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CERTIFIED MAIL – RETURN RECEIPT REQUESTED

July 12, 2019

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Fort Wingate Depot Activity
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Steve Smith
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RE: DISAPPROVAL
FINAL BENCH AND PILOT TESTING WORK PLAN TO SUPPORT FUTURE CORRECTIVE MEASURES STUDY
FORT WINGATE DEPOT ACTIVITY
MCKINLEY COUNTY, NEW MEXICO
EPA ID# NM6213820974
HWB-FWDA-19-002

Dear Messrs. Patterson and Smith:

The New Mexico Environment Department (NMED) is in receipt of the Fort Wingate Depot Activity (Permittee) *Final Bench and Pilot Testing Work Plan to Support Future Corrective Measures Study* (Work Plan), dated April 16, 2019. NMED has reviewed the Work Plan and hereby issues this Disapproval. The Permittee must address the following comments.

1. **Section 1.1, WP Purpose and Scope, lines 25-27, page 1-1**

Permittee Statement: "Groundwater extraction is an active remedy where groundwater is pumped to the surface where it can be treated to acceptable levels prior to discharge to the surface or rejected to the subsurface."

NMED Comment: The statement is not clear. Explain the meaning of "rejected to the subsurface". If it is a typographical error, correct the error in the revised Work Plan.

2. Section 1.1, WP Purpose and Scope, lines 12-13, page 1-2

Permittee Statement: "Perform an in-situ bioremediation remediation pilot test to evaluate nitrate, RDX, and perchlorate degradation rate and treatment efficiency of an electron donor."

NMED Comment: The Permittee also proposes to conduct a bench scale test, an aquifer pump test, and a tracer test in the Work Plan. Successful outcomes of these tests are prerequisites for the bioremediation pilot test. Therefore, the bioremediation pilot test must not be proposed concurrently in the Work Plan. The bioremediation pilot test may be proposed in a separate submittal, if these three tests demonstrate that in-situ bioremediation is potentially viable at the site. Remove all discussion regarding the bioremediation pilot test (e.g., Sections 3.1, 3.2.11, and 4.6) from the revised Work Plan.

3. Section 2.5, Geology and Hydrogeology, lines 13-15 and 26-28, page 2-3

Permittee Statements: "Figure 2-1 presents alluvial aquifer groundwater elevation contours for second quarter 2017. Hydraulic gradients in alluvium ranged from 0.003 to 0.03 foot per foot in 2014 (Sundance 2017)."
and,
"Figure 2-2 presents bedrock aquifer groundwater elevations for second quarter 2017. In 2014, groundwater hydraulic gradients in the bedrock unit ranged from approximately 0.004 to 0.006 foot per foot in the Workshop Area (Sundance 2017)."

NMED Comment: The 2017 groundwater elevation contours and 2014 hydraulic gradient data were presented. Calculate the hydraulic gradient based on 2017 data to be consistent with the groundwater elevation data. Revise the Work Plan accordingly.

4. Section 2.5, Geology and Hydrogeology, lines 21-23, page 2-3

Permittee Statement: "Groundwater elevations are slightly higher in the bedrock groundwater unit compared to the overlying alluvial unit because of its confined nature."

NMED Comment: According to Table 4-1 in the *Final Groundwater Periodic Monitoring Report January through June 2018* (Report), dated April 2019, the groundwater elevations in alluvial wells TMW31S and TMW39S are recorded as 6,669.69 feet and 6,671.09 feet, respectively in April 2018. According to Table 4-2 in the Report, the groundwater elevations in bedrock wells TMW31D and TMW39D are recorded as 6,669.66 feet and 6,670.59 feet, respectively in April 2018. Therefore, the groundwater elevation in the alluvial groundwater unit is slightly higher than in the bedrock groundwater unit at these locations. Evaluate the accuracy of the statement and correct it in the revised Work Plan, as necessary.

5. Section 2.5.1, Alluvial Aquifer, lines 36-38, page 2-3

Permittee Statement: "The nitrate plume appears to originate from the former TNT Leaching Beds and extends to the northwest, to the hydraulically down gradient Administration Area (Figure 2-3)."

NMED Comment: According to Figure 5-1 in the Report, the nitrate concentrations in the vicinity of the TNT Leaching Beds are the highest; the nitrate concentrations in groundwater samples collected from alluvial wells TMW03 and TMW40S are recorded as 120 mg/L and 140 mg/L, respectively. It is apparent that one of the nitrate sources is the TNT Leaching Beds. However, the elevated nitrate level in the vicinity of the TNT Leaching Beds does not appear to be continuous toward the Administration Area. The nitrate concentrations in groundwater samples collected from alluvial wells TMW34 and TMW46 are recorded as 77 mg/L and 78 mg/L, respectively. These wells are located within and downgradient of the Administration Area. The nitrate levels directly downgradient of the TNT Leaching Beds and upgradient of the Administration Area (between the TNT Leaching Beds and Administration Area) are lower than those recorded in wells TMW34 and TMW46. A separate source of the nitrate plume that extends west/northwest from the Administration Area may be present. Revise the Work Plan to discuss this issue accordingly.

6. Section 3.1, Data Quality Objectives, Step 3, Identify Information Inputs, Bench Scale Test, lines 14-17, page 3-2

Permittee Statement: "Nitrate and perchlorate degradation products are not planned to be added to the analytical suite [during the bench scale test] for the following reasons: a. Nitrate degrades to nitrite and nitrogen gas. Nitrite does not persist in the environment as it quickly reverts back to nitrate in the presence of oxygen."

NMED Comment: In order for perchlorate to be biodegraded effectively, anerobic conditions must be maintained. An anaerobic environment is expected to be maintained in groundwater during the implementation of bioremediation. Therefore, nitrite will likely not revert back to nitrate under the test conditions. Nitrite may accumulate or may potentially be converted to various forms to nitrogen gas. Ammonia may also accumulate as a result of ammonification. Therefore, the levels of nitrite, ammonia and nitrogen gas (N_2) must also be monitored in the bench scale test. Revise the Work Plan accordingly.

7. Section 3.1, Data Quality Objectives, Step 3, Identify Information Inputs, Bench Scale Test, lines 25-28, page 3-2

Permittee Statement: "laboratory analytical results for dissolved arsenic to evaluate potential for mobilization under iron reducing conditions[:] a. Arsenic has been identified by the project team as the only compound with potential for mobilization at concentrations exceeding pertinent water quality goals."

NMED Comment: The change of redox state in groundwater may increase the mobilization potential of other metals. Provide a more detailed explanation for why arsenic is the only metal to be monitored during the bench scale test in the revised Work Plan. The selenium and manganese concentrations in groundwater consistently exceed the applicable screening levels in the vicinity of the former TNT leaching beds. Discuss whether the mobilization potential of these metals increases or decreases when reducing conditions are maintained.

8. **Section 3.1, Data Quality Objectives, Step 3, Identify Information Inputs, Bench Scale Test, lines 29-31, page 3-2**

Permittee Statements: "water quality parameters (e.g., oxygen reduction potential [ORP], dissolved organic carbon, ferrous iron, sulfate, pH) to evaluate how addition of electron donor affects water quality and how conditions change over time [during bench scale test]."

NMED Comment: Other water quality parameters (e.g., dissolved oxygen, nitrate, nitrite, ammonia, and nitrogen gas) must also be monitored during the bench scale test. Revise the statement to include all water quality parameters to be monitored during the bench scale test. In addition, the level of dissolved oxygen in the vicinity of the former TNT leaching beds (e.g., TMW03, TMW04) generally indicates that the groundwater is naturally anaerobic. The groundwater may contain enough naturally-occurring carbon substrate to sustain biodegradation of contaminants. If the groundwater contains enough carbon substrate (e.g., total organic carbon) under anaerobic conditions, carbon substrate amendments may not be necessary. The groundwater must first be evaluated to determine whether a carbon substrate is necessary to be conducive to biodegradation. Collect groundwater samples for total organic carbon (TOC) analysis from all wells within the Work Area shown in Figure 1-3, *Work Area* and provide a table that presents the results of the TOC analysis in the revised Work Plan. The table must also include the dissolved oxygen levels in each well. Demonstrate that a carbon substrate amendment is necessary at the site prior to proposing in-situ bioremediation.

9. **Section 3.1, Data Quality Objectives, Step 3, Identify Information Inputs, pages 3-2 – 3-3**

NMED Comment: Although the Permittee proposes groundwater extraction as one of the remedial options, the discussion to treat the extracted groundwater above ground is not included in the Work Plan. The Permittee must evaluate whether the extracted water can effectively be treated to acceptable levels above ground, if the water is planned to be discharged or reinjected. Additionally, the Permittee must evaluate whether the extracted water may cause fouling for the above-ground water treatment system (e.g., clogging of granular activated carbon) and if so, evaluate how such fouling could be prevented or resolved should it occur. In-situ injection technology at the site may not be practicable because the results of previous aquifer testing indicate that hydraulic conductivity is low at the site. Additionally, hydraulic connectivity within the bedrock aquifers is still not well-understood. Groundwater extraction and an above-ground treatment system may potentially

be more practical at the site if groundwater can effectively be extracted. Therefore, evaluation of the efficacy of groundwater extraction and the feasibility for utilizing above-ground treatment system is important. Revise the Work Plan to include more detail regarding the evaluation of groundwater extraction and an above-ground groundwater treatment system.

10. Section 3.1, Data Quality Objectives, Step 5, Develop the Analytic Approach, line 28, page 3-3

Permittee Statement: "Install five wells in the alluvial aquifer and four wells in the bedrock aquifer."

NMED Comment: A map showing the proposed well locations is included in Figure 4-1, *Planned Alluvial Well Construction Locations*. The designation of the proposed well (TMW64) is already used (refer to the *Letter Work Plan Downgradient Alluvial Aquifer Investigation & Installation of One Additional Well Revision 1,* dated May 2019); therefore, the same designation must not be used. Change the designation of the well in all applicable sections, tables, and figures in the revised Work Plan.

11. Section 3.1, Data Quality Objectives, Step 5, Develop the Analytic Approach, lines 3-4, page 3-4

Permittee Statement: "Conduct bromide tracer test in the alluvial and bedrock aquifers using a combination of in well sensors and laboratory analysis."

NMED Comment: Alluvial and bedrock aquifers may be hydraulically connected at the site. In order to eliminate potential influence of bromide from the upgradient test area (shown in Figure 4-2, *Planned Bedrock Well Construction Locations*) to the downgradient test area (shown in Figure 4-1), conduct the tracer test at the downgradient test area before conducting the test at the upgradient test area. Include this provision in the revised Work Plan.

12. Section 3.1, Data Quality Objectives, Step 6, Specify Performance or Acceptance Criteria, lines 17-19, page 3-4

Permittee Statement: "Construct one injection/extraction well in the alluvial aquifer and one injection/extraction well in the bedrock aquifer. The wells will be developed and will produce sufficient water to allow for groundwater sampling and aquifer pump tests."

NMED Comment: The statement indicates that the well is used for both injection and extraction. For injection wells, it is appropriate to set the screened interval below the water table as proposed for uniform distribution of injectate. However, for extraction and

monitoring wells, it is appropriate to set the screened interval across the water table to capture constituents that accumulate at the interface. The Permittee cannot use a single well for both injection and extraction. Propose to install injection and extraction wells separately in the alluvial aquifer. If an unconfined condition exists in the bedrock aquifer, the same provision must also be included for bedrock injection and extraction wells. Revise the Work Plan accordingly.

13. Section 3.2.1.1, Turbidity Meter, lines 5-6, page 3-6

Permittee Statement: " The turbidity meter will be calibrated before each day of sampling using a standard supplied by the manufacturer ranging from 10.0 nephelometric turbidity units (NTU) to 0 NTU."

NMED Comment: The turbidity readings significantly exceed the calibration range of the turbidity meter in many groundwater samples collected from wells at the site. The proposed turbidity meter may not be suitable for the measurement. A turbidity meter that is capable of reading at least up to 1,000 NTU must be used at the site (e.g., Horiba U-52). In addition, the Permittee must calibrate the instrument using standards that cover the expected range of turbidity at FWDA. Revise the Work Plan accordingly.

14. Section 3.2.6, Well Installation and Groundwater Sampling, lines 1-2, page 3-11

Permittee Statement: "When the water table is encountered, field personnel will install the top of screen 5 ft below the water table."

NMED Comments: Installation of the top of screen five feet below the water table is appropriate for injection wells; however, it is not appropriate for monitoring and extraction wells. The screened intervals of monitoring and extraction wells must be set to intersect the water table (see Comment 12). Revise the Work Plan accordingly.

15. Section 3.2.6, Well Installation and Groundwater Sampling, lines 4-6, page 3-11

Permittee Statement: "A CH 50K Air Rotary Casing Hammer (ARCH) drill rig will be used to advance surface casing through the alluvium to the confining bedrock layer to seal off the alluvial water-bearing zone from the bedrock water-bearing zones."

NMED Comment: It is more appropriate to use a hollow stem auger in order to be able to visually inspect fractures within the bedrock layer and to collect rock core samples to be used for the construction of microcosms. Propose to use hollow stem auger or sonic drilling methods in the revised Work Plan. In addition, the Permittee must provide soil boring logs and collect a minimum of two soil samples at the saturation and termination depths in each

boring for analyses for explosive compounds, perchlorate, and metals. Include the provision in the revised Work Plan.

16. Section 3.2.6, Well Installation and Groundwater Sampling, lines 9-10, page 3-11

Permittee Statement: "After reaching the desired depth (approximately 70 ft bgs for the alluvial aquifer and 100 ft bgs for the bedrock aquifer) a well will be constructed in each boring."

NMED Comment: The saturation depths are variable. Adjust the depth of the screened intervals to accommodate the provision required by Comments 12 and 14, as necessary. No revision is required.

17. Section 3.2.6, Well Installation and Groundwater Sampling, lines 4-5, page 3-12

Permittee Statement: "Analytical methods, container type, and preservation requirements for the laboratory analyses are listed on Table 3-1."

NMED Comment: Table 3-1, *Sample Container, Preservation and Hold Times,* lists RDX as the only explosive compound to be analyzed for groundwater samples. However, all analytes listed in EPA Method 8330B must be included for groundwater analysis. Additionally, nitrite, ammonia, nitrogen gas, TAL metals, total organic carbon, sulfide, and methane must also be analyzed for groundwater samples (see Comments 6, 8 and 58). Include the additional analytical parameters for groundwater samples in the revised Work Plan.

18. Section 3.2.9.1, Pumping Test Procedures, lines 29-30, page 2-13

Permittee Statement: "The onsite field coordinator will determine suitable disposal methods based on the expected types and concentrations of contaminants and suspended sediment in the groundwater."

NMED Comment: The suitable disposal methods must be determined through waste analyses conducted by a laboratory rather than a decision made by the onsite field coordinator. Revise the Work Plan accordingly.

19. Section 3.2.9.2, Step Drawdown Test, lines 33-34, page 3-13

Permittee Statement: "The well shall be "step" tested for 2 hours each at rates of 0.15, 0.25, 0.5, 0.75 times the design capacity of the well."

NMED Comment: It is not clear whether the referenced design capacity is meant to be the maximum anticipated yield at the well. Clarify the meaning of the referenced terminology and explain how such data will be obtained in the revised Work Plan.

20. Section 3.2.9.2, Step Drawdown Test, lines 38-39, page 3-13, and lines 1-2, page 3-14

Permittee Statements: "During the test, the time, pumping level, discharge rate, and rate of sand production will be recorded."
and,
"The electrical conductivity (EC), pH and temperature of the discharge water will be recorded."

NMED Comment: The rate of sand production is recorded during the test; however, the method to determine the rate of sand production is not discussed. Include a discussion of the analysis that determines the rate in the revised Work Plan. Note that sand production implies an improperly designed well.

21. Section 3.2.9.3, Constant Rate Test, lines 4-5, page 3-14

Permittee Statement: "A long-term, continuous, constant rate, time-drawdown test shall commence not less than 24 hours and not more than 48 hours after completion of the step drawdown test."

NMED Comment: Ensure that the water level in the pumping well and the observation wells have equilibrated prior to commencing the constant rate test. Revise the Work Plan to include this requirement.

22. Section 3.2.9.3, Constant Rate Test, lines 5-7, 24-25 and 28-30, page 3-14

Permittee Statements: "The rate of pumping is anticipated to be at the design capacity of the well and based upon observations of the Step Drawdown Test."
and,
"Throughout the test, the pumping rate will remain within plus or minus 5 percent (+/- 5 percent) of the selected pumping rate."
and,
"Whenever continuous pumping at a uniform rate has been specified, failure of pumping operations for a period greater than 1 percent of the elapsed pumping time shall require suspension of the test until the water level in the pumped well has recovered to its original level."

NMED Comment: The definition of the "design capacity" is ambiguous (see Comment 19). Maintaining continuous and constant pumping rate appears critical to the test. Explain how the Permittee will ensure that the pumping rate remains within the criteria in the revised Work Plan.

23. Section 3.2.9.3, Constant Rate Test, lines 31-34, page 3-14

Permittee Statement: "Recovery will be considered "complete" after the well has been allowed to rest for a period at least equal to the elapsed pumping time of the aborted test, except that if any three successive water level measurements spaced at least 20 minutes apart show no further rise in the water level in the pumped well, the test may be resumed immediately."

NMED Comment: Recovery must be considered complete when the water level returns to the baseline condition. Resume the test when the water level returns to the baseline level. Remove the "three successive water level measurements" condition from the revised Work Plan.

24. Section 3.2.9.4, Data Reduction and Analysis, lines 2-3, page 3-15

Permittee Statement: "The calculations for these analysis methods may be performed by a computer application, such as Aqtesolv."

NMED Comment: All assumptions and input parameters used for the computer aided calculation must be presented in the bench and pilot testing report. Provide a statement in the revised Work Plan that these parameters will be provided in the report.

25. Section 3.2.10.2.1, Injection Procedures, lines 5-8, page 3-17

Permittee Statement: "If needed, make up water (potable or groundwater extracted from the pump test) will be introduced into the injection well to provide additional hydraulic head to further push the solution into the aquifer."

NMED Comment: Additional hydraulic head is likely to cause an overestimation of the groundwater velocity and is not representative of natural aquifer conditions. Unless sufficient explanation is provided, make-up water must not be introduced during the tracer test. Revise the Work Plan accordingly.

26. Section 3.2.10.2.1, Injection Procedures, lines 13-15, page 3-17

Permittee Statement: "Injection pressures should not exceed 30 pounds per square inch, as indicated on the pressure gauge fitting."

NMED Comment: The proposed pressurized injection must not be utilized; the tracer must be gravity-fed, allowing the aquifer not to exceed its natural flow capacity. The pressurized injection may potentially skew the testing results and create preferential flow paths. Revise the Work Plan accordingly.

27. Section 3.2.10.3, Groundwater Monitoring, lines 25-27, page 3-17

Permittee Statement: "One method will use an AquiStar TempHion bromide water quality sensor with data logger installed in the wells to monitor bromide concentrations over the 0.1 mg/L detection limit."

NMED Comment: According to the instruction manual for the instrument, the first calibration point is indicated as 79.1 mg/L for bromide. The detection limit of 0.1 mg/L is significantly lower than the first calibration point. Confirm that the detection limit of 0.1 mg/L is accurate and provide a reference for the detection limit or revise the statement for accuracy. Calibration must cover the expected full range of concentrations of bromide.

28. Section 3.2.10.4, Data Reduction and Analysis, lines 2-10, page 3-18

Permittee Statement: "Data collected during the tracer test will be analyzed to calculate groundwater velocity as follows:
$V = KI/n$
where:
V = average linear groundwater velocity;
K = hydraulic conductivity;
I = hydraulic gradient; and
n = effective porosity.
If a range of porosities has been identified, velocity for high and low porosity will be calculated."

NMED Comment: The statement is misleading. A tracer test does not provide the data to estimate hydraulic conductivity, hydraulic gradient, or effective porosity. The groundwater velocity can be estimated based on the distance between the injection and monitoring well and the time that breakthrough is observed in the monitoring well. Remove the statement or revise the statement for clarity in the revised Work Plan.

29. Section 3.3.1, IDW Containerization, lines 22-25, page 3-19

Permittee Statement: "Soil generated during well construction activities may be impacted with low concentrations of volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), nitrate, RDX and or perchlorate. It is anticipated that the concentrations will not exceed hazardous thresholds identified by 40 CFR § 261."

NMED Comment: All investigation derived waste (IDW) must be analyzed for potential contaminants and characterized prior to disposal. Although Table 3-1 indicates that waste analyses will be conducted, the statement can be read as "it is anticipated that the concentrations will unlikely exceed hazardous thresholds; therefore, waste analyses will not

be conducted." State clearly that waste analyses will be conducted regardless of anticipated constituent concentrations in the revised Work Plan.

30. Section 3.3.3, IDW Sampling, lines 19-21, page 3-20

Permittee Statement: "Knowledge of potential contaminants will be used to evaluate the physical state of the IDW to determine which specific parameters will be required to properly characterize waste generated from each soil boring/well location."

NMED Comment: The statement is not clear. The presence or absence of contaminants cannot be evaluated from the observation of the physical state. All IDW must be analyzed for the parameters listed in Table 3-1 because the soils potentially contain the listed constituents. Revise the Work Plan accordingly.

31. Section 3.3.3, IDW Sampling, lines 23-27, page 3-20

Permittee Statement: "Waste profile samples will be analyzed for ignitability, corrosivity, reactivity as listed by the USEPA Method in 40 CFR § 261, Toxicity Characteristic Leaching Procedure RCRA 8 Metals as listed by USEPA Methods 1311/6020A/7471B, Explosives as listed by USEPA Method 8330B and paint filter liquids as defined by USEPA Method 9095 (only if visible moisture is present in the soil) (Table 3-1)."

NMED Comment: Table 3-1 lists nitrate-nitrite, perchlorate, SVOCs, and VOCs analyses for waste profiling; however, these analyses are not included in the statement. On the other hand, Table 3-1 does not list ignitability, corrosivity, reactivity, and paint filter analyses as stated. All analytical parameters for waste samples must be listed in the table and stated in the text of the Work Plan. Revise the Work Plan accordingly.

32. Section 3.3.3, IDW Sampling, lines 29-30, page 3-20

Permittee Statement: "Material will not be removed from the site until USACE receives the waste acceptance letter from the landfill/receiving facility."

NMED Comment: The letter must be included in the bench and pilot testing report. No revision is required.

33. Section 3.3.4, IDW Classification and Disposal, lines 35-36, page 3-20

Permittee Statement: "Liquid IDW classified as non-hazardous waste will be disposed of at the onsite waste water evaporation tank or transported offsite."

NMED Comment: If dried sludges are present in the waste water evaporation tank, they must also be tested for the analyses listed in Table 3-1. Include the provision in the revised Work Plan.

34. Section 3.3.4, IDW Classification and Disposal, lines 5-6, page 3-21

Permittee Statement: "Although all waste is expected to be characterized as non-hazardous, if any waste is determined to be RCRA characteristic, the USACE PM will be notified."

NMED Comment: The section only describes the handling of non-hazardous waste; however, no description is provided if the waste is characterized as hazardous except the provision requiring notification to the project manager. More detail should be provided if the waste is characterized as hazardous in the revised Work Plan. Figure 13, *Example IDW Label for Non-Hazardous Waste,* is included; however, the example IDW label for hazardous waste is not. Provide an example label for hazardous waste and include it in the revised Work Plan.

35. Section 4.2.2, Alluvial Aquifer, lines 27-29, page 4-1

Permittee Statement: "Extraction/injection well TMW64 is planned to be constructed in the alluvial aquifer approximately 10 ft hydraulically down gradient from monitoring well TMW03."

NMED Comment: The nitrate, RDX, and perchlorate concentrations in the groundwater samples collected from well TMW40S are higher than those of well TMW03 according to the Report. The tests using well TMW40S rather than TMW03 may provide more conservative results. Revise the Work Plan to conduct the test in the vicinity of well TMW40S; otherwise, explain why the vicinity of TMW03 is more appropriate for the test area in the revised Work Plan.

36. Section 4.2.2, Alluvial Aquifer, lines 3-4, 8-9 and 14-15, page 4-2

Permittee Statements: "Monitoring well TMW66 will be constructed to the northwest and 10 ft hydraulically down gradient from extraction/injection well TMW64."
and,
"Monitoring well TMW67 will be constructed hydraulically down gradient and 20 ft to the north of extraction/injection well TMW64."
and,
"Monitoring well TMW68 is hydraulically down gradient from extraction/injection well TMW64…"

NMED Comment: Section 3.2.9.1 states, "[o]bservation points are normally placed up gradient or cross gradient from the pumped well relative to groundwater flow [for a pump test]". Although there is one upgradient and one cross-gradient monitoring well in the test area, these groundwater monitoring wells are proposed to be installed downgradient from the pumping well. The proposed locations of monitoring wells TMW66, TMW67, and TMW68 appear impractical for the pump test. The field test must be focused on the pump test rather than tracer or bioremediation tests because in-situ injection technologies are unlikely compatible at the site due to the site's low hydraulic conductivity. A groundwater extraction system may be more achievable, and the effectiveness of groundwater extraction must be thoroughly evaluated (see Comment 9). Revise the proposed well locations to focus on the pump test rather than the in-situ injection test in the revised Work Plan.

37. Section 4.2.2, Alluvial Aquifer, lines 18-21. Page 4-2

Permittee Statement: "Monitoring well TWM03 [sic] is located approximately 10 ft hydraulically up gradient from extraction/injection well TMW64, will be used to measure groundwater drawdown during the pump test, groundwater recovery after completion of the pump test, and as an up gradient monitoring well for the bioremediation pilot test."

NMED Comment: The upgradient monitoring well (TMW03) must also be used as a monitoring well for tracer test. Include the provision in the revised Work Plan.

38. Section 4.2.3, Bedrock Aquifer, lines 23-24, page 4-2

Permittee Statement: "Extraction/injection well TMW69 is planned to be constructed in the bedrock aquifer approximately 10 ft away from monitoring well TMW48."

NMED Comment: The perchlorate concentrations in the groundwater samples collected from wells TMW30 and TMW49 are higher than that of well TMW48 and the nitrate concentrations in the groundwater samples collected from wells TMW02, TMW30, and TMW31D are higher than that of TMW48 according to the Report. Provide an explanation for why the vicinity of TMW48 is proposed for the bedrock testing area in the revised Work Plan.

39. Section 4.2.3, Bedrock Aquifer, lines 33-34, page 4-2 and lines 1-2, page 4-3

Permittee Statements: "Monitoring well TMW71 will be constructed 10 ft to the northwest and hydraulically down gradient from extraction/injection well TMW69."
and,
"Monitoring well TMW72 will be constructed to the northwest and 10 ft hydraulically down gradient from extraction/injection well TMW69."

NMED comment: Section 3.2.9.1 states, "[o]bservation points are normally placed up gradient or cross gradient from the pumped well relative to groundwater flow [for a pump test]". The field test must be focused on the pump test rather than the tracer or bioremediation tests (see Comment 36). Revise the proposed well locations to focus on the pump test in the revised Work Plan.

40. Section 4.2.3, Bedrock Aquifer, lines 7-10, page 4-3

Permittee Statement: "Monitoring well TWM48 [sic] is located 10 ft to the southeast and hydraulically up gradient from extraction/injection well TMW69. Monitoring well TMW48 will be used to measure groundwater drawdown during the pump test and groundwater recovery after completion of the pump test and as an up gradient monitoring well for the bioremediation pilot test."

NMED Comment: The upgradient monitoring well (TMW48) must also be used as a monitoring well for the tracer test (see Comment 37). Include the provision in the revised Work Plan.

41. Section 4.3, Bench Scale Testing, lines 20-22, page 4-3

Permittee Statement: "Soil from the bedrock aquifer will not be used for bench scale testing because of the drilling method, which will sufficiently alter the sample to a point where it will no longer be representative of in-situ conditions."

NMED Comment: Comment 15 above states, "[i]t is more appropriate to use a hollow stem auger in order to be able to visually inspect fractures within bedrock layer. Propose to use hollow stem auger or sonic drilling methods in the revised Work Plan." A segment of fractured rock can be used to construct the microcosms if hollow stem auger or sonic drilling is used. Construct the microcosms using the segment of fractured rock core and the groundwater collected from the same area. Revise the Work Plan accordingly.

42. Section 4.3.1, Electron Donor Selection, lines 29-30, page 4-3

Permittee Statement: "EOS [emulsified oil substrates] consist of small, stable vegetable oil droplets that are completely miscible in water."

NMED Comment: When an emulsifier (e.g., surfactant) that solubilizes vegetable oil is diluted below the critical micelle concentration, the emulsion will break and oil will adhere to the soil and cease migration. The data obtained from the tracer test (e.g., rate for particle transport), which accounts for advection only, will be different from that of the bioremediation pilot test. EOS likely travels much slower than a conservative tracer, relying more on dispersive and diffusive forces. Explain how the data collected from the tracer test will be useful for designing the bioremediation pilot test in the revised Work Plan.

Additionally, provide information regarding the chemical composition of EOS with the safety data sheet (SDS) in the revised Work Plan. If available, provide the name of the surfactant(s) used to formulate the EOS and its critical micelle concentration(s).

43. Section 4.3.1, Electron Donor Selection, lines 27-28, page 4-4

Permittee Statement: "A product manufactured by Regenesis, Inc. (Regenesis®) [called 3-D Microemulsion (3DMe)] incorporates esterified lactic acid and esterified long chain fatty acids to provide a controlled release of carbon and electron donor for an approximate 1- to 2-year period."

NMED Comment: Clarity whether the product contains an emulsifier and is formulated for microemulsion. Provide information regarding the chemical composition of 3DMe with the SDS in the revised Work Plan.

44. Section 4.3.1, Electron Donor Selection, pages 4-3 – 4-4

NMED Comment: EOS, acetate, ethanol, and 3DMe are selected as candidates for the amendment. Explain why lactate, which is a potent electron donor and completely miscible in water, is not included as a candidate in the revised Work Plan. If lactate and 3DMe are basically identical, state the fact for clarity and discuss the differences, as well.

45. Section 4.3.2, Microcosm Preparation, lines 18-20, page 4-5

Permittee Statement: "Microcosoms [sic] will be prepared by filling nominal 1,000 mL glass bottles with 300 grams of homogenized soil and 900 mL of groundwater."

NMED Comment: The ratio of soil to groundwater in the microcosm bottles is significantly different from that of aquifers. Explain how the result obtained from the bench scale test can be extrapolated to natural aquifer conditions in the revised Work Plan. In addition, provide a schematic of the microcosm (e.g., headspace connected to Tedlar bags) in the revised Work Plan.

46. Section 4.3.3, Bench Scale Testing Methods, lines 32-33, page 4-5

Permittee Statement: "The four treatment and one control microcosms will be incubated in an anaerobic chamber for a period up to 26 weeks."

NMED Comment: Two types of control microcosms must be constructed; one without any amendment and the other without any amendment, but with microbial growth inhibitor (e.g., acid) added. The latter control is necessary to investigate the rate of abiotic degradation. Include the provision in the revised Work Plan.

47. Section 4.3.3, Bench Scale Testing Methods, lines 33-34, page 4-5

Permittee Statement: "After 2 weeks of inoculation (Week 2) and again at Week 6, each reactor will be destructively sampled and the water analyzed for analytes listed on Table 4-3."

NMED Comment: The statement indicates that replicate reactors are sacrificed for the required analyses. However, the number of replicates constructed per each treatment train is not discussed. Include the discussion in the revised Work Plan.

48. Section 4.4, Aquifer Pump Test, lines 14-15, page 4-6

Permittee Statement: "In 1999, an aquifer test was conducted in the alluvial and bedrock aquifers in the vicinity of the TNT leaching beds (PMC Environmental 2001)."

NMED Comment: The aquifer test (slug test and pump test) was previously conducted at the site. The result obtained from the previous test may be used to supplement the course of remedial selection at the site (see Comments 9 and 36) but cannot be relied upon for remedy selection.

49. Section 4.4.1, Alluvial, lines 30-34, page 4-6

Permittee Statements: "Monitoring well TMW66 will be installed approximately 10 ft hydraulically down gradient from extraction well TMW64. Based on the calculations, 0 ft of drawdown is expected at this location at completion of the 24-hour pump test."
and,
"Monitoring wells TMW67 and TMW68 will be installed 20 ft hydraulically down gradient from extraction well TMW64, and 0 ft of drawdown is expected at these locations."

NMED Comment: The Permittee anticipates zero foot of drawdown at wells TMW66, TMW67, and TMW68. The Permittee is aware of the hydraulic limitation at the site; yet, they propose in-situ bioremediation. Injectate will not likely be distributed effectively within the alluvial aquifer. The Work Plan must provide more focus on the optimization of groundwater extraction and above-ground treatment system (see Comment 9 and 36). Revise the Work Plan accordingly.

50. Section 4.4.2, Bedrock, line 2-3, page 4-7

Permittee Statement: "Using the equation T = Kb and the input parameter of a saturated thickness (b) of 30 ft, and hydraulic conductivity (K) of 4 ft/day, the transmissivity of the alluvium is 120 gpd/ft (Table 4-6)."

NMED Comment: This section provides a discussion for the characteristics of bedrock rather than alluvial aquifer. Correct the typographical error (alluvium) in the revised Work Plan.

51. Section 4.4.2, Bedrock, lines 6-11, page 4-7

Permittee Statements: "Monitoring Well TMW70 will be installed 5 ft cross gradient from extraction well TMW69, and based on a 1.5 gpm groundwater extraction rate, 8.12 ft of drawdown is expected at this location at the completion of the 24-hour pump test."
and,
"Monitoring wells TMW71 and TMW72 will be installed 10 ft hydraulically down gradient from extraction well TMW69, and 6.14 ft of drawdown is expected at this location at completion of the 24-hour pump test."

NMED Comment: The statements indicate that the bedrock aquifer(s) may potentially be compatible with in-situ bioremediation due to the speculated large influence from the pumping well. However, Comment 5 in NMED's *Disapproval Groundwater Periodic Monitoring Report January through June 2016,* dated August 7, 2017, states that the groundwater flow direction has not been fully characterized and hydraulic connectivity is not well-understood in the bedrock aquifer beneath the Workshop Area. The distribution of fluids in fractured rock environment is unpredictable; the fluids may only flow within the fractures intersected by screened intervals. For example, if fractures are connected between injection and extraction wells, hydraulic connectivity would exist between them and hydraulic control would be achievable. On the other hand, if fractures are not connected, no hydraulic connectivity would exist between the wells even if they are only a few feet apart. Prior to conducting the tracer test in the bedrock aquifer, propose to conduct a step drawdown test (single-well test) in all pertinent existing bedrock wells to confirm that the distribution of injectate is achievable in the bedrock aquifer. Include the provision in the revised Work Plan.

52. Section 4.4.3.2, Bedrock Aquifer, lines 8-9, page 4-8

Permittee Statement: "Extraction well TMW69 will be "step" tested at rates of approximately 0.15, 0.25, 0.5, and 0.75 times the 1.5 gpm calculated yield for monitoring well TMW05."

NMED Comment: The total depth of well TMW05 is less than 40 feet below ground surface (bgs) and the data collected from the well may not be applicable to subsurface conditions at depths ranging from 70 to 100 bgs where well TMW69 is proposed to be installed. Use data that is more relevant to the proposed test. Revise the Work Plan accordingly.

53. Section 4.5.3, Data Analysis, lines 12-18, page 4-11

Permittee Statement: "Maximum groundwater velocity will be determined with the following equation:
V=(x-r)/t
where:
V = groundwater velocity (ft/day)
x = distance from the injection well to the down gradient monitoring well (ft)
r = distance between the injection well and the cross gradient monitoring well (ft)
t = time (days)"

NMED Comment: The groundwater velocity is dependent on the relative distances of two monitoring wells from the injection well. If the distance between the injection well and the cross-gradient monitoring well is greater than the distance from the injection well to the downgradient monitoring well, the value of groundwater velocity will be negative according to the equation. Therefore, the equation does not make sense. Provide a more detailed explanation for how the equation is derived or correct the equation in the revised Work Plan. Explain why the equation V = x/t is not used, based on the tracer test accounting for advection only, in the revised Work Plan.

54. Section 5.1, Bench and Pilot Testing Report, lines 5-7, page 5-1

Permittee Statement: "The RCRA Corrective Action Plan Guidance set forth by USEPA's 1994 RCRA Corrective Action Plan (Final) (USEPA 1994) and the RCRA Permit (NMED 2015) for FWDA were used as a basis for the outline of the Bench and Pilot Testing report (Report)."

NMED Comment: Provide specific citations to the appropriate sections of the RCRA Corrective Action Plan and the Permit relevant to the statement for clarification in the revised Work Plan.

55. Section 6.1.2, United States Department of the Army, Fort Wingate Depot Activity, lines 14-15, page 6-1, and Section 6.1.3, United States Army Corps of Engineers, Tulsa District, line 20, page 6-1

Permittee Statements: "USACE's PM [Project Manager] and point of contact (POC) is Mr. Saqib Khan."
and,
"The USACE [Tulsa District] PM is Mr. Steve Smith."

NMED Comment: Mr. Saqib Khan is not a point of contact (POC) and he is not included in the document distribution list in the Work Plan. Messrs. Steve Smith and Mark Patterson are

the POCs. If there is any change to the information, clarify it in the revised Work Plan. In addition, Mr. Smith is titled as a FWDA Program Manager rather than Project Manager and his organization is the United States Army Corps of Engineers (USACE) Fort Worth District rather than USACE Tulsa District. If there is any change to the information, clarify it in the revised Work Plan. Correct the statements for accuracy in the revised Work Plan.

56. Section 6.1.5.4, Bench Scale Testing Services, lines 4-6, page 6-5

Permittee Statement: "Prima Environmental, Inc. (Prima Environmental) will perform bench scale testing services at their laboratory in El Dorado Hills, California. Prima Environmental will evaluate nitrate, RDX, and perchlorate bioremediation in FWDA substrate provided using different electron donors."

NMED Comment: All laboratory analyses associated with bench scale testing must be conducted by independent third-party laboratory. Include the provision in the revised Work Plan.

57. Section 6.1.5.5, Waste Transportation and Disposal, lines 14-16, page 6-5

Permittee Statement: "The IDW will be transported under manifest to an appropriate facility and WM [Waste Management] will provide documentation demonstrating proper disposal of the waste. This information will be provided to FWDA and USACE in the Report."

NMED Comment: The documentation must also be provided to NMED. Include the documentation in the bench and pilot testing report. Revise the Work Plan accordingly.

58. Table 4-3, Microcosm Sampling Frequency and Objectives, page 4-18

NMED Comment: The analysis of ferrous iron and sulfate is included to verify the occurrence of anaerobic biodegradation. However, the proposed analysis does not fully achieve the intended objective. Sulfide and methane must also be monitored during the bench scale testing. Revise the Work Plan accordingly.

59. Table 4-6, Theis Solution Estimates, page 4-21, and Table 4-8, Estimated Tracer Volume, page 4-23

NMED Comment: According to Table 4-6, the transmissivity of bedrock aquifer is recorded as 120 gpd/ft and is twenty times higher than that of alluvial aquifer. According to Table 4-8, the aquifer porosity of bedrock aquifer is 0.005 that is seventy times lower than that of alluvial aquifer. Effective porosity is proportional to hydraulic conductivity; therefore, is proportional to transmissivity as well. The notable inverse relationship between

the transmissivity and porosity must be discussed in the revised Work Plan. It is questionable that the bedrock (sandstone) aquifer with porosity value of 0.005 can deliver fluids in a rate of 120 gpd/ft. The hydraulic conductivity previously calculated for the bedrock aquifer must be reevaluated (see Comment 51).

60. Table 4-8, Estimated Tracer Volume, page 4-23

NMED Comment: One pore volume is estimated using the radius of five feet from the injection well. However, injection fluid will unlikely be distributed evenly within the radius. The injection fluid likely flows more linearly in the downgradient direction. The calculation for pore volume must be reevaluated using the distance between the injection and the nearest downgradient monitoring well. Revise the Work Plan accordingly.

61. Figure 3-12, Example IDW Label for Waste Pending Analysis, page 3-51, and Figure 3-13, Example IDW Label for Non-Hazardous Waste, page 3-53

NMED Comment: These labels must include the date when the container is filled. Revise the labels to have a line to note the date.

The Permittee must submit a revised Work Plan that addresses all comments contained in this Disapproval. Two hard copies and an electronic version of the revised Work Plan must be submitted to NMED. The Permittee must also include a redline-strikeout version in electronic format showing where all revisions to the Work Plan have been made. The revised Work Plan must be accompanied with a response letter that details where all revisions have been made, cross-referencing NMED's numbered comments. The Revised Work Plan must be submitted to NMED no later than **December 31, 2019**.

Should you have any questions, please contact Michiya Suzuki of my staff at (505) 476-6059.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
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