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Responses to Petroleum Storage Tank Bureau Comments Received September 14, 2020 Regarding Lovington 66 Final Remediation Plan

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared the following responses to questions posed by the New Mexico Environment Department (NMED) Petroleum Storage Tank Bureau (PSTB) in an email received September 14, 2020, regarding the Final Remediation Plan (FRP) for the Lovington 66 site. DBS&A submitted the original FRP on August 28, 2020. The PSTB's complete comment is provided in italics, followed by DBS&A's response in regular text. The FRP has been updated to include these responses.

Comments

1. *Soil vapor extraction as the remedial approach does not directly address dissolved phase gw contamination at this site. In Section 3.2: "Remediation Goals and Performance Standards" it is mentioned that the dissolved phase gw contamination will be allowed to naturally attenuate, with the suggestion of additional remediation tools in the future to reduce the dissolved phase gw contamination levels to below NMWQCC standards. Utilizing SVE for source mass removal, clean-up of only two of the three contaminant phases (soil vapor, free product) will be accomplished with this approach. In the FRP in this same section 3.2, the nearby site, LCEC is mentioned. It reads that: "….concentrations decreased quickly following removal of source area contaminant mass", but at LCEC dissolved phase concentrations remain well above standards many years after remediation implementation. As per section 20.5.119.1923 D1 of PSTB regulations (attached), please provide a timeframe for when dissolved phase concentrations will be at or below NMWQCC standards notified.*

Paragraph D (1) from the regulations, cited in NMED comment, states in its entirety:

> D. *All final remediation plans shall, at a minimum, include all of the following:*
> *(1) goals of remediation and target concentrations to be achieved in each medium;*

The regulations do not specify that a timeframe for remediation be provided in the FRP; however, DBS&A typically provides this type of information when it can feasibly be estimated as it relates to the proposed remedial goals and target concentrations. Section 3.2 from the FRP text states that the primary remedial objective is removal of hydrocarbon source mass (i.e., soil vapor and free product). The performance standard is given as follows:

> "Within 2 years of system operation, document that measurable LNAPL is no longer present within the monitor well network and extracted soil vapor concentrations contain less than 100 parts per million by volume (ppmv) of volatile organic compounds (VOCs) as measured by a photoionization detector (PID)."

Absent an immediate threat to human health or the environment, source area mitigation prior to implementation of a groundwater remedy is an appropriate remedial strategy. The FRP explicitly provides for monitoring and assessment of groundwater conditions during and after the source area mitigation, and for implementation of contingency remedial actions should a change in site conditions produce an immediate threat to human health or the environment.

At other sites where SVE applications have been employed (e.g., Lea County Electric Co-op [LCEC], Santa Fe County Judicial Complex [SFCJC], Sandia Fina, and Moberg's Garage), actionable dissolved-phase hydrocarbon concentrations have been observed in groundwater following source removal, but the extent and magnitude of these concentrations have typically been reduced significantly from the pre-remediation condition. DBS&A cited LCEC as an example, because VOC concentrations in on-site wells decreased by several orders of magnitude (e.g., MW-3, MW-5, MW-6, and MW-9), after appropriately-sized remediation equipment was implemented in March 2011. Concentrations of contaminants of concern (COCs) in LCEC wells continue to naturally attenuate, and several wells are now below laboratory reporting limits or NMWQCC standards. Even off-site well MW-10 has seen an order of magnitude decrease in the methyl tertiary-butyl ether (MTBE) concentration since March 2011, and other COCs are below NMWQCC standards. DBS&A expects better performance at the Lovington 66 site due to favorable geology and high air flow rates through the horizontal wells (roughly three times the airflow as the LCEC site).

DBS&A expects that implementation of the SVE remedy and completion of source mass removal will last through the remainder of the current State Lead remediation contract. The dissolved-phase hydrocarbon plume in groundwater does not pose an immediate threat to the City of Lovington municipal water supply or other potential receptors, and DBS&A did not recommend that an active groundwater remedy be implemented for this reason. PSTB concurred with this approach with acceptance of the proposed remedial strategy. During the next State Lead contract, PSTB may wish to re-assess whether site conditions (or priorities) have changed and an active groundwater remedy should be implemented, or if a monitored natural attenuation (MNA) plan should be implemented in accordance with PSTB regulations (NMAC 20.5.119.1915 through 1921). Either course of action will be more appropriate after source mass has been removed. If MNA is selected, PSTB could require “the time necessary for achieving target concentrations” in accordance with paragraph C.8 of NMAC 20.5.119.1915, which can be more reliably estimated following source mass removal, based on reductions in both COC concentrations in groundwater and the residual hydrocarbon mass.

Section 3.2 has been revised to specify attainment of NMWQCC standards as the remedial objective for the groundwater medium.

2. *Calculation 1:*

a. *Pg. 6 of 6: Please clarify and indicate in narrative of calculation if this clean-up time estimate is for the entire plume (Lovington 66 site, Allsup’s 109 site, and NMDOT ROW). Table with interative reduction in mass of LNAPL suggest it is for the entire plume.*

The calculation objective (Section 1.0) has been revised to specifically mention it applies to the comingled LNAPL plume.

b. *Pg. 4 of 6: 90% of 22146.67 gallons of NAPL across entire plume (Lovington 66 site, Allsup’s 109 site, and NMDOT ROW) would be 19,932 gallons. Calculation narrative states 19,800 gallons.*

The total volume of LNAPL was rounded to 22,000 gallons for cleanup time estimation because of the number of assumptions that were used to derive the number, including an assumed formation thickness over half the LNAPL plume. Calculation of volume to two decimal places is not warranted; two significant figures were used instead. In addition, an extremely conservative value of 90 percent was used for the amount of recoverable LNAPL, which produces a conservative (longer) estimate for the time to remove the LNAPL plume (than if a more reasonable value of 60 percent was used).

c. *Pg. 6 of 6: Figure, “Contaminant Removal over Time” – Please provide rationale as to why 2-log removal (LNAPL mass 100 times less than 90% of initial LNAPL mass) is used in the estimation of clean up time rather than 3-log removal, for instance. Contaminant mass remaining is reduced from 123,874lbs to 401 lbs at 1.1 yrs after the commencement of SVE system operations.*

Based on DBS&A experience, 2-log removal is reasonable and cost-effective. Remediation is always a balancing act between time and level of effort. For example, achieving 3-log removal would result in removal of approximately 1,100 additional pounds of contaminant mass (~180 gallons), but it would require about 120 more days. As stated in the calculation, we want to reiterate that these numbers are all theoretical, and actual SVE removal could be more or less based on site specific considerations and equipment performance. However, note how this calculation was used in the context of the revised FRP text: we anticipate removing recoverable LNAPL within one year, but we will reduce soil vapor concentrations below an action level of 100 ppmv within 2 years.

d. *Pg. 6 of 6: 2nd last paragraph re: Estimate of total Clean-up time. It is mentioned that an initial recoverable mass is 19,800 lbs. Did you use the volume of 19,800 gallons using 90% of Total LNAPL Volume (90/100*22,146.67 gallons = 19,932 gallons) when it should have been 90% of Total LNAPL mass? If so, please revise the estimation of clean up time calculation. The paragraph states a goal of a LNAPL mass reduction of 99% (e.g. leaving 1.0% of initial LNAPL mass remaining). Therefore, using 123,874 lbs as the initial LNAPL mass; 1.0/100*123,874 lbs=1238.7 lbs or should it be 1% of initial recoverable LNAPL mass (e.g. 1/100* 90/100 * 123,874 lbs = 1114.9 lbs). In the calculation, narrative shows 1/100*19800 lbs = 198 lbs.*

The calculation has been revised to discuss reducing total recoverable mass of 123,874 pounds to 1,239 pounds, which will theoretically require approximately 295 days (0.8 year).

3. *Calculation 2:*

Review of the SVE head loss calculation yielded minor changes to fluid property values. However, changes did not significantly affect overall design of the system (calculated operating vacuum decreased from 93.6 to 93.5 inches water column, but the design vacuum of 100 inches is unchanged).

a. *Equation 1: denominator should be dynamic viscosity not kinematic viscosity. Please revise notes under equation.*

The method (Section 3.0) has been revised to refer to dynamic viscosity.

b. *Don’t you have to convert the air density of 0.00217 slugs/cu ft to lb_f/cu ft, equating to 0.07 $_{lbf}$/cu ft to have units cancel (unitless)? Converting slugs/cu ft to lb_f/cu ft, would result in a $Re_{conveyance}$ = 3121236.44; similarly for $Re_{Manifold}$ = 4135513.46. If so, revise calculation and subsequently any equation that contain $Re_{Conveyance}$ and $Re_{Manifold}$.*

The source used for dynamic viscosity lists values in slugs/ft-sec. The calculation text on Page 3 has been revised to reflect the correct units; therefore, unit conversions are not needed.

c. *Please include formulas to correct/adjust the dynamic viscosity of air at standard atmospheric pressure, and at 60F for site conditions (elevation of 3910' ; atmospheric pressure of 12.735 psi, 60F). The calculation narrative provides the value ($3.92*10^{-7}$ lb_f*sec/ft^2) but not the formula to arrive at it.*

Dynamic viscosity is linearly-interpolated from a table in a published source, cited.

d. *Please include formula to adjust the density of air at standard atmospheric pressure, and at 60F to site elevation conditions (elevation of 3910'; atmospheric pressure of 12. 735 psi, 60F). Calculation narrative provides the air density at 3910' ($2.17*10^{-3}$ slugs/ft^3) but not the formula to arrive at it. Use of the engineering tool box (https://www.engineeringtoolbox.com/air-altitude[density-volume-d_195.html) yielded an air density at site elevation of 3910', 60F of $2.011*10^{-3}$ slugs/ft^3.*

Air density is linearly-interpolated from a table in a published source, cited. The air density value provided by PSTB would lower the design head loss by approximately 0.5 inch water column, so the DBS&A value is more conservative.

e. *Circuit lengths for SVEs 1 and 2 are stated to be 65' and 70', respectively for the conveyance piping from the entry point to the manifold at the equipment compound. Isn't the blank casing of the horizontal wells included in the pipe length when calculating the major pressure losses due to pipe friction? Revise calculation if appropriate.*

Based on pilot testing and experience at the LCEC site on the north side of Lovington, DBS&A has conservatively assumed that applied well vacuum will be 85 inches water column. This number already includes any losses in the well casing. The applied well vacuum is what you would measure at the wellhead vault at the surface. The SVE head loss calculation intentionally only includes pressure loss in the conveyance piping and SVE manifold.