring wells as aquifer test background observation points. Water produced by extraction well KAFB-106228 will be tested for field water-quality parameters along with laboratory tests for EDB. Extraction water will be treated with carbon, temporarily

stored, tested to confirm EDB removal, and discharged in accordance with N.M. Water Quality Control Commission regulations.

- A description of all other actions and milestones necessary to collapse the dissolved phase EDB plume.

The Permittee's Implementation Plan fulfills the Implementation Plan requirements specified in the NOV and is hereby approved with the following conditions:

1. The Permittee shall add estimated permitting timelines to the Attachment 1 Schedule and submit the revised schedule to NMED within 15 days of receipt of this letter.
2. The Permittee shall submit a separate work plan, subject to NMED approval, for construction of extraction well KAFB-106228. The depth, screened interval and pump setting of extraction well KAFB-106228 will be determined after sampling results are available for probe well KAFB-106212, and any deeper probe wells that may be required at that location in accordance with the August 1, 2014 work plan. The extraction well work plan also shall describe how the observation wells screened at various zones in the vicinity of extraction well KAFB-106228 will be used to determine aquifer response during the pump test.
3. The Permittee shall review the comments provided by the U.S. Environmental Protection Agency on the January 2014 aquifer testing results (copy attached) to ensure that the discrepancies and issues noted are not repeated in the pump testing of extraction well KAFB-106228.
4. The aquifer testing report shall include, in addition to the information described in the aquifer test work plan, an optimal pumping rate for extraction well KAFB-106228 for the period of time up until additional extraction wells begin to operate. The optimal pumping rate may, or may not, be equal to the maximum sustainable pumping rate determined during the step-drawdown test. The Permittee may propose to adjust the pumping rate of extraction well KAFB-106228, subject to NMED approval, based on actual water level and water quality data as pumping and extraction of EDB proceed. As additional extraction wells are drilled and tested in the future, the Permittee shall evaluate the combined pumping effects of KAFB-106228 along with the additional extraction wells, and shall propose optimal pumping rates for each well in the extraction well system.
5. Approval of the Implementation Plan does not completely resolve the violations addressed in the January 15, 2015 NOV. The violations in the NOV shall be deemed to be resolved upon written notification by NMED that the Permittee has successfully completed all actions in the August 1, 2014 Groundwater Extraction Pilot Implementation and Additional Plume Characterization Work Plan, and October 9, 2014 Work Plan Addendum.

NMED technical staff will assist you and your contractor in any way possible to achieve these interim measures.

If you have any questions, please contact me at 505-827-2855.

Sincerely,

Kathryn Roberts
Director
Resource Protection Division

KR/DM

cc: Col. T. Haught, KAFB
D. Wilson, KAFB
B. Gallegos, AEHD
F. Shean, ABCWUA
L. King, EPA-Region 6 (6PD-N)

File: KAFB 2014 Bulk Fuels Facility Spill and Reading

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733

Transmitted via e-mail

February 21, 2014

MEMORANDUM

FROM: Laurie King
Section Chief
Federal Facilities Section (6PD-F)

TO: John Kieling
Hazardous Waste Bureau Chief
New Mexico Environment Department

RE: **Fourth Quarter CY 2013 Aquifer Testing Results, Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, Kirtland Air Force Base, Albuquerque, New Mexico, January 2014**

The United States Environmental Protection Agency (EPA) has reviewed the above referenced report that was sent by the New Mexico Environment Department (NMED) via email to the EPA on January 17, 2014. As requested by the NMED, the EPA provides the following comments.

General Comments

1. The EPA review was limited to the aquifer test components of the report and did not examine sections related to groundwater chemistry analysis.

2. Generally, the step test and constant rate tests both had problems due to inability to maintain target flow rates. The need to reduce flow rates by one half during the constant rate test is particularly problematic for the following reasons:

   - Reduces quality of and confidence in overall pumping and recovery data sets.
   - Violates assumption of constant discharge.
   - Reduced stress on the aquifer that may have resulted in measureable drawdown at more observation wells and greater drawdown at wells where measureable drawdown was observed.
   - Lack of response at numerous observation wells reduces ability to identify and evaluate potential anisotropy.
   - Smaller radius of influence.

3. Despite the limitations identified for this aquifer test, the preferred estimates of hydraulic conductivity and storativity summarized in the conclusions are generally consistent with each other, with other available estimates (e.g. slug test analyses), with typical hydraulic properties of known aquifer materials, and in the case of storativity, an unconfined aquifer.

4. It would be helpful to number the equations presented in the report.

Section 2

5. Section 2, page 6: The list of parameters for the step-drawdown test includes a saturated thickness of 80 ft. Why does this value differ from the 100 ft value listed on page 9 for the constant rate test?

6. An examination of the step-drawdown test raw data indicates there were abnormal drawdown values during the first time-step between approximately 10 and 100 seconds and again at approximately 200 seconds. What is the cause of these anomalous drawdown measurements?

7. Suggest that a plot of pumping well drawdown during the step-drawdown test be included in the final submittal, inclusive of all three steps.

8. Section 2.1, page 6: The reviewer was unable to identify where the use of average discharge rate for the entire step-drawdown test for analysis of recovery data is considered standard industry practice (with specific reference to EPA, 1993). Please provide additional information substantiating this is a standard practice.

9. The drawdown curve presented in Figure 2-1 for the 100 gpm time-step of the step-drawdown test seems non-typical. What could cause the shape of this curve to be sinusoidal?

10. Consistent with the Work Plan and standard industry practice, each step of the step-drawdown test was conducted for two hours (about 7200 seconds). However, examination of pumping well drawdown during the constant rate test (Figure 3-1) indicates that the rate of drawdown increases significantly at approximately 10,000 seconds, beyond the duration of the second time step. Step lengths of three hours or more would have identified the accelerated drawdown and may have resulted in selection of a lower flow rate for the constant rate test. This observation should be considered if additional aquifer testing will be performed for characterization of the fuel spill area.

11. It does not appear that the AQTESOLV solutions for the step-drawdown test (pumping or recovery) were included in the files provided to the EPA by NMED.

12. Section 2.2, pages 6 & 7: Estimation of the non-linear well loss coefficient and associated exponent (C and P) is briefly described and the estimated values of C and P were determined to be 1 and 1.75, respectively. It does not appear that the AQTESOLV solution from which C and P were estimated was included in the files provided to the EPA by NMED. Consequently, these estimates could not be evaluated. According to Walton (1962), the value of C for properly developed and designed wells is generally less than 5 sec^2/ft^5. A C value of 1 suggests that the pumping well is properly designed and adequately developed. This is inconsistent with the report conclusions.

13. Section 2.2, pages 6 & 7: The report did not present estimates of the linear well loss coefficients (B) and did not identify the specific analysis used to estimate B (Kruseman and de Ridder, 1990 offers several methods). Consequently, the evaluation of B values could not be performed. Recommend including this information in the final submittal, including AQTESOLV solutions or other calculations, as appropriate. Linear well losses result from items such as screen entrance head loss, filter pack head loss and potentially other sources of head loss in the penetration zone such as residual mud (if used), biofouling and inadequate development. Kruseman and de Ridder (1990) indicate that linear well losses can be considerably more significant than losses due to turbulent flow as estimated by C.

14. The need to reduce the discharge rate during the third time step is not ideal. Could this have affected the calculation of the C, P and B variables resulting in underestimation of the predicted drawdown at the proposed 100 gpm discharge rate? The selection of this discharge rate for the constant rate test was demonstrated to be incorrect.

15. Were any attempts made to estimate well efficiency as was proposed in the Aquifer Testing Work Plan (October 2013)?

Section 3

16. Section 3.1 states that "The filter pack material and screen slot size used in well construction (Appendix A) were selected to allow water to flow freely from the aquifer material into the well." Recommend that the data collected and analysis performed to substantiate proper well design (i.e. minimization of well losses associated with screen and filter pack selection) should be provided in the final submittal. As described in Driscoll (1986) improper well design can result in significant well losses – independent of adequate well development or potential biofouling of the filter pack, as has been suggested.

17. The slot size for the KAFB-106157 well screen has been consistently identified as 0.03-in; however, the filter pack gradation varies between the well completion log, soil boring log and various written descriptions of the well design contained in other documents. The well completion diagram provided in Appendix A indicates both 8/12 and 10/20 filter pack gradations. Is it an 8/12 or 10/20 filter pack? Forms, logs, tables and written descriptions should be corrected for consistency with as-built conditions.

18. Section 3.1, page 6: Clogging of the filter pack due to biological activity is a plausible explanation, although currently unproven. Is there a way that the potential for biofouling can be evaluated and confirmed (e.g. down-hole video)? Is it possible that well losses increased over time during the aquifer test as a result of biofouling? If biofouling is confirmed to be the primary cause of well losses, would the suggested approach of biocide injection and redevelopment provide a permanent solution or would this likely become a recurring issue?

19. Section 3.1, page 8: The report states that the well remained undeveloped for nearly two years due to delays in work plan approvals. The administrative record indicates NMED approved well development on February 24, 2012, approximately two months after KAFB-106157 was installed. This approval indicated that a hazardous waste permit would be needed to treat the development water and further noted than an emergency permit could be issued for this activity, but none was requested. On June 28, 2012, NMED again approved well development, including a second alternative for managing the development water. This is approximately six months after completion of KAFB-106157. While not ideal, this is far less than the nearly two years described in the January 27 Draft Aquifer Test Letter Report. The conditions imposed by NMED were consistent with RCRA and added additional complexity to the proposed well development efforts; however, these conditions should have been foreseen and were not insurmountable. Well development could have been completed considerably sooner than September 2013.

20. Was concern about potential biofouling (or other similar issues) due to delayed well development ever articulated prior to issuing this report?

21. Section 3.1, page 9: This section states that the aquifer test only impacted intermediate and deep observation wells screened in the same zone as the pumping well. Should this be shallow and intermediate observation wells? The report indicates that measureable drawdown was not detected in deep observation wells.

22. Section 3.2, page 10: The report describes variations in water levels due to changes in barometric pressure and the calculation of barometric efficiency. It is also evident that water level data were corrected for changes in barometric pressure (e.g. see Figure 1-3); however, the manner in which water levels were corrected for changes in barometric pressure are not described in the report. Please clarify.

23. It is unclear which excel tables provided to the EPA by NMED contain corrected data, if any. Observation well transducer data files for the constant rate test were not included in the files provided to the EPA by NMED and consequently not reviewed.

24. The values on the Y-axis (drawdown) in Figure 3-1 appear to be in reverse order. Drawdown decreasing from 35 ft to ~5-10 ft as pumping progresses does not make sense.

25. The pumping well drawdown curve (Figure 3-1) indicates accelerated drawdown beginning at approximately 10,000 seconds. Could this be related to some type of boundary effect where the cone of depression intersects an area of lower conductivity?

26. According to the *Evaluating Hydrocarbon Removal from Source Zones and its Effect on Dissolved Plume Longevity and Magnitude Depletion* (American Petroleum Institute, 2002), groundwater flow through a LNAPL zone is reduced. The approximately ten-foot rise in water levels in the LNAPL source area may have caused vertical smearing of the LNAPL at approximately residual concentrations within the upper saturated zone. Considering that some thickness of the saturated zone may have been at residual LNAPL concentrations prior to the water table rise, this could represent approximately 10 percent or more of the assumed 100 foot aquifer thickness evaluated during the aquifer test. Is it plausible that the presence of entrapped LNAPL could result in reduced groundwater flow and accelerated drawdown observed in the pumping well drawdown curve?

27. Can the available aquifer test data be used to estimate when the cone of depression developed during the constant rate test would have intersected the entrapped LNAPL source zone?

28. Section 3.2, page 10: Is it possible to plot corrected displacement for KAFB-10610, -106032 and -106082 (Figures 3-2, 3-3 and 3-4)? This may help accentuate the "external, non-quantifiable influences" observed in displacement data from these wells as described on page 10.

29. Section 3.2, page 10: It seems unlikely that pumping of the VA well would potentially affect KAFB-10610 and -106082 and not other observation wells in the vicinity (including -106083, which is the intermediate well in the same cluster as -106082). Also see KAFB-106073, -074 and -075 which are relatively close to the VA well, yet show no apparent response to external influences.

30. The background displacement data collected from KAFB-10610 between the step and constant rate tests exhibits an approximate diurnal drawdown and recovery cycle. This cycle appears independent

of water level changes caused by variations in barometric pressure. Is this potentially reflecting the influence of the VA well or some other nearby pumping well?

31. The response to changes in barometric pressure in KAFB-10610 seems dampened relative to other wells (e.g. KAFB-10618 and -106033) during the background monitoring period. Is there a plausible explanation(s) for this behavior? Could this be related to KAFB-10610 being located within the LNAPL source area?

32. Is the VA well on a separate electrical meter? Would it be possible to determine when the VA well was pumping based on electrical power records?

33. Considering the proximity of the VA well to the plume, and a suggestion in the report that operation of the VA well could have affected water levels in at least two observation wells, consideration should be given to installing transducers in several observation wells proximal to the VA well and collecting data during several periods of known VA well operation. The EPA understands that the VA well typically runs a few to several times per day.

34. Although the measured displacements are very small, examination of the corrected displacement curves in Figures F-3, F-4, F-5 and F-7 suggest a response to pumping at the initial 95 gpm flow rate. Once the flow was dropped to 45 gpm, the corrected drawdown levels off and becomes practicably indistinguishable from background noise. However, the corrected displacements in F-5 and F-7 (KAFB-106075 and -106084) do seem to indicate a response consistent with both the start and stop of the constant rate test (disagree with statement on page 10 that no drawdown was observed in these wells but agree that the available drawdown and recovery data from these wells are not useful for analyses). Apparent responses were also noted in several deep wells suggesting that a higher flow rate could have resulted in measureable drawdown in deep observation wells.

35. Section 3.2, page 10: The radius of influence estimates appear reasonable based upon the constant rate test performed. Radius of influence estimates can also be derived from distance drawdown plots. The r_0 values on Figures 3-15 and 3-16 suggest a slightly larger radius of influence ranging between 460 and 550 feet. Although the concept of pumping well capture zones was not addressed in this report, a point of clarification worth making at this juncture is that capture zones are typically smaller than the cone of depression due to the impact of regional hydraulic gradients.

36. Section 3.2, page 10: Text states that the Cooper-Jacob (1946) straight-line time drawdown analysis was conducted on three observation wells. The list of wells identified includes KAFB-106157 which is the pumping well. It should be KAFB-106083.

37. Section 3.2, page 10: The Cooper-Jacob (1946) straight-line time drawdown method and Jacob (1950) distance drawdown method are subject to several simplifying assumptions (e.g. pumping well fully penetrates the aquifer, pumping well is 100% efficient, etc.). Recommend that the report include a summary of the simplifying assumptions for all analyses performed (including AQTESOLV solutions) and identify how site-specific deviations from these ideal conditions could affect the calculated estimates of aquifer properties (T and S).

38. Section 3.2, page 10: Driscoll (1986) states that recovery measurements following variable rate tests cannot be used to estimate aquifer parameters. Please substantiate how use of an average discharge

rate from a variable rate test is appropriate for recovery data analyses (step-test, straight-line time drawdown and straight-line distance drawdown).

39. On Table 3-1, the units of transmissivity are identified as ft^3/day – it should be ft^2/day.

40. The EPA was able to reproduce some of the transmissivity estimates (within rounding uncertainties) presented in Table 3-1 and using the equation presented at the top of page 11. In other cases, the EPA was not able to reproduce the calculated T estimates. The variable responsible for the apparent discrepancy in T estimates is the $\Delta(h_0\text{-}h)$ term. The following table identifies potential discrepancies in $\Delta(h_0\text{-}h)$ (see shaded values). Based on the information provided in the report, the reason for differences in $\Delta(h_0\text{-}h)$ cannot be determined. Please confirm appropriate values and correct the report, if necessary.

Well ID	Pumping or Recovery	$\Delta(h_0\text{-}h)$ presented on Figures 3-9 to 3-12	$\Delta(h_0\text{-}h)$ needed to closely match Table 3-1 T values	EPA $\Delta(h_0\text{-}h)$ estimated from Figures 3-9 to 3-12
KAFB-10617	Pumping	0.115	0.15	0.115
KAFB-10617	Recovery	0.078	0.078	0.078
KAFB-10618	Pumping	0.0.095	0.095	0.12
KAFB-10618	Recovery	0.085	0.059	0.085
KAFB-106083	Pumping	0.195	0.195	0.195
KAFB-106083	Recovery	0.125	0.125	0.125

41. On Figure 3-11, the $\Delta(h_0\text{-}h)$value of 0.0.095 is a typo. It appears that it should be ~0.12 ft based upon review of information presented on this figure; however, it is apparent that a value of 0.095 was used to calculate the estimated T for KAFB-10618 (pumping) presented in Table 3-1.

42. The EPA was unable to reproduce S estimates (Table 3-1) for the straight-line drawdown and recovery analyses using the t_0 value in units of minutes as indicated by the equations presented at the top of page 11. The EPA was able to reproduce the S estimates (within rounding uncertainties) when t_0 values were in units of days. Was the incorrect unit specified for t_0 in the report? Please make appropriate corrections to the report as necessary.

43. The EPA was unable to reproduce T and S estimates (Table 3-1) for the distance-drawdown analyses using the equations presented at the bottom of page 11. The EPA was able to reproduce the reported values (within rounding uncertainties) using equations 9.11 and 9.12 of Driscoll (1986). Were incorrect distance drawdown equations presented in the report? Please make appropriate corrections to the report as necessary.

44. Recommend that worksheets presenting aquifer parameter calculations and input variables should be provided to substantiate the values presented in Table 3-1.

Section 4

45. Concur that apparent significant well losses in KAFB-106157 preclude its utility as an extraction well without rehabilitation. Rehabilitation will also be necessary if NMED requires additional aquifer testing using this well.

46. Ideally the recovery data are best used to evaluate and corroborate pumping well data, rather than as a singular dataset. Concur that due to apparent significant well losses, the recovery data from the pumping well are the preferred dataset for this assessment.

47. Concur that the aquifer property estimates based on the observation well data are preferred for this assessment and are a better measure of the aquifers hydrologic conditions at the downgradient edge of LNAPL area.

If you have any questions concerning these comments, please contact Paul Torcoletti at 214-665-6494 or at *torcoletti.paul@epa.gov* or Tara Hubner at 214-665-7246 or at *hubner.tara@epa.gov*.