Pilot Test Work Plan for Evaluating Vapor-Sampling Systems at Material Disposal Area C

Purpose of Pilot Test	Phase II investigation activities are currently being conducted at Material Disposal Area (MDA) C. These activities include drilling five new boreholes and extending nine existing boreholes to greater depths to determine the nature and extent of contamination. After drilling is completed at each location, a vapor-monitoring system will be installed. The Phase II investigation work plan proposed installing a FLUTe (Flexible Liner Underground Technology) system in each borehole. The FLUTe system uses a flexible liner that provides a seal against the borehole wall once it is filled with sand. The sampling ports and the tubing are installed in the interior sleeves of the liner, and the tubing runs to the surface where vapor samples are collected. The FLUTe membrane liner is made of urethane-coated nylon fabric, and the tubing is made of nylon. Vapor-sampling results at MDA H have raised concerns regarding the potential for absorption of contaminants by the nylon membrane and tubing used in the FLUTe systems. The purpose of this pilot test is to evaluate and compare volatile organic compound (VOC) and tritium concentrations of vapor samples collected from boreholes using three different vapor-monitoring systems: the packer system previously used for vapor sampling at MDA C, the FLUTe system proposed in the MDA C Phase II investigation work plan, and a stainless-steel tubing system. All three systems have been used at Los Alamos National Laboratory (LANL) for collecting vapor-phase samples. The proposed pilot test will evaluate these three systems at a single LANL site.
Number, Locations, and Depths of Boreholes	A total of five boreholes will be included in the pilot test: a set of two "nested" boreholes located adjacent to each other (50-24821 and PT-1), a borehole located inside the MDA C boundary (50-24771), a borehole located to the north of the MDA C boundary (50-24817), and a borehole located to the south of MDA C (50-24820). The proposed pilot test borehole locations are shown in Figure 1. Borehole 50-24821 is currently at a total depth (TD) of 250 ft below ground surface (bgs) and will be extended to at least 450 ft bgs as proposed in the Phase II investigation work plan. After TD is reached, a FLUTe system will be installed. Borehole PT-1 will be drilled to 300 ft bgs and will be sampled using a packer system before a stainless-steel monitoring system is installed. Packer system samples will be collected at 30 ft, 90 ft, and 260 ft, corresponding to low, medium, and high relative concentrations of VOCs in samples collected previously at this location. Sampling ports will be installed at the same depths in both boreholes. These two boreholes will be located approximately 10 ft apart (Figure 1). Pilot test samples will be collected from both boreholes at 30 ft, 90 ft, and 260 ft bgs. Borehole 50-24771 will be extended from its current TD of 150 to 300 ft bgs using a hollow-stem auger drill rig. When 300 ft bgs is reached, packer system samples will be collected at 100 ft and 150 ft bgs, corresponding to low and high relative concentrations of VOCs in samples collected previously at this location. After packer sampling is completed, the borehole will be extended to at least 450 ft bgs, as proposed in the Phase II investigation work plan. A FLUTe system will be installed and pilot test samples will be collected at 100 ft and 150 ft bgs. Borehole 50-24817 will be extended from its current TD of 300 ft bgs to at least 450 ft bgs. Before drilling begins, vapor samples will be collected at 140 ft bgs using a packer system, corresponding to medium relative concentrations of VOCs in samples collected previously at this location. After air-rotary drilling is completed, a FLUTe system will be installed, and pilot test samples will be collected at 140 ft bgs. Borehole 50-24820 will be extended and a FLUTe system will be installed, as proposed in the Phase II investigation work plan. The FLUTe system will be equipped with two sets of tubing, one using the standard nylon and the other using polyvinylidene fluoride (PVDF) tubing to allow a comparison of VOC and tritium data from samples collected through the two types of tubing. Pilot test samples will be collected at 20 ft and 200 ft bgs from the two types of tubing, corresponding to low and high relative concentrations of VOCs in samples collected previously at this location.

Vapor-Sampling Systems	The packer system uses an inflatable packer and a sample-train apparatus to pull vapor from the rock formation at desired sampling intervals. The packer is lowered down the borehole and inflated with nitrogen to seal off a vapor inlet at the desired depth. The sample train is then purged to ensure formation air is being collected. Teflon tubing connects the vapor inlet and the sample train and is replaced for every borehole to prevent cross-contamination. Sampling is performed by extracting the formation air through the vapor inlet at the desired depth. The FLUTe system uses a flexible liner that provides a seal against the borehole wall. The sampling ports and the nylon tubing are installed in the interior sleeves of the liner. The liner is lowered into the borehole while the borehole is supported by a temporary casing, then filled with sand as the casing is withdrawn. The pressure of sand inside the liner seals the liner against the borehole wall, pressing the sampling ports against the formation. Vapor is drawn through a permeable spacer material between the liner and the borehole wall and into the tubing (Figure 2). A diffusion barrier will be installed in the permeable spacer material to minimize the potential for interactions with the material that could affect analyte concentrations. The stainless-steel system uses continuous lengths of 0.25-in.-outside diameter stainless-steel tubing with a single port installed at the target depth of each tube (Figure 2). Bentonite will be used above and below each sampling port to seal off the interval to be sampled. The 5-ft space between the bentonite seals at each sampling interval will be filled with sand. Sampling will be performed by extracting the formation air through the sand layer and into the stainless-steel tubing.
Drilling Approach	The new borehole (location PT-1) will be drilled with the hollow-stem auger method to a depth of 300 ft bgs. After this depth is reached, vapor samples will be collected using the packer system. The inside diameter of the hollow-stem auger flights is 4 in. At borehole locations 50-24771, 50-24817, 50-24820, and 50-24821, air-rotary drilling will be used to extend the borehole into the Otowi Member to a depth of at least 450 ft bgs, as proposed in the Phase II investigation work plan. Casing will be advanced as the drill bit advances and will prevent sloughing of any material from soft, unconsolidated intervals into the borehole during drilling and after drilling is completed. The inside diameter of the casing is 9.625 in. For installation of both FLUTe and stainless-steel systems, sand pack (and bentonite in the case of stainless steel) will be placed in the boreholes using a tremie pipe. The outside diameter of the tremie pipe during FLUTe installation is 4 in. The outside diameter of the tremie pipe during stainless-steel installation is 2 in. Borehole logs will be recorded for all boreholes and will include lithologic descriptions and notes regarding lithologic unit contacts, fractures encountered, and any other conditions that may affect sampling results.
Subsurface Vapor Sampling	All subsurface vapor sampling will be conducted in compliance with Section IX.B.2.g of the Compliance Order on Consent. Purge times for each vapor sampling system were calculated based on the inside diameter of the tubing used (0.18 in for all tubing), the length of tubing for each port, the nominal flow rate of the pumps (30 ft^3/h), and the void space associated with the packers. The time required to purge the entire tubing volume for the FLUTe and stainless-steel systems (and the tubing volume plus packer void space for the packer system) was less than 1 min. Therefore, purge times for all systems will be 5, 10, and 20 min. These purge times are conservative and will allow for the complete purging of all parts of each sampling system to ensure that samples contain formation air. A vapor sample will be collected in a SUMMA canister after each purge interval is completed. A total of three SUMMA samples will be collected at each depth interval. A tritium sampler will be used to collect an additional vapor sample after SUMMA samples are collected. Details of the number, locations, and depths of the vapor samples to be collected are discussed below. At borehole location 50-24821, vapor samples will be collected using the FLUTe system, as proposed in the Phase II investigation work plan. After the FLUTe is installed, three sampling ports will be used in the pilot test (30 ft, 90 ft, and 260 ft bgs). A total of nine VOC samples

	(three samples at three ports) and three tritium samples (one sample at three port) will be collected from borehole 50-24821. At borehole location PT-1, seven stainless-steel sampling ports will be installed at depths matching the FLUTe ports at location 50-24821 (to a maximum depth of 300 ft bgs). Vapor samples will be collected at borehole PT-1 first using the packer system (before the stainless-steel system is installed), then using the stainless-steel system. The stainless-steel system will be installed at borehole PT-1 as soon as practicable after the packer sampling is completed, and sampling will be conducted as soon as possible after installation of the system. A total of 18 VOC samples (three samples at three ports using both packer and stainless-steel systems) and six tritium samples (one sample at three ports using both packer and stainless-steel systems) will be collected from borehole PT-1. At borehole locations 50-24771 and 50-24817, vapor samples will be collected, first using packer systems and then using FLUTe systems. The FLUTe systems will be equipped with standard nylon tubing for all sampling ports. A total of six VOC samples (three samples at two ports) and two tritium samples (one sample at two ports) will be collected from borehole 50-24771. A total of three VOC samples (three samples at one port) and one tritium sample will be collected from borehole 50-24817. At borehole 50-24820, vapor samples will be collected using a FLUTe system at two depth intervals from two different types of tubing. A total of six VOC samples (three samples at two ports) and two tritium samples (one sample at two ports) will be collected.
Vapor-Sampling Protocol	All vapor sampling activities will be performed using the following protocols: • The nominal flow rate for all tests will be 30 ft^3/h. Actual flow rates will be recorded during purging and sampling. The flow rate will be measured using a Kobold Instruments Inc. SCFH Air Meter. • Vapor samples will be collected in SUMMA canisters after each proposed depth interval is purged for 5, 10, and 20 min. • After the third SUMMA sample is collected at each proposed depth interval, a vapor sample will be collected using a silica gel sampler. • Concentrations (percent) of methane, carbon dioxide, and oxygen will be measured and recorded every 2 min during purging and between samples and immediately before samples are collected. Concentrations will be measured using a LANDTEC GEM 500 Gas Extraction Meter. • Ambient-air temperature and barometric pressure will be recorded immediately before each sample is collected. • Any other field conditions that may influence sampling results will be recorded in a field notebook and reported with the pilot test results.
Vapor Sample Analyses	SUMMA canisters will be submitted through LANL's Sample Management Office (SMO) to an off-site contract analytical laboratory for analysis of VOCs by U.S. Environmental Protection Agency (EPA) Method TO-15. Silica-gel samplers will be submitted through the SMO to an off-site contract analytical laboratory for analysis of tritium by EPA Method 906.0. All samples will be submitted with requests for 15 work-day returns of full analytical data packages.

Evaluation of Results and Decision Process	Sampling results will be evaluated by comparing VOC and tritium concentrations collected at the same depth intervals in the FLUTe and stainless-steel systems (at locations 50-24821 and PT-1) with the results of samples collected in packer systems. Individual results will be considered significantly different if single comparisons (e.g., FLUTe vs. packer system at a single depth) show VOC and tritium concentrations with more than 20% relative difference (RPD). System results as a whole (e.g., stainless-steel system vs. corresponding packer system results for all depths) will be considered different if 50% or more of the single comparisons are significantly different. Similar comparisons will be used to evaluate the two tubing types in the FLUTe system at location 50-24820. Individual results will be considered significantly different if the two corresponding results for a single depth have more than 20% RPD, and the systems will be considered different if 50% or more of the single comparisons are significantly different. Analytical result from the three different purge times at each depth interval will also be evaluated to determine if the vapor-sampling systems affect VOC or tritium concentrations as a result of absorption and/or desorption over time.
Schedule	Pilot test field activities will begin after New Mexico Environment Department (NMED) approves this work plan. A detailed schedule for the pilot study is presented in Figure 3. The following durations were used to determine the schedule for drilling, sample collection, analytical analysis, and report preparation and submittal. **Drilling Activities** • Extending borehole 50-24821 from 250 ft to 450 ft bgs, collecting core samples, and installing the FLUTe system are expected to take 13 work days. • Drilling activities, packer sampling, and installing the stainless-steel at borehole PT-1 are expected to take 18 work days. This includes sufficient time for each bentonite interval to set before sand is added. • Extending borehole 50-24771 from 150 ft to 300 ft bgs and collecting core samples are expected to take 2 work days. • Extending borehole 50-24771 from 250 ft to 450 ft bgs, collecting core samples, and installing the FLUTe system are expected to take 13 work days. • Extending borehole 50-24817 from 250 ft to 450 ft bgs, collecting core samples, and installing the FLUTe system are expected to take 13 work days. • Installing the FLUTe system at borehole 50-24820 is expected to take 3 work days. **Sampling Collection** • Collecting VOC and tritium samples at boreholes 50-24821 using the FLUTe system will take approximately 2 work days. • Collecting VOC and tritium samples at borehole location PT-1 using the stainless-steel system will take approximately 2 work days. • Collecting vapor and tritium samples at boreholes 50-24771, 50-24817, and 50-24820 using the FLUTe system will take approximately 3 work days. **Data Evaluation and Report Preparation** • Data evaluation of sampling results is expected to take 5 work days after the last set of analytical data packages is received from the contract laboratories. • LANL expects to receive the final analytical laboratory results within 48 work days of the start of the pilot test field activities. • A pilot test report will be submitted to NMED within 15 work days after the reporting data set is received and evaluated. The report will present all data collected in the pilot test, a summary of the data evaluations performed, and recommendations based on the results. Based on the above estimated durations, the pilot test report is proposed to be delivered to NMED on June 25, 2008 (Figure 3).

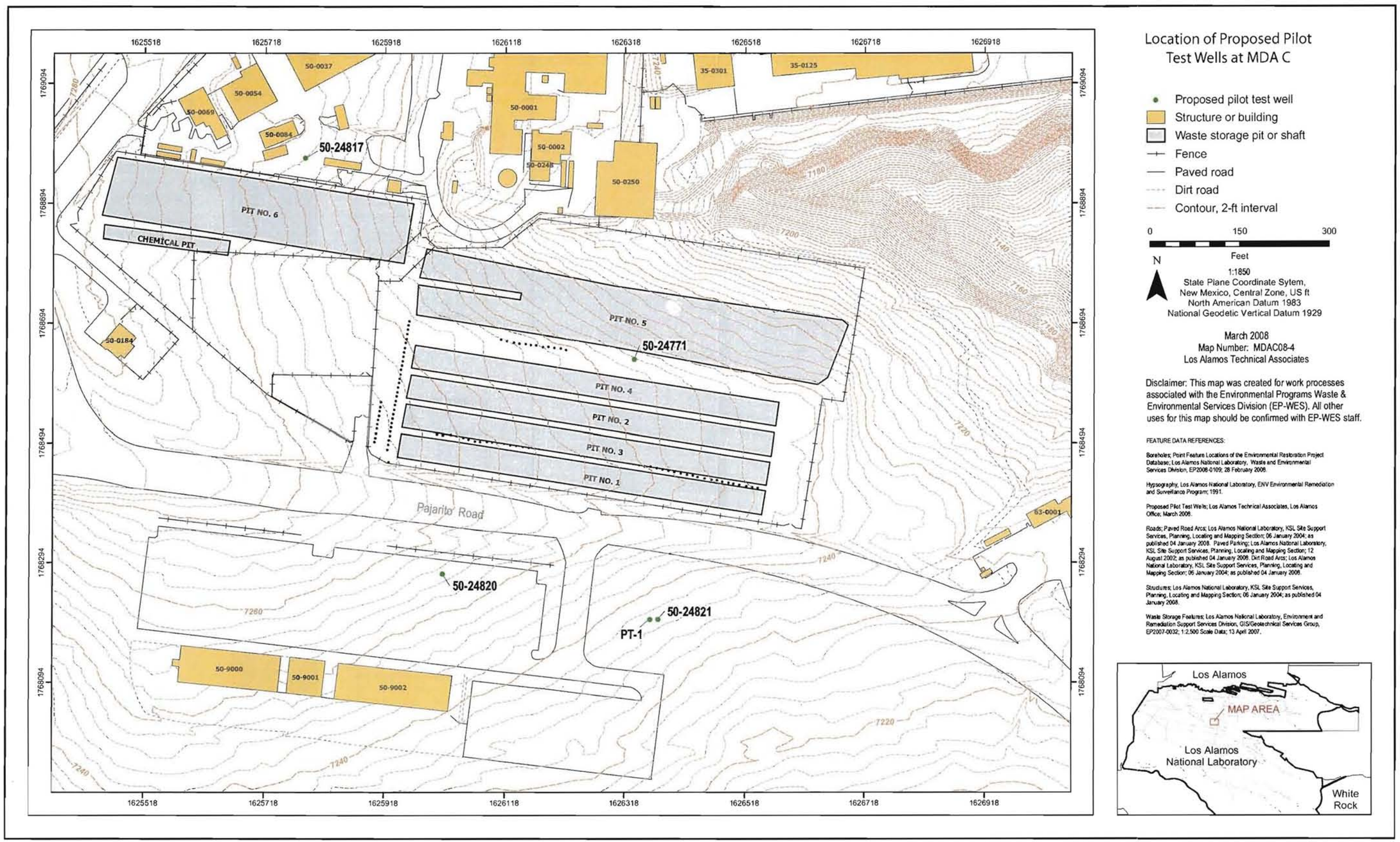

Figure 1 Proposed pilot test borehole locations at MDA C

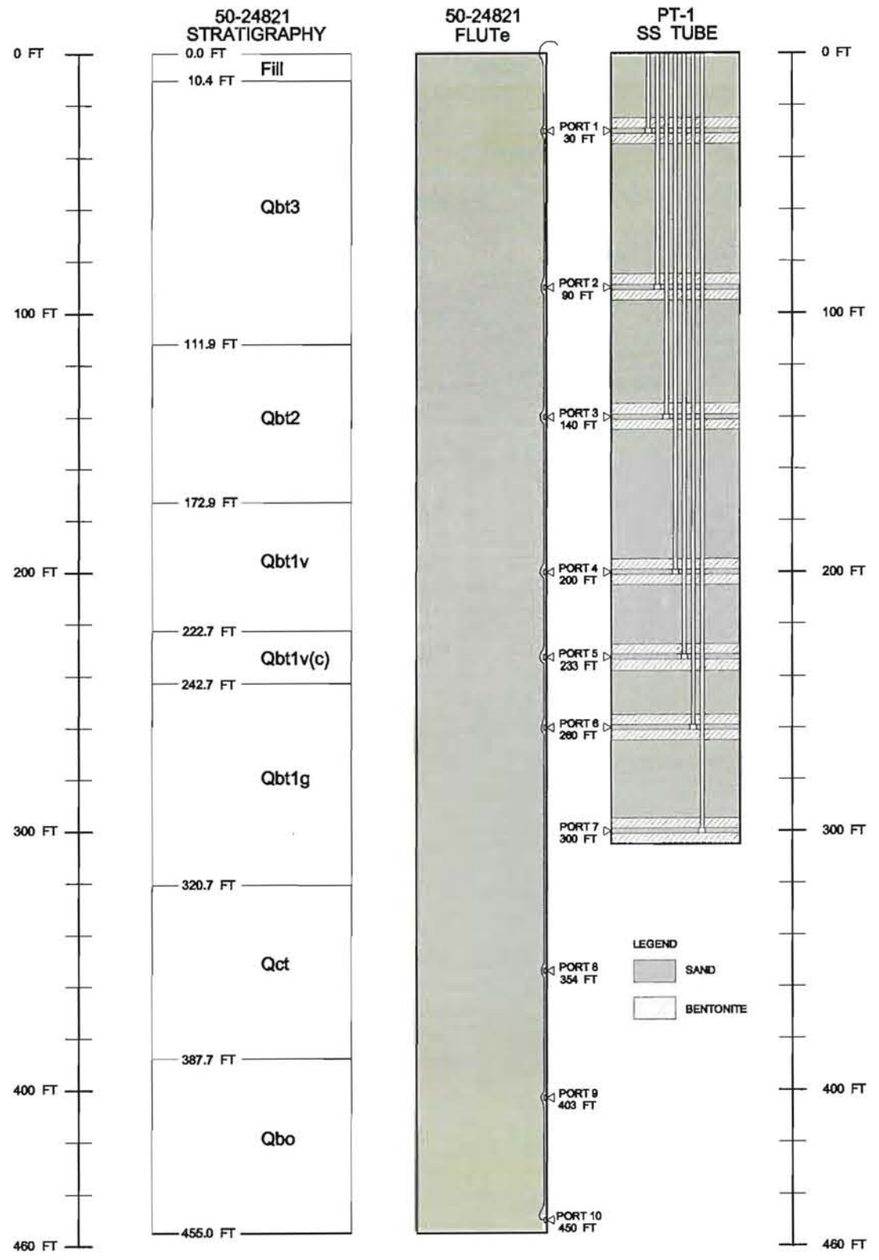

Figure 2 Proposed designs for FLUTe and stainless-steel vapor-sampling systems in pilot test boreholes 50-24821 and PT-1 at MDA C

ID	Task Name	Duration	Start	Finish	Predecessors
1	**MDA C Pilot Test**	**68 days**	**Mar 21 '08**	**Jun 25 '08**	
2	**Drill Boreholes**	**40 days**	**Mar 21 '08**	**May 15 '08**	
3	**Sampling Rig**	**1 day**	**Mar 21 '08**	**Mar 21 '08**	
4	**Collect Packer System Samples**	**1 day**	**Mar 21 '08**	**Mar 21 '08**	
5	50-24817	1 day	Mar 21 '08	Mar 21 '08	
6	**Auger Rig**	**22 days**	**Mar 24 '08**	**Apr 22 '08**	
7	**Drill New Borehole (0-300 ft)**	**18 days**	**Mar 24 '08**	**Apr 16 '08**	
8	PT-1	3 days	Mar 24 '08	Mar 26 '08	5
9	Collect Packer System Samples	3 days	Mar 27 '08	Mar 31 '08	8
10	Install Stainless-Steel System	12 days	Apr 1 '08	Apr 16 '08	9
11	**Drill Existing Boreholes (150-300 ft)**	**4 days**	**Apr 17 '08**	**Apr 22 '08**	
12	50-24771	2 days	Apr 17 '08	Apr 18 '08	10
13	Collect Packer System Samples	2 days	Apr 21 '08	Apr 22 '08	12
14	**Air-Rotary Rig 1**	**39 days**	**Mar 24 '08**	**May 15 '08**	
15	**Drill (300-450 ft)**	**34 days**	**Mar 24 '08**	**May 8 '08**	
16	50-24817	8 days	Mar 24 '08	Apr 2 '08	5
17	50-24821	8 days	Apr 10 '08	Apr 21 '08	25
18	50-24771	8 days	Apr 29 '08	May 8 '08	26
19	**Manufacture FLUTE System**	**28 days**	**Apr 3 '08**	**May 12 '08**	
20	50-24817	2 days	Apr 3 '08	Apr 4 '08	16
21	50-24821	2 days	Apr 22 '08	Apr 23 '08	17
22	50-24771	2 days	May 9 '08	May 12 '08	18
23	**Install FLUTE System**	**39 days**	**Mar 24 '08**	**May 15 '08**	
24	50-24820	3 days	Mar 24 '08	Mar 26 '08	8SS
25	50-24817	3 days	Apr 7 '08	Apr 9 '08	20
26	50-24821	3 days	Apr 24 '08	Apr 28 '08	21
27	50-24771	3 days	May 13 '08	May 15 '08	22
28	**Collect Vapor Samples**	**37 days**	**Mar 27 '08**	**May 16 '08**	
29	PT-1	2 days	Apr 17 '08	Apr 18 '08	10
30	50-24820	1 day	Mar 27 '08	Mar 27 '08	24
31	50-24817	1 day	Apr 10 '08	Apr 10 '08	25
32	50-24821	2 days	Apr 29 '08	Apr 30 '08	26
33	50-24771	1 day	May 16 '08	May 16 '08	27
34	**Waste Management**	**54 days**	**Mar 24 '08**	**Jun 6 '08**	**8SS**
35	**Pilot Test Field Activities Completed**	**0 days**	**Jun 6 '08**	**Jun 6 '08**	34
36	**Lab Analysis of Samples**	**47 days**	**Mar 24 '08**	**May 28 '08**	
37	**Packer System Samples**	**37 days**	**Mar 24 '08**	**May 13 '08**	
38	50-24817	15 days	Mar 24 '08	Apr 11 '08	5
39	PT-1	15 days	Apr 1 '08	Apr 21 '08	9
40	50-24771	15 days	Apr 23 '08	May 13 '08	13
41	**Stainless-Steel System Samples**	**15 days**	**Apr 21 '08**	**May 9 '08**	
42	PT-1	15 days	Apr 21 '08	May 9 '08	29
43	**Flute System Samples**	**43 days**	**Mar 28 '08**	**May 28 '08**	
44	50-24820	15 days	Mar 28 '08	Apr 17 '08	30
45	50-24817	15 days	Apr 11 '08	May 1 '08	31
46	50-24821	15 days	May 1 '08	May 21 '08	32
47	50-24771	7 days	May 19 '08	May 28 '08	33
48	**MDA C Pilot Test Report**	**52 days**	**Apr 14 '08**	**Jun 25 '08**	
49	**Data Analysis and Assessment**	**37 days**	**Apr 14 '08**	**Jun 4 '08**	**36SS+15 days**
50	**Prepare MDA C Pilot Test Report**	**15 days**	**Jun 5 '08**	**Jun 25 '08**	
51	Prepare Draft Report	10 days	Jun 5 '08	Jun 18 '08	49
52	Peer Review Draft Report	3 days	Jun 19 '08	Jun 23 '08	51
53	Incorporate Peer Review Comments	2 days	Jun 24 '08	Jun 25 '08	52
54	**Submit MDA C Pilot Test Report to AA**	**0 days**	**Jun 25 '08**	**Jun 25 '08**	53

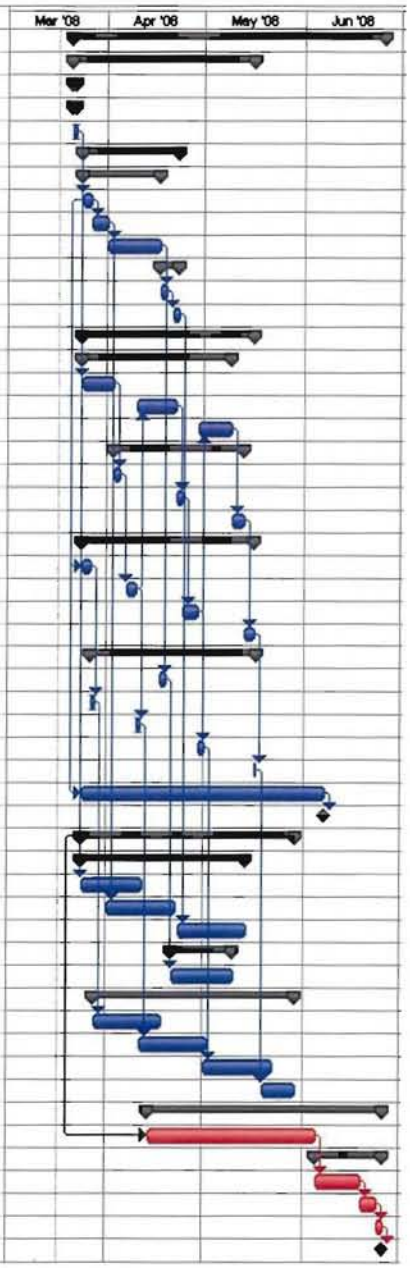

Figure 3 Proposed schedule for the MDA C pilot test and report submittal