A U.S. Department of Energy Site-Specific Advisory Board

NNMCAB Members

May 21, 2020

Mr. Thomas Johnson, Acting Manager
Environmental Management Los Alamos Field Office
3747 West Jemez Road, MS A316
Los Alamos, NM 87544

Dear Mr. Johnson,

I am pleased to enclose Recommendation 2020-02, "Recommendation for an Interim Measure for Volatile Organic Compound Contaminant Source Removal Related to Material Disposal Area C," which was unanimously approved by the Northern New Mexico Citizens' Advisory Board during its teleconference meeting on May 20, 2020.

Please contact me if you have questions regarding this recommendation. We look forward to the response from the Department of Energy.

Sincerely,

Max Baca
Chair, NNMCAB

Enclosure: a/s
Cc w/encl (via e-mail):
U. S. Senator Tom Udall
U. S. Senator Martin Heinrich
U. S. Congressman Ben R. Lujan
Secretary James C. Kenney, NMED
David Borak, DFO
David Nickless, DDFO
Gil L. Vigil, Executive Director Eight Northern Indian Pueblos
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NORTHERN NEW MEXICO CITIZENS' ADVISORY BOARD
Recommendation to the Department of Energy
No. 2020-02
Recommendation for an Interim Measure for Volatile Organic Compound Contaminant Source Removal Related to Material Disposal Area C
Drafted by: Robert Hull for the Risk Evaluation and Management Committee

Background

Throughout its history Los Alamos National Laboratory (LANL) has utilized Material Disposal Areas (MDAs) to dispose of radioactive and hazardous non-radioactive solid, gaseous, and liquid wastes in pits and shafts. One of those MDAs is MDA C, designated under LANL's Consent Order (CO) with the New Mexico Environment Department (NMED) as Solid Waste Management Unit (SWMU) 50-009, which is located at LANL Technical Area 50 (TA-50). MDA C consists of 115 subsurface disposal units (7 pits and 108 shafts) on an 11.8-acre site on Mesita del Buey on the north side of Pajarito Road (See Figure 1 below). MDA C is an inactive landfill that was in operation from 1948 to 1974. The wastes disposed of in this disposal unit contain both hazardous constituents that are regulated by the NMED, and radionuclides that are regulated by the U.S. Department of Energy (DOE). As required by the CO, LANL submitted a Corrective Measures Evaluation (CME) report to the NMED in 2012 (Ref. 1), but no action has thus far been taken for any remedial actions other than site stabilization, but LANL did invoke institutional controls, and continues today to perform monitoring of deep aquifer groundwater and vapor in the unsaturated zone.

While the Northern New Mexico Citizens' Advisory Board (NNMCAB) is concerned with the remedial measures for the entire landfill, the current pressing concern is a volatile organic carbon (VOC) vapor plume located beneath MDA C. This recommendation pertains only to proposing an interim action addressing the vapor plume. The NNMCAB will, as they are able, address other corrective measures in later recommendations.

Our knowledge of the subsurface VOC vapor plume at MDA C results from LANL undertaking three phases of 2005 Consent Order Investigations. These were conducted in 2004-2007, 2008-2009, and 2010-2011. Under these phases NMED directed LANL to define the vertical extent of VOCs in pore gas to screening levels and determine whether contaminants had migrated to groundwater. Data from these three phases is presented in the MDA C CME 2012 Report and herein briefly summarized in Attachment I – Additional Information (after References below).

As stated in the 2012 CME report, "The sources of VOC vapors at MDA C are thought to be associated with wastes disposed of in the pits and shafts at the site, with VOCs being a component of the waste rather than a primary waste form." VOCs are organic chemical compounds whose composition makes it possible for them to evaporate under normal atmospheric conditions of temperature and pressure.

The MDA C 2012 CME Report develops alternatives for remediation and closure of MDA C and does include soil vapor extraction (SVE) treatment to remove the source of these VOCs from the environment and potential future migration to receptors. These would be considered final remedies and must go through the regulatory process for them to be executed.

Comments and Observations

It is some comfort to know that "…the depth where Tier II screening levels were exceeded is bounded vertically at all locations (CME Section 3.2.4.2, pg. 25)." However, it is also obvious from the data on the figures above that VOCs (i.e., at least TCE), are present at some concentration:

1. Below the bottom-most sampling port in each vapor monitoring well, and
2. Beyond all the vapor monitoring wells so far constructed.

Therefore, the vertical and lateral extent of physical contamination (i.e., not Tier II) has not been determined. In order to do that more vapor monitoring wells would:

1. have to be constructed farther out along each of the transects (i.e., A-A', B-B', and C-C') in both directions, and
2. within the plume more vapor monitoring wells would have to be constructed that could have vapor sampling ports deeper and closer to the groundwater.

At meetings discussing the MDA C, the NNMCAB has heard investigators say that based upon more recent data that the overall size and shape of the plume as shown in the figures above has not changed appreciably since the 2012 CME report was prepared. Investigators have also hypothesized that what variations that are observed over time are related to what has been called a sort of "barometric" pumping of the unsaturated zone pore space due to low- and high-pressure weather fronts moving across the mesa. While this should be reassuring, all that really means is that the horizontal and vertical concentration profiles are not changing appreciably. It does not mean that VOC vapors are not moving three-dimensionally. It only means that currently those vapors that could be migrating are less than the calculated Tier II screening levels.

The "correct" conceptual model is moot to the NNMCAB. The NNMCAB is only concerned with the facts that the VOC plume:

1. exists below MDA C consisting of many different VOCs,
2. contains at least one known human carcinogenic VOC (i.e., benzene),
3. almost certainly derives from sources within MDA C,
4. may in the future migrate to the canyons on the boundaries of Mesita del Buey into the air, and
5. has no well-defined restrictive geologic barrier (e.g., like an aquitard) to keep it from infiltrating vertically down to the groundwater, and migration is in fact possibly facilitated by the fissured/fractured geologic strata beneath MDA C.
6. Comprehensive MDA C Clean-up, which subsumes the VOC plume, is currently listed in Appendix B of the Consent Order as a relatively low priority concern under item "K" ("A" being the highest priority).

This current recommendation follows a similar recommendation made in 2010 by the NNMCAB *Recommendation to the Department of Energy, No. 2010-05, Recommendation for Interim Measure for Volatile Organic Constituent Contaminant Source Removal in MDA-L and MDA-G* (Approved 3-31-10) (Ref. 4). That recommendation was responded to by DOE agreeing with the NNMCABs recommendation (Ref. 5). Material Disposal Areas L and G are downslope on the same mesa as MDA C but lower down in the geologic section and involve extensive basaltic geologic horizons. Soil vapor extraction (SVE) pilot tests were performed at both locations (i.e., L and G) proving the efficacy of using SVE to remove VOC mass reduction and plume reduction in this geologic environment. Subsequently LANL prepared an Interim Measures Work Plan for VOC extraction at MDA L (LA-UR-14-23104, May 2014, Ref. 6). NMED approved the Plan which resulted in LANL installing a SVE

system that removed VOCs in 2015 with later "rebound testing" conducted in 2017. Those efforts successfully reduced the plume's mass and mitigated VOC migration towards the water table (Behar et. al 2019, Ref. 7).

Recommendations

1. The NNMCAB recommends that the issue of the VOC Plume be raised as a separate priority concern under Appendix C during the discussion of the FY 2021 Consent Order between EM-LA and NMED. Currently comprehensive clean-up at MDA-C ranks relatively low on the list of Appendix C priorities. Addressing the VOC Plume as a separate clean-up issue would help mitigate immediate environmental concerns.
2. The NNMCAB recommends that DOE initiate an Interim Measure for mass source removal and plume reduction of VOCs from the subsurface of MDA C using SVE at the earliest time feasible.
3. The NNMCAB recommends that DOE should determine the nature and extent of all VOCs above the analytical detection limit in in the subsurface below MDA C both laterally and vertically.
4. The NNMCAB recommends that implementation of a SVE system should include appropriate criteria for terminating system operation in the event that the quantity of VOCs removed over time no longer meets the intent, cost effective goals of this recommendation, or the requirements of the NMED as implemented by the CO.
5. The NNMCAB recommends that DOE consider immediately implementing these Interim Measures for MDA C in accordance with the 2015 Consent Order. Provisions are available in the Consent Order for DOE to implement such proven technologies for cleanup even without a final approval for the remedy from the NMED.

Intent

The intent of this recommendation is to remove the mass of VOCs from the subsurface and to prevent these contaminants from moving into the groundwater or to the atmosphere. The NNMCAB recognizes it will take additional time and studies for the NMED and DOE to develop final remedies for these MDAs. Therefore, an Interim Measure will provide immediate treatment and removal of source material to reduce further contamination of the site.

Effect

The effect of implementing an Interim Measure for source removal of VOCs at MDA C will be to improve the expected performance of the final remedy for MDA C. Removal of the source VOCs in the subsurface will reduce the potential for migration of contaminants from MDA C into the groundwater or the atmosphere.

References

1. *Corrective Measures Evaluation Report for Material Disposal Area C, Solid Waste Management Unit 50-009 at Technical Area 50*, (LA-UR-12-24944, September 2012). [https://permalink.lanl.gov/object/tr?what=info:lanl-repo/eprr/ERID-222830]
2. *Upcoming Legacy Cleanup Decisions at Los Alamos National Laboratory*, January 21, 2020, DOE EM-LA, [https://regionalcoalitionnm.org/wp-content/uploads/2020/01/Upcoming-Legacy-Cleanup-Decisions-at-LANL_01212020.pdf]
3. *Benzene, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 120*, 2018, [https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-

Carcinogenic-Hazards-To-Humans/Benzene-2018]

4. *Interim Measures Work Plan for Soil-Vapor Extraction of Volatile Organic Compounds from Material Disposal Area L, Technical Area 54*, (LA-UR-14-23104, May 2014). [https://permalink.lanl.gov/object/tr?what=info:lanl-repo/eprr/ERID-256730]
5. *Northern New Mexico Citizens' Advisory Board, Recommendation to the Department of Energy No. 2010-05, Recommendation for Interim Measure for Volatile Organic Constituent Contaminant Source Removal in MDA-L and MDA-G*, [https://www.energy.gov/sites/prod/files/2015/07/f25/NNMCAB_Recommendation_2010-05.pdf]
6. *Response to NNMCAB Recommendation 2010-05*, George Rael, October 22, 2010. [https://www.energy.gov/sites/prod/files/2015/07/f25/DOE_Response_2010-05.pdf]
7. *An Investigation of Plume Response to Soil Vapor Extraction and Hypothetical Drum Failure*, Hannah R. Behar, Emily E. Snyder, Stanislaw Marczak, Larry J. Salazar, Bobbie Rappe, Gerald F. Fordham, Shaoping P. Chu, Daniel M. Strobridge, Kay H. Birdsell, Terry A. Miller, Kent C. Rich, and Philip H. Stauffer. Vadose Zone Journal, 14 February, 2019. [https://acsess.onlinelibrary.wiley.com/doi/epdf/10.2136/vzj2018.04.0080]

Attachment I – Additional Information

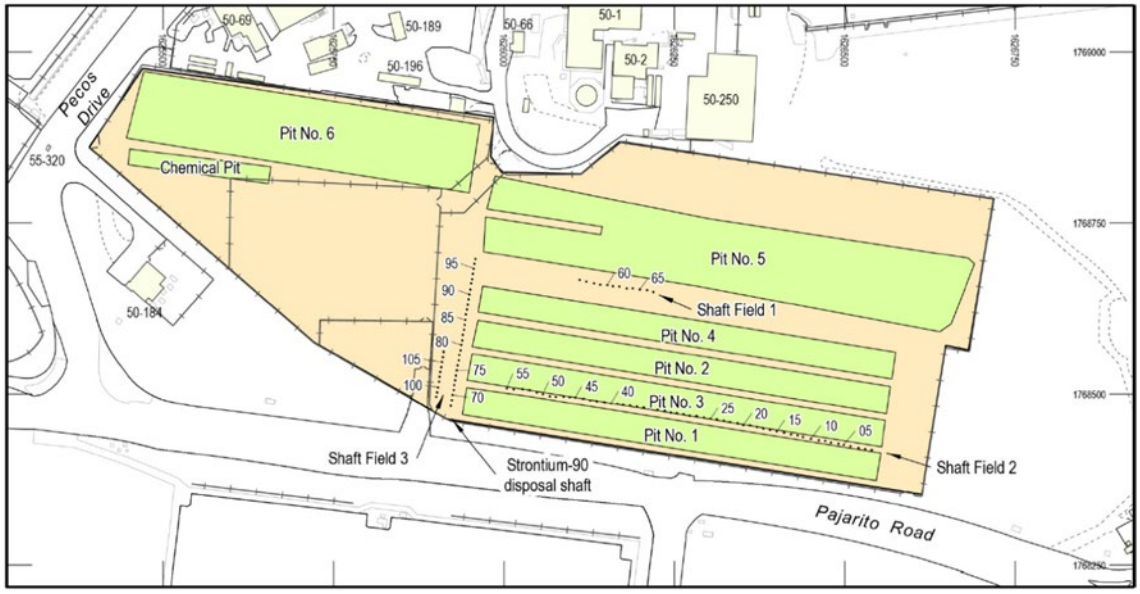

Figure 1. MDA C (from *Upcoming Legacy Cleanup Decisions at Los Alamos National Laboratory*, January 21, 2020, DOE EM-LA, Ref. 2).

The CME Report identified that:

> "Forty-two VOCs were detected in pore-gas samples collected during the first round of sampling. The VOCs with the highest frequency of detection were chloroform (209 of 210 samples), dichlorodifluoromethane (208 of 210 samples), PCE (209 of 210 samples), and TCE (210 of 210 samples). The VOCs with the highest detected concentrations were PCE (maximum concentration 24,000 µg/m^3) and TCE (54,000 µg/m^3). All other VOCs had maximum concentrations less than 10,000 µg/m^3." (MDA C CME Report, 2012, pg. 14)

PCE is known as *perchloroethylene* or as *tetrachloroethylene*.
TCE is known as *trichloroethylene*.

Also as stated in the MDA C CME Report "Most VOCs were detected infrequently (i.e., in less than 25% of samples). The only VOCs that have been detected at more than half the sampling ports are carbon tetrachloride, chloroform, dichlorodifluoromethane, methylene chloride, PCE, and TCE. These six VOCs were detected at more than half the sampling ports in most sampling events, and dichlorodifluoromethane, PCE, and TCE were detected in more than half the sampling events in every event. TCE is the most frequently detected VOC, being detected at 90% to 100% of the sampling ports and is also the VOC detected at the highest concentrations." Some of the sampling ports are shown in Figure 2 (below) as circles on the vertical lines that represent the vapor monitoring wells in a cross-sectional view below MDA C.

One important VOC, benzene, classified by the International Agency for Research on Cancer (IARC) as a Group 1 carcinogen – "carcinogenic to humans" (IARC Monograph 120, 2018, Ref. 3) is reported to have been in the shafts (Shaft Group 2, 2012 CME, pg. 5-6), and was detected in vapor samples collected at MDA C:

> "Benzene was detected above the Tier I screening level only for the January 2011–March 2011

and August 2011 sampling events and only in one sample for each event. For the January 2011–March 2011 event, benzene was detected at 1300 µg/m^3, which is slightly greater than the Tier I screening level (1150 µg/m^3), in the sample from 632.5 ft bgs at location 50-613182. For the August 2011 event, benzene was detected at 4100 µg/m^3 in the sample from 600 ft bgs at location 50-24813. Benzene has been detected at every sampling location and was detected during one to five sampling events at each location. The maximum concentration has been detected at eight locations for the nine sampling events. The pattern of benzene detections suggests diffuse contamination across the site at concentrations near detection limits. The two results above the Tier I screening level were one-time events that were not repeated. At 600 ft bgs at location 50-24813, results from all other sampling events were below detection limits. At 632.5 ft bgs at location 50-613182, benzene was detected at 1.8 µg/m^3 in the August 2011 sampling event and was below detection limits for all other sampling events." (2012 CME, pg. 21)

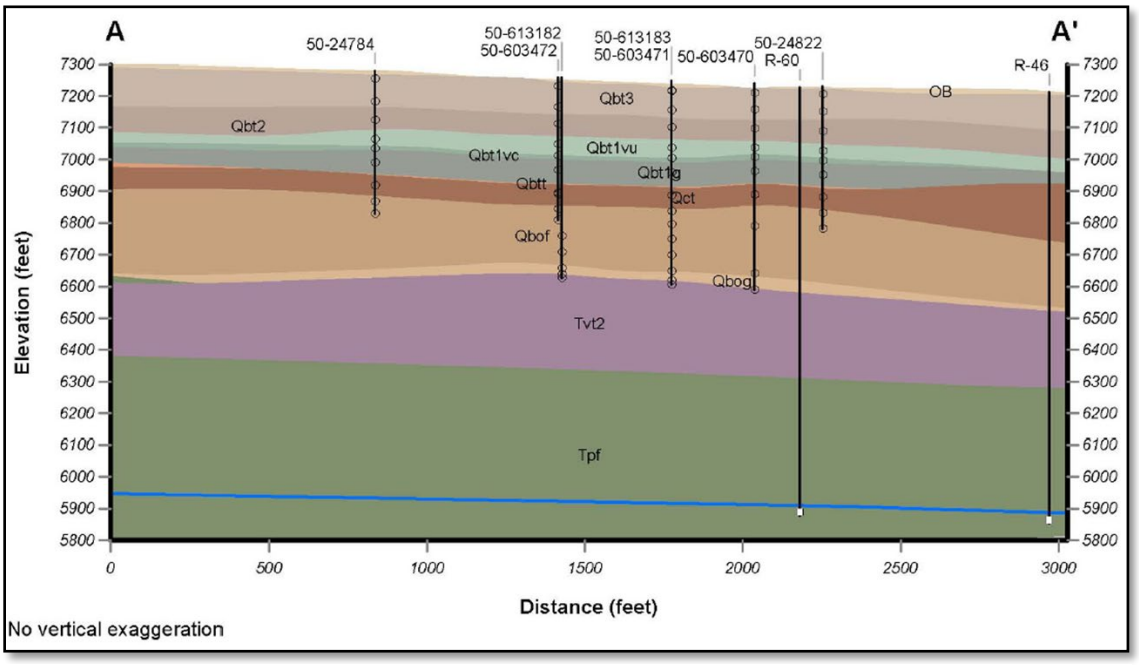

Figure 2. MDA C cross-sectional view of the vertical location of soil vapor monitoring ports (circles over vertical lines) below MDA C (from MDA CME 2012 Report, Figure 2.3-3, pg. 85).

The MDA C CME 2012 Report presented a visual representation of the TCE vapor plume data collected prior to finalizing the 2012 report that resulted from running computer simulation models (Figure 3.2-2, pg. 88). The figures below (Figures 3 and 4) from the report provide an image of what the TCE vapor plume would, based on computer simulation, look like. Figure 3 is a map view indicating how the spread of TCE relates to the MDA C site. Figure 4 is a cross-sectional view indicating how the spread of TCE might look in a geologic slice downward.

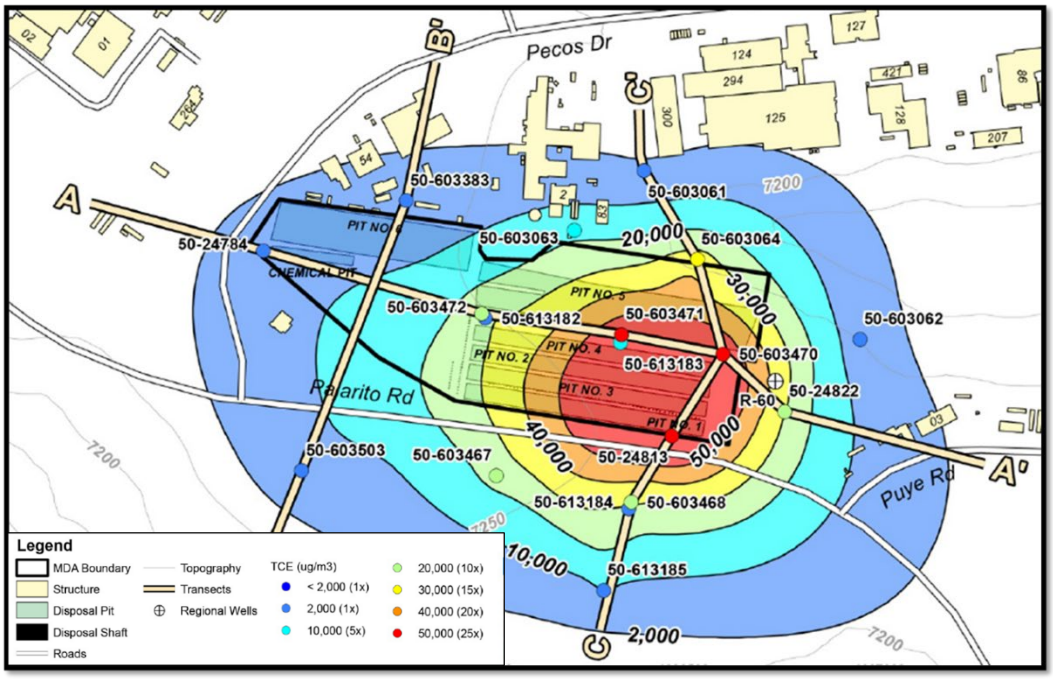

Figure 3. MDA C map view representing the lateral distribution of TCE vapor below MDA C (from MDA CME 2012 Report, Figure 3.2-2, pg. 88).

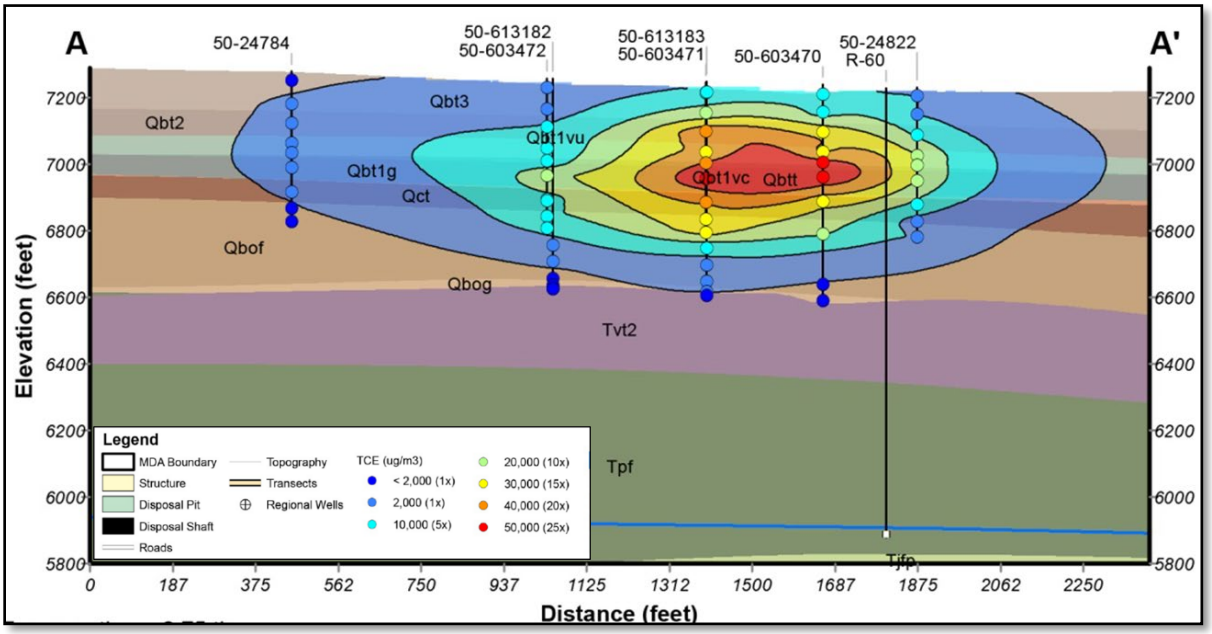

Figure 4. MDA C cross-sectional view representing the vertical distribution of TCE vapor below MDA C (from MDA CME 2012 Report, Figure 3.2-2, pg. 88).

Note that the values shown on Figures 3 and 4 for TCE are not actual concentrations but are values associated with what is called the Tier II screening evaluation. "The Tier II screening method analysis considers the migration of the VOCs to the water table and subsequent mixing with groundwater. This analysis includes migration of VOCs through the vadose zone in both the pore water and vapor phases. The resulting groundwater concentration following mixing immediately beneath the site is calculated and compared with applicable groundwater standards. If that calculated groundwater concentration exceeds a standard, further evaluation of the soil-vapor data is required to assess the potential impact that the particular VOC may have on groundwater." The Tier II screening level for TCE was calculated in the MDA CME 2012 Report to be 28,900 ug/m^3 (pg. 24). Note that iso-concentration lines that extend beyond the last well in any geographic direction or below the last vapor sampling port in the vertical direction are projected estimates generated by the modeling simulation software.

One additional point relates to the site geology. The lowest extent of the TCE-modeled VOC plume lies at the top of a geologic unit known as the Tschicoma Formation (unit Tvt2 on Figure 4). This unit is on the order of 200 feet thick under MDA C and made of massive lava flows that at groundwater regional well R-60 was determined to be intensely fractured and jointed. The next 500 ft. thick geologic formation below that is the Puye Formation (unit Tpf on Figure 4) which is made up of volcaniclastic sediment consisting of poorly sorted to unsorted, medium coarse gravels, fine to coarse sand, and varying amounts of silt. (See CME Report, pg. 8) The Puye Formation contains the regional aquifer. The important point is that the geologic materials below the current leading edge of the VOC plume are all fracture, jointed, or somewhat porous.