APPENDIX A

ANALYTICAL RESULTS

Appendix A.1

SOIL GAS ANALYTICAL RESULTS SUMMARY

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR SOIL GAS SAMPLES COLLECTED IN SEPTEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-SG-01		13-SG-02		13-SG-03		13-SG-03FD*		13-SG-04		13-SG-05	
DATE SAMPLED:			09/04/2014		09/04/2014		09/04/2014		09/04/2014		09/03/2014		09/03/2014	
LAB SAMPLE ID:			P1403609-001		P1403609-002		P1403609-003		P1403609-004		P1403609-005		P1403609-006	
SAMPLE DEPTH (ft bgs):			5.0		5.0		5.0		5.0		5.0		5.0	
	Units													
Volatile Organics - TO-15														
1,1,1-Trichloroethane	µg/m3	52,143	31	U	100	U	16	U	13	U	**0.73**	**J**	**1.0**	
1,1,2,2-Tetrachloroethane	µg/m3	0.48	31	U	99	U	15	U	13	U	0.76	U	0.76	U
1,1,2-Trichloroethane	µg/m3	1.8	32	U	100	U	16	U	14	U	0.80	U	0.79	U
1,1-Dichloroethane	µg/m3	18	32	U	100	U	16	U	14	U	0.80	U	0.79	U
1,1-Dichloroethene	µg/m3	2,086	32	U	100	U	16	U	14	U	0.80	U	0.79	U
1,2,4-Trimethylbenzene	µg/m3	73	**22**	**J**	100	U	**23**		**14**	**J**	**2.8**		**2.0**	
1,2-Dichlorobenzene	µg/m3	2,086	33	U	110	U	17	U	14	U	0.82	U	0.81	U
1,2-Dichloroethane	µg/m3	1.08	32	U	100	U	16	U	14	U	0.80	U	0.79	U
1,2-Dichloropropane	µg/m3	2.8	32	U	100	U	16	U	14	U	0.80	U	0.79	U
1,3,5-Trimethylbenzene	µg/m3	NA	**32**	**J**	**48**	**J**	**26**		**16**		**1.3**		**0.77**	**J**
1,3-Dichlorobenzene	µg/m3	NA	34	U	110	U	17	U	14	U	0.84	U	0.83	U
1,4-Dichlorobenzene	µg/m3	2.6	32	U	100	U	16	U	14	U	0.80	U	0.79	U
1,4-Dioxane	µg/m3	NA	34	U	110	U	17	U	14	U	0.84	U	0.83	U
2-Butanone	µg/m3	52,143	**61**	**J**	110	U	**34**	**J**	**100**	**J**	**180**		**91**	
2-Hexanone	µg/m3	313	34	U	110	U	17	U	14	U	**48**		**18**	
4-Methyl-2-pentanone	µg/m3	31,286	33	U	110	U	17	U	14	U	**9.3**		**2.0**	
Acetone	µg/m3	323,286	**760**	**J**	520	U	**310**	**J**	**1,400**	**J**	**2,300**	**J**	**1,200**	**J**
Benzene	µg/m3	3.6	**13**	**J**	**160**		17	U	14	U	**24**		**1.9**	
Bromomethane	µg/m3	52	30	U	97	U	15	U	13	U	0.74	U	0.74	U
Carbon disulfide	µg/m3	7,300	30	U	97	U	15	U	13	U	**17**		**1.8**	**J**
Carbon tetrachloride	µg/m3	4.7	32	U	100	U	16	U	14	U	**1.5**		**1.1**	
Chlorobenzene	µg/m3	521	33	U	110	U	17	U	14	U	0.82	U	0.81	U
Chloroethane	µg/m3	104,286	30	U	97	U	15	U	13	U	0.74	U	**0.51**	**J**
Chloroform	µg/m3	1.2	32	U	100	U	16	U	14	U	**50**		**960**	
Chloromethane	µg/m3	939	29	U	94	U	15	U	12	U	0.72	U	0.72	U
cis-1,2-Dichloroethene	µg/m3	NA	33	U	110	U	17	U	14	U	**0.54**	**J**	**0.40**	**J**
Cumene	µg/m3	4,171	31	U	99	U	15	U	13	U	**0.75**	**J**	0.76	U
Cyclohexane	µg/m3	62,571	**38**	**J**	**1,100**		32	U	27	U	**2.7**		1.5	U
Dichlorodifluoromethane	µg/m3	1,043	31	U	99	U	15	U	13	U	**2.0**		**3.4**	
Ethylbenzene	µg/m3	11	33	U	110	U	17	U	14	U	**19**		**5.0**	
Hexachlorobutadiene	µg/m3	NA	34	U	110	U	17	U	14	U	0.84	U	0.83	U
m,p-Xylene	µg/m3	1,000	65	U	210	U	**15**	**J**	**14**	**J**	**81**		**17**	
Methyl tert-butyl ether	µg/m3	108	32	U	100	U	16	U	14	U	**0.45**	**J**	0.79	U
Methylene chloride	µg/m3	1,014	31	U	99	U	15	U	**5.9**	**J**	**0.89**	**J**	**1.2**	
Naphthalene	µg/m3	0.83	31	U	100	U	16	U	13	U	0.78	U	0.77	U
n-Propylbenzene	µg/m3	10,429	31	U	99	U	15	U	13	U	**0.98**		**0.42**	**J**

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR SOIL GAS SAMPLES COLLECTED IN SEPTEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID: DATE SAMPLED: LAB SAMPLE ID: SAMPLE DEPTH (ft bgs):	Units	PROJECT ACTION LIMIT[1]	13-SG-01 09/04/2014 P1403609-001 5.0		13-SG-02 09/04/2014 P1403609-002 5.0		13-SG-03 09/04/2014 P1403609-003 5.0		13-SG-03FD* 09/04/2014 P1403609-004 5.0		13-SG-04 09/03/2014 P1403609-005 5.0		13-SG-05 09/03/2014 P1403609-006 5.0	
Volatile Organics - TO-15														
o-Xylene	µg/m3	1,043	31	U	100	U	**6.7**	**J**	**5.9**	**J**	**21**		**6.2**	
Styrene	µg/m3	10,429	34	U	110	U	17	U	14	U	**2.7**		**0.77**	**J**
Tetrachloroethene	µg/m3	108	30	U	97	U	15	U	13	U	**18**		**2.7**	
Toluene	µg/m3	52,143	32	U	100	U	**7.2**	**J**	**15**	**J**	**160**	**J**	**8.9**	**J**
trans-1,2-Dichloroethene	µg/m3	NA	32	U	100	U	16	U	14	U	0.80	U	0.79	U
Trichloroethene	µg/m3	4.8	32	U	100	U	16	U	14	U	**2.2**		**1.1**	
Trichlorofluoromethane	µg/m3	7,300	31	U	99	U	15	U	13	U	**9.2**		**180**	
Vinyl chloride	µg/m3	1.7	30	U	97	U	15	U	13	U	0.74	U	0.74	U

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.

U - Analyte was analyzed for but not detected above the limit of detection (LOD).

J - Analyte detected, estimated concentration.

* - Field duplicate of sample on left.

Detections are bolded.

NOTES:

[1] Project Action Limits are the USEPA Vapor Intrusion Screening Levels (VISLs) Version 3.3, based on May 2014 residential RSLs.

NA - Limit not available.

ft bgs - Feet below ground surface.

Appendix A.2

SOIL SAMPLING ANALYTICAL RESULTS SUMMARY

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR SOIL SAMPLES COLLECTED IN SEPTEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-SS-01A	13-SS-01B	13-SS-01C	13-SS-02A	13-SS-02B	13-SS-02C	13-SS-03A	13-SS-03AFD*	13-SS-03B	13-SS-03C	13-SS-04A
DATE SAMPLED:			09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/08/2014
LAB SAMPLE ID:			1409491-001A	1409491-002B	1409491-003B	1409491-004A	1409491-005B	1409491-006B	1409491-007A	1409491-008A	1409491-009B	1409491-010B	1409491-011A
SAMPLE DEPTH (ft bgs):			0 - 0.5	3 - 5	13 - 15	0 - 0.5	3 - 5	12 - 14	0 - 0.5	0 - 0.5	3 - 5	8 - 10	0 - 0.5
	Units												
otal Petroleum Hydrocarbons - SW8015D													
Diesel Range Organics C10-C28	mg/Kg	5,000	1.9 U	**4.8**	2.8 U	**7.1**	2.0 U	**8,400**	**5.8 J**	**13 J**	2.0 U	**33**	**41**
Volatile Organics - SW8260C													
1,1,1,2-Tetrachloroethane	mg/Kg	2	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,1,1-Trichloroethane	mg/Kg	8,100	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,1,2,2-Tetrachloroethane	mg/Kg	0.6	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,1,2-Trichloroethane	mg/Kg	1.1	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,1-Dichloroethane	mg/Kg	3.6	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,1-Dichloroethene	mg/Kg	230	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,1-Dichloropropene	mg/Kg	NA	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,2,3-Trichlorobenzene	mg/Kg	49	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,2,3-Trichloropropane	mg/Kg	0.0051	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,2,3-Trimethylbenzene	mg/Kg	49	--	0.045 UJ	0.045 UJ	--	0.038 UJ	**11 J**	--	--	0.052 UJ	0.058 UJ	--
1,2,4-Trichlorobenzene	mg/Kg	24	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,2,4-Trimethylbenzene	mg/Kg	58	--	0.045 U	0.045 U	--	0.038 U	**39**	--	--	0.052 U	0.058 U	--
1,2-Dibromo-3-chloropropane	mg/Kg	0.0053	--	0.076 U	0.076 U	--	0.064 U	0.093 U	--	--	0.086 U	0.096 U	--
1,2-Dibromoethane	mg/Kg	0.036	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,2-Dichlorobenzene	mg/Kg	1,800	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,2-Dichloroethane	mg/Kg	0.46	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,2-Dichloropropane	mg/Kg	1	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,3,5-Trimethylbenzene	mg/Kg	780	--	0.045 U	0.045 U	--	0.038 U	**14 J+**	--	--	0.052 U	0.058 U	--
1,3-Dichlorobenzene	mg/Kg	NA	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,3-Dichloropropane	mg/Kg	1,600	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
1,4-Dichlorobenzene	mg/Kg	2.6	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
2,2-Dichloropropane	mg/Kg	NA	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
2-Butanone	mg/Kg	27,000	--	0.38 U	0.38 U	--	0.32 U	0.46 U	--	--	0.43 U	0.48 U	--
2-Chlorotoluene	mg/Kg	1,600	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
2-Hexanone	mg/Kg	200	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
4-Chlorotoluene	mg/Kg	1,600	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
4-Isopropyltoluene	mg/Kg	NA	--	0.045 U	0.045 U	--	0.038 U	**2.3 J+**	--	--	0.052 U	0.058 U	--
4-Methyl-2-pentanone (MIBK)	mg/Kg	5,300	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Acetone	mg/Kg	61,000	--	0.30 U	0.30 U	--	0.26 U	0.37 U	--	--	0.35 U	0.38 U	--
Benzene	mg/Kg	1.2	--	0.045 U	0.045 U	--	0.038 U	**0.49**	--	--	0.052 U	0.058 U	--
Bromobenzene	mg/Kg	290	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Bromochloromethane	mg/Kg	150	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Bromodichloromethane	mg/Kg	0.29	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Bromoform	mg/Kg	67	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Bromomethane	mg/Kg	6.8	--	0.30 U	0.30 U	--	0.26 U	0.37 U	--	--	0.35 U	0.38 U	--
Carbon disulfide	mg/Kg	770	--	0.045 U	0.045 U	--	0.038 U	**0.37 J+**	--	--	0.052 U	0.058 U	--
Carbon tetrachloride	mg/Kg	0.65	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Chlorobenzene	mg/Kg	280	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Chloroethane	mg/Kg	14,000	--	0.30 U	0.30 U	--	0.26 U	0.37 U	--	--	0.35 U	0.38 U	--
Chloroform	mg/Kg	0.32	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Chloromethane	mg/Kg	110	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
cis-1,2-Dichloroethene	mg/Kg	160	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR SOIL SAMPLES COLLECTED IN SEPTEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-SS-04B		13-SS-04C		13-SS-05A		13-SS-05B		13-SS-05BFD*		13-SS-05C		13-SS-06A		13-SS-06B		13-SS-06C		13-SS-07A		13-SS-07B	
DATE SAMPLED:			09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014	
LAB SAMPLE ID:			1409491-012B		1409491-013B		1409491-014A		1409491-015B		1409491-016B		1409491-017B		1409491-018A		1409491-019B		1409491-020B		1409492-001A		1409492-002B	
SAMPLE DEPTH (ft bgs):			5 - 7		14 - 15		0 - 0.5		3 - 5		3 - 5		11 - 13		0 - 0.5		4 - 6		9 - 11		0 - 0.5		9 - 11	
	Units																							
otal Petroleum Hydrocarbons - SW8015D																								
Diesel Range Organics C10-C28	mg/Kg	5,000	**3.4**		**55**		**34**		2.6	U	2.2	U	**2,100**		1.7	U	**33**		**860**		**9.1**		**1,400**	
Volatile Organics - SW8260C																								
1,1,1,2-Tetrachloroethane	mg/Kg	2	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,1,1-Trichloroethane	mg/Kg	8,100	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,1,2,2-Tetrachloroethane	mg/Kg	0.6	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,1,2-Trichloroethane	mg/Kg	1.1	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,1-Dichloroethane	mg/Kg	3.6	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,1-Dichloroethene	mg/Kg	230	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,1-Dichloropropene	mg/Kg	NA	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,2,3-Trichlorobenzene	mg/Kg	49	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,2,3-Trichloropropane	mg/Kg	0.0051	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,2,3-Trimethylbenzene	mg/Kg	49	0.052	UJ	**0.022**	**J**	--		0.051	UJ	0.042	UJ	0.054	UJ	--		0.049	UJ	**0.064**	**J**	--		**0.44**	**J**
1,2,4-Trichlorobenzene	mg/Kg	24	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,2,4-Trimethylbenzene	mg/Kg	58	0.052	U	**0.059**	**J**	--		0.051	U	0.042	U	**1.2**		--		0.049	U	**0.13**		--		**4.5**	
1,2-Dibromo-3-chloropropane	mg/Kg	0.0053	0.087	U	0.088	U	--		0.086	U	0.070	U	0.090	U	--		0.082	U	0.095	U	--		0.097	U
1,2-Dibromoethane	mg/Kg	0.036	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,2-Dichlorobenzene	mg/Kg	1,800	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,2-Dichloroethane	mg/Kg	0.46	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,2-Dichloropropane	mg/Kg	1	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,3,5-Trimethylbenzene	mg/Kg	780	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		**2.0**	
1,3-Dichlorobenzene	mg/Kg	NA	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,3-Dichloropropane	mg/Kg	1,600	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
1,4-Dichlorobenzene	mg/Kg	2.6	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
2,2-Dichloropropane	mg/Kg	NA	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
2-Butanone	mg/Kg	27,000	0.43	U	0.44	U	--		0.43	U	0.35	U	0.45	U	--		0.41	U	0.47	U	--		**0.12**	**J**
2-Chlorotoluene	mg/Kg	1,600	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
2-Hexanone	mg/Kg	200	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
4-Chlorotoluene	mg/Kg	1,600	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
4-Isopropyltoluene	mg/Kg	NA	0.052	U	0.053	U	--		0.051	U	0.042	U	**0.35**		--		0.049	U	**0.082**	**J**	--		**0.74**	
4-Methyl-2-pentanone (MIBK)	mg/Kg	5,300	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Acetone	mg/Kg	61,000	0.35	U	0.35	U	--		0.34	U	0.28	U	0.36	U	--		0.33	U	0.38	U	--		0.48	U
Benzene	mg/Kg	1.2	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		**0.035**	**J**
Bromobenzene	mg/Kg	290	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Bromochloromethane	mg/Kg	150	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Bromodichloromethane	mg/Kg	0.29	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Bromoform	mg/Kg	67	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Bromomethane	mg/Kg	6.8	0.35	U	0.35	U	--		0.34	U	0.28	U	0.36	U	--		0.33	U	0.38	U	--		0.39	U
Carbon disulfide	mg/Kg	770	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		**0.43**	
Carbon tetrachloride	mg/Kg	0.65	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Chlorobenzene	mg/Kg	280	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Chloroethane	mg/Kg	14,000	0.35	U	0.35	U	--		0.34	U	0.28	U	0.36	U	--		0.33	U	0.38	U	--		0.39	U
Chloroform	mg/Kg	0.32	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Chloromethane	mg/Kg	110	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
cis-1,2-Dichloroethene	mg/Kg	160	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR SOIL SAMPLES COLLECTED IN SEPTEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID: DATE SAMPLED: LAB SAMPLE ID: SAMPLE DEPTH (ft bgs):	Units	PROJECT ACTION LIMIT[1]	13-SS-07C 09/08/2014 1409492-003B 12 - 14		13-SS-07CFD* 09/08/2014 1409492-004B 12 - 14		13-SS-08A 09/08/2014 1409492-005A 0 - 0.5		13-SS-08B 09/08/2014 1409492-006B 3 - 5		13-SS-08C 09/08/2014 1409492-007B 10 - 12		13-SS-09A 09/08/2014 1409492-008A 0 - 0.5		13-SS-09B 09/08/2014 1409492-009B 3 - 5		13-SS-09C 09/08/2014 1409492-010B 12 - 14	
otal Petroleum Hydrocarbons - SW8015D																		
Diesel Range Organics C10-C28	mg/Kg	5,000	**1,000**		**1,300**		**10**		**600**		**1,700**		**2.7**		2.6	U	**2,100**	
Volatile Organics - SW8260C																		
1,1,1,2-Tetrachloroethane	mg/Kg	2	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,1,1-Trichloroethane	mg/Kg	8,100	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,1,2,2-Tetrachloroethane	mg/Kg	0.6	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,1,2-Trichloroethane	mg/Kg	1.1	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,1-Dichloroethane	mg/Kg	3.6	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,1-Dichloroethene	mg/Kg	230	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,1-Dichloropropene	mg/Kg	NA	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,2,3-Trichlorobenzene	mg/Kg	49	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,2,3-Trichloropropane	mg/Kg	0.0051	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,2,3-Trimethylbenzene	mg/Kg	49	0.059	UJ	0.055	UJ	--		0.052	UJ	**0.30**	**J**	--		0.033	UJ	**0.27**	**J**
1,2,4-Trichlorobenzene	mg/Kg	24	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,2,4-Trimethylbenzene	mg/Kg	58	**0.14**		**0.10**		--		0.052	U	0.053	U	--		0.033	U	**0.023**	**J**
1,2-Dibromo-3-chloropropane	mg/Kg	0.0053	0.098	U	0.092	U	--		0.086	U	0.089	U	--		0.055	U	0.092	U
1,2-Dibromoethane	mg/Kg	0.036	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,2-Dichlorobenzene	mg/Kg	1,800	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,2-Dichloroethane	mg/Kg	0.46	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,2-Dichloropropane	mg/Kg	1	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,3,5-Trimethylbenzene	mg/Kg	780	**2.3**	**J**	**1.3**	**J**	--		0.052	U	**0.090**		--		0.033	U	0.055	U
1,3-Dichlorobenzene	mg/Kg	NA	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,3-Dichloropropane	mg/Kg	1,600	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
1,4-Dichlorobenzene	mg/Kg	2.6	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
2,2-Dichloropropane	mg/Kg	NA	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
2-Butanone	mg/Kg	27,000	0.49	U	0.46	U	--		0.43	U	0.44	U	--		0.27	U	0.46	U
2-Chlorotoluene	mg/Kg	1,600	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
2-Hexanone	mg/Kg	200	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
4-Chlorotoluene	mg/Kg	1,600	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
4-Isopropyltoluene	mg/Kg	NA	**1.2**		**0.87**		--		**0.026**	**J**	**0.13**		--		0.033	U	0.055	U
4-Methyl-2-pentanone (MIBK)	mg/Kg	5,300	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Acetone	mg/Kg	61,000	0.39	U	0.37	U	--		0.34	U	0.36	U	--		0.27	U	0.37	U
Benzene	mg/Kg	1.2	**0.097**		**0.079**		--		0.052	U	0.053	U	--		0.033	U	0.055	U
Bromobenzene	mg/Kg	290	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Bromochloromethane	mg/Kg	150	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Bromodichloromethane	mg/Kg	0.29	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Bromoform	mg/Kg	67	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Bromomethane	mg/Kg	6.8	0.39	U	0.37	U	--		0.34	U	0.36	U	--		0.22	U	0.37	U
Carbon disulfide	mg/Kg	770	**0.25**	**J**	**0.46**	**J**	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Carbon tetrachloride	mg/Kg	0.65	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Chlorobenzene	mg/Kg	280	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Chloroethane	mg/Kg	14,000	0.39	U	0.37	U	--		0.34	U	0.36	U	--		0.22	U	0.37	U
Chloroform	mg/Kg	0.32	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Chloromethane	mg/Kg	110	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
cis-1,2-Dichloroethene	mg/Kg	160	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR SOIL SAMPLES COLLECTED IN SEPTEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-SS-01A	13-SS-01B	13-SS-01C	13-SS-02A	13-SS-02B	13-SS-02C	13-SS-03A	13-SS-03AFD*	13-SS-03B	13-SS-03C	13-SS-04A
DATE SAMPLED:			09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/09/2014	09/08/2014
LAB SAMPLE ID:			1409491-001A	1409491-002B	1409491-003B	1409491-004A	1409491-005B	1409491-006B	1409491-007A	1409491-008A	1409491-009B	1409491-010B	1409491-011A
SAMPLE DEPTH (ft bgs):			0 - 0.5	3 - 5	13 - 15	0 - 0.5	3 - 5	12 - 14	0 - 0.5	0 - 0.5	3 - 5	8 - 10	0 - 0.5
	Units												
cis-1,3-Dichloropropene	mg/Kg	1.8	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Cyclohexane	mg/Kg	6,500	--	0.076 U	0.075 U	--	0.064 U	**1.3**	--	--	0.086 U	0.096 U	--
Dibromochloromethane	mg/Kg	0.73	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Dibromomethane	mg/Kg	23	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Dichlorodifluoromethane	mg/Kg	87	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Ethylbenzene	mg/Kg	5.8	--	0.045 U	0.045 U	--	0.038 U	**3.5**	--	--	0.052 U	0.058 U	--
Hexachlorobutadiene	mg/Kg	6.8	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Isopropylbenzene	mg/Kg	1,900	--	0.045 U	0.045 U	--	0.038 U	**1.6**	--	--	0.052 U	0.058 U	--
m,p-Xylene	mg/Kg	550	--	0.091 U	0.090 U	--	0.076 U	**13**	--	--	0.10 U	0.12 U	--
Methyl tert-butyl ether	mg/Kg	47	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Methylene chloride	mg/Kg	57	--	0.15 U	0.15 U	--	0.13 U	0.19 U	--	--	0.17 U	0.19 U	--
Naphthalene	mg/Kg	3.8	--	0.045 U	0.045 U	--	0.038 U	**29**	--	--	0.052 U	0.058 U	--
n-Butylbenzene	mg/Kg	3,900	--	0.045 U	0.045 U	--	0.038 U	**3.0 J+**	--	--	0.052 U	0.058 U	--
n-Propylbenzene	mg/Kg	3,300	--	0.045 U	0.045 U	--	0.038 U	**4.2 J+**	--	--	0.052 U	0.058 U	--
o-Xylene	mg/Kg	650	--	0.045 U	0.045 U	--	0.038 U	**1.8**	--	--	0.052 U	0.058 U	--
sec-Butylbenzene	mg/Kg	7,800	--	0.045 U	0.045 U	--	0.038 U	**2.1 J+**	--	--	0.052 U	0.058 U	--
Styrene	mg/Kg	6,000	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
tert-Butylbenzene	mg/Kg	7,800	--	0.045 U	0.045 U	--	0.038 U	**0.54 J+**	--	--	0.052 U	0.058 U	--
Tetrachloroethene	mg/Kg	24	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Toluene	mg/Kg	4,900	--	0.045 U	0.045 U	--	0.038 U	**0.062 J**	--	--	0.052 U	0.058 U	--
trans-1,2-Dichloroethene	mg/Kg	1,600	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
trans-1,3-Dichloropropene	mg/Kg	1.8	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Trichloroethene	mg/Kg	0.94	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Trichlorofluoromethane	mg/Kg	730	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Vinyl chloride	mg/Kg	0.059	--	0.045 U	0.045 U	--	0.038 U	0.056 U	--	--	0.052 U	0.058 U	--
Percent Moisture													
Percent Moisture	%	NA	**7.1**	**21**	**21**	**11**	**8.1**	**25**	**15**	**11**	**20**	**24**	**7.4**

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.
U - Analyte was analyzed for but not detected above the limit of detection (LOD).
UJ - Analyte not detected, reported LOD may be inaccurate or imprecise.
J - Analyte detected, estimated concentration.
J+ - Analyte detected, estimated concentration with a high bias.
* - Field duplicate of sample on left.
Detections are bolded.
Detections above the PAL are highlighted.

NOTES:

[1] For VOCs, Project Action Limits are the USEPA (May 2014) RSLs for residential soil, using a target risk of 1 x 10^{-6} and a target HQ of 1.0. For DRO, Project Action Limit is the State of Utah LUST Tier 1 screening level, used only as a guideline for defining extent of DRO contamination.

NA - Limit not available.
ft bgs - Feet below ground surface.
-- - Analyte not tested.

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR SOIL SAMPLES COLLECTED IN SEPTEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-SS-04B		13-SS-04C		13-SS-05A		13-SS-05B		13-SS-05BFD*		13-SS-05C		13-SS-06A		13-SS-06B		13-SS-06C		13-SS-07A		13-SS-07B	
DATE SAMPLED:			09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014	
LAB SAMPLE ID:			1409491-012B		1409491-013B		1409491-014A		1409491-015B		1409491-016B		1409491-017B		1409491-018A		1409491-019B		1409491-020B		1409492-001A		1409492-002B	
SAMPLE DEPTH (ft bgs):			5 - 7		14 - 15		0 - 0.5		3 - 5		3 - 5		11 - 13		0 - 0.5		4 - 6		9 - 11		0 - 0.5		9 - 11	
	Units																							
cis-1,3-Dichloropropene	mg/Kg	1.8	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Cyclohexane	mg/Kg	6,500	0.087	U	0.088	U	--		0.086	U	0.070	U	0.090	U	--		0.082	U	0.095	U	--		0.097	U
Dibromochloromethane	mg/Kg	0.73	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Dibromomethane	mg/Kg	23	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Dichlorodifluoromethane	mg/Kg	87	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Ethylbenzene	mg/Kg	5.8	0.052	U	0.053	U	--		0.051	U	0.042	U	**0.43**		--		0.049	U	**0.031**	**J**	--		**0.60**	
Hexachlorobutadiene	mg/Kg	6.8	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Isopropylbenzene	mg/Kg	1,900	0.052	U	0.053	U	--		0.051	U	0.042	U	**0.26**		--		0.049	U	**0.037**	**J**	--		**0.31**	
m,p-Xylene	mg/Kg	550	0.10	U	0.10	U	--		0.10	U	0.084	U	**0.042**	**J**	--		0.098	U	0.11	U	--		**0.064**	**J**
Methyl tert-butyl ether	mg/Kg	47	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Methylene chloride	mg/Kg	57	0.17	U	0.18	U	--		0.17	U	0.14	U	0.18	U	--		0.16	U	0.19	U	--		0.19	U
Naphthalene	mg/Kg	3.8	0.052	U	**0.11**	**J**	--		0.051	U	0.042	U	**1.5**		--		0.049	U	**0.46**	**J**	--		**6.4**	
n-Butylbenzene	mg/Kg	3,900	0.052	U	**0.044**	**J**	--		0.051	U	0.042	U	**0.89**		--		0.049	U	0.057	U	--		0.058	U
n-Propylbenzene	mg/Kg	3,300	0.052	U	0.053	U	--		0.051	U	0.042	U	**0.79**		--		0.049	U	**0.080**	**J**	--		**0.76**	
o-Xylene	mg/Kg	650	0.052	U	0.053	U	--		0.051	U	0.042	U	**0.070**	**J**	--		0.049	U	0.057	U	--		**0.049**	**J**
sec-Butylbenzene	mg/Kg	7,800	0.052	U	0.053	U	--		0.051	U	0.042	U	**0.42**		--		0.049	U	**0.073**	**J**	--		**0.53**	
Styrene	mg/Kg	6,000	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
tert-Butylbenzene	mg/Kg	7,800	0.052	U	0.053	U	--		0.051	U	0.042	U	**0.20**		--		0.049	U	**0.031**	**J**	--		**0.30**	
Tetrachloroethene	mg/Kg	24	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Toluene	mg/Kg	4,900	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
trans-1,2-Dichloroethene	mg/Kg	1,600	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
trans-1,3-Dichloropropene	mg/Kg	1.8	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Trichloroethene	mg/Kg	0.94	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Trichlorofluoromethane	mg/Kg	730	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Vinyl chloride	mg/Kg	0.059	0.052	U	0.053	U	--		0.051	U	0.042	U	0.054	U	--		0.049	U	0.057	U	--		0.058	U
Percent Moisture																								
Percent Moisture	%	NA	**18**		**19**		**7.3**		**20**		**20**		**19**		**6.3**		**19**		**21**		**6.9**		**23**	

QA NOTES AND DATA QUALIFIERS:

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* - Field duplicate of sample on left.
Detections are bolded.
Detections above the PAL are highlighted.

NOTES:

[1] For VOCs, Project Action Limits are the USEPA (May 2014) RSLs for residential soil, using a target risk of 1 x 10^{-6} and a target HQ of 1.0. For DRO, Project Action Limit is the State of Utah LUST Tier 1 screening level, used only as a guideline for defining extent of DRO contamination.

NA - Limit not available.
ft bgs - Feet below ground surface.
-- - Analyte not tested.

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR SOIL SAMPLES COLLECTED IN SEPTEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-SS-07C		13-SS-07CFD*		13-SS-08A		13-SS-08B		13-SS-08C		13-SS-09A		13-SS-09B		13-SS-09C	
DATE SAMPLED:			09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014		09/08/2014	
LAB SAMPLE ID:			1409492-003B		1409492-004B		1409492-005A		1409492-006B		1409492-007B		1409492-008A		1409492-009B		1409492-010B	
SAMPLE DEPTH (ft bgs):			12 - 14		12 - 14		0 - 0.5		3 - 5		10 - 12		0 - 0.5		3 - 5		12 - 14	
	Units																	
cis-1,3-Dichloropropene	mg/Kg	1.8	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Cyclohexane	mg/Kg	6,500	0.098	U	0.092	U	--		0.086	U	**0.60**		--		0.055	U	**0.11**	**J-**
Dibromochloromethane	mg/Kg	0.73	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Dibromomethane	mg/Kg	23	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Dichlorodifluoromethane	mg/Kg	87	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Ethylbenzene	mg/Kg	5.8	**1.2**		**0.83**		--		0.052	U	0.053	U	--		0.033	U	0.055	U
Hexachlorobutadiene	mg/Kg	6.8	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Isopropylbenzene	mg/Kg	1,900	**0.58**		**0.41**		--		0.052	U	**0.27**		--		0.033	U	**0.047**	**J**
m,p-Xylene	mg/Kg	550	0.12	U	0.11	U	--		0.10	U	0.11	U	--		0.066	U	0.11	U
Methyl tert-butyl ether	mg/Kg	47	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Methylene chloride	mg/Kg	57	0.20	U	0.18	U	--		0.17	U	0.18	U	--		0.11	U	0.18	U
Naphthalene	mg/Kg	3.8	**7.0**		**5.1**		--		0.052	U	**2.5**		--		**0.029**	**J**	**0.97**	
n-Butylbenzene	mg/Kg	3,900	0.059	U	0.055	U	--		**0.048**	**J**	**0.65**		--		0.033	U	**0.21**	
n-Propylbenzene	mg/Kg	3,300	**1.2**		**0.88**		--		0.052	U	0.053	U	--		0.033	U	**0.059**	**J**
o-Xylene	mg/Kg	650	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
sec-Butylbenzene	mg/Kg	7,800	**1.2**		**0.84**		--		0.052	U	**0.39**		--		0.033	U	**0.44**	
Styrene	mg/Kg	6,000	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
tert-Butylbenzene	mg/Kg	7,800	**0.38**		**0.27**		--		0.052	U	**0.24**		--		0.033	U	**0.29**	
Tetrachloroethene	mg/Kg	24	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Toluene	mg/Kg	4,900	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
trans-1,2-Dichloroethene	mg/Kg	1,600	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
trans-1,3-Dichloropropene	mg/Kg	1.8	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Trichloroethene	mg/Kg	0.94	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Trichlorofluoromethane	mg/Kg	730	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	UJ
Vinyl chloride	mg/Kg	0.059	0.059	U	0.055	U	--		0.052	U	0.053	U	--		0.033	U	0.055	U
Percent Moisture																		
Percent Moisture	%	NA	**22**		**20**		**6.4**		**20**		**18**		**4.5**		**6.1**		**18**	

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.

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NOTES:

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NA - Limit not available.

ft bgs - Feet below ground surface.

-- - Analyte not tested.

Appendix A.3

GROUNDWATER SAMPLING ANALYTICAL RESULTS SUMMARY

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		**PROJECT ACTION LIMIT[1]**	**13-HPGW-01**		**13-HPGW-02**		**13-HPGW-03**		**13-HPGW-04**		**13-HPGW-05**		**13-HPGW-05FD***		**13-HPGW-06**		**13-HPGW-07**		**13-HPGW-08**		**S-25-88**	
DATE SAMPLED:			**09/18/2014**		**09/17/2014**		**09/17/2014**		**09/18/2014**		**09/17/2014**		**09/17/2014**		**09/17/2014**		**09/17/2014**		**09/17/2014**		**11/12/2014**	
LAB SAMPLE ID:	**Units**		**1409836-003B**		**1409836-004C**		**1409836-005C**		**1409836-006B**		**1409836-007C**		**1409836-008C**		**1409836-009B**		**1409836-010C**		**1409836-011B**		**1411600-002C**	
Total Petroleum Hydrocarbons - SW8015D																						
Diesel Range Organics C10-C28	µg/L	10,000	220	UJ	220	U	**230**		360	U	220	U	220	U	220	U	**1,800**	**J-**	**1,300**	**J-**	**580**	**J-**
Volatile Organics - SW8260C																						
1,1,1,2-Tetrachloroethane	µg/L	0.57	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1,1-Trichloroethane	µg/L	8,000	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1,2,2-Tetrachloroethane	µg/L	0.076	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1,2-Trichloroethane	µg/L	0.28	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloroethane	µg/L	2.7	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloroethene	µg/L	280	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloropropene	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2,3-Trichlorobenzene	µg/L	7	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2,3-Trichloropropane	µg/L	0.00075	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
1,2,3-Trimethylbenzene	µg/L	10	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**1.8**		**0.73**	**J**	0.60	U
1,2,4-Trichlorobenzene	µg/L	1.1	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2,4-Trimethylbenzene	µg/L	15	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**0.76**	**J**	0.60	U	0.60	U
1,2-Dibromo-3-chloropropane	µg/L	0.00033	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
1,2-Dibromoethane	µg/L	0.0075	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichlorobenzene	µg/L	300	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichloroethane	µg/L	0.17	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichloropropane	µg/L	0.44	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,3,5-Trimethylbenzene	µg/L	120	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**1.4**		0.60	U	0.60	U
1,3-Dichlorobenzene	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,3-Dichloropropane	µg/L	370	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,4-Dichlorobenzene	µg/L	0.48	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
2,2-Dichloropropane	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
2-Butanone	µg/L	5,600	10	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	10	U	5.0	U	5.0	U	5.0	U
2-Chlorotoluene	µg/L	240	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
2-Hexanone	µg/L	38	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
4-Chlorotoluene	µg/L	250	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
4-Isopropyltoluene	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**2.4**		0.60	U	0.60	U
4-Methyl-2-pentanone (MIBK)	µg/L	1,200	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Acetone	µg/L	14,000	110	U	10	U	10	U	15	U	10	U	10	U	15	U	10	U	4.0	U	13	U
Benzene	µg/L	0.45	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromobenzene	µg/L	62	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromochloromethane	µg/L	83	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromodichloromethane	µg/L	0.13	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromoform	µg/L	9.2	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromomethane	µg/L	7.5	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U
Carbon disulfide	µg/L	810	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Carbon tetrachloride	µg/L	0.45	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Chlorobenzene	µg/L	78	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Chloroethane	µg/L	21,000	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Chloroform	µg/L	0.22	0.60	U	0.60	U	**1.4**		0.60	U	**1.2**		**1.3**		**0.50**	**J**	0.60	U	0.60	U	0.60	U
Chloromethane	µg/L	190	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
cis-1,2-Dichloroethene	µg/L	36	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-26-88		S-29-88		S-30-88		S-55-90		S-55-90FD*		S-78-91		S-81-91		S-82-91		S-87-91		S-91-91	
DATE SAMPLED:			11/12/2014		11/12/2014		11/12/2014		11/12/2014		11/12/2014		11/12/2014		11/12/2014		11/12/2014		11/12/2014		11/12/2014	
LAB SAMPLE ID:	Units		1411600-005C		1411600-009C		1411600-014B		1411600-007B		1411600-008B		1411600-015B		1411600-017B		1411600-010C		1411600-006B		1411600-016B	
Total Petroleum Hydrocarbons - SW8015D																						
Diesel Range Organics C10-C28	µg/L	10,000	**5,200**	**J+**	**900**		**1,500**		**410**		**130**	**J**	**240**	**J-**	210	UJ	53	U	**1,000**	**J-**	**130**	**J**
Volatile Organics - SW8260C																						
1,1,1,2-Tetrachloroethane	µg/L	0.57	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1,1-Trichloroethane	µg/L	8,000	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1,2,2-Tetrachloroethane	µg/L	0.076	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1,2-Trichloroethane	µg/L	0.28	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloroethane	µg/L	2.7	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloroethene	µg/L	280	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloropropene	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2,3-Trichlorobenzene	µg/L	7	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2,3-Trichloropropane	µg/L	0.00075	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
1,2,3-Trimethylbenzene	µg/L	10	0.60	U	0.60	U	**0.47**	**J**	0.60	U	**0.28**	**J**	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2,4-Trichlorobenzene	µg/L	1.1	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2,4-Trimethylbenzene	µg/L	15	0.60	U	0.60	U	**0.86**	**J**	0.60	U	**0.39**	**J**	**0.22**	**J**	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dibromo-3-chloropropane	µg/L	0.00033	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
1,2-Dibromoethane	µg/L	0.0075	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichlorobenzene	µg/L	300	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichloroethane	µg/L	0.17	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichloropropane	µg/L	0.44	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,3,5-Trimethylbenzene	µg/L	120	0.60	U	0.60	U	**0.25**	**J**	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,3-Dichlorobenzene	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,3-Dichloropropane	µg/L	370	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
1,4-Dichlorobenzene	µg/L	0.48	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
2,2-Dichloropropane	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
2-Butanone	µg/L	5,600	**2.9**	**J**	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U
2-Chlorotoluene	µg/L	240	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
2-Hexanone	µg/L	38	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
4-Chlorotoluene	µg/L	250	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
4-Isopropyltoluene	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
4-Methyl-2-pentanone (MIBK)	µg/L	1,200	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Acetone	µg/L	14,000	12	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Benzene	µg/L	0.45	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromobenzene	µg/L	62	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromochloromethane	µg/L	83	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromodichloromethane	µg/L	0.13	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Bromoform	µg/L	9.2	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ
Bromomethane	µg/L	7.5	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U
Carbon disulfide	µg/L	810	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Carbon tetrachloride	µg/L	0.45	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Chlorobenzene	µg/L	78	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Chloroethane	µg/L	21,000	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Chloroform	µg/L	0.22	0.60	U	0.60	U	0.60	U	**1.1**		**1.1**		**0.57**	**J**	0.60	U	0.60	U	0.60	U	0.60	U
Chloromethane	µg/L	190	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
cis-1,2-Dichloroethene	µg/L	36	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-CAM-1		S-CAM-2		S13-CAM-DW1		S13-CAM-DW1	
DATE SAMPLED:			11/12/2014		11/12/2014, 11/13/2014		11/12/2014, 11/13/2014		3/31/2016, 4/1/2016	
LAB SAMPLE ID:			1411600-013C		1411600-011C, 1411662-002B		1411600-003B, -004B		1604069-001, -002	
	Units									
Total Petroleum Hydrocarbons - SW8015D										
Diesel Range Organics C10-C28	µg/L	10,000	**110,000**		**49,000**		**1,400**	**J-**	**170**	**J**
Volatile Organics - SW8260C										
1,1,1,2-Tetrachloroethane	µg/L	0.57	0.60	U	0.60	U	0.60	U	0.60	U
1,1,1-Trichloroethane	µg/L	8,000	0.60	U	0.60	U	0.60	U	0.60	U
1,1,2,2-Tetrachloroethane	µg/L	0.076	0.60	U	0.60	U	0.60	U	0.60	U
1,1,2-Trichloroethane	µg/L	0.28	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloroethane	µg/L	2.7	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloroethene	µg/L	280	0.60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloropropene	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U
1,2,3-Trichlorobenzene	µg/L	7	0.60	U	0.60	U	0.60	U	0.60	U
1,2,3-Trichloropropane	µg/L	0.00075	1.0	U	1.0	U	1.0	U	1.0	U
1,2,3-Trimethylbenzene	µg/L	10	**140**		**13**		0.60	U	0.60	U
1,2,4-Trichlorobenzene	µg/L	1.1	0.60	U	0.60	U	0.60	U	0.60	U
1,2,4-Trimethylbenzene	µg/L	15	**280**		**42**		0.60	U	0.60	U
1,2-Dibromo-3-chloropropane	µg/L	0.00033	1.0	U	1.0	U	1.0	U	1.0	U
1,2-Dibromoethane	µg/L	0.0075	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichlorobenzene	µg/L	300	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichloroethane	µg/L	0.17	0.60	U	0.60	U	0.60	U	0.60	U
1,2-Dichloropropane	µg/L	0.44	0.60	U	0.60	U	0.60	U	0.60	U
1,3,5-Trimethylbenzene	µg/L	120	**100**		**17**		0.60	U	0.60	U
1,3-Dichlorobenzene	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U
1,3-Dichloropropane	µg/L	370	0.60	U	0.60	U	0.60	U	0.60	U
1,4-Dichlorobenzene	µg/L	0.48	0.60	U	0.60	U	0.60	U	0.60	U
2,2-Dichloropropane	µg/L	NA	0.60	U	0.60	U	0.60	U	0.60	U
2-Butanone	µg/L	5,600	**16**		5.0	U	**0.99**	**J**	5.0	U
2-Chlorotoluene	µg/L	240	0.60	U	0.60	U	0.60	U	0.60	U
2-Hexanone	µg/L	38	0.60	U	0.60	U	0.60	U	0.60	U
4-Chlorotoluene	µg/L	250	1.0	U	1.0	U	1.0	U	1.0	U
4-Isopropyltoluene	µg/L	NA	**7.3**		**2.6**		0.60	U	0.60	U
4-Methyl-2-pentanone (MIBK)	µg/L	1,200	0.60	U	0.60	U	0.60	U	0.60	U
Acetone	µg/L	14,000	10	U	10	U	10	U	**3.3**	**J**
Benzene	µg/L	0.45	**15**		**3.4**		0.60	U	0.60	U
Bromobenzene	µg/L	62	0.60	U	0.60	U	0.60	U	0.60	U
Bromochloromethane	µg/L	83	0.60	U	0.60	U	0.60	U	0.60	U
Bromodichloromethane	µg/L	0.13	0.60	U	0.60	U	0.60	U	0.60	U
Bromoform	µg/L	9.2	0.60	UJ	0.60	UJ	0.60	UJ	0.60	U
Bromomethane	µg/L	7.5	4.0	U	4.0	U	4.0	U	4.0	U
Carbon disulfide	µg/L	810	0.60	U	0.60	U	0.60	U	**1.9**	
Carbon tetrachloride	µg/L	0.45	0.60	U	0.60	U	0.60	U	0.60	U
Chlorobenzene	µg/L	78	0.60	U	0.60	U	0.60	U	0.60	U
Chloroethane	µg/L	21,000	1.0	U	1.0	U	1.0	U	1.0	U
Chloroform	µg/L	0.22	0.60	U	0.60	U	0.60	U	0.60	U
Chloromethane	µg/L	190	0.60	U	0.60	U	0.60	U	0.60	U
cis-1,2-Dichloroethene	µg/L	36	0.60	U	0.60	U	0.60	U	0.60	U

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-HPGW-01		13-HPGW-02		13-HPGW-03		13-HPGW-04		13-HPGW-05		13-HPGW-05FD*		13-HPGW-06		13-HPGW-07		13-HPGW-08		S-25-88	
DATE SAMPLED:			09/18/2014		09/17/2014		09/17/2014		09/18/2014		09/17/2014		09/17/2014		09/17/2014		09/17/2014		09/17/2014		11/12/2014	
LAB SAMPLE ID:			1409836-003B		1409836-004C		1409836-005C		1409836-006B		1409836-007C		1409836-008C		1409836-009B		1409836-010C		1409836-011B		1411600-002C	
	Units																					
cis-1,3-Dichloropropene	µg/L	0.47	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Dibromochloromethane	µg/L	0.17	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Dibromomethane	µg/L	8	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Dichlorodifluoromethane	µg/L	200	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ	0.60	UJ
Ethylbenzene	µg/L	1.5	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**0.95**	**J**	0.60	U	0.60	U
Hexachlorobutadiene	µg/L	0.3	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Isopropylbenzene	µg/L	450	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**4.9**		**0.79**	**J**	0.60	U
m,p-Xylene	µg/L	190	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U	1.2	U
Methyl tert-butyl ether	µg/L	14	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Methylene chloride	µg/L	11	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U
Naphthalene	µg/L	0.17	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**87**		**5.5**		0.60	U
n-Butylbenzene	µg/L	1,000	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**1.6**		0.60	U	0.60	U
n-Propylbenzene	µg/L	660	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**2.1**		0.60	U	0.60	U
o-Xylene	µg/L	190	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
sec-Butylbenzene	µg/L	2,000	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**4.0**		**0.80**	**J**	0.60	U
Styrene	µg/L	1,200	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
tert-Butylbenzene	µg/L	690	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	**2.6**		**0.89**	**J**	0.60	U
Tetrachloroethene	µg/L	11	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Toluene	µg/L	1,100	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
trans-1,2-Dichloroethene	µg/L	360	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
trans-1,3-Dichloropropene	µg/L	0.47	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Trichloroethene	µg/L	0.49	0.60	U	0.60	U	0.60	U	**0.86**	**J**	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Trichlorofluoromethane	µg/L	1,100	0.60	U	0.60	U	**1.9**		0.60	U	**2.6**		**3.0**		0.60	U	0.60	U	0.60	U	0.60	U
Vinyl chloride	µg/L	0.019	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U	0.60	U
Polynuclear Aromatic Hydrocarbons - SW8270D-LL																						
2-Methylnaphthalene	µg/L	36	--		0.16	U	0.16	U	--		**0.34**	**J**	**0.92**	**J**	--		**41**		--		0.15	U
Acenaphthene	µg/L	530	--		0.16	U	0.16	U	--		**0.097**	**J**	**0.23**		--		0.16	U	--		0.15	U
Acenaphthylene	µg/L	NA	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Anthracene	µg/L	1,800	--		0.16	U	0.16	U	--		0.16	UJ	0.17	U	--		0.16	U	--		0.15	U
Benzo(a)anthracene	µg/L	0.034	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Benzo(a)pyrene	µg/L	0.0034	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Benzo(b)fluoranthene	µg/L	0.034	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Benzo(g,h,i)perylene	µg/L	NA	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Benzo(k)fluoranthene	µg/L	0.34	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Chrysene	µg/L	3.4	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Dibenz(a,h)anthracene	µg/L	0.0034	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Fluoranthene	µg/L	800	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Fluorene	µg/L	290	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Indeno(1,2,3-cd)pyrene	µg/L	0.034	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Naphthalene	µg/L	0.17	--		0.16	U	0.16	U	--		0.16	UJ	**0.63**	**J**	--		**29**		--		0.15	U
Phenanthrene	µg/L	NA	--		0.16	U	0.16	U	--		**0.25**	**J**	**0.64**	**J**	--		**8.4**		--		0.15	U
Pyrene	µg/L	120	--		0.16	U	0.16	U	--		0.16	U	0.17	U	--		0.16	U	--		0.15	U
Semi-Volatile Organics - SW8270D																						
1,2,4-Trichlorobenzene	µg/L	1.1	--		--		--		--		--		--		--		--		--		--	
2,4,5-Trichlorophenol	µg/L	1,200	--		--		--		--		--		--		--		--		--		--	
2,4,6-Trichlorophenol	µg/L	4	--		--		--		--		--		--		--		--		--		--	

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-26-88	S-29-88	S-30-88	S-55-90	S-55-90FD*	S-78-91	S-81-91	S-82-91	S-87-91	S-91-91
DATE SAMPLED:			11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014
LAB SAMPLE ID:			1411600-005C	1411600-009C	1411600-014B	1411600-007B	1411600-008B	1411600-015B	1411600-017B	1411600-010C	1411600-006B	1411600-016B
	Units											
cis-1,3-Dichloropropene	µg/L	0.47	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Dibromochloromethane	µg/L	0.17	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Dibromomethane	µg/L	8	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Dichlorodifluoromethane	µg/L	200	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ	0.60 UJ
Ethylbenzene	µg/L	1.5	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Hexachlorobutadiene	µg/L	0.3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Isopropylbenzene	µg/L	450	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
m,p-Xylene	µg/L	190	1.2 U	1.2 U	**0.59 J**	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
Methyl tert-butyl ether	µg/L	14	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	**0.23 J**	0.60 U	0.60 U
Methylene chloride	µg/L	11	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Naphthalene	µg/L	0.17	0.60 U	0.60 U	**9.2**	0.60 U	0.60 U	**1.3**	0.60 U	0.60 U	0.60 U	**0.57 J**
n-Butylbenzene	µg/L	1,000	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
n-Propylbenzene	µg/L	660	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
o-Xylene	µg/L	190	0.60 U	0.60 U	**0.35 J**	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
sec-Butylbenzene	µg/L	2,000	0.60 U	**0.41 J**	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	**0.92 J**	0.60 U	0.60 U
Styrene	µg/L	1,200	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
tert-Butylbenzene	µg/L	690	**0.23 J**	**0.49 J**	**0.51 J**	0.60 U	0.60 U	0.60 U	0.60 U	**0.54 J**	0.60 U	0.60 U
Tetrachloroethene	µg/L	11	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Toluene	µg/L	1,100	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
trans-1,2-Dichloroethene	µg/L	360	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
trans-1,3-Dichloropropene	µg/L	0.47	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Trichloroethene	µg/L	0.49	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	**3.1**	0.60 U	0.60 U	0.60 U	0.60 U
Trichlorofluoromethane	µg/L	1,100	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Vinyl chloride	µg/L	0.019	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Polynuclear Aromatic Hydrocarbons - SW8270D-LL												
2-Methylnaphthalene	µg/L	36	**0.45**	**0.52**	--	--	--	--	--	**0.39**	--	--
Acenaphthene	µg/L	530	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Acenaphthylene	µg/L	NA	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Anthracene	µg/L	1,800	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Benzo(a)anthracene	µg/L	0.034	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Benzo(a)pyrene	µg/L	0.0034	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Benzo(b)fluoranthene	µg/L	0.034	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Benzo(g,h,i)perylene	µg/L	NA	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Benzo(k)fluoranthene	µg/L	0.34	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Chrysene	µg/L	3.4	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Dibenz(a,h)anthracene	µg/L	0.0034	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Fluoranthene	µg/L	800	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Fluorene	µg/L	290	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Indeno(1,2,3-cd)pyrene	µg/L	0.034	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Naphthalene	µg/L	0.17	0.16 U	**0.27**	--	--	--	--	--	**0.22**	--	--
Phenanthrene	µg/L	NA	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Pyrene	µg/L	120	0.16 U	0.16 U	--	--	--	--	--	0.15 U	--	--
Semi-Volatile Organics - SW8270D												
1,2,4-Trichlorobenzene	µg/L	1.1	--	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	µg/L	1,200	--	--	--	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	µg/L	4	--	--	--	--	--	--	--	--	--	--

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		**PROJECT ACTION LIMIT[1]**	**S-CAM-1**		**S-CAM-2**		**S13-CAM-DW1**		**S13-CAM-DW1**	
DATE SAMPLED:			**11/12/2014**		**11/12/2014, 11/13/2014**		**11/12/2014, 11/13/2014**		**3/31/2016, 4/1/2016**	
LAB SAMPLE ID:			**1411600-013C**		**1411600-011C, 1411662-002B**		**1411600-003B, -004B**		**1604069-001, -002**	
	Units									
cis-1,3-Dichloropropene	µg/L	0.47	0.60	U	0.60	U	0.60	U	0.60	U
Dibromochloromethane	µg/L	0.17	0.60	U	0.60	U	0.60	U	0.60	U
Dibromomethane	µg/L	8	0.60	U	0.60	U	0.60	U	0.60	U
Dichlorodifluoromethane	µg/L	200	0.60	UJ	0.60	UJ	0.60	UJ	0.60	U
Ethylbenzene	µg/L	1.5	**64**		**5.6**		0.60	U	0.60	U
Hexachlorobutadiene	µg/L	0.3	1.0	U	1.0	U	1.0	U	1.0	U
Isopropylbenzene	µg/L	450	**11**		**2.4**		0.60	U	0.60	U
m,p-Xylene	µg/L	190	**380**		**9.9**		1.2	U	1.2	U
Methyl tert-butyl ether	µg/L	14	**0.74**	**J**	0.60	U	0.60	U	0.60	U
Methylene chloride	µg/L	11	2.0	U	2.0	U	2.0	U	2.0	U
Naphthalene	µg/L	0.17	**280**		**180**		0.60	U	0.60	U
n-Butylbenzene	µg/L	1,000	0.60	U	0.60	U	0.60	U	0.60	U
n-Propylbenzene	µg/L	660	**20**		**5.0**		0.60	U	0.60	U
o-Xylene	µg/L	190	**220**		**11**		0.60	U	0.60	U
sec-Butylbenzene	µg/L	2,000	0.60	U	**1.8**		0.60	U	0.60	U
Styrene	µg/L	1,200	0.60	U	0.60	U	0.60	U	0.60	U
tert-Butylbenzene	µg/L	690	**2.0**		**2.2**		0.60	U	0.60	U
Tetrachloroethene	µg/L	11	0.60	U	0.60	U	0.60	U	0.60	U
Toluene	µg/L	1,100	**38**		**0.82**	**J**	0.60	U	0.60	U
trans-1,2-Dichloroethene	µg/L	360	0.60	U	0.60	U	0.60	U	0.60	U
trans-1,3-Dichloropropene	µg/L	0.47	0.60	U	0.60	U	0.60	U	0.60	U
Trichloroethene	µg/L	0.49	0.60	U	0.60	U	0.60	U	0.60	U
Trichlorofluoromethane	µg/L	1,100	0.60	U	0.60	U	0.60	U	0.60	U
Vinyl chloride	µg/L	0.019	0.60	U	0.60	U	0.60	U	0.60	U
Polynuclear Aromatic Hydrocarbons - SW8270D-LL										
2-Methylnaphthalene	µg/L	36	**2,900**		**1,200**		--		--	
Acenaphthene	µg/L	530	1.6	U	**57**		--		--	
Acenaphthylene	µg/L	NA	1.6	U	1.6	U	--		--	
Anthracene	µg/L	1,800	**68**		**34**		--		--	
Benzo(a)anthracene	µg/L	0.034	1.6	U	1.6	U	--		--	
Benzo(a)pyrene	µg/L	0.0034	1.6	U	1.6	U	--		--	
Benzo(b)fluoranthene	µg/L	0.034	1.6	U	1.6	U	--		--	
Benzo(g,h,i)perylene	µg/L	NA	1.6	U	1.6	U	--		--	
Benzo(k)fluoranthene	µg/L	0.34	1.6	U	1.6	U	--		--	
Chrysene	µg/L	3.4	1.6	U	1.6	U	--		--	
Dibenz(a,h)anthracene	µg/L	0.0034	1.6	U	1.6	U	--		--	
Fluoranthene	µg/L	800	1.6	U	1.6	U	--		--	
Fluorene	µg/L	290	1.6	U	**64**		--		--	
Indeno(1,2,3-cd)pyrene	µg/L	0.034	1.6	U	1.6	U	--		--	
Naphthalene	µg/L	0.17	**730**		**180**		--		--	
Phenanthrene	µg/L	NA	**830**		**260**		--		--	
Pyrene	µg/L	120	**25**		**7.3**		--		--	
Semi-Volatile Organics - SW8270D										
1,2,4-Trichlorobenzene	µg/L	1.1	--		--		--		0.47	U
2,4,5-Trichlorophenol	µg/L	1,200	--		--		--		0.47	U
2,4,6-Trichlorophenol	µg/L	4	--		--		--		0.47	U

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-HPGW-01	13-HPGW-02	13-HPGW-03	13-HPGW-04	13-HPGW-05	13-HPGW-05FD*	13-HPGW-06	13-HPGW-07	13-HPGW-08	S-25-88
DATE SAMPLED:			09/18/2014	09/17/2014	09/17/2014	09/18/2014	09/17/2014	09/17/2014	09/17/2014	09/17/2014	09/17/2014	11/12/2014
LAB SAMPLE ID:			1409836-003B	1409836-004C	1409836-005C	1409836-006B	1409836-007C	1409836-008C	1409836-009B	1409836-010C	1409836-011B	1411600-002C
	Units											
2,4-Dichlorophenol	µg/L	46	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	µg/L	360	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	µg/L	39	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrotoluene	µg/L	0.24	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	µg/L	0.048	--	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene	µg/L	750	--	--	--	--	--	--	--	--	--	--
2-Chlorophenol	µg/L	91	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	µg/L	36	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	µg/L	930	--	--	--	--	--	--	--	--	--	--
2-Nitroaniline	µg/L	190	--	--	--	--	--	--	--	--	--	--
2-Nitrophenol	µg/L	NA	--	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	µg/L	0.12	--	--	--	--	--	--	--	--	--	--
3-Methylphenol + 4-Methylphenol	µg/L	930	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	µg/L	NA	--	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	µg/L	1.5	--	--	--	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	µg/L	NA	--	--	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	µg/L	1,400	--	--	--	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	µg/L	NA	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	µg/L	3.8	--	--	--	--	--	--	--	--	--	--
4-Nitrophenol	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Acenaphthene	µg/L	530	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Anthracene	µg/L	1,800	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	µg/L	0.034	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	µg/L	0.0034	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	µg/L	0.034	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	µg/L	0.34	--	--	--	--	--	--	--	--	--	--
Benzyl alcohol	µg/L	2,000	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	µg/L	59	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroethyl) ether	µg/L	0.014	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroisopropyl)ether	µg/L	0.36	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	µg/L	5.6	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	µg/L	16	--	--	--	--	--	--	--	--	--	--
Carbazole	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Chrysene	µg/L	3.4	--	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	µg/L	0.0034	--	--	--	--	--	--	--	--	--	--
Dibenzofuran	µg/L	7.9	--	--	--	--	--	--	--	--	--	--
Diethylphthalate	µg/L	15,000	--	--	--	--	--	--	--	--	--	--
Dimethylphthalate	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	µg/L	900	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	µg/L	200	--	--	--	--	--	--	--	--	--	--
Fluoranthene	µg/L	800	--	--	--	--	--	--	--	--	--	--
Fluorene	µg/L	290	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	µg/L	0.049	--	--	--	--	--	--	--	--	--	--

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-26-88	S-29-88	S-30-88	S-55-90	S-55-90FD*	S-78-91	S-81-91	S-82-91	S-87-91	S-91-91
DATE SAMPLED:			11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014
LAB SAMPLE ID:	Units		1411600-005C	1411600-009C	1411600-014B	1411600-007B	1411600-008B	1411600-015B	1411600-017B	1411600-010C	1411600-006B	1411600-016B
2,4-Dichlorophenol	µg/L	46	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	µg/L	360	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	µg/L	39	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrotoluene	µg/L	0.24	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	µg/L	0.048	--	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene	µg/L	750	--	--	--	--	--	--	--	--	--	--
2-Chlorophenol	µg/L	91	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	µg/L	36	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	µg/L	930	--	--	--	--	--	--	--	--	--	--
2-Nitroaniline	µg/L	190	--	--	--	--	--	--	--	--	--	--
2-Nitrophenol	µg/L	NA	--	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	µg/L	0.12	--	--	--	--	--	--	--	--	--	--
3-Methylphenol + 4-Methylphenol	µg/L	930	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	µg/L	NA	--	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	µg/L	1.5	--	--	--	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	µg/L	NA	--	--	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	µg/L	1,400	--	--	--	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	µg/L	NA	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	µg/L	3.8	--	--	--	--	--	--	--	--	--	--
4-Nitrophenol	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Acenaphthene	µg/L	530	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Anthracene	µg/L	1,800	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	µg/L	0.034	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	µg/L	0.0034	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	µg/L	0.034	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	µg/L	0.34	--	--	--	--	--	--	--	--	--	--
Benzyl alcohol	µg/L	2,000	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	µg/L	59	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroethyl) ether	µg/L	0.014	--	--	--	--	--	--	--	--	--	--
bis(2-Chloroisopropyl)ether	µg/L	0.36	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	µg/L	5.6	--	--	--	--	--	--	--	--	--	--
Butylbenzylphthalate	µg/L	16	--	--	--	--	--	--	--	--	--	--
Carbazole	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Chrysene	µg/L	3.4	--	--	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	µg/L	0.0034	--	--	--	--	--	--	--	--	--	--
Dibenzofuran	µg/L	7.9	--	--	--	--	--	--	--	--	--	--
Diethylphthalate	µg/L	15,000	--	--	--	--	--	--	--	--	--	--
Dimethylphthalate	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	µg/L	900	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	µg/L	200	--	--	--	--	--	--	--	--	--	--
Fluoranthene	µg/L	800	--	--	--	--	--	--	--	--	--	--
Fluorene	µg/L	290	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	µg/L	0.049	--	--	--	--	--	--	--	--	--	--

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-CAM-1	S-CAM-2	S13-CAM-DW1	S13-CAM-DW1	
DATE SAMPLED:			11/12/2014	11/12/2014, 11/13/2014	11/12/2014, 11/13/2014	3/31/2016, 4/1/2016	
LAB SAMPLE ID:	Units		1411600-013C	1411600-011C, 1411662-002B	1411600-003B, -004B	1604069-001, -002	
2,4-Dichlorophenol	µg/L	46	--	--	--	0.47	U
2,4-Dimethylphenol	µg/L	360	--	--	--	0.93	U
2,4-Dinitrophenol	µg/L	39	--	--	--	9.3	UJ
2,4-Dinitrotoluene	µg/L	0.24	--	--	--	0.47	U
2,6-Dinitrotoluene	µg/L	0.048	--	--	--	0.47	U
2-Chloronaphthalene	µg/L	750	--	--	--	0.93	U
2-Chlorophenol	µg/L	91	--	--	--	0.47	U
2-Methylnaphthalene	µg/L	36	--	--	--	0.47	U
2-Methylphenol	µg/L	930	--	--	--	0.47	U
2-Nitroaniline	µg/L	190	--	--	--	0.47	U
2-Nitrophenol	µg/L	NA	--	--	--	0.47	U
3,3'-Dichlorobenzidine	µg/L	0.12	--	--	--	9.3	U
3-Methylphenol + 4-Methylphenol	µg/L	930	--	--	--	0.93	U
3-Nitroaniline	µg/L	NA	--	--	--	0.93	U
4,6-Dinitro-2-methylphenol	µg/L	1.5	--	--	--	2.3	UJ
4-Bromophenyl-phenylether	µg/L	NA	--	--	--	2.3	U
4-Chloro-3-methylphenol	µg/L	1,400	--	--	--	0.47	U
4-Chlorophenyl-phenylether	µg/L	NA	--	--	--	0.47	U
4-Nitroaniline	µg/L	3.8	--	--	--	0.47	U
4-Nitrophenol	µg/L	NA	--	--	--	9.3	U
Acenaphthene	µg/L	530	--	--	--	0.47	U
Acenaphthylene	µg/L	NA	--	--	--	0.47	U
Anthracene	µg/L	1,800	--	--	--	0.47	U
Benzo(a)anthracene	µg/L	0.034	--	--	--	0.47	U
Benzo(a)pyrene	µg/L	0.0034	--	--	--	0.47	U
Benzo(b)fluoranthene	µg/L	0.034	--	--	--	0.47	U
Benzo(g,h,i)perylene	µg/L	NA	--	--	--	0.47	UJ
Benzo(k)fluoranthene	µg/L	0.34	--	--	--	0.47	U
Benzyl alcohol	µg/L	2,000	--	--	--	0.47	U
bis(2-Chloroethoxy)methane	µg/L	59	--	--	--	0.47	U
bis(2-Chloroethyl) ether	µg/L	0.014	--	--	--	0.47	U
bis(2-Chloroisopropyl)ether	µg/L	0.36	--	--	--	0.47	U
bis(2-Ethylhexyl)phthalate	µg/L	5.6	--	--	--	**1.5**	**J**
Butylbenzylphthalate	µg/L	16	--	--	--	**0.83**	**J**
Carbazole	µg/L	NA	--	--	--	0.47	U
Chrysene	µg/L	3.4	--	--	--	0.47	U
Dibenz(a,h)anthracene	µg/L	0.0034	--	--	--	0.47	U
Dibenzofuran	µg/L	7.9	--	--	--	0.47	U
Diethylphthalate	µg/L	15,000	--	--	--	**0.48**	**J**
Dimethylphthalate	µg/L	NA	--	--	--	**7.6**	
Di-n-butyl phthalate	µg/L	900	--	--	--	0.47	U
Di-n-octyl phthalate	µg/L	200	--	--	--	0.47	U
Fluoranthene	µg/L	800	--	--	--	0.47	U
Fluorene	µg/L	290	--	--	--	0.47	U
Hexachlorobenzene	µg/L	0.049	--	--	--	0.47	U

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-HPGW-01	13-HPGW-02	13-HPGW-03	13-HPGW-04	13-HPGW-05	13-HPGW-05FD*	13-HPGW-06	13-HPGW-07	13-HPGW-08	S-25-88
DATE SAMPLED:			09/18/2014	09/17/2014	09/17/2014	09/18/2014	09/17/2014	09/17/2014	09/17/2014	09/17/2014	09/17/2014	11/12/2014
LAB SAMPLE ID:	Units		1409836-003B	1409836-004C	1409836-005C	1409836-006B	1409836-007C	1409836-008C	1409836-009B	1409836-010C	1409836-011B	1411600-002C
Hexachlorobutadiene	µg/L	0.3	--	--	--	--	--	--	--	--	--	--
Hexachloroethane	µg/L	0.9	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	µg/L	0.034	--	--	--	--	--	--	--	--	--	--
Isophorone	µg/L	78	--	--	--	--	--	--	--	--	--	--
Naphthalene	µg/L	0.17	--	--	--	--	--	--	--	--	--	--
Nitrobenzene	µg/L	0.14	--	--	--	--	--	--	--	--	--	--
n-Nitrosodimethylamine	µg/L	0.00049	--	--	--	--	--	--	--	--	--	--
n-Nitroso-di-n-propylamine	µg/L	0.011	--	--	--	--	--	--	--	--	--	--
n-Nitrosodiphenylamine	µg/L	12	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol	µg/L	0.04	--	--	--	--	--	--	--	--	--	--
Phenanthrene	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Phenol	µg/L	5,800	--	--	--	--	--	--	--	--	--	--
Pyrene	µg/L	120	--	--	--	--	--	--	--	--	--	--
Agent Breakdown Products - SW8321M												
Diisopropylmethylphosphonate (DIMP)	µg/L	1,600	--	--	5.0 U	--	5.0 U	5.0 UJ	--	--	--	--
Dimethylmethylphosphonate (DMMP)	µg/L	46	--	--	5.0 U	--	5.0 U	5.0 UJ	--	--	--	--
Ethylmethylphosphonic acid (EMPA)	µg/L	NA	--	--	5.0 U	--	5.0 UJ	5.0 U	--	--	--	--
Isopropyl methylphosphonic acid (IMPA)	µg/L	2,000	--	--	10 U	--	10 UJ	10 U	--	--	--	--
Methylphosphonic acid (MPA)	µg/L	1,200	--	--	50 R	--	50 R	50 R	--	--	--	--
Thiodiglycol (TDG)	µg/L	1,400	--	--	5.0 U	--	5.0 U	5.0 UJ	--	--	--	--
Total Metals - SW6020A/SW7470A												
Antimony	µg/L	7.8	--	--	--	--	--	--	--	--	--	--
Arsenic	µg/L	0.052	--	--	--	--	--	--	--	--	--	--
Barium	µg/L	3,800	--	--	--	--	--	--	--	--	--	--
Beryllium	µg/L	25	--	--	--	--	--	--	--	--	--	--
Cadmium	µg/L	9.2	--	--	--	--	--	--	--	--	--	--
Chromium	µg/L	22,000	--	--	--	--	--	--	--	--	--	--
Cobalt	µg/L	6	--	--	--	--	--	--	--	--	--	--
Copper	µg/L	800	--	--	--	--	--	--	--	--	--	--
Lead	µg/L	15	--	--	--	--	--	--	--	--	--	--
Manganese	µg/L	430	--	--	--	--	--	--	--	--	--	--
Mercury	µg/L	5.7	--	--	--	--	--	--	--	--	--	--
Molybdenum	µg/L	100	--	--	--	--	--	--	--	--	--	--
Nickel	µg/L	390	--	--	--	--	--	--	--	--	--	--
Selenium	µg/L	100	--	--	--	--	--	--	--	--	--	--
Silver	µg/L	94	--	--	--	--	--	--	--	--	--	--
Thallium	µg/L	0.2	--	--	--	--	--	--	--	--	--	--
Vanadium	µg/L	86	--	--	--	--	--	--	--	--	--	--
Zinc	µg/L	6,000	--	--	--	--	--	--	--	--	--	--
Cations - SW6020A												
Calcium	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Iron	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Magnesium	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Sodium	µg/L	NA	--	--	--	--	--	--	--	--	--	--

SWMU 13 - FUEL SPILL AREA

VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014

TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-26-88	S-29-88	S-30-88	S-55-90	S-55-90FD*	S-78-91	S-81-91	S-82-91	S-87-91	S-91-91
DATE SAMPLED:			11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014
LAB SAMPLE ID:			1411600-005C	1411600-009C	1411600-014B	1411600-007B	1411600-008B	1411600-015B	1411600-017B	1411600-010C	1411600-006B	1411600-016B
	Units											
Hexachlorobutadiene	µg/L	0.3	--	--	--	--	--	--	--	--	--	--
Hexachloroethane	µg/L	0.9	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	µg/L	0.034	--	--	--	--	--	--	--	--	--	--
Isophorone	µg/L	78	--	--	--	--	--	--	--	--	--	--
Naphthalene	µg/L	0.17	--	--	--	--	--	--	--	--	--	--
Nitrobenzene	µg/L	0.14	--	--	--	--	--	--	--	--	--	--
n-Nitrosodimethylamine	µg/L	0.00049	--	--	--	--	--	--	--	--	--	--
n-Nitroso-di-n-propylamine	µg/L	0.011	--	--	--	--	--	--	--	--	--	--
n-Nitrosodiphenylamine	µg/L	12	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol	µg/L	0.04	--	--	--	--	--	--	--	--	--	--
Phenanthrene	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Phenol	µg/L	5,800	--	--	--	--	--	--	--	--	--	--
Pyrene	µg/L	120	--	--	--	--	--	--	--	--	--	--
Agent Breakdown Products - SW8321M												
Diisopropylmethylphosphonate (DIMP)	µg/L	1,600	5.0 U	--	--	--	--	**3.9 J-**	--	--	--	--
Dimethylmethylphosphonate (DMMP)	µg/L	46	5.0 U	--	--	--	--	5.0 UJ	--	--	--	--
Ethylmethylphosphonic acid (EMPA)	µg/L	NA	5.0 UJ	--	--	--	--	5.0 UJ	--	--	--	--
Isopropyl methylphosphonic acid (IMPA)	µg/L	2,000	10 UJ	--	--	--	--	**260 J-**	--	--	--	--
Methylphosphonic acid (MPA)	µg/L	1,200	50 R	--	--	--	--	50 R	--	--	--	--
Thiodiglycol (TDG)	µg/L	1,400	5.0 U	--	--	--	--	5.0 UJ	--	--	--	--
Total Metals - SW6020A/SW7470A												
Antimony	µg/L	7.8	--	--	--	--	--	--	--	--	--	--
Arsenic	µg/L	0.052	--	--	--	--	--	--	--	--	--	--
Barium	µg/L	3,800	--	--	--	--	--	--	--	--	--	--
Beryllium	µg/L	25	--	--	--	--	--	--	--	--	--	--
Cadmium	µg/L	9.2	--	--	--	--	--	--	--	--	--	--
Chromium	µg/L	22,000	--	--	--	--	--	--	--	--	--	--
Cobalt	µg/L	6	--	--	--	--	--	--	--	--	--	--
Copper	µg/L	800	--	--	--	--	--	--	--	--	--	--
Lead	µg/L	15	--	--	--	--	--	--	--	--	--	--
Manganese	µg/L	430	--	--	--	--	--	--	--	--	--	--
Mercury	µg/L	5.7	--	--	--	--	--	--	--	--	--	--
Molybdenum	µg/L	100	--	--	--	--	--	--	--	--	--	--
Nickel	µg/L	390	--	--	--	--	--	--	--	--	--	--
Selenium	µg/L	100	--	--	--	--	--	--	--	--	--	--
Silver	µg/L	94	--	--	--	--	--	--	--	--	--	--
Thallium	µg/L	0.2	--	--	--	--	--	--	--	--	--	--
Vanadium	µg/L	86	--	--	--	--	--	--	--	--	--	--
Zinc	µg/L	6,000	--	--	--	--	--	--	--	--	--	--
Cations - SW6020A												
Calcium	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Iron	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Magnesium	µg/L	NA	--	--	--	--	--	--	--	--	--	--
Sodium	µg/L	NA	--	--	--	--	--	--	--	--	--	--

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-CAM-1	S-CAM-2	S13-CAM-DW1		S13-CAM-DW1	
DATE SAMPLED:			11/12/2014	11/12/2014, 11/13/2014	11/12/2014, 11/13/2014		3/31/2016, 4/1/2016	
LAB SAMPLE ID:			1411600-013C	1411600-011C, 1411662-002B	1411600-003B, -004B		1604069-001, -002	
	Units							
Hexachlorobutadiene	µg/L	0.3	--	--	--		0.47	U
Hexachloroethane	µg/L	0.9	--	--	--		0.47	UJ
Indeno(1,2,3-cd)pyrene	µg/L	0.034	--	--	--		0.47	U
Isophorone	µg/L	78	--	--	--		0.93	U
Naphthalene	µg/L	0.17	--	--	--		0.47	U
Nitrobenzene	µg/L	0.14	--	--	--		0.47	U
n-Nitrosodimethylamine	µg/L	0.00049	--	--	--		0.47	U
n-Nitroso-di-n-propylamine	µg/L	0.011	--	--	--		0.47	U
n-Nitrosodiphenylamine	µg/L	12	--	--	--		0.47	U
Pentachlorophenol	µg/L	0.04	--	--	--		2.3	U
Phenanthrene	µg/L	NA	--	--	--		**0.36**	**J**
Phenol	µg/L	5,800	--	--	--		0.47	U
Pyrene	µg/L	120	--	--	--		0.47	U
Agent Breakdown Products - SW8321M								
Diisopropylmethylphosphonate (DIMP)	µg/L	1,600	--	--	--		--	
Dimethylmethylphosphonate (DMMP)	µg/L	46	--	--	--		--	
Ethylmethylphosphonic acid (EMPA)	µg/L	NA	--	--	--		--	
Isopropyl methylphosphonic acid (IMPA)	µg/L	2,000	--	--	--		--	
Methylphosphonic acid (MPA)	µg/L	1,200	--	--	--		--	
Thiodiglycol (TDG)	µg/L	1,400	--	--	--		--	
Total Metals - SW6020A/SW7470A								
Antimony	µg/L	7.8	--	--	**1.9**	**J**	**0.85**	**J**
Arsenic	µg/L	0.052	--	--	**50**		**69**	
Barium	µg/L	3,800	--	--	**44**		**29**	
Beryllium	µg/L	25	--	--	5.0	U	1.0	U
Cadmium	µg/L	9.2	--	--	**0.64**	**J**	**0.74**	**J**
Chromium	µg/L	22,000	--	--	**4.1**	**J**	**3.0**	**J**
Cobalt	µg/L	6	--	--	**6.2**		**1.9**	**J**
Copper	µg/L	800	--	--	**39**		**11**	
Lead	µg/L	15	--	--	**0.78**	**J**	**0.63**	**J**
Manganese	µg/L	430	--	--	**1,200**		**980**	
Mercury	µg/L	5.7	--	--	0.10	U	0.10	U
Molybdenum	µg/L	100	--	--	**240**		**57**	**J+**
Nickel	µg/L	390	--	--	**28**		**18**	
Selenium	µg/L	100	--	--	**16**		**7.0**	
Silver	µg/L	94	--	--	0.50	U	0.50	U
Thallium	µg/L	0.2	--	--	**0.32**	**J**	**0.26**	**J**
Vanadium	µg/L	86	--	--	**1.8**	**J**	**0.62**	**J**
Zinc	µg/L	6,000	--	--	**45**	**J**	**14**	**J**
Cations - SW6020A								
Calcium	µg/L	NA	--	**98,000**	**700,000**		--	
Iron	µg/L	NA	--	**8,800**	**1,400**		--	
Magnesium	µg/L	NA	--	**290,000**	**1,300,000**		--	
Sodium	µg/L	NA	--	**660,000**	**4,500,000**		--	

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-HPGW-01	13-HPGW-02	13-HPGW-03	13-HPGW-04	13-HPGW-05	13-HPGW-05FD*	13-HPGW-06	13-HPGW-07	13-HPGW-08	S-25-88
DATE SAMPLED:			**09/18/2014**	**09/17/2014**	**09/17/2014**	**09/18/2014**	**09/17/2014**	**09/17/2014**	**09/17/2014**	**09/17/2014**	**09/17/2014**	**11/12/2014**
LAB SAMPLE ID:			**1409836-003B**	**1409836-004C**	**1409836-005C**	**1409836-006B**	**1409836-007C**	**1409836-008C**	**1409836-009B**	**1409836-010C**	**1409836-011B**	**1411600-002C**
	Units											
Anions - EPA 300.0												
Chloride	mg/L	NA	--	--	--	--	--	--	--	--	--	--
Nitrogen, Nitrate-N	mg/L	NA	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	NA	--	--	--	--	--	--	--	--	--	--
Total Dissolved Solids - SM2540C												
Residue, Dissolved	mg/L	NA	--	--	--	--	--	--	--	--	--	--

QA NOTES AND DATA QUALIFIERS:
(NO CODE) - Confirmed identification.
U - Analyte was analyzed for but not detected above the limit of detection (LOD).
UJ - Analyte not detected, reported LOD may be inaccurate or imprecise.
J - Analyte detected, estimated concentration.
J- - Analyte detected, estimated concentration with a low bias.
J+ - Analyte detected, estimated concentration with a high bias.
R - Rejected result.
* - Field duplicate of sample on left.
Detections are **bolded**.
Detections above the PAL are highlighted.

NOTES:

[1] For DRO, Project Action Limits are the State of Utah LUST Tier 1 screening levels, used only as a guideline for determining the extent of DRO contamination. For all other analyses, Project Action Limits are the USEPA (May 2014) tapwater RSLs, using a target risk of 1 x 10-6 and a target HQ of 1.0.

NA - Limit not available.
-- - Analyte not tested.

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-26-88	S-29-88	S-30-88	S-55-90	S-55-90FD*	S-78-91	S-81-91	S-82-91	S-87-91	S-91-91
DATE SAMPLED:			11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014	11/12/2014
LAB SAMPLE ID:			1411600-005C	1411600-009C	1411600-014B	1411600-007B	1411600-008B	1411600-015B	1411600-017B	1411600-010C	1411600-006B	1411600-016B
	Units											
Anions - EPA 300.0												
Chloride	mg/L	NA	--	--	--	--	--	--	--	--	--	--
Nitrogen, Nitrate-N	mg/L	NA	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/L	NA	--	--	--	--	--	--	--	--	--	--
Total Dissolved Solids - SM2540C												
Residue, Dissolved	mg/L	NA	--	--	--	--	--	--	--	--	--	--

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.
U - Analyte was analyzed for but not detected above the limit of detection (LOD).
UJ - Analyte not detected, reported LOD may be inaccurate or imprecise.
J - Analyte detected, estimated concentration.
J- - Analyte detected, estimated concentration with a low bias.
J+ - Analyte detected, estimated concentration with a high bias.
R - Rejected result.
* - Field duplicate of sample on left.
Detections are **bolded**.
Detections above the PAL are highlighted.

NOTES:

[1] For DRO, Project Action Limits are the State of Utah LUST Tier 1 screening levels, used only as a guideline for determining the extent of DRO contamination. For all other analyses, Project Action Limits are the USEPA (May 2014) tapwater RSLs, using a target risk of 1 x 10-6 and a target HQ of 1.0.

NA - Limit not available.
-- - Analyte not tested.

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR GROUNDWATER SAMPLES COLLECTED IN SEPTEMBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	S-CAM-1	S-CAM-2	S13-CAM-DW1	S13-CAM-DW1
DATE SAMPLED:			11/12/2014	11/12/2014, 11/13/2014	11/12/2014, 11/13/2014	3/31/2016, 4/1/2016
LAB SAMPLE ID:	Units		1411600-013C	1411600-011C, 1411662-002B	1411600-003B, -004B	1604069-001, -002
Anions - EPA 300.0						
Chloride	mg/L	NA	--	**480**	**7,100**	--
Nitrogen, Nitrate-N	mg/L	NA	--	0.025 U	0.025 U	--
Sulfate	mg/L	NA	--	**590**	**3,100**	--
Total Dissolved Solids - SM2540C						
Residue, Dissolved	mg/L	NA	--	**2,800**	**17,000**	**16,000**

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.

U - Analyte was analyzed for but not detected above the limit of detection (LOD).

UJ - Analyte not detected, reported LOD may be inaccurate or imprecise.

J - Analyte detected, estimated concentration.

J- - Analyte detected, estimated concentration with a low bias.

J+ - Analyte detected, estimated concentration with a high bias.

R - Rejected result.

* - Field duplicate of sample on left.

Detections are **bolded**.

Detections above the PAL are highlighted.

NOTES:

[1] For DRO, Project Action Limits are the State of Utah LUST Tier 1 screening levels, used only as a guideline for determining the extent of DRO contamination. For all other analyses, Project Action Limits are the USEPA (May 2014) tapwater RSLs, using a target risk of 1 x 10-6 and a target HQ of 1.0.

NA - Limit not available.

-- - Analyte not tested.

Appendix A.4

FIELD QC ANALYTICAL RESULTS SUMMARY

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR FIELD QC WATER SAMPLES COLLECTED SEPTEMBER THROUGH NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13-FB-01	30-FB-01(TA)	13/30-EB-01	13-EB-01	13-EB-02(TA)	13/30-TB-01A	13/30-TB-01B	13-TB-02	13-TB-03	13-TB-04	13-TB-05
DATE SAMPLED:			09/08/2014	09/10/2014	09/09/2014	09/17/2014	09/17/2014	09/08/2014	09/08/2014	09/17/2014	10/09/2014	11/12/2014	11/14/2014
LAB SAMPLE ID:	Units		1409450-002C	320-9374-22	1409450-004B	1409836-002C	320-9497-4	1409450-001A	1409450-005A	1409836-001A	1410460-001A	1411600-001A	1411617-001A
Total Petroleum Hydrocarbons - SW8015D													
Diesel Range Organics C10-C28	µg/L	10,000	230 U	--	220 U	210 UJ	--	--	--	--	--	--	--
Volatile Organics - SW8260C													
1,1,1,2-Tetrachloroethane	µg/L	0.57	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,1,1-Trichloroethane	µg/L	8,000	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,1,2,2-Tetrachloroethane	µg/L	0.076	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,1,2-Trichloroethane	µg/L	0.28	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,1-Dichloroethane	µg/L	2.7	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,1-Dichloroethene	µg/L	280	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,1-Dichloropropene	µg/L	NA	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,2,3-Trichlorobenzene	µg/L	7	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,2,3-Trichloropropane	µg/L	0.00075	1.0 U	--	1.0 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2,3-Trimethylbenzene	µg/L	10	0.60 UJ	--	0.60 UJ	0.60 U	--	0.60 UJ	0.60 UJ	0.60 U	0.60 U	0.60 U	0.60 U
1,2,4-Trichlorobenzene	µg/L	1.1	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,2,4-Trimethylbenzene	µg/L	15	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,2-Dibromo-3-chloropropane	µg/L	0.00033	1.0 U	--	1.0 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	µg/L	0.0075	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,2-Dichlorobenzene	µg/L	300	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,2-Dichloroethane	µg/L	0.17	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,2-Dichloropropane	µg/L	0.44	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,3,5-Trimethylbenzene	µg/L	120	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,3-Dichlorobenzene	µg/L	NA	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,3-Dichloropropane	µg/L	370	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
1,4-Dichlorobenzene	µg/L	0.48	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
2,2-Dichloropropane	µg/L	NA	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
2-Butanone	µg/L	5,600	**1.4 J**	--	10 U	5.0 U	--	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Chlorotoluene	µg/L	240	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
2-Hexanone	µg/L	38	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
4-Chlorotoluene	µg/L	250	1.0 U	--	1.0 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
4-Isopropyltoluene	µg/L	NA	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
4-Methyl-2-pentanone (MIBK)	µg/L	1,200	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Acetone	µg/L	14,000	13 U	--	20 U	4.0 U	--	10 U	4.0 U	4.0 U	10 U	10 U	4.0 U
Benzene	µg/L	0.45	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Bromobenzene	µg/L	62	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Bromochloromethane	µg/L	83	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Bromodichloromethane	µg/L	0.13	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Bromoform	µg/L	9.2	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 UJ	0.60 U
Bromomethane	µg/L	7.5	4.0 UJ	--	4.0 UJ	4.0 U	--	4.0 UJ	4.0 UJ	4.0 U	4.0 U	4.0 U	4.0 U
Carbon disulfide	µg/L	810	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Carbon tetrachloride	µg/L	0.45	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR FIELD QC WATER SAMPLES COLLECTED SEPTEMBER THROUGH NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID: DATE SAMPLED: LAB SAMPLE ID:	Units	PROJECT ACTION LIMIT[1]	13-FB-01 09/08/2014 1409450-002C	30-FB-01(TA) 09/10/2014 320-9374-22	13/30-EB-01 09/09/2014 1409450-004B	13-EB-01 09/17/2014 1409836-002C	13-EB-02(TA) 09/17/2014 320-9497-4	13/30-TB-01A 09/08/2014 1409450-001A	13/30-TB-01B 09/08/2014 1409450-005A	13-TB-02 09/17/2014 1409836-001A	13-TB-03 10/09/2014 1410460-001A	13-TB-04 11/12/2014 1411600-001A	13-TB-05 11/14/2014 1411617-001A
Chlorobenzene	µg/L	78	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Chloroethane	µg/L	21,000	1.0 U	--	1.0 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	µg/L	0.22	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Chloromethane	µg/L	190	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	**0.39 J**	0.60 U	0.60 U
cis-1,2-Dichloroethene	µg/L	36	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
cis-1,3-Dichloropropene	µg/L	0.47	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Dibromochloromethane	µg/L	0.17	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Dibromomethane	µg/L	8	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Dichlorodifluoromethane	µg/L	200	0.60 U	--	0.60 U	0.60 UJ	--	0.60 U	0.60 U	0.60 UJ	0.60 U	0.60 UJ	0.60 U
Ethylbenzene	µg/L	1.5	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Hexachlorobutadiene	µg/L	0.3	1.0 U	--	1.0 U	1.0 U	--	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Isopropylbenzene	µg/L	450	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
m,p-Xylene	µg/L	190	1.2 U	--	1.2 U	1.2 U	--	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
Methyl tert-butyl ether	µg/L	14	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Methylene chloride	µg/L	11	2.0 U	--	2.0 U	2.0 U	--	2.0 U	2.0 U	2.0 U	0.60 U	2.0 U	2.0 U
Naphthalene	µg/L	0.17	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
n-Butylbenzene	µg/L	1,000	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
n-Propylbenzene	µg/L	660	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
o-Xylene	µg/L	190	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
sec-Butylbenzene	µg/L	2,000	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Styrene	µg/L	1,200	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
tert-Butylbenzene	µg/L	690	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Tetrachloroethene	µg/L	11	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Toluene	µg/L	1,100	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
trans-1,2-Dichloroethene	µg/L	360	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
trans-1,3-Dichloropropene	µg/L	0.47	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Trichloroethene	µg/L	0.49	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Trichlorofluoromethane	µg/L	1,100	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Vinyl chloride	µg/L	0.019	0.60 U	--	0.60 U	0.60 U	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Polynuclear Aromatic Hydrocarbons - SW8270D-LL													
2-Methylnaphthalene	µg/L	36	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Acenaphthene	µg/L	530	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Acenaphthylene	µg/L	NA	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Anthracene	µg/L	1,800	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Benzo(a)anthracene	µg/L	0.034	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Benzo(a)pyrene	µg/L	0.0034	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Benzo(b)fluoranthene	µg/L	0.034	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	µg/L	NA	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Benzo(k)fluoranthene	µg/L	0.34	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Chrysene	µg/L	3.4	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--

SWMU 13 - FUEL SPILL AREA
VALIDATED DATA SUMMARY FOR FIELD QC WATER SAMPLES COLLECTED SEPTEMBER THROUGH NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID: DATE SAMPLED: LAB SAMPLE ID:	Units	PROJECT ACTION LIMIT[1]	13-FB-01 09/08/2014 1409450-002C	30-FB-01(TA) 09/10/2014 320-9374-22	13/30-EB-01 09/09/2014 1409450-004B	13-EB-01 09/17/2014 1409836-002C	13-EB-02(TA) 09/17/2014 320-9497-4	13/30-TB-01A 09/08/2014 1409450-001A	13/30-TB-01B 09/08/2014 1409450-005A	13-TB-02 09/17/2014 1409836-001A	13-TB-03 10/09/2014 1410460-001A	13-TB-04 11/12/2014 1411600-001A	13-TB-05 11/14/2014 1411617-001A
Dibenz(a,h)anthracene	µg/L	0.0034	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Fluoranthene	µg/L	800	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Fluorene	µg/L	290	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	µg/L	0.034	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Naphthalene	µg/L	0.17	0.17 U	--	--	**0.090 J**	--	--	--	--	--	--	--
Phenanthrene	µg/L	NA	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Pyrene	µg/L	120	0.17 U	--	--	0.15 U	--	--	--	--	--	--	--
Agent Breakdown Products - SW8321M													
Diisopropylmethylphosphonate (DIMP)	µg/L	1,600	--	5.0 U	--	--	5.0 U	--	--	--	--	--	--
Dimethylmethylphosphonate (DMMP)	µg/L	46	--	5.0 U	--	--	5.0 U	--	--	--	--	--	--
Ethylmethylphosphonic acid (EMPA)	µg/L	NA	--	5.0 U	--	--	5.0 U	--	--	--	--	--	--
Isopropyl methylphosphonic acid (IMPA)	µg/L	2,000	--	10 U	--	--	10 U	--	--	--	--	--	--
Methylphosphonic acid (MPA)	µg/L	1,200	--	50 U	--	--	50 U	--	--	--	--	--	--
Thiodiglycol (TDG)	µg/L	1,400	--	10 U	--	--	5.0 U	--	--	--	--	--	--

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.
U - Analyte was analyzed for but not detected above the limit of detection (LOD).
UJ - Analyte not detected, reported LOD may be inaccurate or imprecise.
J - Analyte detected, estimated concentration.
Detections are bolded.
Detections above the PAL are highlighted.

NOTES:

[1] For DRO, Project Action Limits are the State of Utah LUST Tier 1 screening levels, used only as a guideline for determining extent of DRO contamination. For all other analyses, Project Action Limits are the USEPA (May 2014) tapwater RSLs, using a target risk of 1 x 10-6 and a target HQ of 1.0.
NA - Limit not available.
-- - Analyte not tested.

Appendix A.5

INVESTIGATION DERIVED WASTE ANALYTICAL RESULTS SUMMARY

SWMU 13 - FUEL SPILL AREA
DATA SUMMARY FOR IDW SOIL SAMPLES COLLECTED IN OCTOBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13/30-IDW-S1		13-IDW-S1		13-IDW-S2	
DATE SAMPLED:			10/09/2014		11/14/2014		11/14/2014	
LAB SAMPLE ID:	Units		1410453-001C		1411618-001C		1411618-002C	
Total Petroleum Hydrocarbons - SW8015D								
Diesel Range Organics C10-C28	mg/Kg	5,000	**1,000**		**14**		**1,700**	
Volatile Organics - SW8260C								
1,1,1,2-Tetrachloroethane	mg/Kg	2	0.045	U	0.055	U	0.052	U
1,1,1-Trichloroethane	mg/Kg	8,100	0.045	U	0.055	U	0.052	U
1,1,2,2-Tetrachloroethane	mg/Kg	0.6	0.045	U	0.055	U	0.052	UJ
1,1,2-Trichloroethane	mg/Kg	1.1	0.045	U	0.055	U	0.052	U
1,1-Dichloroethane	mg/Kg	3.6	0.045	U	0.055	U	0.052	U
1,1-Dichloroethene	mg/Kg	230	0.045	U	0.055	U	0.052	U
1,1-Dichloropropene	mg/Kg	NA	0.045	U	0.055	U	0.052	U
1,2,3-Trichlorobenzene	mg/Kg	49	0.045	U	0.055	U	0.052	U
1,2,3-Trichloropropane	mg/Kg	0.0051	0.045	U	0.055	U	0.052	U
1,2,3-Trimethylbenzene	mg/Kg	49	**0.13**		0.055	U	**0.17**	
1,2,4-Trichlorobenzene	mg/Kg	24	0.045	U	0.055	U	0.052	U
1,2,4-Trimethylbenzene	mg/Kg	58	**0.77**		0.055	U	**1.9**	
1,2-Dibromo-3-chloropropane	mg/Kg	0.0053	0.074	U	0.092	U	0.087	U
1,2-Dibromoethane	mg/Kg	0.036	0.045	U	0.055	U	0.052	U
1,2-Dichlorobenzene	mg/Kg	1,800	0.045	U	0.055	U	0.052	U
1,2-Dichloroethane	mg/Kg	0.46	0.045	U	0.055	U	0.052	U
1,2-Dichloropropane	mg/Kg	1	0.045	U	0.055	U	0.052	U
1,3,5-Trimethylbenzene	mg/Kg	780	**0.67**		0.055	U	**1.5**	
1,3-Dichlorobenzene	mg/Kg	NA	0.045	U	0.055	U	0.052	U
1,3-Dichloropropane	mg/Kg	1,600	0.045	U	0.055	U	0.052	U
1,4-Dichlorobenzene	mg/Kg	2.6	0.045	U	0.055	U	0.052	U
2,2-Dichloropropane	mg/Kg	NA	0.045	U	0.055	U	0.052	U
2-Butanone	mg/Kg	27,000	0.37	U	0.46	U	0.43	U
2-Chlorotoluene	mg/Kg	1,600	0.045	U	0.055	U	0.052	U

SWMU 13 - FUEL SPILL AREA
DATA SUMMARY FOR IDW SOIL SAMPLES COLLECTED IN OCTOBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13/30-IDW-S1		13-IDW-S1		13-IDW-S2	
DATE SAMPLED:			10/09/2014		11/14/2014		11/14/2014	
LAB SAMPLE ID:			1410453-001C		1411618-001C		1411618-002C	
	Units							
2-Hexanone	mg/Kg	200	0.045	U	0.055	U	0.052	U
4-Chlorotoluene	mg/Kg	1,600	0.045	U	0.055	U	0.052	U
4-Isopropyltoluene	mg/Kg	NA	**0.30**		0.055	U	**0.64**	
4-Methyl-2-pentanone (MIBK)	mg/Kg	5,300	0.045	U	0.055	U	0.052	U
Acetone	mg/Kg	61,000	**0.076**	**J**	0.37	U	0.43	UJ
Benzene	mg/Kg	1.2	0.045	U	0.055	U	0.052	U
Bromobenzene	mg/Kg	290	0.045	U	0.055	U	0.052	U
Bromochloromethane	mg/Kg	150	0.045	U	0.055	U	0.052	U
Bromodichloromethane	mg/Kg	0.29	0.045	U	0.055	U	0.052	U
Bromoform	mg/Kg	67	0.045	U	0.055	U	0.052	UJ
Bromomethane	mg/Kg	6.8	0.30	U	0.37	U	0.35	U
Carbon disulfide	mg/Kg	770	0.045	U	0.055	U	0.052	U
Carbon tetrachloride	mg/Kg	0.65	0.045	U	0.055	U	0.052	U
Chlorobenzene	mg/Kg	280	0.045	U	0.055	U	0.052	U
Chloroethane	mg/Kg	14,000	0.30	U	0.37	U	0.35	U
Chloroform	mg/Kg	0.32	0.045	U	0.055	U	0.052	U
Chloromethane	mg/Kg	110	0.045	U	0.055	U	0.052	U
cis-1,2-Dichloroethene	mg/Kg	160	0.045	U	0.055	U	0.052	U
cis-1,3-Dichloropropene	mg/Kg	1.8	0.045	U	0.055	U	0.052	U
Dibromochloromethane	mg/Kg	0.73	0.045	U	0.055	U	0.052	U
Dibromomethane	mg/Kg	23	0.045	U	0.055	U	0.052	U
Dichlorodifluoromethane	mg/Kg	87	0.045	U	0.055	U	0.052	U
Ethylbenzene	mg/Kg	5.8	**0.048**	**J**	0.055	U	**0.11**	
Hexachlorobutadiene	mg/Kg	6.8	0.045	U	0.055	U	0.052	U
Isopropylbenzene	mg/Kg	1,900	**0.054**	**J**	0.055	U	**0.22**	
m,p-Xylene	mg/Kg	550	0.089	U	0.11	U	0.10	U
Methyl tert-butyl ether	mg/Kg	47	0.045	U	0.055	U	0.052	U
Methylene chloride	mg/Kg	57	0.15	UJ	0.18	U	0.17	U

SWMU 13 - FUEL SPILL AREA
DATA SUMMARY FOR IDW SOIL SAMPLES COLLECTED IN OCTOBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		**PROJECT ACTION LIMIT[1]**	**13/30-IDW-S1**		**13-IDW-S1**		**13-IDW-S2**	
DATE SAMPLED:			**10/09/2014**		**11/14/2014**		**11/14/2014**	
LAB SAMPLE ID:			**1410453-001C**		**1411618-001C**		**1411618-002C**	
	Units							
Naphthalene	mg/Kg	3.8	**1.9**		0.055	U	**1.1**	
n-Butylbenzene	mg/Kg	3,900	**0.70**		0.055	U	0.052	U
n-Propylbenzene	mg/Kg	3,300	**0.17**		0.055	U	**0.68**	
o-Xylene	mg/Kg	650	**0.019**	**J**	0.055	U	**0.060**	**J**
sec-Butylbenzene	mg/Kg	7,800	**0.24**		0.055	U	**0.49**	
Styrene	mg/Kg	6,000	0.045	U	0.055	U	0.052	U
tert-Butylbenzene	mg/Kg	7,800	**0.13**		0.055	U	**0.31**	
Tetrachloroethene	mg/Kg	24	0.045	U	0.055	U	0.052	U
Toluene	mg/Kg	4,900	0.045	U	0.055	U	0.052	U
trans-1,2-Dichloroethene	mg/Kg	1,600	0.045	U	0.055	U	0.052	U
trans-1,3-Dichloropropene	mg/Kg	1.8	0.045	U	0.055	U	0.052	U
Trichloroethene	mg/Kg	0.94	0.045	U	0.055	U	0.052	U
Trichlorofluoromethane	mg/Kg	730	0.045	U	0.055	U	0.052	U
Vinyl chloride	mg/Kg	0.059	0.045	U	0.055	U	0.052	U
Agent Breakdown Products - SW8321M								
Diisopropylmethylphosphonate (DIMP)	mg/Kg	6,300	0.012	UJ	**--**		**--**	
Dimethylmethylphosphonate (DMMP)	mg/Kg	310	0.012	U	**--**		**--**	
Ethylmethylphosphonic acid (EMPA)	mg/Kg	NA	0.0061	UJ	**--**		**--**	
Isopropyl methylphosphonic acid (IMPA)	mg/Kg	6,200	0.012	UJ	**--**		**--**	
Methylphosphonic acid (MPA)	mg/Kg	3,700	0.061	UJ	**--**		**--**	
Thiodiglycol (TDG)	mg/Kg	5,400	0.012	UJ	**--**		**--**	
TCLP Metals - SW6020A/SW7470A								
Arsenic	mg/L	5	**0.037**		**0.097**		**0.059**	
Barium	mg/L	100	**0.83**	**J+**	**0.50**	**J+**	**1.6**	
Cadmium	mg/L	1	**0.0082**		**0.0062**		**0.010**	

SWMU 13 - FUEL SPILL AREA
DATA SUMMARY FOR IDW SOIL SAMPLES COLLECTED IN OCTOBER AND NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID: DATE SAMPLED: LAB SAMPLE ID:		PROJECT ACTION LIMIT[1]	13/30-IDW-S1 10/09/2014 1410453-001C		13-IDW-S1 11/14/2014 1411618-001C		13-IDW-S2 11/14/2014 1411618-002C	
	Units							
Chromium	mg/L	5	0.020	U	0.020	U	0.020	U
Lead	mg/L	5	**0.0072**		**0.0072**		**0.0049**	
Mercury	mg/L	0.2	**0.000062**	**J**	0.00010	U	0.00010	U
Selenium	mg/L	1	**0.010**		**0.0034**	**J**	**0.0061**	**J**
Silver	mg/L	5	0.00050	U	0.0010	U	0.0010	U
Percent Moisture								
Percent Moisture	%	NA	**20**		**28**		**22**	

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.
U - Analyte was analyzed for but not detected above the limit of detection (LOD).
UJ - Analyte not detected, reported LOD may be inaccurate or imprecise.
J - Analyte detected, estimated concentration.
J+ - Analyte detected, estimated concentration with a high bias.
Detections are bolded.
Detections above the PAL are highlighted.

NOTES:

[1] For DRO, Project Action Limits are the State of Utah LUST Tier 1 screening levels, used only as a guideline for determining extent of DRO contamination. For all other analyses, Project Action Limits are the USEPA (May 2014) RSLs for residential soil, using a target risk of 1 x 10-6 and a target HQ of 1.0.
TCLP limits are the USEPA Hazardous Waste Regulations, 40 CFR §261.21 - 40 CFR §261.24.

NA - Limit not available.
-- - Analyte not tested.

SWMU 13 - FUEL SPILL AREA

DATA SUMMARY FOR IDW WATER SAMPLES COLLECTED SEPTEMBER THROUGH NOVEMBER 2014

TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13/30-IDW-W1		13-IDW-W1		13-IDW-W2		13-IDW-W3		13-IDW-W4	
DATE SAMPLED:			10/09/2014		10/09/2014		11/14/2014		11/14/2014		11/14/2014	
LAB SAMPLE ID:	Units		1410460-003B		1410460-002B		1411617-002B		1411617-003B		1411617-004B	
Total Petroleum Hydrocarbons - SW8015D												
Diesel Range Organics C10-C28	µg/L	10,000	470	UJ	**32,000,000**	**J+**	**3,300**		**230**	**J-**	**38,000**	
Volatile Organics - SW8260C												
1,1,1,2-Tetrachloroethane	µg/L	0.57	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,1,1-Trichloroethane	µg/L	8,000	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,1,2,2-Tetrachloroethane	µg/L	0.076	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,1,2-Trichloroethane	µg/L	0.28	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloroethane	µg/L	2.7	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloroethene	µg/L	280	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,1-Dichloropropene	µg/L	NA	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,2,3-Trichlorobenzene	µg/L	7	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,2,3-Trichloropropane	µg/L	0.00075	1.0	U	100	U	1.0	U	1.0	U	1.0	U
1,2,3-Trimethylbenzene	µg/L	10	0.60	UJ	**870**	**J-**	0.60	U	0.60	U	**170**	**J+**
1,2,4-Trichlorobenzene	µg/L	1.1	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,2,4-Trimethylbenzene	µg/L	15	0.60	U	**2,600**	**J**	0.60	U	0.60	U	**190**	**J-**
1,2-Dibromo-3-chloropropane	µg/L	0.00033	1.0	U	100	U	1.0	U	1.0	U	1.0	U
1,2-Dibromoethane	µg/L	0.0075	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,2-Dichlorobenzene	µg/L	300	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,2-Dichloroethane	µg/L	0.17	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,2-Dichloropropane	µg/L	0.44	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,3,5-Trimethylbenzene	µg/L	120	0.60	U	**1,000**	**J-**	0.60	U	0.60	U	**130**	**J+**
1,3-Dichlorobenzene	µg/L	NA	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,3-Dichloropropane	µg/L	370	0.60	U	60	U	0.60	U	0.60	U	0.60	U
1,4-Dichlorobenzene	µg/L	0.48	0.60	U	60	U	0.60	U	0.60	U	0.60	U
2,2-Dichloropropane	µg/L	NA	0.60	UJ	60	U	0.60	U	0.60	U	0.60	U
2-Butanone	µg/L	5,600	5.0	U	500	U	5.0	U	5.0	U	**180**	**J+**
2-Chlorotoluene	µg/L	240	0.60	U	60	U	0.60	U	0.60	U	0.60	U
2-Hexanone	µg/L	38	0.60	U	60	U	0.60	U	0.60	U	0.60	U

SWMU 13 - FUEL SPILL AREA

DATA SUMMARY FOR IDW WATER SAMPLES COLLECTED SEPTEMBER THROUGH NOVEMBER 2014

TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		PROJECT ACTION LIMIT[1]	13/30-IDW-W1		13-IDW-W1		13-IDW-W2		13-IDW-W3		13-IDW-W4	
DATE SAMPLED:			10/09/2014		10/09/2014		11/14/2014		11/14/2014		11/14/2014	
LAB SAMPLE ID:			1410460-003B		1410460-002B		1411617-002B		1411617-003B		1411617-004B	
	Units											
4-Chlorotoluene	µg/L	250	1.0	U	100	U	1.0	U	1.0	U	1.0	U
4-Isopropyltoluene	µg/L	NA	0.60	U	**150**	**J-**	**0.41**	**J**	0.60	U	**14**	**J+**
4-Methyl-2-pentanone (MIBK)	µg/L	1,200	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Acetone	µg/L	14,000	10	U	1,000	U	17	U	10	U	**97**	**J+**
Benzene	µg/L	0.45	0.60	U	60	U	0.60	U	0.60	U	**2.1**	**J+**
Bromobenzene	µg/L	62	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Bromochloromethane	µg/L	83	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Bromodichloromethane	µg/L	0.13	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Bromoform	µg/L	9.2	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Bromomethane	µg/L	7.5	4.0	U	400	U	4.0	U	4.0	U	4.0	U
Carbon disulfide	µg/L	810	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Carbon tetrachloride	µg/L	0.45	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Chlorobenzene	µg/L	78	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Chloroethane	µg/L	21,000	1.0	U	100	U	1.0	U	1.0	U	1.0	U
Chloroform	µg/L	0.22	0.60	U	60	U	**2.6**		0.60	U	0.60	U
Chloromethane	µg/L	190	0.60	U	60	U	0.60	U	**0.63**	**J**	0.60	U
cis-1,2-Dichloroethene	µg/L	36	0.60	U	60	U	0.60	U	0.60	U	0.60	U
cis-1,3-Dichloropropene	µg/L	0.47	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Dibromochloromethane	µg/L	0.17	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Dibromomethane	µg/L	8	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Dichlorodifluoromethane	µg/L	200	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Ethylbenzene	µg/L	1.5	0.60	U	**54**	**J**	0.60	U	0.60	U	**0.95**	**J**
Hexachlorobutadiene	µg/L	0.3	1.0	U	100	UJ	1.0	U	1.0	U	1.0	U
Isopropylbenzene	µg/L	450	0.60	U	**47**	**J**	0.60	U	0.60	U	**1.6**	**J+**
m,p-Xylene	µg/L	190	1.2	U	**700**		1.2	U	1.2	U	**150**	**J+**
Methyl tert-butyl ether	µg/L	14	0.60	U	60	U	0.60	U	0.60	U	**0.35**	**J**
Methylene chloride	µg/L	11	2.0	U	**270**	**J+**	2.0	U	2.0	U	2.0	UJ
Naphthalene	µg/L	0.17	0.60	U	**2,400**	**J-**	**0.40**	**J**	0.60	U	**130**	**J+**
n-Butylbenzene	µg/L	1,000	0.60	U	**380**	**J-**	0.60	U	0.60	U	**11**	**J+**

SWMU 13 - FUEL SPILL AREA
DATA SUMMARY FOR IDW WATER SAMPLES COLLECTED SEPTEMBER THROUGH NOVEMBER 2014
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID: DATE SAMPLED: LAB SAMPLE ID:	Units	PROJECT ACTION LIMIT[1]	13/30-IDW-W1 10/09/2014 1410460-003B		13-IDW-W1 10/09/2014 1410460-002B		13-IDW-W2 11/14/2014 1411617-002B		13-IDW-W3 11/14/2014 1411617-003B		13-IDW-W4 11/14/2014 1411617-004B	
n-Propylbenzene	µg/L	660	0.60	U	**110**	**J-**	0.60	U	0.60	U	**5.4**	**J+**
o-Xylene	µg/L	190	0.60	U	**360**		0.60	U	0.60	U	**120**	**J+**
sec-Butylbenzene	µg/L	2,000	0.60	U	**99**	**J**	0.60	U	0.60	U	**8.4**	**J+**
Styrene	µg/L	1,200	0.60	U	60	U	0.60	U	0.60	U	0.60	U
tert-Butylbenzene	µg/L	690	0.60	U	**55**	**J**	0.60	U	0.60	U	**3.3**	**J+**
Tetrachloroethene	µg/L	11	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Toluene	µg/L	1,100	0.60	U	60	U	0.60	U	0.60	U	**3.7**	**J+**
trans-1,2-Dichloroethene	µg/L	360	0.60	U	60	U	0.60	U	0.60	U	0.60	U
trans-1,3-Dichloropropene	µg/L	0.47	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Trichloroethene	µg/L	0.49	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Trichlorofluoromethane	µg/L	1,100	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Vinyl chloride	µg/L	0.019	0.60	U	60	U	0.60	U	0.60	U	0.60	U
Agent Breakdown Products - SW8321M												
Diisopropylmethylphosphonate (DIMP)	µg/L	1,600	5.0	U	5.0	U	--		--		--	
Dimethylmethylphosphonate (DMMP)	µg/L	46	5.0	U	5.0	U	--		--		--	
Ethylmethylphosphonic acid (EMPA)	µg/L	NA	5.0	U	5.0	U	--		--		--	
Isopropyl methylphosphonic acid (IMPA)	µg/L	2,000	10	U	10	U	--		--		--	
Methylphosphonic acid (MPA)	µg/L	1,200	50	U	50	U	--		--		--	
Thiodiglycol (TDG)	µg/L	1,400	5.0	U	5.0	U	--		--		--	

QA NOTES AND DATA QUALIFIERS:

(NO CODE) - Confirmed identification.
U - Analyte was analyzed for but not detected above the limit of detection (LOD).
UJ - Analyte not detected, reported LOD may be inaccurate or imprecise.
J - Analyte detected, estimated concentration.
J- - Analyte detected, estimated concentration with a low bias.
J+ - Analyte detected, estimated concentration with a high bias.
Detections are bolded.
Detections above the PAL are highlighted.

NOTES:

[1] For DRO, Project Action Limits are the State of Utah LUST Tier 1 screening levels, used only as a guideline for determining extent of DRO contamination. For all other analyses, Project Action Limits are the USEPA (May 2014) tapwater RSLs, using a target risk of 1 x 10-6 and a target HQ of 1.0.
NA - Limit not available.
-- - Analyte not tested.

Appendix A.6

DATA VALIDATION REPORTS

DATA VALIDATION SUMMARY REPORT
FOR SAMPLES COLLECTED FROM
SWMU 13/30

TOOELE ARMY DEPOT – SOUTH AREA, UTAH

Revision Date: March 11, 2015
Parsons - Austin

INTRODUCTION

A full Stage 4 data validation was performed on a minimum of ten percent of the data produced for the Tooele Army Depot - South Area (TEADS) solid waste management units (SWMU) 13 and 30. A data validation summary report was written for each SDG that received Stage 4 data validation. A Stage 3 data review was performed on all remaining data produced for the TEADS 2014 sampling event at SWMU 13/30. The following table details the sample delivery groups (SDGs) that received Level III review, including the associated SWMU, sample matrix, and parameters analyzed. The samples in these SDGs were analyzed for one or more of the following parameters: volatile organic compounds (VOCs) by SW8260C, polycyclic aromatic hydrocarbons (PAHs) by SW8270D-LL (low level), semivolatile organic compounds (SVOCs) by SW8270D, diesel range organics (DRO) by SW8015D, explosives by SW8330B, metals by SW6020A, mercury by SW7470A, agent breakdown products (ABPs) by SW8321M, select cations by SW6020A, select anions by EPA 300.0, and total dissolved solids (TDS) by Standard Method 2540C.

All samples were collected by Parsons using certified-clean, pre-preserved sampling containers provided by the associated laboratories, RTI Laboratories, Inc. (RTI) in Livonia, Michigan, and TestAmerica Laboratories, Inc. (TA) in Sacramento, California. The samples were placed on ice immediately following collection and were shipped to the applicable laboratory using the insulated coolers provided. Coolers were received by the laboratories at temperatures within the required 0.1 to 6.0^o Celsius, with the exceptions noted in the data verification spreadsheet prepared for each SDG. Samples received at a temperature above the acceptance range but below 10^o Celsius were evaluated using professional judgment. All containers were received at the laboratory in good condition or with sufficient volume to perform the requested analyses.

SDGs AND REQUESTED PARAMETERS

SDG	Laboratory	Matrix	VOCs	PAHs	SVOCs	DRO	Explosives	Metals/ Mercury	ABPs	Cations	Anions	TDS	SWMU
1409491	RTI	Soil	X			X							13
1409492	RTI	Soil	X			X							13
1040493	RTI	Soil				X		X					30
1409513	RTI	Water	X		X	X		X					30
1409514	RTI	Soil	X		X	X		X					30
1409515	RTI	Soil	X		X	X		X					30
1409836	RTI	Water	X	X		X							13
1410058	RTI	Water	X	X		X							30
1410059	RTI	Soil		X				X					30
1410179	RTI	Water	X		X	X	X	X					30
1410198	RTI	Soil	X	X		X	X	X					30
1410230	RTI	Water	X										30
1411600	RTI	Water	X	X		X		X					13
1411662	RTI	Water								X	X	X	13
1604069	RTI	Water	X		X			X				X	13
320-9446	TA	Water							X				30
320-10430	TA	Water							X				13

EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the DoD QSM, Version 5.0 and the project-specific UFP QAPP. Information reviewed in the data packages included sample results; field and laboratory quality control (QC) results; instrument calibration; calibration verifications; case narratives; sample receipt forms, and chain-of-custody (COC) forms. The analyses and findings for the Stage 3 review were included in the Excel spreadsheet prepared for each SDG.

Several exceptions from the project QAPP were identified during data review. These included changes in tolerances for three semivolatile compounds, a surrogate change for the DRO analysis, and a change in method version for ABPs. Due to laboratory error during the project QAPP preparation, the accuracy tolerances listed in the QAPjP were incorrect for the following target analytes in water: 2,4,6-Trichlorophenol, Phenol, and the surrogate Phenol-d5. The soil tolerances were also incorrect for 2,4,6-Trichlorophenol only. The corrected tolerances for 2,4,6-Trichlorophenol were 50-125% for waters and 39-126% for soils. The corrected water tolerances for Phenol were 34-121%, and the corrected water tolerances for the Phenol-d5 surrogate were 33-122%. In addition, the laboratory provided the incorrect information during the project QAPP preparation regarding the surrogate used for DRO. The project QAPP lists the surrogate o-Terphenyl for DRO. However, the laboratory actually used the surrogate Squalene instead. The surrogate recoveries for Squalene were evaluated using the tolerances 70-130% for water and 60-130% for soil. Finally, ABPs were analyzed using TestAmerica's proprietary Standard Operating Procedure (WC-LS-0004) using method 8321M. These deviations from the QAPjP did not affect data quality or usability.

The findings of the Stage 3 review are presented in an Excel spreadsheet developed for each SDG. The spreadsheet contains information regarding sample counts, methods analyzed, and a brief description of any deficiencies found. A table detailing the data qualifiers applied, removed, or changed for the associated samples as a result of the verification are also included in the verification spreadsheet.

The following items were evaluated during the Stage 3 data review.

Accuracy

Accuracy was evaluated using the percent recovery (%R) obtained from the laboratory control sample (LCS), LCS duplicate (LCSD), matrix spike/matrix spike duplicate (MS/MSD) pair, and the surrogate spikes, as applicable.

All laboratory QC was analyzed at the frequency required by the DoD QSM and project QAPP. All field QC was collected and analyzed at the frequency required by the project QAPP.

Accuracy was evaluated using the tolerances provided in the project QAPP with the exceptions noted in the "Evaluation Criteria" section above. Recoveries that exceeded tolerance by five percent (5%) or less were evaluated using professional judgment. Data qualifiers were applied in accordance with the DoD QSM and project QAPP, with professional judgment used for minor exceedances.

Precision

Precision was evaluated using the relative percent difference (RPD) obtained from the LCS/LCSD and MS/MSD concentrations. Precision was further evaluated by comparing the field duplicate and analytical duplicate results. The RPD was calculated for the duplicate analyses if a target analyte was detected above the limit of quantitation (LOQ) in both the parent and duplicate samples. Duplicate results were qualified "J" as estimated if one result was below the LOQ and the other was greater than two times the LOQ. Duplicate precision was considered acceptable if one or both samples had detections at or below the LOQ with the exception noted above.

All laboratory QC was analyzed at the frequency required by the DoD QSM and project QAPP. All field QC was collected and analyzed at the frequency required by the project QAPP.

Precision was evaluated using the tolerances provided in the project QAPP. RPDs that exceeded tolerance by five percent (5%) or less were evaluated using professional judgment. Data qualifiers were applied in accordance with the DoD QSM and project QAPP, with professional judgment used for minor exceedances.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining field and laboratory blanks for cross contamination of samples during collection, transport, and analysis.

All samples were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP with the exceptions previously noted. All samples were prepared and analyzed within the holding time required by the method. The following QC was also examined, as applicable for each analytical method:

- Instrument tune;
- Initial calibration;
- Initial calibration verification (second source standard);
- Continuing calibration verification;
- Internal standards;
- Dilution test / post digestion spike;
- Quarterly LOQ verifications.

Completeness

Based on the Stage 3 data review performed, all data are considered usable for the purposes of this project with one exception. The laboratory (TA) was unable to quantitate the analyte MPA by Method SW8321M in the project sample matrix, as demonstrated by repeated MS/MSD recoveries of zero percent (0%). Due to this systematic issue, all field sample results for MPA were qualified "R" as rejected. The rejected results for MPA were not considered usable. All other data for this project was considered usable as qualified.

Comparability

All data was generated using contract-specific standard preparation and analytical methods. All data was reported with the required calibration and QC documentation using standardized units, as detailed in the following table.

EXTRACTION, ANALYTICAL, AND REPORTING DETAILS

Parameter	Matrix	Prep Method	Analytical Method	Units
VOCs	Water	SW5030B	SW8260C	µg/L
VOCs	Soil	SW5035B	SW8260C	mg/Kg
PAHs	Water	SW3510C	SW8270D-LL	µg/L
PAHs	Soil	SW3550C	SW8270D-LL	mg/Kg
SVOCs	Water	SW3510C	SW8270D	µg/L
SVOCs	Soil	SW3550C	SW8270D	mg/Kg
DRO	Water	SW3510C	SW8015B	µg/L
DRO	Soil	SW3550C	SW8015B	mg/Kg
Explosives	Water	Method	SW8330B	µg/L
Explosives	Soil	Method	SW8330B	mg/Kg
Metals	Water	SW3020A	SW6020A	µg/L
Metals	Soil	SW3050B	SW6020A	mg/Kg
Mercury	Water	Method	SW7470A	µg/L
Mercury	Soil	SW3050B	SW7471A	mg/Kg
ABPs	Water	Method	SW8321M	µg/L
ABPs	Soil	Method	SW8321M	mg/Kg
Cations	Water	SW3020A	SW6020A	µg/L
Anions	Water	Method	EPA 300.0	µg/L
TDS	Water	None	SM2540C	µg/L

DATA USABILITY

The purpose of this data validation report is to ensure the integrity and reliability of analytical laboratory data. The data quality was evaluated based on the precision, accuracy, representativeness, comparability, and completeness (PARCC) characteristics of the data. The Stage 3 data review indicated that the laboratory correctly performed the analyses in accordance with the DoD QSM and QAPjP with the exceptions noted in this report and the individual Excel spreadsheets.

All data reviewed are considered usable for the purposes of this project with the exception of MPA as previously noted.

SDG:	**1409491**			
Matrix:	Soil			
Normal Samples:	18			
Field Duplicates:	2	Parent sample(s):	13-SS-03A (DRO only)	13-SS-05B
MS/MSD:	2	Parent sample(s):	13-SS-03A (DRO only)	13-SS-05B
Trip Blanks:	1	Reported in	SDG 1409450	
Equipment Blanks:	1	Reported in	SDG 1409450	
Source Blanks:	1	Reported in	SDG 1409450	
Sample Collection Date(s):	9/8 - 9/9/14			
Verified By:	K.LaPierre			
Date Verified:	12/21/2014			
Level of Review:	3			
Reviewed to Electronic Data:	12/30/2014			
by:	pjf			

Parameter	Sample Receipt	Hold Time	MB	TB	EB	SB	LCS	LCSD	MS/ MSD	AD	FD	Surrogates	Int. Stds.	DT	PDS	ICAL	ICV	CCV	ICB/ CCB	Flag Changes?
VOC	OK	OK	1	2	3	4	5	NA	6	NA	OK	7	OK	NA	NA	OK	8	9,10	NA	YES
DRO	OK	OK	11	NA	12	13	OK	NA	OK	NA	14	15	NA	NA	NA	OK	OK	OK	NA	YES

Notes:

1 - MB has Methylene Chloride at 0.0505 mg/Kg (LOQ=0.100mg/Kg). All associated sample detections changed to ND at LOQ if within 10 times MB concentration.

2 - Trip blank had several detections that did not affect data quality. No CA needed.

3 - EB had several detections that did not affect data quality. No CA needed.

4 - SB had several detections that did not affect data quality. No CA needed.

5 - LCS not spiked for 1,2,3-Trimethylbenzene. All sample results qualified "UJ" if non-detect or "J" if detected. LCS fails high for Bromomethane (%R=154%, Critieria=53-143%). All samples ND for bromomethane, so no corrective action (CA) needed.

6 - MS/MSD on 13-SS-05B: Not spiked for 1,2,3-Trimethylbenzene. All sample results previously qualified "J"/"UJ" - no additional CA needed. Bromomethane met criteria in the MS (%R=141) buf failed high in the MSD (%R=148, Criteria=53-143%). MSD failure considered a minor exceedance, no CA needed.

7 - Surrogate 4-BFB fails high for 13-SS-02C (%R=139, Criteria=79-119%) due to high concentration of gasoline and diesel range organics in the sample. All detections qualified "J+" in this sample.

8 - ICV not spiked for 1,2,3-Trimethylbenzene. All sample results qualified as estimated. ICV recoveries high for bromomethane & carbon disulfide. Carbon disulfide qualified "J+" in sample 13-SS-02C. All other sample resutls ND for bromomethane and carbon disulfide, no additional CA needed.

9 - Beginning CCV not spiked for 1,2,3-Trimethylbenzene. All sample results qualified as estimated. Carbon disulfide recovered high. All associated sample results ND except 13-SS-02C which was previously qualified "J+". No additonal CA needed.

10 - End CCV not spiked for 1,2,3-TMB. Minor exceedance for trichlorofluoromethane (%D=54, Max=50). No CA deemed necessary.

11 - MB has DRO at 0.63 mg/kg. All associated resutls changed to ND at the LOQ or the concentration found if within 5x MB result.

12 - EB had DRO detected, but detection was changed to ND due to method blank contamination.

13 - SB had DRO detected, but detection was changed to ND due to method blank contamination.

14 - Surrogate Squalene fails high in sample 13-SS-02C (%R=256, Criteria=60-130%) due to high concentration of GRO/DRO. No CA deemed necessary since high surrogate had an assignable cause.

15 - FD RPD high for DRO (parent sample 13-SS-03A). DRO qualified "J" as estimated in parent and FD samples.

Data qualifiers added, removed, or changed as a result of the data review are detailed in the following table:

Sample ID	Analyte	Units	Original Result	Final Result	Reason Code(s)
13-SS-01A	DRO	mg/Kg	1.9	1.9 U	MB
13-SS-01B	1,2,3-Trimethylbenzene	mg/Kg	0.0454 UZYQ	0.0454 UJ	NS
13-SS-01B	Methylene Chloride	mg/Kg	0.0810 JB	0.151 U	MB
13-SS-01C	DRO	mg/Kg	2.8	2.8 U	MB
13-SS-01C	1,2,3-Trimethylbenzene	mg/Kg	0.0453 UZYQ	0.0453 UJ	NS
13-SS-01C	Methylene Chloride	mg/Kg	0.0815 JB	0.151 U	MB
13-SS-02B	DRO	mg/Kg	2.0	2.0 U	MB
13-SS-02B	1,2,3-Trimethylbenzene	mg/Kg	0.0382 UZYQ	0.0382 UJ	NS
13-SS-02B	Methylene Chloride	mg/Kg	0.0674 JB	0.127 U	MB
13-SS-02C	1,2,3-Trimethylbenzene	mg/Kg	10.6 QZY	10.6 J	NS, SH
13-SS-02C	1,3,5-Trimethylbenzene	mg/Kg	13.8	13.8 J+	SH
13-SS-02C	4-Isopropyltoluene	mg/Kg	2.29	2.29 J+	SH
13-SS-02C	Carbon disulfide	mg/Kg	0.372 YZ	0.372 J+	IVH
13-SS-02C	Methylene Chloride	mg/Kg	0.0827 JB	0.186 U	MB
13-SS-02C	n-Butlybenzene	mg/Kg	3.03	3.03 J+	SH
13-SS-02C	n-Propylbenzene	mg/Kg	4.19	4.19 J+	SH
13-SS-02C	sec-Butylbenzene	mg/Kg	2.1	2.10 J+	SH
13-SS-02C	tert-Butylbenzene	mg/Kg	0.537	0.537 J+	SH
13-SS-03A	DRO	mg/Kg	5.8	5.8 J	FD
13-SS-03A FD	DRO	mg/Kg	13	13 J	FD
13-SS-03B	DRO	mg/Kg	1.6 J	2.0 U	MB
13-SS-03B	1,2,3-Trimethylbenzene	mg/Kg	0.0519 UZYQ	0.0519 UJ	NS
13-SS-03B	Methylene Chloride	mg/Kg	0.0787 JB	0.173 U	MB
13-SS-03C	1,2,3-Trimethylbenzene	mg/Kg	0.0575 UZYQ	0.0575 UJ	NS
13-SS-03C	Methylene Chloride	mg/Kg	0.0920 JB	0.192 U	MB
13-SS-04B	1,2,3-Trimethylbenzene	mg/Kg	0.0521 UZYQ	0.0521 UJ	NS
13-SS-04B	Methylene Chloride	mg/Kg	0.0877 JB	0.174 U	MB
13-SS-04C	1,2,3-Trimethylbenzene	mg/Kg	0.0220 JZYQ	0.0220 J	NS
13-SS-04C	Methylene Chloride	mg/Kg	0.0773 JB	0.176 U	MB
13-SS-05B	DRO	mg/Kg	2.6	2.6 U	MB
13-SS-05B	1,2,3-Trimethylbenzene	mg/Kg	0.0515 UXZY	0.0515 UJ	NS
13-SS-05B	Methylene Chloride	mg/Kg	0.0773 JB	0.172 U	MB
13-SS-05BFD	DRO	mg/Kg	2.2	2.2 U	MB
13-SS-05B FD	1,2,3-Trimethylbenzene	mg/Kg	0.0420 UZYQ	0.0420 UJ	NS
13-SS-05BFD	Methylene Chloride	mg/Kg	0.0757 JB	0.140 U	MB
13-SS-05C	1,2,3-Trimethylbenzene	mg/Kg	0.0541 UQZY	0.0541 UJ	NS
13-SS-05C	Methylene Chloride	mg/Kg	0.0902 JB	0.180 U	MB
13-SS-06A	DRO	mg/Kg	1.0 J	1.7 U	MB
13-SS-06B	1,2,3-Trimethylbenzene	mg/Kg	0.0492 UZYQ	0.0492 UJ	NS
13-SS-06B	Methylene Chloride	mg/Kg	0.100 JB	0.164 U	MB
13-SS-06C	1,2,3-Trimethylbenzene	mg/Kg	0.0644 JQZY	0.0644 J	NS
13-SS-06C	Methylene Chloride	mg/Kg	0.0880 JB	0.189 U	MB

SDG: **1409492**
Matrix: Soil
Normal Samples: 9
Field Duplicates: 1 Parent Sample(s): 13-SS-07C
MS/MSD: 0
Trip Blanks: 1 Reported in SDG 1409450
Equipment Blanks: 1 Reported in SDG 1409450
Source Blanks: 1 Reported in SDG 1409450

Sample Collection Date(s): 9/8/2014

Verified By: K.LaPierre
Date Verified: 12/23/2014
Level of Review: 3
Reviewed to Electronic Data: 12/29/2014
by: pjf

Parameter	Sample Receipt	Hold Time	MB	TB	EB	SB	LCS	LCSD	MS/ MSD	AD	FD	Surrogates	Int. Stds.	DT	PDS	ICAL	ICV	CCV	ICB/ CCB	Flag Changes?
VOC	OK	OK	1,2	3	4	5	6,7	NA	NA	NA	8	9	OK	NA	NA	OK	10	11,12,1	NA	YES
DRO	OK	OK	15	NA	16	17	OK	NA	OK	NA	NA	OK	NA	NA	NA	OK	OK	OK	NA	YES

Notes:
1 - VOA batch R71542 MB has MeCl at 0.050 mg/kg. Associated sample results changed to ND at LOQ.
2 - VOA batch R71577 MB has MeCl at 0.0495 mg/kg. Associated sample results changed to ND at LOQ.
3 - Trip blank had several detections. The Acetone results in samples 13-SS-07B and 13-SS-09B were changed to ND at the LOQ. No other CA needed.
4 - EB had several detections that did not affect data quality. No CA needed.
5 - SB had several detections that did not affect data quality. No CA needed.
6 - VOA batch R71542 LCS not spiked for 123-Trimethylbenzene. All sample results qualified "J" if detected or "UJ" if non-detect. Bromomethane recovered high at 154% (Criteria=53-143%). All samples ND, so no CA.
7 - VOA batch R71577 LCS high for Bromomethane at 153% (Criteria=53-143). All samples ND, so no CA.
8 - Field duplicate RPD fails for 135-TMB and Carbon disulfide. Flag both "J" in 13-SS-07C and FD.
9 - Surrogate 4-BFB failed slightly high in samples 13-SS-07B, 13-SS-07C, 13-SS-07CFD, & 13-SS-08C. No CA deemed necessary for marginal failures.
10 - ICV not spiked for 123-Trimethylbenzene. All samples previously qualified "J" / "UJ".) High ICV response for carbon disulfide and carbon tetrachloride. All samples ND for these analytes, so no CA needed.
11 - CCV 091814 not spiked for 123-Trimethylbenzene. All samples previously qualified "J" / "UJ".) High ICV response for carbon disulfide. All samples ND, so no CA needed.
12 - CCV END 091814 not spiked for 123-TMB (J / UJ), marginal low response for trichlorofluoromethane, no CA.
13 - CCV 092214 marginal failures for bromomethane (high) and trichlorofluoromethane (low), no CA.
14 - CCV END 092214 marginal failure for dichlorodifluoromethane (low) - no CA, and fails low for trichlorofluoromehane - UJ sample 13-SS-09C only.
15 - MB has DRO AT 0.52 mg/Kg. All samples within 5x MB concentration changed to ND at the LOQ.
16 - EB had DRO detected, but detection was changed to ND due to method blank contamination.
17 - SB had DRO detected, but detection was changed to ND due to method blank contamination.

Data qualifiers added, removed, or changed as a result of the data review are detailed in the following table:

Sample ID	Analyte	Units	Original Result	Final Result	Reason Code
13-SS-07B	1,2,3-Trimethylbenzene	mg/Kg	0.438 QZY	0.438 J	NS
13-SS-07B	Acetone	mg/Kg	0.134 J	0.484 U	EB
13-SS-07B	Methylene chloride	mg/Kg	0.0900 JB	0.194 U	MB
13-SS-07C	1,2,3-Trimethylbenzene	mg/Kg	0.0586 UQZY	0.0586 UJ	NS
13-SS-07C	1,3,5-Trimethylbenzene	mg/Kg	2.34	2.34 J	FD
13-SS-07C	Carbon disulfide	mg/Kg	0.251 YZ	0.251 J	FD
13-SS-07C	Methylene chloride	mg/Kg	0.105 JB	0.195 U	MB
13-SS-07CFD	1,2,3-Trimethylbenzene	mg/Kg	0.0551 UQZY	0.0551 UJ	NS
13-SS-07CFD	1,3,5-Trimethylbenzene	mg/Kg	1.33	1.33 J	FD
13-SS-07CFD	Carbon disulfide	mg/Kg	0.455 YZ	0.455 J	FD
13-SS-07CFD	Methylene chloride	mg/Kg	0.102 JB	0.184 U	MB
13-SS-08B	1,2,3-Trimethylbenzene	mg/Kg	0.0518 UQZY	0.0518 UJ	NS
13-SS-08B	Methylene chloride	mg/Kg	0.0915 JB	0.173 U	MB
13-SS-08C	1,2,3-Trimethylbenzene	mg/Kg	0.301 QZY	0.301 J	NS
13-SS-08C	Methylene chloride	mg/Kg	0.0924 JB	0.178 U	MB
13-SS-09B	DRO	mg/Kg	2.6	2.6 U	MB
13-SS-09B	1,2,3-Trimethylbenzene	mg/Kg	0.0329 UQZY	0.0329 UJ	NS
13-SS-09B	Acetone	mg/Kg	0.0466 J	0.274 U	EB
13-SS-09B	Methylene chloride	mg/Kg	0.0373 JB	0.110 U	MB
13-SS-09C	1,2,3-Trimethylbenzene	mg/Kg	0.271	0.271 J	NS
13-SS-09C	Methylene chloride	mg/Kg	0.116 J	0.184 U	MB
13-SS-09C	Trichlorofluoromethane	mg/Kg	0.0553 UY	0.0553 UJ	CVL

SDG:	**1409836**		
Matrix:	Water		
Normal Samples:	8		
Field Duplicates:	1		
MS/MSD:	1	Parent Sample(s):	13-HPGW-05
Trip Blanks:	1	VOLATILES ONLY	
Equipment Blanks:	1		
Source Blanks:	1	Reported in	SDG 1409450
Sample Collection Dates:	9/17/2014		
Verified By:	B.Driskill		
Date Verified:	12/30/2014		
Level of Review:	3		
Reviewed to Electronic Data:	1/7/2015		
by:	pjf		

Parameter	Sample Receipt	Hold Time	MB	TB	EB	SB	LCS	LCSD	MS/MSD	AD	FD	Surrogates	Int. Stds.	DT	PDS	ICAL	ICV	CCV	ICB/CCB	Flag Changes?
VOC	OK	OK	1	2	3	4	5	NA	6	NA	OK	7	OK	NA	NA	OK	8	9,10	NA	YES
PAHs	OK	OK	OK	NA	11	OK	OK	NA	12	NA	13	14	OK	NA	NA	OK	OK	OK	NA	YES
DRO	OK	OK	OK	NA	15	16	OK	NA	OK	NA	OK	17	NA	NA	NA	OK	OK	18	NA	YES

Notes:

1- MB has Methylene Chloride at 1.0 ug/L. All sample results changed to ND at LOQ if within 10x the MB concentration.
2 - TB had Methylene Chloride detection. Changed to ND due to MB contamination
3 - EB had Methylene Chloride detection. Changed to ND due to MB contamination.
4 - SB had detections for 2-Butanone, Acetone, and Methylene Chloride. All sample results changed to ND at the LOQ if within 5x/10x the SB concentration.
5 - LCS high for Bromomethane. All sample results ND - no CA needed.
6 - MSD high for Bromomethane. Parent sample ND - no CA needed. N
7 - Sample 13-HPGW-07 had surrogate 4-Bromofluorobenzene slightly high (%R=116, Criteria=85-114%). No CA needed.
8 - ICV response highfor Bromomethane, no CA since sample results are all ND.
9 - Beginning CCV response high for Bromomethane and Bromoform, no CA since all sample results were ND.
10 - Ending CCV response low for Dichlorodifluoromethane. All sample results qualified "UJ".
11 - EB had detection of Naphthalene at 0.090 ug/L (LOQ=0.20ug/L). All sample results either ND or greater than 5x the EB concentration. No CA needed.
12 - MS/MSD on 13-HPGW-05: Anthracene recovered low in both MS and MSD. Parent sample result qualified "UJ". MS/MSD RPDs failed high for all target compounds except Anthracene. High RPDs attributed to spiking error - No CA deemed necessary.
13 - FD on sample 13-HPGW-05: 2-Methylnaphthalene and Phenanthrene RPDs exceeded criteria. Parent and FD results for these analytes qualified "J" as estimated.
Naphthalene was ND in the parent and detected at a concentration greater than the LOQ in the FD. Parent sample result qualified "UJ", FD qualified "J".
14 - SVOC: One surrogate failed slightly low (less than 5%) in the MB. Two surrogates failed low in the MSD. No CA needed.
15 - EB had GRO detected at 31 ug/L (LOQ=210ug/L). All sample results changed to ND at the LOQ if within 5x the EB concentration.
16 - SB had GRO detected at 36 ug/L. All sample results changed to ND at the LOQ if within 5x the SB concentration.
17 - Surrogate Squalene failed low in samples 13-EB-01 and 13-HPGW-01. Both sample results for DRO changed to ND at LOQ due to EB/SB contamination. DRO results qualified "UJ" in both samples.
Surrogate Squalene failed low in samples 13-HPGW-07 and 13-HPGW-08, likely to to interferene from high concentration of DRO. DRO qualified "J-" in both samples.
18 - The ending CCV for PAHs was analyzed slightly (less than one hour) outside the 12-hour criteria. No corrective action was deemed necessary.

Data qualifiers added, removed, or changed as a result of the data review are detailed in the following table:

Sample ID	Analyte	Units	Original Result	Final Result	Reason Code
13-TB-02	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-TB-02	Methylene Chloride	ug/L	0.74 JB	2.0 U	MB
13-EB-01	DRO	ug/L	31 J	210 UJ	SB, SL
13-EB-01	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-EB-01	Methylene Chloride	ug/L	0.81 JB	2.0 U	MB
13-HPGW-01	DRO	ug/L	90 J	220 UJ	SB, SL
13-HPGW-01	2-Butanone (MEK)	ug/L	2.6 J	10 U	SB
13-HPGW-01	Acetone	ug/L	110	110 U	SB
13-HPGW-01	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-01	Methylene Chloride	ug/L	0.55 JB	2.0 U	MB
13-HPGW-02	DRO	ug/L	97 J	220 U	SB
13-HPGW-02	Acetone	ug/L	2.6 J	10 U	SB
13-HPGW-02	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-02	Methylene Chloride	ug/L	0.46 JB	2.0 U	MB
13-HPGW-03	Acetone	ug/L	3.4 J	10 U	SB
13-HPGW-03	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-03	Methylene Chloride	ug/L	0.51 JB	2.0 U	MB
13-HPGW-04	DRO	ug/L	56 J	360 U	SB
13-HPGW-04	Acetone	ug/L	15	15 U	SB
13-HPGW-04	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-04	Methylene Chloride	ug/L	0.51 JB	2.0 U	MB
13-HPGW-05	DRO	ug/L	78 J	220 U	SB
13-HPGW-05	Anthracene	ug/L	0.16 UX	0.16 UJ	ML
13-HPGW-05	2-Methylnaphthalene	ug/L	0.34	0.34 J	FD
13-HPGW-05	Phenanthrene	ug/L	0.25	0.25 J	FD
13-HPGW-05	Naphthalene	ug/L	0.16 U	0.16 UJ	FD
13-HPGW-05	Acetone	ug/L	3.0 J	10 U	SB
13-HPGW-05	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-05	Methylene Chloride	ug/L	0.54 JB	2.0 U	MB
13-HPGW-05FD	DRO	ug/L	92 J	220 U	SB
13-HPGW-05FD	2-Methylnaphthalene	ug/L	0.92	0.92 J	FD
13-HPGW-05FD	Phenanthrene	ug/L	0.64	0.64 J	FD
13-HPGW-05FD	Naphthalene	ug/L	0.63	0.63 J	FD
13-HPGW-05FD	Acetone	ug/L	2.8 J	10 U	SB
13-HPGW-05FD	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-05FD	Methylene Chloride	ug/L	0.64 JB	2.0 U	MB
13-HPGW-06	DRO	ug/L	120 J	220 U	SB
13-HPGW-06	2-Butanone (MEK)	ug/L	1.2 J	10 U	SB
13-HPGW-06	Acetone	ug/L	15	15 U	SB
13-HPGW-06	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-06	Methylene Chloride	ug/L	0.59 JB	2.0 U	MB
13-HPGW-07	DRO	ug/L	1,800	1,800 J-	SL
13-HPGW-07	Acetone	ug/L	5.4 J	10 U	SB
13-HPGW-07	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-07	Methylene Chloride	ug/L	0.59 JB	2.0 U	MB
13-HPGW-08	DRO	ug/L	1,300	1,300 J-	SL
13-HPGW-08	Dichlorodifluoromethane	ug/L	0.60 U	0.60 UJ	CVL
13-HPGW-08	Methylene Chloride	ug/L	0.52 JB	2.0 U	MB

SDG: **1411600**
Matrix: Water
Normal Samples: 13
Field Duplicates: 1 Parent Sample(s): S-55-90 (VOC and DRO only)
MS/MSD: 0
Trip Blanks: 1 VOLATILES ONLY
Equipment Blanks: 0
Source Blanks: 0
Sample Collection Date(s): 11/12/2014
Verified By: B.Driskill
Date Verified: 12/31/2014
Level of Review: 3
Reviewed to Electronic Data: 1/12/2015
by: pjf

Parameter	Sample Receipt	Hold Time	MB	TB	EB	SB	LCS	LCSD	MS/MSD	AD	FD	Surrogates	Int. Stds.	DT	PDS	ICAL	ICV	CCV	ICB/CCB	FD RPD	Flag Changes?
VOC	OK	OK	1	2	NA	NA	OK	OK	NA	NA	OK	OK	OK	NA	NA	OK	3	4,5	NA	OK	YES
PAHs	OK	OK	OK	NA	NA	NA	OK	OK	NA	NA	NA	6	OK	NA	NA	OK	OK	OK	NA	NA	No
DRO	OK	OK	7	NA	NA	NA	OK	OK	NA	NA	OK	8	NA	NA	NA	OK	OK	OK	NA	OK	YES
METALS	OK	OK	9	NA	NA	NA	OK	NA	NA	NA	NA	NA	OK	NA	NA	OK	OK	OK	OK	NA	No
MERCURY	OK	OK	OK	NA	NA	NA	OK	NA	NA	NA	NA	NA	NA	NA	NA	OK	OK	OK	OK	NA	No

Notes:

1 - Method blank 1118: Acetone = 1.1ug/L, MeCl = 0.95ug/L; MB 1119: Acetone = 1.1ug/L, MeCl = 0.69ug/L. All sample resutls changed to ND at LOQ if within 5x/10x the associated MB concentration

2 - TB contained detections of Acetone and MeCl that were changed to ND due to the method blank contamination. No additional CA needed.

3 - ICV fails high for Dichlorodifluoromethane. All samples ND, no CA.

4 - CCV Batch ID 73426 (associated with all samples except S-25-88 and the 5x dilution of S-CAM-1): Bromoform response low, all associated samples qualified "UJ". Ending CCV failed low for Dichlorodifluromethane, all associated samples = UJ. Hexachlorobutadiene failed slightly low (5%), no CA.

5 - CCV Batch ID 73456 (Associated with S-25-88 and the 5x dilution of S-CAM-1 only): Acetone, Bromoform, Bromomethane failed slightly low (less than 5%), no CA. Ending CCV failed low for Dichlorodifluoromethane, all associated samples = UJ. Laboratory case narrative incorrectly states that the ending CCV fails low for 1,1-Dichloropropene. However, the %D for this anlayte was 38.1 and met criteira (max %D=50).

6 - Two of three surrogates were diluted out (zero percent recovery) in the 10x dilution of sample S-CAM-1. No CA needed since the low recoveries were attributed to the dilution analyzed.

7 - Method blank had DRO = 23 ug/L. DRO result for sample S-81-91 changed to ND at the LOQ. All other sample resutls either ND or greater than five times the MB concentration, so no additional CA needed.

8 - Surrogate low and outside criteria for samples: S-25-88, S13-CAM-DW1, S-87-91, and S-78-91. DRO qualified "J-" in these samples. Surrogate failed low for sample S-81-9 so DRO qualified "UJ". Surrogate failed high for sample S-26-88, so DRO qualified "J+".

9 - Method Blank: Chromium = 0.36 ug/L and Molybdenum = 1.2 ug/L. All sample results were greater than 5 times the MB concentration, no CA needed.

Data qualifiers added, removed, or changed as a result of the data review are detailed in the following table:

Sample ID	Analyte	Units	Original Result	Final Result	Reason Code
13-TB-04	Acetone	ug/L	3.4 J	10 U	MB
13-TB-04	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
13-TB-04	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
13-TB-04	Methylene Chloride	ug/L	0.76 J	2.0 U	MB
S-25-88	DRO	ug/L	580	580 J-	SL
S-25-88	Acetone	ug/L	13 Y	13 U	TB
S-25-88	Bromoform	ug/L	0.60 UY	0.60 U	PJ
S-25-88	Bromomethane	ug/L	4.0 UY	4.0 U	PJ
S-25-88	Dichlorofluoromethane	ug/L	0.60 UYZ	0.60 UJ	CVL
S-25-88	Methylene Chloride	ug/L	0.33 J	2.0 U	MB
S13-CAM-DW1	DRO	ug/L	1,400	1,400 J-	SL
S13-CAM-DW1	Acetone	ug/L	4.5 J	10 U	MB
S13-CAM-DW1	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S13-CAM-DW1	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S13-CAM-DW1	Methylene Chloride	ug/L	0.33	2.0 U	MB
S13-CAM-DW1	Antimony	ug/L	1.9 JG	1.9 J	PJ
S-26-88	DRO	ug/L	5,200	5,200 J+	SH
S-26-88	Acetone	ug/L	12	12 U	MB
S-26-88	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-26-88	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-26-88	Methylene Chloride	ug/L	0.42 J	2.0 U	MB
S-87-91	DRO	ug/L	1,000	1,000 J-	SL
S-87-91	Acetone	ug/L	3.4 J	10 U	MB
S-87-91	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-87-91	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-87-91	Methylene Chloride	ug/L	0.33 J	2.0 U	MB
S-55-90	Acetone	ug/L	1.7 J	10 U	MB
S-55-90	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-55-90	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-55-90	Methylene Chloride	ug/L	0.40 J	2.0 U	MB
S-55-90FD	Acetone	ug/L	3.2 J	10 U	MB
S-55-90FD	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-55-90FD	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-55-90FD	Methylene Chloride	ug/L	0.40 J	2.0 U	MB
S-29-88	Acetone	ug/L	2.2 J	10 U	MB
S-29-88	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-29-88	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-29-88	Methylene Chloride	ug/L	0.32 J	2.0 U	MB
S-82-91	Acetone	ug/L	2.2 J	10 U	MB
S-82-91	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-82-91	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-82-91	Methylene Chloride	ug/L	0.30 J	2.0 U	MB
S-CAM-2	Acetone	ug/L	3.3 J	10 U	MB
S-CAM-2	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-CAM-2	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-CAM-2	Methylene Chloride	ug/L	0.38 J	2.0 U	MB
S-CAM-1	Acetone	ug/L	8.8 J	10 U	MB
S-CAM-1	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-CAM-1	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-CAM-1	Methylene Chloride	ug/L	0.41 J	2.0 U	MB
S-30-88	Acetone	ug/L	2.4 J	10 U	MB
S-30-88	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-30-88	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-30-88	Methylene Chloride	ug/L	0.32 J	2.0 U	MB
S-78-91	DRO	ug/L	240	240 J-	SL
S-78-91	Acetone	ug/L	2.6 J	10 U	MB
S-78-91	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-78-91	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-78-91	Methylene Chloride	ug/L	0.44 J	2.0 U	MB
S-91-91	Acetone	ug/L	2.1 J	10 U	MB
S-91-91	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-91-91	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-91-91	Methylene Chloride	ug/L	0.40 J	2.0 U	MB
S-81-91	DRO	ug/L	86 J	210 UJ	MB, SL
S-81-91	Acetone	ug/L	1.9 J	10 U	MB
S-81-91	Bromoform	ug/L	0.60 UY	0.60 UJ	CVL
S-81-91	Dichlorofluoromethane	ug/L	0.60 UZ	0.60 UJ	CVL
S-81-91	Methylene Chloride	ug/L	0.37 J	2.0 U	MB

SDG:	**1411662**
Matrix:	water
Normal Samples:	2
Field Duplicates:	0
Trip Blanks:	0
Equipment Blanks:	0
Source Blanks:	0
Sample Collection Dates:	11/13/2014
Verified By:	B.Driskill
Date Verified:	12/24/2014
Level of Review:	3
Reviewed to Electronic Data:	12/29/2014
by:	pjf

Parameter	Sample Receipt	Hold Time	MB	TB	EB	SB	LCS	LCSD	MS/MSD	AD	FD	Surrogates	Int. Stds	DT	PDS	ICAL	ICV	CCV	ICB/ CCB	Flag Changes?
Anions	OK	OK	OK	NA	NA	NA	OK	NA	NA	NA	NA	NA	NA	NA	NA	OK	OK	OK	OK	No
TDS	OK	OK	OK	NA	NA	NA	OK	NA	NA	OK	NA	NA	NA	NA	NA	NA	NA	OK	NA	No
METALS	OK	OK	OK	NA	NA	NA	OK	NA	NA	NA	NA	NA	NA	1	1	OK	OK	OK	OK	No

Notes:

1 - DT and PDS were performed on a sample unrelated to this project to fulfill batch QC. No CA needed.

No data qualifiers were added, removed, or changed as a result of the data review for this SDG.

SDG:	**1604069**	
Matrix:	GW	
Normal Samples:	1	
Field Duplicates:	0	
MS/MSD:	0	
Trip Blanks:	1	VOLATILES ONLY
Equipment Blanks:	0	
Source Blanks:	0	
Sample Collection Dates:	3/31-4/1/16	
Verified By:	KLaPierre	
Date Verified:	4/16/2016	
Level of Review:	1/3/1900	

Parameter	Sample Receipt	Hold Time	MB	TB	EB	SB	LCS	LCSD	MS/MSD	AD	FD RPD	Surrogates	Int. Stds.	DT	PDS	ICAL	ICV	CCV	ICB/CCB	Flag Changes?
VOC	OK	OK	1	2	NA	NA	OK	OK	NA	NA	NA	OK	OK	NA	NA	OK	3	OK	NA	YES
SVOCs	OK	OK	OK	NA	NA	NA	4	5	NA	NA	NA	6	OK	NA	NA	OK	7	8	NA	YES
DRO	OK	OK	OK	NA	NA	NA	OK	OK	NA	NA	NA	OK	NA	NA	NA	OK	OK	OK	NA	No
METALS	OK	OK	9	NA	NA	NA	OK	NA	10	NA	NA	NA	11	12	13	OK	OK	OK	OK	YES
MERCURY	OK	OK	OK	NA	NA	NA	OK	NA	OK	NA	NA	NA	NA	NA	NA	OK	OK	OK	OK	No
TDS	OK	OK	OK	NA	NA	NA	OK	NA	NA	OK	NA	NA	NA	NA	NA	NA	NA	OK	NA	No

Notes:

1 - Method Blank contained 1,2,3-Trichlorobenzene at 0.42 ug/L (LOQ=1.0 ug/L) and Methylene Chloride at 0.34 ug/L (LOQ=2.0 ug/L). Sample was ND for 1,2,3-Trichlorobenzene, no CA needed. Methylene chloride changed to ND at the LOQ in TB and field sample.
2 - Trip Blank contained Methylene chloride at 0.50 ug/L (LOQ=2.0 ug/L). Sample result changed to ND at the LOQ due to method blank contamination. No further CA needed.
3 - ICV failed slightly high for Styrene (%D=21.8, Max %D=20). All sample results ND. No CA needed.
4 - LCS failed for 3/4-Methylphenol at 113% (Criteria 29-110%), and Carbazole at 123% (Criteria 60-122%). Both minor exceedances so no CA needed.
5 - LCSD failed for 3,3'-Dichlorobenzidine at 130% (Criteria 27-129%), 4-Nitroaniline at 133% (Criteria 50-130%), and Carbazole at 125% (Criteria 60-122%). All minor exceecances so no CA needed.
6 - Sample S13-CAM-DW1: Surrogate 2,4,6-Tribromophenol failed at 143% (Criteria 43-140%). Minor exceedance, no CA needed. Surrogate 2,4,6-Tribromophenol also failed in LCS at 144% and LCSD at 151%. No CA needed.
Surrogate Phenol-d5 failed at 30.8% in the Method Blank (Criteria 33-122%). No CA needed.
7 - ICV failed high for Bis(2-chloroisopropyl)ether (%D=35.1, Max %D=20). Sample result ND so data quality not affected by high bias. No CA needed.
8 - Ending CCV failed low (Max %D=50) for the following analytes: 2,4-Dinitrophenol (%D=86), 4,6-Dinitro-2-methylphenol (%D=89.1), Benzo(ghi)perylene (%D=63.5), and Hexachloroethane (%D=81.2).
All analytes non-detect and qualified "UJ" in the field sample due to the low bias.
9 - Method blank contained Chromium at 0.42 ug/L (LOQ=10 ug/L), Manganese at 0.30 ug/L (LOQ=5.0 ug/L), and Nickel at 0.22 ug/L (LOQ=10 ug/l). All sample results were greater than ten times the MB concentration. No CA needed.
10 - MS/MSD on S13-CAM-DW1: Beryllium failed slightly low (MS=78.3%, MSD=78.1%, Criteira 83-121%), minor exceedances, no CA. Lead failed slightly low (MS=87.0%, MSD=87.0%, Criteira 88-115%), minor excedances, no CA.
Molybdenum failed high (MS=124%, MSD=125%, Criteria=83-115%). Sample results for Molybdenum qualified "J+" due to the high bias.
11 - Beryllium analyzed at 10x dilution because the associated internal standard failed in the 5x analysis. The internal standard met criteia in the 10x analysis.
12 - No DT was performed on this sample. Batch sample unrelated to this site was chosen for DT to fulfill batch QC requirements.
13 - PDS analyzed on S13-CAM-DW1: All metals met criteria (80-120%) except Beryllium (%R=72.3). No CA needed since Beryllium met criteira in the MS/MSD.

Data qualifiers added, removed, or changed as a result of the data review are detailed in the following table:

Sample ID	Analyte	Units	Original Result	Final Result	Reason Code(s)
Trip Blank	Methylene Chloride	µg/L	0.50 J	2.0 U	MB
S13-CAM-DW1	Methylene Chloride	µg/L	0.80 J	2.0 U	MB, TB
S13-CAM-DW1	2,4-Dinitrophenol	µg/L	9.3 U	9.3 UJ	CVL
S13-CAM-DW1	4,6-Dinitro-2-methylphenol	µg/L	2.3 U	2.3 UJ	CVL
S13-CAM-DW1	Benzo(ghi)perylene	µg/L	0.47 U	0.147 UJ	CVL
S13-CAM-DW1	Hexachloroethane	µg/L	0.47 U	0.147 UJ	CVL
S13-CAM-DW1	Molybdenum	µg/L	57	57 J+	MH

SDG:	**320-10430**
Matrix:	Water
Normal Samples:	2
Field Duplicates:	0
MS/MSD:	0
Trip Blanks:	0
Equipment Blanks:	0
Source Blanks:	0
Sample Collection Date(s):	11/12/14, 11/13/14
Verified by:	B.Driskill
Date Verified:	12/23/2014
Level of Review:	3
Reviewed to Electronic Data:	12/30/2014
by:	pjf

Parameter	Sample Receipt	Hold Time	MB	TB	EB	SB	LCS	LCSD	MS/MSD	AD	FD	Surrogates	Int. Stds.	DT	PDS	ICAL	ICV	CCV	ICB/CCB	Flag Changes?
ABPs (8321M)	OK	OK	1	NA	NA	NA	OK	NA	2	NA	NA	see note 4	NA	NA	NA	OK	OK	OK	NA	YES

Notes:

1 - TDG was detected in the MB at 3.92 ug/L (LOQ=10ug/L). All sample results ND for TDG so no corrective action (CA) needed.

2 - MS/MSD analyzed on S-26-88: The following analytes failed low - EMPA (MS=26%, MSD=26%, Criteria=67-128%), IMPA (MS=55%, MSD=57%, Criteria=65-113%), and MPA (MS=0%, MSD=0%, Criteria=60-122%).
Parent sample results for EMPA and IMPA were qualified "UJ".

3 - All MPA results were qualified "R" as rejected due to zero percent recoveries in the project matrix (systematic issue). DMMP failed high (MS=188%, MSD=209%, Criteria=56-116%), all samples ND for DMMP, no CA needed.

4 - Sample S-78-91: Surrogate IMPA-d7 failed low (%R=26, Criteria=50-120). Detections were qualified "J-" and non-detects were qualified "UJ", with the exception of MPA as this analyte was already qualified "R".

Data qualifiers added, removed, or changed as a result of the data review are detailed in the following table:

Sample ID	Analyte	Units	Original Result	Final Result	Reason Code(s)
S-78-91	DIMP	µg/L	3.9 J	3.9 J-	SL
S-78-91	IMPA	µg/L	260	260 J-	SL
S-78-91	DMMP	µg/L	5.0 U	5.0 UJ	SL
S-78-91	EMPA	µg/L	5.0 U	5.0 UJ	SL
S-78-91	MPA	µg/L	50 U	50 R	PJ
S-78-91	TDG	µg/L	5.0 U	5.0 UJ	SL
S-26-88	DMMP	µg/L	5.0 UJ	5.0 U	PJ
S-26-88	MPA	µg/L	50 UJ	50 R	PJ

DATA VALIDATION SUMMARY REPORT
FOR SAMPLES COLLECTED FROM
SWMU 13

TOOELE ARMY DEPOT – SOUTH AREA, UTAH

Data Validation by: Beth Driskill

Revision Date: March 11, 2015
Parsons - Austin

INTRODUCTION

The following data validation summary report covers water samples collected from solid waste management unit (SWMU) 13 at Tooele Army Depot – South Area (TEADS), Utah on September 17, 2014. Samples were logged under the following Sample Delivery Group (SDG):

320-9497

The samples in this SDG were analyzed for Agent Breakdown Products (ABPs) by U.S. EPA Method SW8321M in accordance with the TestAmerica Standard Operating Procedure WS-LC-0004. The following table details the samples included in this SDG.

All samples were collected by Parsons using certified-clean sampling containers provided by TestAmerica Laboratories, Inc. (TAL) in West Sacramento, California. The samples were placed on ice immediately following collection and were shipped to TAL in West Sacramento, California using the provided insulated coolers. All containers were received at the laboratory in good condition and within the temperature acceptance range of 0.2 to 6^{o} Celsius.

All samples were prepared and analyzed following the procedures outlined in the Quality Assurance Project Plan (QAPP) for TEADS 13/30 and the Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.0.

SAMPLE IDS AND REQUESTED PARAMETERS

Sample ID	Matrix	ABPs	Comments
13-HPGW-03	Water	X	
13-HPGW-05	Water	X	MS/MSD
13-HPGW-05FD	Water	X	Field duplicate
13-EB-02	Water	X	Equipment blank

EXTRACTION, ANALYTICAL, AND REPORTING DETAILS

PARAMETER	MATRIX	PREP METHOD	ANALYTICAL METHOD	UNITS
ABPs	Water	SW8321M	SW8321M	µg/L

EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the DoD QSM, Version 5.0 and the project-specific UFP QAPP. Information reviewed in the data packages included sample results; field and laboratory quality control results; instrument calibration; calibration verifications; case narratives; sample receipt forms, and chain-of-custody (COC) forms. The analyses and findings presented in this report are based on the reviewed information, and whether guidelines in the associated analytical method, DoD QSM and QAPP were met.

A Stage 4 review was performed for all data in this SDG.

A table detailing the data qualifiers applied, removed, or changed for the samples in this SDG as a result of the data validation process is included at the end of this report.

ABPS BY SW8321M

General

This SDG consisted of four (4) samples, including two (2) environmental water samples, one field duplicate, and one equipment blank. The samples were collected on September 17, 2014 and were analyzed by method SW8321M for the following project specific agent breakdown products: Diisopropylmethylphosphonate (DIMP), Dimethylmethyl-phosphonate (DMMP), Ethyl methylphosphonic acid (EMPA), Isopropyl methyl phosphonic acid (IMPA), Methylphosponic acid (MPA), and Thiodiglycol (TDG).

The analyses were performed using U.S. EPA Method SW8321M. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPP. All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed in one batch under two initial calibrations (ICALs).

Accuracy

Accuracy was evaluated using the percent recovery (%R) obtained from the laboratory control sample (LCS), the matrix spike/matrix spike duplicate (MS/MSD) pair, and the surrogate spikes.

One LCS sample was analyzed and all recoveries were within acceptance criteria.

Sample 13-HPGW-05 was designated for MS/MSD analysis on the COC. All MS/MSD recoveries were within acceptance criteria, except for the following:

Analyte	MS %R	MSD %R	Criteria
DIMP	141	144	55-117
DMMP	221	259	56-116
EMPA	27	32	67-128
IMPA	(68)	59	65-113
MPA	0	0	60-112

( ) indicates the recovery met criteria.

No corrective action was deemed necessary for DIMP and DMMP since the MS/MSD recoveries indicated a high bias and the parent sample was non-detect. Thus, a significant effect on data quality was not demonstrated. EMPA and IMPA were qualified as "UJ" in the parent sample due to the low bias demonstrated by the MS/MSD. MPA was not recovered in the MS or MSD indicating that the laboratory's ability to quantitate this compound in the sample matrix is uncertain. All environmental sample results for MPA in this SDG were qualified "R".

Surrogate spike compounds were added to every field and QC sample. All surrogate spike recoveries were within acceptance criteria, except for the following:

Sample ID	Surrogate	%R	Criteria
13-HPGW-05FD	TDG-d8	38	50-120%

The laboratory re-extracted and reanalyzed this sample with similar results. The original analysis was used for reporting purposes. All analytes were non-detect in this sample. The results for the associated analytes DIMP, DMMP, and TDG were qualified "UJ" in sample 13-HPGW-05FD due to the low surrogate recovery.

Precision

Precision was evaluated using the relative percent difference (RPD) obtained from the MS/MSD concentrations. Precision was further evaluated by comparing the field duplicate analyte results. A field duplicate was collected for sample 13-HPGW-05.

All MS/MSD RPDs were within acceptance criteria.

All the target analytes were non-detect in parent sample 13-HPGW-05 and the associated field duplicate.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining field and laboratory blanks for cross contamination of samples during collection and analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP. All samples were prepared and analyzed within the holding time required by the method.

- All initial calibration criteria were met. The laboratory noted in the case narrative that the calibration curve standard level 4 (40 ng/mL) was inadvertently analyzed twice and that standard level 5 was not analyzed. The extra standard level 4 was deleted from the calibration curve by the laboratory prior to processing the data. The curve contained the method required number of calibration levels so all criteria were met. The absence of the level 5 standard in the ICAL did not adversely affect the data for this method.

- All secondary source criteria were met. The initial calibration verification (ICV) was prepared from a second source standard.
- All continuing calibration verification (CCV) criteria were met.

One laboratory method blank was associated with the ABP analyses in this SDG. The laboratory method blank was non-detect for all target analytes, except for the following:

Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
MB 320-53061/1-A	TDG	1.34	10

The associated samples were non-detect for TDG so no corrective action was necessary.

The EB (13-EB-02) was non-detect for all target ABPs.

The source blank (30-FB-01) was collected on 9/10/14 and is reported in SDG 320-9374. The source blank was non-detect for all target ABPs, except for the following:

Source Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
30-FB-01	TDG	1.6	10

The associated sample results for TDG in this SDG are all non-detect. Therefore, no corrective action was necessary

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All results for the samples in this SDG were considered usable with the exception of MPA. The results for MPA were "R" flagged because the laboratory was not able to quantitate this compound in the sample matrix. Therefore, the completeness for this SDG is 87.5%, which falls below the minimum acceptance criteria of 90%.

COMPARABILITY

All data was generated using contract-specific standard methods and reported with known data quality, type of analysis, units, etc.

DATA USABILITY

The purpose of this data validation report is to ensure the integrity and reliability of analytical laboratory data. The data quality is evaluated based on precision, accuracy, representativeness, comparability, and completeness (PARCC) characteristics of the data. The validated data indicated that the laboratory correctly performed the analyses. Based on the data quality assessment, three results in this SDG were flagged as rejected and are not considered usable.

All sample LODs and LOQs met the requirements listed in the project QAPP. All Method Quality Objectives have been met.

SENSITIVITY

The DL, LOD, and LOQ values reported for the samples were compared to those listed in the QAPP to ensure that sensitivity requirements were met.

DATA QUALIFIER CHANGES

The following data qualifiers were added, removed, or changed as a result of the data validation process:

Sample ID	Analyte	Units	Original Result	Final Result	Reason Code
13-HPGW-05	DIMP DMMP IMPA	µg/L	5.0 UJ 5.0 UJ 10 UJ	5.0 U 5.0 U 10 U	PJ
13-HPGW-05	MPA	µg/L	50 UJ	50 R	MXL
13-HPGW-03	MPA	µg/L	50 U	50 R	MXL
13-HPGW-05FD	MPA	µg/L	50 U	50 R	MXL
13-HPGW-05FD	DIMP	µg/L	5.0 U	5.0 UJ	SL
13-HPGW-05FD	DMMP	µg/L	5.0 U	5.0 UJ	SL
13-HPGW-05FD	TDG	µg/L	5.0 U	5.0 UJ	SL

DATA VALIDATION SUMMARY REPORT
FOR SAMPLES COLLECTED FROM
SWMU 13/30

TOOELE ARMY DEPOT – SOUTH AREA, UTAH

Data Validation By: Katherine LaPierre

Report Date: January 14, 2015
Parsons - Austin

INTRODUCTION

The following data validation summary report covers water quality control (QC) samples collected from solid waste management unit (SWMU) 13 and SWMU 30 at Tooele Army Depot – South Area (TEADS), Utah on September 8 and 9, 2014. Samples were logged under the following Sample Delivery Group (SDG):

1409450

The samples in this SDG were analyzed for the following parameters: volatile organic compounds (VOCs) by SW8260C, polycyclic aromatic hydrocarbons (PAHs) by SW8270D-LL (low level), semivolatile organic compounds (SVOCs) by SW8270D, diesel range organics by SW8015D, explosives by SW8330B, metals by SW6020A, and mercury by SW7470A. Not all samples were analyzed for all parameters. The following table details the samples included in this SDG and the analytical parameters performed.

All samples were collected by Parsons using certified-clean, pre-preserved sampling containers provided by RTI Laboratories, Inc. (RTI). The samples were placed on ice immediately following collection and were shipped to RTI in four coolers. Three of the four coolers were received by RTI at temperatures within the required 0.1 to 6.0^{o} Celsius. The fourth cooler was received by the laboratory at a temperature of 7.7^{o}C, which was slightly above the acceptance range. Due to laboratory error, the receiving department did not record which samples or containers were received in the cooler with the high temperature. As the affected samples / containers could not be identified and the temperature exceedance was only slightly (1.7^{o}C) above criteria, no corrective action was deemed necessary. All containers were received at the laboratory in good condition.

All samples were prepared and analyzed following the procedures outlined in the Quality Assurance Project Plan (QAPjP) for TEADS 13/30 and the Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.0 with the exceptions noted in this report.

SAMPLE IDs AND REQUESTED PARAMETERS

Sample ID	Matrix	VOCs	PAHs	SVOCs	DRO	Explosives	Metals/ Mercury	Comments
13/30-TB-1A	Water	X						Trip Blank
13-FB-01	Water	X	X		X			Source Blank
30-FB-01	Water	X	X	X	X	X	X	Source Blank
13/30-EB-01	Water	X			X		X	Equipment Blank
13/30-TB-1B	Water	X						Trip Blank

EXTRACTION, ANALYTICAL, AND REPORTING DETAILS

Parameter	Matrix	Prep Method	Analytical Method	Units
VOCs	Water	SW5030B	SW8260C	µg/L
PAHs	Water	SW3510C	SW8270D-LL	µg/L
SVOCs	Water	SW3510C	SW8270D	µg/L
DRO	Water	SW3510C	SW8015D	µg/L
Explosives	Water	Method	SW8330B	µg/L
Metals	Water	SW3020A	SW6020A	µg/L
Mercury	Water	Method	SW7470A	µg/L

EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the DoD QSM, Version 5.0 and the project-specific UFP QAPP. Information reviewed in the data packages included sample results; field and laboratory quality control results; instrument calibration; calibration verifications; case narratives; sample receipt forms, and chain-of-custody (COC) forms. The analyses and findings presented in this report are based on the reviewed information, and whether guidelines in the associated analytical method, DoD QSM and QAPjP were met.

A Stage 3 review was performed for all data in this SDG.

A table detailing the data qualifiers applied, removed, or changed for the samples in this SDG as a result of the data validation process is included at the end of this report.

VOCs

General

The VOC portion of this SDG consisted of five (5) samples, including two (2) trip blanks, two (2) source blanks, and one (1) equipment blank. The samples were collected on September 8 and 9, 2014 and were analyzed for volatile organic compounds as specified in the project QAPP.

The volatiles analyses were performed in accordance with U.S. EPA Method SW8260C. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPjP, with one exception. Due to laboratory error, the target analyte 1,2,3-Trimethylbenzene was omitted from the spiking solution for the laboratory control sample (LCS), LCS duplicate (LCSD), and the continuing calibration verification (CCV) samples that bracketed the batch. The instrument was calibrated for this analyte and a compliant initial calibration verification (ICV) was performed for 1,2,3-Trimethylbenzene using a secondary source. As this analyte is not a common contaminant, the impact on data usability was minimal. All results for this analyte were non-detect and were qualified “UJ” as estimated at the LOD due to the spike omission.

All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed in one batch under a single initial calibration (ICAL).

Accuracy

Accuracy was evaluated using the percent recovery (%R) obtained from the LCS, LCSD, and the surrogate spikes.

One LCS/LCSD pair was analyzed. As previously noted, the LCS/LCSD was not spiked for 1,2,3-Trimethylbenzene. All LCS/LCSD recoveries were within acceptance criteria.

Surrogate spike compounds were added to every field and QC sample. All surrogate spike recoveries were within acceptance criteria.

Precision

Precision was evaluated using the relative percent difference (RPD) obtained from the LCS/LCSD analyte results.

All LCS/LCSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining field and laboratory blanks for cross contamination of samples during collection, transport, and analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP with the exceptions previously noted. All samples were prepared and analyzed within the holding time required by the method.

- All instrument tune criteria were met.
- All initial calibration criteria were met.
- The ICV was prepared from a second source standard. All ICV criteria were met, except for the following:

ICV ID	Analyte	%D	Criteria
VOA11B ICV 090814	Bromomethane	28	%D ≤ 20

The ICV response for bromomethane demonstrated a high bias and all sample results were non-detect for this compound, so no corrective action was necessary.

- As previously noted, the laboratory omitted 1,2,3-Trimethylbenzene from the CCV spike solution. All other CCV criteria were met, with the following exceptions:

CCV ID	Analyte	%D	Criteria
VOA11B CCV 091214	Bromomethane	22.5	%D ≤ 20
VOA11B END CCV 091214	Bromomethane Dichlorodifluoromethane	60.5 50.6	%D ≤ 50

No corrective action was deemed necessary for dichlorodifluoromethane since the %D was less than one percent outside criteria. All sample results for bromomethane were non-detect and were qualified “UJ” as estimated at the LOD due to the non-compliant ending CCV.

- All internal standard criteria were met.
- The laboratory performed quarterly LOQ verifications as required.

One laboratory method blank was associated with the volatiles analyses in this SDG. The laboratory method blank was non-detect for all target VOCs, except for the following:

Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
VOA11B MBLK 091214	Acetone Methylene Chloride	2.0 0.74	10 2.0

All associated sample results for acetone and methylene chloride were changed to non-detect at the LOQ or, if detected above the LOQ and within 10 times the method blank result, non-detect at the concentration found due to the laboratory contamination noted.

The trip blanks were non-detect for all target VOCs, except for the following:

Trip Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
13/30-TB-1A	Acetone	0.62	10
	Methylene Chloride	0.63	2.0
13/30-TB-1B	Methylene Chloride	0.65	2.0

The associated sample results for acetone and methylene chloride were previously changed to non-detect at the LOQ due to the method blank contamination. Therefore, no additional corrective action was necessary.

The equipment blank was non-detect for all target VOCs, except for the following:

EB ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
13/30-EB-01	2-Butanone	2.2	10
	Acetone	20	10
	Methylene Chloride	0.50	2.0

The associated sample results for acetone and methylene chloride were previously changed to non-detect at the LOQ due to the method blank contamination. Therefore, no additional corrective action was necessary.

The source blanks were non-detect for all target VOCs, except for the following:

Source Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
13-FB-01	2-Butanone	1.4	10
	Acetone	13	10
	Methylene Chloride	0.35	2.0
30-FB-01	2-Butanone	2.2	10
	Acetone	18	10
	Methylene Chloride	0.45	2.0

The source blank consists of clean laboratory-pure water poured into the appropriate sample containers onsite. The same source water is used for rinsing reusable sampling equipment and equipment blanks. The equipment blank detections for 2-butanone, acetone, and methylene chloride were changed to non-detect at the LOQ due to the source blank contamination.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatiles results for the samples in this SDG were considered usable. Therefore, the completeness for the VOC portion of this SDG is 100%, which meets the minimum acceptance criteria of 95%.

DRO

General

The DRO portion of this SDG consisted of three (3) samples, including two (2) source blanks and one (1) equipment blank. The samples were collected on September 8 and 9, 2014 and were analyzed for Diesel Range Organics (Carbon range C10-C28) as specified in the project QAPP.

The DRO analyses were performed in accordance with U.S. EPA Method SW8015D. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPjP, with one exception. Due to laboratory error, the surrogate listed in the QAPjP was incorrect. The laboratory used Squalene (not o-Terphenyl) as the surrogate for this analysis. The surrogate recoveries were evaluated using the tolerances provided in the report (70-130% for water). The use of the alternate surrogate did not impact data quality or usability.

All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed in one batch under a single initial calibration (ICAL).

Accuracy

Accuracy was evaluated using the percent recovery obtained from the LCS, LCSD, and the surrogate spikes.

The LCS/LCSD recoveries were within acceptance criteria.

Surrogate spike compounds were added to every field and QC sample. All surrogate spike recoveries were within acceptance criteria.

Precision

Precision was evaluated using the RPD obtained from the LCS/LCSD analyte results.

The LCS/LCSD RPD was within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining field and laboratory blanks for cross contamination of samples during collection and analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP with the exception previously noted. All samples were prepared and analyzed within the holding time required by the method.

- All instrument tune criteria were met.
- All initial calibration criteria were met.
- The ICV was prepared from a second source standard. All ICV criteria were met.

- All CCV criteria were met.
- The laboratory performed quarterly LOQ verifications as required.

One laboratory method blank was associated with the DRO analyses in this SDG. The laboratory method blank contained DRO as follows:

Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
MB-34423	DRO	27	200

All associated sample results for DRO were changed to non-detect at the LOQ due to the laboratory contamination noted.

The equipment blank contained DRO as follows:

EB ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
13/30-EB-01	DRO	44	220

The associated sample results for DRO were previously changed to non-detect at the LOQ due to the method blank contamination. Therefore, no additional corrective action was necessary.

The source blanks contained DRO as follows:

Source Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
13-FB-01	DRO	36	230
30-FB-01	DRO	43	220

The associated sample results for DRO were previously changed to non-detect at the LOQ due to the method blank contamination. Therefore, no additional corrective action was necessary.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All DRO results for the samples in this SDG were considered usable. Therefore, the completeness for the DRO portion of this SDG is 100%, which meets the minimum acceptance criteria of 95%.

PAHs

General

The PAH portion of this SDG consisted of one (1) source blank. The sample was collected on September 8, 2014 and was analyzed for polycyclic aromatic hydrocarbons as specified in the project QAPP.

The PAH analyses were performed in accordance with U.S. EPA Method SW8270D-Low Level. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPjP.

All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed in one batch under a single initial calibration (ICAL).

Accuracy

Accuracy was evaluated using the percent recovery obtained from the LCS, LCSD, and the surrogate spikes.

All LCS/LCSD and surrogate spike recoveries were within acceptance criteria.

Precision

Precision was evaluated using the RPD obtained from the LCS/LCSD analyte results.

All LCS/LCSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining field and laboratory blanks for cross contamination of samples during collection and analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP. All samples were prepared and analyzed within the holding time required by the method.

- All instrument tune criteria were met.
- All initial calibration criteria were met.
- The ICV was prepared from a second source standard. All ICV criteria were met.
- All CCV criteria were met.
- All internal standard criteria were met.
- The laboratory performed quarterly LOQ verifications as required.

One laboratory method blank was associated with the semivolatiles analyses in this SDG. The laboratory method blank was non-detect for all target PAHs.

The source blank was non-detect for all target PAHs.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All PAH results for the samples in this SDG were considered usable. Therefore, the completeness for the PAH portion of this SDG is 100%, which meets the minimum acceptance criteria of 95%.

SVOCs

General

The SVOC portion of this SDG consisted of one (1) source blank. The sample was collected on September 9, 2014 and was analyzed for semivolatile organic compounds as specified in the project QAPP.

The semivolatiles analyses were performed in accordance with U.S. EPA Method SW8270D. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPjP, with a few exceptions. Due to laboratory error, the accuracy tolerances listed in the project QAPP were incorrect for the target analytes 2,4,6-Trichlorophenol and Phenol, and for the surrogate compound Phenol-d5. The tolerances reported in the hard copy were used to evaluate accuracy. This issue did not affect data quality or usability.

All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed in one batch under a single initial calibration (ICAL).

Accuracy

Accuracy was evaluated using the percent recovery obtained from the LCS, LCSD, and the surrogate spikes.

All LCS/LCSD recoveries were within acceptance criteria.

Surrogate spike compounds were added to every field and QC sample. All surrogate spike recoveries were within acceptance criteria, except for the following:

Sample ID	Surrogate	%R	Criteria
MB-34418	Phenol-d5	32.3	33-122%
LCS-34418	Phenol-d5	31.4	33-122%
30-FB-01	Phenol-d5	31.1	33-122%

No corrective action was necessary as the non-compliant surrogate recoveries were only slightly (less than 5%) below criteria.

Precision

Precision was evaluated using the RPD obtained from the LCS/LCSD analyte results.

All LCS/LCSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and

- Examining field and laboratory blanks for cross contamination of samples during collection and analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP with the exceptions previously noted. All samples were prepared and analyzed within the holding time required by the method.

- All instrument tune criteria were met.
- All initial calibration criteria were met.
- The ICV was prepared from a second source standard. All ICV criteria were met.
- All CCV criteria were met, with the following exceptions:

CCV ID	Analyte	%D	Criteria
CCVE 091514	2,4-Dinitrophenol 4,6-Dinitro-2-methylphenol Pentachlorophenol	70.7 53.0 62.9	%D ≤ 50

No corrective action was deemed necessary for 4,6-Dinitro-2-methylphenol since the %D was only three percent outside criteria. The results for 2,4-Dinitrophenol and Pentachlorophenol were non-detect in sample 30-FB-01 and thus were qualified "UJ" as estimated at the LOD due to the non-compliant ending CCV.

- All internal standard criteria were met.
- The laboratory performed quarterly LOQ verifications as required.

One laboratory method blank was associated with the semivolatiles analyses in this SDG. The laboratory method blank was non-detect for all target SVOCs.

The source blank was non-detect for all target SVOCs, except for the following:

Source Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
30-FB-01	Phenol	0.27	5.4

The source blank consists of clean laboratory-pure water poured into the appropriate sample containers onsite. The same source water is used for rinsing reusable sampling equipment and equipment blanks.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All semivolatiles results for the samples in this SDG were considered usable. Therefore, the completeness for the semivolatile portion of this SDG is 100%, which meets the minimum acceptance criteria of 95%.

EXPLOSIVES

General

The explosives portion of this SDG consisted of one (1) source blank. The sample was collected on September 9, 2014 and was analyzed for explosives organic compounds as specified in the project QAPP.

The explosives analyses were performed in accordance with U.S. EPA Method SW8330B. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPjP.

All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed in one batch under a single initial calibration (ICAL).

Accuracy

Accuracy was evaluated using the percent recovery obtained from the LCS, LCSD, and the surrogate spikes.

All LCS/LCSD recoveries were within acceptance criteria, except for the following:

Analyte	LCS %R	LCSD %R	Criteria
Nitroglycerin	72	(79)	74-127

( ) indicates the recovery met criteria.

No corrective action was necessary as the LCSD recovery met criteria and the LCS was only two percent below criteria. Thus, a significant impact on data quality was not demonstrated.

Surrogate spike compounds were added to every field and QC sample. All surrogate spike recoveries were within acceptance criteria.

Precision

Precision was evaluated using the RPD obtained from the LCS/LCSD analyte results.

All LCS/LCSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining field and laboratory blanks for cross contamination of samples during collection, transport, and analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP. All samples were prepared and analyzed within the holding time required by the method.

- All instrument tune criteria were met.
- All initial calibration criteria were met.
- The ICV was prepared from a second source standard. All ICV criteria were met.
- All CCV criteria were met.
- The laboratory performed quarterly LOQ verifications as required.

One laboratory method blank was associated with the explosives analyses in this SDG. The laboratory method blank was non-detect for all target explosives.

The source blank was non-detect for all target explosives.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All explosives results for the samples in this SDG were considered usable. Therefore, the completeness for the explosives portion of this SDG is 100%, which meets the minimum acceptance criteria of 95%.

METALS

General

The metals portion of this SDG consisted of two (2) samples, including one (1) source blank and one (1) equipment blank. The samples were collected on September 9, 2014 and were analyzed for metals as specified in the project QAPP.

The metals analyses were performed in accordance with U.S. EPA Method SW6020A. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPjP.

All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed in one batch under a single initial calibration (ICAL). All analyses were performed at a 5x dilution inherent in the method.

Accuracy

Accuracy was evaluated using the percent recovery obtained from the LCS and the matrix spike/matrix spike duplicate (MS/MSD) pair. No sample was designated for MS/MSD analysis on the COC. However, the laboratory performed an MS/MSD on sample 13/30-EB-01 to fulfill batch requirements.

All LCS recoveries were within acceptance criteria.

All MS/MSD recoveries were within acceptance criteria, except for the following:

Analyte	MS %R	MSD %R	Criteria
Antimony	(107)	118	85-117
Silver	(108)	117	85-116

( ) indicates the recovery met criteria.

No corrective action was deemed necessary since the recoveries were only slightly (1%) above criteria. Thus, a significant effect on data quality was not demonstrated.

Precision

Precision was evaluated using the RPD obtained from the MS/MSD analyte results.

All MS/MSD RPDs were within acceptance criteria.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining field and laboratory blanks for cross contamination of samples during collection and analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP with the exceptions previously noted. All samples were prepared and analyzed within the holding time required by the method.

- All instrument tune criteria were met.
- All initial calibration criteria were met.
- The ICV was prepared from a second source standard. All ICV criteria were met.
- All CCV criteria were met.
- All internal standard criteria were met.
- The laboratory performed quarterly LOQ verifications as required.

One laboratory method blank was associated with the metals analyses in this SDG. The laboratory method blank was non-detect for all target metals, except for the following:

Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
MB-34411	Molybdenum	0.72	5.0

All associated sample results for molybdenum were changed to non-detect at the LOQ due to the laboratory contamination noted.

The equipment blank was non-detect for all target metals, except for the following:

EB ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
13/30-EB-01	Manganese	0.30	5.0
	Molybdenum	1.5	5.0
	Silver	0.18	1.5

The source blank was non-detect for all target metals, except for the following:

Source Blank ID	Analyte	Conc. (µg/L)	LOQ (µg/L)
30-FB-01	Beryllium	0.45	1.0
	Chromium	0.74	10
	Cobalt	0.17	5.0
	Copper	0.75	5.0
	Manganese	0.45	5.0
	Molybdenum	2.2	5.0
	Nickel	0.34	10
	Zinc	4.8	50

The source blank consists of clean laboratory-pure water poured into the appropriate sample containers onsite. The same source water is used for rinsing reusable sampling equipment and equipment blanks. The equipment blank detections for Molybdenum and Manganese were changed to non-detect at the LOQ due to the source blank contamination.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All metals results for the samples in this SDG were considered usable. Therefore, the completeness for the metals portion of this SDG is 100%, which meets the minimum acceptance criteria of 95%.

MERCURY

General

The mercury portion of this SDG consisted of two (2) samples, including one (1) source blank and one (1) equipment blank. The samples were collected on September 9, 2014 and were analyzed for mercury as specified in the project QAPP.

The mercury analyses were performed in accordance with U.S. EPA Method SW7470A. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPjP.

All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed in one batch under a single initial calibration (ICAL).

Accuracy

Accuracy was evaluated using the percent recovery obtained from the LCS.

The LCS recovery was within acceptance criteria.

Precision

Precision could not be evaluated for the mercury portion of this SDG since no duplicate analyses were performed.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining field and laboratory blanks for cross contamination of samples during collection and analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP with the exceptions previously noted. All samples were prepared and analyzed within the holding time required by the method.

- All initial calibration criteria were met.
- The ICV was prepared from a second source standard. All ICV criteria were met.
- All CCV criteria were met.
- The laboratory performed quarterly LOQ verifications as required.

One laboratory method blank was associated with the mercury analyses in this SDG. The laboratory method blank was non-detect for mercury.

The equipment blank and source blank were both non-detect for mercury.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All mercury results for the samples in this SDG were considered usable. Therefore, the completeness for the mercury portion of this SDG is 100%, which meets the minimum acceptance criteria of 95%.

COMPARABILITY

All data was generated using contract-specific standard methods and reported with known data quality, type of analysis, units, etc.

DATA USABILITY

The purpose of this data validation report is to ensure the integrity and reliability of analytical laboratory data. The data quality is evaluated based on precision, accuracy, representativeness, comparability, and completeness (PARCC) characteristics of the data. The validated data indicated that the laboratory correctly performed the analyses. Based on the data quality assessment, none of the data were qualified as rejected.

All data in this SDG are considered usable for the purposes of this project. All sample LODs and LOQs met the requirements listed in the project QAPP. All Method Quality Objectives have been met.

SENSITIVITY

The DL, LOD, and LOQ values reported for the samples were compared to those listed in the QAPjP to ensure that sensitivity requirements were met.

It should be noted that the laboratory LOD and LOQ values varied slightly from the QAPjP for DRO, PAHs, and SVOCs due to slight variations in the volume collected. For slow-purging wells, reduced volume was collected for DRO as the project action limit (PAL) for DRO is exceptionally high. All other sensitivity requirements were met.

DATA QUALIFIER CHANGES

The following data qualifiers were added, removed, or changed as a result of the data validation process:

Sample ID	Analyte	Units	Original Result	Final Result	Reason Code
13/30-TB-1A	1,2,3-Trimethylbenzene	µg/L	0.60 UYQ	0.60 UJ	Not spiked
13/30-TB-1A	Acetone	µg/L	0.62 J	10 U	MB
13/30-TB-1A	Bromomethane	µg/L	4.0 UYZ	4.0 UJ	CVL
13/30-TB-1A	Methylene chloride	µg/L	0.63 J	2.0 U	MB
13-FB-01	1,2,3-Trimethylbenzene	µg/L	0.60 UYQ	0.60 UJ	Not spiked
13-FB-01	Acetone	µg/L	13	13 U	MB
13-FB-01	Bromomethane	µg/L	4.0 UYZ	4.0 UJ	CVL
13-FB-01	Methylene chloride	µg/L	0.35 J	2.0 U	MB
13-FB-01	DRO	µg/L	36 J	230 U	MB
30-FB-01	1,2,3-Trimethylbenzene	µg/L	0.60 UYQ	0.60 UJ	Not spiked
30-FB-01	Acetone	µg/L	18	18 U	MB
30-FB-01	Bromomethane	µg/L	4.0 UYZ	4.0 UJ	CVL
30-FB-01	Methylene chloride	µg/L	0.45 J	2.0 U	MB
30-FB-01	DRO	µg/L	43 J	220 U	MB
30-FB-01	2,4-Dinitrophenol	µg/L	11 U	11 UJ	CVL
30-FB-01	Pentachlorophenol	µg/L	2.7 U	2.7 UJ	CVL
30-FB-01	Molybdenum	µg/L	2.2 J	5.0 U	MB
13/30-EB-01	1,2,3-Trimethylbenzene	µg/L	0.60 UYQ	0.60 UJ	Not spiked
13/30-EB-01	2-Butanone (MEK)	µg/L	2.2 J	10 U	SB

Sample ID	**Analyte**	**Units**	**Original Result**	**Final Result**	**Reason Code**
13/30-EB-01	Acetone	µg/L	20	20 U	MB
13/30-EB-01	Bromomethane	µg/L	4.0 UYZ	4.0 UJ	CVL
13/30-EB-01	Methylene chloride	µg/L	0.50 J	2.0 U	MB
13/30-EB-01	DRO	µg/L	44 J	220 U	MB
13/30-EB-01	Manganese	µg/L	0.30 J	5.0 U	SB
13/30-EB-01	Molybdenum	µg/L	1.5 J	5.0 U	MB
13/30-TB-1B	1,2,3-Trimethylbenzene	µg/L	0.60 UYQ	0.60 UJ	Not spiked
13/30-TB-1B	Bromomethane	µg/L	4.0 UYZ	4.0 UJ	CVL
13/30-TB-1B	Methylene chloride	µg/L	0.65 J	2.0 U	MB

DATA VALIDATION SUMMARY REPORT
for samples collected from
SWMU 13/30

TOOELE ARMY DEPOT – SOUTH AREA, UTAH

Data Validation by: Katherine LaPierre

Revision Date: December 20, 2014
Parsons - Austin

INTRODUCTION

The following data validation summary report covers soil gas samples and the associated field quality control (QC) samples collected from solid waste management unit (SWMU) 13 and 30 at Tooele Army Depot – South Area (TEADS), Utah during the period from September 3 through September 5, 2014. Samples were logged under the following Sample Delivery Group (SDG):

P1403609

The samples in this SDG were analyzed for volatile organic compounds (VOCs) by Compendium Method TO-15. The field QC samples collected in association with this SDG included two field duplicate (FD) samples. The following table details the samples included in this SDG and the associated parameters.

All samples were collected by Parsons using certified-clean SUMMA canisters provided by ALS Environmental (ALS). The samples were shipped to Air Toxics using the provided shipping crates. All containers were received at the laboratory in good condition.

All samples were prepared and analyzed following the procedures outlined in the Quality Assurance Project Plan (QAPjP) for TEADS 13/30 and the Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.0.

It should be noted that the laboratory data was reported using the DoD QSM 5.0 accuracy tolerances instead of those listed in the project QAPP. Data quality was not adversely affected as all recoveries met both sets of tolerances with one minor exceedance. No data qualifiers were applied or changed as a result of this issue.

SAMPLE IDs AND REQUESTED PARAMETERS

Sample ID	Matrix	VOCs	Comments
13-SG-01	SG	X	
13-SG-02	SG	X	
13-SG-03	SG	X	
13-SG-03FD	SG	X	Field duplicate
13-SG-04	SG	X	
13-SG-05	SG	X	
30-SG-01	SG	X	
30-SG-02	SG	X	
30-SG-03	SG	X	
30-SG-04	SG	X	
30-SG-05	SG	X	
30-SG-06	SG	X	
30-SG-07	SG	X	
30-SG-07FD	SG	X	Field duplicate
30-SG-08	SG	X	
30-SG-09	SG	X	

SG = Soil Gas

EXTRACTION, ANALYTICAL, AND REPORTING DETAILS

Parameter	Matrix	Prep Method	Analytical Method	Units
VOCs	Soil Gas	NA	TO-15	$\mu g/m^3$

TO = Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air

EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the DoD QSM, Version 5.0 and the project-specific UFP QAPP. Information reviewed in the data packages included sample results; field and laboratory quality control results; instrument calibration; calibration verifications; case narratives; sample receipt forms, and chain-of-custody (COC) forms. The analyses and findings presented in this report are based on the reviewed information, and whether guidelines in the associated analytical method, DoD QSM and QAPjP were met.

A Stage 4 review was performed for all data in this SDG.

A table detailing the data qualifiers applied, removed, or changed for the samples in this SDG as a result of the data validation process is included at the end of this report.

VOCS BY TO-15

General

This SDG consisted of fifteen (15) samples, including thirteen (13) environmental soil gas samples and two field duplicates. The samples were collected during the period from September 3 through September 5, 2014 and were analyzed for TO-15 volatile organic compounds as specified in the project QAPP.

The volatiles analyses were performed according to Compendium Method TO-15. All samples in this SDG were analyzed following the procedures outlined in the DoD QSM, version 5.0 and the project QAPjP with one exception. The laboratory reported all QC samples using the accuracy tolerances listed in the DoD QSM, which differ slightly from the tolerances listed in the project QAPP. Data quality and usability was not affected and no data qualifiers were applied for this issue. All samples were prepared and analyzed within the holding time required by the method. The samples were analyzed three batches under a single initial calibration (ICAL).

Accuracy

Accuracy was evaluated using the percent recovery (%R) obtained from the laboratory control samples (LCS) and the surrogate spikes.

Three LCS samples were analyzed, one for each batch. All LCS recoveries were within acceptance criteria.

Surrogate spike compounds were added to every field and QC sample. All surrogate spike recoveries were within acceptance criteria.

Precision

Precision was evaluated using the relative percent difference (RPD) obtained from the field duplicate and laboratory duplicate analyte results. The laboratory analyzed sample 30-SG-07FD in duplicate.

The RPD was calculated for all target analytes detected at or above the LOQ in sample 13-SG-03 and the associated field duplicate. The RPDs listed in the table below were calculated using the analyte concentrations from the raw data, before rounding. The field duplicate pair demonstrated significant variability, as follows:

13-SG-03

Analyte	Parent ($\mu g/m^3$)	FD ($\mu g/m^3$)	RPD	Criteria
Acetone	310	1400	105	RPD ≤ 35
2-Butanone (MEK)	34	100	79	
Toluene	7.2	15	52	
m/p-Xylene	15	14	1.9	
o-Xylene	6.7	5.9	8.8	
1,3,5-Trimethylbenzene	26	16	29	
1,2,4-Trimethylbenzene	23	14	29	

The results for acetone, 2-butanone, and toluene were qualified “J” as estimated in the parent and field duplicate samples due to the variability demonstrated by the field duplicate pair.

The RPD was calculated for all target analytes detected at or above the LOQ in sample 30-SG-07 and the associated field duplicate. The RPDs listed in the table below were calculated using the analyte concentrations from the raw data, before rounding. The field duplicate pair demonstrated significant variability, as follows:

Analyte	Parent (µg/m^3)	FD (µg/m^3)	RPD	Criteria
Acetone	840	260	59	RPD ≤ 35
Trichloroethene	72	81	7.9	
Toluene	620	38	91	
Ethylbenzene	1100	87	89	
m/p-Xylene	7100	430	91	
o-Xylene	3200	240	89	
Cumene	360	42	83	
n-Propylbenzene	610	42	90	
1,3,5-Trimethylbenzene	1100	54	93	
1,2,4-Trimethylbenzene	1300	44	95	

The results for acetone, toluene, ethylbenzene, m/p-xylene, o-xylene, cumene, n-propylbenzene, 1,3,5-trimethylbenznee, and 1,2,4-trimethylbenzene were qualified “J” as estimated in the parent and field duplicate samples due to the variability demonstrated by the field duplicate pair.

In addition, as acetone and toluene demonstrated significant variability in both field duplicate pair, all acetone and toluene detections were flagged “J” as estimated for the samples in this SDG. The chromatograms for the field duplicate samples were inspected and no evidence of unusual matrix interference was found.

All target analytes detected in both the parent (30-SG-07FD) and analytical duplicate samples at a concentration equal to or above the LOQ met RPD criteria, as follows:

Analyte	Parent (µg/m^3)	AD (µg/m^3)	RPD	Criteria
Dichlorodifluoromethane	31.1	31.9	2.5	RPD ≤ 25
Acetone	264	290	9.4	
Trichloroethene	80.6	82.6	2.5	
Toluene	37.8	38.3	1.3	
Ethylbenzene	87.1	87.3	0.2	
m/p-Xylene	427	429	0.5	
o-Xylene	236	240	1.7	
Cumene	42.4	42.6	0.5	
n-Propylbenzene	41.9	42.1	0.5	
1,3,5-Trimethylbenzene	53.8	53.7	0.2	
1,2,4-Trimethylbenzene	44.3	44.6	0.7	

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the COC procedures to those described in the DoD QSM and project QAPP;
- Comparing actual analytical procedures to those described in the DoD QSM and project QAPP;
- Evaluating holding times; and
- Examining laboratory blanks for cross contamination of samples during analysis.

The samples in this SDG were analyzed following the COC and the analytical procedures described in the DoD QSM and project QAPP. All samples were prepared and analyzed within the holding time required by the method.

- All instrument tune criteria were met.
- All initial calibration criteria were met.
- All secondary source criteria were met. The initial calibration verification (ICV) was prepared from a second source standard.
- All continuing calibration verification (CCV) criteria were met.
- All internal standard criteria were met.

Three laboratory method blanks were associated with the volatiles analyses in this SDG. The laboratory method blanks were non-detect for all target analytes, except for the following:

Blank ID	Analyte	Conc. (µg/m^3)	LOQ (µg/m^3)
P140921-MB	Acetone	0.97	5.0

The method blank noted in the table above was only associated with samples diluted due to the high concentration of acetone. All associated samples had acetone concentrations that exceeded 10 times the method blank result. Therefore, no corrective action was necessary.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

All volatiles results for the samples in this SDG were considered usable. Therefore, the completeness for this SDG is 100%, which meets the minimum acceptance criteria of 95%.

COMPARABILITY

All data was generated using contract-specific standard methods and reported with known data quality, type of analysis, units, etc.

DATA USABILITY

The purpose of this data validation report is to ensure the integrity and reliability of analytical laboratory data. The data quality is evaluated based on precision, accuracy, representativeness, comparability, and completeness (PARCC) characteristics of the data. The validated data indicated that the laboratory correctly performed the analyses. Based on the data quality assessment, none of the data were qualified as rejected.

All data in this SDG are considered usable for the purposes of this project. All sample LODs and LOQs met the requirements listed in the project QAPP. All Method Quality Objectives have been met.

SENSITIVITY

The DL, LOD, and LOQ values reported for the samples were compared to those listed in the QAPjP to ensure that sensitivity requirements were met. Canisters were pressurized at the laboratory in accordance with the method, resulting in sample-specific canister dilution factors. In addition, the laboratory pre-screened all canisters and adjusted the final analytical volume for each sample to ensure target analyte concentrations were within the linear range of the instrument.

It should be noted that the laboratory LOD values varied slightly from the QAPP as these values are re-generated each year when the laboratory receives new / recertified SUMMA canisters.

Samples 13-SG-04, 13-SG-05, 30-SG-01, and 30-SG-02 were originally analyzed using the standard volume of 1 liter, and were reanalyzed using a smaller volume to bring specific analytes within calibration range, as follows:

Sample ID	Volume	Analyte(s)
13-SG-04	0.10 L	Acetone, 2-Butanone (MEK)
13-SG-05	0.10 L	Acetone, Chloroform
30-SG-01	0.10 L	Acetone
30-SG-02	0.10 L	Acetone

The chromatograms for these samples demonstrated a pattern similar to weathered diesel or heating oil. Sensitivity for these samples met QAPP criteria with all LOQs reported at concentrations below the Project Action Levels (PALs), with two exceptions. The LOQs for 1,1,2,2-tetrachloroethane and naphthalene exceeded the associated PALs, but the MDLs for these analytes were below the PALs for all four samples. Therefore, data sensitivity was acceptable for these samples.

All samples not listed in the table above were analyzed using reduced volume due to high concentrations of target and non-target compounds. The chromatograms for these samples demonstrated a late-eluting fuel pattern similar to gasoline. Due to the dilutions required, all or some of the following analytes were reported as non-detect with elevated MDLs that exceeded the PALs: 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,2-dichloropropane, 1,4-dichlorobenzene, 2-hexanone, benzene, bromomethane, carbon tetrachloride, chlorobenzene, chloroform, ethylbenzene, methyl t-butyl ether, naphthalene, tetrachloroethene, trichloroethene, and vinyl chloride.

DATA QUALIFIER CHANGES

The following data qualifiers were added, removed, or changed as a result of the data validation process:

Sample ID	Analyte	Units	Original Result	Final Result	Reason
13-SG-01	Acetone	µg/m^3	760	760 J	FD
13-SG-03	Acetone 2-Butanone (MEK) Toluene	µg/m^3	310 34 7.2	310 J 34 J 7.2 J	FD FD FD
13-SG-03FD	Acetone 2-Butanone (MEK) Toluene	µg/m^3	1,400 100 15	1,400 J 100 J 15 J	FD FD FD
13-SG-04	Acetone Toluene	µg/m^3	2,300 160	2,300 J 160 J	FD FD
13-SG-05	Acetone Toluene	µg/m^3	1,200 8.9	1,200 J 8.9 J	FD FD
30-SG-01	Acetone Toluene	µg/m^3	1,900 75	1,900 J 75 J	FD FD
30-SG-02	Acetone Toluene	µg/m^3	1,400 30	1,400 J 30 J	FD FD
30-SG-04	Toluene	µg/m^3	18,000	18,000 J	FD
30-SG-05	Acetone Toluene	µg/m^3	540 2,900	540 J 2,900 J	FD FD
30-SG-06	Toluene	µg/m^3	1,000	1,000 J	FD
30-SG-07	Acetone Toluene Ethylbenzene m/p-Xylene o-Xylene Cumene n-Propylbenzene 1,3,5-Trimethylbenzene 1,2,4-Trimethylbenzene	µg/m^3	840 620 1,100 7,100 3,200 360 610 1,100 1,300	840 J 620 J 1,100 J 7,100 J 3,200 J 360 J 610 J 1,100 J 1,300 J	FD FD FD FD FD FD FD FD FD
30-SG-07FD	Acetone Toluene	µg/m^3	260 38	260 J 38 J	FD FD

Sample ID	Analyte	Units	Original Result	Final Result	Reason
	Ethylbenzene		87	87 J	FD
	m/p-Xylene		430	430 J	FD
	o-Xylene		240	240 J	FD
	Cumene		42	42 J	FD
	n-Propylbenzene		42	42 J	FD
	1,3,5-Trimethylbenzene		54	54 J	FD
	1,2,4-Trimethylbenzene		44	44 J	FD
30-SG-08	Acetone	μg/m^3	1,400	1,400 J	FD
	Toluene		330	330 J	FD
30-SG-09	Acetone	μg/m^3	2,700	2,700 J	FD
	Toluene		240	240 J	FD

FD = Field Duplicate RPD fails

Appendix A.7

LABORATORY DATA PACKAGE

Laboratory Data Reports

Click on links below to open files

ALS_P1403609

RTI_Rpt_1409450_Final_v4

RTI_Rpt_1409491_Final_v3-2

RTI_Rpt_1409492_Final_v5

RTI_Rpt_1409836_Final_v4

RTI_Rpt_1411600_Final_v1

RTI_Rpt_1411662_Final_v2

RTI_Rpt_1604069_Final_v3

TA_320-9497 Level 4 Report

TA_320-10430 Level 4 Report

```
                              Quantitation Report    (QT Reviewed)

 Data Path : C:\msdchem\1\data\121714\
 Data File : 12171410.D
 Acq On    : 17 Dec 2014  10:04 pm
 Operator  :
 Sample    : MB-35373
 Misc      : MBLK SW_8270A
 ALS Vial  : 6   Sample Multiplier: 1

 Quant Time: Dec 18 12:34:30 2014
 Quant Method : C:\msdchem\1\methods\120814S7.M
 Quant Title  :
 QLast Update : Tue Dec 16 12:56:05 2014
 Response via : Initial Calibration

        Compound                   R.T. QIon  Response  Conc Units Dev(Min)
  --------------------------------------------------------------------------
  Internal Standards
    1) 1,4-Dichlorobenzene-d4      4.948  152   170655    40.00 ug/mL   -0.02
   23) Naphthalene-d8              6.697  136   623710    40.00 ug/mL   -0.02
   41) Acenaphthene-d10            8.674  164   380223    40.00 ug/mL   -0.02
   65) Phenanthrene-d10           10.164  188   634181    40.00 ug/mL   -0.01
   80) Chrysene-d12               12.770  240   660458    40.00 ug/mL   -0.02
   89) Perylene-d12               14.080  264   573581    40.00 ug/mL   -0.01

  System Monitoring Compounds
    2) 1,4-Dioxane-d8              1.677   96    26454    15.99 µg/mL   0.05
    Spiked Amount     25.000   Range   0 - 150    Recovery   =   63.96%
    6) 2-Fluorophenol              3.384  112    85975    16.66 ug/mL  -0.01
    Spiked Amount     25.000   Range   0 - 150    Recovery   =   66.64%
    8) Phenol-d5                   4.552   99   107585    17.66 ug/mL  -0.03
    Spiked Amount     25.000   Range   0 - 150    Recovery   =   70.64%
   24) Nitrobenzene-d5             5.715   82   106857    18.85 ug/mL  -0.03
    Spiked Amount     25.000   Range   0 - 150    Recovery   =   75.40%
   46) 2-Fluorobiphenyl            7.987  172   226737    17.86 ug/mL  -0.02
    Spiked Amount     25.000   Range   0 - 150    Recovery   =   71.44%
   64) 2,4,6-Tribromophenol        9.477  330    35690    21.98 ug/mL  -0.02
    Spiked Amount     25.000   Range   0 - 150    Recovery   =   87.92%
   82) Terphenyl-d14              11.760  244   315271    23.31 ug/mL   0.00
    Spiked Amount     25.000   Range   0 - 150    Recovery   =   93.24%

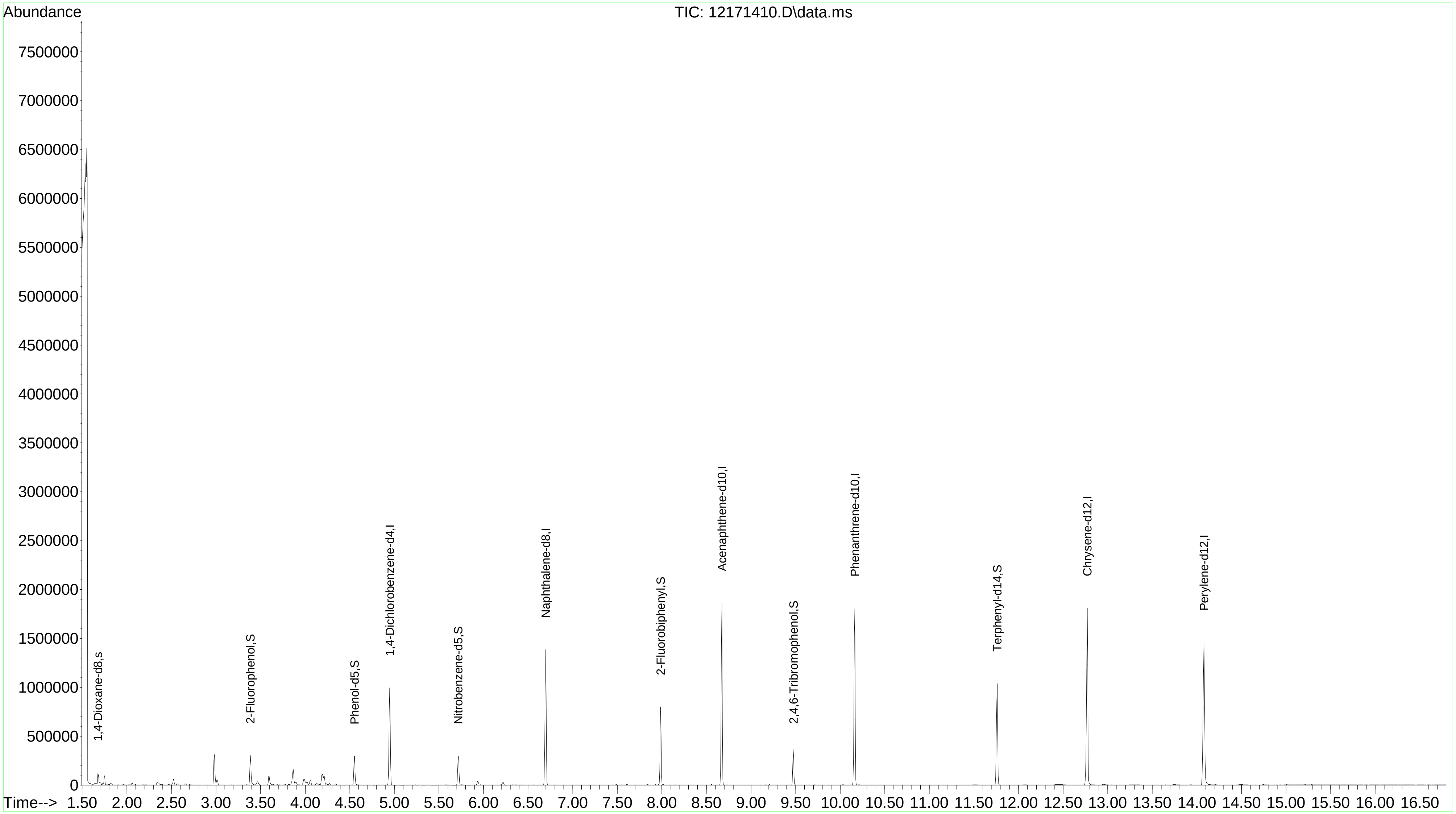
  Target Compounds                                                   Qvalue
  --------------------------------------------------------------------------

  (#) = qualifier out of range (m) = manual integration (+) = signals summed
```

Quantitation Report (QT Reviewed)

```
Data Path : C:\msdchem\1\data\121714\
Data File : 12171410.D
Acq On    : 17 Dec 2014  10:04 pm
Operator  :
Sample    : MB-35373
Misc      : MBLK SW_8270A
ALS Vial  : 6   Sample Multiplier: 1

Quant Time: Dec 18 12:34:30 2014
Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :
QLast Update : Tue Dec 16 12:56:05 2014
Response via : Initial Calibration
```



```
                              Quantitation Report    (QT Reviewed)

Data Path : C:\msdchem\1\data\121714\
Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

Quant Time: Dec 18 13:03:50 2014
Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :
QLast Update : Tue Dec 16 12:56:05 2014
Response via : Initial Calibration

        Compound                   R.T. QIon  Response  Conc Units Dev(Min)
 --------------------------------------------------------------------------
 Internal Standards
   1) 1,4-Dichlorobenzene-d4      4.948  152   169755    40.00 ug/mL   -0.02
  23) Naphthalene-d8              6.698  136   627348    40.00 ug/mL   -0.02
  41) Acenaphthene-d10            8.674  164   387543    40.00 ug/mL   -0.02
  65) Phenanthrene-d10           10.164  188   635895    40.00 ug/mL   -0.01
  80) Chrysene-d12               12.780  240   671069    40.00 ug/mL    0.00
  89) Perylene-d12               14.086  264   569850    40.00 ug/mL    0.00

 System Monitoring Compounds
   2) 1,4-Dioxane-d8              0.000   96        0     0.00 µg/mL
   Spiked Amount     25.000   Range   0 - 150    Recovery   =    0.00%
   6) 2-Fluorophenol              0.000  112        0     0.00 ug/mL
   Spiked Amount     25.000   Range   0 - 150    Recovery   =    0.00%
   8) Phenol-d5                   0.000   99        0     0.00 ug/mL
   Spiked Amount     25.000   Range   0 - 150    Recovery   =    0.00%
  24) Nitrobenzene-d5             0.000   82        0     0.00 ug/mL
   Spiked Amount     25.000   Range   0 - 150    Recovery   =    0.00%
  46) 2-Fluorobiphenyl            0.000  172        0     0.00 ug/mL
   Spiked Amount     25.000   Range   0 - 150    Recovery   =    0.00%
  64) 2,4,6-Tribromophenol        0.000  330        0     0.00 ug/mL
   Spiked Amount     25.000   Range   0 - 150    Recovery   =    0.00%
  82) Terphenyl-d14               0.000  244        0     0.00 ug/mL
   Spiked Amount     25.000   Range   0 - 150    Recovery   =    0.00%

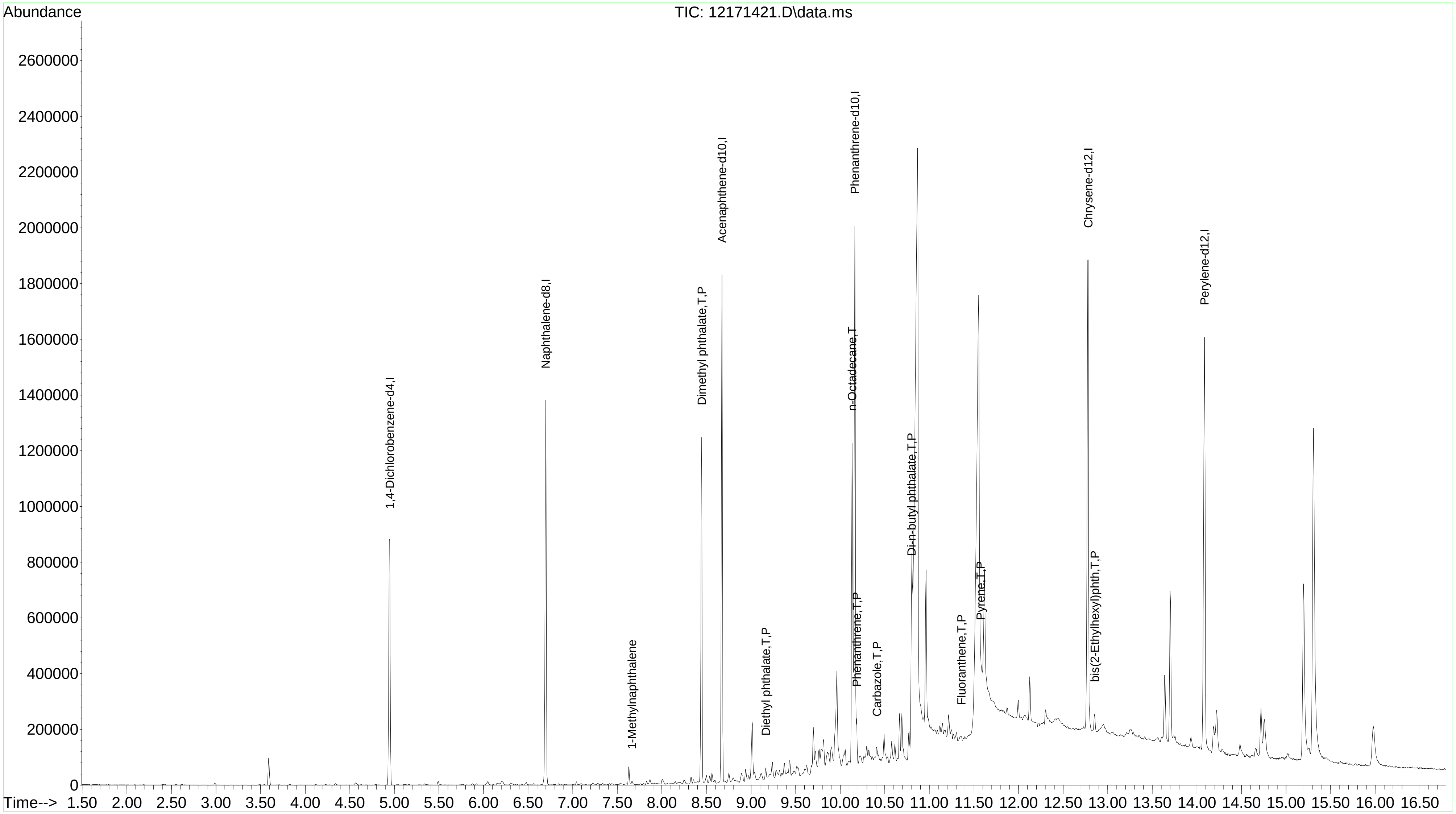
 Target Compounds                                                  Qvalue
  40) 1-Methylnaphthalene         7.665  142     2590     0.24 µg/mL#    93
  49) Dimethyl phthalate          8.447  163   471037    36.90 ug/mL     96
  60) Diethyl phthalate           9.166  149    10408     0.77 ug/mL#    98
  73) n-Octadecane               10.133   57   179200    21.26 ug/mL#    86
  74) Phenanthrene               10.185  178    50382     2.69 ug/mL     97
  76) Carbazole                  10.413  167     5692     0.35 ug/mL#    76
  77) Di-n-butyl phthalate       10.798  149     6984     0.30 ug/mL#    87
  78) Fluoranthene               11.359  202     1138     0.06 ug/mL#    81
  81) Pyrene                     11.575  202     2895     0.14 ug/mL#    81
  85) bis(2-Ethylhexyl)phth      12.854  149    18921     1.35 ug/mL#    89
 --------------------------------------------------------------------------

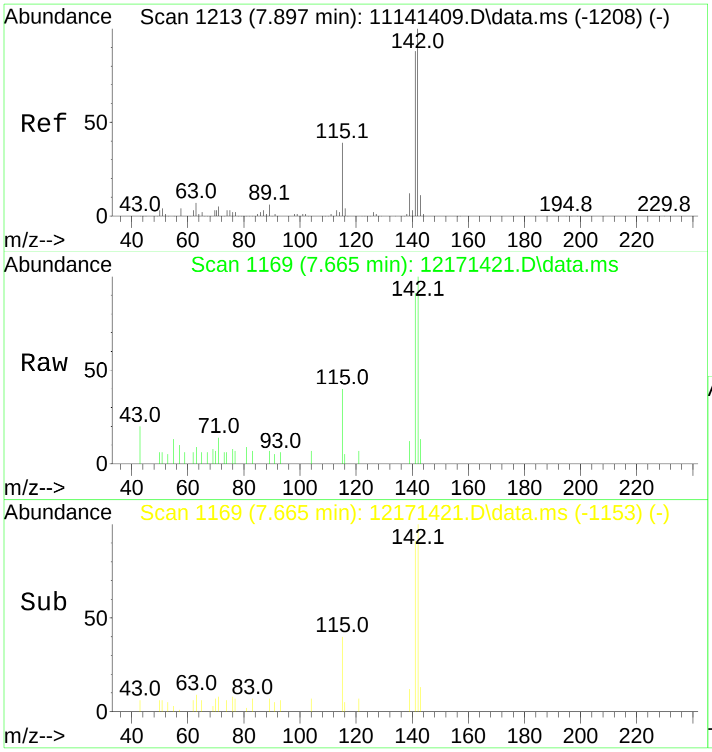
 (#) = qualifier out of range (m) = manual integration (+) = signals summed
```

Quantitation Report   (QT Reviewed)

```
Data Path : C:\msdchem\1\data\121714\
Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

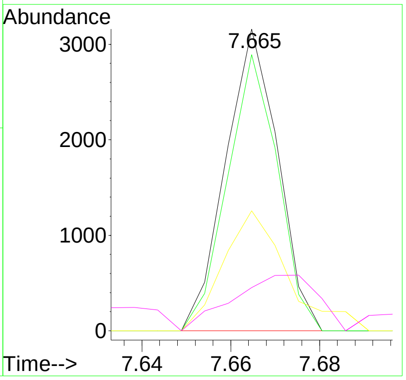
Quant Time: Dec 18 13:03:50 2014
Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :
QLast Update : Tue Dec 16 12:56:05 2014
Response via : Initial Calibration
```

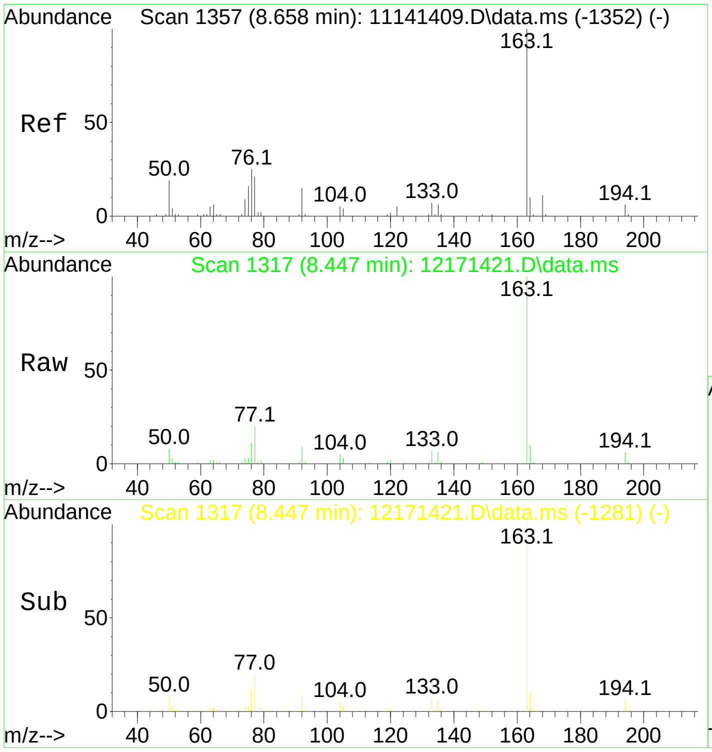




```
#40
1-Methylnaphthalene
Concen:    0.24 µg/mL
RT:   7.665 min  Scan# 1169
Delta R.T.  -0.015 min
Lab File:   12171421.D
Acq: 18 Dec 2014   2:49 am

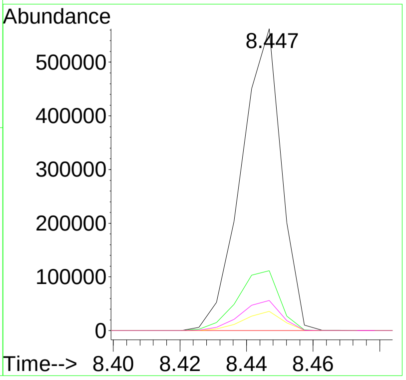
Tgt Ion:142 Resp:    2590
Ion  Ratio  Lower  Upper
142  100
141   88.5   70.1  105.1
115   46.3   32.2   48.2
 71   30.0    4.2    6.4#
```

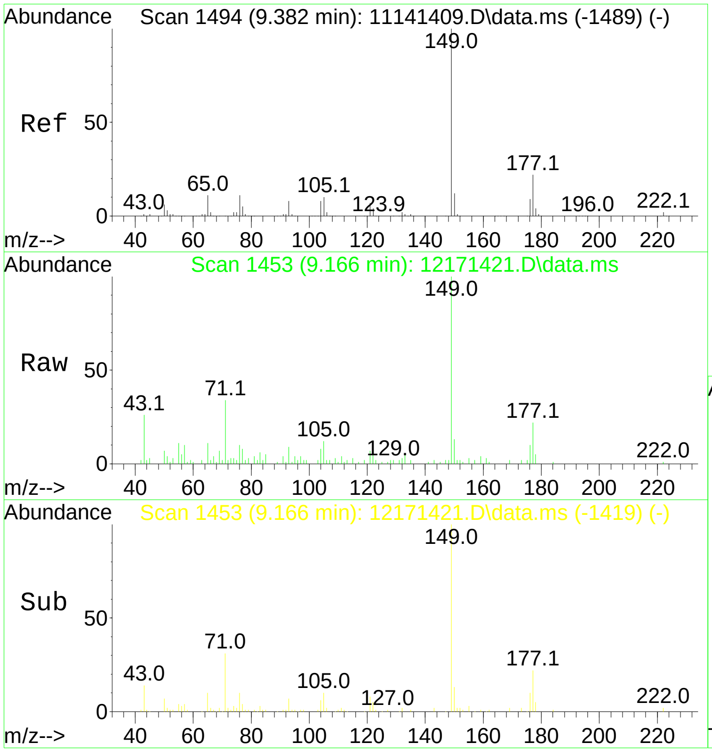




```
#49
Dimethyl phthalate
Concen:   36.90 ug/mL
RT:   8.447 min  Scan# 1317
Delta R.T.  -0.010 min
Lab File:   12171421.D
Acq: 18 Dec 2014   2:49 am

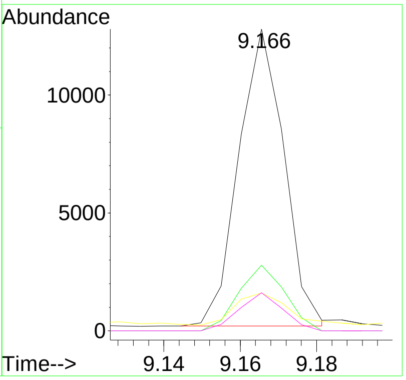
Tgt Ion:163 Resp:  471037
Ion  Ratio  Lower  Upper
163  100
 77   20.8   19.3   28.9
194    6.3    4.8    7.2
164   10.1    8.1   12.1
```

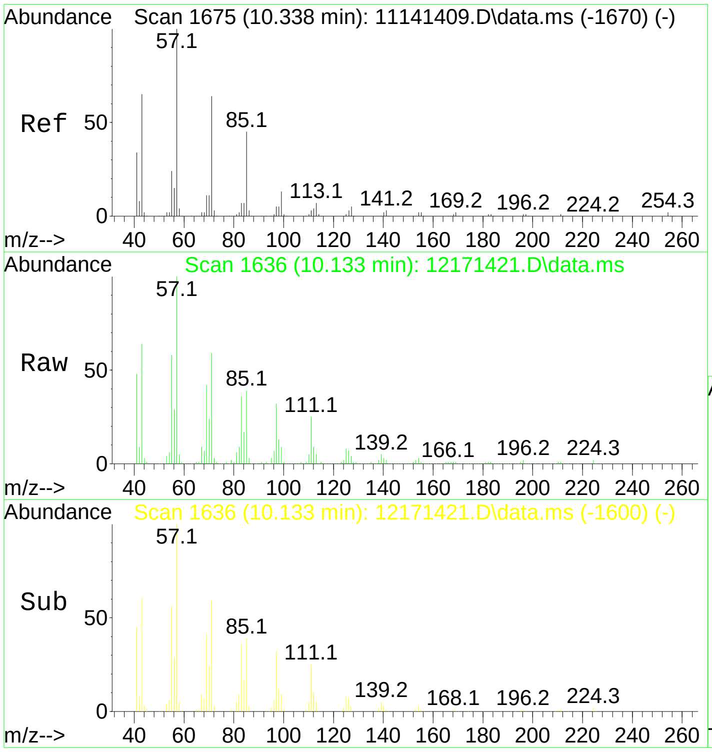




```
#60
Diethyl phthalate
Concen:    0.77 ug/mL
RT:   9.166 min  Scan# 1453
Delta R.T.  -0.020 min
Lab File:   12171421.D
Acq: 18 Dec 2014   2:49 am

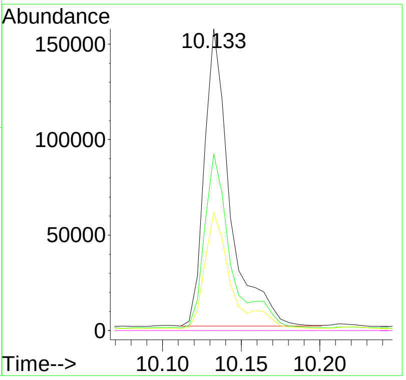
Tgt Ion:149 Resp:   10408
Ion  Ratio  Lower  Upper
149  100
177   22.7   17.8   26.6
105   12.5    8.2   12.2#
150   12.6    9.8   14.6
```

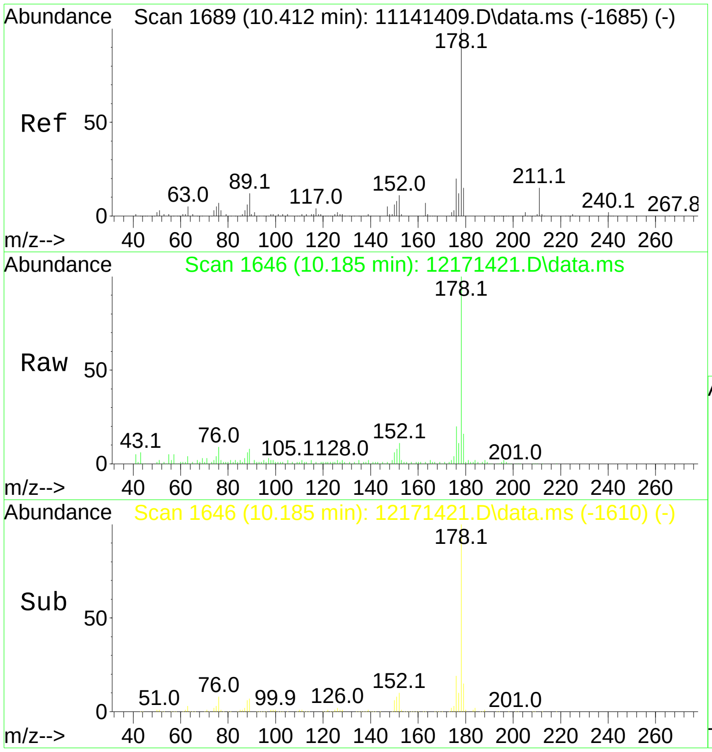




```
#73
n-Octadecane
Concen:   21.26 ug/mL
RT:  10.133 min  Scan# 1636
Delta R.T.  -0.010 min
Lab File:   12171421.D
Acq: 18 Dec 2014   2:49 am

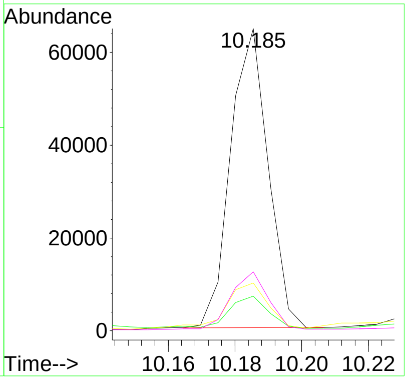
Tgt Ion: 57 Resp:  179200
Ion  Ratio  Lower  Upper
 57  100
 71   52.7   50.8   76.2
 85   35.0   35.8   53.8#
254    0.0    1.8    2.6#
```

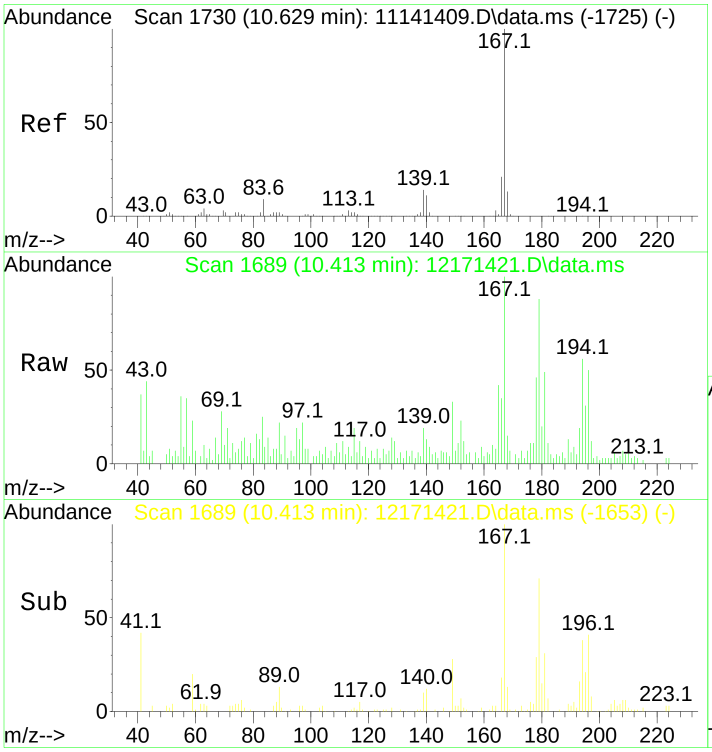




```
#74
Phenanthrene
Concen:    2.69 ug/mL
RT:  10.185 min   Scan# 1646
Delta R.T.   -0.011 min
Lab File:    12171421.D
Acq: 18 Dec 2014    2:49 am

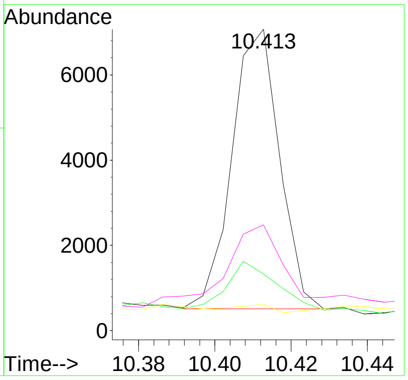
Tgt Ion:178 Resp:    50382
Ion   Ratio  Lower   Upper
178   100
152    10.9    8.8    13.2
179    18.0   12.2    18.2
176    18.9   15.6    23.4
```

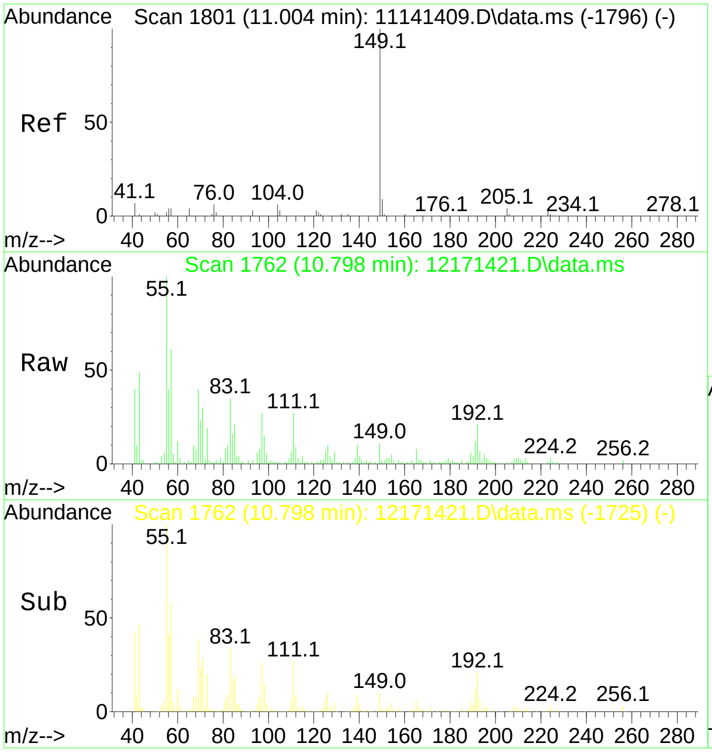




```
#76
Carbazole
Concen:    0.35 ug/mL
RT:  10.413 min   Scan# 1689
Delta R.T.   -0.010 min
Lab File:    12171421.D
Acq: 18 Dec 2014    2:49 am

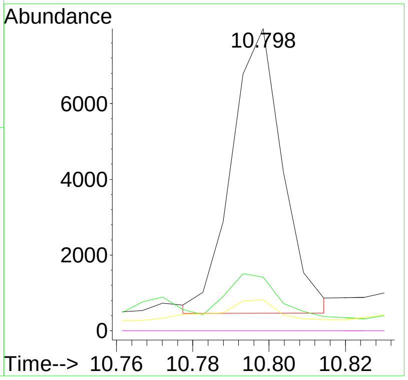
Tgt Ion:167 Resp:     5692
Ion   Ratio  Lower   Upper
167   100
139    19.1   11.3    16.9#
 84     2.5    7.4    11.2#
166    36.2   16.2    24.4#
```

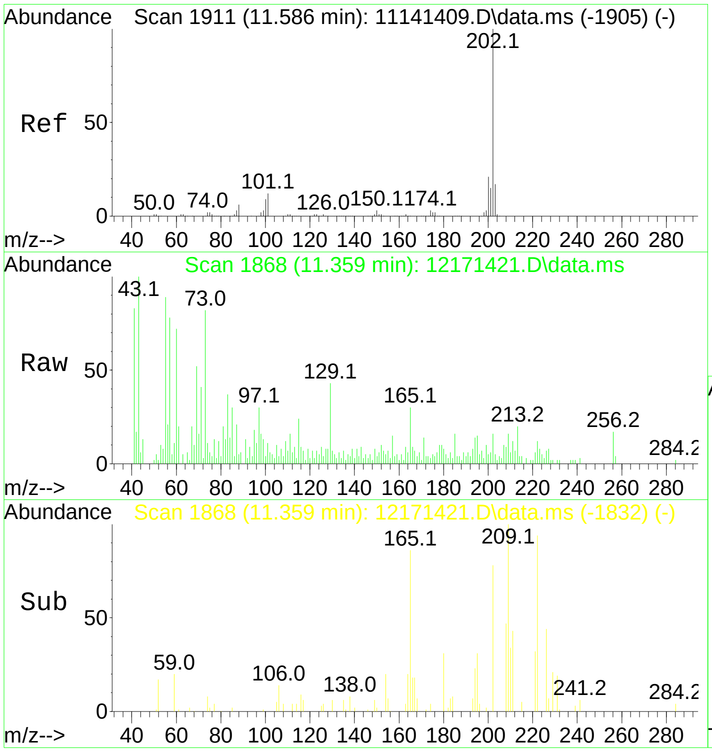




```
#77
Di-n-butyl phthalate
Concen:    0.30 ug/mL
RT:  10.798 min  Scan# 1762
Delta R.T.  -0.006 min
Lab File:   12171421.D
Acq: 18 Dec 2014   2:49 am

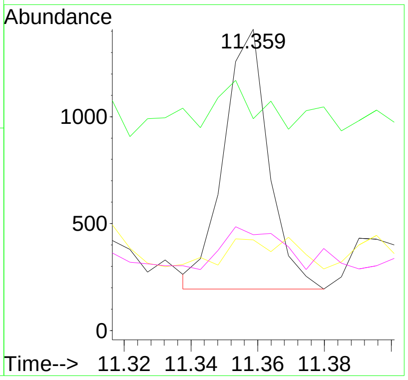
Tgt Ion:149 Resp:    6984
Ion  Ratio  Lower  Upper
149  100
150   16.3    7.3   10.9#
104    6.2    4.4    6.6
278    0.0    0.2    0.4#
```

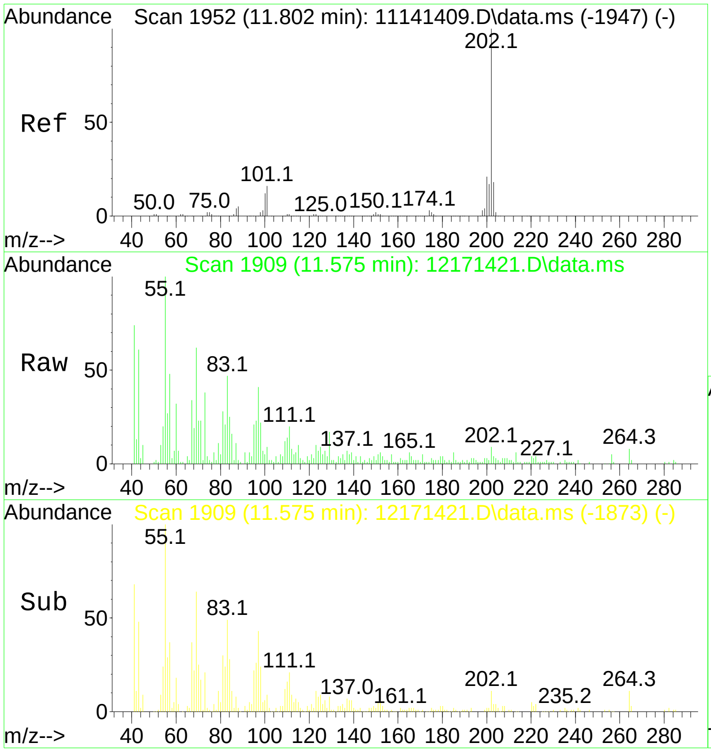




```
#78
Fluoranthene
Concen:    0.06 ug/mL
RT:  11.359 min  Scan# 1868
Delta R.T.  -0.010 min
Lab File:   12171421.D
Acq: 18 Dec 2014   2:49 am

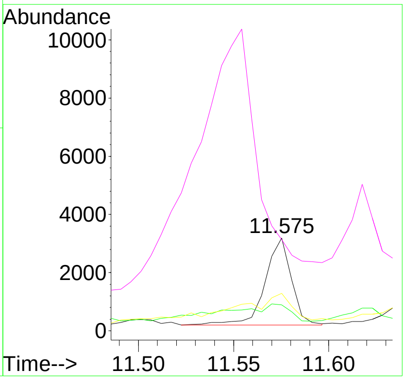
Tgt Ion:202 Resp:    1138
Ion  Ratio  Lower  Upper
202  100
101   15.6   10.4   15.6
203    8.3   13.8   20.8#
 88   20.4    5.0    7.6#
```

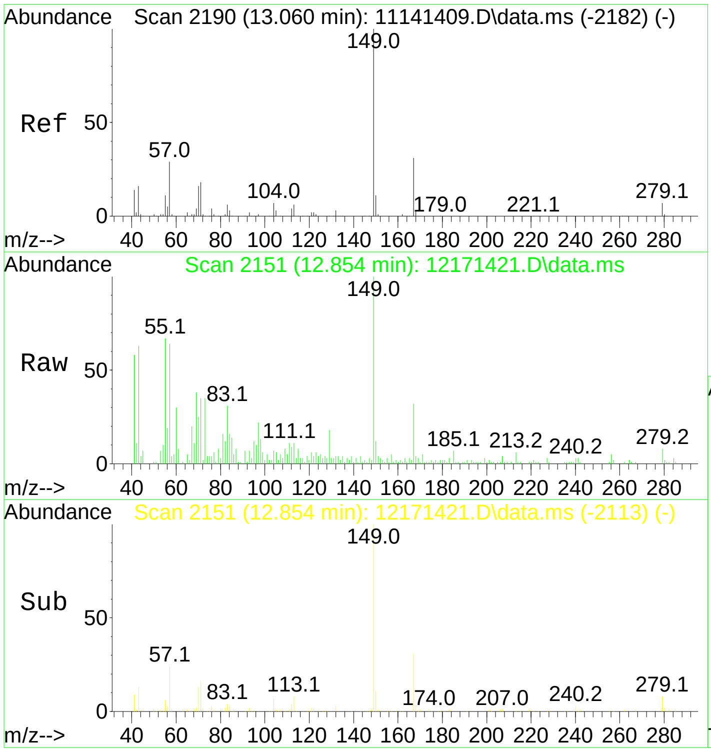




```
#81
Pyrene
Concen:    0.14 ug/mL
RT:  11.575 min   Scan# 1909
Delta R.T.  -0.011 min
Lab File:   12171421.D
Acq: 18 Dec 2014   2:49 am

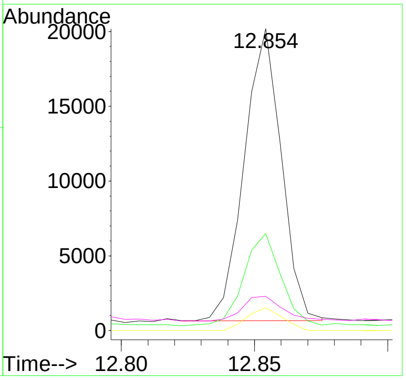
Tgt Ion:202 Resp:    2895
Ion  Ratio  Lower  Upper
202  100
200   20.0   16.8   25.2
203   28.1   14.2   21.4#
101    0.0   12.2   18.4#
```





```
#85
bis(2-Ethylhexyl)phth
Concen:    1.35 ug/mL
RT:  12.854 min   Scan# 2151
Delta R.T.   0.000 min
Lab File:   12171421.D
Acq: 18 Dec 2014   2:49 am

Tgt Ion:149 Resp:   18921
Ion  Ratio  Lower  Upper
149  100
167   31.8    0.0    0.0#
279    7.5    0.0    0.0#
113    9.5   11.2   16.8#
```



```
                                         LSC Area Percent Report

 Data Path : C:\msdchem\1\data\121714\
 Data File : 12171421.D
 Acq On    : 18 Dec 2014   2:49 am
 Operator  :
 Sample    : 1411600-003A
 Misc      : SAMP SW_8270A
 ALS Vial  : 17   Sample Multiplier: 1

 Integration Parameters: rteint.p
 Integrator: RTE
 Smoothing : OFF                            Filtering: 5
 Sampling  : 1                               Min Area: 1 % of largest Peak
 Start Thrs: 0.2                            Max Peaks: 100
 Stop Thrs : 0                          Peak Location: TOP

 If leading or trailing edge < 100 prefer < Baseline drop else tangent >
 Peak separation: 5

 Method    : C:\msdchem\1\methods\120814S7.M
 Title     :

 Signal     : TIC: 12171421.D\data.ms

peak  R.T. first  max last  PK   peak      corr.   corr.    % of
  #    min   scan scan scan  TY  height      area   % max.   total
---  ----- ----- ---- ---- ---  -------   -------  ------  -------
 1   3.590   394  398  406 rVB    97013     95954   1.93%   0.311%
 2   4.943   649  654  660 rVB   881953    985145  19.80%   3.190%
 3   6.698   979  986  990 rBV  1380109   1327816  26.68%   4.300%
 4   7.628  1159 1162 1166 rBV    62713     54882   1.10%   0.178%
 5   8.447  1311 1317 1320 rBV  1237752   1059456  21.29%   3.431%

 6   8.674  1355 1360 1364 rBV  1819998   1574701  31.65%   5.099%
 7   8.938  1407 1410 1415 rBV3   45116     53377   1.07%   0.173%
 8   9.012  1419 1424 1428 rBV   204986    236383   4.75%   0.765%
 9   9.240  1463 1467 1471 rVB2   56444     63419   1.27%   0.205%
10   9.430  1500 1503 1507 rVB    52182     56118   1.13%   0.182%

11   9.514  1516 1519 1525 rVB6   33460     59929   1.20%   0.194%
12   9.699  1551 1554 1557 rVV   163432    170898   3.43%   0.553%
13   9.720  1557 1558 1563 rVV    76512     82383   1.66%   0.267%
14   9.763  1563 1566 1568 rVV2   82290     95219   1.91%   0.308%
15   9.789  1568 1571 1574 rVV3   77982    137163   2.76%   0.444%

16   9.816  1574 1576 1579 rVV   111573    102395   2.06%   0.332%
17   9.858  1579 1584 1589 rVV3   63587    145708   2.93%   0.472%
18   9.900  1589 1592 1596 rVV3   79705    117932   2.37%   0.382%
19   9.964  1596 1604 1613 rVV4  345904    603426  12.13%   1.954%
20  10.043  1614 1619 1620 rVV    42020     61026   1.23%   0.198%

21  10.133  1632 1636 1639 rBV  1148324   1167805  23.47%   3.782%
22  10.164  1639 1642 1645 rVV  1921264   1759210  35.35%   5.697%
23  10.185  1645 1646 1649 rVB   162201     78830   1.58%   0.255%
24  10.228  1649 1654 1658 rBV8   29179     51561   1.04%   0.167%
25  10.407  1686 1688 1695 rVB3   45863     57364   1.15%   0.186%

26  10.492  1701 1704 1710 rVB    89465     85385   1.72%   0.277%
27  10.577  1717 1720 1724 rVB    65040     59263   1.19%   0.192%
28  10.614  1724 1727 1730 rVB6   61920     56199   1.13%   0.182%
29  10.666  1734 1737 1739 rBV   162296    135925   2.73%   0.440%
30  10.693  1739 1742 1752 rVB3  169981    191235   3.84%   0.619%

31  10.772  1753 1757 1759 rBV   102146    115536   2.32%   0.374%
32  10.804  1759 1763 1765 rBV   695503    872132  17.53%   2.824%
33  10.867  1765 1775 1786 rVV  2072860   4975969 100.00%  16.114%
34  10.962  1789 1793 1796 rBV   544913    502545  10.10%   1.627%
35  11.216  1838 1841 1845 rBV    73158     72919   1.47%   0.236%

36  11.554  1892 1905 1912 rBV  1535592   3722346  74.81%  12.054%
37  11.618  1913 1917 1931 rVB   483499    792483  15.93%   2.566%
38  12.125  2010 2013 2020 rVB   163869    161413   3.24%   0.523%
39  12.305  2044 2047 2056 rBV    52071     96870   1.95%   0.314%
40  12.780  2131 2137 2147 rVB  1689886   1907399  38.33%   6.177%
```

LSC Area Percent Report

```
 Data Path : C:\msdchem\1\data\121714\
 Data File : 12171421.D
 Acq On    : 18 Dec 2014   2:49 am
 Operator  :
 Sample    : 1411600-003A
 Misc      : SAMP SW_8270A
 ALS Vial  : 17   Sample Multiplier: 1

 Integration Parameters: rteint.p
 Integrator: RTE
 Smoothing : OFF                           Filtering: 5
 Sampling  : 1                              Min Area: 1 % of largest Peak
 Start Thrs: 0.2                           Max Peaks: 100
 Stop Thrs : 0                         Peak Location: TOP

 If leading or trailing edge < 100 prefer < Baseline drop else tangent >
 Peak separation: 5

 Method    : C:\msdchem\1\methods\120814S7.M
 Title     :

41  12.854  2148 2151 2155 rVB    63104     59750   1.20%   0.193%
42  13.642  2296 2300 2307 rVB   238553    283993   5.71%   0.920%
43  13.700  2307 2311 2316 rBV   541106    581194  11.68%   1.882%
44  14.086  2378 2384 2393 rVB  1482158   1656137  33.28%   5.363%
45  14.186  2400 2403 2406 rBV2   81598    105175   2.11%   0.341%

46  14.223  2407 2410 2415 rVB2  144068    188285   3.78%   0.610%
47  14.482  2456 2459 2467 rVB2   35588     50740   1.02%   0.164%
48  14.656  2489 2492 2499 rBV9   32363     53858   1.08%   0.174%
49  14.720  2500 2504 2507 rVV2  174565    218990   4.40%   0.709%
50  14.757  2507 2511 2522 rVB3  139078    255985   5.14%   0.829%

51  15.195  2588 2594 2603 rBV   629798   1009034  20.28%   3.268%
52  15.306  2609 2615 2638 rVB  1186939   2143834  43.08%   6.942%
53  15.977  2736 2742 2757 rVB2  137104    327744   6.59%   1.061%

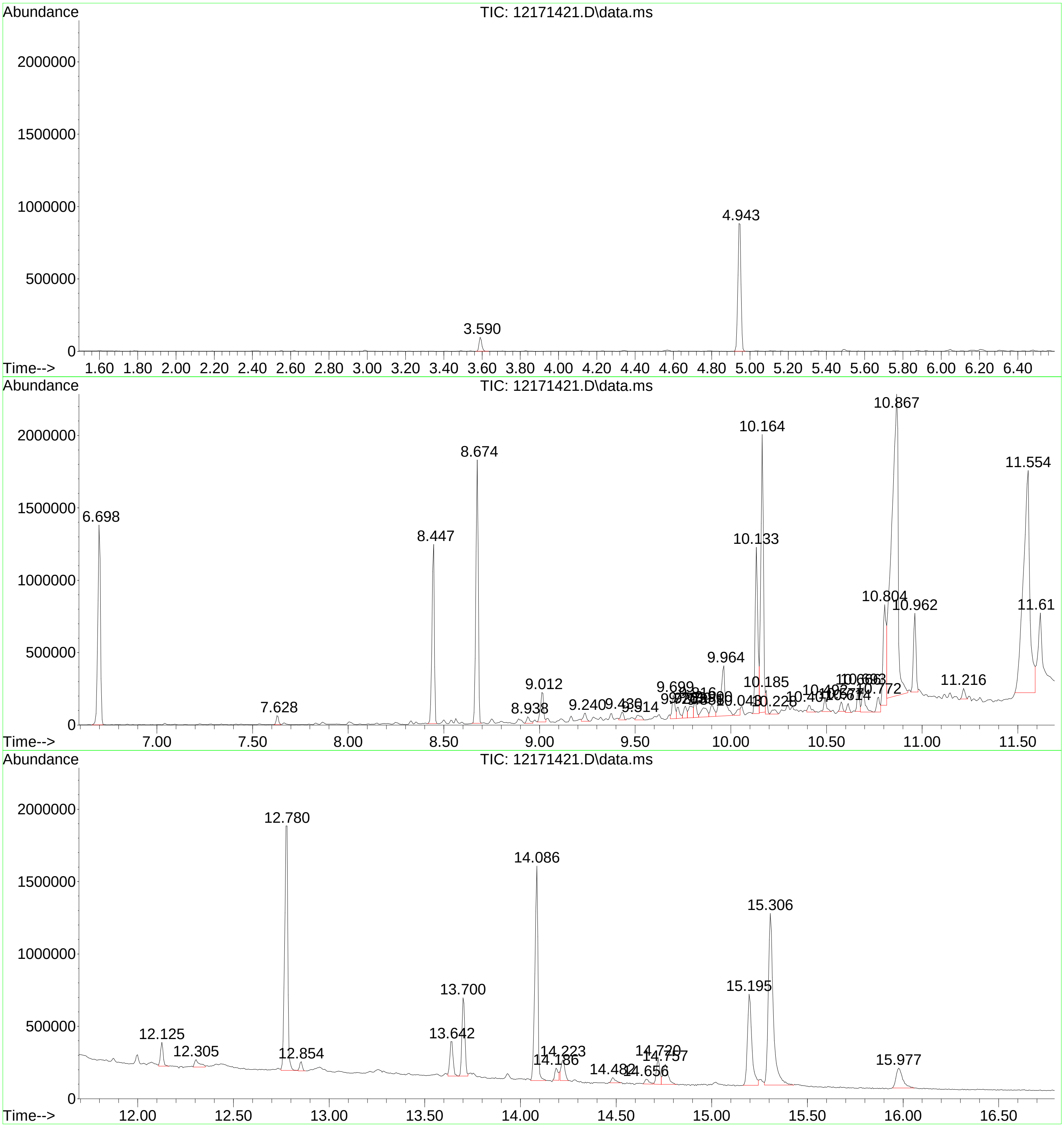

                        Sum of corrected areas:    30880438
```

LSC Report - Integrated Chromatogram

```
Data Path : C:\msdchem\1\data\121714\
Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :

TIC Library   : C:\Database\NIST129K.L
TIC Integration Parameters: LSCINT.P
```



```
                                 Library Search Compound Report

Data Path : C:\msdchem\1\data\121714\
Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :

TIC Library   : C:\Database\NIST129K.L
TIC Integration Parameters: LSCINT.P

*********************************************************************
Peak Number  1  Cyclopentanone, 2-methyl- $...  Concentration Rank 14

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
  3.590    3.90 ug/mL       95954   1,4-Dichlorobenzene-d4      4.948

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Cyclopentanone, 2-methyl- $$ .al...  98 C6H10O         001120-72-5 95
 2 Cyclohexanone                        98 C6H10O         000108-94-1 94
 3 Cyclohexanone                        98 C6H10O         000108-94-1 91
 4 Cyclohexanone $$ Anon $$ Anone $...  98 C6H10O         000108-94-1 91
 5 Cyclopentanone, 2-methyl-            98 C6H10O         001120-72-5 87


*********************************************************************
Peak Number  2  Dodecanoic acid                 Concentration Rank 10

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
  9.012    6.00 ug/mL      236383   Acenaphthene-d10            8.674

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Dodecanoic acid                     200 C12H24O2       000143-07-7 97
 2 Dodecanoic acid                     200 C12H24O2       000143-07-7 90
 3 Dodecanoic acid $$ n-Dodecanoic ... 200 C12H24O2       000143-07-7 87
 4 Lauric anhydride                    382 C24H46O3       000645-66-9 70
 5 Tridecanoic acid $$ n-Tridecanoi... 214 C13H26O2       000638-53-9 68


*********************************************************************
Peak Number  3  Pentadecane, 2,6,10,14-tetr...  Concentration Rank 15

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
  9.699    3.89 ug/mL      170898   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Pentadecane, 2,6,10,14-tetramethyl- 268 C19H40         001921-70-6 70
 2 Hexadecane, 2,6,11,15-tetramethy... 282 C20H42         000504-44-9 64
 3 Pentadecane, 2,6,10,14-tetramethyl- 268 C19H40         001921-70-6 62
 4 Pentadecane, 2,6,10,14-tetrameth... 268 C19H40         001921-70-6 62
 5 Decane, 2-methyl-                   156 C11H24         006975-98-0 60


*********************************************************************
Peak Number  4  Phenol, 2-(1,1-dimethylethy...  Concentration Rank 18

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
  9.789    3.12 ug/mL      137163   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Phenol, 2-(1,1-dimethylethyl)-3-... 164 C11H16O        013037-79-1 46
 2 Benzeneacetic acid, 4-methoxy-, ... 180 C10H12O3       023786-14-3 25
 3 Benzeneacetic acid, 4-methoxy-, ... 180 C10H12O3       023786-14-3 25
```

```
Data Path : C:\msdchem\1\data\121714\
Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :

TIC Library   : C:\Database\NIST129K.L
TIC Integration Parameters: LSCINT.P

 4 .beta.(p-Methoxyphenyl)propionit... 161 C10H11NO       022442-48-4 25
 5 3-(4-Methoxyphenyl)propionic acid   180 C10H12O3       001929-29-9 25


*********************************************************************
Peak Number  5  4-Nonylphenol                   Concentration Rank 17

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
  9.858    3.31 ug/mL      145708   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 4-Nonylphenol                       220 C15H24O        000104-40-5 46
 2 Phenol, 4-(1,1-dimethylpropyl)-     164 C11H16O        000080-46-6 46
 3 Phenol, m-tert-butyl-               150 C10H14O        000585-34-2 43
 4 Phenol, m-tert-butyl-               150 C10H14O        000585-34-2 43
 5 Methyl dithio-3-methylbenzoate      182 C9H10S2        000000-00-0 43


*********************************************************************
Peak Number  6  Acetamide, N-(3-methylphenyl)-  Concentration Rank 20

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
  9.900    2.68 ug/mL      117932   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Acetamide, N-(3-methylphenyl)-      149 C9H11NO        000537-92-8 47
 2 Acetamide, N-(2-methylphenyl)-      149 C9H11NO        000120-66-1 47
 3 Silane, chlorotripropyl- $$ Trip... 192 C9H21ClSi      000995-25-5 47
 4 Benzenepropanoic acid, .alpha.,4... 182 C9H10O4        000306-23-0 22
 5 Benzenepropanoic acid, .alpha.,4... 182 C9H10O4        000306-23-0 22


*********************************************************************
Peak Number  7  Tetradecanoic acid              Concentration Rank  5

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
  9.964   13.72 ug/mL      603426   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Tetradecanoic acid                  228 C14H28O2       000544-63-8 99
 2 Tetradecanoic acid                  228 C14H28O2       000544-63-8 98
 3 Tetradecanoic acid                  228 C14H28O2       000544-63-8 97
 4 Tetradecanoic acid $$ Myristic a... 228 C14H28O2       000544-63-8 76
 5 Undecanoic acid                     186 C11H22O2       000112-37-8 62


*********************************************************************
Peak Number  8  Anthracene, 2-methyl-           Concentration Rank 19

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
 10.666    3.09 ug/mL      135925   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
```

```
Data Path : C:\msdchem\1\data\121714\
Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :

TIC Library   : C:\Database\NIST129K.L
TIC Integration Parameters: LSCINT.P

---------------------------------------------------------------------
 1 Anthracene, 2-methyl-                192 C15H12         000613-12-7 97
 2 Phenanthrene, 1-methyl-              192 C15H12         000832-69-9 96
 3 Phenanthrene, 2-methyl-              192 C15H12         002531-84-2 95
 4 Anthracene, 9-methyl-                192 C15H12         000779-02-2 94
 5 Phenanthrene, 1-methyl- $$ 1-Met... 192 C15H12         000832-69-9 94


*********************************************************************
Peak Number  9  Phenanthrene, 2-methyl-         Concentration Rank 13

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
 10.693    4.35 ug/mL      191235   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Phenanthrene, 2-methyl-              192 C15H12         002531-84-2 96
 2 Anthracene, 2-methyl-                192 C15H12         000613-12-7 96
 3 1H-Cyclopropa[l]phenanthrene,1a,... 192 C15H12         000949-41-7 96
 4 Phenanthrene, 1-methyl-              192 C15H12         000832-69-9 96
 5 Anthracene, 9-methyl- $$ 9-Methy... 192 C15H12         000779-02-2 95


*********************************************************************
Peak Number 10  n-Hexadecanoic acid             Concentration Rank  1

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
 10.867  113.14 ug/mL     4975970   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 n-Hexadecanoic acid                  256 C16H32O2       000057-10-3 98
 2 n-Hexadecanoic acid                  256 C16H32O2       000057-10-3 94
 3 n-Hexadecanoic acid $$ Hexadecan... 256 C16H32O2       000057-10-3 94
 4 Tridecanoic acid $$ n-Tridecanoi... 214 C13H26O2       000638-53-9 93
 5 n-Hexadecanoic acid                  256 C16H32O2       000057-10-3 93


*********************************************************************
Peak Number 11  Eicosane                        Concentration Rank  6

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
 10.962   11.43 ug/mL      502545   Phenanthrene-d10           10.164

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Eicosane                             282 C20H42         000112-95-8 98
 2 Eicosane                             282 C20H42         000112-95-8 97
 3 Eicosane                             282 C20H42         000112-95-8 97
 4 Eicosane                             282 C20H42         000112-95-8 96
 5 Pentadecane                          212 C15H32         000629-62-9 96


*********************************************************************
Peak Number 12  (2-Methyl-but-3-enyl-2-oxy)...  Concentration Rank 16

  R.T.     EstConc          Area       Relative to ISTD         R.T.
```

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Data Path : C:\msdchem\1\data\121714\
Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :

TIC Library   : C:\Database\NIST129K.L
TIC Integration Parameters: LSCINT.P

---------------------------------------------------------------------
 12.125    3.38 ug/mL      161413   Chrysene-d12               12.780

 Hit# of  5    Tentative ID              MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 (2-Methyl-but-3-enyl-2-oxy)-trim... 158 C8H18OSi      000000-00-0 42
 2 Dodecanoic acid, tert-butyldimet... 314 C18H38O2Si    000000-00-0 27
 3 3-Dimethyl(prop-2-enyl)silyloxyt... 298 C18H38OSi     000000-00-0 27
 4 Silane, trimethyl[[5-methyl-2-(1... 228 C13H28OSi     018419-38-0 22
 5 2-Butenoic acid, tert-butyldimet... 200 C10H20O2Si    000000-00-0 16


*********************************************************************
Peak Number 13  2-Hexyl-1-octanol               Concentration Rank  8

  R.T.     EstConc          Area       Relative to ISTD        R.T.
---------------------------------------------------------------------
 13.642    6.86 ug/mL      283993   Perylene-d12               14.086

 Hit# of  5    Tentative ID              MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 2-Hexyl-1-octanol                   214 C14H30O       019780-79-1 64
 2 1-Decanol, 2-hexyl-                 242 C16H34O       002425-77-6 52
 3 1-Hexadecene                        224 C16H32        000629-73-2 50
 4 1-Octadecene                        252 C18H36        000112-88-9 43
 5 1-Heptadecene                       238 C17H34        006765-39-5 38


*********************************************************************
Peak Number 14  Squalene                        Concentration Rank  4

  R.T.     EstConc          Area       Relative to ISTD        R.T.
---------------------------------------------------------------------
 13.700   14.04 ug/mL      581194   Perylene-d12               14.086

 Hit# of  5    Tentative ID              MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Squalene                            410 C30H50        007683-64-9 91
 2 2,6,10,14,18,22-Tetracosahexaene... 410 C30H50        000111-02-4 91
 3 .psi.,.psi.-Carotene, 7,7',8,8',... 547 C40H66        000502-62-5 83
 4 2,6,10,14-Hexadecatetraenoic aci... 332 C22H36O2      024035-35-6 78
 5 2,6,10-Dodecatrien-1-ol, 3,7,11-... 264 C17H28O2      004128-17-0 64


*********************************************************************
Peak Number 15  Borinic acid, diethyl-, nap...  Concentration Rank 12

  R.T.     EstConc          Area       Relative to ISTD        R.T.
---------------------------------------------------------------------
 14.223    4.55 ug/mL      188285   Perylene-d12               14.086

 Hit# of  5    Tentative ID              MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 Borinic acid, diethyl-, naphthal... 212 C14H17BO      061249-74-9 40
 2 6-(2-Methoxy-ethyl)-2,3-dimethyl... 228 C13H24O3      000000-00-0 38
 3 3,5-Heptanedione, 2,2,6,6-tetram... 184 C11H20O2      001118-71-4 38
 4 1,4-Dioxaspiro[4,5]decane-7-buta... 284 C16H28O4      000000-00-0 32
 5 3,5-Heptanedione, 2,2,6,6-tetram... 184 C11H20O2      001118-71-4 30
```

```
                                      Library Search Compound Report

  Data Path : C:\msdchem\1\data\121714\
  Data File : 12171421.D
  Acq On    : 18 Dec 2014   2:49 am
  Operator  :
  Sample    : 1411600-003A
  Misc      : SAMP SW_8270A
  ALS Vial  : 17   Sample Multiplier: 1

  Quant Method : C:\msdchem\1\methods\120814S7.M
  Quant Title  :

  TIC Library   : C:\Database\NIST129K.L
  TIC Integration Parameters: LSCINT.P

  *********************************************************************
  Peak Number 16  1-Decanol, 2-hexyl- $$ 2-He...  Concentration Rank 11

    R.T.     EstConc          Area       Relative to ISTD         R.T.
  ---------------------------------------------------------------------
   14.720    5.29 ug/mL      218990   Perylene-d12               14.086

   Hit# of  5    Tentative ID              MW  MolForm       CAS#       Qual
  ---------------------------------------------------------------------
   1 1-Decanol, 2-hexyl- $$ 2-Hexyl-1... 242 C16H34O       002425-77-6 62
   2 Ethanol, 2-(tetradecyloxy)-         258 C16H34O2      002136-70-1 53
   3 1-Decanol, 2-hexyl-                 242 C16H34O       002425-77-6 53
   4 1-Octadecanol                       270 C18H38O       000112-92-5 38
   5 1-Octanol, 2-butyl-                 186 C12H26O       003913-02-8 30


  *********************************************************************
  Peak Number 17  4,4,4-Trifluoro-3-hydroxy-2...  Concentration Rank  9

    R.T.     EstConc          Area       Relative to ISTD         R.T.
  ---------------------------------------------------------------------
   14.757    6.18 ug/mL      255985   Perylene-d12               14.086

   Hit# of  5    Tentative ID              MW  MolForm       CAS#       Qual
  ---------------------------------------------------------------------
   1 4,4,4-Trifluoro-3-hydroxy-2-meth... 200 C7H11F3O3     000000-00-0 27
   2 10-Nonadecanone $$ Di-n-nonyl ke... 282 C19H38O       000504-57-4 25
   3 Butane, 1,4-diiodo-                 310 C4H8I2        000628-21-7 22
   4 Naphthalene, 2-methyl-1-propyl-     184 C14H16        054774-89-9 14
   5 2,5-Cyclohexadien-1-one, 4-(phen... 183 C12H9NO       002406-04-4 14


  *********************************************************************
  Peak Number 18  Tetrapentacontane, 1,54-dib...  Concentration Rank  3

    R.T.     EstConc          Area       Relative to ISTD         R.T.
  ---------------------------------------------------------------------
   15.195   24.37 ug/mL     1009030   Perylene-d12               14.086

   Hit# of  5    Tentative ID              MW  MolForm       CAS#       Qual
  ---------------------------------------------------------------------
   1 Tetrapentacontane, 1,54-dibromo-    915 C54H108Br2    000000-00-0 55
   2 Nonahexacontanoic acid              999 C69H138O2     040710-32-5 53
   3 Eicosane                            282 C20H42        000112-95-8 49
   4 3-Hexadecene, (Z)-                  224 C16H32        034303-81-6 49
   5 3-Eicosene, (E)-                    280 C20H40        074685-33-9 49


  *********************************************************************
  Peak Number 19  Lauric anhydride $$ Dodecan...  Concentration Rank  2

    R.T.     EstConc          Area       Relative to ISTD         R.T.
  ---------------------------------------------------------------------
   15.306   51.78 ug/mL     2143830   Perylene-d12               14.086

   Hit# of  5    Tentative ID              MW  MolForm       CAS#       Qual
  ---------------------------------------------------------------------
   1 Lauric anhydride $$ Dodecanoic a... 382 C24H46O3      000645-66-9 40
   2 4-Dibenzofuranamine $$ 4-Aminodi... 183 C12H9NO       050548-43-1 38
   3 Benzamide, 4-bromo- $$ Benzamide... 199 C7H6BrNO      000698-67-9 35
```

Library Search Compound Report

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Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :

TIC Library   : C:\Database\NIST129K.L
TIC Integration Parameters: LSCINT.P

 4 Lauric anhydride                    382 C24H46O3       000645-66-9 32
 5 5,8-Methano-4H-3,1-benzoxazine-2... 183 C9H13NOS       000000-00-0 27


*********************************************************************
Peak Number 20  4-Dibenzofuranamine $$ 4-Am...  Concentration Rank  7

  R.T.     EstConc          Area       Relative to ISTD         R.T.
---------------------------------------------------------------------
 15.977    7.92 ug/mL      327744   Perylene-d12               14.086

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 4-Dibenzofuranamine $$ 4-Aminodi... 183 C12H9NO        050548-43-1 25
 2 2-Fluoro-7-nitrofluorene $$ Fluo... 229 C13H8FNO2      001806-25-3 22
 3 Dodecanoic acid, ethenyl ester $... 226 C14H26O2       002146-71-6 14
 4 Acetamide, N-[1-(2-ethyl-1-piper... 212 C12H24N2O      055030-28-9 14
 5 Phenol, 2-(2-benzoxazolyl)- $$ P... 211 C13H9NO2       000835-64-3 14
```

```
                            Tentatively Identified Compound (LSC) summary

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  Data File : 12171421.D
  Acq On    : 18 Dec 2014   2:49 am
  Operator  :
  Sample    : 1411600-003A
  Misc      : SAMP SW_8270A
  ALS Vial  : 17   Sample Multiplier: 1

  Quant Method : C:\msdchem\1\methods\120814S7.M
  Quant Title  :

  TIC Library   : C:\Database\NIST129K.L
  TIC Integration Parameters: LSCINT.P

                                                   |--Internal Standard---|
  TIC Top Hit name      RT  EstConc Units Response |#    RT     Resp  Conc|
----------------------------------------------------------------------------
Cyclopentanone,...   3.590     3.9  ug/mL    95954   1   4.948  985145  40.0
Dodecanoic acid      9.012     6.0  ug/mL   236383   3   8.674 1574700  40.0
Pentadecane, 2,...   9.699     3.9  ug/mL   170898   4  10.164 1759210  40.0
Phenol, 2-(1,1-...   9.789     3.1  ug/mL   137163   4  10.164 1759210  40.0
4-Nonylphenol        9.858     3.3  ug/mL   145708   4  10.164 1759210  40.0
Acetamide, N-(3...   9.900     2.7  ug/mL   117932   4  10.164 1759210  40.0
Tetradecanoic acid   9.964    13.7  ug/mL   603426   4  10.164 1759210  40.0
Anthracene, 2-m...  10.666     3.1  ug/mL   135925   4  10.164 1759210  40.0
Phenanthrene, 2...  10.693     4.3  ug/mL   191235   4  10.164 1759210  40.0
n-Hexadecanoic ...  10.867   113.1  ug/mL  4975970   4  10.164 1759210  40.0
Eicosane            10.962    11.4  ug/mL   502545   4  10.164 1759210  40.0
(2-Methyl-but-3...  12.125     3.4  ug/mL   161413   5  12.780 1907400  40.0
2-Hexyl-1-octanol   13.642     6.9  ug/mL   283993   6  14.086 1656140  40.0
Squalene            13.700    14.0  ug/mL   581194   6  14.086 1656140  40.0
Borinic acid, d...  14.223     4.5  ug/mL   188285   6  14.086 1656140  40.0
1-Decanol, 2-he...  14.720     5.3  ug/mL   218990   6  14.086 1656140  40.0
4,4,4-Trifluoro...  14.757     6.2  ug/mL   255985   6  14.086 1656140  40.0
Tetrapentaconta...  15.195    24.4  ug/mL  1009030   6  14.086 1656140  40.0
Lauric anhydrid...  15.306    51.8  ug/mL  2143830   6  14.086 1656140  40.0
4-Dibenzofurana...  15.977     7.9  ug/mL   327744   6  14.086 1656140  40.0
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                         Library Search Compound Report

Data Path : C:\msdchem\1\data\121714\
Data File : 12171421.D
Acq On    : 18 Dec 2014   2:49 am
Operator  :
Sample    : 1411600-003A
Misc      : SAMP SW_8270A
ALS Vial  : 17   Sample Multiplier: 1

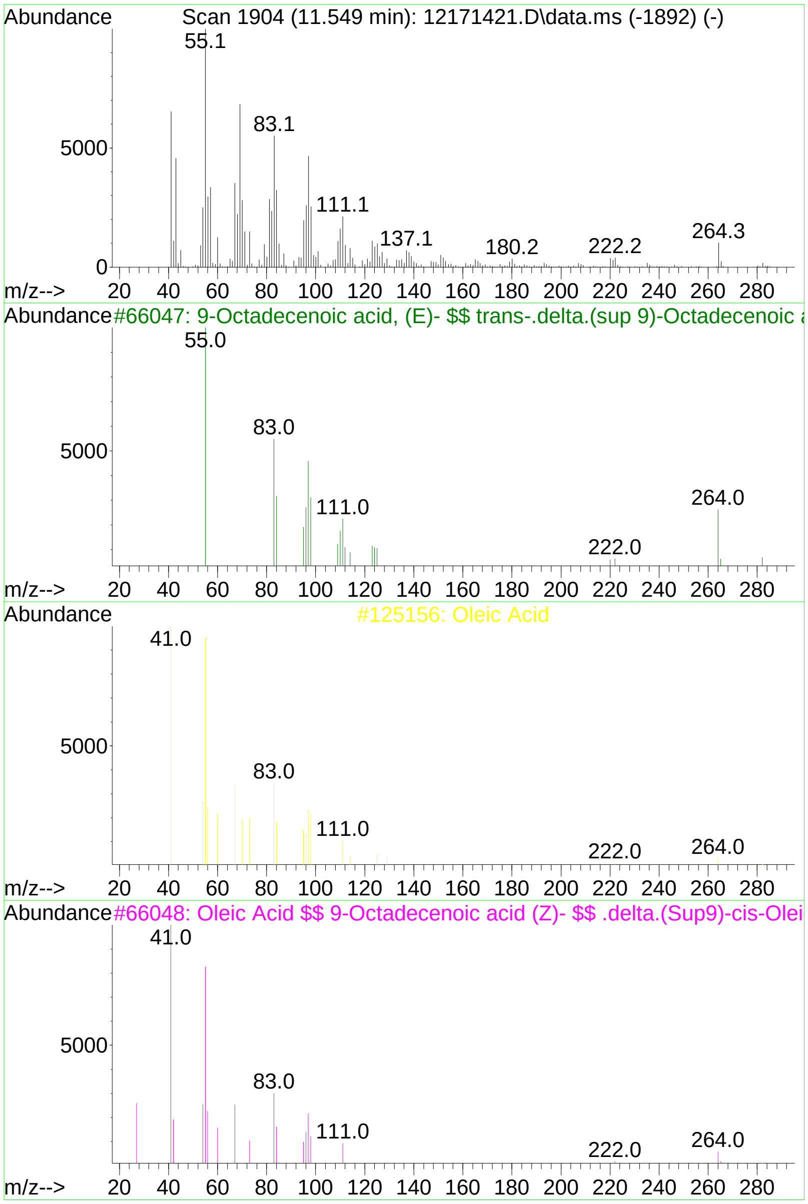
Quant Method : C:\msdchem\1\methods\120814S7.M
Quant Title  :

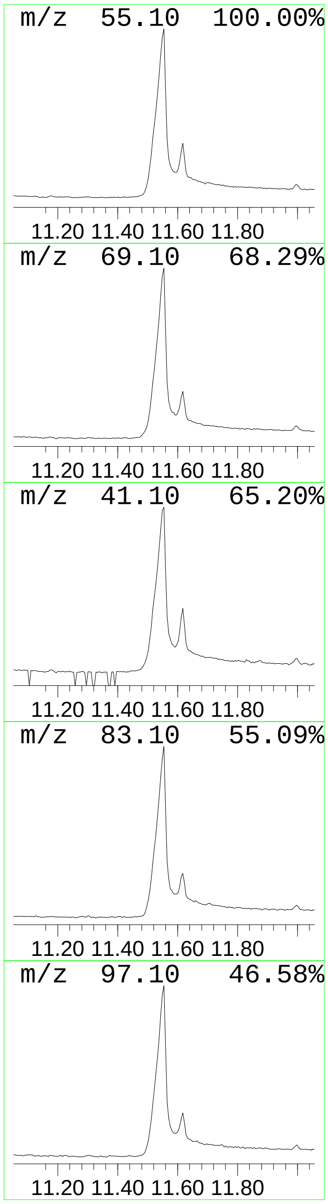
TIC Library   : C:\Database\NIST129K.L
TIC Integration Parameters: LSCINT.P

*********************************************************************
Peak Number 21  9-Octadecenoic acid, (E)- $...  Concentration Rank 21

  R.T.     EstConc          Area       Relative to ISTD        R.T.
---------------------------------------------------------------------
 11.554   78.06 ug/mL     3722350   Chrysene-d12              12.780

 Hit# of  5    Tentative ID             MW  MolForm       CAS#       Qual
---------------------------------------------------------------------
 1 9-Octadecenoic acid, (E)- $$ tra... 282 C18H34O2       000112-79-8 99
 2 Oleic Acid                          282 C18H34O2       000112-80-1 92
 3 Oleic Acid $$ 9-Octadecenoic aci... 282 C18H34O2       000112-80-1 91
 4 Octadec-9-enoic acid                282 C18H34O2       000000-00-0 91
 5 Hexadecenoic acid, Z-11-            254 C16H30O2       002416-20-8 86
```





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                            Tentatively Identified Compound (LSC) summary

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  Data File : 12171421.D
  Acq On    : 18 Dec 2014   2:49 am
  Operator  :
  Sample    : 1411600-003A
  Misc      : SAMP SW_8270A
  ALS Vial  : 17   Sample Multiplier: 1

  Quant Method : C:\msdchem\1\methods\120814S7.M
  Quant Title  :

  TIC Library   : C:\Database\NIST129K.L
  TIC Integration Parameters: LSCINT.P

                                                   |--Internal Standard---|
  TIC Top Hit name      RT  EstConc Units Response |#    RT     Resp  Conc|
----------------------------------------------------------------------------
Cyclopentanone,...   3.590     3.9  ug/mL    95954   1   4.948  985145  40.0
Dodecanoic acid      9.012     6.0  ug/mL   236383   3   8.674 1574700  40.0
Pentadecane, 2,...   9.699     3.9  ug/mL   170898   4  10.164 1759210  40.0
Phenol, 2-(1,1-...   9.789     3.1  ug/mL   137163   4  10.164 1759210  40.0
4-Nonylphenol        9.858     3.3  ug/mL   145708   4  10.164 1759210  40.0
Acetamide, N-(3...   9.900     2.7  ug/mL   117932   4  10.164 1759210  40.0
Tetradecanoic acid   9.964    13.7  ug/mL   603426   4  10.164 1759210  40.0
Anthracene, 2-m...  10.666     3.1  ug/mL   135925   4  10.164 1759210  40.0
Phenanthrene, 2...  10.693     4.3  ug/mL   191235   4  10.164 1759210  40.0
n-Hexadecanoic ...  10.867   113.1  ug/mL  4975970   4  10.164 1759210  40.0
Eicosane            10.962    11.4  ug/mL   502545   4  10.164 1759210  40.0
(2-Methyl-but-3...  12.125     3.4  ug/mL   161413   5  12.780 1907400  40.0
2-Hexyl-1-octanol   13.642     6.9  ug/mL   283993   6  14.086 1656140  40.0
Squalene            13.700    14.0  ug/mL   581194   6  14.086 1656140  40.0
Borinic acid, d...  14.223     4.5  ug/mL   188285   6  14.086 1656140  40.0
1-Decanol, 2-he...  14.720     5.3  ug/mL   218990   6  14.086 1656140  40.0
4,4,4-Trifluoro...  14.757     6.2  ug/mL   255985   6  14.086 1656140  40.0
Tetrapentaconta...  15.195    24.4  ug/mL  1009030   6  14.086 1656140  40.0
Lauric anhydrid...  15.306    51.8  ug/mL  2143830   6  14.086 1656140  40.0
4-Dibenzofurana...  15.977     7.9  ug/mL   327744   6  14.086 1656140  40.0
9-Octadecenoic ...  11.554    78.1  ug/mL  3722350   5  12.780 1907400  40.0
```

APPENDIX B

FIELD LOGS

Note: Field Logs include work completed at SWMUs 13 and 30 as field activities were conducted concurrently.

PROJECT TEAD-S

Notebook No. 1

Continued From Page p 1/2

Chris Duncan 749125.04000 9-2-2014

0745 Arrive to TEAD-S gate waiting for subcontractor Craig Clement.

0755 Craig Clement arrives on-site and gets badged.

0810 Arrive to CAMDS. Go over project safety and Daily H3S forms. Craig will be installing active VMP points at SWMU 13 and 30 down to 5 ft bgs

0900 Craig mobes rig to VMP location 13-SG-05 and begins installing VMP.

0945 VMP 13-SG-05 installed craig mobes to 13-SG-04 and begins installing VMP. I begin checking initial vacuums on summa canisters from ALS.

Canister #	Initial Vacuum
01710	-25
02221	-25
22107/004374	-25
00300	-25
02168	-25
003687	-25
01511	-25
003559	-25
003379	-25
002672	-25
004889	-25
01760	-25
01334	-22.5
004197	-25
003177	-25
01919	-25
004292	-25
004286	-25

1010 All summas initial vac is good. Craig completes install of VMP 13-SG-04 and moves to 13-SG-03

1050 VMP 13-SG-03 installed Craig moves to 13-SG-01

Continued on Page

Read and Understood By

Signed

Date 9-2-2014

Signed

Date

PROJECT TEAD-S

Notebook No. 1

Continued From Page p 2/2

Chris Duncan 749125.04000 9-2-2014

1125 VMP 13-SG-01 has been installed. Craig moves to VMP 13-SG-02.

1155 Craig has not been able to punch through area designated as 13-SG-02. Getting refusal at ~ 1.5 ft bgs. Possible Concrete slab. I have him continue moving a few feet west until he is able to punch through. Finally punches through approx. 15-20 ft west of proposed sample location. Craig begins installing VMP 13-SG-02

1215 VMP 13-SG-02 installed. Craig moves rig over to VMP 30-SG-01.

1245 VMP 30-SG-01 has been installed. Craig moves rig over to VMP 30-SG-02.

1310 VMP 30-SG-02 has been installed. Craig moves to VMP 30-SG-03 inside wastewater lagoon.

1345 VMP 30-SG-03 has been installed. Craig does not have any more probes but will get more tomorrow. We shutdown the site for the day.

1415 Craig and I leave the site. I head to Tooele Field office to unload equipment and prep for upcoming sampling.

1900 Leave Tooele field office for home.

Continued on Page

Read and Understood By

Chris Duncan 9-2-2014

Signed Date Signed Date

PROJECT TEAD-S

Notebook No. 1

Continued From Page p 113

Chris Duncan 749125.04000 9-3-2014

0800 Arrive to CAMDS and begin prepping for vapor sampling. Calculate purge volumes for Active soil gas sampling:

Volume of Boring

$r = (2\frac{1}{4}\text{ inch}) \div 2 = 1.125$

$\text{area} = \pi(1.125)^2 = 3.976$ inches squared

$\text{volume} = (3.976\text{ in}^2)(12\text{ in}) = 47.712\text{ in}^3 = 781.86\text{ mL}$

Volume of Tubing

5 ft of tubing plus added 10 ft of tubing to account for extra tubing related to hookups (15 ft = 180")

$r = (0.170") \div 2 = 0.085$

$\text{area} = \pi(0.085)^2 = 0.0227\text{ in}^2$

$\text{volume} = (0.0227\text{ in}^2)(180\text{ in}) = 4.086\text{ in}^3 = 66.96\text{ mL}$

One Purge Volume

5 ft VMP = (781.86 mL) + (66.96 mL) = 848.82 mL

Overall Purge Volume

5 ft VMP = 848.82 mL X 5 = 4244 mL

= 4244 mL ÷ 200 mL/min = 21.2 minute purge time

0930 Calibrate FID and begin setting up on VMP 13-SG-05

VMP 13-SG-05 (canister # 00300)

static test passed, > 4% H5N95 in shroud

1103 Begin purging at 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	0.0	0	0
3 min	0.0	0	0
5 min	0.0	0	0
10 min	0.0	0	0
15 min	0.0	0	0
20 min	0.0	0	0
22 min	0.0	0	0

1125 Collect sample 13-SG-05

Initial Vac: 25 Final Vac:

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1155 Move to VMP 13-SG-04 and begin setting up.

VMP 13-SG-04 (canister # 021168)

static test passed, > 4% H5N95 in shroud

1214 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	7.1	0	5
3 min	1.3	0	5
5 min	0.4	0	4
10 min	1.1	0	3.5
15 min	0.3	0	3.5
20 min	0.7	0	4
22 min	0.7	0	3.5

1236 Collect sample 13-SG-04

Initial Vac: 25 Final Vac: 7

1305 Talk to Craig Clement on phone. The Active soil gas probes have still not arrived to his house. He is not going to come out today. He will install the last six probes tomorrow. I run to Tooele field office to get needed sampling equip.

1505 Arrive to 30-SG-03 inside wastewater lagoon and set up sample train.

VMP 30-SG-03 (canister # ~~003687~~ cco) ~~01710~~ cco

static test passed, > 4% H5N95 in shroud

1538 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac (Hg")
1 min	5.7	0	3
3 min	1.2	0	3
5 min	0.0	0	3
10 min	0.0	0	3
15 min	0.0	0	3
20 min	0.0	0	3
22 min	0.0	0	3

1600 Collect sample 30-SG-03 - No sample collected

Initial Vac: -25 Final Vac: — No sample collected *

* Swapped summa canisters. First one failed.

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VMP 30-SG-02 (canister # 02221)

static test passed, > 4% H5N95 in shroud

1712 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac (Hg")
1 min	0.0	0	0.5
3 min	0.0	0	0.5
5 min	0.0	0	0.5
10 min	0.0	0	0.5
15 min	0.0	0	0.5
20 min	0.0	0	0.5
22 min	0.0	0	0.5

1735 Collect sample 30-SG-02

Initial Vac: 25 Final Vac: 7

VMP 30-SG-01 (canister #01334)

static test passed, > 4% H5N95 in shroud

1821 Begin Purging @ 200 mL/min

1'

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	0.0	0	6
3 min	0.0	0	8
5 min	0.0	0	9
10 min	0.0	0	9
15 min	0.0	0	8
20 min	0.0	0	7.5
22 min	0.0	0	7.5

1843 Collect sample 30-SG-01

Initial Vac: 22.5 Final Vac: 8

* While attempting to collect vapor sample from 30-SG-03 inside the wastewater lagoon I waited over an hour as the flow controller/summa canister tried to pull a sample, but was unable to. I swapped the flow controller and summa canister and the same problem occurred only this time water started up the tubing. From what I can tell the probe seems to be in groundwater

2010 Leave site for home.

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0700 Arrive on-site along with Craig Clement. We hold a H&S briefing and then drive over to burn trenches at SWMU 30 for one last look to make sure the Soil gas locations are within the trenches.

0815 Craig begins installing VMPs 30-SG-04 and 30-SG-05. I go to VMP 13-SG-02 and prep for sampling.

VMP 13-SG-02 (canister # 01919)

static test passed, >4%. H5N95 in shroud

0841 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	0.0	0	0
3 min	0.0	0	0
5 min	0.0	0	0
10 min	0.0	0	0
15 min	0.0	0	0
20 min	0.0	0	0
22 min	0.0	0	0

0903 Collect sample 13-SG-02

Initial Vac: 25 Final Vac: 7

0905 Craig completes installing VMPs 30-SG-04 and 30-SG-05. Moves to VMPs 30-SG-06, and 30-SG-07

0940 Craig completes installing VMPs 30-SG-06 and 30-SG-07 Moves to VMPs 30-SG-08 and 30-SG-09

VMP 13-SG-01 (canister # 003177)

static test passed, 74% H5N95 in shroud

0953 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	79.0	0	0
5 min	62.6	0	0
10 min	47.9	0	0
15 min	40.0	0	0
20 min	32.7	0	0
22 min	31.3	0	0

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1015 Collect sample 13-SG-01
Initial Vac: 25   Final Vac: 7

1025 Troy Johnson, Dave Larsen, and Kevin Draper arrive on-site. Craig Clement finishes installing VMPs 30-SG-08 and 30-SG-09.

1045 Craig Clement leaves the site. I escort Dave Larsen and crew over to the burn trenches. Dave wants to look at our sampling locations in the trenches.

1115 Dave Larsen concurs with sampling locations. They leave the site. I head to 13-SG-03 and set up for sampling.

VMP 13-SG-03 (canister # 004292)

static test passed, H5N95 >4% in shroud

1135 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	31.2	0	0
3 min	23.9	0	0
5 min	19.7	0	0
10 min	14.1	0	0
15 min	11.3	0	0
20 min	9.5	0	0
22 min	8.8	0	0

1157 Collect sample 13-SG-03 and 13-SG-03FD
#004292 (13-SG-03) Initial Vac: 25   Final Vac: 7
#004286 (13-SG-03FD) Initial Vac: 25   Final Vac: 7

1245 Troy Johnson meets me at bldg 4053 at Area 2 to help me pick up a drum I was storing there.

1330 Arrive back to CAMDS. Drop off drum and clean up site.

1400 Leave site for home.

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Chris Duncan   749125.04000   9-5-2014

0800 Arrive to CAMDS. Prep for sampling, calibrate FID.
0817 Arrive to 30-SG-04 and set up to sample.

VMP 30-SG-04 (canister # 002672)

static test passed, H5N95 > 4% in shroud

0833 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	3425	0	1
3 min	2330	0	1
5 min	2002	0	1
10 min	2583	0	1
15 min	2438	0	0.5
20 min	2267	0	0.5
22 min	2215	0	0.5

0855 Collect sample 30-SG-04
Initial Vac: 25   Final Vac: 7

VMP 30-SG-05 (canister # 003379)

static test passed, H5N95 > 4% in shroud

0929 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	411.2	0	0
3 min	244.5	0	0
5 min	206.5	0	0
10 min	130.1	0	0
15 min	95.5	0	0
20 min	73.9	0	0
22 min	68.6	0	0

0951 Collect sample 30-SG-05
Initial Vac: 25   Final Vac: 7

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VMP 30-SG-06 (canister # 004374)

static test passed, H5N95 > 4% in shroud

1028 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	152.6	0	0
3 min	110.5	0	0
5 min	92.7	0	0
10 min	75.1	0	0
15 min	63.1	0	0
20 min	50.2	0	0
22 min	48.3	0	0

1050 Collect sample 30-SG-06

Initial Vac: 25 Final Vac: 7

VMP 30-SG-07 (canister # 003559)

static test passed, H5N95 > 4% in shroud

1125 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	48.1	0	0
3 min	34.9	0	0
5 min	29.0	0	0
10 min	21.8	0	0
15 min	19.4	0	0
20 min	17.0	0	0
22 min	16.2	0	0

1147 Collect sample 30-SG-07

Initial Vac: 25 Final Vac: 7

1148 Collect sample 30-SG-07FD (canister # 01511)

Initial Vac: 25 Final Vac: 7

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VMP 30-SG-08 (canister #004197)

static test passed, H5N95 > 4% in shroud

1234 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	30.5	0	1
3 min	19.4	0	1
5 min	19.2	0	1.5
10 min	18.1	0	3
15 min	17.4	0	3.4
20 min	13.4	0	3.5
22 min	11.4	0	3.5

1256 Collect sample 30-SG-08

Initial Vac: 25 Final Vac: 7

VMP 30-SG-09 (canister #01760)

static test passed, H5N95 > 4% in shroud

1340 Begin purging @ 200 mL/min

Time (min)	FID (ppm)	H5N95 (ppm)	Vac ("Hg)
1 min	29.5	0	0
3 min	20.3	0	0
5 min	16.7	0	0
10 min	12.4	0	0
15 min	12.3	0	0
20 min	12.0	0	0
22 min	11.8	0	0

1402 Collect sample 30-SG-09

Initial Vac: 25 Final Vac: 7

1445 Finished with active soil gas sampling. Clean up sampling equipment and head to Tooele field office.

1545 Arrive to Tooele field office. Prep samples for shipping and prep for next weeks sampling event.

1745 Head to airport to ship samples.

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Chris Duncan 749125.04000 9-8-2014

0700 Arrive to Tooele field office. Unload coolers and pack sampling equipment.

0800 Arrive to CAMDS at TEAD-S. Craig Clement arrives with me. Conduct H&S briefing and prep for soil sampling.

0850 prepare trip blank. Calibrate FID and collect Field blank 13-FB-01

0925 Craig mobilizes geoprobe rig to soil boring location 13-SS-08.

0940 Commence drilling

1000 Collect sample 13-SS-08A from surface

1005 collect sample 13-SS-08B from 3-5 ft bgs

1020 collect sample 13-SS-08C from ~~8-10~~ 10-12 ft bgs. Changed depth on lower sample due to higher hits on the FID.

1030 Move to 13-SS-09.

1035 commence drilling.

1045 Collect surface sample 13-SS-09A

1050 Collect sample 13-SS-09B from 3-5 ft bgs

1055 Collect sample 13-SS-09C from 12-14 ft bgs where the highest FID readings occurred

1110 Move to 13-SS-06

1120 Commence drilling

1135 Collect surface sample 13-SS-06A

1140 Collect sample 13-SS-06B from 4-6 ft bgs

1145 collect sample 13-SS-06C from 9-11 ft bgs

1200 Move to 13-SS-07

1210 Commence drilling

1220 Collect surface sample 13-SS-07A

1225 Collect sample 13-SS-07B from 9-11 ft bgs

1230 Collect sample 13-SS-07C from 12-14 ft bgs

1235 Collect sample 13-SS-07CFD from 12-14 ft bgs

1300 Move to 13-SS-04

1310 Commence drilling

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1315 Collect Sample 13-SS-04A from surface
1320 Collect Sample 13-SS-04B from 5-7 ft bgs
1325 Collect Sample 13-SS-04C from 14-15 ft bgs in the soil beneath very high FID readings.
1405 Move to 13-SS-05
1415 Commence drilling
1430 Collect surface sample 13-SS-05A
1435 Collect sample 13-SS-05B, FD, MS, and MSD from 3-5 ft bgs
1445 Collect sample 13-SS-05C from 11-13 ft bgs
1500 Move to 13-SS-02
1515 A massive thunderhead has arrived and their is lighting in the area. The storm does not look like its going to let up. Craig and I decide to shutdown fieldwork.
1530 Craig leaves the site. I head to the Tooele field office.
1600 Arrive to Tooele field office. Unload equipment and samples. Prep for tomorrows sampling. Write Daily Report form.
1740 Leave field office for home.

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Chris Duncan 749125.04000 9-9-2014

0740 Arrive to CAMDS at TEAD-S. prepare H_2S briefing. calibrate FID and prep for sampling.

0805 Craig Clement arrives on-site. Bruce Van Etten from the army corps of Engineers calls and he is on the TEAD-S Depot. I run up to main gate to escort him to SWMU 13.

0840 Arrive back to SWMU 13 with Bruce. Conduct H_2S briefing.

0855 Commence drilling at 13-SS-02

0910 Collect surface sample 13-SS-02A

0915 Collect sample 13-SS-02B from 3-5 ft bgs

0920 Collect sample 13-SS-02C from 12-14 ft bgs. Very high petroleum odor and high FID readings. Soil was stained dark black.

0945 Move to 13-SS-01

1000 Commence drilling at 13-SS-01

1010 Collect surface sample 13-SS-01A

1015 Collect sample 13-SS-01B from 3-5 ft bgs

1020 Collect sample 13-SS-01C from 13-15 ft bgs. sampled this location beneath the stained soil to see if we are below the contamination.

1050 Move to 13-SS-03

1055 Commence drilling

1105 Collect surface sample 13-SS-03A, FD, MS, MSD

1110 Collect sample 13-SS-03B from 3-5 ft bgs

1115 Collect sample 13-SS-03C from 8-10 ft bgs

1135 Dave Shank the Parsons Project Manager arrives on-site.

1205 Dave Shank leaves the site. We move to 30-SS-01 in Boiler blowdown ditch.

1225 Collect surface sample 30-SS-01A

1235 Collect sample 30-SS-01B from 3-5 ft bgs.

1240 Collect sample 30-SS-01C from 8-10 ft bgs. This was the only area that was stained and FID was 17.1 ppm

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Chris Duncan 749125.04000 9-9-2014

1255 A massive Thunderstorm is rolling through with lightning. We stop work to wait it out.

1415 While waiting out the storm I collect field blank sample 30-FB-01.

1450 The storm is not letting up and Craigs direct push rig is stuck in the boiler blowdown ditch. I am going to pull him out with the work truck.

1515 Craigs rig is unstuck. The storm is getting worse. We shutdown field activities for the day.

1520 I collect Equipment Blank 13/30-EB-01.

1535 All hands off-site. I head to Tooele field office. I pick up ice for sample shipment on the way.

1600 Arrive to Tooele field office. Prep and pack samples for shipping.

1745 Leave field office for airport.

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Chris Duncan 749125.04000 9-10-2014

0730 Arrive to CAMDS. Prepare H&S briefing. Calibrate FID.
0805 Craig Clement and Bruce VanEtten on-site. Conduct H&S briefing and prep for sampling.
0830 Commence drilling at 30-SS-02
0840 Collect surface sample 30-SS-02A
0845 Collect sample 30-SS-02B from 3-5 ft bgs
0850 Collect sample 30-SS-02C from 8-10 ft bgs
0915 Move to 30-SS-03
0930 Commence Drilling
0945 Collect surface sample 30-SS-03A
0950 Collect sample 30-SS-03B from 3-5 ft bgs
0955 Collect sample 30-SS-03C from 8-10 ft bgs
1010 Move to 30-SS-09. Collect Field Blank (30-FB-01) for ABPs
1030 Commence drilling
1045 Collect sample 30-SS-09A from surface
1050 Collect sample 30-SS-09B, FD, MS, MSD from 3-5 ft bgs
1055 Collect sample 30-SS-09C from 8-10 ft bgs
1115 Move to 30-OWS-01.
1130 Collect soil sample 30-OWS-01S from the manhole (FID=0.0) on the northeast side of the lagoon
1145 Move to 30-SS-07 inside the lagoon
1210 Collect sample 30-SS-07A from surface
1215 Collect sample 30-SS-07B from 3-5 ft bgs
1220 Collect sample 30-SS-07C from 8-10 ft bgs
1240 Move to 30-SS-08 inside the lagoon
1245 Commence drilling
1255 Collect sample 30-SS-08A from surface
1300 Collect sample 30-SS-08B from 3-5 ft bgs
1305 Collect sample 30-SS-08C from 8-10 ft bgs
1320 Move to 30-SS-06 inside the lagoon
1330 Commence drilling
1345 Collect surface sample 30-SS-06A, FD

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1350 Collect sample 30-SS-06B from 3-5 ft bgs

1355 Collect sample 30-SS-06C from 8-10 ft bgs

1415 Move to 30-SS-04 inside the lagoon

1430 Commence drilling

1445 Collect sample 30-SS-04A

1450 Collect sample 30-SS-04B from 3-5 ft bgs

1455 Collect sample 30-SS-04C from 8-10 ft bgs

1515 Move to 30-SS-05 inside lagoon

1530 Collect surface sample 30-SS-05A

1535 Collect sample 30-SS-05B from 3-5 ft bgs

1540 Collect sample 30-SS-05C from 8-10 ft bgs

1550 Finished with soil sampling at SWMU 30.

30-EB-01

1600 Collect Equipment Blank for ABPs (sent to Test America)

1605 Collect Equipment Blank (30-EB-02) (sent to RTI)

1630 Head to Tooele field office

1715 Arrive to field office. Unload soil samples. Prep for Hydrapunch sampling and write daily report.

1920 Leave field office.

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Date

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Chris Duncan 749125.04000 9-11-2014

0740 Arrive to CAMDS. Prepare H_2S briefing and prep for sampling. Bruce VanEtten from USACE already on-site.

0800 Craig Clement on-site. Conduct H_2S briefing and prep for sampling.

0840 Arrive to 30-HPGW-08 at The Debris piles and prep for hydrapunch sampling.

0855 Craig begins installing screen into groundwater

0910 Screen in place from 11-15 ft bgs. Set up for sampling

0940 Collect sample 30-HPGW-08

1000 I read in SOP for hydrapunch sampling that we need to be collecting water quality parameter readings prior to sampling. I shutdown operations and call Dave Shank. He agrees we need parameters. I can have one in tomorrow but this shutsdown work for today. (water quality meter)

1030 We clean up site.

1100 All hands off-site. I talk to katherine our chemist and she would like me to ship soil samples collected from yesterday. I head to Tooele field office. Pick up ice on the way.

1130 I get a phone call from Matt Ivers. He asks me to stop by the landfill at TEAD-N and label some carbon vessels. Also asks me to check air flows at bldg 620. I do this then go to field office.

1230 Arrive to field office. Pack samples and prep for tomorrows sampling.

1430 Leave field office for airport.

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Chris Duncan 749125.04000 9-12-2014

0740	Arrive to CAMDS. Begin staking step out boring locations.
0800	Craig Clement on-site. I conduct H&S briefing calibrate FID and prep for borings.
0900	Mobe to first step out boring 13-SS-07A
0910	Commence drilling
0945	Complete drilling down to 20 ft bgs. Log Core and take FID readings. all FID readings are 0.0. Core looks clean.
1000	Clean up, decon, and move to 13-SS-05A
1015	Commence drilling
1040	Complete drilling down to 20 ft bgs, slight petroleum odor from 11-15 ft bgs. Highest reading on FID = 75.3 ppm
1100	clean up, decon equipment and move to 13-SS-02A
1115	Commence drilling
1140	Complete drilling down to 20 ft bgs. Slight petroleum odor from 10-14 ft bgs. Highest FID reading = 50.1 ppm. log core decon equipment and move to 13-SS-09A
1205	Commence drilling
1240	Drilling complete down to 20 ft bgs. No odor or FID hits from 0-20 ft bgs. log core.
1300	Decon equipment and move to 13-SS-01A
1320	Commence drilling
1350	Drilling complete down to 20 Ft bgs. Log core. core is contaminated from approx. 11-14 ft bgs with the highest FID reading @ 150 ppm at 13 ft bgs. 11-14 ft is stained dark gray to black.
1400	Decon equipment and move to 13-SS-10
1415	Commence drilling
1440	Drilling complete. Log core and take FID readings. highest FID reading = 124.0 ppm. core is contaminated from approx. 9-12 ft bgs.
1455	Decon equipment and clean up the site.
1530	Leave the site

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PROJECT TEAD-5 **Notebook No.** 1

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Chris Duncan 749125. 04000 9-15-2014

0745 Arrive to CAMDS. Calibrate YSI in prep for hydrapunch sampling.

0800 Craig Clement on-site. Conduct H&S briefing.

YSI calibration

	pre cal	post cal
Ph	7.06	7.00
Cond.	1.227	1.413
DO	7.96	8.90
ORP	227.8	240.3

Turbidimeter Calibration was good.

0830 Mobe to 30-HPGW-08 at debris piles.

0850 Craig begins installing hydrapunch screen.

0935 Sreen is placed at approx. 10-15 ft bgs. Collect sample 30-HPGW-08. Initial YSI Readings are:

PH	Temp °c	DO (mg/L)	Cond (ms/cm)	ORP	Turb (ntus)
7.11	14.94	2.07	31.00	252.9	>1,000

0945 Decon equipment and move to 30-HPGW-09

0955 Craig begins installing hydrapunch screen

1005 Screen is placed at approx 10-15 ft bgs. Collect sample 30-HPGW-09. Initial YSI readings:

PH	Temp (°c)	DO (mg/L)	Cond. (ms/cm)	ORP	Turb. (ntus)
7.45	14.40	4.83	17.65	253.3	>1,000

1015 Decon equipment and move to 30-HPGW-10

1025 Craig begins installing hydrapunch screen.

1045 Screen is placed at approx. 10-15 ft bgs. Collect sample 30-HPGW-10, FD, MS, MSD. Initial YSI readings:

PH	Temp (°C)	DO (mg/L)	Cond (ms/cm)	ORP	Turb (ntus)
7.17	13.60	14.38	24.38	208.9	>1,000

1145 Decon equipment and move to 30-HPGW-~~12~~ CCD 11

1210 Craig begins installing hydrapunch screen

1215 Screen is placed at approx. 10-15 ft bgs. Collect sample 30-HPGW-~~12~~ CCD 11 Initial YSI readings:

pH	Temp (°c)	DO (mg/L)	Cond (ms/cm)	ORP	Turb (ntus)

1220 Hole is bone dry. Craig pushes to 20 ft bgs

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1220 Craig completes push to 20 ft bgs. still dry. No sample collected.

1250 Move on to 30-HPGW-12. Craig begins placing screen.

1345 Screen is placed at approx. 16-20 ft bgs. Collect sample 30-HPGW-12. Initial YSI readings:

PH	Temp (°c)	Cond (ms/cm)	DO (mg/L)	ORP	Turb. (ntus)
7.51	13.65	45.19	5.51	76.2	>1,000

1400 Move to 30-HPGW-07.

1420 Craig begins installing hydrapunch screen

1445 Had to put the screen from 16-20 ft bgs to get water. collect sample 30-HPGW-07. Initial YSI readings:

PH	Temp (°c)	Cond (ms/cm)	DO (mg/L)	ORP	Turb. (ntus)
7.50	15.35	51.53	6.09	155.3	>1,000

1515 Decon equipment and go back to 30-HPGW-11. We move the sample location to the south approx. 30 ft.

1530 Craig begins installing hydrapunch screen

1545 Screen installed to 20 ft bgs. No water. We will try going deeper.

1615 Screen is set from 24-28 ft bgs. Begin collecting sample 30-HPGW-11.

1625 Hole is dry. Only able to collect 1/3 of a 1-liter Amber glass. We will leave it overnight to recharge and continue sampling in the morning. Clean up site.

1710 All hands off-site.

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PROJECT TEAD-S **Notebook No.** 1

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Chris Duncan 749125.04000 9-16-2014

0700 Arrive to Tooele field office. load sample equipment. Head to TEAD-S.

0750 Arrive to CAMDS. Calibrate YSI and turbidimeter

YSI 556 #R8316	Pre cal	post cal
Cond.	1.389	1.413
PH	6.98	7.00
DO	7.85	8.90
ORP	235.2	240.1

Turbidemeter calibration is good

0815 Craig Clement on-site. Conduct HBS briefing

0840 Head to 30-HPGW-11 to collect more sample volume

0855 Complete sample volume was collected from 30-HPGW-11. No parameters collected. we ran out of water.

0915 Collect field blank 30-FB-01 for Dioxins/Furans

0930 Craig begins installing screen at 30-HPGW-13

0945 Screen installed from 11-16 ft bgs. Collect sample 30-HPGW-13, FD, MS, MSD. Initial water parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
7.26	10.64	6.98	12.94	-58.8	>1,000

1030 Move to 30-HPGW-01 and begin installing screen

1100 Screen installed to 11-16 ft bgs. collect sample (hydrocarbon smel 30-HPGW-01. Initial Groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb. (ntus)
7.49	10.62	7.80	15.67	-6.2	>1,000

1130 Decon equipment and move to 30-HPGW-02 and begin installing screen. Dave Larsen and Troy Johnson on-site.

1210 Screen installed to 11-16 ft bgs. Collect sample 30-HPGW-02. Initial groundwater parameter readings:

PH	Cond. (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb. (ntus)
7.73	13.69	10.09	13.68	19.8	>1,000

1220 Dave Larsen and Troy Johnson leave the site. Craig decons equipment and we move to 30-HPGW-03

1235 Craig begins installing screen. Note: Sample 30-HPGW-02 had visible gas bubbles in VOAs.

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Chris Duncan 749125.04000 9-16-2014

1250 Screen installed to 11-16 ft bgs. Collect sample 30-HPGW-03. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
7.38	15.89	8.65	15.54	20.2	>1,000

1310 Decon equipment and move to 30-HPGW-04

1345 Screen set at 10-15 ft bgs. Collect sample 30-HPGW-04, FD, MS, MSD. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
8.01	3.122	7.81	12.19	8.2	>1,000

1410 Move to 30-HPGW-05 and begin installing screen

1445 Screen installed from 10-15 ft bgs. Collect sample 30-HPGW-05. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
7.57	13.99	10.14	13.79	-23.6	>1,000

1500 Decon equipment and move to 30-HPGW-06 and begin installing screen

1530 Screen installed to 10-15 ft bgs. Collect sample 30-HPGW-06. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
7.76	9.474	13.21	14.41	-27.4	>1,000

1550 Clean up site.

1605 Collect Equipment blanks 30-EB-03 (RTI), 30-EB-01 (Cape Fear), 30-EB-01 (Test America).

1630 Head to Tooele field office. Craig leaves the site.

1655 Arrive to Tooele field office. Prep and pack samples for shipping.

1800 Leave field office for airport.

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PROJECT TEAD-S

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Chris Duncan 749125.04000 9-17-2014

0700 Arrive to Tooele field office. load sampling equipment.

0800 Arrive to CAMDS. Calibrate YSI and turbidimeter

YSI 556 #R8316	pre cal	post cal
PH	7.10	7.01
Cond.	1.361	1.413
DO	6.89	8.90
Temp	14.86	13.89
ORP	231.6	240.2

Turbidimeter calibration is good.

0810 Craig Clement on-site. Conduct H2S briefing.

0840 Mobe to hydrapunch location 13-HPGW-08 and begin installing screen

0920 Screen installed to 10-15 ft bgs. Collect sample 13-HPGW-08. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb. (ntus)
7.19	12.99	4.81	14.51	-22.8	>1,000

0950 Decon equipment and move to 13-HPGW-07

1000 Begin installing screen

1030 Screen installed to 10-15 ft bgs. Collect sample 13-HPGW-07. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)

1035 Hole is not producing water. Craig is going deeper and setting screen to 15-20 ft

1040 Screen is set at 15-20 ft bgs. water smells like hydrocarbons

1045 New sample time collect 13-HPGW-07. Initial GW parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
7.57	15.25	7.85	20.77	-91.1	>1,000

1100 Decon equipment and move to 13-HPGW-05 and begin installing screen.

1130 Screen installed from 10-15 ft bgs. collect sample 13-HPGW-05, FD, MS, MSD. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
7.64	10.72	5.49	18.24	-10.4	>1,000

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Chris Duncan 749125 04000 9-17-2014

1210 Decon equipment and move to 13-HPGW-06

1225 Begin installing screen

1255 Screen installed from 10-15 ft bgs. Collect sample 13-HPGW-06. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
7.99	7.156	11.31	15.71	85.3	560

1345 Decon equipment and move to 13-HPGW-03

1350 Craig begins installing screen

1400 Screen installed from 10-15 ft bgs. Hole is bone dry. Craig goes deeper and sets screen from 15-20 ft bgs

1445 Collect sample 13-HPGW-03. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb. (ntus)
7.91	1.859	8.03	16.93	52.1	71,000

1525 Decon equipment and move to 13-HPGW-02 and begin installing screen.

1545 Screen installed from 10-15 ft bgs. hole is dry. Craig pushes 5 more feet.

1605 Screen is installed from 15-20 ft bgs. Collect sample 13-HPGW-02. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
7.48	3.798	5.21	17.85	42.8	223

1640 Decon equipment and clean up site.

1715 Collect equipment blanks (13-EB-01-RTI) and 13-EB-02 (Test America ABPs)

1730 All hands off-site. I go drop off samples in Tooele and pick up GPS unit from South Jordan office.

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Chris Duncan 749125.04000 9-18-2014

0700 Arrive to CAMOS. Craig Clement on-site. I conduct H&S briefing then calibrate YSI and turbidimeter

YSI 556 #R8316	pre cal	post cal
PH	7.12	7.01
Cond	1.381	1.413
DO	7.51	8.70
Temp	15.54	15.69
ORP	229.3	239.8

Turbidimeter calibration is good

0740 Craig mobilizes Direct Push rig to 13-HPGW-01 and begins installing screen

0750 Screen installed from 10-15 ft bgs. No water. Craig will have to push deeper.

0810 Screen installed from 15-20 ft bgs. Only approximately 4 inches of water in bottom of screen. Collect sample 13-HPGW-01. Not enough water to collect initial groundwater parameters.

0830 Decon equipment and prepare for step-out borings. We have one hydropunch left to do but we are waiting for Dave Larsen to arrive so he can collect a split sample

0850 Craig begins step-out boring 13-SS-06A. I calibrate FID.

0930 Craig completes boring down to 20 ft bgs. I complete FID readings, and log core. craig decons equipment and moves to 13-SS-03B

0945 Craig begins drilling 13-SS-03B

1030 Craig completes boring down to 20 ft bgs. I complete FID readings of core and begin logging. Craig decons equipment then moves to 13-SS-05B

1050 Craig begins drilling 13-SS-05B. Dave Shank calls and lets me know that Dave Larsen from DSHW will not make it to the site today

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Chris Duncan 749125. 04000 9-18-2014

1130 Craig completes boring down to 20 ft bgs. I complete FID readings and log core. Craig decons equipment then moves to 13-SS-02B

1200 Craig begins drilling 13-SS-02B

1235 Craig completes boring down to 20 Ft bgs. I complete FID readings and log core. Craig decons equipment

1255 Craig begins drilling 13-SS-10B

1335 Craig completes boring down to 20 ft bgs. I complete FID readings and log core. Craig decons equipment and preps for the last hydropunch sample

1400 Craig begins installing hydropunch screen at 13-HPGW-04

1410 Screen installed from 10-15 Ft bgs. Not producing water. Craig pushes screen five more feet.

1420 Screen installed from 15-20 ft bgs. Collect sample 13-HPGW-04. Initial groundwater parameters:

PH	Cond (ms/cm)	DO (mg/L)	Temp (°c)	ORP	Turb (ntus)
Not enough water to collect parameters.					>1,000

only able to collect VOCs (3 VOAs) and half a liter for TPH-DRO.

1530 Clean up the site. Decon equipment.

1545 All hands off-site. I head to Tooele field office.

1620 Arrive to field office. Prep and pack hydropunch samples for shipping.

1800 Leave field office for airport.

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PROJECT TEAD-S

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Chris Duncan 749125.04000 9-19-2014

1015 Arrive to CAMDS. calibrate FID. Prepare H2S briefing.

1035 Craig Clement on-site. I conduct H2S briefing and we prepare for step-out soil borings at SWMU 13.

1050 I stake boring location to target the source of contamination. I have to move the boring to the western edge of the source area due to concrete that craig cannot push through. Location should be good on the downgradient edge of the source area.

1110 Craig begins drilling

1120 Craigs direct push rig has shutdown. He thinks he may have gotten some bad diesel fuel this morning. He is trying to work on it now.

1210 Rig is up and running. Craig changed the filter. Thinks bad gas plugged his filter.

1215 Craig resumes drilling at 13-SS-11.

1340 Craig completes boring down to 24 ft bgs. FID is reading 0.0 ppm from approx. 22.5 ft bgs and below. This boring location is elevated by foundations and fill material about 3-4 ft higher than the surrounding previous borings. Craig decons equipment and I log core.

1355 Move to 13-SS-10C.

1405 Craig commences drilling

1440 Craig completes boring down to 20 ft bgs. FID reads 0.0 ppm from 0-20 ft bgs. Craig decons equipment and I log core.

1500 Clean up site and Craig loads all his equipment.

1540 All hands off-site. I head to Tooele field office to unload equipment and pack FID for shipping.

1615 Leave field office for airport.

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Chris Duncan 9-19-2014

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PROJECT TEAD-S
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Chris Duncan 749125.04000 9-23-2014

1045 At Tooele field office. Just finished collecting water levels for a different project. Begin taking an inventory of sample containers to make sure we have enough for the test pitting phase of the project at SWMU 30.

1130 Finished with bottle count. Need a few more 250mL plastic HNO_3 preserved bottles. I call Katherine Lapierre. She is having them sent to our office. Begin gathering needed equipment for test pitting.

1230 Head to TEAD-S to GPS all sample locations that have already been collected.

1315 Arrive to SWMU 13 and begin GPS at sample locations.

1440 Finished with SWMU 13. Move to SWMU 30

1500 Use sta rod to measure depth of outflow pipe inside the Southwest Wastewater Lagoon. Depth from bottom to top of the PVC casing is approx. 4 ft.

1530 Arrive at suspected OWS and measure from the sediment inside to the top of the rim of the manhole. Depth is approx. 55ft. Take pictures of inside the suspected OWS and of the sediment inside.

1600 Continue GPS of SWMU 30 sample locations.

1645 Finished with GPS of all previously collected sample locations at SWMUs 13 and 30.

1705 Leave site for home.

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PROJECT TEAD-S

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Chris Duncan   749125.04000   9-29-2014

0700 Arrive to TEAD-S Maingate. Meeting Scott Evans from C3G for start of test pit work at SWMU 30. Calibrate PID and Landfill Gas Analyzer. Prepare for Project Safety Kickoff with new subcontractor (C3G).

0830 Receive phone call from Scott Evans (C3G) and he has been sitting at Maingate at TEAD-North Area. I inform him I am at the TEAD-south area. He is on his way.

0850 Scott Evans arrives to TEAD-S. He gets badged and we head to CAMDS.

0915 Arrive to CAMDS. Go over Project safety covering APP/SSHP and Applicable AHAs.

0945 Go to Debris Piles and prepare for some scratch investigation of debris piles

1015 Dave Larsen, Troy Johnson and Paige Walton arrive on-site. We begin Scratch # 1 on asphalt pile on north end of debris pile. PID readings are 0.0 ppm underneath asphalt.

1030 Begin scratch # 2 into soil and asphalt pile. PID readings: 0.0 ppm throughout.

1045 Move to scratch # 3 in concrete rubble. PID readings: 0.0 ppm throughout. lots of asphalt chunks mixed underneath concrete rubble

1055 Move to scratch # 4 in area of clay soil with no vegetation. PID readings: 0.0 ppm throughout.

1105 Move to Scratch # 5 in a soil only pile. PID readings: 0.0 ppm throughout

1115 Move to scratch # 6 in concrete and rebar rubble. PID readings are 0.0 ppm throughout.

1125 Move to scratch # 7 in soil only pile. PID readings: 0.0 ppm throughout.

1135 Move to scratch # 8 in soil only pile. PID readings: 0.0 ppm throughout.

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Chris Duncan 749125.04000 9-29-2014

1145 Move to soil pile #9 in soil and asphalt mixed with PVC piping. PID readings are 0.0 ppm throughout

1155 Move to scratch #10 in soil and asphalt. PID readings: 0.0 ppm throughout

1205 Move to south end of pile to test pit some locations that Dave, Paige, and Troy would like to see. Begin digging scratch #11 in soil and asphalt mixed with fiberglass. PID readings are 0.0 ppm throughout.

1215 Move to Soil and asphalt pile on SE corner for scratch #12. PID readings throughout are 0.0 ppm

1220 Dave Larsen, Troy Johnson, and Paige Walton leave the site. Scott and I move to scratch #13 in concrete rubble pile. PID readings are 0.0 ppm throughout

1230 Move to scratch #14 in solid asphalt pile. PID readings are 0.0 ppm throughout. underneath asphalt are sheets of plywood or USB boards.

1240 Move to scratch #15 in pile of large pieces of concrete PID readings are 0.0 ppm throughout.

1250 It begins to rain. Scott and I break for lunch.

1315 Move to scratch #16 in soil and asphalt pile. PID readings are 0.0 ppm throughout.

1325 Move to Scratch #17 in a soil/concrete/wood pile PID readings throughout are 0.0 ppm.

1335 Move to Scratch #18 in a soil and asphalt pile. PID readings are 0.0 ppm throughout.

1345 Move to scratch #19 in soil and asphalt pile. PID readings are 0.0 ppm throughout.

1355 Move to scratch #20 in soil only pile on southwest corner of debris piles. PID readings are 0.0 ppm throughout. This concludes the representative scratches across the debris piles. All locations looked clean with no staining and all PID readings were 0.0 ppm.

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Chris Duncan 749125.04000 9-29-2014

1415 Move to Test Pit location 30-TPSS-13 in the no vegetation area on the east side of the debris piles.

1425 Collect surface sample 30-TPSS-13A. Scott is deconning backhoe bucket.

1435 Scott begins digging test pit 30-TPSS-13.

1445 Scott has reached a depth of 3.5 ft bgs. I collect sample 30-TPSS-13B. Soil looks native and clean. PID readings are 0.0 ppm

1530 Scott has reached 10 ft bgs. I collect sample 30-TPSS-13C. Soil looks like native clay. PID readings are 0.0 ppm.

1545 Scott begins filling in test pit as I finish logging the test pit.

1600 Decon backhoe and Label new drum PARSNZ14272Z01

1630 Collect equipment blank 30-EB-04 using stainless steel trowel that I used to collect soil samples.

1700 All hands off-site. I go to Tooele field office.

1730 Arrive to field office. Unload samples, finish paperwork and do Daily field report.

1805 Leave field office for home.

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PROJECT TEAD-S

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Chris Duncan 749125.04000 9-30-2014

0755 Arrive to CAMDS. Calibrate PID and prepare H&S briefing.

0805 Scott Evans arrives on-site. Conduct H&S briefing and prep for test pitting and soil sampling at debris piles.

0830 Head to debris piles and set up to test pit and sample 30-TPSS-07. This is a solid pile of asphalt so only one sample will be collected from the native soil beneath the solid asphalt pile. I log the asphalt pile while Scott works his way into the debris piles to gain access to the sample location.

0840 Scott begins trying to flip over or break up the asphalt pile. The pile is bigger and heavier than expected. Scott is able to lift the pile up enough for me to reach a sample shovel underneath. PID readings under the pile are 0.0 ppm

0900 Collect sample 30-TPSS-07B from native soil underneath the solid asphalt. Scott decons bucket.

0920 Move to 30-TPSS-08. This is a pile of concrete rubble mixed with rebar, wood, and an empty paint can.

0930 Scott removes debris down to native soil underneath.

0945 Collect sample 30-TPSS-08B from soil underneath concrete rubble. PID readings are 0.0 ppm throughout debris pile and soil underneath pile.

0955 Finish logging test pit. Scott decons backhoe bucket.

1010 Move to 30-TPSS-09. This is a soil and asphalt debris pile.

1015 Scott begins test pit. I log.

1025 Collect sample 30-TPSS-09A from the center of debris (2ft bgs) pile. PID readings are 0.0 ppm

1035 Collect sample 30-TPSS-09B from native soil below (4ft bgs) the debris pile. PID readings are 0.0 ppm throughout the debris pile. Scott decons backhoe bucket

1050 Move to 30-TPSS-10. This is a soil only pile.

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PROJECT TEAD-S

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Chris Duncan 749125.04000 9-30-2014

1100 Scott begins test pit 30-TPSS-10 in soil pile

1110 Collect samples 30-TPSS-10A and 30-TPSS-10AFD from 2'

1120 Collect sample 30-TPSS-10B from ~5 ft bgs. Scott decons backhoe bucket. I finish logging test pit. PID readings throughout the test pit were 0.0 ppm

1150 Move to 30-TPSS-11. This is a soil only pile. I take measurements of debris pile.

1200 Scott begins digging test pit.

1210 Collect sample 30-TPSS-11A from ~2.5' bgs, PID readings are 0.0 ppm

1220 Collect sample 30-TPSS-11B from ~5.5 ft bgs. PID readings are 0.0 ppm throughout test pit. Scott decons backhoe bucket. I finish logging test pit.

1250 Move to 30-TPSS-12. This is a soil and Asphalt debris pile. I take measurements of pile.

1300 Scott begins test pit.

1310 Collect sample 30-TPSS-12A from ~1.5 ft bgs in center of asphalt debris. PID readings are 0.0 ppm

1320 Collect sample 30-TPSS-12B from ~5.5 ft bgs in native soil beneath the debris pile. PID readings throughout debris pile is 0.0 ppm. Scott decons backhoe bucket.

1350 Move to 30-TPSS-14. This is in a pile of wood debris. Also some metal debris and a steel bucket. I take measurements of the debris.

1400 Scott scrapes wood debris to one side. PID readings are 0.0 ppm

1410 Collect sample 30-TPSS-14B from surface soil beneath the wood debris. Scott decons backhoe bucket. I finish logging.

1425 Move to 30-TPSS-15. This is a soil and asphalt pile. I measure pile.

1435 Scott begins test pit.

1445 Collect sample 30-TPSS-15A from ~2.5' bgs in center of asphalt debris. PID readings are 0.0 ppm

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Chris Duncan 749125.04000 9-30-2014

1455 Collect sample 30-TPSS-15B from ~ 5 ft bgs. Beneath the asphalt debris. PID readings throughout the debris pile are 0.0 ppm. Scott decons backhoe bucket. I finish logging.

1515 I go to location where Dave Larsen and Paige Walton want a surface soil sample inside the debris pile area. The area is a low spot between debris piles.

1525 Collect surface sample 30-DPSS-01. Scott Evans leaves the site. Test pits at the debris piles are complete.

1545 Leave site for Tooele field office. Pick up bags of ice on the way.

1620 Arrive to field office. Prep and pack samples for shipping and finish paperwork.

1730 Leave field office for airport to ship samples

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PROJECT TEAD-5 **Notebook No.** 1

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Chris Duncan 749125.04000 10-1-2014

0750 Arrive to CAMOS. Calibrate PID and Landfill gas analyzer.

0810 Scott Evans from C&G arrives on-site. Conduct H&S briefing and prep for test pitting at burn trenches at SWMU 30.

0835 Arrive to test pit location 30-TPSS-06 and set up site.

0850 Begin digging test pit.

0855 Hit the top of debris at ~1-1.5 ft bgs. PID reading is 0.0 ppm in breathing zone and 0.0 ppm of discolored black soil. Gas analyzer readings are CH_4: 0.0% CO_2: 0.1% O_2: 21.4%

0900 Collect sample above debris at 1 ft bgs (30-TPSS-06A, FD, MS, MSD)

1030 Resume digging. Troy Johson and Kevin Draper from TEAD were on-site from 0910-0920.

1040 Hit center of debris. at approx. 4 ft bgs. PID reading is 0.0 in breathing zone. and 135.7 ppm from dark black stained soil. Gas analyzer readings: CH_4: 0% CO_2: 0.0% O_2: 21.5%

1050 Troy Johnson, Paige Walton, and Kevin Draper on-site.

1100 Collect sample 30-TPSS-06B from center of debris at 4 ft bgs.

1120 Troy, Paige, and Kevin off-site. We resume digging.

1130 Groundwater is encountered at 8 ft bgs and debris is still present. It looks like we started the test pit on the south edge of the trench. debris gets deeper as we move north. I have Scott dig deeper on the north edge of the test pit.

1140 Clean soil encountered at approx 10 ft bgs underneath groundwater. Terminate digging at 10.5 ft bgs. PID readings from 10-10.5 ft are 0.0 ppm. Gas analyzer readings are: CH_4: 0.0% CO_2: 0.0% O_2: 21.3%

1150 Collect sample 30-TPSS-06C from 10.5 ft bgs

1210 Log Test pit.

1230 Scott fills in test pit then decons backhoe bucket. I finish paperwork.

1310 Begin test pit 30-TPSS-05. Move test pit location ~5 ft to the north to try and hit the center of the trench.

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Chris Duncan 749125. 04000 10-1-2014

1320 Debris encountered at approx. 3 ft. I collect sample 30-TPSS-05A at 2 ft bgs just above debris. PID readings 0.0 ppm

13 Landfil gas analyzer: CH_4: 0.0%, CO_2: 0.0%, O_2: 21.3%.

1335 resume digging.

1345 At approx. 4 ft bgs we encounter 3-4 rusted 55-gallon drums. We stop digging at 5 ft bgs. I call Dave Shank. We decide its best to terminate this test pit for now. Scott decons backhoe bucket and we move to test pit 30-TPSS-04. PID readings from soil around drums is 111.3 ppm. Breathing zone=0.0

1420 Begin digging test pit 30-TPSS-04

1430 Troy Johnson arrives on-site. We go over and look at test pit 30-TPSS-05 with the drums. We decide to grab a sample from the center of debris.

1450 Troy leaves the site. I collect sample 30-TPSS-05B from 5 ft bgs in center of debris.

1510 Resume digging test pit 30-TPSS-04.

1515 We begin seeing debris at approx. 2.5 ft bgs. I collect sample 30-TPSS-04A from above the debris at 2 ft bgs

1525 Resume digging.

1550 Encounter center of debris and collect sample 30-TPSS-04B. PID readings are 0.0 ppm in breathing zone and 0.8 ppm near soil. Gas analyzer readings: CH_4: 0.0% CO_2: 0.0% O_2: 21.4%. Encountered debris includes steel buckets, metal banding, aluminum, and scrap metal. Also looks like a railroad beam in middle of test pit at approx. 5 ft bgs. Scott is unable to remove it.

1645 While test pitting Scott was clearing soil underneath the railroad beams and pinched a hydraulic hose and it split. We shutdown operations. Scott lays the backhoe bucket and arm across the hole for the night to cover it. We clean up the site.

1715 All hands off-site.

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PROJECT TEAD-S

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Chris Duncan 749125-04000 10-2-2014

0750 Arrive to CAMOS. Scott Evans arrives with me. I conduct a Health and Safety briefing then Scott begins replacing hydraulic hose on backhoe. I collectedequipment blank last night (30-EB-05) at the Tooele field office using stainless steel sample spoon after leaving the site.

0805 Calibrate Gas analyzer and PID.

0820 Dave Shank arrives on-site. we look at test pit #5 with the drums.

0845 Dave leaves site. Scott has finished replacing hydraulic hose. We resume digging 30-TPSS-04 from 9 ft bgs Strong hydrocarbon odor below 9 ft bgs. debris is mainly wood posts, and scrap metal (rusted nails). PID reading in breathing zone is 1.2 ppm. PID readings on soil is 3.3 ppm

0900 backhoe has maxed out its reach at 13 ft bgs. very strong hydrocarbon odor from soil at 13 ft bgs. soil looks to be a native sand lense. PID readings in breathing zone are 1.6 ppm. PID readings from soil are 139.8 ppm gas analyzer readings: CH_4 - 0.0%, CO_2 - 0.0%, O_2 - 21.3%

0910 Collect sample 30-TPSS-04C from sand lense at 13 ft bgs

0920 Begin logging test pit.

0925 Troy Johnson and Kevin Draper arrive on-site.

0950 Troy tells me we are through with test pit 30-TPSS-05 and to fill it in. Him and Kevin leave the site.

1000 I go to test pit 30-TPSS-05 to log test pit. Scott fills in test pit 30-TPSS-04 and decons backhoe bucket.

1040 Scott backfills 30-TPSS-05 and decons backhoe bucket.

1100 Begin digging test pit 30-TPSS-03.

1145 Collect sample 30-TPSS-03A from 3 ft bgs above debris

1205 Collect sample 30-TPSS-03B from 6 ft bgs in center of debris. Debris includes: metal wire, banding, large chunks of burnt slag, one railroad beam, burnt wood, rusted nails. PID readings from 0-6 ft bgs are 0.0 ppm. Gas analyzer CH_4 - 0.0%, CO_2 - 0.0%, O_2 - 21.4%

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Chris Duncan 749125. 04000 10-2-2014

1230 Terminate test pit at 12 ft bgs. Collect sample 30-TPSS-03C from 12 ft bgs. PID readings are 0.0 ppm and gas analyzer: CH_4 - 0.0%, CO_2 - 0.0%, O_2 - 21.3%. No hydrocarbon odor

1245 Log test pit.

1320 Finished logging. Scott backfills test pit 30-TPSS-03 then decons bucket

1420 Begin Test Pit 30-TPSS-02. Collect sample 30-TPSS-02A above debris at 3 ft bgs. PID readings are 0.0 ppm; Gas analyzer readings - CH_4 - 0.0%, CO_2 - 0.0%, O_2 - 21.3%

1440 Collect sample 30-TPSS-02B from 5 ft bgs in center of debris. Debris includes burnt wood, glass amber bottles, one railroad track beam, metal piping, metal banding and wire, and misc. rusted metal. PID readings from debris center are 0.5 ppm. Gas analyzer is CH_4 - 0.0%, CO_2 - 0.0%, O_2 - 21.3%

1505 Resume test pitting to define edges and bottom of trench

1530 Terminate test pit at 10 ft bgs below debris. encountered groundwater at 7 ft bgs. Collect sample 30-TPSS-02C, FD PID readings are 0.0 ppm and gas analyzer readings: CH_4 - 0.0%, CO_2 - 0.0%, O_2 - 21.3%

1550 Begin logging test pit.

1615 Scott begins backfilling 30-TPSS-02. I clean up site.

1630 Scott decons backhoe bucket.

1645 All hands off-site. I head to Tooele field office.

1715 Arrive to field office. Prep and pack samples for shipping.

1835 Leave field office for airport.

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Chris Duncan 749125.04000 10-3-2014

0730 Arrive to Tooele field office. load sampling supplies and sump pump for transferring water from decon pad to drum

0820 Arrive to CAMDS. Scott Evans already on-site. Conduct H&S briefing, calibrate PID and Gas analyzer.

0850 Begin excavating Test Pit 30-TPSS-01

0900 Begin seeing small amounts of debris at 4 ft bgs. I collect sample 30-TPSS-01A from 3 ft bgs above debris. PID readings are 0.0 ppm and gas analyzer readings: CH_4 - 0.0%, CO_2 - 0.0%, O_2 - 21.4%.

0930 Reach center of debris. Debris includes wood, wood posts, Scrap metal, one railroad track beam, and large pieces of metal slag. PID readings around slag are 3,600 ppm, and 0.0 in breathing zone. Gas analyzer readings: CH_4 - 0.0%, CO_2 - 0.1%, O_2 - 21.4%. Collect sample 30-TPSS-01B near slag at 6 ft bgs.

0955 Resume excavating from 6 ft bgs.

1040 Terminate test pit at 12 ft bgs in native clay. PID readings are 0.5 ppm probably due to pulling the soil through contaminated groundwater and debris. Gas analyzer readings: CH_4 - 0.0%, CO_2 - 0.0%, O_2 - 21.5%.

1045 Collect sample 30-TPSS-01C from 12 ft bgs below debris

1105 Begin Logging test pit. Scott smooths out each test pit location

1240 Scott backfills 30-TPSS-01 and decons backhoe bucket. I transfer decon water from decon pad (trough).

1300 Close drum PARSNZ1427201 - Decon water from test pitting at SWMU 30.

1310 All hands off-site. I pick up ice and go to Tooele field office.

1345 Arrive to Tooele field office. Prep and pack samples for shipping.

1600 Leave field office for airport.

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PROJECT TEAD-S

Notebook No. 1

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Chris Duncan 749125.04000 10-7-2014

0800 Arrive to Tooele field office. load soil vapor sampling supplies, and pallets. Head to TEAD-S.

0930 Arrive to CAMDS. Unload pallets. Conduct H&S briefing, and calibrate gas analyzer. Prepare for soil gas sampling specifically targeting methane and CO_2 with gas analyzer at all previously installed VMPs at SWMUs 13 and 30.

1005 Arrive to 13-SG-01 and set up to sample. sample times and purge volumes are based off the same calculations found on page 3 of this field notebook.

VMP 13-SG-01 (5ft)

1012 Begin Purging at 200 mL/min

Time (min)	CH_4 (%)	CO_2 (%)	O_2 (%)
1	0.0	6.0	14.2
2	0.0	6.0	14.1
3	0.0	6.0	14.1
5	0.0	6.1	14.0
8	0.0	6.1	13.9
10	0.0	6.1	13.9
13	0.0	6.0	13.9
15	0.0	6.0	13.9

VMP 13-SG-02 (5ft)

1035 Begin purging at 200 mL/min

Time (min)	CH_4 (%)	CO_2 (%)	O_2 (%)
30 sec	8.2	13.0	00.1
1	8.3	13.1	0.0
2	8.5	13.1	0.0
3	8.6	13.1	0.0
5	8.7	13.2	0.0
10	8.9	13.1	0.0
15	9.1	13.1	0.0
20	9.2	13.1	0.0
21	9.2	13.1	0.0
22	9.2	13.1	0.0

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PROJECT TEAD-S

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Chris Duncan 749125.04000 10-7-2014

1045 Troy Johson, Dave Larsen, and Brad Lauchner arrives on-site to talk about progress of the project.

1105 Troy, Dave, and Brad leave the site

13-SG-03 (5ft)

1115 Begin purging at 200 mL/min

Time (min)	CH4 (%)	CO2 (%)	O2 (%)
1	0.1	5.7	14.8
2	0.1	5.7	14.8
4	0.1	5.7	14.8
8	0.1	5.6	14.7
12	0.1	5.6	14.5
16	0.1	5.6	14.5

VMP 13-SG-04 (5ft)

1136 Begin purging at 200 mL/min

Time (min)	CH4 (%)	CO2 (%)	O2 (%)
1	0.1	5.7	12.4
2	0.1	5.7	12.4
4	0.1	5.6	12.4
8	0.1	5.6	12.3
12	0.1	5.6	12.3
16	0.1	5.6	12.3

VMP 13-SG-05 (5ft)

1155 Begin purging at 200 mL/min

Time (min)	CH4 (%)	CO2 (%)	O2 (%)
1	0.1	2.8	14.9
2	0.1	2.8	14.9
3	0.1	2.8	14.9
6	0.1	2.8	15.0
10	0.1	2.8	15.1
13	0.1	2.8	15.2
15	0.1	2.8	15.2

1215 Move to SWMU 30. Begin setting up on 30-SG-01

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VMP 30-SG-01 (5ft)

1222 Begin purging at 200 mL/min

Time (min)	CH_4 (%)	CO_2 (%)	O_2 (%)
1	0.1	1.8	13.8

1223 To much vacuum. Gas analyzer and sample pump keep turning off. Move to 30-SG-02

VMP 30-SG-02 (5ft)

1232

Time (min)	CH_4 (%)	CO_2 (%)	O_2 (%)
1	0.1	1.0	19.7
2	0.1	0.6	20.1
3	0.1	0.6	20.1
6	0.1	0.5	20.2
10	0.1	0.4	20.2
13	0.1	0.4	20.2
15	0.1	0.4	20.2

VMP 30-SG-04 (5ft)

1250 Begin purging at 200 mL/min

Time (min)	CH_4 (%)	CO_2 (%)	O_2 (%)
1	1.5	1.9	16.2
2	2.2	1.9	16.2
3	2.5	1.9	16.2
5	2.7	1.9	16.2
8	2.9	1.8	16.1
12	2.8	1.8	16.0
16	2.6	1.8	15.9
18	2.7	1.8	15.8

VMP 30-SG-05 (5ft)

1313 Begin purging at 200 mL/min

Time (min)	CH_4 (%)	CO_2 (%)	O_2 (%)
1	1.3	2.0	16.5
2	1.1	2.0	16.5
3	1.0	2.0	16.5
5	0.8	2.0	16.5
8	0.6	2.0	16.7

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PROJECT TEAD-S

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Time (min)	CH4 (%)	CO2 (%)	O2 (%)
10	0.5	2.0	16.7
12	0.5	2.0	16.7
14	0.5	2.0	16.7
16	0.5	1.9	16.8

VMP 30-SG-06 (5 ft)

1338 Begin purging at 200 mL/min

Time (min)	CH4 (%)	CO2 (%)	O2 (%)
1	0.4	2.5	15.9
2	0.4	2.5	15.9
3	0.4	2.5	15.9
5	0.4	2.5	15.9
8	0.3	2.5	16.0
12	0.3	2.5	16.1
14	0.3	2.5	16.1
15	0.3	2.5	16.1

VMP 30-SG-07 (5 ft)

1405 Begin purging at 200 mL/min

Time (min)	CH4 (%)	CO2 (%)	O2 (%
1	0.3	2.7	18.0
2	0.3	2.7	18.0
3	0.3	2.7	18.0
5	0.3	2.7	18.0
8	0.2	2.7	18.0
12	0.2	2.7	18.0
14	0.2	2.7	18.1
15	0.2	2.7	18.1

1420 Move to VMP SG-08

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PROJECT TEAD - S

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Chris Duncan 749125.04000 10-7-2014

VMP 30-SG-08 (5 ft)

1440 Begin purging at 200 mL/min

Time (min)	CH_4 (%)	CO_2 (%)	O_2 (%)
1	0.2	0.4	20.9
2	0.2	0.3	21.0
3	0.2	0.3	21.0
5	0.2	0.3	21.0
8	0.2	0.3	21.0
12	0.2	0.3	21.0
14	0.2	0.3	20.9
15	0.2	0.3	20.8

VMP 30-SG-09 (5 ft)

1505 Begin purging at 200 mL/min

Time (min)	CH_4 (%)	CO_2 (%)	O_2 (%)
1	0.1	1.7	18.3
2	0.2	1.7	18.2
3	0.2	1.7	18.2
5	0.2	1.7	18.2
8	0.1	1.7	18.2
12	0.1	1.7	18.3
14	0.1	1.7	18.3
15	0.1	1.7	18.3

1530 Clean up site

1545 Leave site

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PROJECT TEAD - S

Notebook No. 1

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Chris Duncan 749125 04000 10-9-2014

0755 Arrive to Quality Container and pick up five 55-gallon drums in prep for future work.

0845 Arrive to Tooele field office. Load equipment needed to perform bail down test at SWMU 13.

0945 Arrive to SWMU 13 at CAMDS. Conduct HBS briefing, calibrate PID, and unload drums.

1007 Arrive to S-CAM-1 and prepare to bail down free product in well. PID reading in breathing zone is 0.0 ppm PID readings inside casing of well is 0.2 ppm. Initial Depth to product is 11.93 ft btoc. Depth to water is 13.27 ft btoc. Total of 1.34 ft of product in well.

1020 Begin bailing product from well.

1106 All product bailed from S-CAM-1. Total of 9 gallons bailed. Begin collecting readings. Please see form.

1150 Move to S-CAM-2 and prep to bail. PID readings in breathing zone are 0.0 ppm, and 0.3 ppm inside well casing. Initial depth to product = 14.24 ft btoc. Initial depth to water = 15.05 ft btoc. Total thickness = 0.81 ft

1155 Begin bailing product from well.

1220 All product bailed from S-CAM-2. Total of 7 gallons bailed. Begin collecting readings. Please see form

1300 Move to S-28-88 and prep to bail well. PID readings are 0.0 ppm in breathing zone and 0.2 ppm inside well casing. Initial depth to product = 13.82 ft btoc Initial depth to water = 14.39 ft btoc. Total thickness = 0.57 ft.

1308 Begin bailing product from well

1328 All product removed from S-28-88. Total of 8 gallons bailed. Begin collecting readings. Please see form.

1505 Transfer free product from buckets to drum. Label and open drum PARSNZ1428201

1515 Collect IDW sample 13-IDW-W1 from PARSNZ1428201 with free product.

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Chris Duncan 749125.04000 10-9-2014

1600 Collect IDW sample 30-IDW-W1 from drum PARSNZ1427201 containing decon water from Test pitting at SWMU 30 Debris Piles and Burn Trenches.

1625 Collect IDW sample 13/30-IDW-W1 from drum PARSNZ1403401 containing decon water from water levels, Direct Push activities, and hydropunch purge water at SWMUs 13 and 30.

1645 Collect IDW sample 13/30-IDW-S1 from drum PARSNZ1425101 containing Direct Push soil cuttings from SWMUs 13 and 30.

1710 Collect last reading from 5-28-88. Clean up site. lock wells and head to Tooele Field Office.

1805 Arrive to field office. Prep IDW samples for shipping.

1855 Leave field office for airport to ship samples.

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PROJECT TEAD-S

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Chris Duncan 749125.04000 10-28-2014

0730 Arrive to TEAD-N badging office. ConeTec crew is meeting me here to obtain badges for access to TEAD-S.

0750 ConeTec arrives to badging office. We get them badged and then head to TEAD-S.

0910 Arrive to CAMDS at TEAD-S. We go look at the wells that ConeTec will be upgrading. We quickly realize we will need a concrete cutter as 3 of the 4 wells are set in concrete foundations. I call Dave to let him know the situation.

0930 I go over project safety with ConeTec covering APP/SSHP and AHAs.

0945 ConeTec begins upgrading and extending casing on well S-26-88, which is the only well not in concrete or asphalt.

1015 Terry from ConeTec is trying to sub-out the concrete cutting.

1100 S-26-88 well casing has been extended by ~~41 ft 6 in~~ CD 41.5". aboveground well casing in place to 3 ft above ground surface and well pad form is in place. ConeTec crew begins concrete mixing.

1210 Concrete has been poured into the 2X2 foot pad with 5-inches below ground surface and 5-inches above.

1220 Terry is able to get ahold of Greenes Inc. and they are available to cut concrete tomorrow morning.

1230 ConeTec crew and I leave the site. There is nothing more we can do until the concrete has been cut. I head to the Tooele field office to pick up rental equipment.

1345 Picked up rental equipment from field office. Head to Quality container to get 55-gallon drums.

1450 Pick up 4-55 gallon drums from Quality container then head home.

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PROJECT TEAD-S **Notebook No.** 1

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Chris Duncan 749125.04000 10-29-2014

0850 Arrive to TEAD-N Badging office. Dustin Marshall from Greenes Inc. already there. We go in and get him badged then head to TEAD-S.

0930 Arrive to CAMDS at TEAD-S. ConeTec crew already on-site. I conduct H2S briefing and go over project safety with Dustin.

1000 Dustin begins cutting pad around S-87-91.

1015 Dustin completes cutting at S-87-91 and moves to S-25-88 to cut pad. Terry and Ryan from ConeTec begin installing aboveground completion at S-87-91. I go unload drums.

1030 Dustin completes cutting around S-25-88 and moves to S-CAM-1.

1055 Dustin completes cutting at S-CAM-1. He cleans up his equipment, and leaves the site.

1105 I run to Tooele field office to get pallets and drum lids. ConeTec brought 5 drums on-site today, but they have no lids.

1235 Arrive back to SWMU 13. Terry and Ryan have completed the aboveground completion for S-87-91 and have moved on to S-25-88. The new PVC riser placed on S-87-91 is 32 1/16 ~~36.00~~ CCD inches above the old top of casing.

1305 I stage one drum on a pallet at each of the wells we will be redeveloping.

1330 Measure stick-up at S-25-88. from top of old casing to the top of the new casing is 35 3/8 inches.

1430 Troy Johnson and Kevin Draper arrive on-site to check on progress.

1440 Troy and Kevin leave the site.

1520 Measure new riser on S-CAM-1. Measurement from top of old casing to top of new casing is 36 1/16 inches.

1630 Crew completes aboveground completion at S-CAM-1.

1640 All hands off-site.

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Chris Duncan 749125.04000 10-30-2014

0750 Arrive to TEAD-N badging office.

0800 Shawn steiner and Brian Mercer from ConeTec arrive and I help get them badged then head to TEAD-S.

0840 Arrive to SWMU 13 at TEAD-S. Conduct H2S briefing.

0900 Shawn and Brian set up CPT rig over deep well location. Terry and Ryan begin trying to remove fallen bailer from S-87-91. I calibrate YSI and PID, and Turb.

0945 No luck retrieving bailer. Terry is having someone come out with a special fishing tool. They move on to S-26-88 and set up on well.

1010 Begin bailing S-26-88. PID readings in breathing zone are 0.0 PPM and 0.8 inside well casing.

1045 Shawn and Brian are waiting on a dissepation test with CPT rig. They go assess well S-27-88 to see if the well can be rehabbed. I take measurement on well and get a total depth of 5.40 ft btoc. constructed depth is 20 ft.

1050 Terry begins surging well S-26-88.

1100 Shawn is hitting an impermeable barrier at S-27-88 at approx. 6 ft bgs. The well is compromised. I have him abondon the well.

1130 Complete surging S-26-88. Terry begins bailing again.

1140 Shawn completes well abandonment on S-27-88. Him and Brian go back to CPT rig to check on dissepation test.

1150 Terry completes bailing. Begins installing pump.

1215 Pump installed. Begin pumping.

1220 Well pumped dry immediately. Pump (2" Grundfos) is set to pump as low as possible. I have them pull pump and resume bailing to reach purge volume.

1240 Shawn and Brian are setting up drill rig to install large (15" OD) diameter augers down to approx. 15 ft bgs.

1245 Terry and Ryan have bailed S-26-88 dry. Total amount bailed was 42 gallons. They begin cleaning up and deconning equipment.

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Chris Duncan 749125.04000 10-30-2014

1345 Ryan is set-up on S-25-88 ready to develop. Terry and Brian are going to keep drilling down to 50 ft bgs.

1400 Ryan begins bailing S-25-88. Shawn Steiner leaves the site.

1410 S-25-88 was bailed dry after approx. 5 gallons was bailed. We are waiting as it slowly recharges. I begin logging the deep well, and calibrate the gas analyzer

1430 Well S-25-88 is recharging extremely slow. We decide to move to the next well and come back to S-25-88 later to surge. Ryan begins decon of equipment. I go back to logging deep well. Shawn Steiner back on-site.

1450 Drill crew has completed drilling down to 32 ft bgs. Ryan moves development rig to S-CAM-1 and begins setting up on well.

1500 Ryan begins bailing S-CAM-1. PID readings in breathing zone are 4.9 PPM. 111.0 PPM inside well casing. We are making sure we stand up wind.

1530 Drill crew has completed drilling down to 52 ft bgs. I go log core.

1545 Troy Johnson arrives on-site to give me well keys, then leaves the site. Shawn Steiner and Brian Mercer leave the site. I go around site and label drums. Label drum holding 42 gallons of Development water from S-26-88, PARSNZ1430301

1555 Label drum holding 5 gallons of development water from well S-25-88, PARSNZ1430302

1600 Label drum we are currently putting development water into from S-CAM-1 - PARSNZ1430303.

1605 Label two drums with soil cuttings from the deep well - PARSNZ1430304 and PARSNZ1430305

1623 Begin pumping S-CAM-1 at 0.5 gpm

1658 Cease pumping, well is stabilized and cleaned up. approx. 37 gallons was purged from the well. clean up site and decon equipment.

1730 All hands off-site.

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PROJECT TEAD-S

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Chris Duncan 749125.04000 10-31-2014

0750 Arrive to CAMDS at TEAD-S. prepare H&S briefing and calibrate equipment.

0820 CoreTec crew arrives on-site. Conduct H&S briefing

0835 CoreTec preps to begin drilling and well development

0910 Brian and Terry resume drilling deep well from 50 ft bgs. Ryan takes development rig to S-87-91 to try and retrieve the lost bailer.

0955 Ryan has retrieved the bailer from S-87-91. I have him let that well recover and move him to S-25-88 to begin surging the well. Water level on arrival is 16.93 ft btoc. This is still 2-feet lower than the initial water level yesterday. The well did not recover overnight.

1010 Ryan begins surging S-25-88.

1015 Brian and Terry reach a total Depth on deep well at 59 ft bgs. I observed a gravel zone from approx. 55-57 ft bgs in drill core which coincides with the CPT test. I will set the screen to straddle this gravel zone. I take a water level and get 29.5 ft bgs Well construction for the deep well will be as follows:

Grout	3-47 ft bgs	PureGold bentonite powder
Pellets	47-52 ft bgs	Cetco 1/4-inch tablets
10-20 Sand	52-59 ft bgs	10-20 Colorado Silica Sand
Screen	54-59 ft bgs	Continuous 2" PVC Vee Wrap

1025 Crew is ready to construct the well. They will be using 5-feet of 2-inch schedule 40 PVC well screen (0.010 slot) manufactured by Environmental Manufacturing Inc. from 54-59 ft bgs. Attached above the screen is 2-inch schedule 40 PVC blank casing also manufactured by Environmental Manufacturing Inc. All casing and the screen is new in plastic, with flush threaded joints and rubber O-rings.

1030 Crew begins lowering well string.

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PROJECT TEAD-5

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Chris Duncan 749125.04000 10-31-2014

1040 Well string is in place. Crew begins adding filter pack using 10-20 colorado silica sand. Volume calculation for sand pack:

$H = 59 - 52 = 7$ ft

Radius of borehole = 8.125/2 = 4.063/12 = 0.34 ft

Volume of borehole = $3.14(7.0\text{ft})(0.34\text{ ft})^2 = 2.64\text{ ft}^3$

50 lb bag of 10-20 silica sand = 0.56 ft^3

Radius of well casing = 2.375/2 = 1.19/12 = 0.10 ft

Volume borehole - Volume casing = Annular Volume

$3.14(7\text{ft})(0.34\text{ft})^2 - 3.14(7\text{ft})(0.10\text{ft})^2 =$

$2.64\text{ ft}^3 - 0.22 = 2.42\text{ ft}^3$

It should require 4.5 bags of sand to place the filter pack.

1050 Ryan completes surging 5-25-88 and begins bailing it.

1100 Ryan bails 5-25-88 dry after approx. 3 gallons were bailed. Ryan decons equipment and moves to 5-87-91

1125 There is only 1-foot of water in 5-87-91. The well has 2.5 ft of sediment in the bottom, so I have Ryan bail the well to try and remove the sediment.

1130 Drill crew has completed filter pack having used 4.5 bags of sand just like calculated. Crew begins placing pellet seal using 2-5 gallon buckets of 1/4-inch tablets.

1150 Drill crew has completed placing pellet seal from 47-52 ft bgs. They will wait 30 min. to let the pellets hydrate.

1220 Ryan has bailed 5-87-91 dry. He removed 0.60 ft of sediment from the well. He begins deconning equipment.

1225 Drill crew begins lowering 1 1/4-inch PVC tremmie pipe downhole in prep for grouting. The tremmie pipe will be lowered to just above the pellet seal and will be pulled upward as they grout towards surface.

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Read and Understood By

Chris Duncan 10-31-2014

Signed Date Signed Date

PROJECT TEAD-S

Notebook No. 1

Continued From Page p 3/3

Chris Duncan 749125.04000 10-31-2014

1230 I label drum containing development water from S-87-91 (PARSNZ14304O1)

1235 Drill crew begins grouting from 47 ft bgs. They will be mixing 2 bags of PureGold bentonite powder with approximately 30 gallons of water in their mixing drum. This will produce 4.4 ft^3 of 30% solids grout slurry. Volume Calculation:

Volume of Borehole − Volume of Well Casing

$(47ft)(3.14)(0.34ft)^2 - (47ft)(3.14)(0.10ft)^2$

$17.1 ft^3 - 1.48 ft^3 = 15.62 ft^3$

$15.62 ft^3 / 4.4 ft^3 / batch = 3.5$ batches or 7 bags.

However, the top 10 ft of the borehole was augered with 15-inch OD diameter augers, therefore it may take more bags of grout then calculated.

1245 I close drums PARSNZ1430304 and PARSNZ1430305 containing drill cuttings and open drum PARSNZ1430402 for more drill cuttings. Drill crew is pulling augers casing as they grout towards surface and are containerizing cuttings.

1250 Ryan begins sealing the bottom of the protective well casings of the newly installed aboveground completions by placing a 6-inch layer of PureGold medium chips in the bottom then hydrating the chips. He is also installing a weep hole above the seal and painting the aboveground completions red.

1355 Drill crew have grouted up to 10-foot augers. I open new drum labeled PARSNZ1430403 to containerize the contaminated top 10-feet of soil cuttings.

1450 Drill crew has completed grouting to surface having used 8 bags of grout. Crew cleans up site.

1520 Ryan completes painting and installing weep holes and chip seal.

1550 All hands off-site.

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Chris Duncan 10-31-2014

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PROJECT TEAD-S

Notebook No. 1

Continued From Page p1/2

Chris Duncan 749125.04000 11-3-2014

0715 Arrive to Troy Johnsons office at TEAD-S. I talk to him about where we can dump the concrete and asphalt rubble that was accumulated from cutting during well upgrades. Troy gave me permission to dispose of the rubble at the SWMU 28 Landfill. He also signed the application card for the new deep well (S13-CAM-DW1).

0750 Arrive to SWMU 13. Prepare H&S briefing then clean up trash around the site.

0815 Brian and Terry from ConeTec arrive on-site. I conduct H&S briefing.

0830 I take water level and total depth measurement at new deep well (S13-CAM-DW1) Water level = 10.90 ft bgs, total depth = 58.33 ft bgs. The stick up on the well is approx. 2.75 ft above ground surface. I also measure depth to grout in borehole at 4.5 ft bgs.

0835 Terry begins adding Cetco Medium bentonite chips to borehole to bring it up to approx. 2-3 ft bgs.

0840 Terry added 3-50 lb bags of chips. He hydrates chips with water. Crew begins digging for installation of an aboveground completion and four protective bollards at S13-CAM-DW1.

0930 Crew begins installing aboveground well completion at S13-CAM-DW1. I take water level at 5-25-88. This is the well that didn't fully recharge overnight after bailing dry. Water level = 14.79 ft btoc. The well has fully recharged over the weekend.

0945 I open drum labled PARSNZ1430701 for remaining soil cuttings at S13-CAM-DW1.

1000 I go around to the recently upgraded wells and add gravel inside the protective well casings. The gravel was from sand bags I had on-site to build a decon pad.

1130 Crew has completed installing aboveground completion with bollards and a 2x2 foot well pad at S13-CAM-DW1. I close drums PARSNZ1430701 and PARSNZ1430403.

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Chris Duncan 11-3-2014

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PROJECT TEAD-S

Notebook No. 1

Continued From Page p 212

Chris Duncan 749125. 04000 11-3-2014

1135 Crew begins concrete finish work on the three wells where concrete or asphalt was cut. The crew is filling the gap between the 2x2 ft pad and the 3x3 ft area that was cut and removed.

1200 I take inventory on all drums located on the site.

1330 Crew completes all concrete finish work. They move Drill rig and casing to decon pad and begin decon of all drilling equipment. I open drum labeled PARSNZ1430702 to contain decon water.

1410 Crew has completed decon of equipment. We begin loading concrete and asphalt rubble onto ConeTec flatbed truck.

1515 All concrete and asphalt rubble has been removed from the site. We haul it to the SWMU 28 Landfill to dispose of it.

1600 All concrete and asphalt rubble has been disposed of ConeTec and I go over daily.

1615 All hands off-site.

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Chris Duncan 11-3-2014

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PROJECT TEAD-S

Notebook No. 1

Continued From Page p 1/2

Chris Duncan 749125.04000 11-7-2014

0750 Arrive to SWMU 13 at CAMDS. Prepare H2S briefing and calibrate YSI and Turbidimeter to prep for well development of S13-CAM-DW1.
YSI 556 serial number:

	pre cal	post cal
PH 7.0	7.13	7.00
PH 10.0	9.96	10.00
Cond.	1.464	1.413
ORP	251.3	240.1
DO	10.17	9.71

Turbidimeter calibration is good.

0820 Terry Campbell from ConeTec arrives on-site. I conduct H2S briefing.

0830 Terry sets up on well S13-CAM-DW1. I take water level and total depth measurements. WL = 13.57 ft btoc. TD = 59.95 ft btoc (soft bottom).

0925 Terry begins bailing S13-CAM-DW1. Open drum PARSNZ1431101

0950 Complete first round of bailing. Begin surging the well.

1030 Complete surging well. Begin second round of bailing.

1055 Complete bailing. Terry begins installing pump.

1120 Begin pumping.

1145 Close drum PARSNZ1431101 and open drum PARSNZ1431102

1255 Close drum PARSNZ1431102 and open drum PARSNZ1431103

1305 Quit pumping after over 10 purge volumes have been removed. Turbidity did not drop below 10 NTUs, but all parameters stabilized. Begin site clean up.

1330 Terry Begins painting well (red) and bollards.

1410 Terry Leaves the site. I wait to see if the well comes back to SWL. currently at 14.01 ft btoc. Do site clean up while waiting.

1430 Water level still 14.01 ft btoc. I fill inside of protective well casing with gravel from sand bags located on-site.

1445 Water level still 14.01 ft btoc. I leave site for Tooele field office

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Read and Understood By

Chris Duncan 11-7-2014

Signed Date Signed Date

Chris Duncan 749125.04000 11-7-2014

1715 Arrive to Tooele field office. Unload equipment. Pack Water quality parameter meter and Turbidimeter for shipping.

1735 Head to Fed Ex and then home.

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Chris Duncan 11-7-2014

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PROJECT TEAD-S

Notebook No. 1

Continued From Page p 1/1

Chris Duncan 749125 04000 11-10-2014

0930 Arrive to Tooele field office. Gather equipment and prep for Hydrasleeve sampling. Hydrasleeve materials and PID are being shipped to the field office this morning.

1130 Hydrasleeve materials and PID arrive. Calibrate PID and head to TEAD-S

1230 Arrive to TEAD-S. and prep for installation of hydrasleeve samplers.

1300 Install sampler in well S-25-88

1315 Install sampler in well S13-CAM-DW1

1345 Install sampler in well S-26-88

1410 Install sampler in well S-29-88

1420 Install sampler in well S-30-88

1430 Install sampler in well S-78-91

1450 Install sampler in well S-91-91

1510 Install sampler in well S-82-91

1530 Install sampler in well S-81-91

1545 Install sampler in well S-55-90

1610 Install sampler in well S-CAM-2

1630 Install sampler in well S-CAM-1

1645 Install sampler in well S-87-91

1705 Leave site for home.

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Read and Understood By

Chris Duncan
Signed

11-10-2014
Date

Signed

Date

PROJECT TEAD-S

Notebook No. 1

Continued From Page p 1/1

Chris Duncan 749125.04000 11-12-2014

0800 Arrive to Tooele field office. Grab some needed supplies then head to TEAD-S.

0850 Arrive to TEAD-S SWMU 13. Conduct H&S briefing and calibrate PID, then prep for sampling.

0905 Troy Johnson arrives to give me new locks for upgraded wells and new well

0910 Troy leaves site. I go to well S-25-88 and prep for hydrasleeve sampling.

1000 Collect partial sample for S-25-88 then reinstall new hydrasleeve sampler.

1040 Collect partial sample for S13-CAM-DW1 then reinstall new hydrasleeve sampler.

1115 Collect partial sample for S-26-88 then reinstall new hydrasleeve sampler.

1140 Collect partial sample for S-87-91 then reinstall new hydrasleeve sampler.

1200 Collect partial sample for S-55-90 and S-55-90FD then reinstalled new hydrasleeve sampler.

1250 Collect partial sample for S-29-88 then reinstall new hydrasleeve sampler.

1330 Collect partial sample for S-82-91 then reinstall new hydrasleeve sampler.

1410 Collect partial sample for S-CAM-2 then reinstall new hydrasleeve sampler.

1440 Collect partial sample for S-CAM-1 then reinstall new hydrasleeve sampler

1530 Collect sample S-30-88.

1550 Collect sample S-78-91.

1620 Collect sample S-91-91

1650 Collect sample S-81-91

1715 Leave site for Tooele field office.

1745 Arrive to field office. Load equipment needed for Dave Larsen (UDEQ) to collect split sample from S13-CAM-DW1

1840 Leave field office for home.

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Chris Duncan 11-12-2014

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PROJECT TEAD-S

Notebook No. 1

Continued From Page p 1/2

Chris Duncan / Monica Morales 749125.04000 11-13-2014

0645 Arrive to South Jordan office. Monica is meeting me at 7:00.

0730 No Monica. I leave her a message then head to TEAD-S.

0745 Monica calls, she slept in accidentally. Tells me to go without her.

0830 Arrive to SWMU 13 at TEAD-S. Conduct H&S briefing and calibrate PID.

0930 Arrive to S-25-88 and prepare for sampling.

1005 Collect remaining volume in PAHs jar for sample S-25-88.

1030 I go to each of the upgraded wells and add well identifiers (labels) to each of them.

1125 Collect sample S-26-88 for ABPs and remaining volume in PAHs jar

1205 Troy Johnson and Dave Larsen arrive on-site. We set-up to sample S13-CAM-DW1.

1215 Collect sample S13-CAM-DW1 for Metals/cations and Anions/TDS. Dave Larsen collects a split sample for all analyses collected from S13-CAM-DW1 yesterday and today.

1235 Troy and Dave leave the site.

1300 Collect remaining volume in TPH-DRO jars for sample S-55-90 and S-55-90FD.

1320 Collect sample S-29-88 for remaining volume in PAHs jar.

1345 Collect sample S-82-91 for remaining volume in PAHs jar.

1420 Collect sample S-CAM-1 for Anions/TDS, Cations, and remaining volume in PAHs jar.

1450 Collect sample S-CAM-1 for remaining volume in PAHs jar.

1505 Empty remaining sample purge water into drum labeled PARSNZ1430702.

1510 Decon hydrasleeve weights and clips. Decon water also goes in drum labeled PARSNZ1430702.

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Chris Duncan 11-13-2014

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PROJECT TEAD-S
Notebook No. 1
Continued From Page p 2/2

Chris Duncan 749125.04000 11-13-2014

1515 Close drum labeled PARSNZ1430702 containing decon water from drilling and well development equipment and hydrasleeve sampling activities.
1520 Close drum labeled PARSNZ1431103 containing development water from deep well S13-CAM-DW1.
1530 Head to Tooele field office.
1600 Arrive to field office. Prep and pack all hydrasleeve groundwater samples for shipping. Prep for tomorrows IOW sampling. Unload equipment from truck.
1745 Leave field office for airport Fed Ex.
1830 Drop samples off at Fed Ex then head home.

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Chris Duncan 11-13-2014
Signed Date

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PROJECT TEAD-S

Notebook No. 1

Continued From Page p 1/2

Chris Duncan 749125.04000 11-14-2014

0820 Arrive to SWMU 13 at TEAD-S. Conduct H&S briefing and prep for IDW sampling.

0900 Collect sample IDW sample 13-IDW-W2 from drum labeled PARSNZ1430702 containing decon water from drilling and well development equipment. Drum also contains all decon and excess purge water from hydrasleeve sampling activities.

0940 Collect IDW sample 13-IDW-W3 from drums labeled PARSNZ1431101, PARSNZ1431102, and PARSNZ1431103 containing well development water from the newly installed deep well S13-CAM-DW1. This was a composite sample from all 3 drums.

1000 Collect composite IDW soil sample 13-IDW-S1 from drums: PARSNZ1430304, PARSNZ1430305, PARSNZ1430402, and PARSNZ1430701 containing soil cuttings from 10-59 ft bgs from installing new deep well S13-CAM-DW1.

1030 Collect IDW soil sample 13-IDW-S2 from drum labeled PARSNZ1430403 containing contaminated 0-10 ft bgs soil cuttings from drilling new deep well S13-CAM-DW1.

1115 Collect composite IDW water sample 13-IDW-W4 from drums: PARSNZ1430301, PARSNZ1430302, PARSNZ1430303, and PARSNZ1430401 containing development water from redeveloped upgraded wells: S-26-88, S-25-88, S-CAM-1, and S-87-91.

1145 Finish collecting IDW samples. Place locks that troy Johnson gave me on upgraded wells S-25-88, S-26-88, S-87-91, and S-CAM-1. Also place lock on new deep well S13-CAM-DW1. Key is a gold Taylor with GW 13 imprinted on it.

1200 Notice the well identifier stickers placed on upgraded wells are peeling off after last nights rain/snow. I will have to paint them on when its not wet and rainy. Clean up site and load excess drums and pallets.

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Chris Duncan 11-14-2014

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Chris Duncan 749125.04000 11-14-14

1220 Head to Tooele field office.

1250 Arrive to field office. Prep and pack samples for shipping. Pack rental sampling equipment. Clean up field office and truck from project.

1445 Matt Ivers from Parsons is going to drop off samples, and rental equipment at Fed Ex on his way home. I take stencils and red well paint and head back to TEAD-S.

1520 Arrive to SWMU 13 at TEAD-S. Begin painting a second coat of red paint on well S13-CAM-DW1 including protective bollards.

1545 Painting complete. Begin stencilling well identifiers on S-25-88, S-26-88, S-87-91, S-CAM-1, and S13-CAM-DW1. I remove old stickers that were falling off.

1730 Complete stencilling wells. Drill a weep hole into well S13-CAM-DW1.

1745 Site is clean and all tasks and sampling is complete. I leave site for home.

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Read and Understood By

Chris Duncan 11-14-2014

Signed Date Signed Date

APPENDIX C

SWMU 13 BORING LOGS

PARSONS

Hole No. 13-SS-01 **Well No.** ____________

DRILLING LOG

CLIENT USACE

INSTALLATION TEAD-S

SHEET 1 **OF** 2 **SHEETS**

1. PROJECT SWMU 13 CMS

10. DATE HOLE **STARTED** 9-9-14 **COMPLETED** 9-9-14

2. LOCATION *(Coordinates or Station)*

11. DRILLING METHOD / DRILLING RIG Direct Push

3. DRILLING CONTRACTOR Clement Drilling

12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"

4. NAME OF DRILLER Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☒ ____ IDW ☐ ____ OTHER ☐ ____ ☐ ____

5. NAME OF GEOLOGIST Chris Duncan

14. TOTAL RECOVERY FOR BORING ~85%

6. DIRECTION OF HOLE
☒ VERTICAL
☐ INCLINED ____________ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN
☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____________

7. THICKNESS OF OVERBURDEN 15

17. ELEVATION
☒ GROUND SURFACE 5046 ☐ TOP OF CASING ________

8. DEPTH DRILLED INTO ROCK 0

18. ELEVATION GROUND WATER ~10 ft bgs

9. TOTAL DEPTH OF HOLE 15

19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
	1		GM	0-2.5 Silty Gravel w/ sand (GM) yellow brown (10YR 5/6), moist, loose to med dense, mixed w/ asphalt from 0-0.5 ft bgs, 60% gravel, fine to exceeding 1.5", subangular to subround, 20% fine to med sand, 20% silty fines	0.0	
	2				0.0	
	3				0.0	
60%	4			2.5-10.5 Silt w/sand (ML), brown (7.5YR 5/3), moist, soft, 70% silty fines, 30% fine sand	0.0	
	5				0.0	
	6		ML		0.0	
	7				0.0	
90%	8				0.0	
	9				19.8	slight petroleum odor from 9-10 ft bgs
	10				66.2	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION ~ 5046	Hole No. 13-SS-01
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
			ML	10.5 - 13.5 Sandy Lean Clay (CL) brown grading to dark gray, 12-13 ft bgs is stained black, moist to wet, firm, 60% clay fines, 40% fine sand.		very strong petroleum odor from 10-13 ft bgs
	11		CL		233.6	
90%	12				87.2	
	13				201.0	
	14		SP	13.5 - 15.0 Poorly Graded sand light brown, moist to wet, very tight soil, 80% fine sand, 20% silty to clayey fines	17.2	
85%	15				1.9	

PARSONS

Hole No. 13-SS-01A Well No. ____________

DRILLING LOG

CLIENT: USACE

INSTALLATION: TEAD-S

SHEET 1 OF 2 SHEETS

1. PROJECT: SWMU 13 CMS (step out)

10. DATE HOLE: STARTED 9-12-14 COMPLETED 9-12-14

2. LOCATION (Coordinates or Station): Step-Out Boring

11. DRILLING METHOD / DRILLING RIG: Direct Push

3. DRILLING CONTRACTOR: Clement Drilling

12. SIZE AND TYPE OF BIT: Borehole

4. NAME OF DRILLER: Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN: ANALYTICAL ☐ ____ IDW ☐ ____ OTHER ☐ ____ ☐ ____

5. NAME OF GEOLOGIST: Chris Duncan

14. TOTAL RECOVERY FOR BORING: ~85%

6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES: 0

16. DATUM FOR ELEVATION SHOWN: ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____

7. THICKNESS OF OVERBURDEN: 20

17. ELEVATION: ☒ GROUND SURFACE 5046 ☐ TOP OF CASING ____

8. DEPTH DRILLED INTO ROCK: 0

18. ELEVATION GROUND WATER: ~10 ft bgs

9. TOTAL DEPTH OF HOLE: 20

19. SIGNATURE OF GEOLOGIST: Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
			A	0-0.5 asphalt and gravel		
	1			0.5-8.2 Silt w/sand (ML) brown (7.5YR 5/3), moist, soft to firm, 60% silty fines, 40% fine sand	0.0	
	2				0.0	
	3				0.0	
50%	4		ML		0.0	
	5				0.0	
	6				0.0	
	7				0.0	
80%	8			8.2-11.5 Sandy Lean clay (CL) light brownish gray, moist, firm to hard, 60% clayey fines, 40% fine sand	0.0	
	9		CL		0.0	
	10				0.0	

PARSONS

DRILLING LOG (Cont. Sheet)	**ELEVATION** 5046	**Hole No.** 13-55-01A
PROJECT SWMU 13 CMS	**INSTALLATION** TEAD-S	**SHEET** 2 **OF** 2 **SHEETS**

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	11		CL		28.3	
90%	12		SP-SM	11.5-13.5 poorly graded sand w/silt, stained black to dark gray, wet, soft or loose, 75% fine to med sand, 25% silty fines	73.8	strong petroleum odor from 10-14 ft bgs
	13			13.5-20.0 Sandy Lean Clay (CL) light brownish gray (2.5Y 6/2), moist to wet, soft, 40% fine sand, 60% clayey fines	150.2	
	14				22.4	
	15				1.9	
90%	16		CL		0.0	
	17				0.0	
	18				0.0	
			SP	sand lense		
	19		CL		0.0	
90%	20				0.0	

PARSONS

Hole No. 13-SS-02 Well No. ____________

DRILLING LOG

CLIENT: USACE

INSTALLATION: TEAD-S

SHEET 1 OF 2 SHEETS

1. PROJECT: SWMU 13 CMS

10. DATE HOLE — STARTED: 9-9-14 — COMPLETED: 9-9-14

2. LOCATION (Coordinates or Station):

11. DRILLING METHOD / DRILLING RIG: Direct Push

3. DRILLING CONTRACTOR: Clement Drilling

12. SIZE AND TYPE OF BIT: Borehole = 2 1/8" Core = 1.5"

4. NAME OF DRILLER: Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN: ☒ ANALYTICAL ____ ☐ IDW ____ OTHER ☐ ____ ☐ ____

5. NAME OF GEOLOGIST: Chris Duncan

14. TOTAL RECOVERY FOR BORING: ~85%

6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES: 0

16. DATUM FOR ELEVATION SHOWN: ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____

7. THICKNESS OF OVERBURDEN: 15

17. ELEVATION: ☒ GROUND SURFACE 5052 ☐ TOP OF CASING ____

8. DEPTH DRILLED INTO ROCK: 0

18. ELEVATION GROUND WATER: ~ 10 ft bgs

9. TOTAL DEPTH OF HOLE: 15

19. SIGNATURE OF GEOLOGIST: Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				0-8.5 Silt w/sand (ML), brown (7.5YR 5/3), moist, soft to firm, 0.3-0.7 ft bgs is a concrete layer, 60% silty fines, 40% fine sand		
	1				0.0	
	2				0.0	
	3				0.2	
60%	4		ML		0.3	
	5				0.0	
	6				0.0	
	7				0.0	
90%	8				0.0	
	9			8.5-15.0 Lean Clay (CL) light gray, 12.5-14.0 ft bgs is dark black stained soil, moist, very firm, 70% clay fines, 30% fine sand	61.2	
	10		CL		121.3	

PARSONS

DRILLING LOG (Cont. Sheet)

ELEVATION 5052

Hole No. 13-SS-02

PROJECT SWMU 13 CMS

INSTALLATION TEAD-S

SHEET 2 OF 2 SHEETS

	DEPTH (FT)	GRAPHIC LOG	ASTM SOIL CLASS SYMBOLS	CLASSIFICATION OF MATERIALS *(Description)*	PID (ppm)	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)*
	a	b	c	d	e	g
				8.5-15.0 Lean Clay (CL) as previously described		very strong petroleum odor from ~9-15 ft bgs
	11				55.3	
100%	12				48.6	
	13		CL		232.0	
	14				166.3	
90%	15				59.4	

PARSONS

Hole No. 13-SS-02A Well No. ____

DRILLING LOG CLIENT USACE	INSTALLATION TEAD-S SHEET 1 OF 2 SHEETS
1. PROJECT SWMU 13 CMS (step out)	10. DATE HOLE STARTED 9-12-14 COMPLETED 9-12-14
2. LOCATION (Coordinates or Station) Step-Out Boring	11. DRILLING METHOD / DRILLING RIG Direct Push
3. DRILLING CONTRACTOR Clement Drilling	12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"
4. NAME OF DRILLER Craig Clement	13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ____ IDW ☐ ____ OTHER ☐ ____ ☐ ____
5. NAME OF GEOLOGIST Chris Duncan	14. TOTAL RECOVERY FOR BORING ~85%
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEGREES FROM VERTICAL	15. TOTAL NUMBER CORE BOXES 0
	16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____
7. THICKNESS OF OVERBURDEN 20	17. ELEVATION ☒ GROUND SURFACE 5052 ☐ TOP OF CASING ____
8. DEPTH DRILLED INTO ROCK 0	18. ELEVATION GROUND WATER ~10 ft bgs
9. TOTAL DEPTH OF HOLE 20	19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
			C	0-1.0 silty gravel mixed with concrete, mostly concrete		
	1				0.0	
	2			1.0-11.6 silt w/sand (ML) brown grading to gray, moist to wet, 40% fine sand, 60% silty fines, soft to firm	0.0	
	3				0.0	No Odor down to 9 ft
50%	4				0.0	
	5		ML		0.0	
	6				0.0	
	7				0.0	
70%	8				0.0	
	9				0.0	
	10				50.1	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5052	Hole No. 13-SS-02A
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	11		ML		36.7	slight petroleum odor from 10-14 ft bgs
95%	12		CL	11.6-18.0 Sandy Lean Clay (CL) olive gray (5Y 4/2), moist, firm, some black staining (minimal), 60% clayey fines, 40% fine sand	41.2	
	13				21.3	
	14				42.7	
	15				10.0	
95%	16				0.0	
	17				0.0	
	18			18.0-20.0 Silt w/sand (ML) light brownish gray (2.5Y 6/2) moist, soft to firm, 60% silty fines, 40% fine sand	0.0	No odor from 15-20 ft bgs
	19		ML		0.0	
95%	20				0.0	

PARSONS

Hole No. 13-SS-02B Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS
10. DATE HOLE STARTED 9-18-14 COMPLETED 9-18-14
2. LOCATION *(Coordinates or Station)* Step-out boring
11. DRILLING METHOD / DRILLING RIG Direct Push
3. DRILLING CONTRACTOR Clement Drilling
12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"
4. NAME OF DRILLER Craig Clement
13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ___ IDW ☐ ___ OTHER ☒ none ☐ ______
5. NAME OF GEOLOGIST Chris Duncan
14. TOTAL RECOVERY FOR BORING ~85%
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ______ DEGREES FROM VERTICAL
15. TOTAL NUMBER CORE BOXES 0
16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ______
7. THICKNESS OF OVERBURDEN 20
17. ELEVATION ☒ GROUND SURFACE 5052 ☐ TOP OF CASING ______
8. DEPTH DRILLED INTO ROCK 0
18. ELEVATION GROUND WATER ~10 ft bgs
9. TOTAL DEPTH OF HOLE 20
19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
	1		GM	0-2.0 silty Gravel w/sand (GM) yellowish brown (10YR 5/6), dry, loose, 60% fine gravel, subround to subangular, 30% silty fines, 10% fine to med sand	0.0	
	2				0.0	
	3			2.0-7.4 silt w/sand (ML) brown (7.5YR 5/3), moist, firm to soft, 70% silty fines, 30% fine sand	0.0	
60%	4				0.0	No Odor or visible staining
	5		ML		0.0	
	6				0.0	
	7				0.0	
90%	8		CL	7.4-9.3 Lean Clay w/sand (CL) olive brown (2.5Y 4/3), moist to dry, firm, 70% clayey fines, 20% fine sand, 10% silty fines	0.0	
	9				0.0	
	10		CL	9.3-20.0 See next page	0.0	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5052	Hole No. 13-55-02B
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				9.3-20.0 Sandy Lean Clay (CL) pale olive (5Y 6/4), moist to wet, soft to firm, 60% clayey fines, 40% fine sand		
	11				0.0	
95%	12				0.0	
	13				0.0	No Odor or visible staining
	14				0.0	
	15		CL		0.0	
95%	16				0.0	
	17				0.0	
	18				0.0	
	19				0.0	
95%	20				0.0	

PARSONS

Hole No. 13-SS-03 Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS	10. DATE HOLE	STARTED 9-9-14	COMPLETED 9-9-14
2. LOCATION (Coordinates or Station)	11. DRILLING METHOD / DRILLING RIG Direct Push		
3. DRILLING CONTRACTOR Clement Drilling	12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"		
4. NAME OF DRILLER Craig Clement	13. TOTAL NO. OF SAMPLES TAKEN	ANALYTICAL ☒ ____ IDW ☐ ____	OTHER ☐ ________ ☐ ________
5. NAME OF GEOLOGIST Chris Duncan	14. TOTAL RECOVERY FOR BORING ~85%		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ________ DEGREES FROM VERTICAL	15. TOTAL NUMBER CORE BOXES 0		
	16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ________		
7. THICKNESS OF OVERBURDEN 15	17. ELEVATION ☒ GROUND SURFACE 5047 ☐ TOP OF CASING ________		
8. DEPTH DRILLED INTO ROCK 0	18. ELEVATION GROUND WATER ~10 ft bgs		
9. TOTAL DEPTH OF HOLE 15	19. SIGNATURE OF GEOLOGIST Chris Duncan		

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				0-10.5 silt w/sand (ML), brown (7.5 YR 5/3), moist, trace gravel from 0-1.5 ft, 70% silty fines, 30% fine sand		
	1				0.0	
	2				0.0	
	3				0.0	No odor
70%	4		ML		0.0	
	5				0.0	
	6				0.0	
	7				0.0	
90%	8				0.0	
	9				0.0	
	10				0.0	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5047	Hole No. 13-SS-03
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET OF SHEETS

	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
			ML	10.5-15.0 Sandy Lean Clay (CL) lightgray grading to light brown, moist, firm, 60% clayey fines, 40% fine sand		
	11				0.0	No odor
80%	12				0.0	
	13		CL		0.0	
	14				0.0	
90%	15				0.0	

PARSONS

Hole No. 13-SS-03B Well No. ________

DRILLING LOG

CLIENT: USACE

INSTALLATION: TEAD-S

SHEET 1 OF 2 SHEETS

1. PROJECT: SWMU 13 CMS

10. DATE HOLE: STARTED 9-18-14 COMPLETED 9-18-14

2. LOCATION *(Coordinates or Station)*: step-out boring

11. DRILLING METHOD / DRILLING RIG: Borehole = 2 1/8" Core = 1.5"

3. DRILLING CONTRACTOR: Clement Drilling

12. SIZE AND TYPE OF BIT: Direct Push

4. NAME OF DRILLER: Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN: ANALYTICAL ☐ ___ IDW ☐ ___ OTHER ☒ none ☐ ___

5. NAME OF GEOLOGIST: Chris Duncan

14. TOTAL RECOVERY FOR BORING: ~85%

6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ______ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES: 0

16. DATUM FOR ELEVATION SHOWN: ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ______

7. THICKNESS OF OVERBURDEN: 20

17. ELEVATION: ☒ GROUND SURFACE 5047 ☐ TOP OF CASING ______

8. DEPTH DRILLED INTO ROCK: 0

18. ELEVATION GROUND WATER: ~10 ft bgs

9. TOTAL DEPTH OF HOLE: 20

19. SIGNATURE OF GEOLOGIST: Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
				0-8.5 Silt w/sand (ML), brown (7.5YR 5/3), moist, soft, 70% silty fines, 30% fine sand		
	1				0.0	
	2				0.0	
	3				0.0	No Odor or visible staining
70%	4		ML		0.0	
	5				0.0	
	6				0.0	
	7				0.0	
80%	8			8.5-12.0 Lean Clay w/sand (CL) brown, gray layer from 11-12 ft, moist to wet, soft, 70% clayey fines, 30% fine sand	0.0	
	9		CL		0.0	
	10				0.0	

PARSONS

DRILLING LOG (Cont. Sheet)
ELEVATION 5047
Hole No. 13-SS-03B
PROJECT SWMU 13 CMS
INSTALLATION TEAD-S
SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	11		CL		4.1	very slight petroleum odor at 12 ft bgs
95%	12			12.0-20.0 Sandy Lean Clay (CL) pale olive (5Y 6/4), moist to wet, soft to firm, some iron oxide staining, 55% clayey fines, 45% fine sand	31.0	
	13				2.3	
	14				0.0	
	15				0.0	
95%	16		CL		0.0	
	17				0.0	
	18				0.0	
	19				0.0	
90%	20				0.0	

PARSONS

Hole No. 13-SS-04 Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS
1. PROJECT SWMU 13 CMS		10. DATE HOLE STARTED 9-8-14	COMPLETED 9-8-14
2. LOCATION *(Coordinates or Station)*		11. DRILLING METHOD / DRILLING RIG Direct Push	
3. DRILLING CONTRACTOR Clement Drilling		12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"	
4. NAME OF DRILLER Craig Clement		13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☒ ____ IDW ☐ ____	OTHER ☐ ____ ☐ ____
5. NAME OF GEOLOGIST Chris Duncan		14. TOTAL RECOVERY FOR BORING ~85%	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEGREES FROM VERTICAL		15. TOTAL NUMBER CORE BOXES 0	
		16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____	
7. THICKNESS OF OVERBURDEN 15		17. ELEVATION ☒ GROUND SURFACE 5049 ☐ TOP OF CASING ____	
8. DEPTH DRILLED INTO ROCK 0		18. ELEVATION GROUND WATER ~10 ft bgs	
9. TOTAL DEPTH OF HOLE 15		19. SIGNATURE OF GEOLOGIST Chris Duncan	

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
				0-7.3 silt w/sand (ML) brown (7.5YR 5/3), moist, soft 40% fine sand, 60% silty fines		
	1				2.0	
	2				11.3	
	3		ML		12.6	
65%	4				26.2	slight petroleum odor from 3-5 ft bgs
	5				11.1	
	6				53.2	
	7			7.3-8.0 Sandy Lean Clay lense Gray w/ iron oxide staining	113.8	very strong odor from 5-15 ft bgs
85%	8		CL	8.0-12.9 Poorly Graded sand w/silt, Dark black soil, wet, soft to firm, 70% fine to med sand, 30% silty fines	7.8	
	9		SP/SM		49.8	
	10				163.7	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5049	Hole No. 13-SS-04
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	11		SP/ SM	8.0 - 12.9 Poorly Graded sand w/silt as previously described	50.6	
95%	12				457.6	strong petroleum odor
	13			12.9 - 15.0 Clayey sand (SC) yellow brown (10YR 5/6), moist, tight or firm, 60% fine sand, 40% clayey fines	144.8	
	14		SC		6.8	
95%	15				11.2	

PARSONS

Hole No. 13-SS-05 Well No. ____________

DRILLING LOG

CLIENT USACE

INSTALLATION TEAD-S

SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS

10. DATE HOLE STARTED 9-8-14 COMPLETED 9-8-14

2. LOCATION (Coordinates or Station)

11. DRILLING METHOD / DRILLING RIG Direct Push

3. DRILLING CONTRACTOR Clement Drilling

12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"

4. NAME OF DRILLER Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☒ ____ IDW ☐ ____ OTHER ☐ ____ ☐ ____

5. NAME OF GEOLOGIST Chris Duncan

14. TOTAL RECOVERY FOR BORING ~90%

6. DIRECTION OF HOLE
☒ VERTICAL
☐ INCLINED ____________ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____________

7. THICKNESS OF OVERBURDEN 15

17. ELEVATION ☒ GROUND SURFACE 5019 ☐ TOP OF CASING ____________

8. DEPTH DRILLED INTO ROCK 0

18. ELEVATION GROUND WATER ~10 ft bgs

9. TOTAL DEPTH OF HOLE 15

19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	1		GM	0-3.0 Silty Gravel w/sand (GM) yellow brown (10YR 5/6), moist, loose, 55% gravel, fine to exceeding 1.5", subangular to subround, 20% fine to med sand, 25% silty fines	0.9	
	2				1.0	
	3		CL	3.0-9.2 Sandy Lean Clay (CL), brown (7.5YR 5/3), moist, grades to gray at 7.6 ft with white mottling, 60% clayey fines, 40% fine sand	0.9	
90%	4				0.8	
	5				0.0	
	6				0.1	
	7				0.0	
90%	8				0.0	
	9			9.2-13.5 see next page	18.9	
	10		SP/SM		37.8	

PARSONS

DRILLING LOG (Cont. Sheet)	**ELEVATION** 5049	**Hole No.** 13-SS-05
PROJECT SWMU 13 CMS	**INSTALLATION** TEAD-S	**SHEET** 2 **OF** 2 **SHEETS**

	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
				CCD ~~3.0~~ - 9.2-13.5 Poorly Graded sand w/silt, gray with black staining, moist to wet, firm or tight, 60% fine to med sand, 40% silty fines		
	11		SP/		36.2	strong petroleum odor from 9-12 ft bgs
90%	12		SM		118.1	
	13					
				13.5-15.0 Sandy Lean Clay (CL) yellow brown (10YR 5/6), moist, firm, 60% clay fines, 40% fine sand	7.8	
	14		CL		1.2	
90%	15				5.6	odor begins to taper off

PARSONS

Hole No. 13-SS-05A Well No. ____________

DRILLING LOG

CLIENT USACE

INSTALLATION TEAD-S

SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS (step out)

10. DATE HOLE STARTED 9-12-14 COMPLETED 9-12-14

2. LOCATION (Coordinates or Station) Step-Out Boring

11. DRILLING METHOD / DRILLING RIG Direct Push

3. DRILLING CONTRACTOR Clement Drilling

12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"

4. NAME OF DRILLER Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ___ IDW ☐ ___ OTHER ☐ ________ ☐ ________

5. NAME OF GEOLOGIST Chris Duncan

14. TOTAL RECOVERY FOR BORING ~85%

6. DIRECTION OF HOLE
☒ VERTICAL
☐ INCLINED ____________ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ________

7. THICKNESS OF OVERBURDEN 20

17. ELEVATION ☒ GROUND SURFACE 5049 ☐ TOP OF CASING ________

8. DEPTH DRILLED INTO ROCK 0

18. ELEVATION GROUND WATER ~10 ft bgs

9. TOTAL DEPTH OF HOLE 20

19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				0-3.8 Silty Gravel w/sand (GM) brown to yellow brown, moist, 60% gravel up to 1", subang to subround, 10% fine to med sand, 30% silty fines		
	1				0.0	
	2		GM		0.0	
	3				0.0	
70%	4			3.8-8.3 Sandy Lean Clay (CL) light brownish gray (2.5Y 6/2), moist, firm, some white mottling, 40% fine sand, 60% clayey fines	0.0	No Odor
	5				0.0	
	6		CL		0.0	
	7				0.0	
95%	8			8.3-12.0 silt w/sand (ML) pale olive (5Y 6/4), moist to wet, tight 60% silty fines, 40% fine sand	0.0	
	9		ML		0.0	
	10				0.0	

PARSONS

DRILLING LOG (Cont. Sheet)

ELEVATION 5049

Hole No. 13-SS-05A

PROJECT SWMU 13 CMS

INSTALLATION TEAD-S

SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	11		ML		1.2	
90%	12		SP-SM	12.0-13.5 Poorly Graded sand w/silt (SP-SM) gray grading to yellow brown, moist to wet, 70% fine sand, 30% silty fines	23.7	slight petroleum odor from 11-15 ft bgs
	13				75.3	
	14		ML	13.5-16.4 silt w/sand (ML) light brownish gray (2.5Y 6/2) moist soft to firm, 60% silty fines, 40% fine sand	21.2	
	15				0.0	
95%	16				0.0	
	17		CL	16.4-20.0 Sandy Lean Clay (CL) gray to light brownish gray, moist trace gravel, 45% fine sand, 50% clayey fines, 5% gravel up to 1"	0.0	
	18				0.0	
	19				0.0	
90%	20				0.0	

PARSONS

Hole No. 13-SS-05B Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS
1. PROJECT SWMU 13 CMS		10. DATE HOLE STARTED 9-18-14	COMPLETED 9-18-14
2. LOCATION *(Coordinates or Station)* step-out boring		11. DRILLING METHOD / DRILLING RIG Direct Push	
3. DRILLING CONTRACTOR Clement Drilling		12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"	
4. NAME OF DRILLER Craig Clement		13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ___ IDW ☐ ___	OTHER ☒ none ☐ ______
5. NAME OF GEOLOGIST Chris Duncan		14. TOTAL RECOVERY FOR BORING	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ______ DEGREES FROM VERTICAL		15. TOTAL NUMBER CORE BOXES 0	
		16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ______	
7. THICKNESS OF OVERBURDEN 20		17. ELEVATION ☒ GROUND SURFACE 5049 ☐ TOP OF CASING ______	
8. DEPTH DRILLED INTO ROCK 0		18. ELEVATION GROUND WATER ~ 10 ft bgs	
9. TOTAL DEPTH OF HOLE 20		19. SIGNATURE OF GEOLOGIST Chris Duncan	

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
	1		GM	0-3.5 silty Gravel w/sand and intermixed with concrete, yellowish brown (10YR 5/6), dry loose, 55% fine gravel, subang to subround, 45% fine to med sand and concrete debris,	0.0	
	2				0.0	
	3				0.0	
60%	4		ML	3.5-8.0 Silt w/sand (ML) brown (7.5 YR 5/3), moist, soft, 65% silty fines, 35% fine sand	0.0	
	5				0.0	No Odor
	6				0.0	
	7				0.0	
40%	8		CL	8.0-10.5 Lean Clay (CL) olive brown (2.5Y 4/3), moist, soft to firm, white mottling throughout, 70% clayey fines, 20% fine sand, 10% silty fines	0.0	
	9				0.0	
	10				0.0	

PARSONS

DRILLING LOG (Cont. Sheet)

ELEVATION 5049

Hole No. 13-55-05B

PROJECT SWMU 13 CMS

INSTALLATION TEAD-S

SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
			CL	10.5-20.0 Sandy Lean Clay (CL) pale olive (5Y 6/4), moist to wet, soft to firm, gravel lense @ 17-17.5 ft, 55% clayey fines, 45% fine sand, some iron oxide staining from 18-20 ft		
	11				0.0	
95%	12				0.0	
	13				0.0	
	14				0.0	No Odor or visible staining
	15		CL		0.0	
95%	16				0.0	
	17				0.0	
	18				0.0	
	19				0.0	
95%	20				0.0	

PARSONS

Hole No. 13-SS-06 **Well No.** ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET OF SHEETS

1. PROJECT SWMU 13 CMS

10. DATE HOLE STARTED 9-8-14 COMPLETED 9-8-14

2. LOCATION *(Coordinates or Station)*

11. DRILLING METHOD / DRILLING RIG Direct Push

3. DRILLING CONTRACTOR Clement Drilling

12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"

4. NAME OF DRILLER Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☒ ____ IDW ☐ ____ OTHER ☐ ____ ☐ ____

5. NAME OF GEOLOGIST Chris Duncan

14. TOTAL RECOVERY FOR BORING ~90%

6. DIRECTION OF HOLE
☒ VERTICAL
☐ INCLINED ____________ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____________

7. THICKNESS OF OVERBURDEN 15

17. ELEVATION ☒ GROUND SURFACE 5048 ☐ TOP OF CASING ____________

8. DEPTH DRILLED INTO ROCK 0

18. ELEVATION GROUND WATER ~10 ft bgs

9. TOTAL DEPTH OF HOLE 15

19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
			GM	0-1.0 Silty Gravel w/sand (GM) yellowish brown (10YR 5/6), moist, loose, 50% gravel, fine to exceeding 1.5", subang to subround, 20% fine sand, 30% silty fines		
	1				0.7	
	2			1.0-7.2 Silt w/sand (ML), moist, soft, brown, 60% silty fines, 40% fine to med sand	0.9	
	3				1.1	
80%	4		ML		1.7	
	5				1.1	
	6				19.3	
	7			7.2-13.5 Sandy Lean Clay (CL) Gray (Gley 1-6/N), moist to wet, firm, 45% fine sand, 55% clayey fines	9.7	slight petroleum odor from 5-8 ft bgs
90%	8				4.3	
	9		CL		4.8	
	10				45.8	

PARSONS

DRILLING LOG (Cont. Sheet)

ELEVATION 5048

Hole No. 13-SS-06

PROJECT SWMU 13 CMS

INSTALLATION TEAD-S

SHEET 2 **OF** 2 **SHEETS**

	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	11		CL	7.2-13.5 Sandy Lean Clay (CL) As previously described	65.2	strong petroleum odor from 8-15 ft bgs
90%	12				7.8	
	13				50.9	
	14		SP/SM	13.5-15.0 Poorly Graded sand w/silt (SP/SM), gray grading to light brown, moist, tight, 70% fine to med sand, 30% silty fines	16.3	
95%	15				30.8	

PARSONS

Hole No. 13-SS-06A Well No. ____________

DRILLING LOG

CLIENT USACE

INSTALLATION TEAD-S

SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS

10. DATE HOLE STARTED 9-18-14 COMPLETED 9-18-14

2. LOCATION (*Coordinates or Station*) step-out boring

11. DRILLING METHOD / DRILLING RIG Direct Push

3. DRILLING CONTRACTOR Clement Drilling

12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"

4. NAME OF DRILLER Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ___ IDW ☐ ___ OTHER ☒ none ☐ ___

5. NAME OF GEOLOGIST Chris Duncan

14. TOTAL RECOVERY FOR BORING ~75%

6. DIRECTION OF HOLE
☒ VERTICAL
☐ INCLINED ____________ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____________

7. THICKNESS OF OVERBURDEN 20

17. ELEVATION ☒ GROUND SURFACE 5048 ☐ TOP OF CASING ________

8. DEPTH DRILLED INTO ROCK 0

18. ELEVATION GROUND WATER ~10 ft bgs

9. TOTAL DEPTH OF HOLE 20

19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (*Description*) d	PID (ppm) e	REMARKS (*Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant*) g
				0-8 silt w/sand (ML) yellowish brown (10YR 5/6), dry to moist, soft, 60% silty fines, 40% fine sand		
	1				0.0	
	2				0.0	
	3				0.0	
60%	4		ML		0.0	
	5				0.0	
	6				0.0	
	7				0.0	
80%	8			8-13.8 Sandy Lean Clay (CL), gray to olive gray, moist, firm, 55% clayey fines, 45% fine sand	0.0	
	9		CL		2.4	petroleum odor from 9-13 ft bgs
	10				78.8	

PARSONS

DRILLING LOG (Cont. Sheet)	**ELEVATION** 5048	**Hole No.** 13-SS-06A
PROJECT SWMU 13 CMS	**INSTALLATION** TEAD-S	**SHEET** 2 **OF** 2 **SHEETS**

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				8.0-13.8 Sandy Lean Clay (CL) as previously described		
	11				37.1	strong petroleum odor
90%	12		CL		85.9	
	13				20.6	
	14			13.8-20.0 Interbedded sand seams, silt, and clay 0.5 to 1 ft thick, moist to wet, gray to light brownish gray	0.0	
	15				0.0	
90%	16		SP/ SM/ CL		0.0	
	17				0.0	
	18				0.0	
	19				0.0	
95%	20				0.0	

PARSONS

Hole No. 13-SS-07 Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS

10. DATE HOLE STARTED 9-8-14 COMPLETED 9-8-14

2. LOCATION *(Coordinates or Station)*

11. DRILLING METHOD / DRILLING RIG Direct Push

3. DRILLING CONTRACTOR Clement Drilling

12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"

4. NAME OF DRILLER Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☒ ____ IDW ☐ ____ OTHER ☐ ________ ☐ ________

5. NAME OF GEOLOGIST Chris Duncan

14. TOTAL RECOVERY FOR BORING ~90%

6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____________ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____________

7. THICKNESS OF OVERBURDEN 15

17. ELEVATION ☒ GROUND SURFACE 5048 ☐ TOP OF CASING ________

8. DEPTH DRILLED INTO ROCK 0

18. ELEVATION GROUND WATER ~10 ft bgs

9. TOTAL DEPTH OF HOLE 15

19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
	1		GM	0-1.5 Silty Gravel w/sand (GM) yellow brown (10YR 5/6), moist, loose, intermixed w/ asphalt, 70% gravel, fine to exceeding 1.5", subang to subround, 15% fine to med sand, 15% silt	1.4	
	2				1.6	
	3			1.5-7.8 Silt w/sand (ML) brown (7.5YR 5/3), moist, firm, 60% silty fines, 40% fine sand	1.4	
90%	4				1.4	
	5		ML		0.9	
	6				0.9	
	7				0.9	High Petroleum odor from 5-15 ft bgs
90%	8			7.8-13.1 Poorly Graded sand w/silt (SP/SM) Dark gray to black stained soil throughout, tight, moist to wet, 60% fine sand, 40% silty fines	15.1	
	9		SP/SM		35.2	
	10				40.1	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5048	Hole No. 13-SS-07

PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				7.8-13.1 Poorly Graded sand w/silt as previously described		
	11		SP/		35.6	
90%	12		SM		40.6	High Petroleum odor
					39.6	
	13			13.1-15.0 Lean Clay (CL), dark gray to black stained soil, stiff, very firm, moist, 70% clayey fines, 15% fine sand, 15% silty fines		
	14		CL		55.9	
90%	15				6.6	

PARSONS

Hole No. 13-SS-07A Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS
1. PROJECT SWMU 13 CMS		10. DATE HOLE STARTED 9-12-14	COMPLETED 9-12-14
2. LOCATION (Coordinates or Station) Step-Out Boring		11. DRILLING METHOD / DRILLING RIG Direct Push	
3. DRILLING CONTRACTOR Clement Drilling		12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"	
4. NAME OF DRILLER Craig Clement		13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ____ IDW ☐ ____	OTHER ☐ ____ ☐ ____
5. NAME OF GEOLOGIST Chris Duncan		14. TOTAL RECOVERY FOR BORING ~85%	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEGREES FROM VERTICAL		15. TOTAL NUMBER CORE BOXES 0	
		16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____	
7. THICKNESS OF OVERBURDEN 20		17. ELEVATION ☒ GROUND SURFACE 5048 ☐ TOP OF CASING ____	
8. DEPTH DRILLED INTO ROCK 0		18. ELEVATION GROUND WATER ~10 ft bgs	
9. TOTAL DEPTH OF HOLE 20		19. SIGNATURE OF GEOLOGIST Chris Duncan	

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	1		GM	0-1.5 Silty Gravel w/sand (GM) brown (7.5YR 5/3) moist, 60% gravel, mostly fine up to 1", subangular to subround, 10% fine to med sand, 30% silty fines	0,0	
	2				0.0	
	3			1.5-13.5 Silt w/sand (ML) light brownish gray (2.5Y 6/2), moist to wet, 50% fine sand, 50% silty fines, clay lense from 5.5-6.0 ft bgs	0.0	
50%	4		ML		0.0	No Odor
	5				0.0	
	6		CL		0.0	
	7				0.0	
95%	8		ML		0.0	
	9				0.0	
	10				0.0	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5048	Hole No. 13-SS-07A
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				1.5-13.5 Silt w/sand (ML) as previously described		
	11				0.0	
95%	12		ML		0.0	
	13				0.0	
				13.5-20.0 Sandy Lean Clay (CL) pale olive (5Y 6/4), moist, hard, iron oxide staining throughout, 30% fine sand, 70% clayey fines three thumb sized coarse gravels @ 15.5 ft bgs		
	14				0.0	No Odor
	15				0.0	
90%	16				0.0	
	17		CL		0.0	
	18				0.0	
	19				0.0	
90%	20				0.0	

PARSONS

Hole No. 13-SS-08 Well No. ____

DRILLING LOG

CLIENT: USACE

INSTALLATION: TEAD-S

SHEET 1 OF 2 SHEETS

1. PROJECT: SWMU 13 CMS
2. LOCATION *(Coordinates or Station)*: SWMU 13
3. DRILLING CONTRACTOR: Clement Drilling
4. NAME OF DRILLER: Craig Clement
5. NAME OF GEOLOGIST: Chris Duncan
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ____ DEGREES FROM VERTICAL
7. THICKNESS OF OVERBURDEN: 12
8. DEPTH DRILLED INTO ROCK: 0
9. TOTAL DEPTH OF HOLE: 12
10. DATE HOLE: STARTED 9-8-14 COMPLETED 9-8-14
11. DRILLING METHOD / DRILLING RIG: Direct Push
12. SIZE AND TYPE OF BIT: Borehole = 2⅛" Core = 1.5"
13. TOTAL NO. OF SAMPLES TAKEN: ANALYTICAL ☒ ____ IDW ☐ ____ OTHER ☐ ____ ☐ ____
14. TOTAL RECOVERY FOR BORING: ~ 85%
15. TOTAL NUMBER CORE BOXES: 0
16. DATUM FOR ELEVATION SHOWN: ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____
17. ELEVATION: ☒ GROUND SURFACE 5048 ☐ TOP OF CASING ____
18. ELEVATION GROUND WATER: ~ 10 ft bgs
19. SIGNATURE OF GEOLOGIST: Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
				0-1.5 Silty Gravel w/sand (GM) yellowish brown (10YR 3/4), moist, loose, 60% gravel fine to exceeding 1.5", subang to sub-round, 10% fine to med sand, 30% silty fines		Asphalt layer from 0.4-0.7 ft
	1		GM		0.4	
	2				0.1	
	3			1.5-6.2 Silt w/sand (ML), brown (7.5YR 5/3), moist, soft, 60% silty fines, 40% fine sand	0.1	
70%	4		ML		0.1	
	5				0.2	
	6			6.2-12.0 Sandy Lean Clay (CL), light gray (2.5Y 6/2), moist to wet, firm, 35% fine sand, 65% clay fines	0.3	
	7				0.1	
90%	8		CL		1.0	slight petroleum odor from approx. 8-12 ft bgs
	9				3.0	
	10				8.9	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5048	Hole No. 13-SS-08

PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
11		CL	6.2 - 12.0 Sandy Lean Clay as previously described	8.5	
12				27.7	

90%

PARSONS

Hole No. 13-SS-09 Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS
1. PROJECT SWMU 13 CMS		10. DATE HOLE STARTED 9-8-14	COMPLETED 9-8-14
2. LOCATION *(Coordinates or Station)*		11. DRILLING METHOD / DRILLING RIG Direct Push	
3. DRILLING CONTRACTOR Clement Drilling		12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"	
4. NAME OF DRILLER Craig Clement		13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☒ ____ IDW ☐ ____	OTHER ☐ ____ ☐ ____
5. NAME OF GEOLOGIST Chris Duncan		14. TOTAL RECOVERY FOR BORING ~85%	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEGREES FROM VERTICAL		15. TOTAL NUMBER CORE BOXES 0	
		16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____	
7. THICKNESS OF OVERBURDEN 15		17. ELEVATION ☒ GROUND SURFACE 5049 ☐ TOP OF CASING ____	
8. DEPTH DRILLED INTO ROCK 0		18. ELEVATION GROUND WATER ~10 ft bgs	
9. TOTAL DEPTH OF HOLE 15		19. SIGNATURE OF GEOLOGIST Chris Duncan	

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
	1			0-5.5 Silty Gravel w/sand (GM) yellow brown (10YR 5/6), moist, med dense, 50% gravel, fine to exceeding 1.5", 25% fine to med sand, 25% silty fines,	0.2	
	2				0.1	
	3		GM		0.1	
60%	4				0.2	
	5				0.2	
	6			5.5-8.0 Silt w/sand (ML), yellowish brown (10YR 5/6), moist, soft, 60% silty fines, 40% fine sand	0.3	
	7		ML		0.4	
100%	8			8.0-10.0 Silty Gravel w/sand (GM) yellowish brown, same as above	1.1	
	9		GM		0.5	slight petroleum odor from 8-10ft
	10				2.7	

PARSONS

DRILLING LOG (Cont. Sheet)

ELEVATION 5049

Hole No. 13-SS-09

PROJECT SWMU 13 CMS

INSTALLATION TEAD-S

SHEET 2 OF 2 SHEETS

	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				<u>10.0-15.0</u> silty to clayey sand 10-13.5 ft is stained dark gray soil, 13.5-15.0 is light brown w/ iron oxide staining throughout wet, firm, 60% fine sand, 20% silty fines, 20% clayey fines	12.5	
	11				55.0	strong petroleum odor and stained soil from 10-13 ft
80%	12		SM/SC		42.0	
	13					
	14				39.8	
90%	15				2.8	slight odor @ 15 ft

PARSONS

Hole No. 13-SS-09A Well No. ______

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS (step out)

10. DATE HOLE STARTED 9-12-14 COMPLETED 9-12-14

2. LOCATION (Coordinates or Station) Step-Out Boring

11. DRILLING METHOD / DRILLING RIG Direct Push

3. DRILLING CONTRACTOR Clement Drilling

12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"

4. NAME OF DRILLER Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ___ IDW ☐ ___ OTHER ☐ ___ ☐ ___

5. NAME OF GEOLOGIST Chris Duncan

14. TOTAL RECOVERY FOR BORING ~85%

6. DIRECTION OF HOLE

☒ VERTICAL

☐ INCLINED ______ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ______

7. THICKNESS OF OVERBURDEN 20

17. ELEVATION ☒ GROUND SURFACE 5049 ☐ TOP OF CASING ______

8. DEPTH DRILLED INTO ROCK 0

18. ELEVATION GROUND WATER ~ 10 ft bgs

9. TOTAL DEPTH OF HOLE 20

19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				0-3.5 Silty Gravel w/sand (GM) brown (7.5YR 5/3), moist, loose, 60% gravel up to 1", subang to subround, 10% fine sand, 30% silty fines		
	1				0.0	
	2		GM		0.0	
	3				0.0	
70%				3.5-13.8 silt w/sand (ML) brown (7.5YR 5/3), moist, soft to firm, 60% silty fines, 40% fine sand		
	4				0.0	No Odor
	5				0,0	
	6				0.0	
	7		ML		0.0	
90%						
	8				0,0	
	9				0.0	
	10				0.	

PARSONS

DRILLING LOG (Cont. Sheet)
ELEVATION 5049
Hole No. 13-SS-09A
PROJECT SWMU 13 CMS
INSTALLATION TEAD-S
SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	11				0,0	
90%	12		ML		0.0	
	13				0.0	No odor or signs of contamination
	14		SP	13.8-16.0 Sandy Lean Clay (CL) olive gray (5Y 4/2) grading to pale olive (5Y 6/4), moist, top of horizon is a 6-inch sand lense, 60% clayey fines, 40% fine sand	0.0	
	15				0.0	
90%	16			16.0-20.0 Interbedded clays, silts, and sand lenses, light brownish gray, very wet at 16-17 ft, some iron oxide staining throughout	0.0	
	17				0.0	
	18		SP/ SM/ CL		0.0	No odor or signs of contamination
	19				0.0	
90%	20				0.0	

PARSONS

Hole No. 13-55-10 Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION	SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS (step out)

10. DATE HOLE STARTED 9-12-14 COMPLETED 9-12-14

2. LOCATION (Coordinates or Station) Step-Out Boring

11. DRILLING METHOD / DRILLING RIG Direct Push

3. DRILLING CONTRACTOR Clement Drilling

12. SIZE AND TYPE OF BIT Borehole = 2 1/8" Core = 1.5"

4. NAME OF DRILLER Craig Clement

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ____ IDW ☐ ____ OTHER ☐ ____ ☐ ____

5. NAME OF GEOLOGIST Chris Duncan

14. TOTAL RECOVERY FOR BORING ~80%

6. DIRECTION OF HOLE

☒ VERTICAL

☐ INCLINED ____________ DEGREES FROM VERTICAL

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ________

7. THICKNESS OF OVERBURDEN 20

17. ELEVATION ☒ GROUND SURFACE 5047 ☐ TOP OF CASING ________

8. DEPTH DRILLED INTO ROCK 0

18. ELEVATION GROUND WATER ~ 10 ft bgs

9. TOTAL DEPTH OF HOLE 20

19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				0-8.5 silt w/sand (ML) brown (7.5YR 5/3) moist, soft to firm, 60% silty fines, 40% fine sand		
	1				0.0	
	2				0.0	
	3				0.0	
30%	4		ML		0.0	
	5				0.0	
	6				0.0	
	7				0.0	
60%	8				0.0	
	9		CL	8.5-20.0 Sandy Lean Clay (CL) 8.5 ft to 13 ft bgs is dark gray to black. 13 to 20 ft is pale olive, moist to wet, firm, 30% fine sand, 70% clayey fines	115.0	strong petroleum odor from 9-12 ft bgs
	10				124.0	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5047	Hole No. 13-SS-10
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
	11			8.5-20.0 Sandy Lean Clay as previously described	53.2	petroleum odor
90%	12				45.1	
	13					
			CL		0.0	
	14				0.0	
	15				0.0	
90%	16				0.0	
	17				0.0	
	18		SP	sand lense	0.0	
	19		CL		0.0	
90%	20				0.0	

PARSONS

Hole No. 13-SS-10B Well No. ______

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS

1. PROJECT SWMU 13 CMS
10. DATE HOLE STARTED 9-18-14 COMPLETED 9-18-14
2. LOCATION (Coordinates or Station) step-out boring
11. DRILLING METHOD / DRILLING RIG Direct Push
3. DRILLING CONTRACTOR Clement Drilling
12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"
4. NAME OF DRILLER Craig Clement
13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ___ IDW ☐ ___ OTHER ☒ none ☐ ______
5. NAME OF GEOLOGIST Chris Duncan
14. TOTAL RECOVERY FOR BORING ~85%
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ______ DEGREES FROM VERTICAL
15. TOTAL NUMBER CORE BOXES 0
16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ______
7. THICKNESS OF OVERBURDEN 20
17. ELEVATION ☒ GROUND SURFACE 5047 ☐ TOP OF CASING ______
8. DEPTH DRILLED INTO ROCK 0
18. ELEVATION GROUND WATER ~10 ft bgs
9. TOTAL DEPTH OF HOLE 20
19. SIGNATURE OF GEOLOGIST Chris Duncan

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				0-8.2 silt w/sand (ML) brown (7.5YR 5/3), moist, soft to firm, 55% silty fines, 45% fine sand		
	1				0.0	
	2				0.0	
	3				0.0	
70%	4		ML		0.0	
	5				0.0	
	6				0.0	
	7				0.0	
85%	8			8.2-20.0 Sandy Lean Clay (CL) 9-12 ft is dark gray/black staining, followed by pale olive, moist to wet, firm to soft, 55% clayey fines, 45% fine sand (strong odor)	0.3	
	9		CL		130.0	strong petroleum odor from 9-12 ft bgs
	10				71.2	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5047	Hole No. 13-SS-10B

PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
				8.2-20.0 Sandy Lean Clay as previously described		strong petroleum odor and stained soil (dark gray/black) from 9-12 ft bgs
	11					
90%					85.4	
	12				21.2	
	13				0.0	
	14		CL		0.0	
	15				0.0	
90%	16				0.0	
	17				0.0	
	18				0.0	
	19				0.0	
90%	20				0.0	

PARSONS

Hole No. 13-SS-10C Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS
1. PROJECT SWMU 13 CMS	10. DATE HOLE	STARTED 9-19-14	COMPLETED 9-19-14
2. LOCATION *(Coordinates or Station)* Step-out boring	11. DRILLING METHOD / DRILLING RIG Direct Push		
3. DRILLING CONTRACTOR Clement Drilling	12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"		
4. NAME OF DRILLER Craig Clement	13. TOTAL NO. OF SAMPLES TAKEN	ANALYTICAL ☐ ___ IDW ☐ ___	OTHER ☒ none ☐ ______
5. NAME OF GEOLOGIST Chris Duncan	14. TOTAL RECOVERY FOR BORING ~85%		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____________ DEGREES FROM VERTICAL	15. TOTAL NUMBER CORE BOXES 0		
	16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ________		
7. THICKNESS OF OVERBURDEN 20	17. ELEVATION ☒ GROUND SURFACE 5047 ☐ TOP OF CASING ________		
8. DEPTH DRILLED INTO ROCK 0	18. ELEVATION GROUND WATER ~10 ft bgs		
9. TOTAL DEPTH OF HOLE 20	19. SIGNATURE OF GEOLOGIST Chris Duncan		

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
	1			0-6.5 Silt w/sand (ML). brown (7.5YR 5/3), moist, soft to firm, 60% silty fines, 40% fine sand	0.0	
	2				0.0	
	3		ML		0.0	
80%	4				0.0	No Odor
	5				0.0	
	6				0.0	
	7			6.5-10.5 Lean clay w/sand (CL) brown (7.5YR 5/3), moist, soft to firm, 70% clayey fines, 20% fine sand, 10% silty fines	0.0	
80%	8		CL		0.0	
	9				0.0	
	10				0.0	

PARSONS

DRILLING LOG (Cont. Sheet)	**ELEVATION** 5047	**Hole No.** 13-SS-10C
PROJECT SWMU 13 CMS	**INSTALLATION** TEAD-S	**SHEET** 2 **OF** 2 **SHEETS**

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
			CL	10.5 - 20.0 Sandy Lean Clay (cl) pale olive (5Y 6/4), moist to wet, firm, 60% clayey fines, 40% fine sand, intermittent sand seams from 1-3 inches throughout		
	11				0.0	
90%	12				0.0	
	13				0.0	
	14				0.0	No Odor
	15		CL		0.0	
90%	16				0.0	
	17				0.0	
	18				0.0	
	19				0.0	
90%	20				0.0	

PARSONS

Hole No. 13-SS-11 Well No. ____________

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 2 SHEETS
1. PROJECT SWMU 13 CMS		10. DATE HOLE STARTED 9-19-14	COMPLETED
2. LOCATION *(Coordinates or Station)* source boring		11. DRILLING METHOD / DRILLING RIG Direct Push	
3. DRILLING CONTRACTOR Clement Drilling		12. SIZE AND TYPE OF BIT Borehole = 2⅛" Core = 1.5"	
4. NAME OF DRILLER Craig Clement		13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ___ IDW ☐ ___	OTHER ☒ none ☐ ___
5. NAME OF GEOLOGIST Chris Duncan		14. TOTAL RECOVERY FOR BORING ~85%	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEGREES FROM VERTICAL		15. TOTAL NUMBER CORE BOXES 0	
		16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ____	
7. THICKNESS OF OVERBURDEN 24		17. ELEVATION ☒ GROUND SURFACE 5052 ☐ TOP OF CASING ____	
8. DEPTH DRILLED INTO ROCK 0		18. ELEVATION GROUND WATER ~10 ft bgs	
9. TOTAL DEPTH OF HOLE 24		19. SIGNATURE OF GEOLOGIST Chris Duncan	

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
	0			0-6.5 Silty Gravel w/sand (GM) yellowish brown (10YR 5/6), dry to slightly moist, loose, 50% fine gravel, subang to subround, 20% fine to coarse sand, 30% silty fines, 0-2 ft is intermixed with concrete and asphalt debris		
	1				0.0	
	2					No odor from 0-6 ft
	3		GM		0.0	
40%	4				0.0	
	5				0.0	
	6				0.0	
				6.5-8.3 Silt w/sand (ML) Dark brown (7.5YR 3/4), moist to wet, very soft, 65% silty fines, 35% fine sand	0.3	very little odor from 6-8 ft bgs (dark brown soil)
	7		ML		159.8	
80%	8			8.3-20.0 Sandy Lean Clay (CL) dark gray / black from 8.3-15 ft grading to light brownish gray, moist firm, 55% clayey fines, 45% fine sand	188.7	
	9		CL		241.0	very strong petroleum odor from 9-17 ft bgs
	10				98.7	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5052	Hole No. 13-SS-11
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 2 SHEETS

% Recovery	DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
				8.3-20.0 Sandy Lean Clay as previously described		
	11				112.7	strong petroleum odor from 9-17 ft
90%	12				179.0	
	13		CL		321.0	
	14				101.2	
	15				118.9	
90%	16				225.0	
			SP	sand lense		
	17				83.8	
	18		CL		69.1	slight petroleum odor from 17-19 ft bgs
	19		SP	sand lense	138.7	
90%	20		CL	20.0-24.0 Interbedded silts, clays, and sand lenses, light brownish gray (2.5Y 6/2), most to wet, firm or dense	23.6	little to no odor from 19-21 ft
	21		SM/		9.9	
	22		CL/			No odor from 21-24 ft
			SP	sand lense	15.8	
	23				0.0	
90%	24				0.0	

APPENDIX D

SWMU 13
HYDRASLEEVE SAMPLE LOGS

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125. 04000 | Well LOCID: S-30-88
Installation: TEAD-S | Log Book No. 1 | Pages: 58
Contractor: Parsons | Sampler(s):
HS Deployment Date: 11/10/14 Time: 1420 | Weather: Wind Dir: S , at ~10 mph; Air Temp: 43°F
Well Labeled: Y/N [Y] Well Secure: Y/N [Y] | Comments:
PID SN: | Well Headspace (PID mu): 0.0ppm Odor: none
Water Level Instrument: Solinst 122 | Serial No.: 014019
SWL (ft BTOC): 10.86 | Measured Well Depth (ft BTOC): 20.09 | Reported Well Depth (ft BTOC):
Sediment Thickness (ft): | Number of Hydrasleeves deployed in well: 1 | Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom weight | Total Weight used (oz.): 5
Sleeve bag length (in): 30 | HS bag volume (ml): 1,600 | Depth to top of sleeve (ft BTOC): 17.09
Bottom Weighted: Y/N [Y] | Top Weighted: Y/N [N]

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-30-88 | Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1530
Log Book No. 1 | Pages: 59
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good

Weather: Wind Dir: S , at ~ 0 mph; Precipitation: none Air Temperature: 30 °F
Sample No. (FIELDSAMPID): S-30-88 | Sample Date: 11/12/14 | Sample Time: 1530
Sampler (s): Chris Duncan | Sample Beg. Depth (ft BTOC): 17.09 | Sample Ending Depth (ft BTOC): 14.09
Sample Collection Method: ☒Discharge Tube ☐Other (explain):
Approximate Volume of Excess Sample Water After Sampling (ml): 600 mL
Excess Sample Water Placed in Container: Y/N [Y] | Container Number: PARSNZ1430702
SWL Following Sampling (ft BTOC): 10.87 | Sample Equipment Decon Date: 11-13-14 by: CCD
Decon Water Placed in Drum: Y/N [Y] | Drum Number: PARSNZ1430702
Prepared by: Chris Duncan Date: 11/12/14 | Reviewed by: Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000
Well LOCID: 5-78-91
Installation: TEAD-S
Log Book No. 1
Pages: 58
Contractor: Parsons
Sampler(s): Chris Duncan
HS Deployment Date: 11/10/14 Time: 1430
Weather: Wind Dir: S , at ~10 mph; Air Temp: 43°F
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]
Comments:
PID SN:
Well Headspace (PID mu): 0.0 ppm Odor: none
Water Level Instrument: Solinst 122
Serial No.: 014019
SWL (ft BTOC): 11.27
Measured Well Depth (ft BTOC): 24.90
Reported Well Depth (ft BTOC):
Sediment Thickness (ft):
Number of Hydrasleeves deployed in well: 1
Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom weight Total Weight used (oz.): 5
Sleeve bag length (in): 30
HS bag volume (ml): 1,600
Depth to top of sleeve (ft BTOC): 21.90
Bottom Weighted: Y/N [Y] Top Weighted: Y/N [N]

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-78-91
Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1550
Log Book No. 1
Pages: 59
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good

Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 30 °F
Sample No. (FIELDSAMPID): 5-78-91
Sample Date: 11/12/14
Sample Time: 1550
Sampler (s): Chris Duncan
Sample Beg. Depth (ft BTOC): 21.90
Sample Ending Depth (ft BTOC): 18.90
Sample Collection Method: ☒Discharge Tube ☐Other (explain):
Approximate Volume of Excess Sample Water After Sampling (ml): 200 mL
Excess Sample Water Placed in Container: Y/N [Y]
Container Number: PARSNZ1430702
SWL Following Sampling (ft BTOC): 11.29
Sample Equipment Decon Date: 11-13-14 by: CCD
Decon Water Placed in Drum: Y/N [Y]
Drum Number: PARSNZ1430702
Prepared by: Chris Duncan Date: 11/12/14
Reviewed by: Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125. 04000	Well LOCID: S-91-91	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/10/14 Time: 1450	Weather: Wind Dir: S , at ~10 mph; Air Temp: 43 °F	
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]	Comments:	
PID SN:	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 9.98	Measured Well Depth (ft BTOC): 25.99	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 22.99
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-91-91	Hydrasleeve Retrieval Date: 11-12-14	Retrieval Time: 1620
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none	Air Temperature: 25 °F	
Sample No. (FIELDSAMPID): S-91-91	Sample Date: 11/12/14	Sample Time: 1620
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 22.99	Sample Ending Depth (ft BTOC): 18.99
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 600		
Excess Sample Water Placed in Container: Y/N [Y]	Container Number: PARSNZ1430702	
SWL Following Sampling (ft BTOC): 10.01	Sample Equipment Decon Date: 11-13-14 by: CLD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11/12/14	Reviewed by:	Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125. 04000	Well LOCID: S-81-91	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s):	
HS Deployment Date: 11 /10/14 Time: 1530	Weather: Wind Dir: S , at ~10 mph; Air Temp: 43 °F	
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]	Comments:	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 13.59	Measured Well Depth (ft BTOC): 25.38	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 22.38
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-81-91	Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1650	
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~10 mph; Precipitation: none Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): S-81-91	Sample Date: 11 /12/ 14	Sample Time: 1650
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 22.38	Sample Ending Depth (ft BTOC): 18.38
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 600		
Excess Sample Water Placed in Container: Y/N [Y]	Container Number: PARSNZ1430702	
SWL Following Sampling (ft BTOC): 13.60	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11 /12 /14	Reviewed by: Date: / /	

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: 5-25-88	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/10/14 Time: 1300	Weather: Wind Dir: S , at ~10 mph; Air Temp: 40°F	
Well Labeled: Y/N [N] Well Secure: Y/N [N]	Comments: newly installed completion	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	

SWL (ft BTOC): 14.79	Measured Well Depth (ft BTOC): 22.05	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,800	Depth to top of sleeve (ft BTOC): 19.05
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-25-88	Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time:	
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~ 10 mph; Precipitation: none Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): 5-25-88	Sample Date: 11/12/14	Sample Time: 1000
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 19.05	Sample Ending Depth (ft BTOC): 15.05
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 0		
Excess Sample Water Placed in Container: Y/N [N]	Container Number: -	
SWL Following Sampling (ft BTOC): 15.41	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSN21430702	
Prepared by: Chris Duncan Date: 11/12/14	Reviewed by: Date: / /	

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: 5-25-88	
Installation: TEAD-S	Log Book No. 1	Pages: 59
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/12/14 Time: 1005	Weather: Wind Dir: S , at ~10mph; Air Temp: 25°F	
Well Labeled: Y/N [N] Well Secure: Y/N [N]	Comments: newly installed aboveground completi	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 15.41	Measured Well Depth (ft BTOC): 22.05	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒ Polypropylene Rope ☐ Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 19.05
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-25-88	Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1005	
Log Book No. 1	Pages: 60	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 26 °F		
Sample No. (FIELDSAMPID): 5-25-88	Sample Date: 11/13/14	Sample Time: 1005
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 19.05	Sample Ending Depth (ft BTOC): 15.05
Sample Collection Method: ☒ Discharge Tube ☐ Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 800		
Excess Sample Water Placed in Container: Y/N [Y]	Container Number: PARSNZ1430702	
SWL Following Sampling (ft BTOC): 15.42	Sample Equipment Decon Date: 11-13-14 by: CLD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11/13/14	Reviewed by: Date: / /	

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: 513-CAM-DW1	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/10/14 Time: 1315	Weather: Wind Dir: S , at ~10 mph; Air Temp: 44°F	
Well Labeled: Y/N [N] Well Secure: Y/N [N]	Comments: Newly installed deep well	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	

SWL (ft BTOC): 13.64	Measured Well Depth (ft BTOC): 61.5	Reported Well Depth (ft BTOC): 61.5
Sediment Thickness (ft): 0	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: 8 oz (bottom)	Total Weight used (oz.): 8	
Sleeve bag length (in): 38	HS bag volume (ml): 1,300	Depth to top of sleeve (ft BTOC): 58.5
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 513-CAM-DW1	Hydrasleeve Retrieval Date: 11-12-14	Retrieval Time: 1040
Log Book No. 1	Pages: 59	

Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good

Weather: Wind Dir: S , at ~10 mph; Precipitation: none Air Temperature: 25 °F

Sample No. (FIELDSAMPID): 513-CAM-DW1	Sample Date: 11/12/14	Sample Time: 1040
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 58.5	Sample Ending Depth (ft BTOC): 55.5

Sample Collection Method: ☒Discharge Tube ☐Other (explain):

Approximate Volume of Excess Sample Water After Sampling (ml): 0

Excess Sample Water Placed in Container: Y/N [N]	Container Number: -
SWL Following Sampling (ft BTOC): 13.65	Sample Equipment Decon Date: 11-13-14 by: CCD
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702
Prepared by: Chris Duncan Date: 11/12/14	Reviewed by: Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000 | Well LOCID: 513-CAM-DW1

Installation: TEAD-S | Log Book No. 1 | Pages: 59

Contractor: Parsons | Sampler(s): Chris Duncan

HS Deployment Date: 11/12/14 Time: 1050 | Weather: Wind Dir: S, at ~ 10 mph; Air Temp: 25°F

Well Labeled: Y/N [N] Well Secure: Y/N [N] | Comments: newly installed deep well

PID SN: 023460 | Well Headspace (PID mu): 0.0 ppm Odor: none

Water Level Instrument: Solinst 122 | Serial No.: 014019

SWL (ft BTOC): 13.65 | Measured Well Depth (ft BTOC): 61.5 | Reported Well Depth (ft BTOC): 61.5

Sediment Thickness (ft): 0 | Number of Hydrasleeves deployed in well: 1 | Tether Line Material: ☒Polypropylene Rope ☐Stainless steel

Type of Tether Weight: Bottom weight | Total Weight used (oz.): 8

Sleeve bag length (in): 38 | HS bag volume (ml): 1,300 | Depth to top of sleeve (ft BTOC): 58.5

Bottom Weighted: Y/N [Y] | Top Weighted: Y/N [N]

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 513-CAM-DW1 | Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1215

Log Book No. 1 | Pages: 60

Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good.

Weather: Wind Dir: S, at ~ 5 mph; Precipitation: snow Air Temperature: 25 °F

Sample No. (FIELDSAMPID): 513-CAM-DW1 | Sample Date: 11/13/14 | Sample Time: 1215

Sampler (s): Chris Duncan | Sample Beg. Depth (ft BTOC): 58.5 | Sample Ending Depth (ft BTOC): 54.5

Sample Collection Method: ☒Discharge Tube ☐Other (explain):

Approximate Volume of Excess Sample Water After Sampling (ml): 0

Excess Sample Water Placed in Container: Y/N [N] | Container Number: -

SWL Following Sampling (ft BTOC): 13.65 | Sample Equipment Decon Date: 11-13-14 by: CCD

Decon Water Placed in Drum: Y/N [Y] | Drum Number: PARSN21430702

Prepared by: Chris Duncan Date: 11/13/14 | Reviewed by: Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: 5-26-88	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11 /10/14 Time: 1345	Weather: Wind Dir: S , at ~10 mph; Air Temp: 43°F	
Well Labeled: Y/N [N] Well Secure: Y/N [N]	Comments: newly installed above ground completion	
PID SN: 023460	Well Headspace (PID mu): 0.0ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 14.91	Measured Well Depth (ft BTOC): 23.30	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 20.30
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-26-88	Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1115	
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~ 10 mph; Precipitation: none Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): 5-26-88	Sample Date: 11 /12/ 14	Sample Time: 1115
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 20.30	Sample Ending Depth (ft BTOC): 16.30
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 0		
Excess Sample Water Placed in Container: Y/N [N]	Container Number: –	
SWL Following Sampling (ft BTOC): 14.93	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11 /12/14	Reviewed by: Date: / /	

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125 | Well LOCID: 5-26-88

Installation: TEAD-S | Log Book No. 1 | Pages: 59

Contractor: Parsons | Sampler(s): Chris Duncan

HS Deployment Date: 11/12/14 Time: 1125 | Weather: Wind Dir: S , at ~ 10 mph; Air Temp: 25°F

Well Labeled: Y/N [N] Well Secure: Y/N [N] | Comments: newly installed aboveground completion

PID SN: 023460 | Well Headspace (PID mu): 0.0 ppm Odor: none

Water Level Instrument: Solinst 122 | Serial No.: 014019

SWL (ft BTOC): 14.93 | Measured Well Depth (ft BTOC): 23.30 | Reported Well Depth (ft BTOC):

Sediment Thickness (ft): | Number of Hydrasleeves deployed in well: 1 | Tether Line Material: ☒ Polypropylene Rope ☐ Stainless steel

Type of Tether Weight: Bottom weight Total Weight used (oz.): 5

Sleeve bag length (in): 30 | HS bag volume (ml): 1,600 | Depth to top of sleeve (ft BTOC): 20.30

Bottom Weighted: Y/N [Y] Top Weighted: Y/N [N]

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-26-88 | Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1125

Log Book No. 1 | Pages: 60

Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good

Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 30 °F

Sample No. (FIELDSAMPID): 5-26-88 | Sample Date: 11/13/14 | Sample Time: 1125

Sampler (s): Chris Duncan | Sample Beg. Depth (ft BTOC): 20.30 | Sample Ending Depth (ft BTOC): 16.30

Sample Collection Method: ☒ Discharge Tube ☐ Other (explain):

Approximate Volume of Excess Sample Water After Sampling (ml): 600

Excess Sample Water Placed in Container: Y/N [Y] | Container Number: PARSNZ1430702

SWL Following Sampling (ft BTOC): 14.93 | Sample Equipment Decon Date: 11-13-14 by: CCD

Decon Water Placed in Drum: Y/N [Y] | Drum Number: PARSNZ1430702

Prepared by: Chris Duncan Date: 11/13/14 | Reviewed by: Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125. 04000

Well LOCID: 5-29-88

Installation: TEAD-S

Log Book No. 1

Pages: 58

Contractor: Parsons

Sampler(s):

HS Deployment Date: 11 /10/ 14 Time: 1410

Weather: Wind Dir: S , at ~10 mph; Air Temp: 43°F

Well Labeled: Y/N [Y] Well Secure: Y/N [Y]

Comments:

PID SN: 023460

Well Headspace (PID mu): 0.0 ppm Odor: none

Water Level Instrument: Solinst 122

Serial No.: 014019

SWL (ft BTOC): 11.94

Measured Well Depth (ft BTOC): 20.30

Reported Well Depth (ft BTOC):

Sediment Thickness (ft):

Number of Hydrasleeves deployed in well: 1

Tether Line Material: ☒Polypropylene Rope ☐Stainless steel

Type of Tether Weight: Bottom weight Total Weight used (oz.): 5

Sleeve bag length (in): 30

HS bag volume (ml): 1,600

Depth to top of sleeve (ft BTOC): 17.30

Bottom Weighted: Y/N [Y] Top Weighted: Y/N [N]

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-29-88

Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1250

Log Book No. 1

Pages: 59

Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good

Weather: Wind Dir: S , at ~ 10 mph; Precipitation: none Air Temperature: 25 °F

Sample No. (FIELDSAMPID): 5-29-88

Sample Date: 11 /12/ 14

Sample Time: 1250

Sampler (s): Chris Duncan

Sample Beg. Depth (ft BTOC): 17.30

Sample Ending Depth (ft BTOC): 13.30

Sample Collection Method: ☒Discharge Tube ☐Other (explain):

Approximate Volume of Excess Sample Water After Sampling (ml): 0

Excess Sample Water Placed in Container: Y/N [N]

Container Number: -

SWL Following Sampling (ft BTOC): 11.95

Sample Equipment Decon Date: 11-13-14 by: CCD

Decon Water Placed in Drum: Y/N [Y]

Drum Number: PARSNZ1430702

Prepared by: Chris Duncan Date: 11 / 12 / 14

Reviewed by: Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: 5-29-88	
Installation: TEAD-S	Log Book No. 1	Pages: 59
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/12/14 Time: 1300	Weather: Wind Dir: S , at ~10 mph; Air Temp: 25°F	
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]	Comments:	
PID SN: 023460	Well Headspace (PID mu): 0.0ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 11.95	Measured Well Depth (ft BTOC): 20.30	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒ Polypropylene Rope ☐ Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 17.30
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-29-88	Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1320	
Log Book No. 1	Pages: 60	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good.		
Weather: Wind Dir: S , at ~ 5 mph; Precipitation: snow Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): 5-29-88	Sample Date: 11/13/14	Sample Time: 1320
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 17.30	Sample Ending Depth (ft BTOC): 13.30
Sample Collection Method: ☒ Discharge Tube ☐ Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 800		
Excess Sample Water Placed in Container: Y/N [Y]	Container Number: PARSNZ1430702	
SWL Following Sampling (ft BTOC): 11.95	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11/13/14	Reviewed by:	Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125. 04000	Well LOCID: 5-82-91	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11 /10/ 14 Time: 1510	Weather: Wind Dir: S , at ~10 mph; Air Temp: 43°F	
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]	Comments:	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 13.20	Measured Well Depth (ft BTOC): 25.70	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 22.70
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-82-91	Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1330	
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): 5-82-91	Sample Date: 11 /12 /14	Sample Time: 1330
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 22.70	Sample Ending Depth (ft BTOC): 18.70
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 0		
Excess Sample Water Placed in Container: Y/N [N]	Container Number: -	
SWL Following Sampling (ft BTOC): 13.20	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: ParsNA1430702	
Prepared by: Chris Duncan Date: 11 /12 /14	Reviewed by: Date: / /	

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: 5-82-91	
Installation: TEAD-S	Log Book No. 1	Pages: 59
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/12/14 Time: 1345	Weather: Wind Dir: S , at ~ 5 mph; Air Temp: 25°F	
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]	Comments:	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 13.20	Measured Well Depth (ft BTOC): 25.70	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒ Polypropylene Rope ☐ Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 22.70
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-82-91	Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1345	
Log Book No. 1	Pages: 60	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good.		
Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 30 °F		
Sample No. (FIELDSAMPID): 5-82-91	Sample Date: 11/13/14	Sample Time: 1345
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 22.70	Sample Ending Depth (ft BTOC): 18.70
Sample Collection Method: ☒ Discharge Tube ☐ Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 800		
Excess Sample Water Placed in Container: Y/N [Y]	Container Number: PARSNZ1430702	
SWL Following Sampling (ft BTOC): 13.20	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11/13/14	Reviewed by: Date: / /	

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: S-55-90	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s):	
HS Deployment Date: 11/10/14 Time: 1545	Weather: Wind Dir: S , at ~10 mph; Air Temp: 43°F	
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]	Comments:	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 11.27	Measured Well Depth (ft BTOC): 20.91	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom Weight	Total Weight used (oz.): 5	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 17.91
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-55-90	Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1200	
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good.		
Weather: Wind Dir: S , at ~ 10 mph; Precipitation: none Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): S-55-90, S-55-90FD	Sample Date: 11/12/14	Sample Time: 1200
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 17.91	Sample Ending Depth (ft BTOC): 13.91
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 0		
Excess Sample Water Placed in Container: Y/N [N]	Container Number: -	
SWL Following Sampling (ft BTOC): 11.33	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11/12/14	Reviewed by: Date: / /	

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000
Well LOCID: S-55-90
Installation: TEAD-S
Log Book No. 1
Pages: 59
Contractor: Parsons
Sampler(s): Chris Duncan
HS Deployment Date: 11/12/14 Time: 1220
Weather: Wind Dir: S, at ~10 mph; Air Temp: 25°F
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]
Comments:
PID SN: 023460
Well Headspace (PID mu): 0.0 ppm Odor: none
Water Level Instrument: Solinst 122
Serial No.: 014019
SWL (ft BTOC): 11.33
Measured Well Depth (ft BTOC): 20.91
Reported Well Depth (ft BTOC):
Sediment Thickness (ft):
Number of Hydrasleeves deployed in well: 1
Tether Line Material: ☒ Polypropylene Rope ☐ Stainless steel
Type of Tether Weight: Bottom weight
Total Weight used (oz.): 5
Sleeve bag length (in): 30
HS bag volume (ml): 1,600
Depth to top of sleeve (ft BTOC): 17.91
Bottom Weighted: Y/N [Y]
Top Weighted: Y/N [N]

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-55-90
Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1300
Log Book No. 1
Pages: 60
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good.

Weather: Wind Dir: S, at ~ 5 mph; Precipitation: snow Air Temperature: 25 °F
Sample No. (FIELDSAMPID): S-55-90, S-55-90FD
Sample Date: 11/13/14
Sample Time: 1300
Sampler (s): Chris Duncan
Sample Beg. Depth (ft BTOC): 17.91
Sample Ending Depth (ft BTOC): 13.91
Sample Collection Method: ☒ Discharge Tube ☐ Other (explain):
Approximate Volume of Excess Sample Water After Sampling (ml): 600
Excess Sample Water Placed in Container: Y/N [Y]
Container Number: PARSNZ1430702
SWL Following Sampling (ft BTOC): 11.33
Sample Equipment Decon Date: 11-13-14 by: CCD
Decon Water Placed in Drum: Y/N [Y]
Drum Number: PARSNZ1430702
Prepared by: Chris Duncan Date: 11/13/14
Reviewed by: Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125. 04000	Well LOCID: S-CAM-2	
Installation: TEAD-S	Log Book No. 1	Pages:
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/10/14 Time: 1610	Weather: Wind Dir: S , at ~10 mph; Air Temp: 43°F	
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]	Comments:	
PID SN:	Well Headspace (PID mu): 0.1 ppm Odor: yes	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 14.26	Measured Well Depth (ft BTOC): 26.20	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom Weight	Total Weight used (oz.): 8	
Sleeve bag length (in): 38	HS bag volume (ml): 1,300	Depth to top of sleeve (ft BTOC): 10.26
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-CAM-2	Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1410	
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): S-CAM-2	Sample Date: 11/12/14	Sample Time: 1410
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 22.20 ~~10.26~~ CCD	Sample Ending Depth (ft BTOC): 18.20 ~~7.26~~ CCD
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 0		
Excess Sample Water Placed in Container: Y/N [N]	Container Number: –	
SWL Following Sampling (ft BTOC): 14.25	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ14307O2	
Prepared by: Chris Duncan Date: 11/12/14	Reviewed by: Date: / /	

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000
Well LOCID: S-CAM-2
Installation: TEAD-S
Log Book No. 1
Pages: 59
Contractor: Parsons
Sampler(s): Chris Duncan
HS Deployment Date: 11/12/14 Time: 1420
Weather: Wind Dir: S , at ~ 5 mph; Air Temp: 25°F
Well Labeled: Y/N [Y] Well Secure: Y/N [Y]
Comments:
PID SN: 023460
Well Headspace (PID mu): 1.2 ppm Odor: yes
Water Level Instrument: Solinst 122
Serial No.: 014019
SWL (ft BTOC): 14.25
Measured Well Depth (ft BTOC): 26.20
Reported Well Depth (ft BTOC):
Sediment Thickness (ft):
Number of Hydrasleeves deployed in well: 1
Tether Line Material: ☒ Polypropylene Rope ☐ Stainless steel
Type of Tether Weight: Bottom weight
Total Weight used (oz.): 8
Sleeve bag length (in): 38
HS bag volume (ml): 1,300
Depth to top of sleeve (ft BTOC): 22.20
Bottom Weighted: Y/N [Y]
Top Weighted: Y/N [N]

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-CAM-2
Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1420
Log Book No. 1
Pages: 60
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good.

Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 30 °F
Sample No. (FIELDSAMPID): S-CAM-2
Sample Date: 11/13/14
Sample Time: 1420
Sampler (s): Chris Duncan
Sample Beg. Depth (ft BTOC): 22.20
Sample Ending Depth (ft BTOC): 18.20
Sample Collection Method: ☒ Discharge Tube ☐ Other (explain):
Approximate Volume of Excess Sample Water After Sampling (ml): 0
Excess Sample Water Placed in Container: Y/N [N]
Container Number: –
SWL Following Sampling (ft BTOC): 14.31
Sample Equipment Decon Date: 11-13-14 by: CCD
Decon Water Placed in Drum: Y/N [Y]
Drum Number: PARSNZ1430702
Prepared by: Chris Duncan Date: 11/13/14
Reviewed by:
Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: S-CAM-1	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/10/14 Time: 1630	Weather: Wind Dir: S , at ~10 mph; Air Temp: 43°F	
Well Labeled: Y/N [Y] Well Secure: Y/N [N]	Comments: newly installed aboveground completion	
PID SN:	Well Headspace (PID mu): 3.6 Odor: yes	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): DTP=15.05 DTW=16.06	Measured Well Depth (ft BTOC): 25.85	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒ Polypropylene Rope ☐ Stainless steel
Type of Tether Weight: Bottom weight	Total Weight used (oz.): 8	
Sleeve bag length (in): 38	HS bag volume (ml): 1,300	Depth to top of sleeve (ft BTOC): 21.85
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-CAM-1	Hydrasleeve Retrieval Date: 11-12-14 Retrieval Time: 1440	
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): S-CAM-1	Sample Date: 11/12/14	Sample Time: 1440
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 21.85	Sample Ending Depth (ft BTOC): 17.85
Sample Collection Method: ☒ Discharge Tube ☐ Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 0		
Excess Sample Water Placed in Container: Y/N [N]	Container Number: –	
SWL Following Sampling (ft BTOC): 16.10	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11/12/14	Reviewed by:	Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: S-CAM-1	
Installation: TEAD-S	Log Book No. 1	Pages: 59
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/12/14 Time: 1450	Weather: Wind Dir: , at ~___mph; Air Temp: °F	
Well Labeled: Y/N [N] Well Secure: Y/N [N]	Comments: newly installed aboveground completion	
PID SN: 023460	Well Headspace (PID mu): 3.8 ppm Odor: yes	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 16.10	Measured Well Depth (ft BTOC): 25.85	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well:	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Bottom Weight	Total Weight used (oz.): 8	
Sleeve bag length (in): 38	HS bag volume (ml): 1,300	Depth to top of sleeve (ft BTOC): 21.85
Bottom Weighted: Y/N [Y]	Top Weighted: Y/N [N]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-CAM-1	Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1450	
Log Book No. 1	Pages: 60	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S , at ~ 5 mph; Precipitation: snow Air Temperature: 25 °F		
Sample No. (FIELDSAMPID): S-CAM-1	Sample Date: 11/13/14	Sample Time: 1450
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 21.85	Sample Ending Depth (ft BTOC): 17.85
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 600		
Excess Sample Water Placed in Container: Y/N [Y]	Container Number: PARSNZ1430702	
SWL Following Sampling (ft BTOC): 16.11	Sample Equipment Decon Date: 11-13-14 by: CCO	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11/13/14	Reviewed by: Date: / /	

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125.04000	Well LOCID: S-87-91	
Installation: TEAD-S	Log Book No. 1	Pages: 58
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/10/14 Time: 1645	Weather: Wind Dir: , at ~___mph; Air Temp: °F	
Well Labeled: Y/N [N] Well Secure: Y/N [N]	Comments: newly installed aboveground completion	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	
SWL (ft BTOC): 16.62	Measured Well Depth (ft BTOC): 18.05	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Top weight	Total Weight used (oz.): 8	
Sleeve bag length (in): 30	HS bag volume (ml): 1,600	Depth to top of sleeve (ft BTOC): 17.95
Bottom Weighted: Y/N [N]	Top Weighted: Y/N [Y]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: S-87-91	Hydrasleeve Retrieval Date: 11-12-14	Retrieval Time: 1140
Log Book No. 1	Pages: 59	
Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:		
Comments on Well and Hydrasleeve Tether Assembly Condition: Good		
Weather: Wind Dir: S, at ~10 mph; Precipitation: none	Air Temperature: 25 °F	
Sample No. (FIELDSAMPID): S-87-91	Sample Date: 11/12/14	Sample Time:
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 18.00	Sample Ending Depth (ft BTOC): 16.62
Sample Collection Method: ☒Discharge Tube ☐Other (explain):		
Approximate Volume of Excess Sample Water After Sampling (ml): 0		
Excess Sample Water Placed in Container: Y/N [N]	Container Number: –	
SWL Following Sampling (ft BTOC): 16.62	Sample Equipment Decon Date: 11-13-14 by: CCD	
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSNZ1430702	
Prepared by: Chris Duncan Date: 11/12/14	Reviewed by:	Date: / /

ATTACHMENT 5-2

HYDRASLEEVE SAMPLE LOG

HYDRASLEEVE DEPLOYMENT

Project No.: 749125. 04000	Well LOCID: 5-87-91	
Installation: TEAD-S	Log Book No. 1	Pages: 59
Contractor: Parsons	Sampler(s): Chris Duncan	
HS Deployment Date: 11/12/14 Time: 1150	Weather: Wind Dir: S , at ~ 10 mph; Air Temp: 25°F	
Well Labeled: Y/N [N] Well Secure: Y/N [N]	Comments: newly installed aboveground completion	
PID SN: 023460	Well Headspace (PID mu): 0.0 ppm Odor: none	
Water Level Instrument: Solinst 122	Serial No.: 014019	

SWL (ft BTOC): 16.62	Measured Well Depth (ft BTOC): 18.05	Reported Well Depth (ft BTOC):
Sediment Thickness (ft):	Number of Hydrasleeves deployed in well: 1	Tether Line Material: ☒Polypropylene Rope ☐Stainless steel
Type of Tether Weight: Top weight	Total Weight used (oz.): 8	
Sleeve bag length (in): 30	HS bag volume (ml): 1,800	Depth to top of sleeve (ft BTOC): 17.95
Bottom Weighted: Y/N [N]	Top Weighted: Y/N [Y]	

HYDRASLEEVE RETRIEVAL AND SAMPLE

Well LOCID: 5-87-91	Hydrasleeve Retrieval Date: 11-13-14 Retrieval Time: 1150
Log Book No. 1	Pages: 60

Was ALL Deployed Equipment Retrieved (Line, Bags, Weights): Y/N [Y] if NO, Explain:

Comments on Well and Hydrasleeve Tether Assembly Condition: Good

Weather: Wind Dir: S , at ~ 5 mph; Precipitation: none Air Temperature: 30 °F

Sample No. (FIELDSAMPID): 5-87-91	Sample Date: 11/13/14	Sample Time: 1150
Sampler (s): Chris Duncan	Sample Beg. Depth (ft BTOC): 17.95	Sample Ending Depth (ft BTOC): 16.63

Sample Collection Method: ☒Discharge Tube ☐Other (explain):

Approximate Volume of Excess Sample Water After Sampling (ml): 0

Excess Sample Water Placed in Container: Y/N [N]	Container Number: –
SWL Following Sampling (ft BTOC): 17.01	Sample Equipment Decon Date: 11-13-14 by: CCD
Decon Water Placed in Drum: Y/N [Y]	Drum Number: PARSN214307-02
Prepared by: Chris Duncan Date: 11/13/14	Reviewed by: Date: / /

APPENDIX E

APPLICATION FOR INSTALLATION OF MONITORING WELL S13-CAM-DW1

REQUEST FOR NON-PRODUCTION WELL CONSTRUCTION

UTAH DIVISION OF WATER RIGHTS

(for wells deeper than 30 feet)

Well Type (check one):

Test ( ) Monitoring (X) Cathodic Protection ( ) Closed Loop Heat Exchange* ( )

Piezometer ( ) Inclinometer ( ) Dewatering ( ) Other

This form cannot be used for open loop heat exchange wells. A non-consumptive use water right application must be filed for open loop heat exchange wells.

Applicant/Owner Name: Tooele Army Depot-South

Mailing Address: JMTE-GME-ENV, Building 5119, 1 Tooele Army Depot, Tooele UT 84074-5000

Project Address: CAMDS Facility, SWMU 13/30

Contact Person: Troy Johnson Phone: 435-830-5493

Proposed Start Date: 10-28-2014 Anticipated Completion Date: 10-30-2014

Well Driller Name & License #: Shawn Steiner 745 Proposed # of Wells: 1

PROPOSED LOCATION OF WELLS: County: Tooele Area: TEAD-South

[✓ NO]/SO. DISTANCE (feet)	EAST/WEST DISTANCE (feet)	SECTION CORNER	SECTION	TOWNSHIP	RANGE	BASE	DIAMETER (inches)	DEPTH (feet)	PROPERTY PARCEL NUMBER
40°17'12.44"	112°22'5.38"	NE NE	23	6S	5W	SL	4	120	Tooele Army Depot South

Use back of form or additional paper if more room is needed. If providing well locations in latitude/logitude or UTM coordinates, please also provide the map datum used (e.g., NAD27, NAD83, WGS84, etc.). ***This form must be completed and signed by the owner/applicant and not by the licensed driller.***

EXPLANATORY: WGS 84 Map Datum used (Google Earth)

10-18-2014

Signature of Applicant *(attesting to completeness & accuracy)* Date

FOR OFFICE USE ONLY

Approved By: *Approval Date:* *Non-Production Well No.:*

1896

GARY R. HERBERT
Governor
SPENCER J. COX
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCES
Division of Water Rights

MICHAEL R. STYLER
Executive Director

KENT L. JONES
State Engineer/Division Director

October 27, 2014

TOOELE ARMY DEPOT SOUTH
C/O TROY JOHNSON
JMTE-GME-ENV, BLD 5119
TOOELE, UT 84074-8000

Dear Applicant:

RE: MONITOR WELL#: 1415003M00

Regarding your request to drill **1 MONITOR WELL(S),** the anticipated drilling depths will exceed the minimum regulated and reporting depth of 30 feet, thereby requiring permission from the Division of Water Rights to proceed with this project.

The specifications outlined in your well project request dated October 22, 2014, meet the State Engineer's requirements and permission is **HEREBY GRANTED.** Therefore, this letter is your authorization to proceed with the construction of the well(s) in accordance with those specifications and with respect to the following provisions:

1) Small diameter casing is to be used in the construction of the well(s) and no more water is to be diverted than is necessary to determine the quality of the groundwater by obtaining representative samples as required by the project.

2) The well(s) must be drilled by a currently licensed Utah driller and must be drilled in a manner consistent with the construction standards cited in the Utah State Administrative Rules for Well Drillers (R655-4 UAC).

3) The enclosed Driller (START) Card form must be given to the licensed driller for his submittal prior to commencing well construction. The other enclosed form is the 'Applicant Card.' It is **YOUR RESPONSIBILITY** to sign and return this Applicant Card form to our office upon well completion.

4) At such time as the well(s) are no longer utilized to monitor ground water or the intent of the project is terminated, the well(s) must be permanently abandoned in a manner consistent with the Administrative Rules (R655-4 UAC).

5) **THIS PERMIT MAY NOT BE THE ONLY AUTHORIZATION NEEDED TO DRILL A WELL.** The applicant is responsible for obtaining other permits/authorizations from federal agencies, other state agencies, and/or local jurisdictions as applicable. Moreover, if the applicant is not the landowner, it is the applicant's responsibility to ensure that approvals/permissions have been obtained to trespass and drill a well(s) on the property. **THIS PERMIT DOES NOT GIVE AUTHORIZATION TO TRESPASS ON PRIVATE PROPERTY.**

NOTE: Please be aware that your permission to proceed with the drilling under this authorization expires April 27, 2015.

Sincerely,

Jim Goddard

Jim V. Goddard, P.G.
Well Drilling Program

1594 West North Temple, Suite 220, PO Box 146300, Salt Lake City, UT 84114-6300
telephone (801) 538-7240 • facsimile (801) 538-7467 • *www.waterrights.utah.gov*

DRILLER (START) CARD for MONITOR WELL#: 1415003M00

IMPORTANT: THIS CARD MUST BE RECEIVED BY THE DIVISION OF WATER RIGHTS PRIOR TO THE BEGINNING OF WELL CONSTRUCTION -- REQUIRED ONLY FOR WELLS DEEPER THAN 30 FT.

OWNER/APPLICANT NAME: TOOELE ARMY DEPOT SOUTH
MAILING ADDRESS: C/O TROY JOHNSON, JMTE-GME-ENV, BLD 5119, TOOELE, UT
PHONE NUMBER: 435-830-5493
WELL LOCATION: S 1207' W 908' from NE Cor, S23, T6S, R5W, SLB&M.
WELL UTM COORDINATES: Northing: 4460281 Easting: 383766
WELL ACTIVITY: NEW (X) REPAIR ( ) REPLACE ( ) ABANDON ( )
CLEAN ( ) DEEPEN ( )

For surface seals in unconsolidated formations (clay, silt, sand, and gravel), will you be using a temporary conductor casing or other formation stabilizer (e.g., drilling mud) in the surface seal interval to maintain the required annular space?

YES or NO (Circle one).

Answering 'NO' suggests that you will be placing the surface seal in an open and unstabilized annular space, which may require onsite inspection of seal placement by the State Engineer's Office.

PROPOSED START DATE: 10-30-2014

PROJECTED COMPLETION DATE: 11-3-2014

LICENSE #: ____________ LICENSEE/COMPANY: ConeTec

______________________________ ______________

Licensee Signature Date

NOTICE TO APPLICANT: THIS CARD IS TO BE GIVEN TO A UTAH LICENSED WATER WELL DRILLER FOR SUBMITTAL TO THE DIVISION OF WATER RIGHTS PRIOR TO WELL CONSTRUCTION.
STATE OF UTAH DIVISION OF WATER RIGHTS Phone No. 801-538-7416
Fax No. 801-538-7467

COMMENTS: ______________________________

APPLICANT CARD for MONITOR WELL#: 1415003M00

IMPORTANT: THIS CARD MUST BE COMPLETED, SIGNED AND RETURNED BY THE WELL OWNER/APPLICANT AS SOON AS THE WELL IS DRILLED BY A LICENSED UTAH WATER WELL DRILLER.

OWNER/APPLICANT NAME: TOOELE ARMY DEPOT SOUTH
MAILING ADDRESS: C/O TROY JOHNSON, JMTE-GME-ENV, BLD 5119, TOOELE, UT
PHONE NUMBER: 435-830-5493
WELL LOCATION: S 1207' W 908' from NE Cor, S23, T6S, R5W, SLB&M.
WELL UTM COORDINATES: Northing: 4460281 Easting: 383766
WELL ACTIVITY: NEW (X) REPAIR ( ) REPLACE ( ) ABANDON ( )
CLEAN ( ) DEEPEN ( )

WELL COMPLETION DATE: November 3, 2014

NAME OF DRILLING COMPANY/LICENSEE: ConeTec

11-3-2014

Owner/Applicant Signature Date

***COMPLETE, SIGN AND RETURN THIS PORTION UPON FINAL WELL COMPLETION -
DO NOT GIVE THIS CARD TO LICENSED WELL DRILLER - YOU MUST RETURN IT.
STATE OF UTAH DIVISION OF WATER RIGHTS Phone No. 801-538-7416
Fax No. 801-538-7467

COMMENTS:

START/APPLICANT CARD INSTRUCTIONS: First, for each well, you must give a Driller (Start) Card to the licensed driller with whom you contract to construct the well. Second, it is your responsibility to sign and return this Applicant Card to this office immediately after completion of the well. **CAUTION: There may be local health requirements for the actual siting of your well. Please check with the proper local authority before construction begins. See the enclosed sheet addressing construction information.**

APPENDIX F

MONITORING WELL S13-CAM-DW1 INSTALLATION DOCUMENTATION

Note: Appendix F contains the S13-CAM-DW1 Drillers Report, Cone Penetration Test (CPT) Report, Boring Log, and Development Log.

WELL DRILLER'S REPORT
State of Utah
Division of Water Rights

For additional space, use "Additional Well Data Form" and attach

Well Identification

Non-Production Well: 1415003M00 WIN: 438086

Owner *Note any changes*

TOOELE ARMY DEPOT SOUTH
C/O TROY JOHNSON
JMTE-GME-ENV, BLD 5119
TOOELE, UT 84074-8000

Contact Person/Engineer:

Well Location *Note any changes*

S 1207 W 908 from the NE corner of section 23, Township 6S, Range 5W, SL B&M

Location Description: (address, proximity to buildings, landmarks, ground elevation,local well #)

Drillers Activity Start Date: 10/30/14 Completion Date: 11/3/14

Check all that apply: ☒ New ☐ Repair ☐ Deepen ☐ Clean ☐ Replace ☐ Public Nature of Use: MONITOR WELL

If a replacement well, provide location of new well. ____ feet north/south and ____ feet east/west of the existing well.

DEPTH (feet) FROM	TO	BOREHOLE DIAMETER (in)	DRILLING METHOD	DRILLING FLUID
0	60	8	HOLLOW STEM AUGER	N/A

Well Log

DEPTH (feet) FROM	TO	WATER	PERMEABLE		UNCONSOLIDATED							CONSOLIDATED	COLOR	DESCRIPTION AND REMARKS (e.g., relative %, grain size, sorting, angularity, bedding, grain composition density, plasticity, shape, cementation, consistancy, water bearing, odor, fracturing, minerology, texture,degree of weathering, hardness, water quality, etc.)
			High	Low	CLAY	SILT	SAND	GRAVEL	COBBLES	BOULDER	OTHER	ROCK TYPE		
0	60				X	X	X							

Static Water Level

Date 11/7/14 Water Level 10.0 feet Flowing? ☐ Yes ☒ No

Method of Water Level Measurement TAPE If Flowing, Capped Pressure — PSI

Point to Which Water Level Measurement was Referenced GROUND Elevation —

Height of Water Level reference point above ground surface — feet Temperature ____ degrees ☐C ☐F

Construction Information

DEPTH (feet)		CASING			DEPTH (feet)		☒SCREEN ☐PERFORATIONS		☐OPEN BOTTOM
FROM	TO	CASING TYPE AND MATERIAL/GRADE	WALL THICK (in)	NOMINAL DIAM. (in)	FROM	TO	SCREEN SLOT SIZE OR PERF SIZE (in)	SCREEN DIAM. OR PERF LENGTH (in)	SCREEN TYPE OR NUMBER PERF (per round/interval)
0	54	PVC	SCH40	2	54	59	0.010	2	SCH.40

Well Head Configuration: 8" UPRIGHT

Access Port Provided? ☒Yes ☐No

Casing Joint Type: FLUSH THREADED

Perforator Used: N/A

Was a Surface Seal Installed? ☒Yes ☐No

Depth of Surface Seal: 52 feet

Drive Shoe? ☐Yes ☒No

Surface Seal Material Placement Method: TREMIE

Was a temporary surface casing used? ☒Yes ☐No If yes, depth of casing: 60 feet diameter: 8 inches

DEPTH (feet)		SURFACE SEAL / INTERVAL SEAL / FILTER PACK / PACKER INFORMATION		
FROM	TO	SEAL MATERIAL, FILTER PACK and PACKER TYPE and DESCRIPTION	Quantity of Material Used (if applicable)	GROUT DENSITY (lbs./gal., # bag mix, gal./sack etc.)
0	47	HS BENTONITE GROUT	400 #	50 #/14 GAL
47	52	1/4 BENTONITE PELLETS	100 #	82 pcf
52	60	10/20 SILICA SAND	350 #	120 pcf

Well Development and Well Yield Test Information

DATE	METHOD	YIELD	Units Check One GPM	CFS	DRAWDOWN (ft)	TIME PUMPED (hrs & min)

Pump (Permanent)

Pump Description:

Horsepower:

Pump Intake Depth: feet

Approximate Maximum Pumping Rate:

Well Disinfected upon Completion? ☐Yes ☐No

Comments

Description of construction activity, additional materials used, problems encountered, extraordinary Circumstances, abandonment procedures. *Use additional well data form for more space.*

Well Driller Statement

This well was drilled and constructed under my supervision, according to applicable rules and regulations, and this report is complete and correct to the best of my knowledge and belief.

Name CONETEC INC
(Person, firm, or Corporation) (Print or Type)

License No. 745

Signature
(Licensed Well Driller)

Date 11/15/14

ConeTec, Inc.
Geotechnical and Environmental Site Investigation Contractors
3750 West 500 South, Salt Lake City, UT 84104 ● PO Box 22082, Salt Lake City, UT 84122
Tel: (801) 973-3801 ● Fax: (801) 973-3802 ● Web: www.conetec.com ● Email: saltlakecity@conetec.com

November 11, 2014

Job No.: 14-52099

Mr. David Shank
Parsons
10235 South Jordan Gateway
Suite 300
South Jordan, UT 84095

Tel: (801) 572-5999
Fax: (801) 572-9069
Email: david.shank@parsons.com

Re: CPT Test Results
TEAD-S SWMU-13
Near Tooele, Utah

Dear Dave,

Per your request, we have completed the CPT investigation for the above referenced project. This report presents standard CPT plots and pore pressure dissipation plots in PDF format. Additionally, the CPT data, PPD data and some typical geotechnical interpretations from CPT data are provided in Excel format. The following table summarizes the CPT testing services completed at the site.

CPT Location	CPT Filename	CPT Depth (ft.)	PPD Depth (ft.)	PPD Duration (ft.)	Ueq (ft.)	Assumed Water Table (ft.)	Comments
CPT-01	14-52099_CP01	64.47	51.84	1500	42.0	9.8	Refusal
			56.43	400	45.7		
			64.47	6000	---		PPD Stopped by Client

All CPT testing was performed in accordance with ASTM D5778 and industry standard practices. A compression model electronic piezocone penetrometer, with a 15-cm^2 tip and a 225-cm^2 friction sleeve was used for all of the testing. The cone penetrometer is designed with an equal end area friction sleeve and a tip end area ratio of 0.80. At the beginning of the sounding, the cone was outfitted with a vacuum saturated, 6-mm thick, porous plastic pore pressure element that is located immediately behind the tip in the u_2 location. The coordinates shown on the plots are for location reference only and generally have an accuracy of ±30 feet and are referenced to the WGS84 Datum.

Many correlations have been developed for design parameters based on CPT data. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Assumptions have been made regarding soil unit weights, groundwater level and interpretational methods, which may or may not apply to this site. The water table value used in the CPT interpretations was based on the results of the shallowest pore pressure dissipation test in each sounding. Additionally, the following table summarizes the values assigned to the specific soil behavior type zones that are used in the interpretations.

Zone	SPT qt/N	Unit Wt. (kN/m^3)	Unit Wt. (pcf)	Drainage Condition	Description
0	1.0	18.46	117.5	Neither	Undefined
1	2.0	17.5	111.4	Undrained	Sensitive Fines
2	1.0	12.5	79.6	Undrained	Organic Soil
3	1.0	17.5	111.4	Undrained	Clay
4	1.5	18.0	114.6	Undrained	Silty Clay
5	2.0	18.0	114.6	Undrained	Clayey Silt
6	2.5	18.0	114.6	Both	Silt
7	3.0	18.5	117.8	Drained	Sandy Silt
8	4.0	19.0	120.9	Drained	Silty Sand/Sand
9	5.0	19.5	124.1	Drained	Sand
10	6.0	20.0	127.3	Drained	Gravelly Sand
11	1.0	20.5	130.5	Drained	Stiff Fine Grained
12	2.0	19.0	120.9	Drained	Cemented Sand

We appreciate the opportunity of providing these services to you. If you have any questions regarding the enclosed material or if, we can be of additional assistance, please contact us.

Sincerely,

ConeTec, Inc.

Raymond Parkhurst

Raymond Parkhurst
Field Operations Manager

Reviewed By:

Shawn Steiner

Shawn D. Steiner, P.E.
Regional Manager

Enclosures

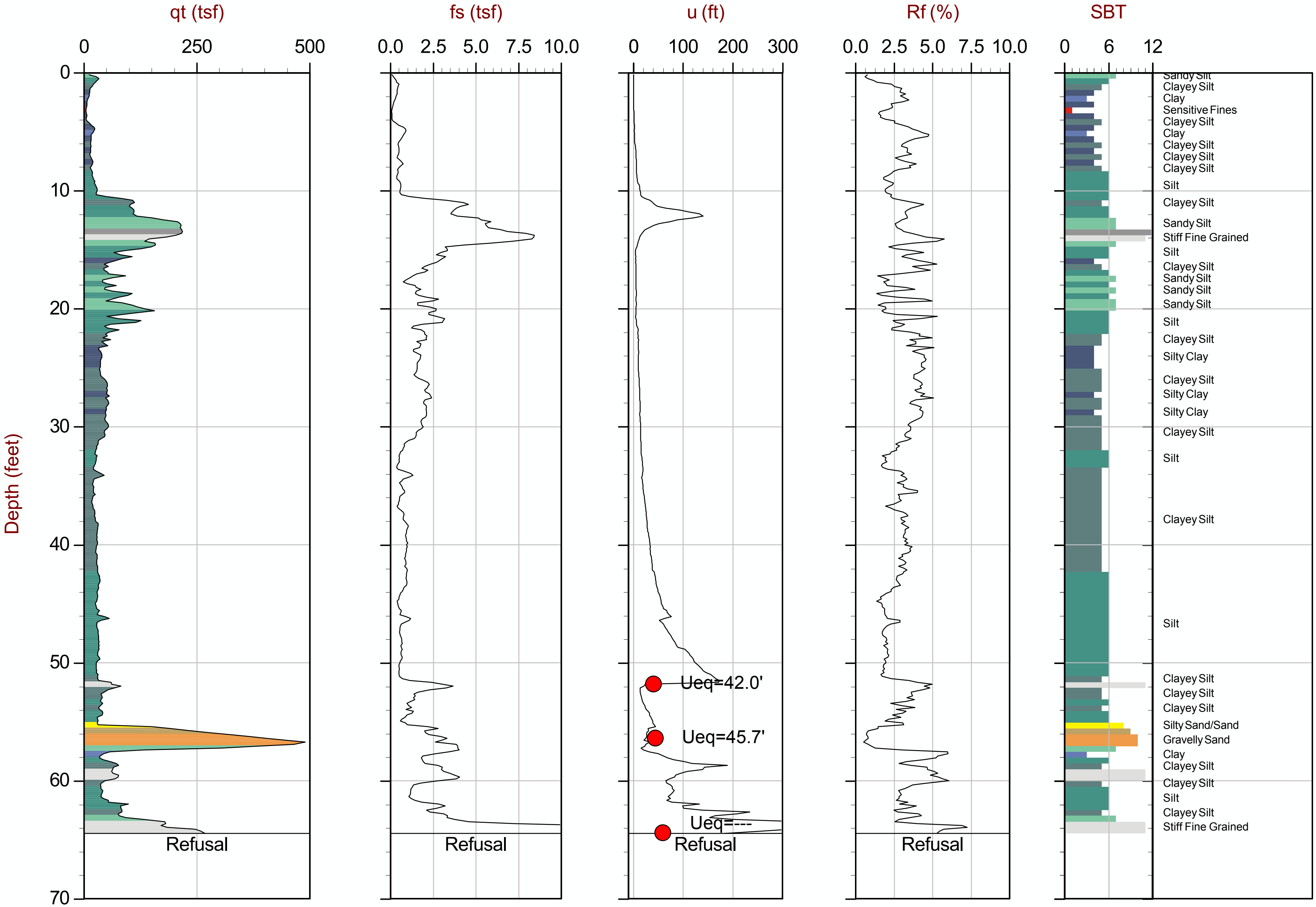
CPT Plots

CONETEC

Parsons

Job No: 14-52099
Date: 10:30:14 09:14
Site: TEAD-S-SWMU-13

Sounding: CPT-01
Cone: 420:T1500F15U500



Max Depth: 19.650 m / 64.47 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.150 m

File: 14-52099_CP01.COR
Unit Wt: SBT Chart Soil Zones

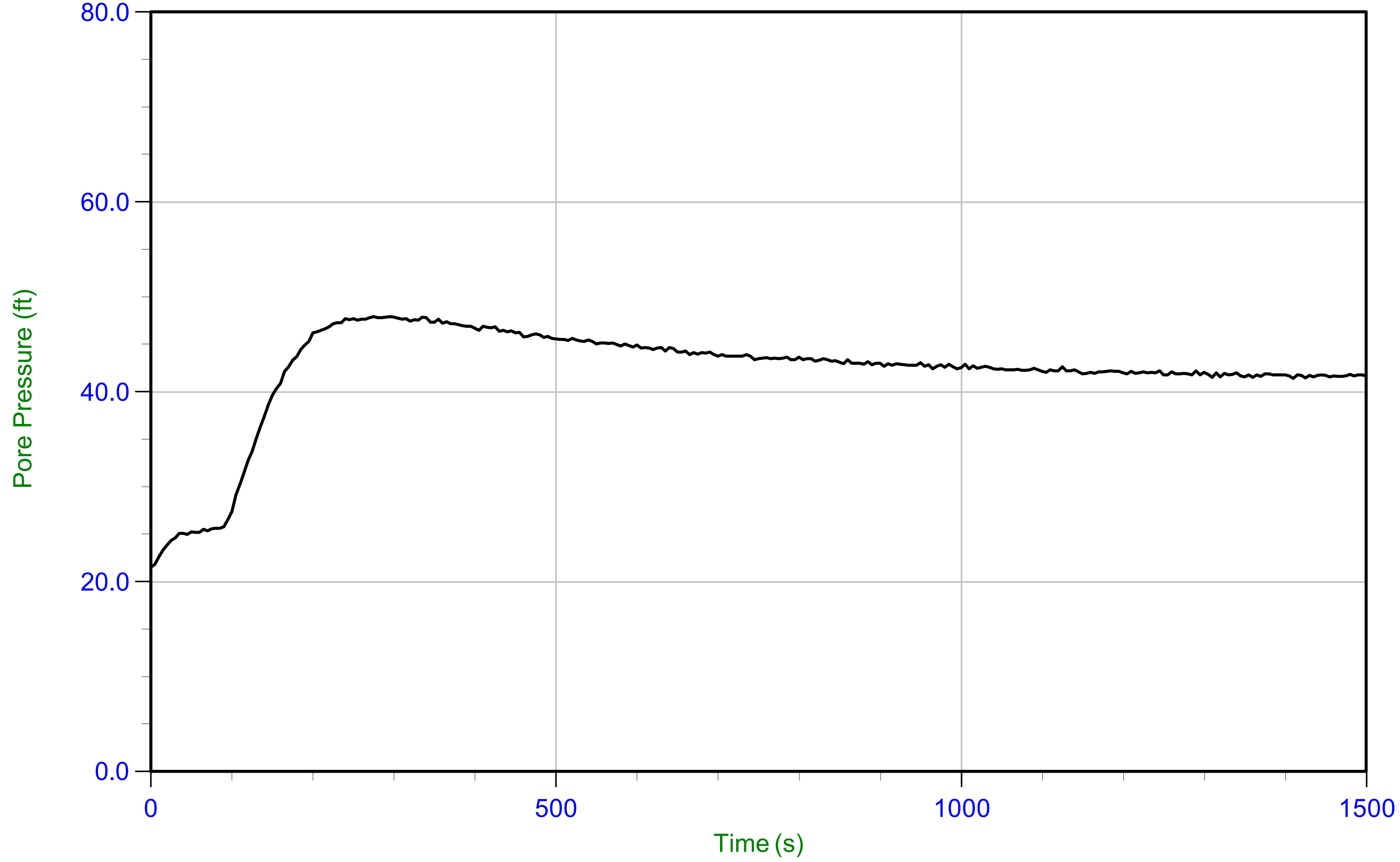
SBT: Lunne, Robertson and Powell, 1997
Coords: Lat: 40.286770 Long: -112.368230
● Equilibrium Pore Pressure from Dissipation

PPD Plots

Parsons

Job No: 14-52099
Date: 30-Oct-2014 09:14:21
Site: TEAD-S-SWMU-13

Sounding: CPT-01
Cone: 420
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-52099_CP01.PPD
Depth: 15.800 m / 51.837 ft
Duration: 1500.0 s

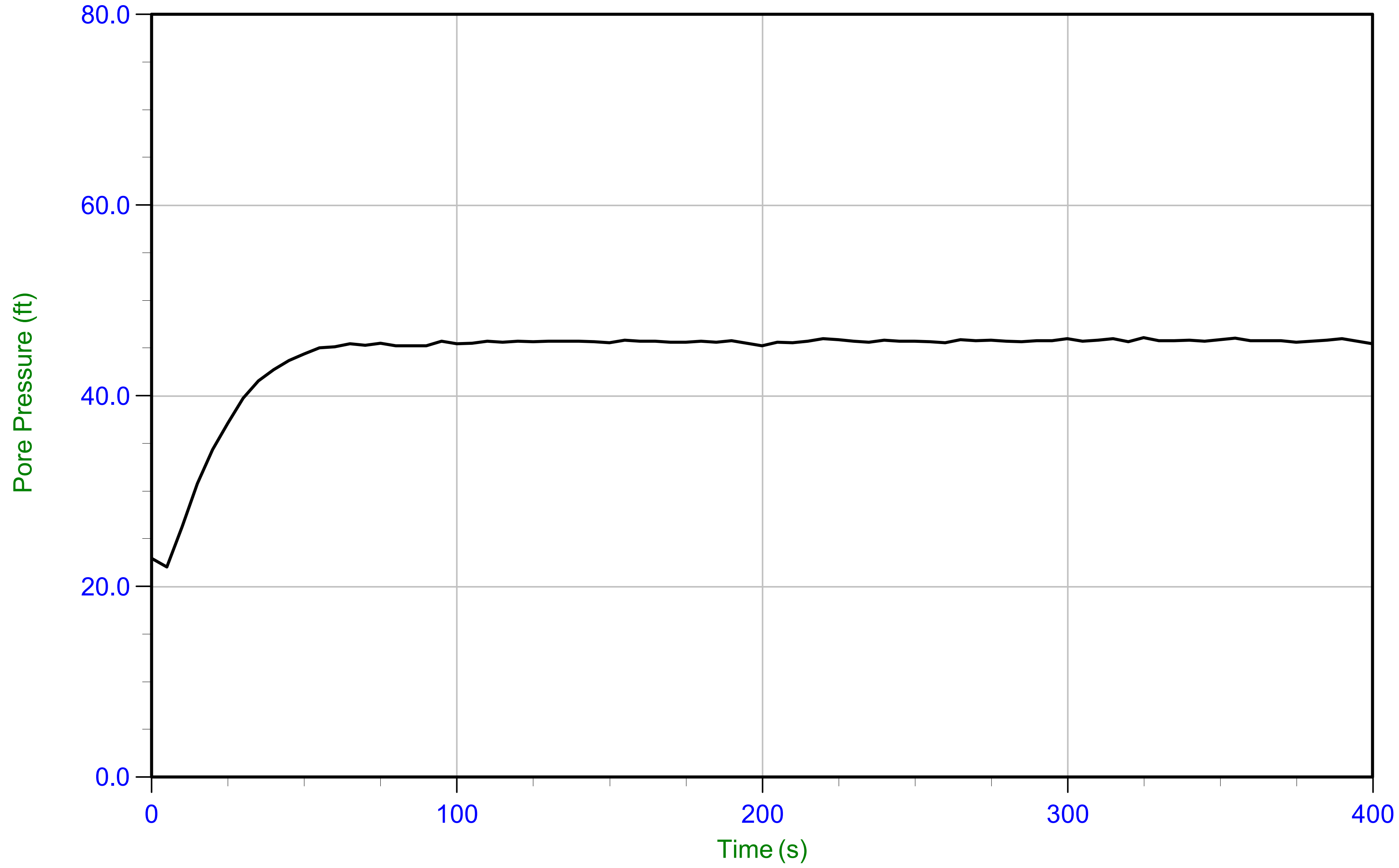
U Min: 21.5 ft
U Max: 47.9 ft

WT: 2.996 m / 9.829 ft
Ueq: 42.0 ft

Parsons

Job No: 14-52099
Date: 30-Oct-2014 09:14:21
Site: TEAD-S-SWMU-13

Sounding: CPT-01
Cone: 420
Cone Area: 15 sq cm



Trace Summary:

Filename: 14-52099_CP01.PPD
Depth: 17.200 m / 56.430 ft
Duration: 400.0 s

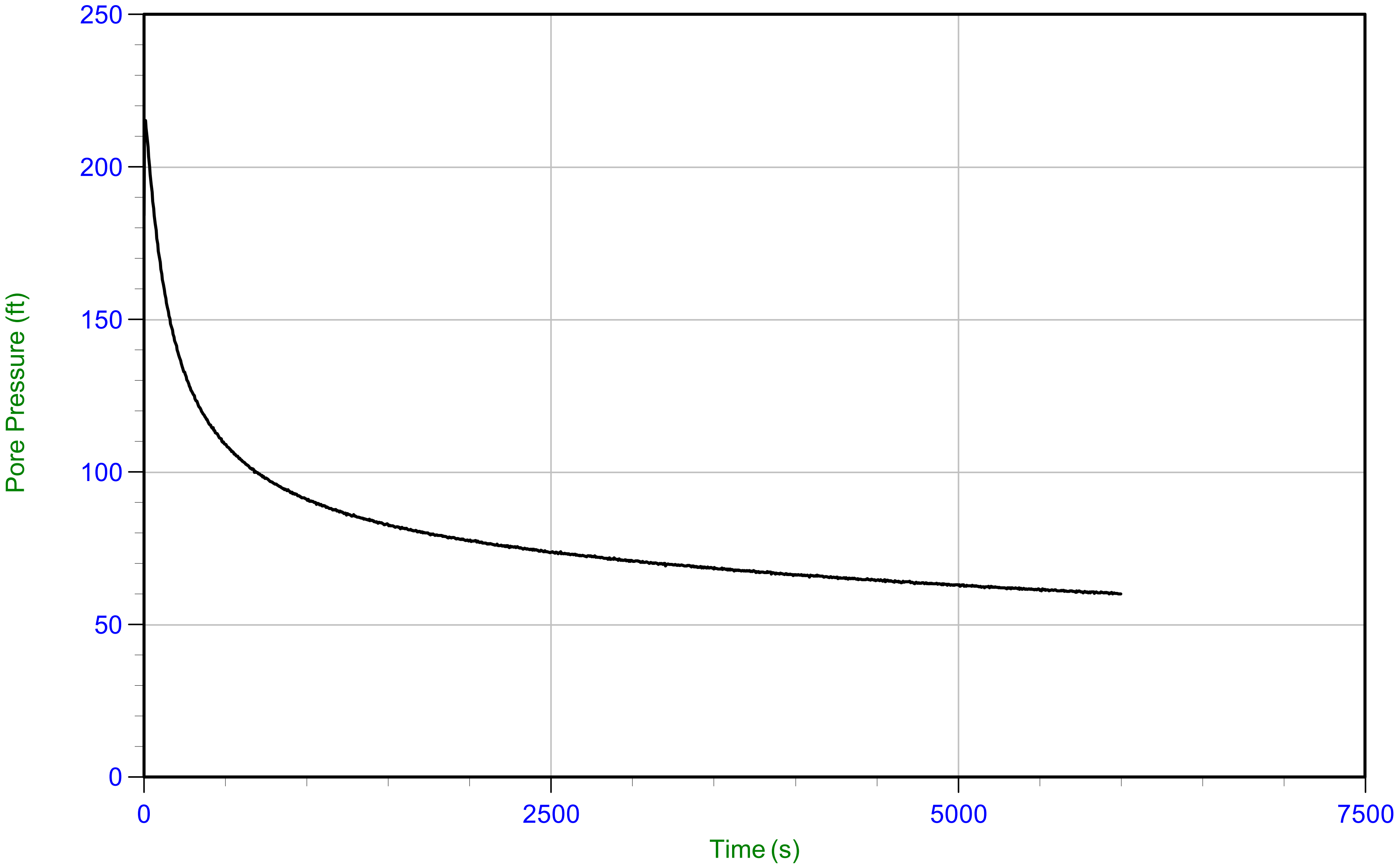
U Min: 22.1 ft
U Max: 46.1 ft

WT: 3.274 m / 10.741 ft
Ueq: 45.7 ft

Parsons

Job No: 14-52099
Date: 30-Oct-2014 09:14:21
Site: TEAD-S-SWMU-13

Sounding: CPT-01
Cone: 420
Cone Area: 15 sq cm



Trace Summary:	Filename: 14-52099_CP01.PPD	U Min: 60.1 ft
	Depth: 19.650 m / 64.468 ft	U Max: 215.3 ft
	Duration: 6000.0 s	

PARSONS

Hole No. ____________ Well No. S13-CAM-DW1

DRILLING LOG	CLIENT USACE	INSTALLATION TEAD-S	SHEET 1 OF 3 SHEETS

1. PROJECT SWMU 13 CMS

2. LOCATION *(Coordinates or Station)*

3. DRILLING CONTRACTOR ConeTec

4. NAME OF DRILLER Terry Campbell

5. NAME OF GEOLOGIST Chris Duncan

6. DIRECTION OF HOLE
☒ VERTICAL
☐ INCLINED ____________ DEGREES FROM VERTICAL

7. THICKNESS OF OVERBURDEN 59

8. DEPTH DRILLED INTO ROCK 0

9. TOTAL DEPTH OF HOLE 59

10. DATE HOLE STARTED 10-30-2014 COMPLETED

11. DRILLING METHOD / DRILLING RIG Hollow Stem Auger / D-1

12. SIZE AND TYPE OF BIT 8-inch OD auger casing

13. TOTAL NO. OF SAMPLES TAKEN ANALYTICAL ☐ ____ IDW ☒ 1 OTHER ☐ ________ ☐ ________

14. TOTAL RECOVERY FOR BORING ~50%

15. TOTAL NUMBER CORE BOXES 0

16. DATUM FOR ELEVATION SHOWN ☐ TBM ☒ MSL ☐ TOC ☐ OTHER ________

17. ELEVATION ☒ GROUND SURFACE 5,046 ☐ TOP OF CASING ________

18. ELEVATION GROUND WATER ~10 ft bgs

19. SIGNATURE OF GEOLOGIST Chris Duncan

DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS *(Description)* d	PID (ppm) e	REMARKS *(Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant)* g
2 4 6 8 10		ML	0-11 Silt w/sand (ML) Brown (7.5YR-5/3) moist, soft or loose, 70% silty fines, 30% fine to med sand	0.0 CH4=0	15-inch OD auger down to 10 ft bgs
12 14 16		CL	11.0-16.5 Lean Clay w/sand (CL) light brownish gray (2.5Y 6/2), moist, soft to firm, 60% clayey fines, 30% fine sand, 10% silty fines	1.7 CH4=0 0.0 CH4=0	8-inch OD auger down to 59 ft bgs
18 20		SP-SM	16.5-20.0 Poorly Graded Sand w/silt (SP-SM), brown to light brownish gray, moist, loose, 70% fine to med sand, 30% silty fines	CH4=0 0.0	

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5046	Hole No. S13-CAM-DW1
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 2 OF 3 SHEETS

DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
22			<u>20-36.5</u> Sandy Lean Clay (CL), Light Brownish Gray (2.5Y 6/2), moist to wet, firm, 60% clayey fines, 30% fine sand, 10% silty fines, clayey fines increase w/depth		
24					
26		CL		0.1 $CH_4=0$	
28					
30				0.0 $CH_4=0$	
32					
34				0.0 $CH_4=0$	
36			<u>36.5-54.8</u> Lean Clay w/sand (CL) Light Brownish Gray (2.5Y 6/2), moist, firm, 75% clayey fines, 15% fine sand, 10% silty fines		
38					
40				0.0 $CH_4=0$	
42					
44		CL			
46				0.0 $CH_4=0$	
48					
50				0.0 $CH_4=0$	
52					
54					

PARSONS

DRILLING LOG (Cont. Sheet)	ELEVATION 5046	Hole No. S13-CAM-DW1
PROJECT SWMU 13 CMS	INSTALLATION TEAD-S	SHEET 3 OF 3 SHEETS

DEPTH (FT) a	GRAPHIC LOG b	ASTM SOIL CLASS SYMBOLS c	CLASSIFICATION OF MATERIALS (Description) d	PID (ppm) e	REMARKS (Drilling time, water loss, depth of weathering, type of PID reading, etc., if significant) g
		CL			
56		GM	54.8 - 57.0 Silty Gravel w/sand Gray (Gley 1-6/N), moist to wet, med dense, 50% gravel up to 1.5", subangular to subround, 25% silty fines, 25% fine sand	0.0 CH4= 0	
58		CL	57.0 - 59.0 Lean Clay w/sand, light brownish gray (2.5Y 6/2), moist, firm, 75% clayey fines, 15% fine sand, 10% silty fines	0.0 CH4= 0	
60			End of borehole @ 59' bgs		

WELL DEVELOPMENT LOG

Site ID: SWMU 13
Well No.: S13-CAM-DW1
Page 1 of 2
Installation: TEAD-S
Location: CAMDS
Project No.: 749125.04000
Client/Project: USACE
Development Subcontractor: ConeTec
Drillers: Terry Campbell, Brian Mercer
Start Date: 11-7-14
Completion Date: 11-7-14
Casing Dia.: 2
Dev. Rig: WD-1
Developed by: Terry Campbell
Log Book No.: 1
Pages: 56-57
Well Vol.: 11.7

Development method: Bailing - Surging - Bailing - Pumping

Equipment: Bailed using a 1.75-inch diameter, 10-foot long, stainless steel bailer. Surged using a custom made 1.5-inch steel surge block. Pumped using a 1.75-inch diameter Grundfos pump (2-inch pump).

Date Stabilized Groundwater Depth Measured: 11 / 7 / 14. Pre-Dev. SWL 13.57 ft.
Pre-Dev Total Depth 59.95 ft. Post-Dev. SWL: 14.19 ft. Post-Dev. Total Well Depth: 61.5 ft.
Silt Removed: 18.6 inches. Range and average discharge rate: 1.0 gpm.
Total quantity of water removed: 133 gals. Maximum drawdown during development 18.20 ft. at 1.5 gpm.
Disposition of discharged water: 3-55 gallon drums
Drum No. PARSNZ1431101
PARSNZ1431102
PARSNZ1431103

Purge Data

Total depth 59.95 - Depth to water 13.57 = Column Height (Ht.) 46.38 x
Gal/ft *0.251 = Well Volume 11.7 + Water Added 0 = 11.7 x Number of
Volumes to be purged 5 = Required purge Volume 58.5. Actual purge Volume 133 gal

* calculation based off a 2-inch diameter well set inside an 8-inch diameter borehole with 7.0 ft of saturated sand pack interval

Time	Volume Removed (gal.)	Water Level (ft BGS)	Turbidity	Clarity/ Color	TDS ppm	ORP mV	Temp. °C	pH (.)	CONDUCTIVITY (µmhos/cm)	Remarks:
0925										
0950	10	14.31	71,000	lt. gray/brown						Bailing
0955										
1030	0	13.35	71,000	lt. gray/brown						Surging
1035										
1055	13	14.78	71,000	lt. gray/brown						Bailing

Comments:

Development complete: ☒ Yes ☐ No

Reviewed by: Chris Duncan
Date: 11/18/14

WELL DEVELOPMENT LOG (CONT.)

Site ID: SWMU 13 | Well No.: S13-CAM-DW1 | Page 2 of 2

Installation: TEAD-S | Location: Deep Well

Time	Volume Removed (gal.)	Water Level (ft BGS)	Turbidity	Clarity/ Color	DO mg/L ~~TDS ppm~~	ORP mV	Temp. °C	pH (.)	CONDUCTIVITY ~~(μmhos/cm)~~ mS/cm	Remarks:
1120	Begin	Pumping								1.5 GPM
1130	15	18.20	71,000	lt. gray	4.19	-8.9	14.53	6.91	17.85	1.5 GPM
1135	20	16.95	734	cloudy	4.60	-6.3	14.57	6.87	17.86	Dropped it to 1.0 GPM
1145	30	16.80	622	cloudy	2.84	1.4	14.72	6.88	17.89	1.0 GPM
1155	40	16.76	379	cloudy	2.93	5.5	14.76	6.89	17.86	1.0 GPM
1205	50	16.75	321	cloudy	2.94	8.5	14.82	6.88	17.94	1.0 GPM
1215	60	16.74	377	cloudy	2.59	19.1	14.87	6.90	17.98	1.0 GPM
1225	70	16.73	379	cloudy	2.88	53.9	14.94	6.92	18.07	Big jump in ORP
1235	80	16.73	258	cloudy	2.91	50.3	14.97	6.94	18.13	1.0 GPM
1245	90	16.73	246	cloudy	3.02	49.2	14.99	6.94	18.08	1.0 GPM
1255	100	16.73	373	cloudy	3.05	46.8	14.98	6.94	18.08	1.0 GPM
1305	110	16.73	280	cloudy	2.98	45.6	14.99	6.94	18.08	1.0 GPM
		All Parameters Stable								

COMMENTS: Pump intake set at 60.45 ft btoc. Total depth after bailing and surging was 61.45. Pump was set 1-foot off bottom

APPENDIX G

RE-DEVELOPMENT LOGS AND PRODUCT RECOVERY TEST RESULTS

Note: Appendix G contains re-development logs for monitoring well S-CAM-1, S-25-88, S-26-88, and S-87-91 and Free product recovery test results for monitoring wells S-28-88, S-CAM-1, and S-CAM-2.

WELL DEVELOPMENT LOG

Site ID: SWMU 13 | Well No.: S-CAM-1 | Page 1 of 2
Installation: TEAD-S | Location: CAMDS
Project No.: 749125.04000 | Client/Project: USACE
Development Subcontractor: | Drillers:
Start Date: 10-30-14 | Completion Date: 10-30-14 | Casing Dia.: 2 | Dev. Rig: WD-1
Developed by: Ryan Bernier | Log Book No.: 1 | Pages: 51-53 | Well Vol.: 2.95

Development method: Bailing - Surging - Bailing - Pumping

Equipment: Bailed using a 1.75-inch, 5-foot long, stainless steel bailer. Surged using a 1.5-inch diameter custom made steel surge block. Pumped using a 1.75-inch Grundfos pump (2-inch pump).

15.01 ft btoc (DTP)

Date Stabilized Groundwater Depth Measured: 10 / 30 / 14. Pre-Dev. SWL 16.29 ft.
Pre-Dev Total Depth 25.79 ft. Post-Dev. SWL: 22.30 ft. Post-Dev. Total Well Depth: 25.85 ft.
Silt Removed: 0.72 inches. Range and average discharge rate: 0.5 gpm.
Total quantity of water removed: 37.5 gals. Maximum drawdown during development 22.34 ft. at 0.5 gpm.
Disposition of discharged water: 55-gallon drum Drum No. PARSNZ1430303

Purge Data

Total depth 25.79 - Depth to water 16.29 = Column Height (Ht.) 9.50 x Gal/ft * 0.31 = Well Volume 2.95 + Water Added 0 = 2.95 x Number of Volumes to be purged 5 = Required purge Volume 14.75. Actual purge Volume 37.5 gal

* calculation based off a 2-inch diameter well set inside a 4-inch diameter borehole with 9.50 ft of saturated sand pack interval.

Time	Volume Removed (gal.)	Water Level (ft BGS)	Turbidity	Clarity/ Color	TDS ppm	ORP mV	Temp. °C	pH (.)	CONDUCTIVITY (µmhos/cm)	Remarks:
1505										
1530	12	16.59	800	cloudy/clear						Bailing
1530										
1610	0	16.59	800	cloudy/clear						Surging
1610										
1620	5	16.59	800	cloudy/clear						Bailing

Comments:

Development complete: ☒ Yes ☐ No

Reviewed by: Chris Duncan Date: 11/18/14

WELL DEVELOPMENT LOG (CONT.)

Site ID: SWMU 13
Well No.: S-CAM-1
Page 2 of 2
Installation: TEAD-S
Location: CAMDS

Time	Volume Removed (gal.)	Water Level (ft BGS)	Turbidity	Clarity/ Color	TDS ppm	ORP mV	Temp. °C	pH (.)	CONDUCTIVITY ~~(umhos/cm)~~ mS/cm	Remarks:
1623	1.5	19.90	513	brown	–	-83.5	19.32	7.37	5.543	0.5 gal/min
1626	3.0	21.60	820	brown	–	-103.9	17.72	7.15	5.180	
1629	4.5	22.20	851	brown	–	-113.2	17.55	7.10	5.225	
1632	6.0	22.15	182	cloudy	–	-122.8	17.42	7.07	5.225	
1635	8.5	22.05	121	cloudy	–	-123.6	17.36	7.07	5.213	
1638	10.0	22.30	64.8	cloudy	–	-128.1	17.26	7.06	5.193	
1641	11.5	22.32	53.1	clear	–	-132.4	17.19	7.06	5.147	
1644	13.0	22.20	44.0	cloudy/clear	–	-136.6	17.13	7.05	5.116	
1647	14.5	22.33	36.8	clear	–	-139.7	17.06	7.05	5.082	
1650	16.0	22.30	26.4	clear	–	-141.5	17.04	7.05	5.059	
1653	17.5	22.33	12.2	clear	–	-139.3	17.03	7.04	5.019	
1655	19.0	22.34	9.8	clear	–	-140.1	17.02	7.04	5.004	
1658	20.5	22.33	11.0	clear	–	-141.0	17.00	7.04	5.001	
1703			9.5							

COMMENTS: Pump intake set at 24.79 ft btoc (1-foot off bottom)

WELL DEVELOPMENT LOG

Site ID: SWMU 13	Well No.: S-25-88		Page 1 of 1
Installation: TEAD-S		Location: CAMDS	
Project No.: 749125.04000	Client/Project: USACE		
Development Subcontractor: ConeTec		Drillers:	
Start Date: 10-30-14	Completion Date: 10-31-14	Casing Dia.: 4	Dev. Rig: WD-1
Developed by: Ryan Bernier	Log Book No.: 1	Pages: 51-53	Well Vol.: 5.45

Development method: Bailing - Surging - Bailing

Equipment: Bailed using a 3.75-inch, 10-foot long stainless steel bailer. Surging using custom made 3.5-inch diameter steel surge block.

Date Stabilized Groundwater Depth Measured: 10 / 30 / 14. Pre-Dev. SWL 14.79 ft.
Pre-Dev Total Depth 20.85 ft. Post-Dev. SWL: 21.95 ft. Post-Dev. Total Well Depth: 22.27 ft.
Silt Removed: 17.04 inches. Range and average discharge rate: — gpm.
Total quantity of water removed: 8 gals. Maximum drawdown during development — ft. at — gpm.
Disposition of discharged water: 55-gallon drum Drum No. PARSNZ1430302

Purge Data

Total depth 20.85 - Depth to water 14.79 = Column Height (Ht.) 6.06 x
Gal/ft * 0.90 = Well Volume 5.45 + Water Added 0 = 5.45 x Number of
Volumes to be purged 5 = Required purge Volume 27.3. Actual purge Volume ~ 8 gal

* calculation based off a 4-inch diameter well set inside a 6-inch diameter borehole with 6.06 ft of saturated sand pack interval.

10/30/14 Time	Volume Removed (gal.)	Water Level (ft BGS)	Turbidity	Clarity/ Color	TDS ppm	ORP mV	Temp. °C	pH (.)	CONDUCTIVITY (µmhos/cm)	Remarks:
1400										
1410	5	20.85	>1,000	Dark Gray						Bailed Dry
10/31/14										SWL = 16.93 ft btoc
1010										
1050	0	16.50	>1,000	Dark Gray						Surging
1050										
1100	3	21.95	>1,000	Light Gray						Bailed Dry

Comments: Well was bailed dry on 10-30-14 after only 3 bailers were removed. Well recharge was extremely slow. We let well recover overnight, but it was still 2.14 ft below SWL measured on 10-30-14. Surged the well on 10-31-14 and bailed dry after. 17-inches of silt removed.

Development complete: ☒ Yes ☐ No

Reviewed by: Chris Duncan Date: 11/18/14

WELL DEVELOPMENT LOG

Site ID: SWMU 13
Well No.: S-26-88
Page 1 of 1
Installation: TEAD-S
Location: CAMDS
Project No.: 749125. 04000
Client/Project: USACE
Development Subcontractor: Cone Tec
Drillers:
Start Date: 10-30-14
Completion Date: 10-30-14
Casing Dia.: 4
Dev. Rig: WD-1
Developed by: Terry Campbell
Log Book No.: 1
Pages: 51-53
Well Vol.: 6.5

Development method: Bailing - Surging - Bailing - Pumping - Bailing

Equipment: Bailer is a 1.75-inch diameter, 10-foot long, stainless steel bailer. Surge block is a custom made 3.50-inch diameter steel surge block. Pump is a 2-inch Grundfos pump

Date Stabilized Groundwater Depth Measured: 10 / 30 / 14. Pre-Dev. SWL 14.93 ft.
Pre-Dev Total Depth 22.20 ft. Post-Dev. SWL: 20.40 ft. Post-Dev. Total Well Depth: 23.30 ft.
Silt Removed: 13.2 inches. Range and average discharge rate: 0.5 gpm.
Total quantity of water removed: 42 gals. Maximum drawdown during development 7.27 ft. at 0.5 gpm.
Disposition of discharged water: 55-gallon drum Drum No. PARSNZ1430301

Purge Data

Total depth 22.20 - Depth to water 14.93 = Column Height (Ht.) 7.27 x
Gal/ft * 0.90 = Well Volume 6.5 + Water Added 0 = 6.5 x Number of
Volumes to be purged 5 = Required purge Volume 32.5. Actual purge Volume 42.0

* calculation based off a 4-inch diameter well set inside a 6-inch diameter borehole with 7.27 ft of saturated sand pack interval.

Time	Volume Removed (gal.)	Water Level (ft BGS)	Turbidity	Clarity/ Color	TDS ppm	ORP mV	Temp. °C	pH (.)	CONDUCTIVITY (µmhos/cm)	Remarks:
1010										
1050	12	16.63	>1,000	Black						Bailing
1050										
1130	0	15.17	>1,000	Dark Gray						Surging
1130										
1150	10	16.71	>1,000	Dark Gray						Bailing
1220										
1245	20	20.40	>1,000	Gray						Bailing

Comments: Well is slightly bent. Could not get large dia. bailer downhole. Used smaller 1.75-inch bailer. Installed pump after second round of bailing. Pumping at 0.5 gpm the well immediately went dry. We pulled the pump and continued bailing to reach purge volume.

Development complete: ☒Yes ☐No

Reviewed by: Chris
Date: 11 / 18 / 14

WELL DEVELOPMENT LOG

Site ID: SWMU 13 | Well No.: S-87-91 | Page 1 of 1

Installation: TEAD-S | Location: CAMDS

Project No.: 749125.04000 | Client/Project: USACE

Development Subcontractor: ConeTec | Drillers:

Start Date: 10-31-14 | Completion Date: 10-31-14 | Casing Dia.: 4 | Dev. Rig: WD-1

Developed by: Ryan Bernier | Log Book No.: 1 | Pages: 51-53 | Well Vol.: 0.75 gal

Development method: Bailing

Equipment: Bailing using a 3.75-inch stainless steel bailer, 10-foot long.

Date Stabilized Groundwater Depth Measured: 10 / 31 / 14. Pre-Dev. SWL 16.62 ft.

Pre-Dev Total Depth 17.45 ft. Post-Dev. SWL: 17.95 ft. Post-Dev. Total Well Depth: 18.05 ft.

Silt Removed: 7.2 inches. Range and average discharge rate: — gpm.

Total quantity of water removed: 4 gals. Maximum drawdown during development — ft. at — gpm.

Disposition of discharged water: 55-gallon drum Drum No. PARSNZ1430401

Purge Data

Total depth 17.45 - Depth to water 16.62 = Column Height (Ht.) 0.83 x

Gal/ft * 0.9 = Well Volume 0.75 + Water Added 0 = 0.75 x Number of

Volumes to be purged 5 = Required purge Volume 3.7. Actual purge Volume ~ 4 gal

* Calculation based off a 4-inch diameter well set inside a 6-inch diameter borehole with 0.80 ft of saturated sand pack interval.

Time	Volume Removed (gal.)	Water Level (ft BGS)	Turbidity	Clarity/ Color	TDS ppm	ORP mV	Temp. °C	pH (.)	CONDUCTIVITY (μmhos/cm)	Remarks:
1140										
1215	4	17.85	>1,000	Gray						Bailed Dry

Comments: Not much water in well, but recharges quickly. Over 7-inches of silt removed. Not enough water in well to surge. We bailed until no more silt was being removed from the well.

Development complete: ☒ Yes ☐ No

Reviewed by: Chris Duncan Date: 11/18/14

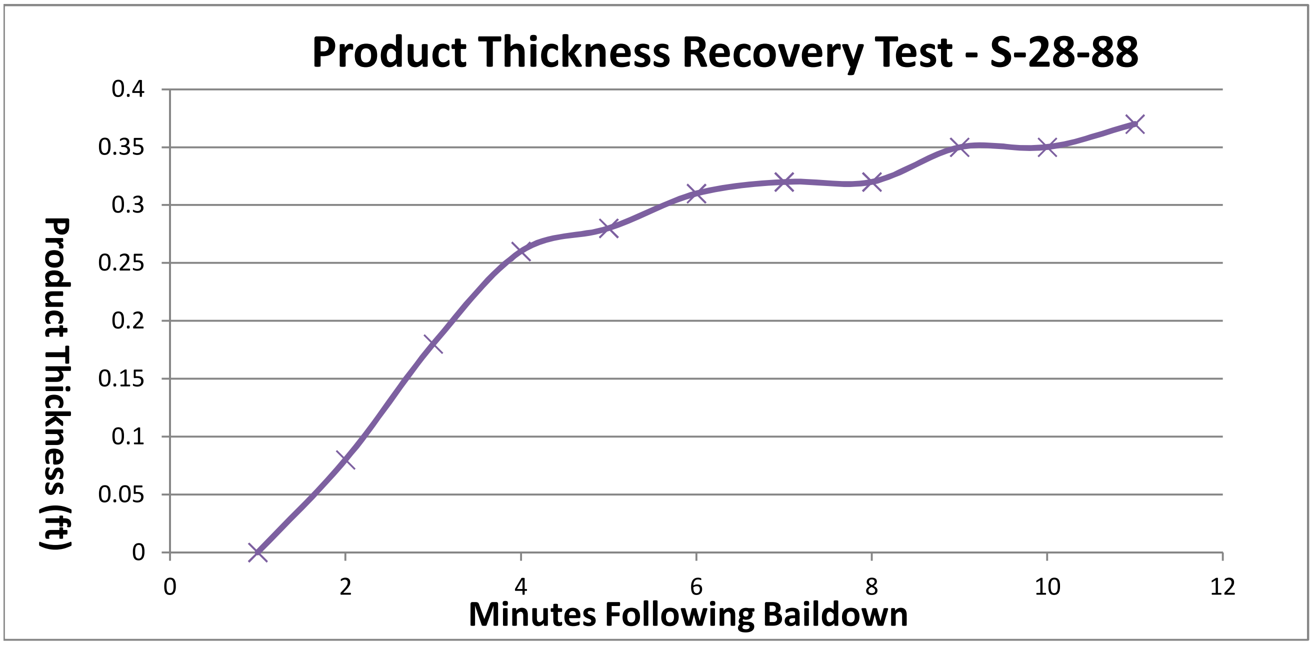
Well ID: S-28-88

Date: 10-09-2014

Purged Volume: Approximately 8.0 gal

Time	DTP	DTW	Total
Initial	13.82	14.39	0.57
13:28	14.23	14.23	0
13:30	13.99	14.07	0.08
13:35	13.9	14.08	0.18
13:45	13.87	14.13	0.26
14:00	13.86	14.14	0.28
14:15	13.86	14.17	0.31
14:35	13.86	14.18	0.32
14:50	13.86	14.18	0.32
15:37	13.85	14.2	0.35
16:09	13.85	14.2	0.35
17:10	13.85	14.22	0.37

DTP: Depth to Product
DTW: Depth to Water



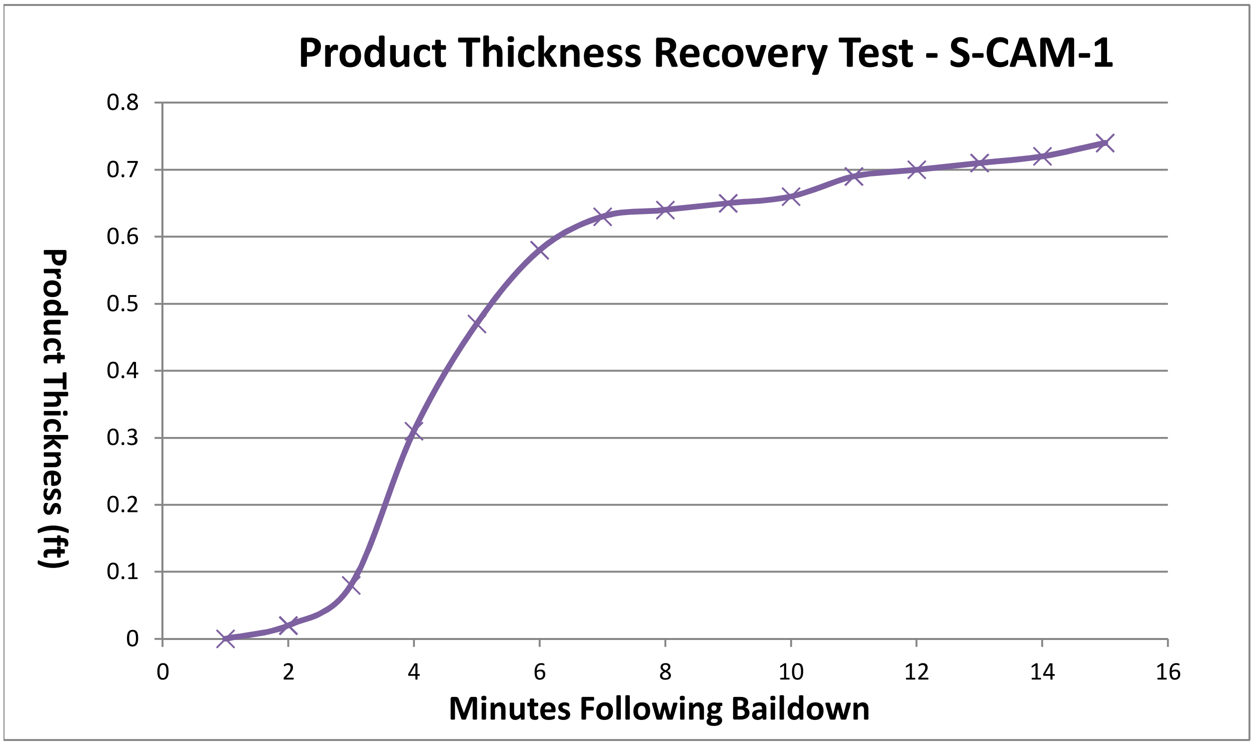
Well ID: S-CAM-1

Date: 10-09-2014

Purged Volume: Approximately 9.0 gal

Time	DTP	DTW	Total
Initial	11.93	13.27	1.34
11:06	12.24	12.24	0
11:08	12.17	12.19	0.02
11:13	12.14	12.22	0.08
11:23	12.1	12.41	0.31
11:31	12.07	12.54	0.47
11:46	12.05	12.63	0.58
12:14	12.04	12.67	0.63
12:42	12.04	12.68	0.64
12:58	12.03	12.68	0.65
13:42	12.02	12.68	0.66
14:22	12.02	12.71	0.69
14:56	12.02	12.72	0.7
15:46	12.02	12.73	0.71
16:15	12.02	12.74	0.72
17:04	12.02	12.76	0.74

DTP: Depth to Product
DTW: Depth to Water



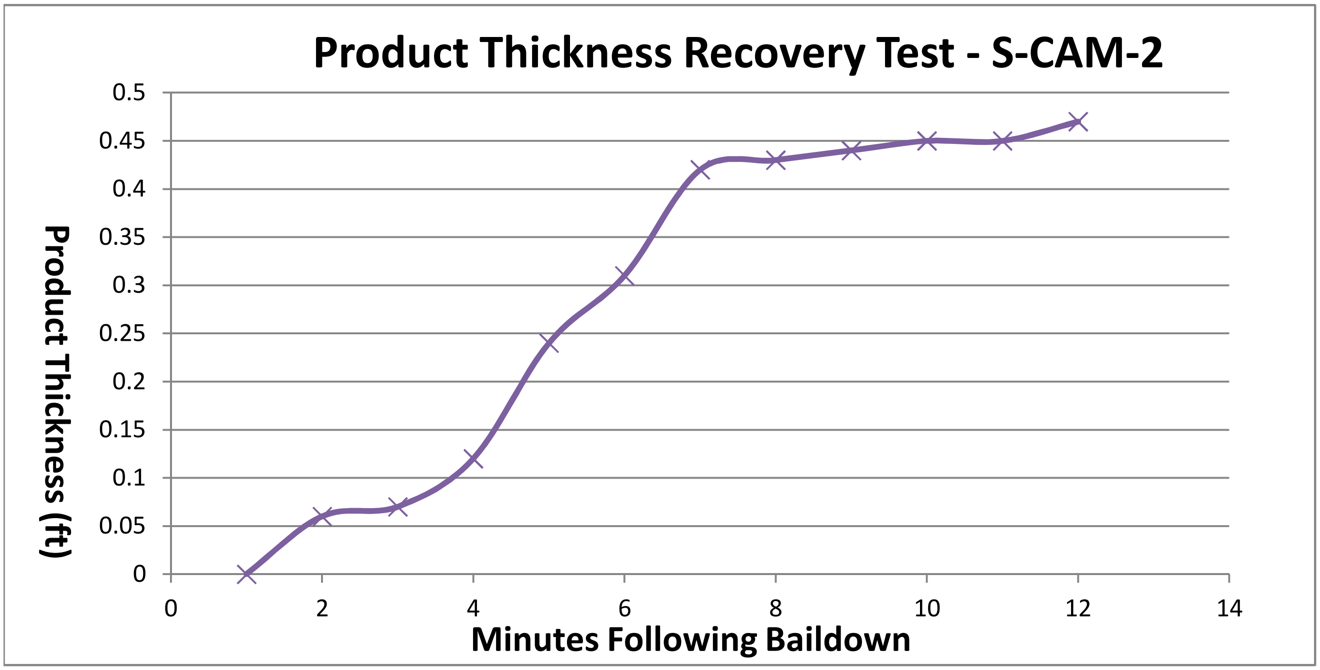
Well ID: S-CAM-2

Date: 10-09-2014

Purged Volume: Approximately 7.0 gal

Time	DTP	DTW	Total
Initial	14.24	15.05	0.81
12:20	14.42	14.42	0
12:22	14.37	14.43	0.06
12:25	14.36	14.43	0.07
12:35	14.35	14.47	0.12
12:46	14.32	14.56	0.24
12:56	14.31	14.62	0.31
13:38	14.29	14.71	0.42
14:18	14.28	14.71	0.43
14:53	14.28	14.72	0.44
15:42	14.28	14.73	0.45
16:12	14.28	14.73	0.45
17:06	14.28	14.75	0.47

DTP: Depth to Product
DTW: Depth to Water



APPENDIX H

CORRECTIVE MEASURES TECHNOLOGIES SCREENING

APPENDIX H
TECHNOLOGY SCREENING

Table of Contents

H.1 SCREENING PROCESS

Based on site information and the CAOs developed for SWMU 13, a range of response actions and associated technologies were identified to provide potential remedies or components of corrective measures alternatives for SWMU 13. Limitations, applicability, and cost data for the screening of technologies were collected from the Interstate Technology Regulatory Council (ITRC) (ITRC 2009a) and EPA 510-R-96-001, *How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites* (USEPA 1996). Potential corrective measures technologies were evaluated with respect to the following factors:

Site Characteristics - Site data was reviewed to identify conditions that may limit the use of certain technologies. Technologies that were clearly precluded by site characteristics or safety hazards were eliminated from further consideration.

Waste Characteristics - Waste characteristics that limit the effectiveness of potential technologies were considered as part of the screening process. Technologies clearly limited by the SWMU 13 waste characteristics were eliminated from consideration. Waste characteristics affect the feasibility of in-situ method, direct treatment methods and land disposal.

Technology Limitations - During the screening of technologies, the level of technology development, performance record, and construction, operation and maintenance problems were considered. Technologies that are unreliable, perform poorly, or have not been fully demonstrated were eliminated from considerations.

H.2 INSTITUTIONAL CONTROLS

H.2.1 Groundwater Restrictions

Restrictions would be implemented by the Army prohibiting access to or the use of groundwater at the site. Such restrictions would prevent human exposure to contaminated groundwater, but would provide no additional protection of the environment.

Site and Waste Characteristics

- Site and waste characteristics would not affect the implementation or effectiveness of restrictions on groundwater use or access.
- There are, no safety hazards associated with implementing such restrictions.

Technology Limitations

- Groundwater restrictions would be highly implementable at a relatively low cost.
- Groundwater restrictions would result in no waste generation or management.
- Groundwater restrictions would be a long-term measure, likely to be implemented in combination with other corrective measures technologies.

Retain – This option was retained for further consideration due to effectiveness in reducing exposure to site contaminants and low costs. This option alone does not completely satisfy the CAOs for SWMU 13.

H.2.2 Excavation Restrictions

Restrictions would be implemented by the Army prohibiting excavation at SWMU 13 without proper management of excavated soil. Such restrictions would limit human exposure and ensure appropriate handling and management of contaminated soil. Excavation restrictions would provide no additional protection of the environment.

Site and Waste Characteristics

- Site and waste characteristics would not affect the implementation or effectiveness of excavation restrictions.
- There are, no safety hazards associated with the implementation of such restrictions.

Technology Limitations

- Excavation restrictions would be highly implementable at a relatively low cost.
- Excavation restrictions would result in no waste generation or management.
- Excavation restrictions would be a long-term measure, likely to be implemented in combination with other corrective measures technologies.

Retain – This option was retained for further consideration due to effectiveness in reducing exposure to site contaminants and low costs. This option alone does not completely satisfy the CAOs for SWMU 13.

H.2.3 Groundwater Monitoring

Groundwater monitoring provides a means of determining if further degradation of groundwater is occurring and if LNAPL and contaminated groundwater are migrating. Groundwater monitoring is also a means of monitoring the effectiveness of other corrective measures that may be implemented.

Site and Waste Characteristics

- Site and waste characteristics would not affect the implementation or effectiveness of groundwater monitoring.
- There are minimal safety hazards associated with groundwater monitoring. The potential exposure of monitoring personnel can be easily managed during field activities.

Technology Limitations

- Groundwater monitoring is highly implementable at a relatively low cost.

- Groundwater monitoring would result in the generation of a minimal amount of waste to be managed and disposed of.
- Groundwater monitoring would be a long-term measure, likely to be implemented in combination with other corrective measures technologies.

Retain – This option was retained for further consideration due to its effectiveness in monitoring site conditions and the effectiveness of other corrective measures at a low cost. This option alone does not completely satisfy the CAOs for SWMU 13.

H.2.4 Building Restrictions

Restrictions would be implemented by the Army prohibiting either 1) building over areas with elevated chloroform or methane in soil gas or 2) requiring a vapor barrier and sub-slab venting system to mitigate elevated chloroform or methane. Such restrictions would limit human exposure. Building restrictions would provide no additional protection of the environment.

Site and Waste Characteristics

- Site and waste characteristics would not affect the implementation or effectiveness of building restrictions.
- There are minimal safety hazards associated with building restrictions. The installation of a vapor barrier and sub-slab venting system would not represent any safety hazards that are not already associated with construction activities.

Technology Limitations

- Vapor barriers and sub-slab venting systems can only be installed in new construction.
- Building restrictions, vapor barriers, and sub-slab venting would not result in the generation any waste.
- Minimal O&M costs.
- Sub-slab venting system can initially be installed as a passive system. Some monitoring would then be required. If CAOs are not achieved, the passive system can be upgraded to an active system, which will increase O&M costs.

Retain – This option was retained for further consideration due to its effectiveness in mitigating human exposures to site contaminants at a low cost. This option alone does not completely satisfy the CAOs for SWMU 13.

H.3 MASS RECOVERY

H.3.1 Excavation

The targeted LNAPL area is removed from the subsurface through excavation or large diameter borings, and the waste material is disposed of at an appropriate disposal facility.

Site Characteristics

- Excavation of LNAPL is effective in removing LNAPL from both fine and course-grain materials in the unsaturated zone, and can be effective in removal of a significant amount of LNAPL mass from the saturated zone.
- Safety issues associated with excavation are typical and considered moderate. Safety issues associated with excavation involve side-stability issues and the potential for collapse. Traffic safety could also be an issue. Excavated material could come in contact with workers during implementation, exposure to contaminated soil, liquids, and vapors must be managed.

Waste Characteristics

- Excavation is effective in the removal of medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- Excavation is an implementable technology with logistical challenges depending on the size of the LNAPL body and may result in relatively high costs.
- Excavation may be impacted on the site by the need to remove and dispose of concrete foundations and slabs remaining on the site. A significant waste stream will be generated requiring off-site treatment and disposal.
- Compared to other technologies, excavation can be accomplished in a short period of time.

Retain – This option is retained for further consideration in conjunction with other technologies due to its effectiveness in removing LNAPL from the saturated and unsaturated zones and short remedial time frame. This technology alone does not completely satisfy the CAOs.

H.3.2 LNAPL Skimming

LNAPL skimming uses a single pump or hydrophobic belt (e.g., bladder pump, pneumatic pump, or belt skimmer) to extract LNAPL from a well. LNAP skimming removes limited groundwater from the well.

Site Characteristics

- LNAPL skimming can be effective in preventing further degradation of groundwater and the removal of LNAPL from the saturated zone. Skimming is effective in removing LNAPL from course-grain materials, and to a lesser degree from fine-grain materials. Skimming removes LNAPL at the groundwater surface, but does not significantly reduce the LNAPL mass in the unsaturated zone over the short-term or dissolved petroleum constituents in groundwater.
- Safety issues involved with LNAPL skimming are considered low and include potential exposure of field personnel to contaminants which must be managed during operations, as well as the potential release of recovered material.

Waste Characteristics

- LNAPL skimming is effective in the removal of medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- LNAPL skimming is a proven technology that is readily implementable.
- LNAPL skimming is limited to mobile LNAPL bodies. Based on the current understanding of site conditions at SWMU 13, the remedial time frame will require long term operations and maintenance.
- The size of the LNAPL body directly affects the cost. Based on the current understanding of SWMU 13, the cost would be moderate compared to several other high cost technologies considered.
- LNAPL skimming will require management and proper disposal of a moderate volume of waste in comparison to other technologies considered.

Retain – This option is retained for further consideration in conjunction with other technologies. Although a long-term remedial alternative, the aerial extent of measurable free product is limited and is recoverable at a cost considered to be moderate in comparison to other technologies evaluated. This technology alone does not completely satisfy the CAOs.

H.3.3 Dual Pump Liquid Extraction

LNAPL is hydraulically recovered by using two pumps simultaneously to remove LNAPL and groundwater.

Site Characteristics

- Dual pump liquid extraction can be effective in the removal of LNAPL from the saturated zone. This technology is not effective in removal of LNAPL from the unsaturated zone. Dual pump extraction removes mobile LNAPL with a capture zone dictated by the cone of groundwater depression.

- Safety issues involved with dual pump extraction are considered moderate and include potential exposure of field personnel to contaminants which must be managed during operations, the potential release of recovered material, and potential electrical concerns with submersible pumps in wells.

Waste Characteristics

- Dual pump extraction is effective in the removal of medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- Dual pump liquid extraction is most effective in course-grain materials at locations where LNAPL is known to be mobile. Based on the current understanding of site conditions at SWMU 13, implementation of dual pump extraction would likely have limited effectiveness and would require long term operations.
- Operation and maintenance costs are expected to be moderate to high depending on the life of the project.
- As both LNAPL and groundwater are removed, dual pump liquid extraction would result in the generation of a significant amount of waste that would require management and treatment or disposal.

Reject – Dual pump extraction has been rejected as an appropriate technology at SWMU 13, based on the current understanding of site conditions, waste management requirements, and costs. Dual pump extraction is effective in course-grain materials where LNAPL is known to be mobile. Effectiveness is limited in fine-grained materials, such as those found at SWMU 13. Additionally, as both LNAPL and groundwater are removed by this technology, a significant amount waste would be generated requiring management, treatment, and/or disposal. Waste management costs are considered high.

H.3.4 Multiphase Extraction

LNAPL and groundwater are removed through the use of dedicated pumps. Vacuum enhancement is typically added to increase LNAPL hydraulic recovery rates.

Site Characteristics

- Multiphase extraction can be effective in the removal of LNAPL from the saturated zone under certain site conditions. This technology is not effective in removal of LNAPL from the unsaturated zone. Multiphase extraction removes mobile LNAPL with a capture zone dictated by the cone of groundwater depression.

- Safety issues involved with multiphase extraction include potential exposure of field personnel to contaminants which must be managed during operations, the potential release of recovered material, and potential electrical concerns with submersible pumps in wells.

Waste Characteristics

- Multiphase extractions is effective in the removal of medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- Multiphase extraction is technically implementable but is most effective in course-grain materials, and at locations where LNAPL is known to be mobile. Based on the current understanding of site conditions at SWMU 13 where the saturated zone is comprised primarily of fine grain materials, with a limited groundwater gradient, implementation of multiphase extraction would likely have limited effectiveness and would require long-term operations.
- As both LNAPL and groundwater are removed, multiphase extraction would result in the generation of a significant amount of waste that would require management and treatment or disposal.
- Capital costs and operation and maintenance costs are considered moderate to high in comparison to other technologies which provide mass removal of LNAPL.

Reject – Like dual pump extraction, multiphase extraction has been rejected as an appropriate technology at SWMU 13, based on the current understanding of site conditions, waste management requirements, and costs. Multiphase extraction is effective in course-grain materials where LNAPL is known to be mobile. Effectiveness is limited in fine-grained materials, such as those found at SWMU 13. Additionally, as both LNAPL and groundwater are removed by this technology, a significant amount waste would be generated requiring management, treatment, and/or disposal. Waste management costs are considered high.

H.3.5 Groundwater Treatment

Groundwater is extracted and treated through carbon absorption and/or air stripping to remove dissolved petroleum constituents from groundwater.

Site Characteristics

- Groundwater treatment is most effective in course-grain materials and to a lesser degree in fine-grain materials. Groundwater treatment would remove dissolved petroleum constituents from groundwater, but would only be effective if the LNAPL body was removed from the saturated and unsaturated zone prior to implementation.

- Safety hazards associated with groundwater treatment are considered moderate and consist primarily of potential releases of contaminated groundwater to the surface.

Waste Characteristics

- Groundwater treatment is only effective in the removal of medium to heavy dissolved petroleum constituents with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light dissolved petroleum constituents with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- Implementation of groundwater treatment is technically feasible but would require the installation of a significant amount of infrastructure and would require long-term operations.
- Installation, operations and maintenance costs associated with a groundwater treatment system would be high in comparison to other alternatives.
- Operation of a groundwater treatment system would result in the generation of a significant volume of waste requiring management and treatment.

Reject – Groundwater treatment has been rejected as an appropriate technology at SWMU 13, based on implementation, operations, and maintenance costs; its ability to treat only dissolved phase petroleum constituents; and waste management requirements and cost. As groundwater is removed, and potentially filtered through carbon, a significant amount of waste would be generated requiring treatment/disposal, with waste management costs being considered high. Implementation capital costs and operations and maintenance cost would be high in comparison to other technologies. As groundwater treatment would only removed dissolve phase petroleum constituents, additional measures would be required to remove the free-phase LNAPL body.

H.3.6 Water Flooding

Water is injected to enhance the hydraulic LNAPL gradient and recovery. Hot water may be injected to reduce interfacial tension and viscosity of the LNAPL and further enhance LNAPL removal by hydraulic recovery.

Site Characteristics

- Water flooding would only be an appropriate technology if combined with other technologies that provide hydraulic controls. Water flooding is only effective in the saturated zone, and is used to create an artificial gradient. Although feasible in fine-grained materials, water flooding is most effective in course-grained material, where dispersion efficiency of the injected water can be controlled.

- The primary safety concerns with water flooding injection, extraction, and treatment which present a moderate risk but are manageable.

Waste Characteristics

- Water flooding is effective in mobilizing medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- Water flooding is most effective in homogeneous course-grained materials where dispersion of the injected water can be controlled. Water flooding of the SWMU 13 site would likely require a significant number of injection points in order to obtain efficient dispersion of the injected water. Significant infrastructure injection (injection wells and piping) would be required.
- Water flooding would require long-term operations in conjunction with other mass recovery technologies.
- Continuous injection, treatment and re-circulation of water would result in high operation and maintenance costs, along with a significant volume of waste which would require handling and proper treatment.

Reject – Water flooding has been rejected as an appropriate technology at SWMU 13, as additional measures which provide hydraulic recovery would be required along with this technology. As such, capital costs for implementation would be high, as would ongoing operation and maintenance costs. Additionally, the continuous injection, treatment, and recirculation of water would result in the generation of a significant amount of waste requiring management, treatment, and disposal at a high cost.

H.4 PHASE CHANGE

H.4.1 Natural Attenuation

LNAPL constituents are naturally depleted from the LNAPL body over time by volatilization, dissolution, dispersion, absorption and, degradation.

Site Characteristics

- Natural attenuation can be effective in the removal of LNAPL from the saturated and unsaturated zone in both fine and course-grain material. At SWMU 13, sampling conducted during the data gap investigation, indicates that natural attenuation is likely to be occurring.

- The primary safety concern with natural attenuation is the generation of methane gas which presents a hazard, but can be monitored and managed.

Waste Characteristics

- Natural attenuation is most effective on LNAPLs that have high volatility and solubility (e.g., gasoline, benzene). Natural attenuation is not as effective on LNAPLs which have a lower volatility and solubility (e.g., diesel, heating oil). As volatile LNAPL constituents are stripped, LNAPL can become more viscous due to preferential loss of light fractions and will concentrate into recalcitrant constituents as less recalcitrant constituents are depleted. Natural attenuation is effective on the removal of dissolved petroleum constituents in groundwater. Natural attenuation of groundwater would only be effective if the LNAPL source is removed.

Technology Limitations

- Natural attenuation is highly implementable at a relatively low cost, requiring only groundwater monitoring to track the progress and effectiveness of the technology.
- As no LNAPL mass recovery occurs, long-term monitoring will be required.
- Waste generation and management would be limited to liquids generated during sampling events.

Retain – Natural attenuation is retained for further consideration in conjunction with other technologies. Natural attenuation would likely only be an appropriate technology if combined with other technologies which remove the LNAPL source. This technology alone does not completely satisfy the CAOs.

H.4.2 Air Sparging/Soil Vapor Extraction

Air sparging injects air into LNAPL body to volatilize LNAPL constituents, and vapors are vacuum extracted. Air sparging or soil vapor extraction can also be used individually if conditions are appropriate.

Site Characteristics

- Air sparging and soil vapor extraction are most effective in course-grain materials in both the saturated and unsaturated zone. These technologies would be limited in effectiveness in fine-grained materials such as those known to exist at SWWMU 13.
- Safety issues associated with air sparging and soil vapor extraction are considered moderate and consist primarily the potential release of vapors.

Waste Characteristics

- Air sparging and soil vapor extraction are not as effective on LNAPLs which have a lower volatility and solubility (e.g., diesel, heating oil). These technologies are most appropriate for LNAPLs with have a higher volatility and solubility.

Technology Limitations

- Although air sparging with soil vapor extraction would be implementable at SWMU 13, site conditions limit its effectiveness.
- In general, air sparging and soil vapor extraction are more cost-effective that other active LNAPL mass removal technologies under ideal site conditions.
- Soil vapor extraction, depending on the contaminant concentrations extracted, may require treatment through carbon vessels or other treatment processes resulting in a moderate volume of waste to be managed and properly disposed of.
- Air sparging and soil vapor extraction may be effective in the short-term in removing the volatile fraction, but would have little effect on the heavy end hydrocarbons.

Reject – Air sparging and soil vapor extraction have been rejected as an appropriate technology primarily due to their ineffectiveness in removing heavy end hydrocarbons in low permeability soils, such as those found at SWMU 13. Additionally, air sparging and soil vapor extraction would only be effective if implemented along with a technology that would remove the LNAPL. Implementing such a remedy in conjunction with air sparging and soil vapor extraction would result in significant capital implementation and operation and maintenance costs.

H.4.3 Bio-Slurping/Enhanced Fluid Recovery

LNAPL is remediated via a combination of vacuum-enhanced recovery and bioventing processes.

Site Characteristics

- Bio-slurping/enhanced fluid recovery is effective in the removal of mobile LNAPL in fine and course-grain materials from the saturated and unsaturated zone. Site conditions at SWMU 13 indicate that LNAPL mobility is limited due to the fine-grained subsurface material and lack of groundwater gradient at the site.
- The primary safety concern is considered low and consists of the potential for vapor releases due to vacuum operations.

Waste Characteristics

- Bio-slurping/enhanced fluid recovery is effective in the removal of medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- Due to the immobility of the LNAPL body at SWMU 13, this technology is implementable but would require the introduction of an artificial groundwater gradient, along with some means of hydraulic control.

- Capital costs and operation and maintenance costs are considered to moderate in comparison to other technologies.
- Bio-slurping would result in the generation of a significant amount of waste requiring management and proper disposal.

Reject – Bio-slurping/enhanced fluid recovery has been rejected as an appropriate technology at SWMU 13, as it is known to be effective only on mobile LNAPL bodies. Implementation of this technology would require the introduction of an artificial groundwater gradient by such means as water flooding, along with hydraulic control. Implementation capital costs, and operations and maintenance costs associated with implementing this technology, along with other measures to provide an artificial gradient and hydraulic controls, are considered to be very high.

H.4.4 In-Situ Chemical Oxidation

Site Characteristics

- In-situ chemical oxidation is effective in both the saturated and unsaturated zone, but is not effective on heavy end LNAPLs, such as diesel fuel. Effectiveness is limited to course-grained materials that provide for adequate dispersion of injected oxidants.
- The primary safety concern would be associated with mixing oxidizers and combustible liquids, which would result in a high hazard.

Waste Characteristics

- In-situ chemical oxidation is not effective on LNAPLs which have a lower volatility and solubility (e.g. diesel, heating oil). This technology is most appropriate for LNAPLs with a higher volatility and solubility.

Technology Limitations

- Implementation of in-situ chemical oxidation is implementable but would require the installation of a significant number of injection points at SWMU 13. As many of the former concrete slabs remain on site, a significant effort would be required to remove or core the concrete to install injection points.
- Due to the area requiring treatment, costs are expected to be relatively high.
- In comparison to other technologies, the remedial time-frame would be short.
- Minimal amounts of waste requiring handling and management would be generated.

Reject – In-situ chemical oxidation has been rejected as an appropriate technology at SMMU 13 due to its limited effectiveness in treating heavy end LNAPL, such as diesel fuel. In-situ chemical oxidation is also less effective in fine grain soils, such as those found at the site. Use of this technology would result in a high cost as a significant number of injection points and multiple applications of an oxidation agent would likely be required.

H.4.5 Advanced Aerobic Biodegradation

Advanced aerobic biodegradation is the practice of adding oxygen releasing compounds (ORC) to saturated soil and groundwater to increase the number and vitality of indigenous microorganisms capable of performing biodegradation. The natural attenuation of petroleum hydrocarbons in untreated, oxygen depleted aquifers is slow. The addition of oxygen assists in the acceleration of the degradation process.

Site Characteristics

- The effectiveness of advanced aerobic biodegradation is limited by amount of LNAPL requiring treatment. This technology would be most effective in treating residual LNAPL after mass removal by means of other technologies.

Waste Characteristics

- Advanced aerobic biodegradation is a proven technology for the treatment of petroleum hydrocarbons.
- The amount of ORC required is dependent on the amount of LNAPL to be treated.

Technology Limitations

- Advanced aerobic biodegradation would only be cost effective in treating residual levels of petroleum hydrocarbon contamination. The use of ORC would be most effective in combination with other technologies that remove the majority of the LNAPL prior to the application of ORC.

Retain – Advanced aerobic biodegradation has been retained for consideration with other mass removal technologies, as it is proven to be an effective technology for treating residual concentrations of petroleum hydrocarbons.

H.4.6 Bio-Ponding

Bio-ponding consists of the excavation of a pit within the area of free product, installation of a sump pump and aeration system, and land-farming petroleum contaminated soil on site. The aeration of site groundwater promotes volatilization of and oxygenation to promote degradation of petroleum hydrocarbons.

Site Characteristics

- The effectiveness of bio-ponding and aeration of groundwater may be limited by the aerial extent of LNAPL and limited mobility due to site gradient. Land-farming of petroleum contaminated soil on site would be effective in treating excavated soil.

Waste Characteristics

- Oxygenation would enhance aerobic biodegradation of petroleum hydrocarbons.
- Land-farming would effectively treat contaminated soil which could be re-used as backfill material.

Technology Limitations

- As noted above, based on the groundwater gradient at the site, oxygenation and biodegradation may only occur within the ponding area.

Retain – Bio-ponding has been retained for consideration, as it provides an effective means of treating contaminated soil, and does provide some enhancement to natural attenuation of LNAPL within the excavated pit.

H.5 PHASE CHANGE AND MASS REMOVAL

H.5.1 Surfactant Enhanced Subsurface Remediation

A surfactant is injected that increases LNAPL solubility and LNAPL mobility. The dissolved phase and LNAPL are then recovered via hydraulic recovery.

Site Characteristics

- Surfactant enhanced subsurface remediation would only be an appropriate technology if implemented along with a technology that provides hydraulic controls and mass removal. This technology is most effective in course grained homogeneous soils. The success rate is higher for very small LNAPL bodies. As the treatment area increases in size, the chance for success decreases.
- Surfactants are not dangerous, but there may be safety issues due to the equipment used to inject the surfactant and treat the extracted mixture. LNAPL may be extracted and handled.

Waste Characteristics

- Surfactant enhanced subsurface remediation is effective in the removal of medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- As indicated above, implementation of surfactant enhanced remediation would require the implementation of other technologies (such as groundwater treatment) to provide hydraulic control and mass recovery. This technology is only applicable to the saturated zone, thus requiring an additional technology to address the unsaturated zone.
- Costs associated with this technology are considered high when implemented with other recovery technologies.

Reject – Surfactant enhanced subsurface remediation has been rejected as an appropriate technology at SWMU 13, due to its ineffectiveness in fine grain soils, and its inability to treat the unsaturated zone. In order to implement this technology, a technology capable of treating the unsaturated zone would also be required, resulting in a high capital implementation and operation and maintenance costs.

H.5.2 Steam/Hot Air Injection

LNAPL is removed by forcing steam into the aquifer to vaporize, solubilize, and induce LNAPL flow. Vapors, dissolved phase, and LNAPL are recovered via vapor extraction and hydraulic recovery.

Site Characteristics

- Steam/hot air injection is effective in treating both light and heavy end petroleum hydrocarbons in the saturated and unsaturated zones. This technology is most effective in course grained materials. Implementation of this technology would only be appropriate if implemented along with a technology that provides hydraulic controls and mass removal.
- The primary safety issue associated with steam/hot air injection is the generation of vapors at the surface.

Waste Characteristics

- Steam/hot air injection is effective in the removal of medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- Steam/hot air injection is most effective in course grained material. Spacing and density of injection probes is critical in obtaining effective dispersion efficiency of the steam/hot air.
- High costs to generate and maintain steam and high operation and maintenance costs. In short durations, this technology may be cost effective.

Reject – Steam/hot air injection has been rejected as an appropriate technology at SWMU 13 due to its ineffectiveness in fine grain material, and the high cost associated with the installation of injection points required to obtain effective dispersion. Additionally, in order to implement this technology, other measures capable of recovering and treating vapors, dissolved phase petroleum constituents, and LNAPL would be required. Costs associated with the implementation, operations, maintenance, and waste management would be very high.

H.6 MASS CONTROL

H.6.1 Extraction Trench

Physical containment uses engineered barriers to control horizontal migration of LNAPL, isolate LNAPL, and allow for removal of LNAPL by hydraulic recovery. An intercept trench would be installed to collect free product which would be removed from the trench with skimming pumps installed in collection sumps.

Site Characteristics

- The effectiveness of an extraction trench for mass removal is most effective with mobile LNAPL. Implementation of this technology for mass removal would be limited due to the relatively flat groundwater gradient at the site. If containment is the goal, with removal of as much LNAPL as is practicable, such a trench would be effective over the long term.
- Some potential for construction related safety issues that are typical and routine. Potential side wall collapse during excavation and long-term geotechnical stability.

Waste Characteristics

- An intercept trench would be effective in the removal of mobile LNAPL from the saturated and unsaturated zone. Site conditions at SWMU 13 indicate that LNAPL mobility is limited due to the fine-grained subsurface material and lack of groundwater gradient at the site.

Technology Limitations

- Based on the depth to groundwater, construction of an extraction trench at SWMU 13 is feasible. As indicated above, installation of a collection trench would provide containment, with limited mass removal.
- Cost may be significant depending on the length and depth of the containment structure trench.

Retain – An extraction trench has been retained for further consideration. An extraction trench would be effective for containment of LNAPL.

H.6.2 In-Situ Soil Mixing (Stabilization)

In-situ soil mixing uses mechanical mixing of soil or aquifer materials with chemical oxidants, and/or, low-permeability materials such as clay or Portland cement.

Site Characteristics

- In-situ soil mixing (stabilization) is effective in treating both light and heavy end hydrocarbons in both the saturated and unsaturated zone. This technology can be implemented as a single technology that will stabilize the source area, as well as minimize further degradation of groundwater.

- Some potentially significant safety issues associated with mixing oxidizers with combustible liquids as well as temporary ground surface instability.

Waste Characteristics

- In-situ soil mixing is effective in immobilizing medium to heavy LNAPL with low volatility and solubility (e.g., weathered gasoline, diesel fuel, fuel oil, crude oil, etc.), as well as light LNAPL with high volatility and solubility (e.g., gasoline, benzene, ethylbenzene, toluene, etc.).

Technology Limitations

- Due to the depth of groundwater at SWMU 13, implementation of this technology is feasible. Implementation of this technology will require long-term residual waste management.

Retain – In-situ soil mixing is retained for further consideration in conjunction with other technologies. This technology alone does not completely satisfy the CAOs.

APPENDIX I

JOHNSON AND ETTINGER MODEL SPREADSHEETS

TABLE I.1
NON-DETECTS IN SOIL GAS GREATER THAN THE PROJECT ACTION LIMITS
Tooele Army Depot - South

Analyte	Project Action Limit ($\mu g/m^3$)	Maximum LOD for Non-Detects ($\mu g/m^3$)	Maximum MDL for Non-Detects ($\mu g/m^3$)
1,1,2,2-Tetrachloroethane	0.48	99	37
1,1,2-Trichloroethane	1.8	100	40
1,1-Dichloroethane	18	100	40
1,2-Dichloroethane	1.08	100	40
1,2-Dichloropropane	2.8	100	40
1,4-Dichlorobenzene	2.6	100	35
Carbon tetrachloride	4.7	100	37
Chloroform	1.2	100	42
Ethylbenzene	11	100	40
Naphthalene	0.83	100	45
Trichloroethene	4.8	100	35
Vinyl chloride	1.7	97	42

Definitions: LOD – limit of detection; MDL – method detection limit.

SG-ADV
Version 2.0; 02/03

DATA ENTRY SHEET
Residents - Evaluation of Non-Detects at 13-SG-02 using MDLs

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
79345	3.70E+01			1,1,2,2-Tetrachloroethane
79005	4.00E+01			1,1,2-Trichloroethane
75343	4.00E+01			1,1-Dichloroethane
107062	4.00E+01			1,2-Dichloroethane
78875	4.00E+01			1,2-Dichloropropane
106467	3.50E+01			1,4-Dichlorobenzene
56235	3.70E+01			Carbon tetrachloride
67663	4.20E+01			Chloroform
100414	4.00E+01			Ethylbenzene
91203	**4.50E+01**			**Naphthalene**
79016	**3.50E+01**			**Trichloroethene**
75014	**4.20E+01**			**Vinyl chloride**

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^{o}C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
S	1.66	0.375	0.054								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)		ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.45		5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Exposure Time ET (unitless)
70	26	26	350	1

END

CHEMICAL PROPERTIES SHEET
Residents - Evaluation of Non-Detects at 13-SG-02 using MDLs

COPC	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1,1,2,2-Tetrachloroethane	7.10E-02	7.90E-06	3.44E-04	25	8,996	419.60	661.15	167.85	5.8E-05	2.1E-01
1,1,2-Trichloroethane	7.80E-02	8.80E-06	9.11E-04	25	8,322	386.15	602.00	133.41	1.6E-05	1.4E-02
1,1-Dichloroethane	7.42E-02	1.05E-05	5.61E-03	25	6,895	330.55	523.00	98.96	0.0E+00	5.0E-01
1,2-Dichloroethane	1.04E-01	9.90E-06	9.77E-04	25	7,643	356.65	561.00	98.96	2.6E-05	0.0E+00
1,2-Dichloropropane	7.82E-02	8.73E-06	2.79E-03	25	7,590	369.52	572.00	112.99	1.9E-05	4.0E-03
1,4-Dichlorobenzene	6.90E-02	7.90E-06	2.39E-03	25	9,271	447.21	684.75	147.00	0.0E+00	8.0E-01
Carbon tetrachloride	7.80E-02	8.80E-06	3.03E-02	25	7,127	349.90	556.60	153.82	1.5E-05	0.0E+00
Chloroform	1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	119.38	2.3E-05	9.8E-02
Ethylbenzene	7.50E-02	7.80E-06	7.86E-03	25	8,501	409.34	617.20	106.17	2.5E-06	1.0E+00
Naphthalene	5.90E-02	7.50E-06	4.82E-04	25	10,373	491.14	748.40	128.18	3.4E-05	3.0E-03
Trichloroethene	7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	131.39	1.1E-04	4.0E-02
Vinyl chloride	1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	62.50	8.8E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET
Residents - Evaluation of Non-Detects at 13-SG-02 using MDLs

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	3.70E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	3.50E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	3.70E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.20E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.50E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	3.50E+01	3.05E+04
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.20E+01	3.05E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	10,529	1.44E-04	6.19E-03	1.76E-04	1.15E-02	0.00E+00	0.00E+00	1.15E-02	137.4
1.06E+06	3.77E-04	15	9,560	4.14E-04	1.77E-02	1.76E-04	1.26E-02	0.00E+00	0.00E+00	1.26E-02	137.4
1.06E+06	3.77E-04	15	7,438	3.03E-03	1.30E-01	1.76E-04	1.20E-02	0.00E+00	0.00E+00	1.20E-02	137.4
1.06E+06	3.77E-04	15	8,510	4.84E-04	2.07E-02	1.76E-04	1.68E-02	0.00E+00	0.00E+00	1.68E-02	137.4
1.06E+06	3.77E-04	15	8,620	1.37E-03	5.88E-02	1.76E-04	1.26E-02	0.00E+00	0.00E+00	1.26E-02	137.4
1.06E+06	3.77E-04	15	11,232	9.47E-04	4.06E-02	1.76E-04	1.12E-02	0.00E+00	0.00E+00	1.12E-02	137.4
1.06E+06	3.77E-04	15	7,848	1.59E-02	6.80E-01	1.76E-04	1.26E-02	0.00E+00	0.00E+00	1.26E-02	137.4
1.06E+06	3.77E-04	15	7,543	1.96E-03	8.42E-02	1.76E-04	1.68E-02	0.00E+00	0.00E+00	1.68E-02	137.4
1.06E+06	3.77E-04	15	10,143	3.40E-03	1.46E-01	1.76E-04	1.21E-02	0.00E+00	0.00E+00	1.21E-02	137.4
1.06E+06	3.77E-04	15	12,901	1.66E-04	7.12E-03	1.76E-04	9.54E-03	0.00E+00	0.00E+00	9.54E-03	137.4
1.06E+06	3.77E-04	15	8,543	5.08E-03	2.18E-01	1.76E-04	1.28E-02	0.00E+00	0.00E+00	1.28E-02	137.4
1.06E+06	3.77E-04	15	4,988	1.78E-02	7.65E-01	1.76E-04	1.71E-02	0.00E+00	0.00E+00	1.71E-02	137.4

INTERMEDIATE CALCULATIONS SHEET
Residents - Evaluation of Non-Detects at 13-SG-02 using MDLs

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF (mg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	3.70E+01	0.10	8.33E+01	1.15E-02	4.00E+02	6.69E+78	1.41E-03	5.21E-02	5.8E-05	2.1E-01
15	4.00E+01	0.10	8.33E+01	1.26E-02	4.00E+02	5.67E+71	1.47E-03	5.89E-02	1.6E-05	1.4E-02
15	4.00E+01	0.10	8.33E+01	1.20E-02	4.00E+02	2.69E+75	1.44E-03	5.75E-02	NA	5.0E-01
15	4.00E+01	0.10	8.33E+01	1.68E-02	4.00E+02	6.53E+53	1.66E-03	6.65E-02	2.6E-05	NA
15	4.00E+01	0.10	8.33E+01	1.26E-02	4.00E+02	3.72E+71	1.47E-03	5.89E-02	1.9E-05	4.0E-03
15	3.50E+01	0.10	8.33E+01	1.12E-02	4.00E+02	1.30E+81	1.39E-03	4.86E-02	NA	8.0E-01
15	3.70E+01	0.10	8.33E+01	1.26E-02	4.00E+02	5.68E+71	1.47E-03	5.44E-02	1.5E-05	NA
15	4.20E+01	0.10	8.33E+01	1.68E-02	4.00E+02	6.54E+53	1.66E-03	6.99E-02	2.3E-05	9.8E-02
15	4.00E+01	0.10	8.33E+01	1.21E-02	4.00E+02	4.21E+74	1.44E-03	5.78E-02	2.5E-06	1.0E+00
15	4.50E+01	0.10	8.33E+01	9.54E-03	4.00E+02	7.20E+94	1.28E-03	5.77E-02	3.4E-05	3.0E-03
15	3.50E+01	0.10	8.33E+01	1.28E-02	4.00E+02	7.02E+70	1.48E-03	5.18E-02	1.1E-04	4.0E-02
15	4.20E+01	0.10	8.33E+01	1.71E-02	4.00E+02	6.32E+52	1.68E-03	7.04E-02	8.8E-06	1.0E-01

RESULTS SHEET
Residents - Evaluation of Non-Detects at 13-SG-02 using MDLs

COPC	**Incremental Risk from Vapor** intrusion to indoor air, carcinogen (unitless)	**Hazard Quotient from Vapor** intrusion to indoor air, noncarcinogen (unitless)
1,1,2,2-Tetrachloroethane	1.08E-06	2.38E-04
1,1,2-Trichloroethane	3.35E-07	4.03E-03
1,1-Dichloroethane	-	1.10E-04
1,2-Dichloroethane	6.16E-07	-
1,2-Dichloropropane	4.07E-07	1.41E-02
1,4-Dichlorobenzene	-	5.82E-05
Carbon tetrachloride	2.91E-07	-
Chloroform	5.72E-07	6.84E-04
Ethylbenzene	**5.15E-08**	**5.54E-05**
Naphthalene	**6.98E-07**	**1.84E-02**
Trichloroethene	**2.03E-06**	**1.24E-03**
Vinyl chloride	**2.21E-07**	**6.75E-04**
Total:	**6E-06**	**0.04**

SG-ADV
Version 2.0; 02/03

Reset to Defaults

DATA ENTRY SHEET
Industrial Workers - Evaluation of Non-Detects at 13-SG-02 using MDLs

Soil Gas Concentration Data

ENTER **Chemical** CAS No. (numbers only, no dashes)	ENTER **Soil gas** conc., C_g (mg/m^3)	OR	ENTER **Soil gas** conc., C_g (ppmv)	Chemical
79345	3.70E+01			1,1,2,2-Tetrachloroethane
79005	4.00E+01			1,1,2-Trichloroethane
75343	4.00E+01			1,1-Dichloroethane
107062	4.00E+01			1,2-Dichloroethane
78875	4.00E+01			1,2-Dichloropropane
106467	3.50E+01			1,4-Dichlorobenzene
56235	3.70E+01			Carbon tetrachloride
67663	4.20E+01			Chloroform
100414	4.00E+01			Ethylbenzene
91203	4.50E+01			Naphthalene
79016	3.50E+01			Trichloroethene
75014	4.20E+01			Vinyl chloride

MORE
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ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	S		

MORE
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ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
S	1.66	0.375	0.054								

MORE
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ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP $(g/cm\text{-}s^2)$	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)		ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	1.5		5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Exposure Time ET (unitless)
70	25	25	250	0.333333333

END

CHEMICAL PROPERTIES SHEET
Industrial Workers - Evaluation of Non-Detects at 13-SG-02 using MDLs

COPC	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^{o}C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^{o}K)	Critical temperature, T_C (^{o}K)	Molecular weight, MW (g/mol)	Unit risk factor, URF (mg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
1,1,2,2-Tetrachloroethane	7.10E-02	7.90E-06	3.44E-04	25	8,996	419.60	661.15	167.85	5.8E-05	2.1E-01
1,1,2-Trichloroethane	7.80E-02	8.80E-06	9.11E-04	25	8,322	386.15	602.00	133.41	1.6E-05	1.4E-02
1,1-Dichloroethane	7.42E-02	1.05E-05	5.61E-03	25	6,895	330.55	523.00	98.96	0.0E+00	5.0E-01
1,2-Dichloroethane	1.04E-01	9.90E-06	9.77E-04	25	7,643	356.65	561.00	98.96	2.6E-05	0.0E+00
1,2-Dichloropropane	7.82E-02	8.73E-06	2.79E-03	25	7,590	369.52	572.00	112.99	1.9E-05	4.0E-03
1,4-Dichlorobenzene	6.90E-02	7.90E-06	2.39E-03	25	9,271	447.21	684.75	147.00	0.0E+00	8.0E-01
Carbon tetrachloride	7.80E-02	8.80E-06	3.03E-02	25	7,127	349.90	556.60	153.82	1.5E-05	0.0E+00
Chloroform	1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	119.38	2.3E-05	9.8E-02
Ethylbenzene	7.50E-02	7.80E-06	7.86E-03	25	8,501	409.34	617.20	106.17	2.5E-06	1.0E+00
Naphthalene	5.90E-02	7.50E-06	4.82E-04	25	10,373	491.14	748.40	128.18	3.4E-05	3.0E-03
Trichloroethene	7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	131.39	1.1E-04	4.0E-02
Vinyl chloride	1.06E-01	1.23E-05	2.69E-02	25	5,250	259.25	432.00	62.50	8.8E-06	1.0E-01

END

INTERMEDIATE CALCULATIONS SHEET
Industrial Workers - Evaluation of Non-Detects at 13-SG-02 using MDLs

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	3.70E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	3.50E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	3.70E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.20E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.00E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.50E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	3.50E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	4.20E+01	1.02E+05
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	#N/A	1.02E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	10,529	1.44E-04	6.19E-03	1.76E-04	1.15E-02	0.00E+00	0.00E+00	1.15E-02	137.4
1.06E+06	3.77E-04	15	9,560	4.14E-04	1.77E-02	1.76E-04	1.26E-02	0.00E+00	0.00E+00	1.26E-02	137.4
1.06E+06	3.77E-04	15	7,438	3.03E-03	1.30E-01	1.76E-04	1.20E-02	0.00E+00	0.00E+00	1.20E-02	137.4
1.06E+06	3.77E-04	15	8,510	4.84E-04	2.07E-02	1.76E-04	1.68E-02	0.00E+00	0.00E+00	1.68E-02	137.4
1.06E+06	3.77E-04	15	8,620	1.37E-03	5.88E-02	1.76E-04	1.26E-02	0.00E+00	0.00E+00	1.26E-02	137.4
1.06E+06	3.77E-04	15	11,232	9.47E-04	4.06E-02	1.76E-04	1.12E-02	0.00E+00	0.00E+00	1.12E-02	137.4
1.06E+06	3.77E-04	15	7,848	1.59E-02	6.80E-01	1.76E-04	1.26E-02	0.00E+00	0.00E+00	1.26E-02	137.4
1.06E+06	3.77E-04	15	7,543	1.96E-03	8.42E-02	1.76E-04	1.68E-02	0.00E+00	0.00E+00	1.68E-02	137.4
1.06E+06	3.77E-04	15	10,143	3.40E-03	1.46E-01	1.76E-04	1.21E-02	0.00E+00	0.00E+00	1.21E-02	137.4
1.06E+06	3.77E-04	15	12,901	1.66E-04	7.12E-03	1.76E-04	9.54E-03	0.00E+00	0.00E+00	9.54E-03	137.4
1.06E+06	3.77E-04	15	8,543	5.08E-03	2.18E-01	1.76E-04	1.28E-02	0.00E+00	0.00E+00	1.28E-02	137.4
1.06E+06	3.77E-04	15	4,988	1.78E-02	7.65E-01	1.76E-04	1.71E-02	0.00E+00	0.00E+00	1.71E-02	137.4

INTERMEDIATE CALCULATIONS SHEET
Industrial Workers - Evaluation of Non-Detects at 13-SG-02 using MDLs

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF (mg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	3.70E+01	0.10	8.33E+01	1.15E-02	4.00E+02	6.69E+78	4.22E-04	1.56E-02	5.8E-05	2.1E-01
15	4.00E+01	0.10	8.33E+01	1.26E-02	4.00E+02	5.67E+71	4.41E-04	1.77E-02	1.6E-05	1.4E-02
15	4.00E+01	0.10	8.33E+01	1.20E-02	4.00E+02	2.69E+75	4.31E-04	1.73E-02	NA	5.0E-01
15	4.00E+01	0.10	8.33E+01	1.68E-02	4.00E+02	6.53E+53	4.99E-04	2.00E-02	2.6E-05	NA
15	4.00E+01	0.10	8.33E+01	1.26E-02	4.00E+02	3.72E+71	4.42E-04	1.77E-02	1.9E-05	4.0E-03
15	3.50E+01	0.10	8.33E+01	1.12E-02	4.00E+02	1.30E+81	4.16E-04	1.46E-02	NA	8.0E-01
15	3.70E+01	0.10	8.33E+01	1.26E-02	4.00E+02	5.68E+71	4.41E-04	1.63E-02	1.5E-05	NA
15	4.20E+01	0.10	8.33E+01	1.68E-02	4.00E+02	6.54E+53	4.99E-04	2.10E-02	2.3E-05	9.8E-02
15	4.00E+01	0.10	8.33E+01	1.21E-02	4.00E+02	4.21E+74	4.33E-04	1.73E-02	2.5E-06	1.0E+00
15	4.50E+01	0.10	8.33E+01	9.54E-03	4.00E+02	7.20E+94	3.84E-04	1.73E-02	3.4E-05	3.0E-03
15	3.50E+01	0.10	8.33E+01	1.28E-02	4.00E+02	7.02E+70	4.44E-04	1.55E-02	1.1E-04	4.0E-02
15	4.20E+01	0.10	8.33E+01	1.71E-02	4.00E+02	6.32E+52	5.03E-04	2.11E-02	8.8E-06	1.0E-01

RESULTS SHEET
Industrial Workers - Evaluation of Non-Detects at 13-SG-02 using MDLs

COPC	**Incremental Risk from Vapor** intrusion to indoor air, carcinogen (unitless)	**Hazard Quotient from Vapor** intrusion to indoor air, noncarcinogen (unitless)
1,1,2,2-Tetrachloroethane	7.39E-08	1.70E-05
1,1,2-Trichloroethane	2.30E-08	2.88E-04
1,1-Dichloroethane	-	7.88E-06
1,2-Dichloroethane	4.23E-08	-
1,2-Dichloropropane	2.80E-08	1.01E-03
1,4-Dichlorobenzene	-	4.16E-06
Carbon tetrachloride	2.00E-08	-
Chloroform	3.93E-08	4.88E-05
Ethylbenzene	3.53E-09	3.96E-06
Naphthalene	4.80E-08	1.32E-03
Trichloroethene	1.39E-07	8.87E-05
Vinyl chloride	1.52E-08	4.82E-05
Total:	**4E-07**	**0.003**

DATA ENTRY SHEET
13-SG-01 Benzene in Soil Gas

SG-ADV
Version 3.1; 02/04

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	1.30E+01			Benzene

MORE ↓

Totals must add up to value of Ls (cell F24)

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	79.248	73.152	0	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
S	1.66	0.375	0.054	SIL	1.49	0.439	0.18				

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.45	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	26	26	350

END

CHEMICAL PROPERTIES SHEET
13-SG-01 Benzene in Soil Gas

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^{o}C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^{o}K)	Critical temperature, T_C (^{o}K)	Molecular weight, MW (g/mol)	Unit risk factor, URF (mg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	78.11	7.8E-06	3.0E-02

INTERMEDIATE CALCULATIONS SHEET
13-SG-01 Benzene in Soil Gas

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
8.20E+08	137.4	0.321	0.259	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	1.30E+01	3.05E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	8,111	2.83E-03	1.22E-01	1.76E-04	1.42E-02	5.08E-03	0.00E+00	7.26E-03	137.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.30E+01	0.10	8.33E+01	1.42E-02	4.00E+02	3.99E+63	1.10E-03	1.43E-02	7.8E-06	3.0E-02

END

RESULTS SHEET
13-SG-01 Benzene in Soil Gas

INCREMENTAL RISK CALCULATIONS:			Screening Levels:	
Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)		Cancer Soil gas conc., C_g (mg/m^3)	Noncancer Soil gas conc., C_g (mg/m^3)
4.0E-08	4.6E-04		3.3E+02	2.8E+04

MESSAGE AND ERROR SUMMARY BELOW:
(DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET
13-SG-02 Benzene in Soil Gas

SG-ADV
Version 3.1; 02/04

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	1.60E+02			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
S	1.66	0.375	0.054								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP ($g/cm-s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)		ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.45		5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	26	26	350

END

CHEMICAL PROPERTIES SHEET
13-SG-02 Benzene in Soil Gas

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	78.11	7.8E-06	3.0E-02

INTERMEDIATE CALCULATIONS SHEET
13-SG-02 Benzene in Soil Gas

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	1.60E+02	3.05E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	8,111	2.83E-03	1.22E-01	1.76E-04	1.42E-02	0.00E+00	0.00E+00	1.42E-02	137.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.60E+02	0.10	8.33E+01	1.42E-02	4.00E+02	3.99E+63	1.55E-03	2.48E-01	7.8E-06	3.0E-02

END

RESULTS SHEET
13-SG-02 Benzene in Soil Gas

INCREMENTAL RISK CALCULATIONS:			Screening Levels:	
Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)		Cancer Soil gas conc., C_g (mg/m^3)	Noncancer Soil gas conc., C_g (mg/m^3)
6.9E-07	7.9E-03		2.3E+02	2.0E+04

MESSAGE AND ERROR SUMMARY BELOW:
(DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET
13-SG-04 Benzene in Soil Gas

SG-ADV
Version 3.1; 02/04

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	2.40E+01			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	SIL		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
SIL	1.49	0.439	0.18								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP ($g/cm-s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.45	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	26	26	350

END

CHEMICAL PROPERTIES SHEET
13-SG-04 Benzene in Soil Gas

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	78.11	7.8E-06	3.0E-02

INTERMEDIATE CALCULATIONS SHEET
13-SG-04 Benzene in Soil Gas

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
8.20E+08	137.4	0.259	ERROR	ERROR	0.307	2.82E-09	0.798	2.25E-09	4,000	2.40E+01	3.05E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, $D^{eff}{}_A$ (cm^2/s)	Stratum B effective diffusion coefficient, $D^{eff}{}_B$ (cm^2/s)	Stratum C effective diffusion coefficient, $D^{eff}{}_C$ (cm^2/s)	Total overall effective diffusion coefficient, $D^{eff}{}_T$ (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	8,111	2.83E-03	1.22E-01	1.76E-04	5.08E-03	0.00E+00	0.00E+00	5.08E-03	137.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.40E+01	0.10	8.33E+01	5.08E-03	4.00E+02	1.17E+178	8.74E-04	2.10E-02	7.8E-06	3.0E-02

END

RESULTS SHEET
13-SG-04 Benzene in Soil Gas

INCREMENTAL RISK CALCULATIONS:			Screening Levels:	
Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)		Cancer Soil gas conc., C_g (mg/m^3)	Noncancer Soil gas conc., C_g (mg/m^3)
5.8E-08	6.7E-04		4.1E+02	3.6E+04

MESSAGE AND ERROR SUMMARY BELOW:
(DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET
13-SG-04 Chloroform in Soil Gas

SG-ADV
Version 3.1; 02/04

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
67663	5.00E+01			Chloroform

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	SIL		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
SIL	1.49	0.439	0.18								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP $(g/cm\text{-}s^2)$	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.45	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	26	26	350

END

CHEMICAL PROPERTIES SHEET
13-SG-04 Chloroform in Soil Gas

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF ($(mg/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	119.38	2.3E-05	9.8E-02

INTERMEDIATE CALCULATIONS SHEET
13-SG-04 Chloroform in Soil Gas

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
8.20E+08	137.4	0.259	ERROR	ERROR	0.307	2.82E-09	0.798	2.25E-09	4,000	5.00E+01	3.05E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	7,543	1.96E-03	8.42E-02	1.76E-04	6.01E-03	0.00E+00	0.00E+00	6.01E-03	137.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF (mg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	5.00E+01	0.10	8.33E+01	6.01E-03	4.00E+02	4.59E+150	9.76E-04	4.88E-02	2.3E-05	9.8E-02

END

RESULTS SHEET

13-SG-04 Chloroform in Soil Gas

INCREMENTAL RISK CALCULATIONS:		Screening Levels:	
Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Cancer Soil gas conc., C_g (mg/m^3)	Noncancer Soil gas conc., C_g (mg/m^3)
4.0E-07	4.8E-04	1.3E+02	1.0E+05

MESSAGE AND ERROR SUMMARY BELOW:
(DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET
13-SG-04 Ethylbenzene in Soil Gas

SG-ADV
Version 3.1; 02/04

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
100414	1.90E+01			Ethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^{o}C)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	SIL		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
SIL	1.49	0.439	0.18								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.45	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	26	26	350

END

CHEMICAL PROPERTIES SHEET
13-SG-04 Ethylbenzene in Soil Gas

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.50E-02	7.80E-06	7.86E-03	25	8,501	409.34	617.20	106.17	2.5E-06	1.0E+00

INTERMEDIATE CALCULATIONS SHEET
13-SG-04 Ethylbenzene in Soil Gas

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
8.20E+08	137.4	0.259	ERROR	ERROR	0.307	2.82E-09	0.798	2.25E-09	4,000	1.90E+01	3.05E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	10,143	3.40E-03	1.46E-01	1.76E-04	4.33E-03	0.00E+00	0.00E+00	4.33E-03	137.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	1.90E+01	0.10	8.33E+01	4.33E-03	4.00E+02	8.80E+208	7.82E-04	1.49E-02	2.5E-06	1.0E+00

END

RESULTS SHEET
13-SG-04 Ethylbenzene in Soil Gas

INCREMENTAL RISK CALCULATIONS:			Screening Levels:	
Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)		Cancer Soil gas conc., C_g (mg/m^3)	Noncancer Soil gas conc., C_g (mg/m^3)
1.3E-08	1.4E-05		1.4E+03	1.3E+06

MESSAGE AND ERROR SUMMARY BELOW:
(DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET
13-SG-04 Trichloroethene in Soil Gas

SG-ADV
Version 3.1; 02/04

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
79016	2.20E+00			Trichloroethylene

MORE ↓

			ENTER	ENTER	ENTER			
			Totals must add up to value of Ls (cell F24)					
ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	Thickness of soil stratum A, h_A (cm)	Thickness of soil stratum B, (Enter value or 0) h_B (cm)	Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	SIL		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
SIL	1.49	0.439	0.18								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.45	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	26	26	350

END

CHEMICAL PROPERTIES SHEET
13-SG-04 Trichloroethene in Soil Gas

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF ($(mg/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	131.39	4.1E-06	2.0E-03

INTERMEDIATE CALCULATIONS SHEET
13-SG-04 Trichloroethene in Soil Gas

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
8.20E+08	137.4	0.259	ERROR	ERROR	0.307	2.82E-09	0.798	2.25E-09	4,000	2.20E+00	3.05E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	8,543	5.08E-03	2.18E-01	1.76E-04	4.56E-03	0.00E+00	0.00E+00	4.56E-03	137.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	2.20E+00	0.10	8.33E+01	4.56E-03	4.00E+02	2.37E+198	8.11E-04	1.78E-03	4.1E-06	2.0E-03

END

Residents, USEPA Toxicity Values, Vapor Intrusion from Groundwater
USEPA's ADAF Spreadsheet for Trichloroethene Risk Calculations

Note: Highlighed cells can be adjusted depending on exposure scenario
(e.g., in Col C, set to 0 for age groups without exposure)

Inhalation (concentration-equivalence across age groups)

Adjusted by Parsons to include Exposure Frequency

Col A	Col B	Col C		Col D	Col E	Col F	Col G	Col H	Col I	Col J	Col K	Col L
	Exposure Scenario Parameters					Dose-Response Assessment Calculations						
Units:		$(\mu g/m^3$ air)	-	yr	-	$(\mu g/m^3$ air$)^{-1}$	-	-	$(\mu g/m^3$ air$)^{-1}$	$(\mu g/m^3$ air$)^{-1}$	-	-
Age group	Risk per $\mu g/m^3$ Air Equivalence	Exposure Concentration	**EF (Exposure Frequency)**	Age Group Duration	Duration Adjustment (Col D / 70 yr)	Kidney Unadjusted Lifetime Unit Risk (p 5-137 [5.2.2.1.4])	Kidney Cancer Default ADAF	**Kidney ADAF-Adjusted Partial Risk (Col B x Col C x Col E x Col F x Col G x EF)**	Kidney+NHL+ Liver Unadjusted Lifetime Unit Risk (p 5-139 [5.2.2.2])	NHL+ Liver Lifetime Unit Risk (Col I − Col F)	**NHL and Liver Partial Risk (Col B x Col C x Col E x Col J x EF)**	**Total Partial Risk (Col H + Col K)**
Birth to <1 month	1	1.78E-03	9.59E-01	0.083	0.0012	1.0E-06	10	**2.0E-11**	4.1E-06	3.1E-06	**6.3E-12**	**2.7E-11**
1 to <3 months	1	1.78E-03	9.59E-01	0.167	0.0024	1.0E-06	10	**4.1E-11**	4.1E-06	3.1E-06	**1.3E-11**	**5.3E-11**
3 to <6 months	1	1.78E-03	9.59E-01	0.250	0.0036	1.0E-06	10	**6.1E-11**	4.1E-06	3.1E-06	**1.9E-11**	**8.0E-11**
6 to <12 months	1	1.78E-03	9.59E-01	0.500	0.0071	1.0E-06	10	**1.2E-10**	4.1E-06	3.1E-06	**3.8E-11**	**1.6E-10**
1 to <2 years	1	1.78E-03	9.59E-01	1.000	0.0143	1.0E-06	10	**2.4E-10**	4.1E-06	3.1E-06	**7.6E-11**	**3.2E-10**
2 to <3 years	1	1.78E-03	9.59E-01	1.000	0.0143	1.0E-06	3	**7.3E-11**	4.1E-06	3.1E-06	**7.6E-11**	**1.5E-10**
3 to <6 years	1	1.78E-03	9.59E-01	3.000	0.0429	1.0E-06	3	**2.2E-10**	4.1E-06	3.1E-06	**2.3E-10**	**4.5E-10**
6 to <11 years	1	1.78E-03	9.59E-01	5.000	0.0714	1.0E-06	3	**3.7E-10**	4.1E-06	3.1E-06	**3.8E-10**	**7.5E-10**
11 to <16 years	1	1.78E-03	9.59E-01	5.000	0.0714	1.0E-06	3	**3.7E-10**	4.1E-06	3.1E-06	**3.8E-10**	**7.5E-10**
16 to <18	1	1.78E-03	9.59E-01	2.000	0.0286	1.0E-06	1	**4.9E-11**	4.1E-06	3.1E-06	**1.5E-10**	**2.0E-10**
18 to <21	1	1.78E-03	9.59E-01	3.000	0.0429	1.0E-06	1	**7.3E-11**	4.1E-06	3.1E-06	**2.3E-10**	**3.0E-10**
21 to <26	1	1.78E-03	9.59E-01	6.000	0.0857	1.0E-06	1	**1.5E-10**	4.1E-06	3.1E-06	**4.5E-10**	**6.0E-10**
26 to 70	1	1.78E-03	9.59E-01	0.000	0.0000	1.0E-06	1	**0.0E+00**	4.1E-06	3.1E-06	**0.0E+00**	**0.0E+00**
			350 days/yr								**Total unit risk:**	**3.83E-09**

RESULTS SHEET

13-SG-04 Trichloroethene in Soil Gas

INCREMENTAL RISK CALCULATIONS:			Screening Levels:	
Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)		Cancer Soil gas conc., C_g (mg/m^3)	Noncancer Soil gas conc., C_g (mg/m^3)
3.8E-09	8.6E-04		5.7E+02	2.6E+03

MESSAGE AND ERROR SUMMARY BELOW:
(DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET
Residents 13-SG-05 Chloroform in Soil Gas

SG-ADV
Version 3.1; 02/04

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
67663	9.60E+02			Chloroform

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
S	1.66	0.375	0.054								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP ($g/cm-s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	0.45	5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	26	26	350

END

CHEMICAL PROPERTIES SHEET
Residents 13-SG-05 Chloroform in Soil Gas

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	119.38	2.3E-05	9.8E-02

INTERMEDIATE CALCULATIONS SHEET
Residents 13-SG-05 Chloroform in Soil Gas

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
8.20E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	9.60E+02	3.05E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	7,543	1.96E-03	8.42E-02	1.76E-04	1.68E-02	0.00E+00	0.00E+00	1.68E-02	137.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF $(mg/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
15	9.60E+02	0.10	8.33E+01	1.68E-02	4.00E+02	6.54E+53	1.66E-03	1.60E+00	2.3E-05	9.8E-02

END

RESULTS SHEET
Residents 13-SG-05 Chloroform in Soil Gas

INCREMENTAL RISK CALCULATIONS:			Screening Levels:	
Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)		Cancer Soil gas conc., C_g (mg/m^3)	Noncancer Soil gas conc., C_g (mg/m^3)
1.3E-05	1.6E-02		7.3E+01	6.1E+04

MESSAGE AND ERROR SUMMARY BELOW:
(DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

DATA ENTRY SHEET
Industrial Workers 13-SG-05 Chloroform in Soil Gas

SG-ADV
Version 3.1; 02/04

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g (mg/m^3)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
67663	9.60E+02			Chloroform

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
15	152.4	11.1	152.4	0	0	S		

MORE ↓

ENTER Stratum A SCS soil type Lookup Soil Parameters	ENTER Stratum A soil dry bulk density, r_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, q_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type Lookup Soil Parameters	ENTER Stratum B soil dry bulk density, r_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, q_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type Lookup Soil Parameters	ENTER Stratum C soil dry bulk density, r_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, q_w^C (cm^3/cm^3)
S	1.66	0.375	0.054								

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, DP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)		ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	1000	1000	244	0.1	1.5		5

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	25	25	250

END

CHEMICAL PROPERTIES SHEET

Industrial Workers 13-SG-05 Chloroform in Soil Gas

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $DH_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF ($(mg/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	119.38	2.3E-05	9.8E-02

INTERMEDIATE CALCULATIONS SHEET
Industrial Workers 13-SG-05 Chloroform in Soil Gas

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. (mg/m^3)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	137.4	0.321	ERROR	ERROR	0.003	9.94E-08	0.998	9.93E-08	4,000	9.60E+02	1.02E+05

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
1.06E+06	3.77E-04	15	7,543	1.96E-03	8.42E-02	1.76E-04	1.68E-02	0.00E+00	0.00E+00	1.68E-02	137.4

Convection path length, L_p (cm)	Source vapor conc., C_{source} (mg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (mg/m^3)	Unit risk factor, URF (mg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
15	9.60E+02	0.10	8.33E+01	1.68E-02	4.00E+02	6.54E+53	4.99E-04	4.79E-01	2.3E-05	9.8E-02

END

RESULTS SHEET

Industrial Workers 13-SG-05 Chloroform in Soil Gas

INCREMENTAL RISK CALCULATIONS:		Screening Levels:	
Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)	Cancer Soil gas conc., C_g (mg/m^3)	Noncancer Soil gas conc., C_g (mg/m^3)
2.7E-06	3.3E-03	3.6E+02	2.9E+05

MESSAGE AND ERROR SUMMARY BELOW:
(DO NOT USE RESULTS IF ERRORS ARE PRESENT)

SCROLL DOWN TO "END"

END

APPENDIX J

LNAPL VOLUME ESTIMATE

APPENDIX J
SWMU 13 Free Product Volume Estimate

Well ID	Measured Product Thickness (ft.) (Parsons, 2014)	Estimated Product Thickness in Soil (ft.) *(Hf)*
S-CAM-1	1.52	0.235
A-CAM-2	0.93	0.144
S-28-88	0.61	0.094
	Average Thickness *(Avg H_f)*	0.158

$$H_f = \frac{H_o (P_w - P_o)}{P_o}$$

H_f = Thickness of hydrocarbon in formation

H_o = Thickness of hydrocarbon in well

P_w = Density of water (1.00)

P_o = Density of hydrocarbon [.866 for #2 fuel oil from Exhibit III-9 (USEPA 1996)]

Impacted Area (sq. feet)	Average Thickness (ft.)	Affected Volume (cu. Feet)	Effective Porosity (%)	Free Product Vol (cu. Feet)	Free Product Vol (gal)
60,000	0.158	9470	0.2	1894	14167

$$V = E_p \ (A \times Avg\ H_f)$$

V = Volume (cubic feet)

E_p = Effective porosity [0.20 for silt from Exhibit III-6 (USEPA 1996)]

A = Area of affected media (square feet)

Avg H_f = Thickess of hydrocarbons in formation

APPENDIX K

COST ESTIMATES FOR CORRECTIVE MEASURES ALTERNATIVES

Appendix K
TABLE K.1
SWMU 13 CMS COSTS
ALTERNATIVE 1 - EXCAVATION, ADVANCED AEROBIC BIODEGRADATION, AND ICs
Tooele Army Depot - South

Capital Cost	Units	Unit Cost	QTY	Total Cost
Excavate/Stockpile Cover Material	yd	$7	18000	**$121,904**
Excavate Contaminated Soil	yd	$7	13000	**$97,045**
Backfill Excavation	yd	$19	31000	**$573,500**
ORC Placement	ls	$25,500	1	**$25,500**
Load Contaminated Soil for Transport	yd	$9	13000	**$110,500**
Waste Transportation	trip	$474	435	**$206,147**
Waste Disposal	ton	$16	14918	**$244,921**
Sampling and Analysis	ls	$54,882	1	**$54,882**
			Subtotal	**$1,434,398**

Indirect Capital Cost	Total Cost
CMI-C Labor (Project Management, Engineering, and Staff Support)	**$157,956**
Fees (Profit, G&A, etc.)	**$121,230**
Travel	**$17,333**
Subtotal	**$296,518**

Annual Operation and Maintenance Costs (1 year)	Units	Unit Cost	QTY	Total Cost
Sampling and Analysis	ls	$11,153	1	**$11,153**
Labor (Project Management and Staff Support)	ls	$55,329	1	**$55,329**
Fees (Profit, G&A, etc.)	ls	$4,498	1	**$4,498**
Travel	ls	$936	1	**$936**
			Subtotal	**$71,916**
			Subtotal (CMI-C and 1 year O/M)	**$1,802,832**

Assumptions

1. Excavation and stockpiling of 18,000 cu yds cover material for backfill.
2. Excavate and dispose of 13,000 cu yds contaminated soil.
3. Disposal quantity assumes a soil density of 2295 lbs/cu yd.
4. In addition to reuse of cover material, assumes 1300 cu yds imported from local borrow site.
5. Groundwater monitoring will be conducted on an annual basis, with sampling for TPH-DRO, VOCs, SVOCs, and natural attenuation indicators.

Appendix K
TABLE K.2
SWMU 13 CMS COSTS
ALTERNATIVE 2 - LNAPL SKIMMING, NATURAL ATTENUATION, AND ICs
Tooele Army Depot - South

Capital Cost				
	Units	**Unit Cost**	**QTY**	**Total Cost**
Well Installation	ea	$5,915	2	**$11,830**
Skimming Pumps	ea	$2,475	5	**$12,373**
Waste Management	ls	$2,739	1	**$2,739**
Sampling and Analysis	ls	$6,688	1	**$6,688**
			Subtotal	**$33,631**

Indirect Capital Cost	
	Total Cost
CMI-C Labor (Project Management, Engineering, and Staff Support)	**$88,956**
Fees (Profit, G&A, etc.)	**$9,794**
Travel	**$3,319**
Subtotal	**$102,069**

Annual Operation and Maintenance Costs (1 year)				
	Units	**Unit Cost**	**QTY**	**Total Cost**
Skimming Pump Maintenance and Repair	ls	$1,696	1	**$1,696**
Waste Management	ls	$2,696	1	**$2,696**
Sampling and Analysis	ls	$15,980	1	**$15,980**
Labor (Project Management and Staff Support)	ls	$103,157	1	**$103,157**
Fees (Profit, G&A, etc.)	ls	$8,578	1	**$8,578**
Travel	ls	$4,212	1	**$4,212**
			Subtotal	**$136,319**

Subtotal (CMI-C and 1 year O/M) **$272,019**

Assumptions

1. Skimming pumps to be placed in wells S-CAM-1, S-CAM-2, S-28-88, and two newly installed wells.
2. Skimming pumps will be solar powered with no additional site utilities required.
3. Free product will be accumulated in 55 gallon drums with secondary containment at each well location.
4. Groundwater monitoring will be conducted on an annual basis, with sampling for TPH-DRO, VOCs, SVOCs, and natural attenuation indicators.

Appendix K

TABLE K.3

SWMU 13 CMS COSTS

ALTERNATIVE 3 - IN-SITU SOIL MIXING (STABILIZATION) AND ICs

Tooele Army Depot - South

Capital Cost	Units	Unit Cost	QTY	Total Cost
Excavate/Stockpile Cover Material	yd	$7	18000	**$120,433**
Borings	ea	$1,265	765	**$968,097**
Inject Reagent/Slurry	yd	$50	7500	**$373,350**
Backfill Excavation	yd	$19	18000	**$333,000**
Sampling and Analysis	ls	$12,210	1	**$12,210**
			Subtotal	**$1,807,089**

Indirect Capital Cost	Total Cost
CMI-C Labor (Project Management, Engineering, and Staff Support)	**$159,971**
Fees (Profit, G&A, etc.)	**$149,769**
Travel	**$17,333**
Subtotal	**$327,073**

Annual Operation and Maintenance Costs (1 year)	Units	Unit Cost	QTY	Total Cost
Sampling and Analysis	ls	$11,153	1	**$11,153**
Labor (Project Management and Staff Support)	ls	$55,329	1	**$55,329**
Fees (Profit, G&A, etc.)	ls	$4,498	1	**$4,498**
Travel	ls	$936	1	**$936**
			Subtotal	**$71,916**

Subtotal (CMI-C and 1 year O/M) **$2,206,078**

Assumptions

1. Excavation and stockpiling of 18,000 cu yds cover material for backfill.
2. Borings from 8 to 15 ft bgs, 765 boring required to cover 60,000 sq ft affected area.
3. Stablize 13,000 cu ft of contaminated media
4. Stabilization to be accomplished with cement based slurry.
5. Groundwater monitoring will be conducted on an annual basis, with sampling for TPH-DRO, VOCs, SVOCs, and natural attenuation indicators.

Appendix K
TABLE K.4
SWMU 13 CMS COSTS
ALTERNATIVE 4 - EXTRACTION TRENCH, NATURAL ATTENUATION, AND ICs
Tooele Army Depot - South

Capital Cost

	Units	Unit Cost	QTY	Total Cost
Trench Installation	ls	$11,199	1	**$11,199**
Skimming Pumps	ea	$2,434	10	**$24,335**
Collection Piping	ft	$45	650	**$29,431**
Waste Management	ls	$15,725	1	**$15,725**
Sampling and Analysis	ls	$6,828	1	**$6,828**
			Subtotal	**$87,518**

Indirect Capital Cost

	Total Cost
CMI-C Labor (Project Management, Engineering, and Staff Support)	**$100,424**
Fees (Profit, G&A, etc.)	**$15,868**
Travel	**$3,733**
Subtotal	**$120,024**

Annual Operation and Maintenance Costs (1 year)

	Units	Unit Cost	QTY	Total Cost
Skimming Pump Maintenance and Repair	ls	$1,510	1	**$1,510**
Waste Management	ls	$3,291	1	**$3,291**
Sampling and Analysis	ls	$15,074	1	**$15,074**
Labor (Project Management and Staff Support)	ls	$105,995	1	**$105,995**
Fees (Profit, G&A, etc.)	ls	$8,847	1	**$8,847**
Travel	ls	$4,493	1	**$4,493**
			Subtotal	**$139,210**

Subtotal (CMI-C and 1 year O/M) **$346,753**

Assumptions

1. 500 ft trench 2.5 ft wide x 15 ft deep.
2. Unimpacted soil to be used as backfill.
3. Free product to be removed from 10 collection sumps.
4. Skimming pumps will be solar powered with no additional site utilities required.
5. Free product will be accumulated in 55 gallon drums with secondary containment at each well location.
6. Groundwater monitoring will be conducted on an annual basis, with sampling for TPH-DRO, VOCs, SVOCs, and natural attenuation indicators.

Appendix K
TABLE K.5
SWMU 13 CMS COSTS
ALTERNATIVE 5 - BIO-PONDING AND ICs
Tooele Army Depot - South

Capital Cost	Units	Unit Cost	QTY	Total Cost
Excavate/Stockpile Cover Material	yd	$9	18000	**$153,059**
Excavate Contaminated Soil/Transport to Treatment Pad	yd	$19	13000	**$243,897**
Treatment Pad	ea	$25,500	1	**$25,500**
Soil/Groundwater Treatment	yd	$480,387	1	**$480,387**
Backfill Excavation	yd	$26	13000	**$333,000**
Groundwater Aeration System	ea	$18,000	1	**$18,000**
Sampling and Analysis	ls	$31,714	1	**$31,714**
			Subtotal	**$1,285,556**

Indirect Capital Cost		Total Cost
CMI-C Labor (Project Management, Engineering, and Staff Support)		**$207,450**
Fees (Profit, G&A, etc.)		**$112,850**
Travel		**$17,333**
	Subtotal	**$337,633**

Annual Operation and Maintenance Costs (1 year)	Units	Unit Cost	QTY	Total Cost
Sampling and Analysis	ls	$11,153	1	**$11,153**
Labor (Project Management and Staff Support)	ls	$55,329	1	**$55,329**
Fees (Profit, G&A, etc.)	ls	$4,498	1	**$4,498**
Travel	ls	$936	1	**$936**
			Subtotal	**$71,916**

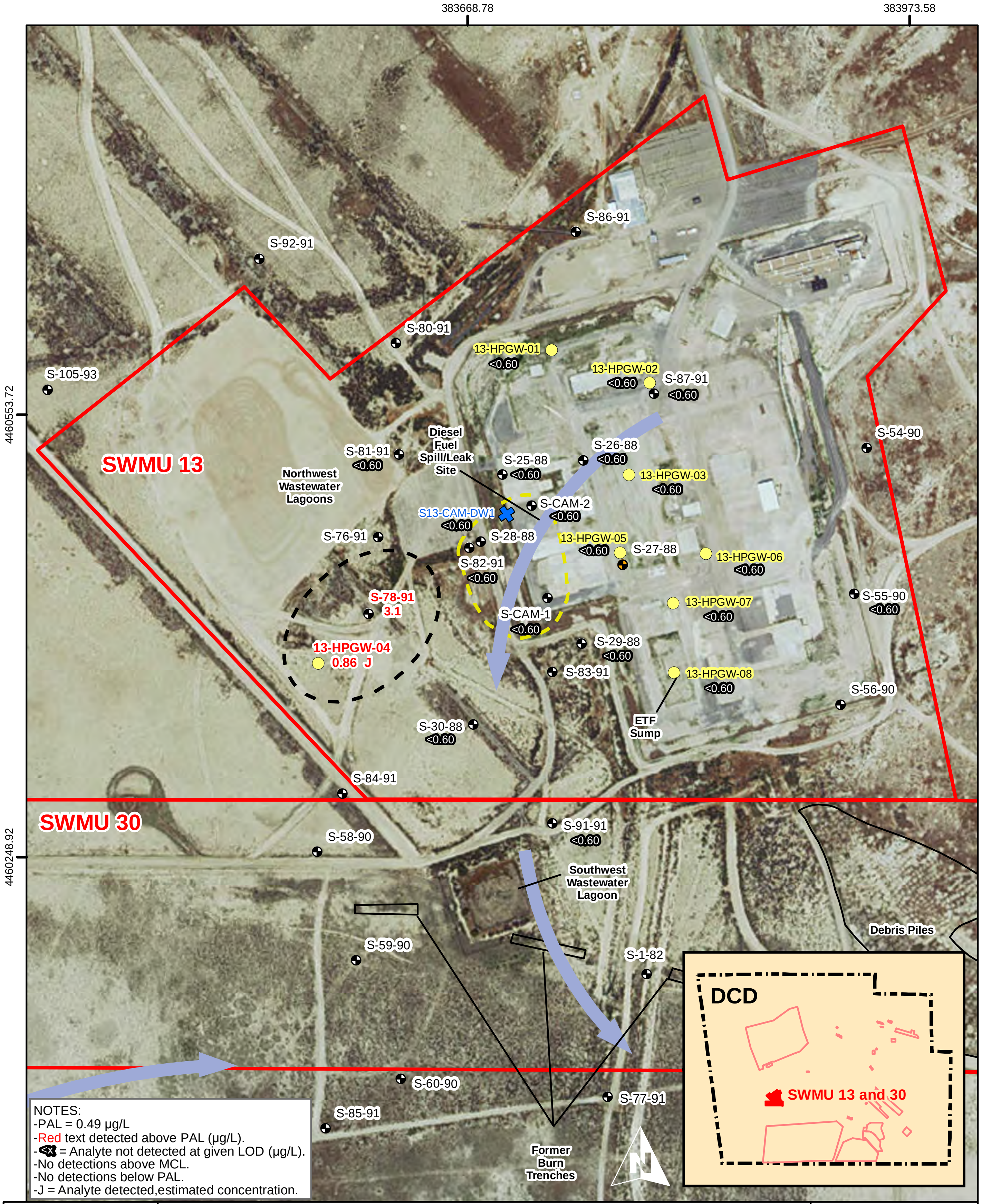
Subtotal (CMI-C and 1 year O/M) **$1,695,105**

Assumptions

1. Excavation and stockpiling of 18,000 cu yds cover material for backfill.
2. Excavate and treat 13,000 cu yds contaminated soil.
3. 200' x 200' treatment pad for treatment of 2950 cu yds per batch.
4. Five batches will require treatment at 2950 cu yds per batch.
5. Groundwater monitoring will be conducted on an annual basis, with sampling for TPH-DRO, VOCs, SVOCs, and natural attenuation indicators.

APPENDIX L

ISOCONCENTRATION MAPS



NOTES:
-PAL = 0.49 µg/L
-Red text detected above PAL (µg/L).
-<X = Analyte not detected at given LOD (µg/L).
-No detections above MCL.
-No detections below PAL.
-J = Analyte detected,estimated concentration.

Figure L.1

Trichloroethene in Groundwater

Measured using EPA Method 8260C

Legend

- ⊕ Monitoring Well
- ⊕ Monitoring Well - Inoperable
- ○ Hydropunch
- ✖ New Deep Monitoring Well
- ➡ General Direction of Groundwater Movement (based on freshwater equivalent head)
- ▭ Concentration Exceeding PAL of 0.49 µg/L
- ▭ Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
- 🟥 SWMU Boundary

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

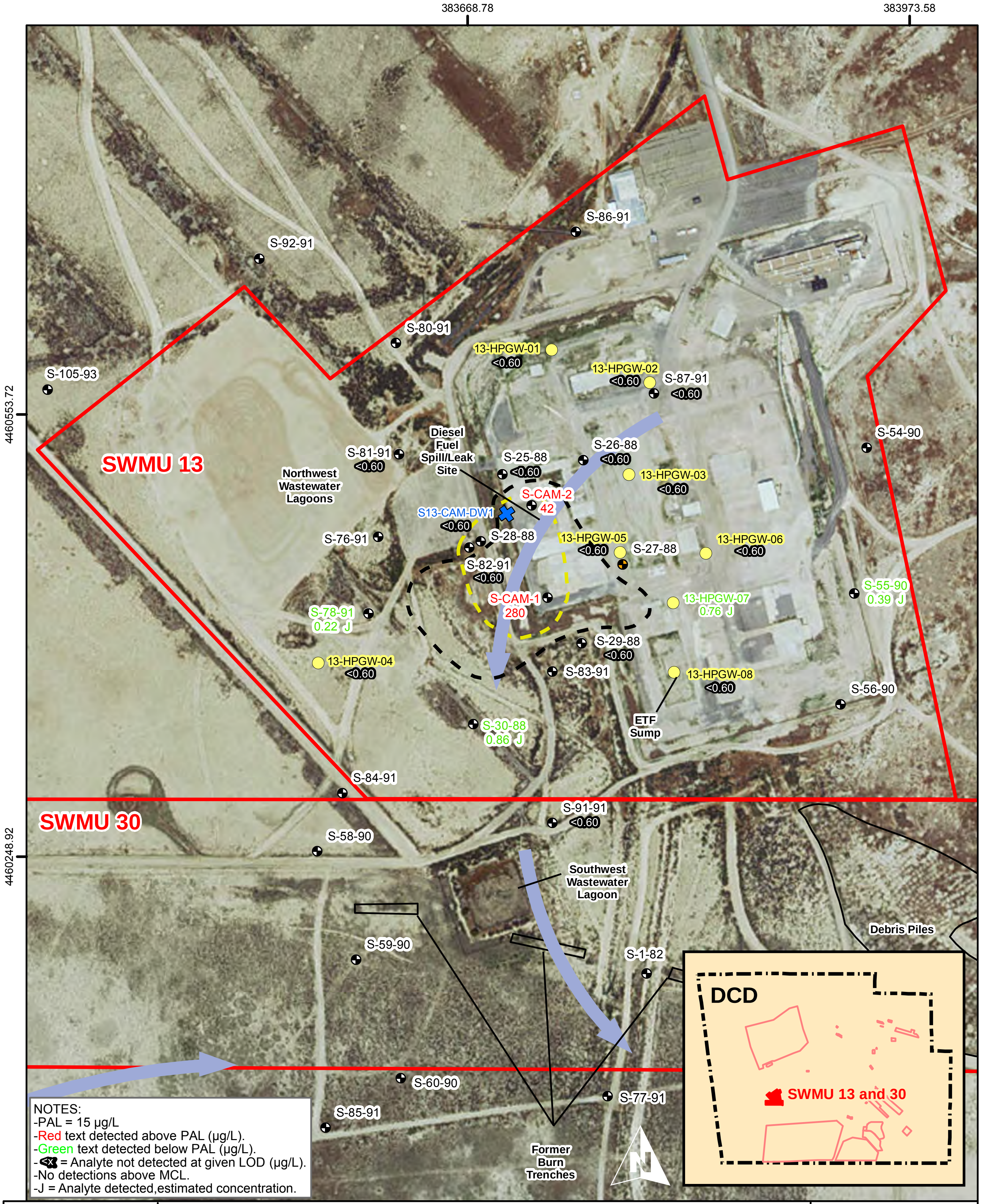
Feet
0 150 300

Projection & Grid Cooridnates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

X:\GISCADD\projects\TEAD_S_13_30\Mapfiles\CMS_Report\Trichloroethene_GW.mxd 1/15/2016



NOTES:
-PAL = 15 µg/L
-Red text detected above PAL (µg/L).
-Green text detected below PAL (µg/L).
-<x = Analyte not detected at given LOD (µg/L).
-No detections above MCL.
-J = Analyte detected,estimated concentration.

Figure L.2

1,2,4-Trimethylbenzene in Groundwater Measured using EPA Method 8260C

Legend

⊕	Monitoring Well
⊕	Monitoring Well - Inoperable
●	Hydropunch
✖	New Deep Monitoring Well
➡	General Direction of Groundwater Movement (based on freshwater equivalent head)
▭	Concentration Exceeding PAL of 15 µg/L
▭	Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
▭	SWMU Boundary

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Feet
0 150 300

Projection & Grid Coorindates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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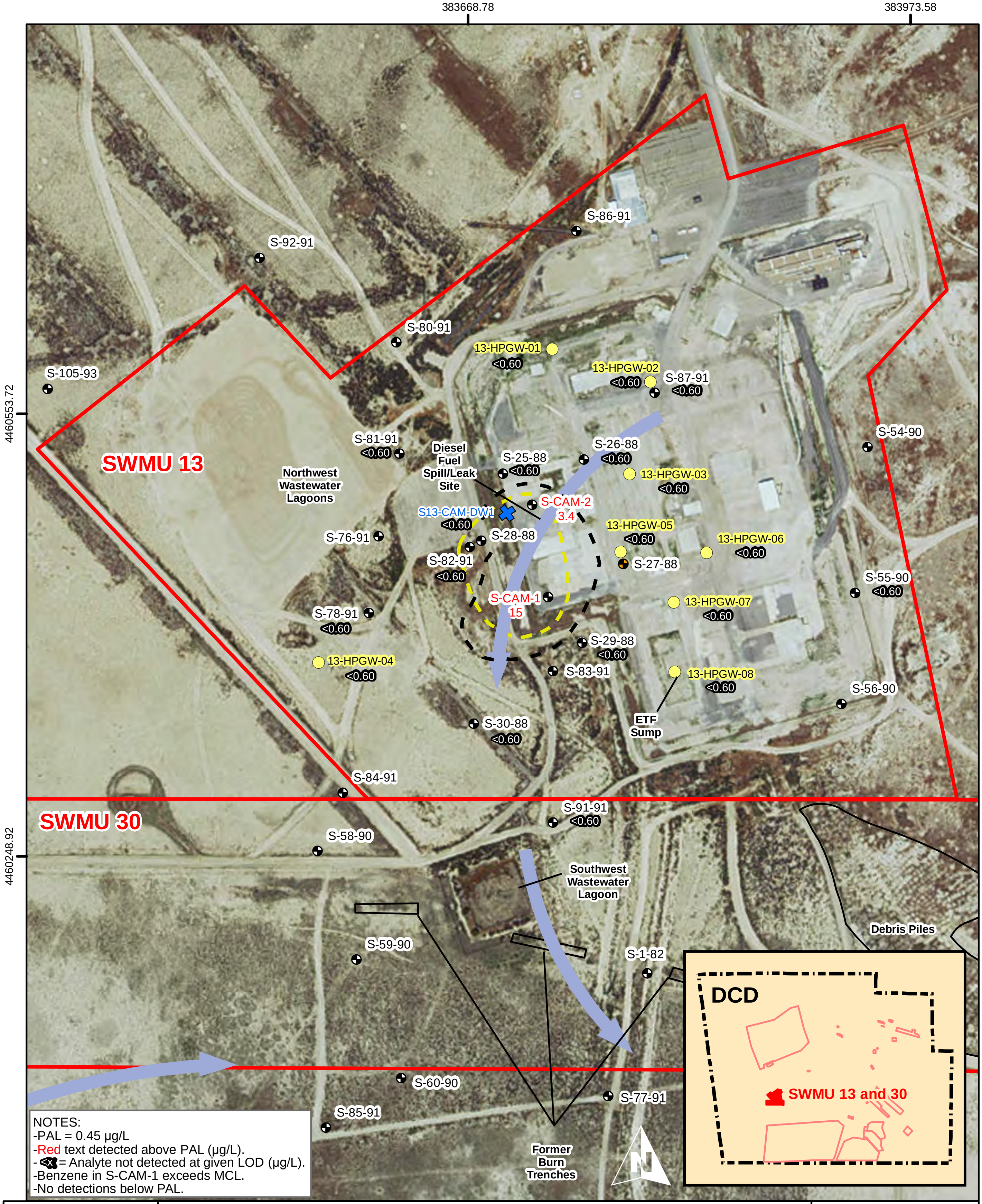

NOTES:
-PAL = 0.45 µg/L
-Red text detected above PAL (µg/L).
-<x = Analyte not detected at given LOD (µg/L).
-Benzene in S-CAM-1 exceeds MCL.
-No detections below PAL.

Figure L.3

Benzene in Groundwater

Measured using
EPA Method 8260C

Legend

- ⊕ Monitoring Well
- ⊕ Monitoring Well - Inoperable
- ○ Hydropunch
- ✖ New Deep Monitoring Well
- ➡ General Direction of Groundwater Movement (based on freshwater equivalent head)
- ▭ Concentration Exceeding PAL of 0.45 µg/L
- ▭ Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
- 🟥 SWMU Boundary

Feet
0 150 300

Projection & Grid Coorindates:
NAD83 StatePlane Utah Central

PARSONS

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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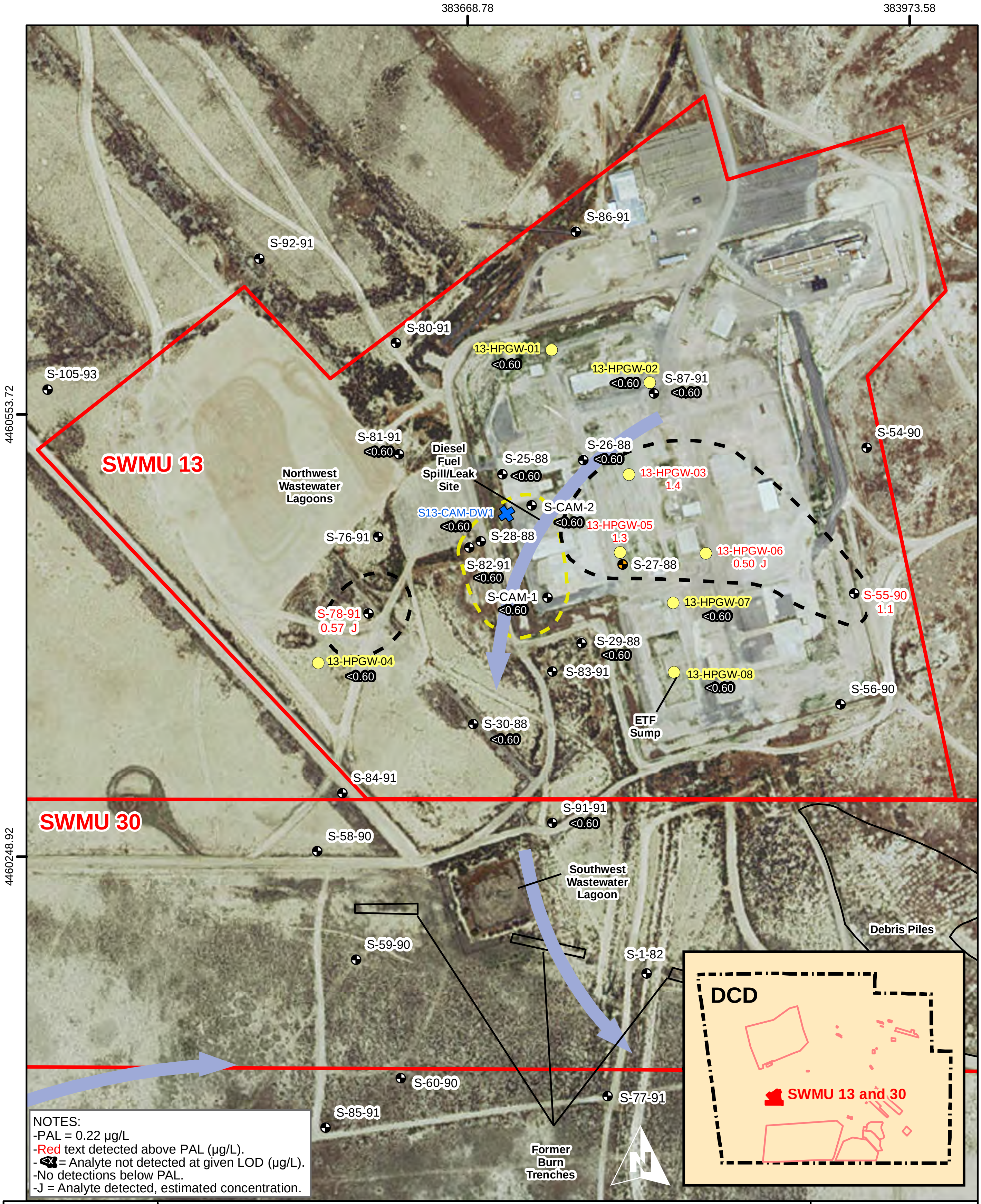

NOTES:
-PAL = 0.22 µg/L
-Red text detected above PAL (µg/L).
-<X = Analyte not detected at given LOD (µg/L).
-No detections below PAL.
-J = Analyte detected, estimated concentration.

Figure L.4

Chloroform in Groundwater

Measured using EPA Method 8260C

Legend

- ⊕ Monitoring Well
- ⊕ Monitoring Well - Inoperable
- ● Hydropunch
- ✖ New Deep Monitoring Well
- ➡ General Direction of Groundwater Movement (based on freshwater equivalent head)
- ▭ Concentration Exceeding PAL of 0.22 µg/L
- ▭ Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
- ▭ SWMU Boundary

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Feet
0 150 300

Projection & Grid Coorindates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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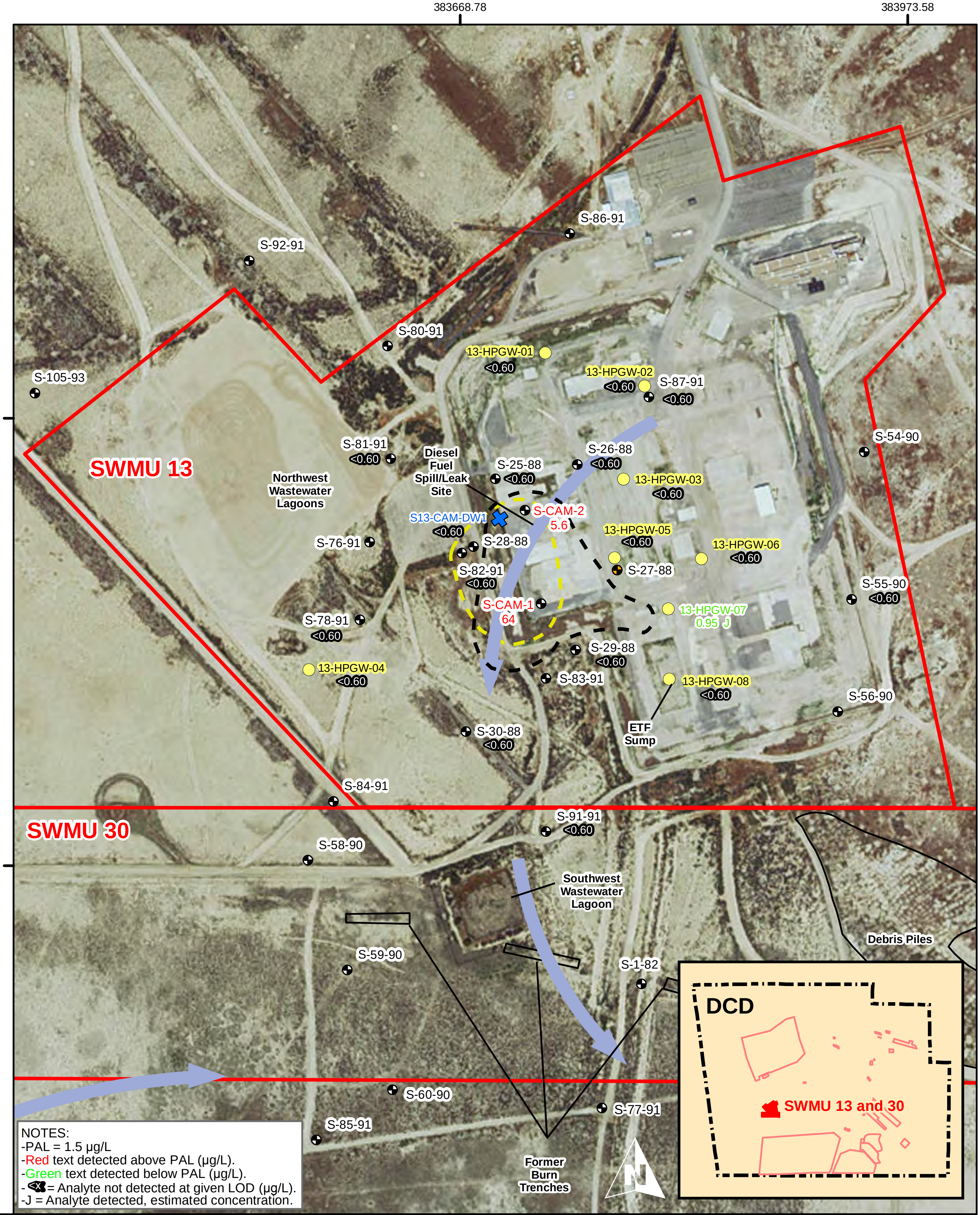

NOTES:
-PAL = 1.5 µg/L
-Red text detected above PAL (µg/L).
-Green text detected below PAL (µg/L).
- ⊗ = Analyte not detected at given LOD (µg/L).
-J = Analyte detected, estimated concentration.

Figure L.5

Ethylbenzene in Groundwater

Measured using EPA Method 8260C

Legend

- ⊕ Monitoring Well
- ⊕ Monitoring Well - Inoperable
- ○ Hydropunch
- ✖ New Deep Monitoring Well
- ➡ General Direction of Groundwater Movement (based on freshwater equivalent head)
- ⬚ Concentration Exceeding PAL of 1.5 µg/L
- ⬚ Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
- ▭ SWMU Boundary

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Feet
0 150 300

Projection & Grid Cooridnates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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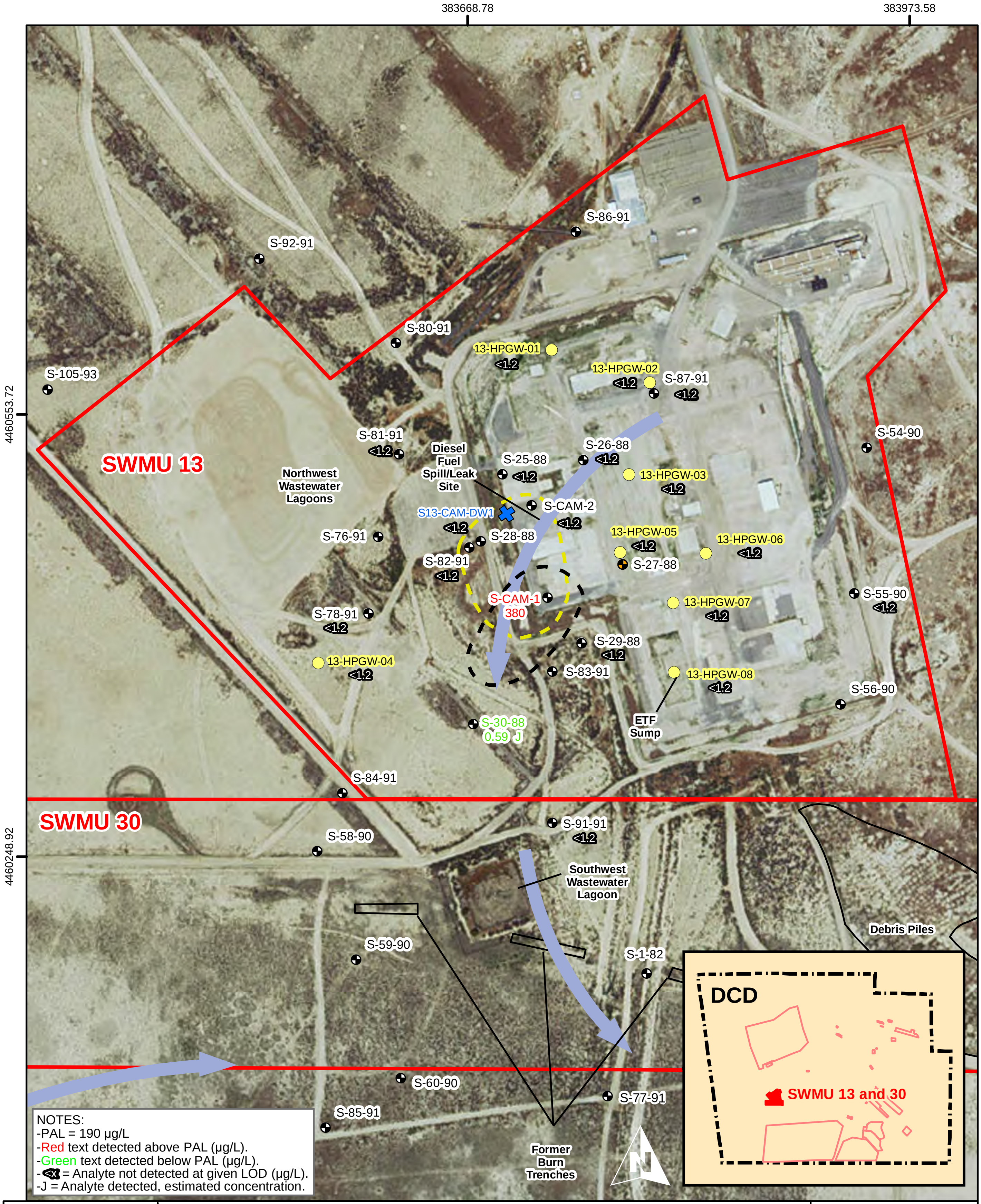

NOTES:
- PAL = 190 µg/L
- Red text detected above PAL (µg/L).
- Green text detected below PAL (µg/L).
- <X = Analyte not detected at given LOD (µg/L).
- J = Analyte detected, estimated concentration.

Figure L.6

m,p-Xylene in Groundwater

Measured using EPA Method 8260C

Legend

- ⊕ Monitoring Well
- ⊕ Monitoring Well - Inoperable
- ○ Hydropunch
- ✖ New Deep Monitoring Well
- ➡ General Direction of Groundwater Movement (based on freshwater equivalent head)
- ⬚ Concentration Exceeding PAL of 190 µg/L
- ⬚ Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
- 🟥 SWMU Boundary

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Feet
0 150 300

Projection & Grid Coordinates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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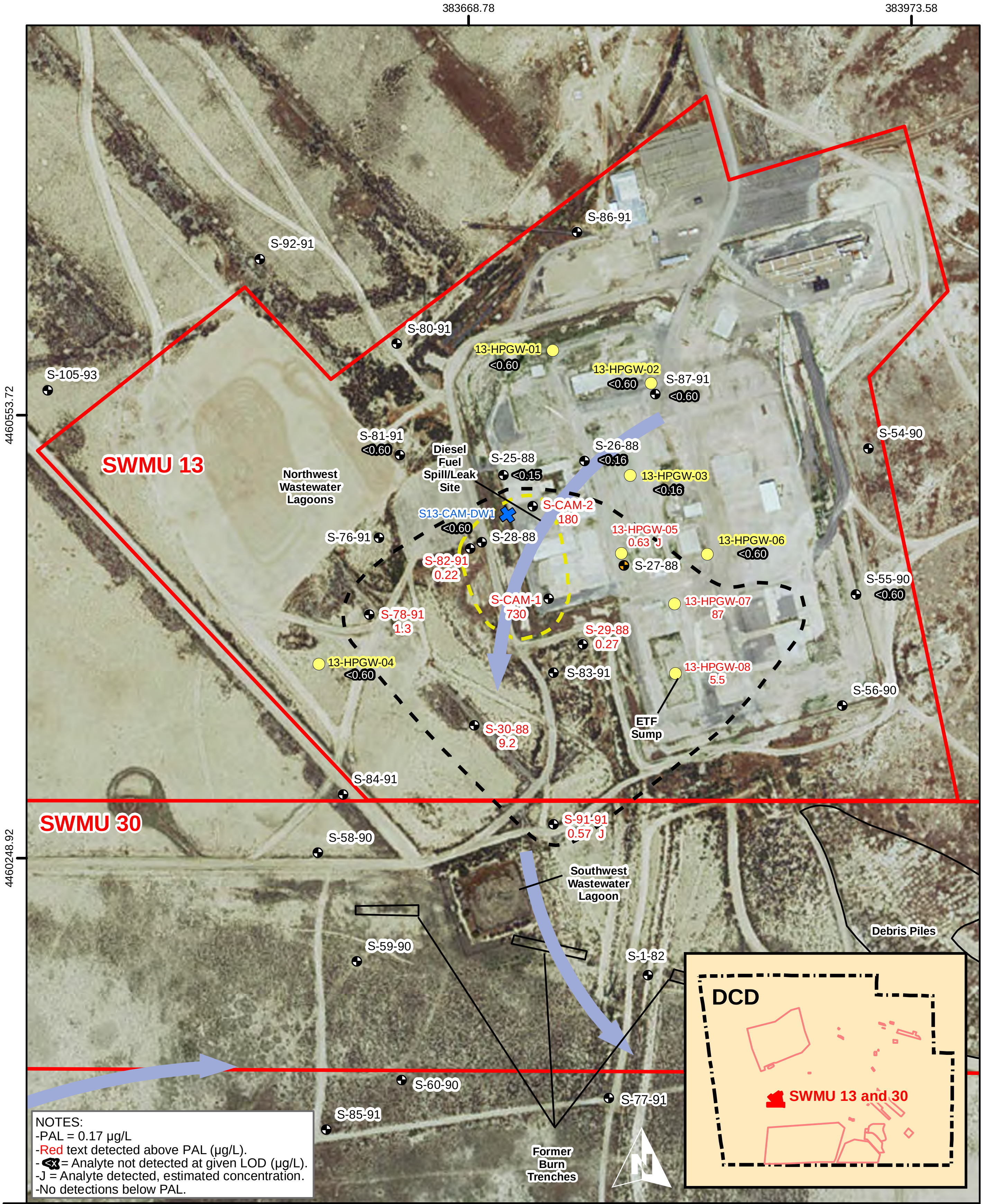


NOTES:
-PAL = 0.17 µg/L
-Red text detected above PAL (µg/L).
-<X = Analyte not detected at given LOD (µg/L).
-J = Analyte detected, estimated concentration.
-No detections below PAL.

Figure L.7
Naphthalene in Groundwater

For detects, greater of EPA Methods 8260C and 8270D-LL; for non-detects, lesser of the two methods.

Legend

- ● Monitoring Well
- ● Monitoring Well - Inoperable
- ○ Hydropunch
- ✖ New Deep Monitoring Well
- ➡ General Direction of Groundwater Movement (based on freshwater equivalent head)
- ▭ Concentration Exceeding PAL of 0.17 µg/L
- ▭ Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
- ▭ SWMU Boundary

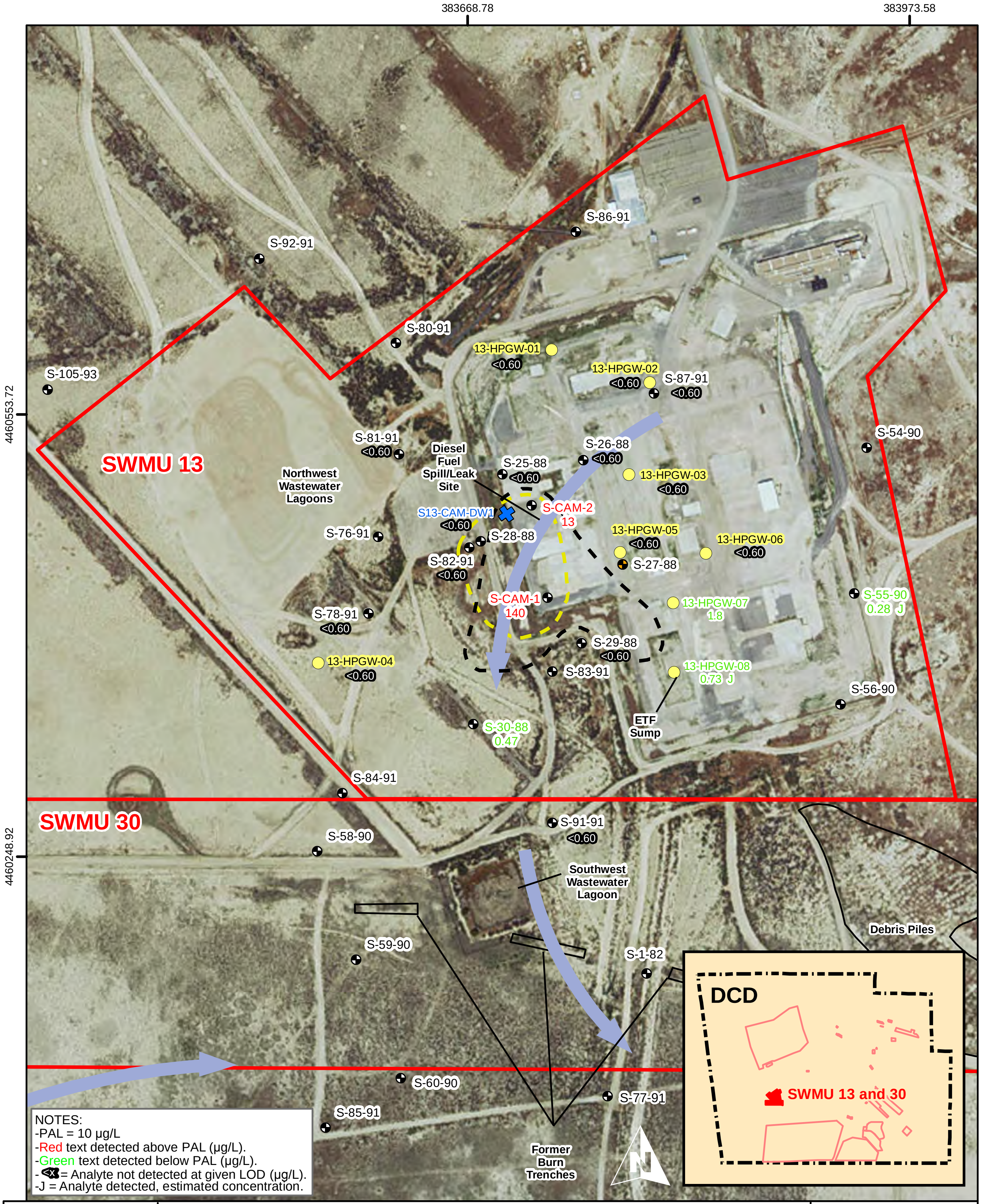
Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Feet
0 150 300

Projection & Grid Coorindates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1



NOTES:
-PAL = 10 µg/L
-Red text detected above PAL (µg/L).
-Green text detected below PAL (µg/L).
- <X = Analyte not detected at given LOD (µg/L).
-J = Analyte detected, estimated concentration.

Figure L.8

1,2,3-Trimethylbenzene in Groundwater Measured using EPA Method 8260C

Legend

- ⊕ Monitoring Well
- ⊕ Monitoring Well - Inoperable
- ○ Hydropunch
- ✖ New Deep Monitoring Well
- ➡ General Direction of Groundwater Movement (based on freshwater equivalent head)
- ⬚ Concentration Exceeding PAL of 10 µg/L
- ⬚ Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
- 🟥 SWMU Boundary

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Feet
0 150 300

Projection & Grid Coorindates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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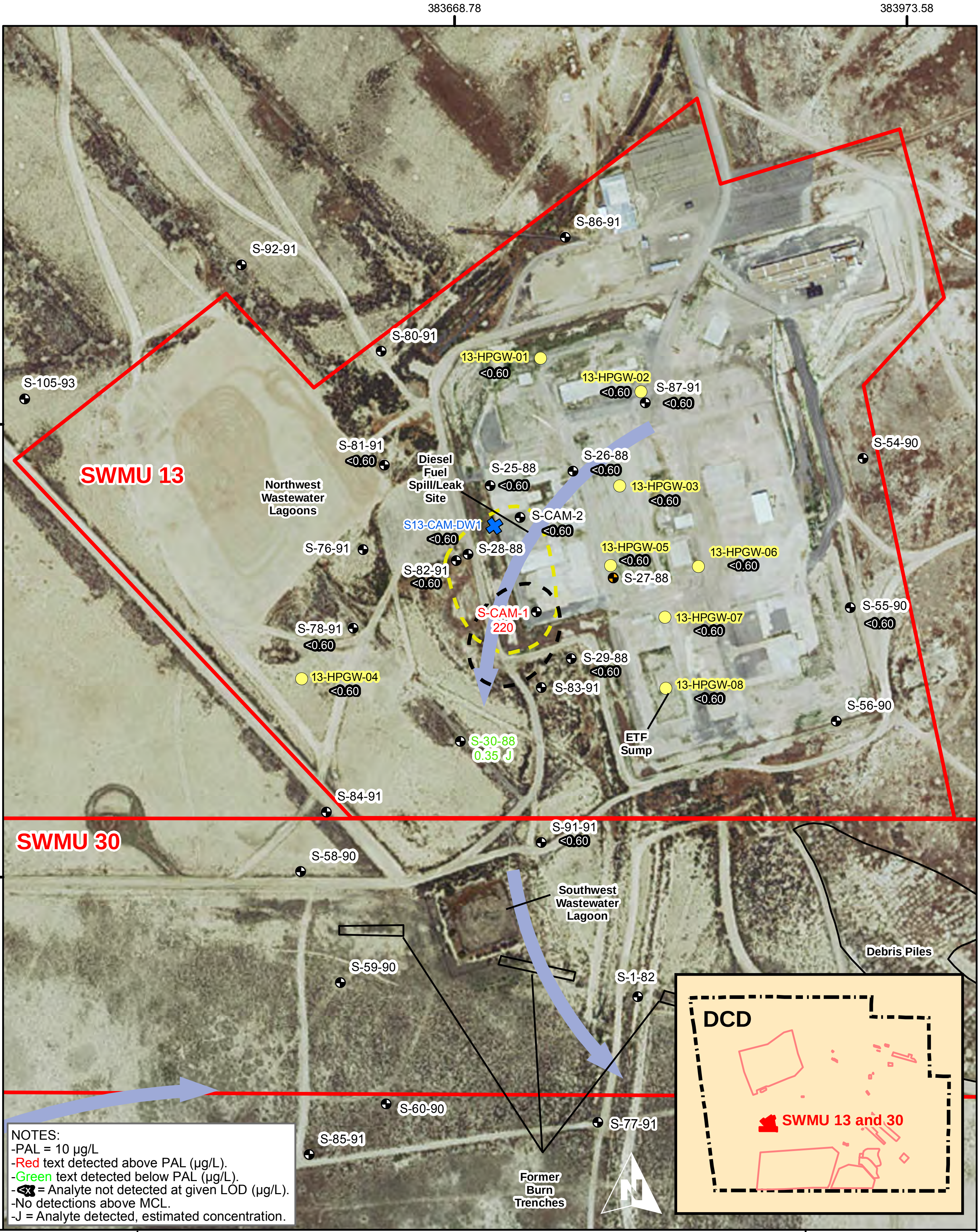

NOTES:
-PAL = 10 µg/L
-Red text detected above PAL (µg/L).
-Green text detected below PAL (µg/L).
-<x = Analyte not detected at given LOD (µg/L).
-No detections above MCL.
-J = Analyte detected, estimated concentration.

Figure L.9

o-Xylene in Groundwater

Measured using EPA Method 8260C

Legend

⊕	Monitoring Well	▭	Concentration Exceeding PAL 10 µg/L
⊕	Monitoring Well - Inoperable	▭	Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
○	Hydropunch	🟥	SWMU Boundary
✖	New Deep Monitoring Well		
➡	General Direction of Groundwater Movement (based on freshwater equivalent head)		

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Feet
0 150 300

Projection & Grid Cooridnates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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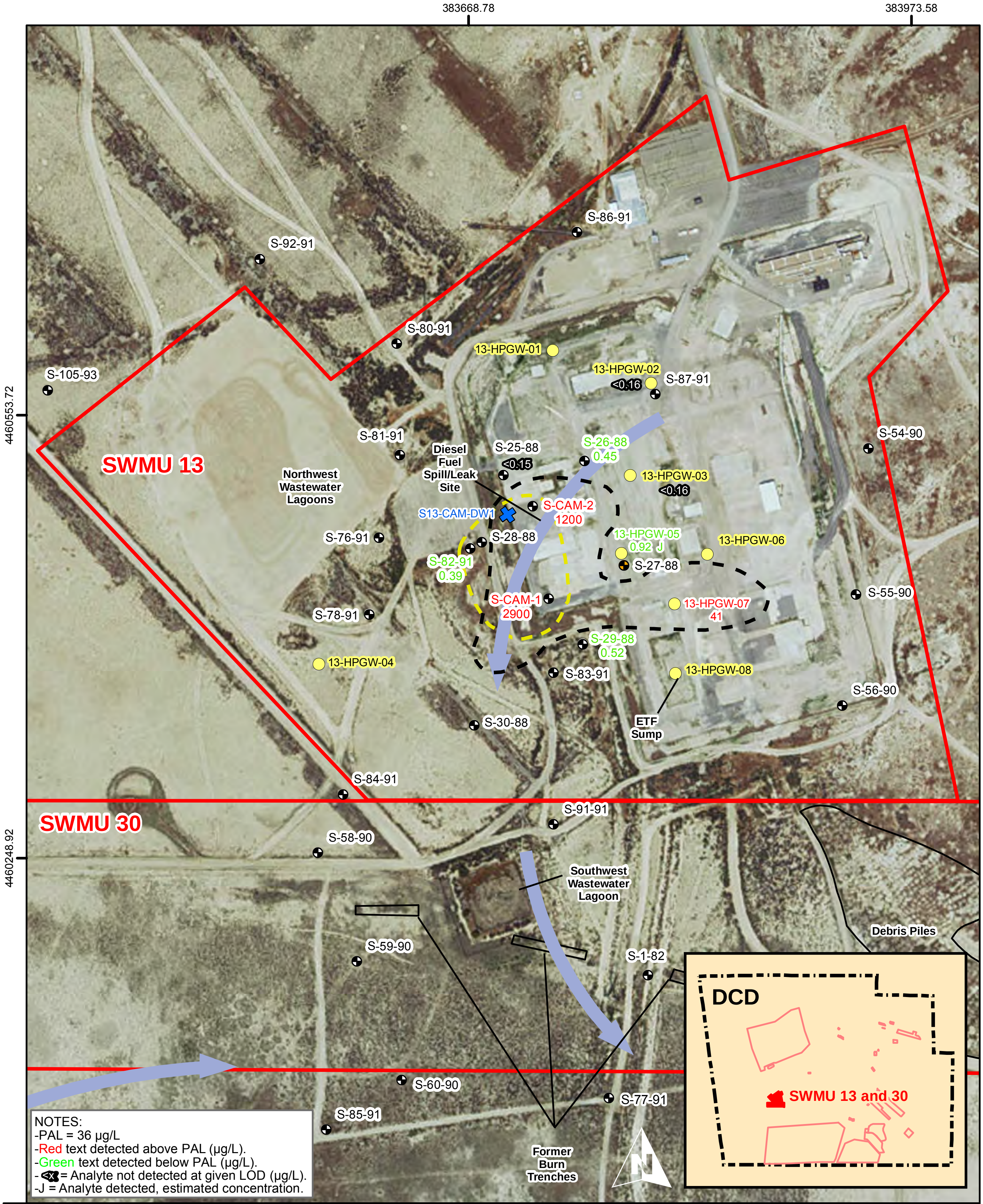

NOTES:
-PAL = 36 µg/L
-Red text detected above PAL (µg/L).
-Green text detected below PAL (µg/L).
-<x = Analyte not detected at given LOD (µg/L).
-J = Analyte detected, estimated concentration.

Figure L.10

2-Methylnaphthalene in Groundwater Measured using EPA Method 8270D-LL

Legend

- ● Monitoring Well
- ● Monitoring Well - Inoperable
- ○ Hydropunch
- ✖ New Deep Monitoring Well
- ➡ General Direction of Groundwater Movement (based on freshwater equivalent head)
- ▭ Concentration Exceeding PAL of 36 µg/L
- ▭ Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
- 🟥 SWMU Boundary

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Feet
0 150 300

Projection & Grid Coorindates:
NAD83 StatePlane Utah Central

PARSONS

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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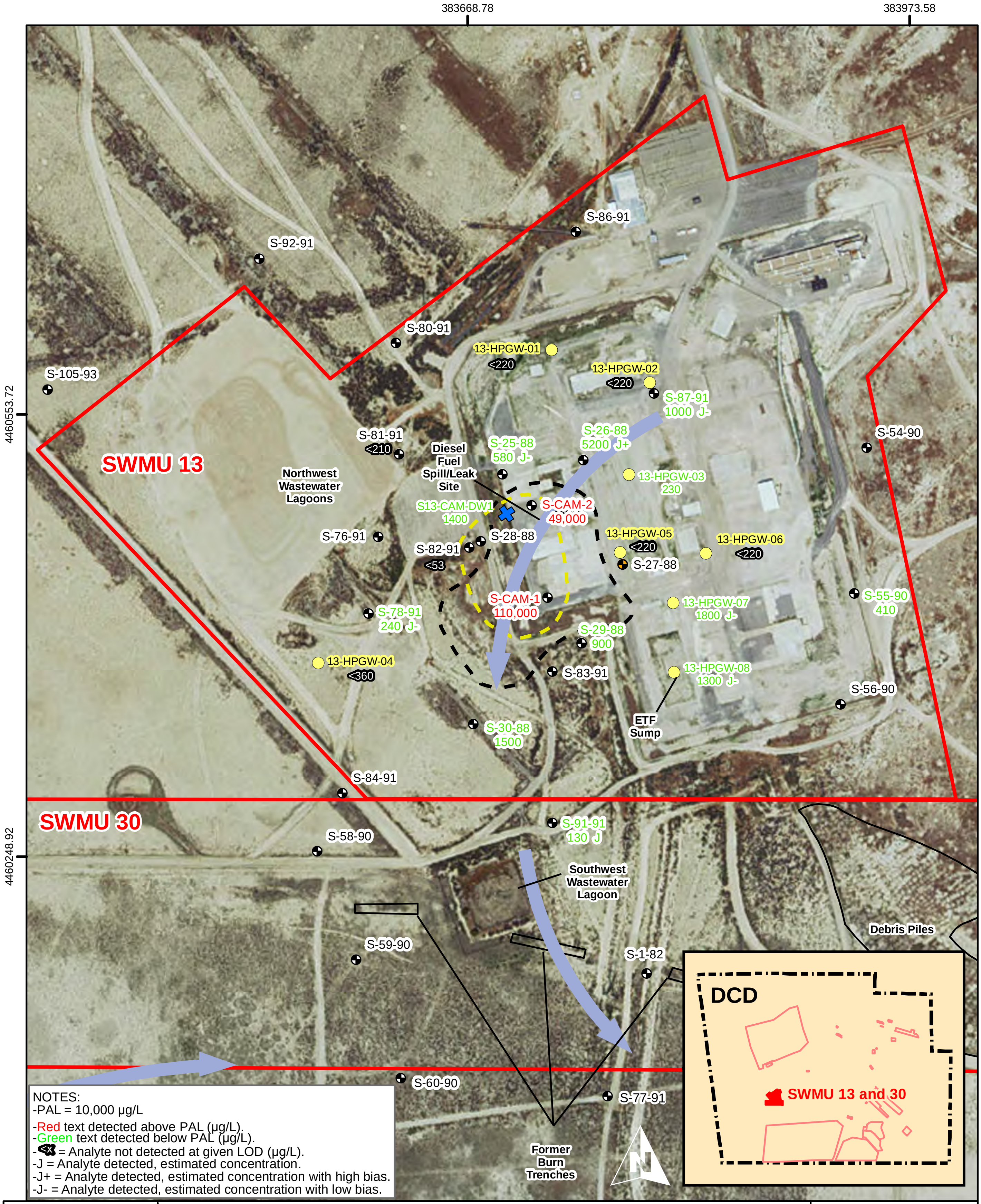

NOTES:
-PAL = 10,000 µg/L
-Red text detected above PAL (µg/L).
-Green text detected below PAL (µg/L).
-<X = Analyte not detected at given LOD (µg/L).
-J = Analyte detected, estimated concentration.
-J+ = Analyte detected, estimated concentration with high bias.
-J- = Analyte detected, estimated concentration with low bias.

Figure L.11

TPH-DRO in Groundwater

Measured using EPA Method 8015D

Legend

⊕	Monitoring Well	▬ ▬	Concentration Exceeding PAL of 10,000 µg/L
⊕	Monitoring Well - Inoperable	▬ ▬	Extent of Free Product-Feb. 2014 (Parsons Well Inspection and Water Table Measurements)
●	Hydropunch	☐	SWMU Boundary
✖	New Deep Monitoring Well		
➡	General Direction of Groundwater Movement (based on freshwater equivalent head)		

Feet
0 150 300

Projection & Grid Coorindates:
NAD83 StatePlane Utah Central

PARSONS

Imagery: ESRI (c) 2015
Boundary, SWMUs, Wells: Deseret Chemical Depot

Date:	1/15/2016
Prepared:	RGS
Checked:	DS
Revision:	1

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APPENDIX M

SOIL TO GROUNDWATER EVALUATION

TABLE M.1
Comparison of SWMU 13 Soil Concentrations to SSLs
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		Soil to Groundwater SSL$^{(1)}$	13-SS-01B	13-SS-01C	13-SS-02B	13-SS-02C	13-SS-03B	13-SS-03C	13-SS-04B
SAMPLE DEPTH (ft bgs):	Units		3 - 5	13 - 15	3 - 5	12 - 14	3 - 5	8 - 10	5 - 7
Volatile Organics - SW8260C									
1,2,3-Trimethylbenzene	mg/Kg	0.31	--	--	--	11	--	--	--
1,2,4-Trimethylbenzene	mg/Kg	0.42	--	--	--	39	--	--	--
1,3,5-Trimethylbenzene	mg/Kg	3.3	--	--	--	14	--	--	--
2-Butanone	mg/Kg	24	--	--	--	--	--	--	--
4-Isopropyltoluene	mg/Kg	NA	--	--	--	2.3	--	--	--
Benzene	mg/Kg	0.0047	--	--	--	0.49	--	--	--
Carbon disulfide	mg/Kg	4.8	--	--	--	0.37	--	--	--
Cyclohexane	mg/Kg	260	--	--	--	1.3	--	--	--
Ethylbenzene	mg/Kg	0.034	--	--	--	3.5	--	--	--
Isopropylbenzene	mg/Kg	14.8	--	--	--	1.6	--	--	--
m,p-Xylene	mg/Kg	3.8	--	--	--	13	--	--	--
Naphthalene	mg/Kg	0.011	--	--	--	29	--	--	--
n-Butylbenzene	mg/Kg	64.6	--	--	--	3.0	--	--	--
n-Propylbenzene	mg/Kg	24.4	--	--	--	4.2	--	--	--
o-Xylene	mg/Kg	3.8	--	--	--	1.8	--	--	--
sec-Butylbenzene	mg/Kg	117	--	--	--	2.1	--	--	--
tert-Butylbenzene	mg/Kg	31.0	--	--	--	0.54	--	--	--
Toluene	mg/Kg	15.2	--	--	--	0.062	--	--	--

NOTES:

(1) Risk-based SSLs (USEPA, 2015) based on a dilution attenuation factor of 20
NA - SSL not available.
ft bgs - Feet below ground surface.
-- - Analyte not detected

🟩 Analyte exceeds SSL but in smear zone or below water table

🟨 Analyte exceeds SSL in soil above the smear zone

APPENDIX N

INTERCEPT TRENCH CASE STUDIES

APPENDIX N
INTERCEPT TRENCH STUDIES

Intercept trenches are commonly used to recover LNAPL from the subsurface and have been found to be particularly effective in the recovery of free-phase floating hydrocarbons. Intercept trenches function by creating a zone of high permeability within the aquifer by means of an open excavation backfilled with a coarse grain material such as gravel that retains high the permeability required for the collection of LNAPL.

LNAPL migrates near the top of the capillary fringe in porous media. As the highly permeable trench backfill does not support a capillary fringe, the LNAPL rests on top of the water table within the intercept trench. The saturation of the downgradient side of the trench inhibits LNAPL migration from the trench hydraulically trapping the LNAPL in the trench, provided that recovery of LNAPL is maintained and the thickness of LNAPL in the trench is less than the capillary fringe height in the native soil down-gradient of the trench.

Free product skimming can be accomplished in a variety of methods that can generally be place in two categories; active skimming and passive skimming. Active skimming, which has been proposed as a component of the corrective measures for SWMU 13 is typically achieved using pneumatic or electric pumps designed to remove only the free product floating on the water table.

Studies reviewed during the CMS indicating that intercept trenches are a cost effective means of containment and recovery of LNAPL at other sites included the following:

- Federal Remediation Technologies Roundtable (FRTR) Cost and Performance Case Studies
    - Groundwater Containment at Site SS-07, Pope Air Force Base (Attachment 1)
    - Groundwater Containment at Site FT-01, Pope Air Force Base (Attachment 2)
    - Groundwater Containment at Sites SD-29 and ST-30, Shaw Air Force Base (Attachment 3)

Additional studies reviewed and considered in developing corrective measures for TEAD-S SWMU 13 included:

- Evaluating the Effectiveness of Interceptor Trenches in Groundwater Pollution Control (Attachment 4)
- Petroleum Hydrocarbon Remediation of the Subcutaneous Zone of a Karst Aquifer, Lexington, Kentucky (Attachment 5).

Appendix N.1

GROUNDWATER CONTAINMENT AT SITE SS-07, POPE AFB

Groundwater Containment at Site SS-07, Pope AFB

Site Background

This section focuses on the groundwater containment system located at the Blue Ramp Spill Site, SS-07, Pope AFB. A site map for SS-07 is included as Figure 42.

Contaminants in Soil

- Soil vapor investigations indicate concentrations of greater than 1,000 ppm of VOCs exist in the vadose zone.
- The soil vapor plume is estimated at 25 acres in areal extent.

Contaminants in Groundwater

- As much as 75,000 gallons of JP-4 free product are floating on top of the groundwater.
- Dissolved VOCs have also been detected within the groundwater.

Lithology

- Subsurface soils are silty to clayey fine-grained sands.
- Clay lenses ranging from 1 to 5 feet in thickness.
- Groundwater is encountered between 22.5 and 27 feet bgs.

Groundwater Containment System Details

- Dual pump recovery system with one free product cut-off trench (Radian Corporation, 1996).
- In 1993 and 1995, the free product cut-off trench was extended.
- The system operates at an average groundwater flow rate of 1 gpm.
- JP-4 is recovered by pneumatic skimmer pumps and is stored in a product recovery tank.

Operation Period

- The system began operation in November 1993 and may operate approximately 40 years.

Total Capital Costs

- $394,000 for initial capital investment.

Total O&M Costs

- Total cumulative O&M costs from November 1993 through November 1996 were $96,200.

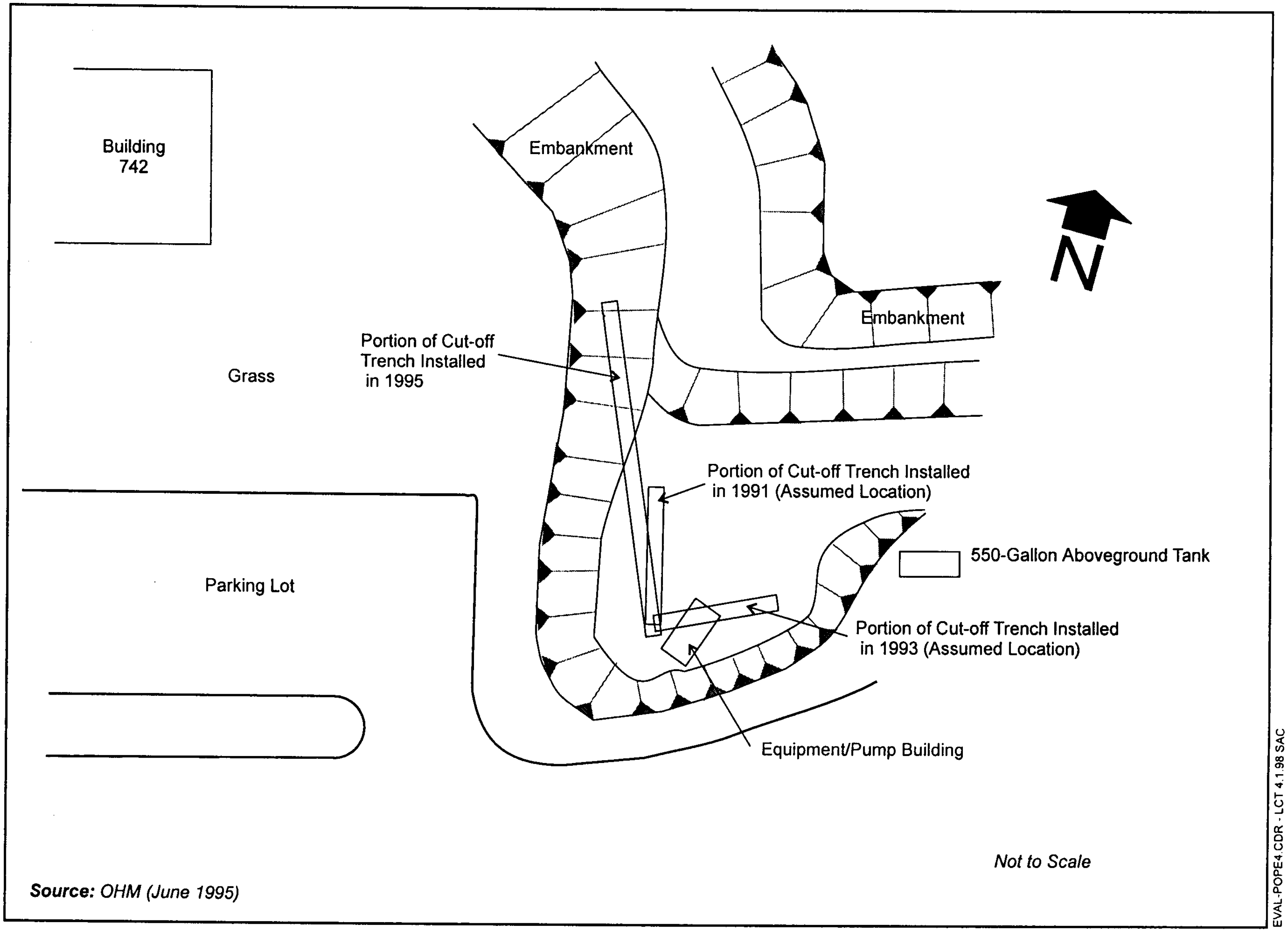
Cost and Performance of Groundwater Containment at Site SS-07

Groundwater Containment with Free Product Source Removal Operational Objectives

The objective of free product source removal is typically to remove liquid-phase contamination as quickly and cost-effectively as possible to prevent continued contamination of surrounding soil and groundwater. The emphasis for free product removal is that the mass of contaminants is cost effectively removed.

Cost for Operation

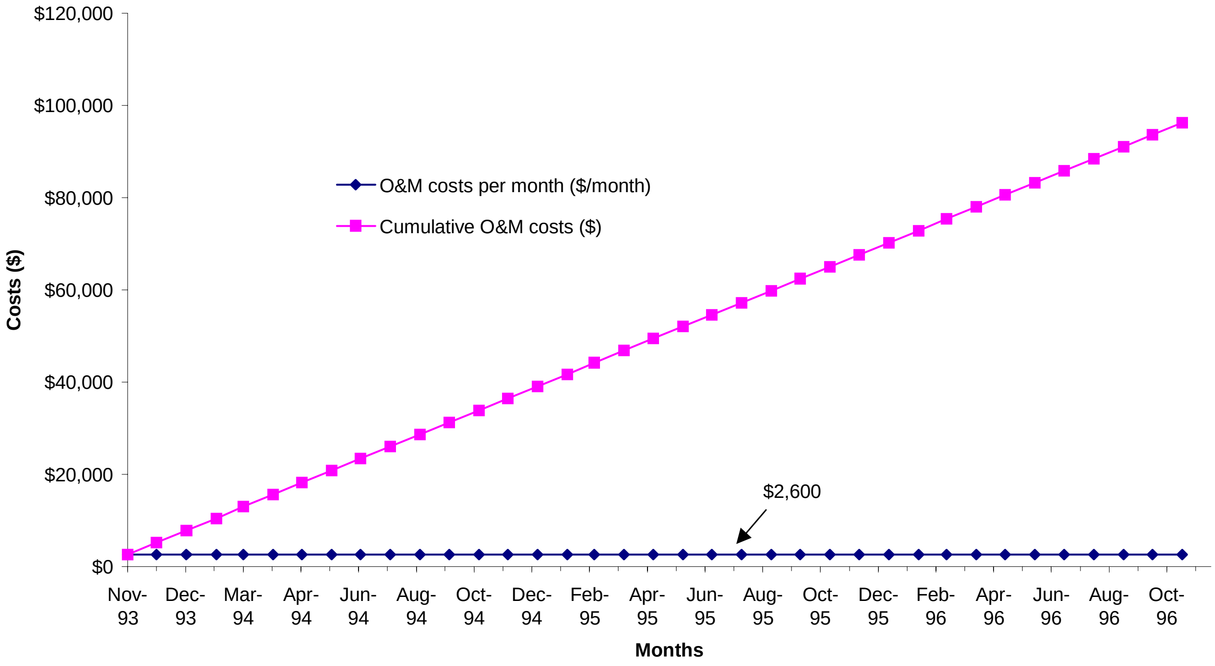
Figure 43 illustrates curves of the O&M costs for the groundwater containment system at Site SS-07. Accurate month to month data were not available. The monthly O&M costs average $2,600. Total O&M costs after three years of operation were $96,200.



Source: *OHM (June 1995)*

Figure 42. Free Product Recovery System at Site SS-07, Pope AFB

Figure 43
Monthly and Cumulative O&M Costs vs. Time
JP-4 Free Product Recovery
Site SS-07, Pope AFB



Raws07.xls; O&M costs

Contaminant Removal

Figure 44 illustrates curves of the removal rates of JP-4 product at the groundwater containment system at Site SS-07. Monthly removal rates of JP-4 product ranged from 1 to 340 gallons. Total contaminant removal after three years of operation was 3,516 gallons of JP-4 product. After April 1995 the curve representing the cumulative removal rate had begun to flatten, indicating that the removal rate for this system is slowing. It is recommended that the system be evaluated for increasing product removal.

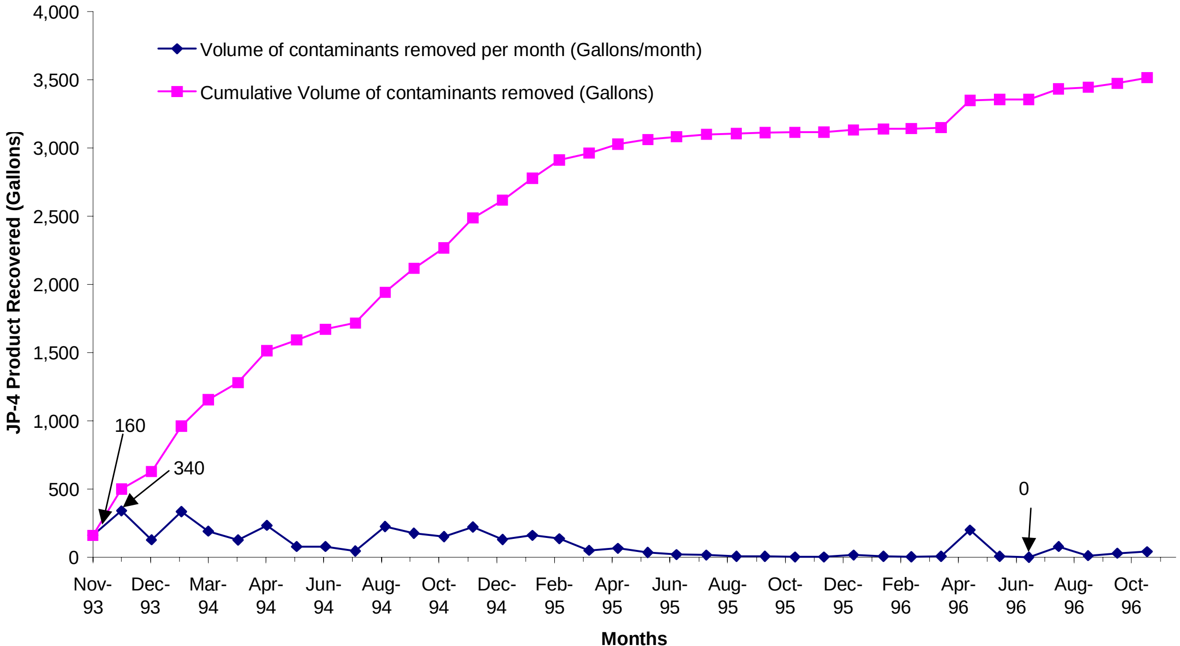
Correlation of Costs and Contaminant Removal

Figures 45 and 46 illustrate the relationship between the O&M costs and the removal rates for the groundwater containment system at Site SS-07.

Figure 45 illustrates the cumulative O&M cost relative to the cumulative contaminant removal. In November 1996, this curve was no longer vertical. In November 1996, this groundwater containment system was operating adequately for this system's performance and meeting its operational objectives of cost-effectively removing contaminants.

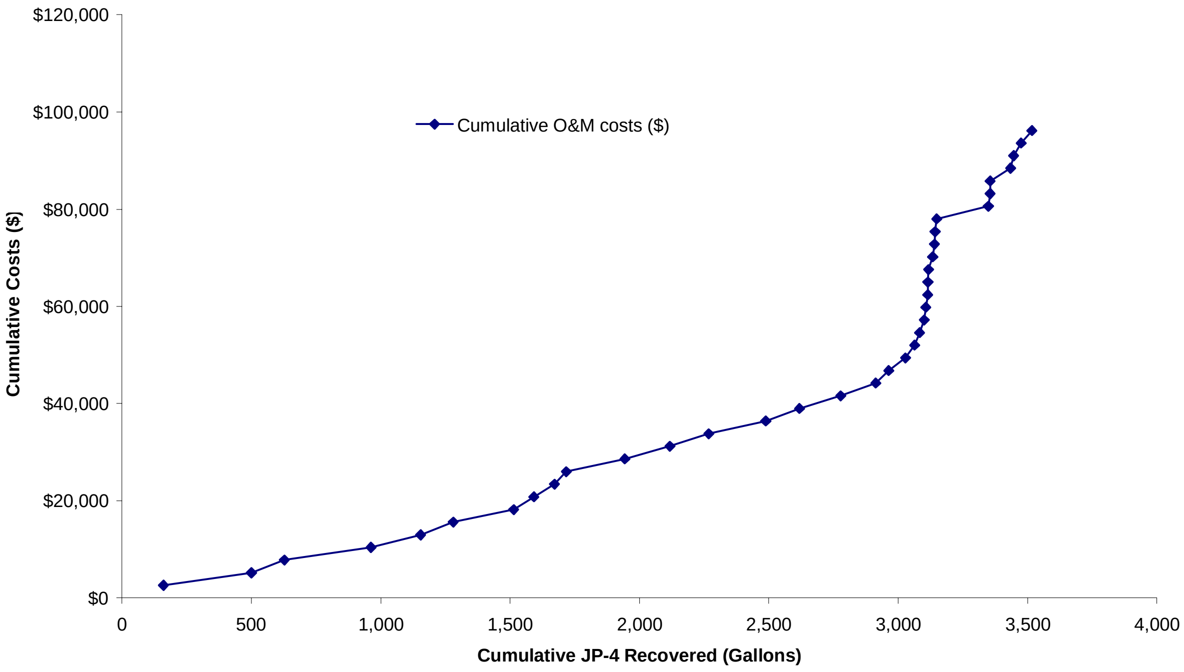
Figure 46 illustrates curves of the monthly as well as the cumulative cost per unit of contaminant removal over the operation time of the technology. The first curve illustrates the cost per gallon of JP-4 product removal in each month. The cumulative curve illustrates that the average cost per unit of contaminant removal was $27.36/gallon of JP-4 product after three years of operation time.

Figure 44
Monthly & Cumulative JP-4 Product Recovery vs. Time
Site SS-07, Pope AFB



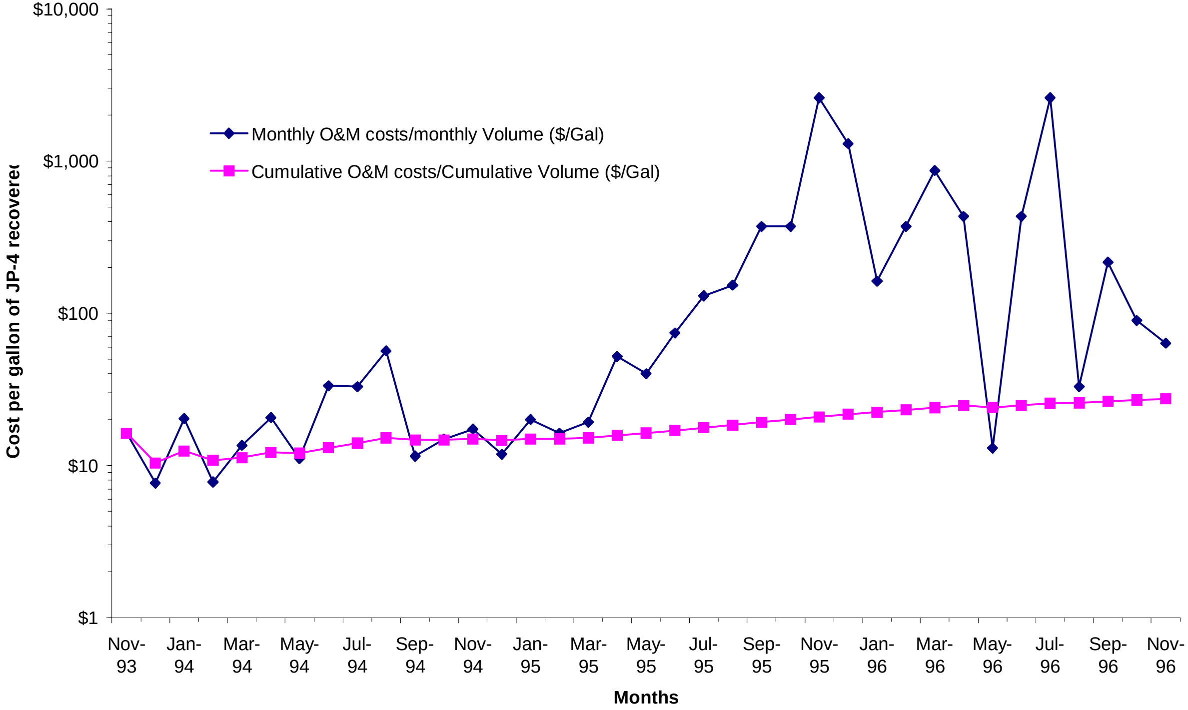
Rawss07.xls; Volume

Figure 45
Cumulative O&M Costs vs. JP-4 Product Volume Recovered
Site SS-07, Pope AFB



Rawss07.xls; O&M vs. vol

Figure 46
Monthly and Cumulative Costs per Gallon of JP-4 Recovered vs. Time
Site SS-07, Pope AFB



Rawss07.xls; mon$pergalovert

APPENDIX A

Detailed Cost and Performance Data Table

JP-4 Free Product Recovery Pumping
Blue Ramp Spill Site (SS-07)
Pope AFB

Date of contamination removal	Volume of contaminants removed per month (Gallons/month)	Cumulative Volume of contaminants removed (Gallons)	O&M costs per month ($/month)	Cumulative O&M costs ($)	Monthly O&M costs/monthly Volume ($/Gal)	Cumulative O&M costs/Cumulative Volume ($/Gal)
Nov-93	160	160	$2,600	$2,600	$16.25	$16.25
Dec-93	340	500	$2,600	$5,200	$7.65	$10.40
Jan-94	128	628	$2,600	$7,800	$20.31	$12.42
Feb-94	334	962	$2,600	$10,400	$7.78	$10.81
Mar-94	192	1,154	$2,600	$13,000	$13.54	$11.27
Apr-94	126	1,280	$2,600	$15,600	$20.63	$12.19
May-94	234	1,514	$2,600	$18,200	$11.11	$12.02
Jun-94	78	1,592	$2,600	$20,800	$33.33	$13.07
Jul-94	79	1,671	$2,600	$23,400	$32.91	$14.00
Aug-94	46	1,717	$2,600	$26,000	$56.52	$15.14
Sep-94	226	1,943	$2,600	$28,600	$11.50	$14.72
Oct-94	175	2,118	$2,600	$31,200	$14.86	$14.73
Nov-94	150	2,268	$2,600	$33,800	$17.33	$14.90
Dec-94	220	2,488	$2,600	$36,400	$11.82	$14.63
Jan-95	130	2,618	$2,600	$39,000	$20.00	$14.90
Feb-95	160	2,778	$2,600	$41,600	$16.25	$14.97
Mar-95	135	2,913	$2,600	$44,200	$19.26	$15.17
Apr-95	50	2,963	$2,600	$46,800	$52.00	$15.79
May-95	65	3,028	$2,600	$49,400	$40.00	$16.31
Jun-95	35	3,063	$2,600	$52,000	$74.29	$16.98
Jul-95	20	3,083	$2,600	$54,600	$130.00	$17.71
Aug-95	17	3,100	$2,600	$57,200	$152.94	$18.45
Sep-95	7	3,107	$2,600	$59,800	$371.43	$19.25
Oct-95	7	3,114	$2,600	$62,400	$371.43	$20.04
Nov-95	1	3,115	$2,600	$65,000	$2,600.00	$20.87
Dec-95	2	3,117	$2,600	$67,600	$1,300.00	$21.69
Jan-96	16	3,133	$2,600	$70,200	$162.50	$22.41
Feb-96	7	3,140	$2,600	$72,800	$371.43	$23.18
Mar-96	3	3,143	$2,600	$75,400	$866.67	$23.99
Apr-96	6	3,149	$2,600	$78,000	$433.33	$24.77
May-96	200	3,349	$2,600	$80,600	$13.00	$24.07
Jun-96	6	3,355	$2,600	$83,200	$433.33	$24.80
Jul-96	0	3,355	$2,600	$85,800	$2,600.00	$25.57
Aug-96	79	3,434	$2,600	$88,400	$32.91	$25.74
Sep-96	12	3,446	$2,600	$91,000	$216.67	$26.41
Oct-96	29	3,475	$2,600	$93,600	$89.66	$26.94
Nov-96	41	3,516	$2,600	$96,200	$63.41	$27.36

Appendix N.2

GROUNDWATER CONTAINMENT AT SITE FT-01, POPE AFB

Groundwater Containment at Site FT-01, Pope AFB

Site Background

This section focuses on the groundwater containment system located at FT-01, Pope AFB. A site map for FT-01 is included as Figure 37.

Contaminants in Soil

- TPH concentrations detected up to 44,000 ppm.
- In September 1993, 3,175 tons of contaminated soil were removed from the site.

Contaminants in Groundwater

- The areal extent of JP-4 fuel contamination was estimated at 1.5 acres.
- As much as 24,000 gallons of free product are floating on top of the groundwater.

Lithology

- Fine- to medium-grained sands to 25 feet bgs; hard silty clay from a depth of 26 feet bgs to 70 feet bgs.
- Groundwater is encountered between 2 and 5 feet bgs.

Groundwater Containment System Details

- Free floating product recovery system.
- The system consists of four recovery wells (RW-1, RW-2, RW-3, and MW-2) and one trench.
- JP-4 is recovered by a pneumatic skimmer pump and stored in a product recovery tank.

Operation Period

- The system began operation in November 1993 and may operate until 2001.

Total Capital Costs

- $289,000 for initial capital investment.

Total O&M Costs

- Total cumulative O&M costs from November 1993 through November 1996 were $66,600.

Cost and Performance of Groundwater Containment at Site FT-01

Groundwater Containment with Free Product Source Removal Operational Objectives

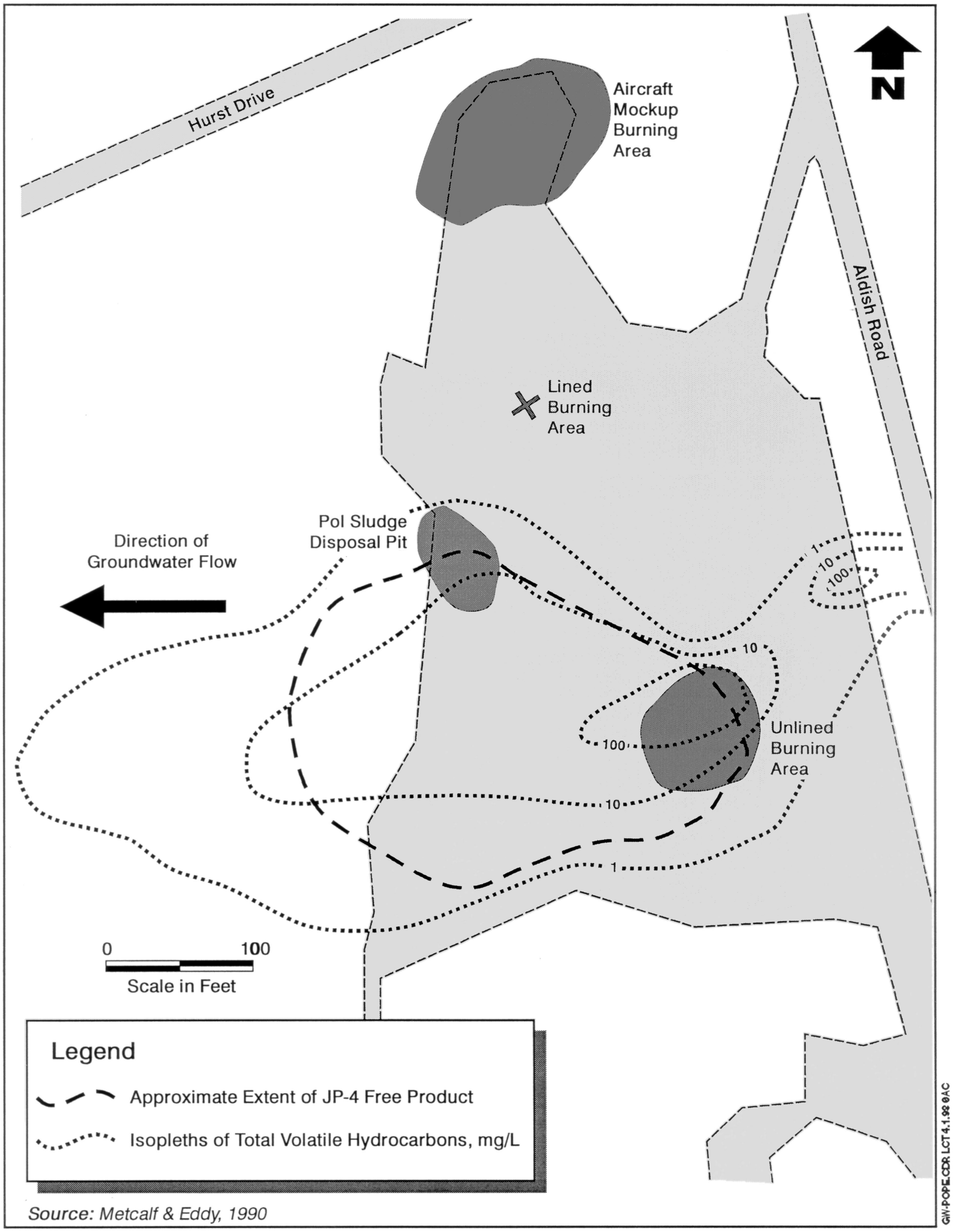
The objective of free product source removal is typically to remove liquid-phase contamination as quickly and cost-effectively as possible to prevent continued contamination of surrounding soil and groundwater. The emphasis for free product removal is that the mass of contaminants is cost effectively removed.

Cost for Operation

Figure 38 illustrates curves of the O&M costs for the groundwater containment system at Site FT-01. Accurate month to month data were not available. The monthly O&M costs average $1,800. Total O&M costs after three years of operation were $66,600.

Contaminant Removal

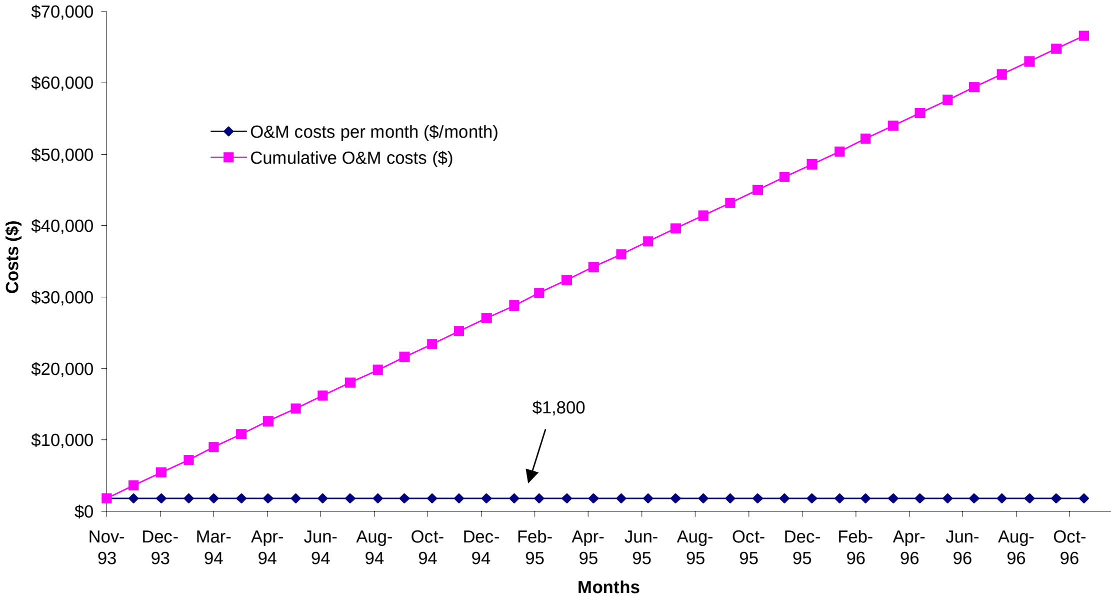
Figure 39 illustrates curves of the removal rates of JP-4 product at the groundwater containment system at Site FT-01. Monthly removal rates of JP-4 product ranged from 1 to 650 gallons. Total contaminant removal after three years of operation was 5,163 gallons of JP-4 product. In November 1996, the curve representing the cumulative removal rate had not flattened, indicating that the removal rate was still adequate for this system's performance and it was meeting its operational objectives.



Source: Metcalf & Eddy, 1990

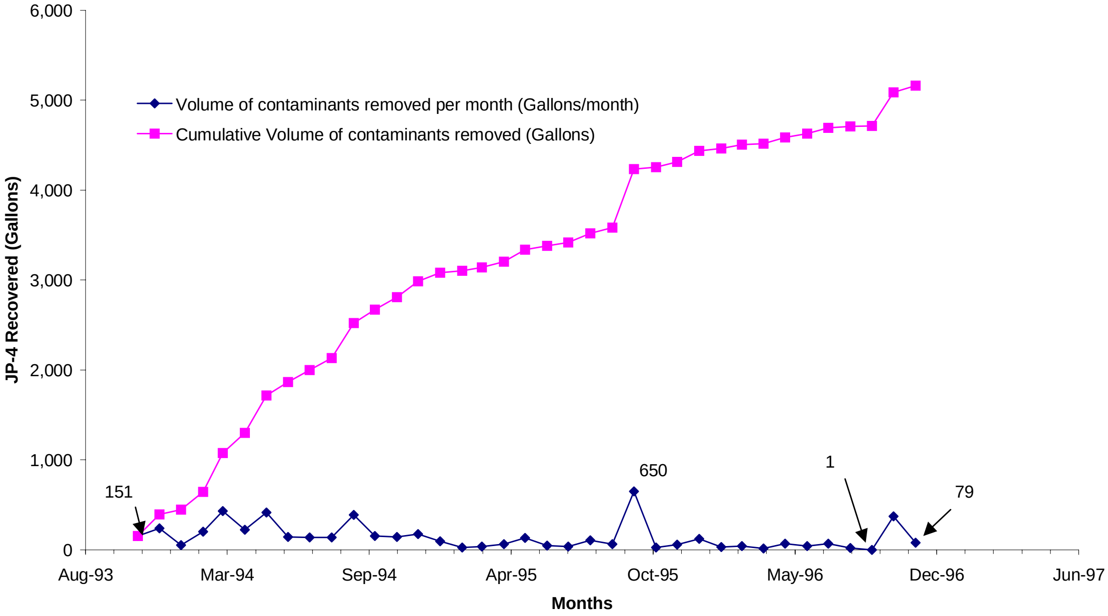
Figure 37. Extent of JP-4 Free Product and Total VOCs in Groundwater, Site FT-01, Pope AFB

Figure 38
Monthly and Cumulative O&M Costs vs. Time
JP-4 Free Product
Site FT-01, Pope AFB



Rawft01.xls; O&M costs

Figure 39
Monthly & Cumulative JP-4 Product Recovery vs. Time
Site FT-01, Pope AFB



Rawft01.xls; Volume

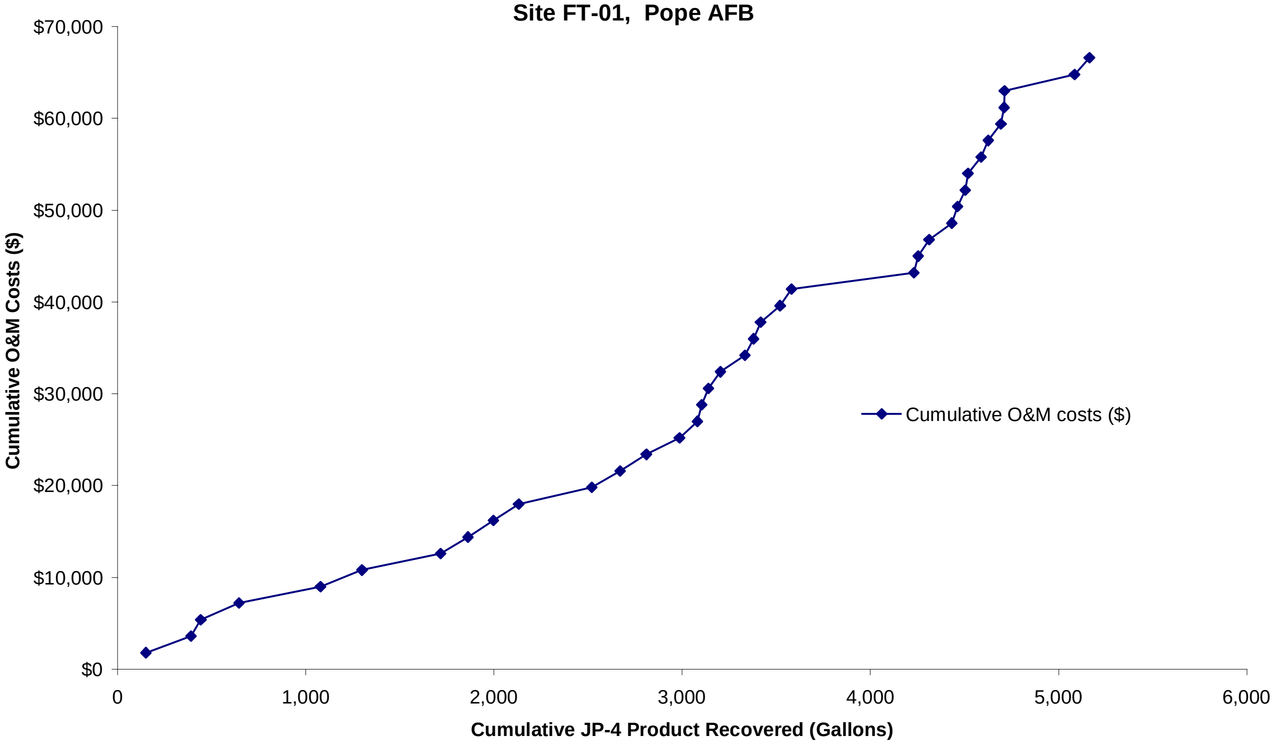
Correlation of Costs and Contaminant Removal

Figures 40 and 41 illustrate the relationship between the O&M costs and the removal rates for the groundwater containment system at Site FT-01.

Figure 40 illustrates the cumulative O&M cost over the cumulative contaminant removal. As of November 1996, this curve had not steepened. In November 1996, this groundwater containment system was operating efficiently for this system's performance and was meeting its operational objectives.

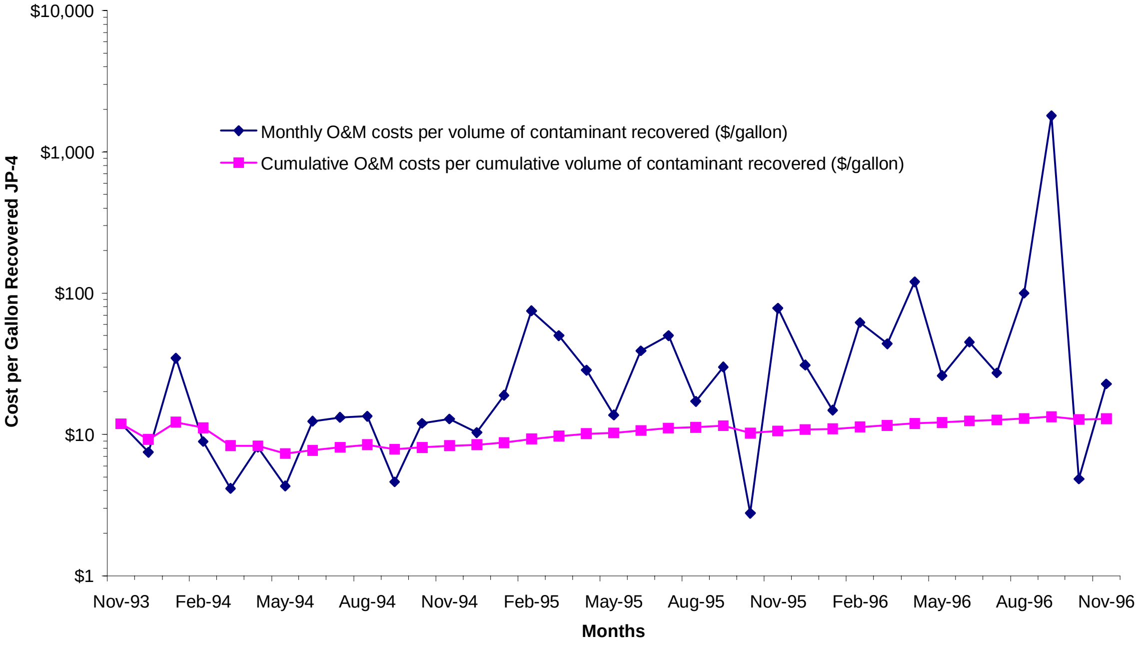
Figure 41 illustrates curves of the monthly and cumulative cost per unit of contaminant removal over the operation time of the technology. The monthly curve illustrates the cost per gallon of JP-4 product removal in each month. The cumulative curve illustrates that the average cost per unit of contaminant removal was $12.90/gallon of JP-4 product after three years of operation time.

Figure 40
Cumulative O&M Costs vs. Cumulative JP-4 Recovered
Site FT-01, Pope AFB



Rawft01.xls; $ vs. vol

Figure 41
Monthly and Cumulative Costs per Gallon of JP-4 Recovery vs. Time
Site FT-01, Pope AFB



Rawft01.xls; monthly$pergalovert

APPENDIX A

Detailed Cost and Performance Data Table

JP-4 Free-Product Recovery Pumping
Fire Protection Training Area No. 4 (FT-01)
Pope AFB

Date of contamination removal	Volume of contaminants removed per month (Gallons/month)	Cumulative Volume of contaminants removed (Gallons)	O&M costs per month ($/month)	Cumulative O&M costs ($)	Monthly O&M costs per volume of contaminant recovered ($/gallon)	Cumulative O&M costs per cumulative volume of contaminant recovered ($/gallon)
Nov-93	151	151	$1,800.00	$1,800.00	$11.92	$11.92
Dec-93	240	391	$1,800.00	$3,600.00	$7.50	$9.21
Jan-94	52	443	$1,800.00	$5,400.00	$34.62	$12.19
Feb-94	202	645	$1,800.00	$7,200.00	$8.91	$11.16
Mar-94	433	1,078	$1,800.00	$9,000.00	$4.16	$8.35
Apr-94	221	1,299	$1,800.00	$10,800.00	$8.14	$8.31
May-94	417	1,716	$1,800.00	$12,600.00	$4.32	$7.34
Jun-94	145	1,861	$1,800.00	$14,400.00	$12.41	$7.74
Jul-94	136	1,997	$1,800.00	$16,200.00	$13.24	$8.11
Aug-94	134	2,131	$1,800.00	$18,000.00	$13.43	$8.45
Sep-94	389	2,520	$1,800.00	$19,800.00	$4.63	$7.86
Oct-94	150	2,670	$1,800.00	$21,600.00	$12.00	$8.09
Nov-94	140	2,810	$1,800.00	$23,400.00	$12.86	$8.33
Dec-94	175	2,985	$1,800.00	$25,200.00	$10.29	$8.44
Jan-95	95	3,080	$1,800.00	$27,000.00	$18.95	$8.77
Feb-95	24	3,104	$1,800.00	$28,800.00	$75.00	$9.28
Mar-95	36	3,140	$1,800.00	$30,600.00	$50.00	$9.75
Apr-95	63	3,203	$1,800.00	$32,400.00	$28.57	$10.12
May-95	131	3,334	$1,800.00	$34,200.00	$13.74	$10.26
Jun-95	46	3,380	$1,800.00	$36,000.00	$39.13	$10.65
Jul-95	36	3,416	$1,800.00	$37,800.00	$50.00	$11.07
Aug-95	105	3,521	$1,800.00	$39,600.00	$17.14	$11.25
Sep-95	60	3,581	$1,800.00	$41,400.00	$30.00	$11.56
Oct-95	650	4,231	$1,800.00	$43,200.00	$2.77	$10.21
Nov-95	23	4,254	$1,800.00	$45,000.00	$78.26	$10.58
Dec-95	58	4,312	$1,800.00	$46,800.00	$31.03	$10.85
Jan-96	121	4,433	$1,800.00	$48,600.00	$14.88	$10.96
Feb-96	29	4,462	$1,800.00	$50,400.00	$62.07	$11.30
Mar-96	41	4,503	$1,800.00	$52,200.00	$43.90	$11.59
Apr-96	15	4,518	$1,800.00	$54,000.00	$120.00	$11.95
May-96	69	4,587	$1,800.00	$55,800.00	$26.09	$12.16
Jun-96	40	4,627	$1,800.00	$57,600.00	$45.00	$12.45
Jul-96	66	4,693	$1,800.00	$59,400.00	$27.27	$12.66
Aug-96	18	4,711	$1,800.00	$61,200.00	$100.00	$12.99
Sep-96	1	4,712	$1,800.00	$63,000.00	$1,800.00	$13.37
Oct-96	372	5,084	$1,800.00	$64,800.00	$4.84	$12.75
Nov-96	79	5,163	$1,800.00	$66,600.00	$22.78	$12.90

Appendix N.3

GROUNDWATER CONTAINMENT AT SITES SD-29 AND ST-30, SHAW AFB

Groundwater Containment at Sites SD-29 and ST-30, Shaw AFB

Site Background on Site SD-29

This section focuses on the interim action groundwater containment system located at Site SD-29, Shaw AFB. A site map for SD-29 is included as Figure 25.

Contaminants in Soil

- In January 1992, sixty gallons of JP-4 jet fuel was spilled when a pump failed at an oil/water separator located at the site.
- Eighty tons of contaminated soil was excavated.
- Further investigation indicated that the soil at the site was contaminated with volatile organic compounds (VOCs), with contaminant concentrations increasing with sample depth.

Contaminants in Groundwater

- Free product JP-4 jet fuel, dissolved fuel components, and dissolved chlorinated solvents have been identified in the groundwater.

Lithology/Hydogeology

- Sands and silts.
- Groundwater is found in a shallow water table aquifer and the Upper Black Creek Aquifer.

Groundwater Containment System Details

- Interim action JP-4 free product recovery system.
- Pneumatic product skimmer pumps were used from March 1995 through January 1996.
- Passive skimmer bailers were placed in wells in January 1996.
- Approximately 5 gallons of JP-4 was recovered during its year of operation.
- Contaminated groundwater was treated with an air stripper.
- An Interim Corrective Measure, consisting of three extraction wells, has been designed and is being implemented to address the mobile JP-4, dissolved fuel, and dissolved chlorinated solvent plumes. The target pump rate is 1 to 2 gpm.

Operation Period

- The interim action system began operation in March 1995 and was operated through February 1996.
- The interim action system was shut down when product recovery became negligible.

Total Capital Costs

- The estimated capital costs for the SD-29 interim action groundwater containment system was $394,000.

Total O&M Costs

- See below.

Site Background on Site ST-30

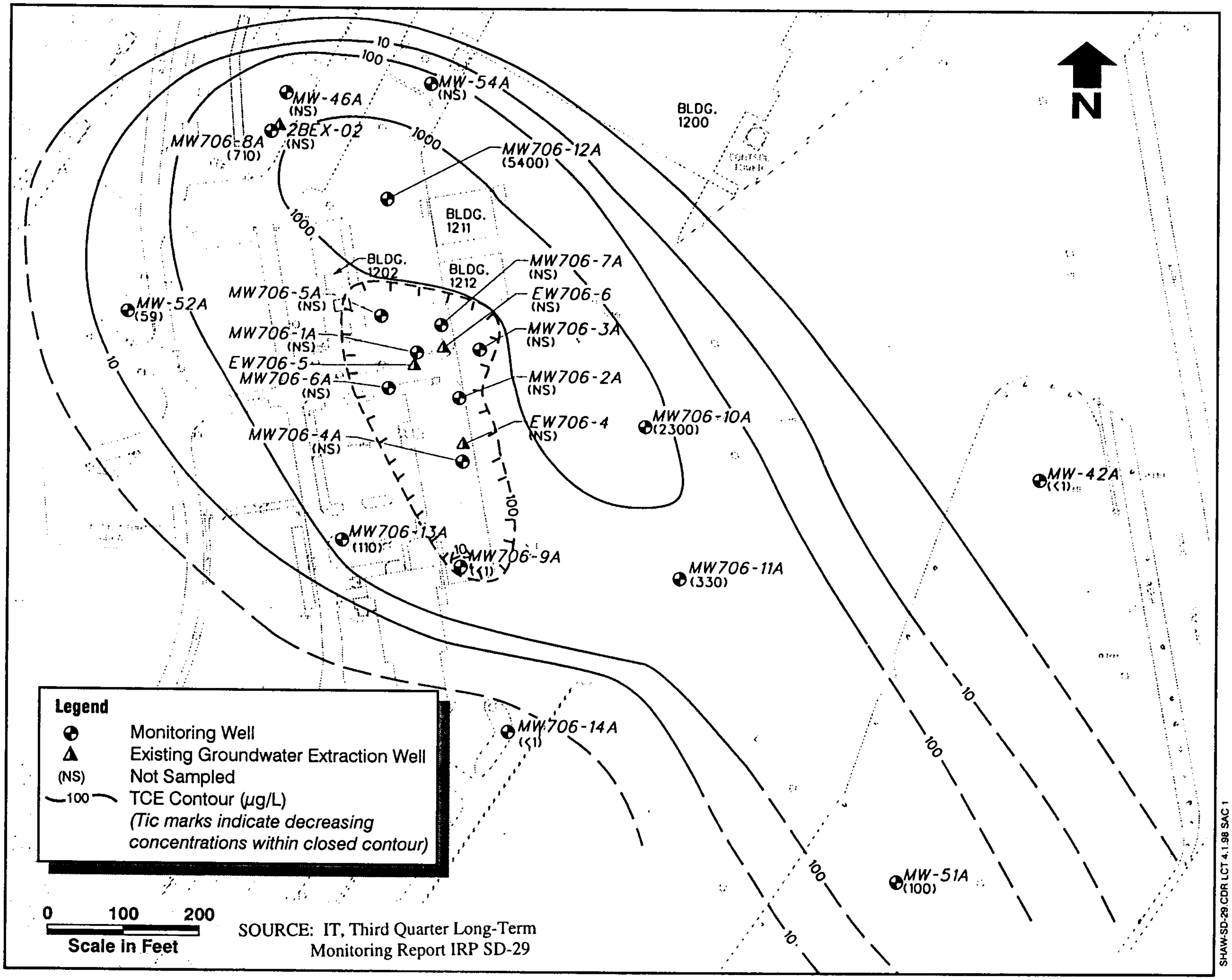
This section focuses on the interim action groundwater containment system located at Site ST-30, Shaw AFB. A site map for ST-30 is included as Figure 26.

Contaminants in Soil

- Soil was contaminated with JP-4 jet fuel by a leaking jet fuel supply line.
- TPH concentrations ranged from 87 to 592 ppm.

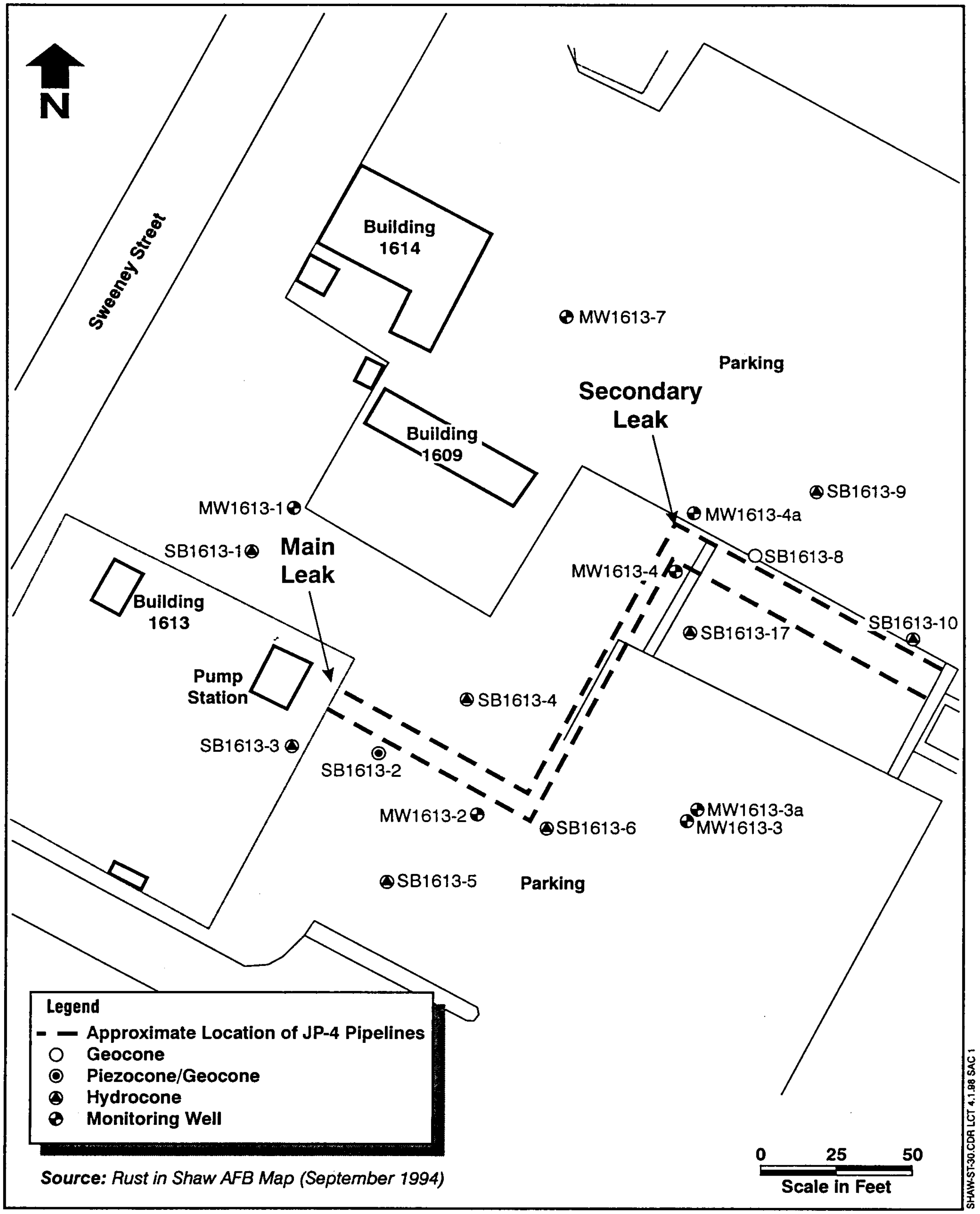
Contaminants in Groundwater

- Free product JP-4 jet fuel was identified on groundwater.



SOURCE: IT, Third Quarter Long-Term Monitoring Report IRP SD-29

Figure 25. Location of Site SD-29 Oil/Water Separator, Shaw AFB



Source: *Rust in Shaw AFB Map (September 1994)*

Figure 26. Location of Leaking Fuel Line, Site ST-30, Shaw AFB

Lithology

- Predominantly interlayered poorly graded, well graded, and clayey coarse to fine grain sands.

Groundwater Containment System Details

- In March 1995, an interim action free product recovery system was installed to remove free-phase JP-4.
- Contaminated groundwater was treated with an air stripper.
- Approximately 97 gallons of JP-4 was recovered during its year of operation.
- Pneumatic product skimmer pumps were used from March 1995 through January 1996.
- Passive skimmer bailers were installed in January 1996 and are checked monthly.
- There are currently no remedial activities or monitoring at ST-30.

Operation Period

- The interim action system was operated from March 1995 through February 1996.
- The interim action system was shut down when recovery of JP-4 became negligible.

Total Capital Costs

- Data not available.

Total O&M Costs – Sites SD-29 and ST-30

- Total cumulative costs for the SD-29 and ST-30 interim action free product recovery system were $17,000 from March 1995 through February 1996.

Cost and Performance of Groundwater Containment at Sites SD-29 and ST-30

Groundwater Containment with Free Product Source Removal Operational Objectives

The objective of free product source removal is typically to remove liquid-phase contamination as quickly and cost-effectively as possible to prevent continued contamination of surrounding soil and groundwater. The emphasis for free product removal is that the mass of contaminants is cost effectively removed.

Cost for Operation

Figure 27 illustrates curves of O&M costs for the interim action groundwater containment systems at Sites SD-29 and ST-30. The monthly O&M costs ranged from $0 to $6,021. Total O&M costs after one year of operation were $17,000.

Contaminant Removal

Figures 28 and 29 illustrate curves of the removal rates of JP-4 free product for the interim action groundwater containment system at Sites SD-29 and ST-30. Monthly removal rates of JP-4 free product ranged from 0 to 50 gallons. Total contaminant removal after one year of operation was 102 gallons of JP-4 free product. By October 1995, both curves representing the cumulative removal rate had flattened, indicating that the removal rates were negligible and a system evaluation for reducing operating cost was warranted. In January 1996 passive skimmer bailers were installed in the recovery wells. The interim action systems were shut down in February 1996 as recovery was negligible and the system was no longer able to meet the operation objectives.

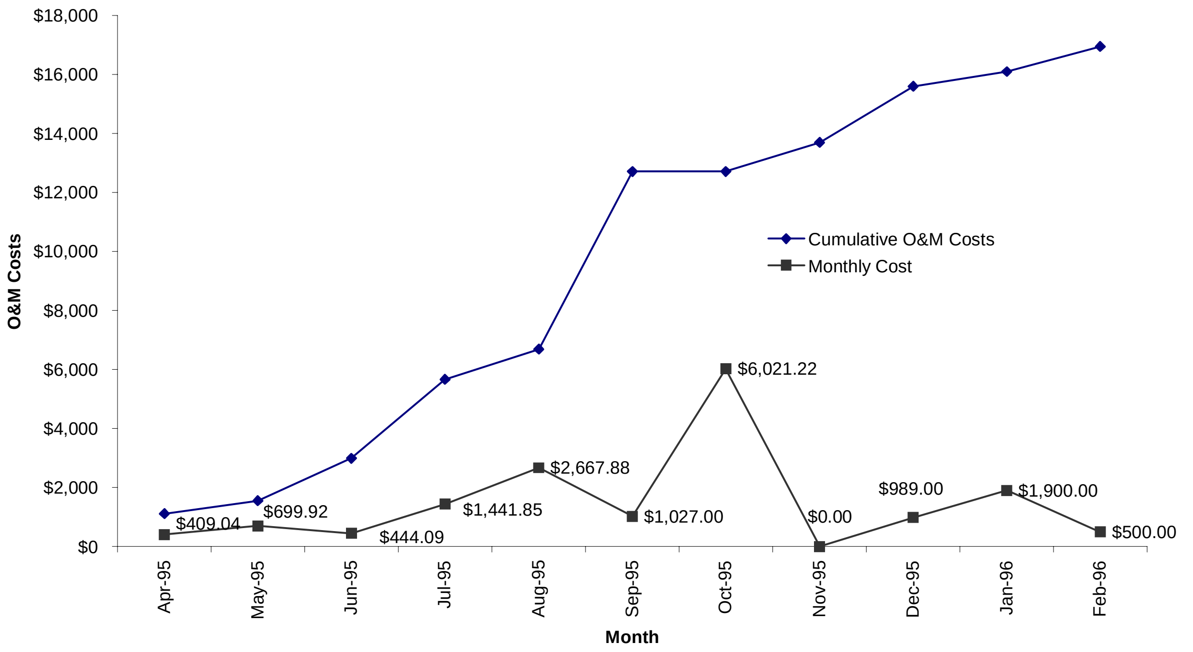
Correlation of Costs and Contaminant Removal

Figures 30 and 31 illustrate the relationship between the O&M costs and the JP-4 recovery of the interim action groundwater containment system at Sites SD-29 and ST-30.

Figure 30 illustrates the cumulative O&M cost relative to the cumulative contaminant removal. During October 1995, the curve had become vertical where the cost per unit of contaminant removal rose exponentially. In January 1996, to reduce cost, passive skimmer bailers were installed in the recovery wells. The system was shut down in February 1996 as recovery was negligible and the system was no longer able to meet the operation objectives.

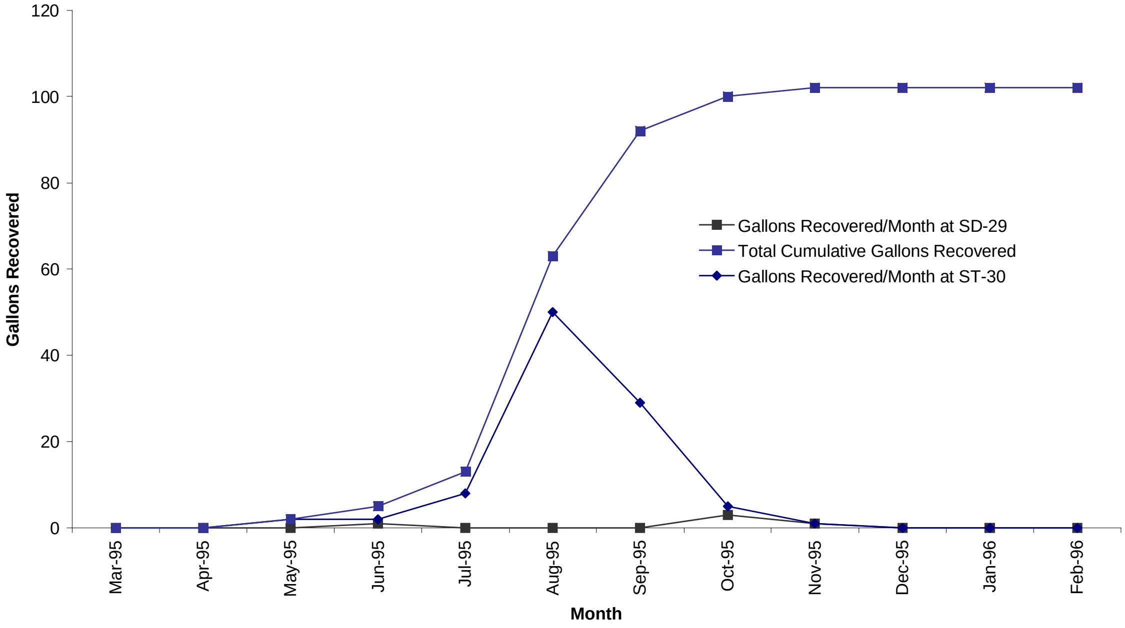
Figure 31 illustrates curves of the monthly and cumulative cost per unit of contaminant removal over the operation time of the systems. The monthly curve illustrates the cost per gallon of JP-4 removal in each month. The cumulative curve illustrates that the average cost per unit of contaminant removal was $166/gallon of JP-4 after one year of operation.

Figure 27
Cumulative and Monthy O&M Costs vs. Time
Sites SD-29 and ST-30, Shaw AFB



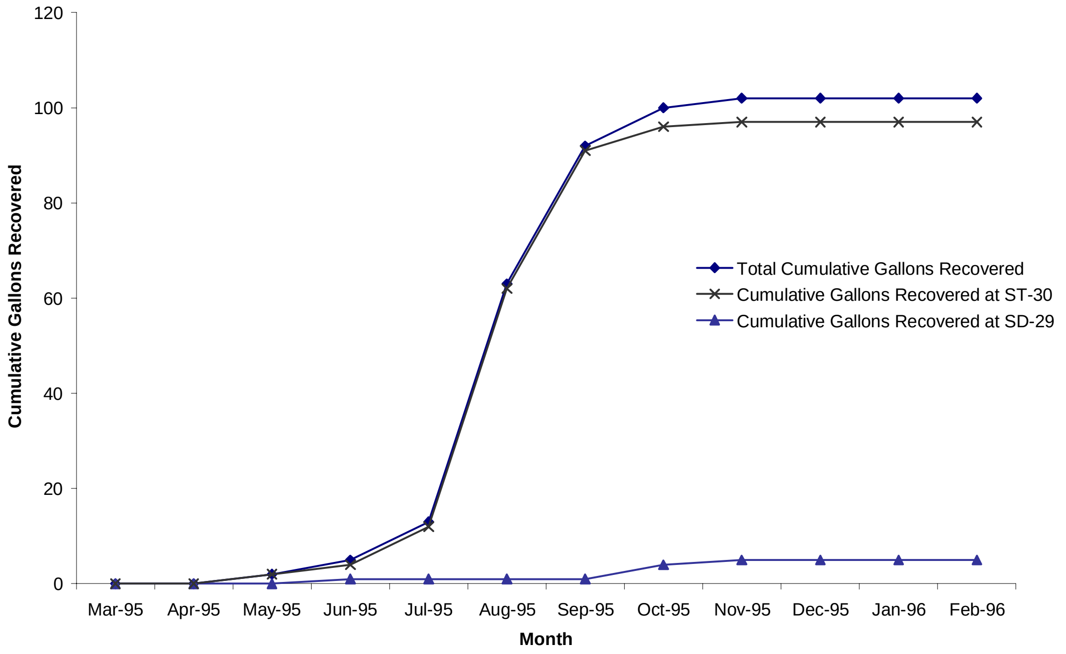
Shaw2930.xls; Cumulative and Monthly Costs

Figure 28
Monthly JP-4 Free Product Recovered at Sites SD-29 and ST-30 and Cumulative Gallons Recovered, Shaw AFB



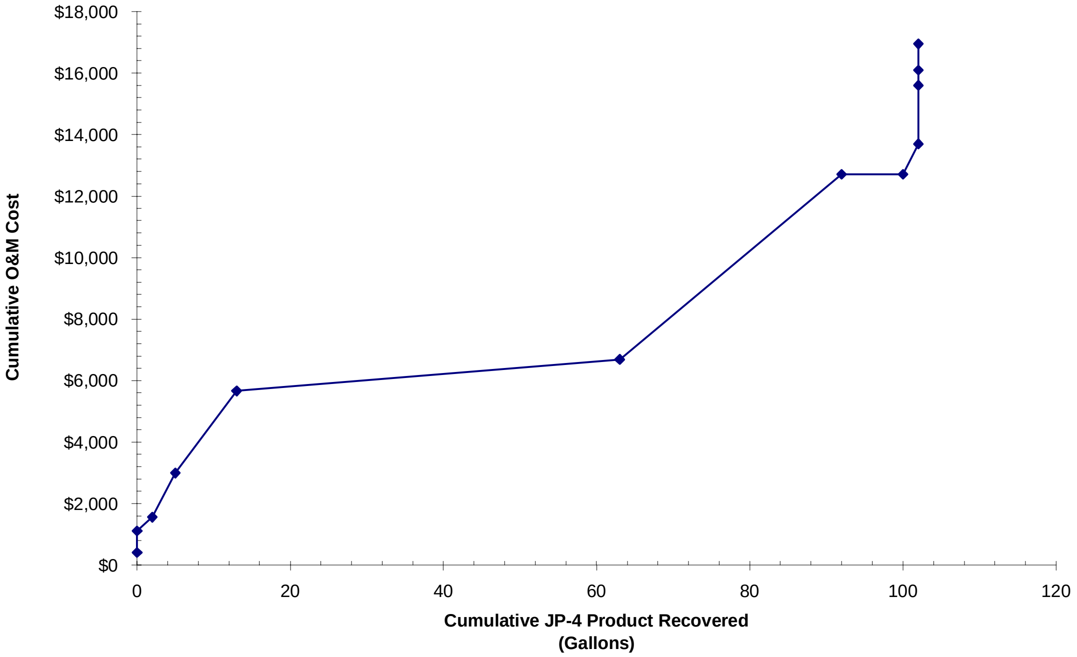
Shaw2930.xls; Monthly Gallons Recovered

Figure 29
Cumulative JP-4 Free Product Recovered
Site SD-29 and ST-30, Shaw AFB



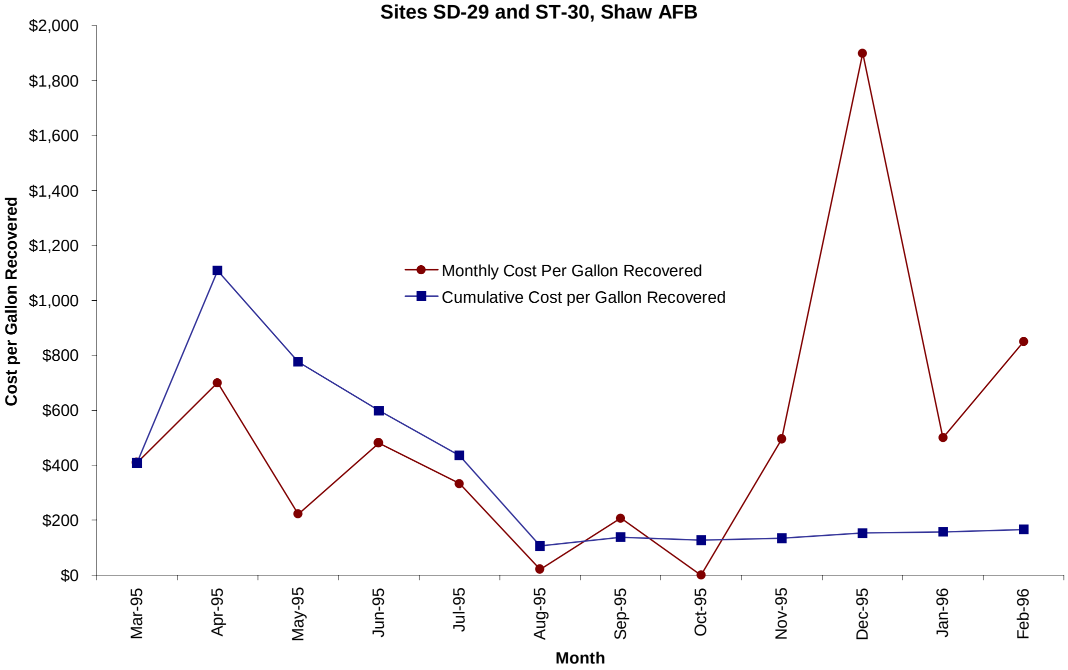
Shaw2930.xls; Cumulative Gallons Recovered

Figure 30
Cumulative O&M Costs per Cumulative JP-4 Product Recovered
Sites SD-29 and ST-30, Shaw AFB



Shaw2930.xls; Cumulative Cost & Gallons

Figure 31
Cumulative and Monthly Costs per Gallon Recovered vs. Time
Sites SD-29 and ST-30, Shaw AFB



Shaw2930.xls; Cost Per Gallon

APPENDIX A

Detailed Cost and Performance Data Tables

JP-4 Free Product Recovery
Sites SD-29 and ST-30
Shaw Air Force Base

Cost Per Gallon For Free Product Recovery Interim Remedial Action System At IRP Sites SD-29 and ST-30 O&M Cost

Month	Gallons Recovered/Month	Total Cumulative Gallons Recovered	Monthly Cost	Cumulative O&M Costs	Monthly Cost Per Gallon Recovered	Cumulative Cost per Gallon Recovered
Mar-95	0	0	$409.04	$409.04	$409.04	$409.04
Apr-95	0	0	$699.92	$1,108.96	$699.92	$1,108.96
May-95	2	2	$444.09	$1,553.05	$222.05	$776.53
Jun-95	3	5	$1,441.85	$2,994.90	$480.62	$598.98
Jul-95	8	13	$2,667.88	$5,662.78	$333.49	$435.60
Aug-95	50	63	$1,027.00	$6,689.78	$20.54	$106.19
Sep-95	29	92	$6,021.22	$12,711.00	$207.63	$138.16
Oct-95	8	100	$0.00	$12,711.00	$0.00	$127.11
Nov-95	2	102	$989.00	$13,700.00	$494.50	$134.31
Dec-95	0	102	$1,900.00	$15,600.00	$1,900.00	$152.94
Jan-96	0	102	$500.00	$16,100.00	$500.00	$157.84
Feb-96	0	102	$850.00	$16,950.00	$850.00	$166.18

Free Product Recovery
Remedial Action System
IRP Site SD-29, Building 1202

Month	Gallons Recovered/Month at SD-29	Cumulative Gallons Recovered at SD-29
Mar-95	0	0
Apr-95	0	0
May-95	0	0
Jun-95	1	1
Jul-95	0	1
Aug-95	0	1
Sep-95	0	1
Oct-95	3	4
Nov-95	1	5
Dec-95	0	5
Jan-96	0	5
Feb-96	0	5

Free Product Recovery Interim
Remedial Action System
Operable Unit 1, IRP Site ST-30

Month	Gallons Recovered/Month at ST-30	Cumulative Gallons Recovered at ST-30
Mar-95	0	0
Apr-95	0	0
May-95	2	2
Jun-95	2	4
Jul-95	8	12
Aug-95	50	62
Sep-95	29	91
Oct-95	5	96
Nov-95	1	97
Dec-95	0	97
Jan-96	0	97
Feb-96	0	97

Appendix N.4

EVALUATING THE EFFECTIVENESS OF INTERCEPTOR TRENCHES IN GROUND WATER POLLUTION CONTROL

EVALUATING THE EFFECTIVENESS OF INTERCEPTOR TRENCHES IN GROUND WATER POLLUTION CONTROL

Cem B. Avci[1], Osman S. Börekci[1], J. Philip Harvey[2], James E. Miller[3]

ABSTRACT

The effectiveness of interceptor trenches in controlling the migration of chemicals in ground water often needs to be evaluated in the design stage or during their operation. Current analytical techniques used to provide estimates for the variables involved in the design of the trenches can be limited by initial assumptions and boundary conditions. These boundary conditions may include an aquifer bounded by an impermeable layer (i.e. underlying clay confining unit) or by downgradient hydraulic influences such as a slurry wall or large surface water body. In this paper an analytical approach is proposed which solves not only for design variables associated with interceptor trenches, but also considers these limiting boundary conditions.

The proposed analytical approach involves superposition of analytical functions which satisfy the governing Laplace equation and uses the theory of complex potentials. A case study involving the release of petroleum hydrocarbons into a shallow ground water system near a lake was examined as a test of the proposed analytical approach. The proposed method was applied to a number of case scenarios with good results. Results calculated using the new approach compare favorably to those measured at the case site and to those simulated using numerical methods. In addition, the new method was applied to a number of case scenarios (which varied the baseline conditions) and provided expected results. The convergence of results indicate that the proposed analytical approach provides a valid method in evaluating the effectiveness of interceptor trenches.

INTRODUCTION

Interceptor trenches comprise simple physical control measures to mitigate the migration of floating separate phase hydrocarbons and organic chemicals dissolved in shallow ground water. In this paper, interceptor trenches refer to a wide range of lateral groundwater collection systems from tile-drain type systems to deep horizontal well installations. The design of an interceptor trench is usually not elaborate and their construction is relatively simple. Recent technology in trench construction methods, such as continuous trenching equipment, use of biodegradable slurries, geotextile or plastic shoring material and other innovations have made the use of interceptor trenches more frequent. In addition, technological improvements in horizontal and directional well drilling has resulted in greater use of these interceptor systems. All of these construction methods involve the installation of a horizontal collection system which intersects a large area of the aquifer. Ground water is

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directed to the interceptor trench as a result of a hydraulic head drop maintained across the length of the trench. The hydraulic head drop can be caused by gravity drainage (as in a traditional French Drain) or by actively pumping from a collection sump attached to the trench system.

The effectiveness of interceptor trenches in controlling the migration of separate phase and dissolved chemicals in shallow ground water often needs to be evaluated in the design stage. Analytical and numerical techniques can be used to provide initial estimates for the variables involved in the design of the trenches. These variables include the width and depth of the trench, average drawdown in trench, as well as the expected flow rate per unit length of the trench. One means of evaluating the effectiveness of the trenches is to calculate the expected ground water capture zone of the trench, or dividing streamline, as presented in Figure 1.

Analytical techniques are presently available for a number of steady-state flow scenarios (Cohen and Miller, 1983: Zheng et al., 1988) involving interceptor trenches installed in unconfined and confined aquifers. Some of these solutions, however are found to focus on the lateral influence of the trenches and therefore, cannot be used to predict the deeper hydraulic control considerations. The solutions developed by Zheng et al. (1988) address directly the analysis of ground water capture zones. Their solutions, however, are limited to an infinite aquifer with linearly sloping water table and minimal penetration by the interceptor trench.

The present paper proposes an analytical approach for the evaluation of ground water flow conditions in aquifers where partially penetrating interceptor trenches are used to control the migration of contaminated ground water. The analysis is applicable to aquifers bounded by an impermeable layer at the bottom (i.e. underlying clay layer) and incorporates the effects of downgradient hydraulic influences such as slurry walls and lakes. The analytical expressions, obtained by solving the governing steady-state ground water flow equations, include the evaluation of the stream function which allows for the direct determination of the capture zone. A case study involving the migration of petroleum hydrocarbons in a shallow ground water system near a large lake was examined as part of this study.

ANALYTICAL APPROACH

The effectiveness of an interceptor trenches at the case site was evaluated using two analytical techniques and a numerical modeling method. The first analytical technique was developed by the authors using steady-state ground water flow equations described by Strack (1989). These derivations are presented in detail in this paper. A second analytical technique used a solution previously developed by Zheng et al. (1988). Finally, a three-dimensional finite difference model, MODFLOW, after McDonald and Harbaugh (1983), was used to check the analytical solutions derived in this paper.

Proposed Analytical Method

A new analytical technique was developed by the authors to evaluate conditions at the case site and to evaluate varying boundary conditions which might be encountered in the future or encountered at other installations.

The analytical approach was derived by considering the influence of each ground water control mechanism in the flow field. These flow conditions were analyzed by solving the governing, steady-state, ground water flow equations using analytical techniques described by Strack (1989). The solution technique consisted of superposing a number of suitable closed-form analytical functions, based on the features controlling the ground water flow as presented in Figure 3. All of the selected analytical functions satisfied the governing Laplace equation and provided expressions of the stream function and potential function in infinite aquifers. The combination of these appropriate analytical functions chosen to satisfy the various boundary conditions observed in the field yielded a closed form expression which subsequently was used to predict the ground water flow regime. The selected analytical functions used were:

- uniform flow: described the flow field under confined conditions that would exist had there been no other flow control mechanisms;
- line sink: selected to represent the influence of the partially penetrating trench on the flow field as well as the presence of the constant head boundary condition (lake or river) which fully penetrates the aquifer; and
- double-root dipole: selected to represent a very thin impermeable layer (slurry wall) downgradient of the flow field.

Each of the analytical functions has a complex potential given by:

$$\Omega = \Phi + i\Psi \tag{1}$$

where the potential function ϕ and the streamfunction Ψ fulfill the Cauchy-Reimann conditions. The function Ω - $\Omega(z)$ is a function of the complex variable $z = x + iy$.

The stream function and potential function for uniform flow are given by:

$$\Omega = -[Q_{xu} - iQ_{yu}]\, z + \Phi_o \tag{2}$$

where Q_{xu} and Q_{yu} are the components of the discharge vector for rectilinear flow and Φ_o is a constant.

The line sink represents a distribution of wells along a line where the inflow. It outflow takes place uniformly along a line; the line sink of length **L** as shown in Figure 3a is defined by the complex and points $\mathbf{z_1}$ and $\mathbf{z_2}$ where the wells all have a discharge $\sigma\Delta\xi$, and $\Delta\xi$ is the distance between the wells. The complex potential for a line sink is given by (Strack, 1989):

$$\Omega = \frac{\sigma L}{4\pi}\left[(Z+1)\ln(Z+1) - (Z-1)\ln(Z-1) + 2\ln\left[\frac{1}{2}(z_2 - z_1)\right] - 2\right] \tag{3}$$

where the z-plane is transformed to the Z-plane using:

$$Z = X+iY = \frac{z-\frac{1}{2}(z_1+z_2)}{\frac{1}{2}(z_2-z_1)} \tag{4}$$

The analytical element which can be used simulate thin straight isolated features such as slurry walls or sheet pilings is a double root dipole function (Strack, 1989). A thin impermeable layer of length **L** which lies between complex points $\mathbf{z_1}$ and $\mathbf{z_2}$ in the physical plane is initially transformed into the **Z** coordinate using the relationship (Figure 3b). The additional coordinate transform being used is of the form:

$$\chi = Z+\sqrt{(Z+1)(Z-1)} \tag{5}$$

The complex potential for a line-dipole is a function where the real part is continuous and the imaginary part is discontinuous across the element. These conditions are given by:

$$-1 \le X \le 1 \;\; Y = 0 \qquad \begin{matrix} \Phi^+ - \Phi^- = 0 \\ \\ \Psi^+ - \Psi^- = \mu(X) \end{matrix} \tag{6}$$

where μ is the density distribution of the line dipole. The complex potential function as given by:

$$\Omega = \sum_{j=1}^{n} \frac{a_j}{\chi^j} + \sum_{r=1}^{m} \sum_{j=1}^{m_r} \left[\frac{\beta_r^j \bar{\delta}_r}{(\chi - \delta_r)^j} + \frac{\bar{\beta}_r^j \bar{\delta}_r}{(\chi - \bar{\delta}_r)^j} \right] \tag{7}$$

where:

$$\beta_r^j = b_r^j + ic_r^j \tag{8}$$

satisfies these conditions. The use of the double root dipole depends on the selection of the number of degrees of freedom as given by the coefficients a_j, b_r^j, and c_r^j. These coefficients are determined by solving for known values of density distribution at control points selected along the surface of the line dipole.

The impermeable boundary conditions show in Figure 2 are determined by the use of the method of images (Bear, 1979); each of the analytical functions used for the simulation of ground water flow control mechanisms are evaluated as images along the upper portion of the aquifer as well as the lower portion to yield impermeable flow conditions along these lines.

Solution After Zheng et al. (1988)

The ground flow conditions in the vicinity of a partially penetrating trench in an aquifer of infinite depth with a linearly varying water table can be simulated by the methods described in Zheng et al. (1988). In this analysis, the solution by Slichter (1899) of horizontal flow into a trench was superimposed with a linearly varying water table condition to yield the hydraulic head distribution:

$$h(x,y') = h_o + Ix - \frac{1}{\pi}[h_o - h_d]\left[\tan^{-1}\frac{a+x}{y'} + \tan^{-1}\frac{a-x}{y'}\right] \quad \textbf{(9)}$$

and the stream function:

$$\psi(x,y') = \sqrt{K_x\,K_y}\left[Iy' - \frac{1}{2'\pi}\,[h_o - h_d]\,\ln\frac{(a+x)^2 + y'^2}{(a-x)^2 + y'^2}\right] \quad \textbf{(10)}$$

Here K_x, K_y are the hydraulic conductivity in the x and y directions respectively (Figure 4), **I** is the uniform water table gradient, $\mathbf{h_o}$ is the head in the aquifer underlying the trench and $y' = y\sqrt{K_x/K_y}$; the head along $y = 0$ is a linear water table $\mathbf{h = h_o + Ix}$, the constant head in the trench of width **2a** is given by $\mathbf{h_d}$.

The stagnation point (x_{sp}, y'_{sp}) existing on the downgradient side of the trench is given by:

$$x_{sp} = -\left[\frac{a^2}{2} + \frac{1}{2}\left[a^4 + \frac{4a^2(h_o - h_d)^2}{\pi^2 I^2}\right]^{\frac{1}{2}}\right]^{\frac{1}{2}} \quad \textbf{(11)}$$

$$y_{sp}' = \left[x_{sp}^2 - a^2\right]^{\frac{1}{2}} \quad \textbf{(12)}$$

The values of the stagnation point coordinates are inserted into equation (9) to yield the stagnation streamline; this streamline represents the capture zone of the interceptor trench.

The present study as well as the procedures advocated by Zheng et al. (1988) are based on satisfying the Laplace equation in a flow domain where the nonlinear behavior created by the presence of the water table zone are ignored; both methods can be applied in homogeneous aquifers. In cases where the hydrogeologic conditions do not exactly match the conditions underlying the derivation of the analytical procedures, these methods can, then be viewed as a first approximate of the effectiveness of the capture zone.

SITE DESCRIPTION

The case study was applied to a site located at the south end of the a large lake. The site borders the lake and forms the northern most extent of a major active petroleum refinery. Site topography is relatively flat, with ground surface elevations approximately 10 feet above normal lake water levels.

The underlying site geology comprises approximately 110 ft of unconsolidated glacial deposits overlying Silurian aged dolomitic limestone. The upper most 30 to 40 ft of glacial deposits consist of fine to medium grained sands and man-made fill material. Below this sand unit is 70 to 80 ft of clayey, glacial till. Ground water flow occurs primarily in the upper sand unit as the clayey till unit is a significant barrier to vertical ground water flow.

Hydraulic conductivity testing for the upper glacial sand unit indicated an average of 7.1 x 10^{-3} cm/sec (20 ft/day). The average hydraulic conductivity of the underlying clayey till unit was measured to be 2.0 x 10^{-8} cm/sec (5.7 x 10^{-5} ft/day). Ground water flows predominantly in the upper sand unit due to the low hydraulic conductivity of the underlying clayey till unit.

Ground water flows from south to north and towards the lake. Significant vertical gradients are not measured within the upper sand unit and ground water flow is considered to be predominantly horizontal. Ground water levels are subject to fluctuations related to variations in the lake level.

In 1969, an interceptor trench was installed along the shoreline of the site area (Figure 5). The primary purpose of this interceptor trench is to remove separate phase hydrocarbons floating on the water table. Shallow ground water is also collected as part of the operations. The collection system consists of a subsurface interceptor trench containing slotted piping, which is connected to a large sump. Ground water intercepted within the trench is conveyed to the sump in response to continuous pumping at the sump. The interceptor trench is approximately 700 ft long and about 11 ft deep. Figure 6 presents hydrogeologic cross-sections through the interceptor trench. The water level information presented in this figure is from May 1991. A field investigation in the spring of 1991 was performed to determine operational conditions of the existing systems and to evaluate the capture zone of the interceptor trench. These data (Table 1) provide the basis to test the analytical and numerical techniques discussed in this paper.

RESULTS OF ANALYSES

The proposed analytical approach was used to evaluate the effectiveness of the interceptor trench at the case site using conditions measured in May 1991. In addition, the method after Zheng et al. (1988) and MODFLOW modeling were used to evaluate baseline conditions. Field measured data and operational information (Table 1) provided the input parameters for each method. The proposed analytical approach was applied to several flow scenarios based on the hydrogeologic conditions found near the lake. The flow scenarios were selected to:

- establish baseline conditions to calibrate the analytical model and subsequently compare with field measured values and with numerical simulations;
- investigate the impact of lake water level variations on the effectiveness of the trench operations;
- investigate the impact of the aquifer depth on the effectiveness of the trench operations; and
- review the feasibility of constructing a partially penetrating slurry wall downgradient of the operating trenches as an additional remedial measure.

Variables for each case are summarized in Table 2.

Scenario 1: May 1991 Baseline Conditions

The analytical model developed in this paper was calibrated to the hydrogeologic conditions established in May 1991 which were taken to represent baseline conditions (Table 1). The hydrogeologic variables in the model are shown in Table 2 under Case 1. The available information consisted of the trench flow rate (13.7 ft^3/day/ft) per unit length of the 700 ft long trench (50 gpm total flow), the hydraulic head in the trench varying between 577.8 and 576.4 ft, the lake water level (580.3 ft), the induced ground water gradient (0.011 ft/ft) and the upgradient water level (584.2 ft) observed at an observation well 500 ft from the trench.

The analytical model was used with Q_{xu} = 0.011; a trench depth of 3.4 ft the below water table; operating at a strength of a 0.202 to yield a flow rate of 13.7 ft^3/day/ft; using a hydraulic conductivity of 20 ft/day. The model predicts the streamline and hydraulic head distribution presented in Figure 7. This figure indicates that the trench is successful in capturing all of the ground water upgradient of the trench and creates a large enough drawdown at the trench to withdraw water from the lake as well. The dividing streamline is found to extend to the top of the clayey till unit. Approximately 46 percent of the water withdrawn from the trench is obtained from the lake.

The same hydrogeologic conditions were simulated by a numerical model in order to compare to the results of the new analytical model. The finite difference model MODFLOW was used to simulate the steady state two-dimensional profile using the baseline conditions. A finite difference grid consisting of 25 layers with 130 columns was used to simulate the flow conditions occurring in the unconfined aquifer; the grid distribution was selected to be closely spaced in the vicinity of the trench to adequately simulate the impact of the trench operations. Constant head boundary conditions were selected 500 ft upgradient of the trench (584.2 ft), at the trench (578 ft) and the lake water level (580.3 ft). A homogeneous and isotropic aquifer was assumed with a hydraulic conductivity of 20 ft/day. The hydraulic head distribution across the aquifer and the water table profile predicted by the numerical model and the analytical method are presented in Figures 8 and 9, respectively. The water table predicted by the MODFLOW model is shown to consistently predict slightly higher water levels than the analytical method in the upgradient region; on the other hand, the water level predictions downgradient of the trench are very similar in each case. The differences in upgradient water levels are most likely due to the constant head boundary condition assumed in the numerical model at 500 ft from the trench. The slightly higher water levels predicted by the numerical model also affect the hydraulic head distribution upgradient of the trench as shown in Figure 8.

The depth of capture (vertical extent of pumping influence from the interceptor trench) and the relative ground water flow rates from the upgradient direction were also evaluated using the method after Zheng et al. (1988). Standard seepage analyses (using Darcys Law and Dupuit, (1863) approximations) were used to calculate flow from the downgradient, lake side, direction. Each of these solutions required assumptions which did not completely match given site conditions/boundary conditions (i.e. lower confining layer and constant head at lake). Consequently, results should be viewed with some caution. Table 1 summarizes the input parameters for the calculations using the Zheng et al. (1988) method and using Dupuit (1863) seepage analysis. Table 3 summarize results of these two analyses.

The results presented in Table 3 indicate that approximately 28 gpm of ground water flow is being collected by the interceptor trench in the downgradient direction. Results of the analysis of flow from the upgradient direction indicated a range of discharges from 15 to 25 gpm; dependent upon the hydraulic conductivity ratio. The analysis also suggested that the depth of capture of the interceptor trench ranged from 38 ft to 19 ft below the static water table.

The streamline distribution using this method is presented in Figure 10 for comparison with the proposed analytical approach. This comparison indicates that the method after Zheng et al. (1988), by itself, is not adequate to predict the flow conditions occurring in the aquifer because the aquifer thickness is too small to satisfy the infinite aquifer condition. Also, the constant head boundary condition existing near the trench cannot be ignored as this condition strongly influences ground water flow regime in the aquifer.

Scenario 2: Impact of Varying Lake Water Levels

The proximity of the lake as a constant head boundary condition, represents an important factor in the effectiveness of the trench operations due to variations in lake water levels. Lake water levels at the case site have been recorded to significantly vary overtime. Consequently, ground water flow conditions near the trench will change with the varying lake water levels. The analytical model was used to predict the flow conditions that would likely exist under recorded high and low lake water level values.

A lake elevation of 584 ft represents a historic high water level condition. The analytical model was used with the variable values listed in Table 2 as Case 2. All parameters were held constant (including hydraulic gradient) while lake levels were changed. The average hydraulic head in the trench was predicted as 578.3 ft under an extraction rate of 30 ft^3/day/ft. The streamline and hydraulic head distribution are presented in Figure 11. The trench captures all of the water upgradient of the trench and therefore is successful in controlling migration of contaminated ground water. The lake supplied approximately 78 percent of the water discharged from the trench.

A lake elevation of 577 ft represents a historic low water level condition. The analytical model was used with the variable values listed in Table 2 as Case 3; the average hydraulic head in the trench was predicted to be 577.3 ft under an extraction rate of 4 ft^3/day/ft. The streamlines and hydraulic head distribution are presented in Figure 12. The low lake water level decreases the amount of water than can be extracted from the trench and therefore diminishes its effectiveness in controlling the ground water flow upgradient of the trench. These results can be observed from Figure 12 where the capture zone of the trench is shown to encompass only a portion of the entire thickness of the water bearing zone. The capture zone of the trench is found to extend to a depth of 559 ft; the upgradient ground water flowing between elevation 559 ft and 550 ft (bottom of aquifer) therefore flows underneath the trench and toward the lake.

The low lake water level hydrogeologic conditions were also examined using the Zheng et. al (1988) analysis. The variable values that were used in the analysis were the induced hydraulic gradient i as 0.011 ft/ft, a trench width a of 1.5 ft, a hydraulic head level difference at the trench of 1.4 ft and a isotropic hydraulic conductivity value of 20 ft/day. The capture zone predicted by Zheng et. al. (1988) and by the current method are presented in Figure 13. The proposed analytical approach predicts a smaller capture zone in the vicinity in the trench due to the effects of the underlying clayey till unit. The stagnation points are predicted to be closer to the trench. However, the point of origin of the capture zone on the water table are predicted to be the same by both methods of analysis.

Scenario 3: Impact of Varying Aquifer Thickness

The thickness of the aquifer represents an important variable in gaging the effectiveness of interceptor trench operations. The impact of the aquifer thickness on the capture zone of the trench was investigated by varying the aquifer thickness while keeping other hydrogeologic conditions constant under baseline conditions.

An aquifer thickness of 100 ft was assumed and the proposed analytical approach was used with the variables presented in Table 4 under Case 4. The average hydraulic head in the trench was predicted at 580 ft at a flow rate of 13.7 ft^3/day/ft. The drawdown in the trench is predicted to be less than that measured in the baseline conditions (Case 1). This is likely due to the increase in the aquifer thickness which represents an increase in the aquifer transmissivity resulting in smaller drawdowns. Figure 14 indicates the distribution of streamlines and hydraulic heads predicted by the analytical method. The increase in the aquifer thickness results in a greater percentage of flow from the upgradient direction of the trench than in the May 1991 baseline conditions. A trench operating at the same discharge rate (13.7 ft^3/day/ft) is not adequate to collect all of the ground water migrating towards the lake. A capture zone extending to elevation 515 ft is created. Under these circumstances, ground water flowing between the lower confining layer of the aquifer (480 ft) and the capture zone (515 ft) will migrate unaffected by the trench towards the lake.

Ground water flow conditions which might exist in a 20 ft thick aquifer (less than baseline conditions) was evaluated with the new analytical model using the variables presented in Table 2 under Case 5. The average hydraulic head in the trench was predicted as 576.4 ft at a flow rate of 13.7 ft^3/day/ft; the drawdown in the trench was found to be higher than the baseline conditions (Case 1). This is due to the decrease in the aquifer thickness which represents a decrease in the aquifer transmissivity resulting in higher drawdowns. Figure 15 indicates the stream line and hydraulic head distributions predicted by the analytical model. The trench is found to be successful in capturing all of the ground water flowing from the upgradient direction. However, the decrease in aquifer transmissivity results in a greater amount of drawdown at the trench than the baseline conditions, specifically 576.4 ft versus 578 ft. The effect of the increase in the trench drawdown is to create a greater cone of depression near the constant boundary head condition and thus a greater amount of water is found to be migrating from the lake toward the trench. Approximately, 71 percent of the water withdrawn from the trench comes from the lake compared to 46 percent as predicted in Case 1.

Scenario 4: Impact of a Partially Penetrating Impermeable Flow Boundary

The case where an impermeable boundary, or slurry wall, installed downgradient of the trench was examined with the case of low lake water levels. The previous analysis (low lake level) had indicated that the trench was not successful in capturing all of the ground water migrating towards the lake. A simulated impermeable boundary was installed 80 ft downgradient of the trench and extended to an elevation of 565 ft (15 ft above the top of clay layer). The proposed analytical approach was used with the variables presented in Table 2 as Case 6. The resulting streamline and the hydraulic head distributions are indicated in Figure 16. These results suggest that the slurry wall (constructed under these conditions) will not likely impact the flow regime nor impact the operation of the trench. The same amount of ground water will flow towards the lake as expected since the flow out of the trench was kept the same. However, the impact of the slurry wall would be to increase the hydraulic head values in the vicinity of the trench and therefore provide more hydraulic head within the trench which can then be reduced by increasing the flow rate. The hydraulic head distribution in Figure 16 indicates that the slurry wall indeed increases the hydraulic head distribution in the vicinity of the wall, however, the effects do not extend to the location of the trench and therefore the hydraulic head distribution in the trench will be the same.

SUMMARY

The effectiveness of interceptor trenches, as determined by their adequate capture zones, needs to be evaluated in the design stage and during operations. Analytical methods provide quick and relatively easy means for establishing initial trench effectiveness. However, many of the closed form analytical solutions require limiting assumptions regarding boundary conditions. These conditions, often encountered in the field, will influence the flow regime and therefore the capture zone of the trench. The present paper has proposed an analytical approach for trenches installed in aquifers bounded by a lower impermeable boundary and by downgradient hydraulic influences (slurry walls and lakes). The proposed approach superposes a series of analytical functions using the theory of complex potentials

The proposed analytical approach was applied to a case site involving an interceptor trench currently in use to collect and remove separate phase hydrocarbons floating on the water table. Various hydrogeologic scenarios were used to establish the impact of variable lake levels, aquifer thickness, and the presence of a slurry wall on the trench operation. Results from the proposed analytical approach compared favorably with those measured in the field and those simulated by numerical modeling. This suggests that the new method may be applied to a number of field conditions to predict the effectiveness of an interceptor trench.

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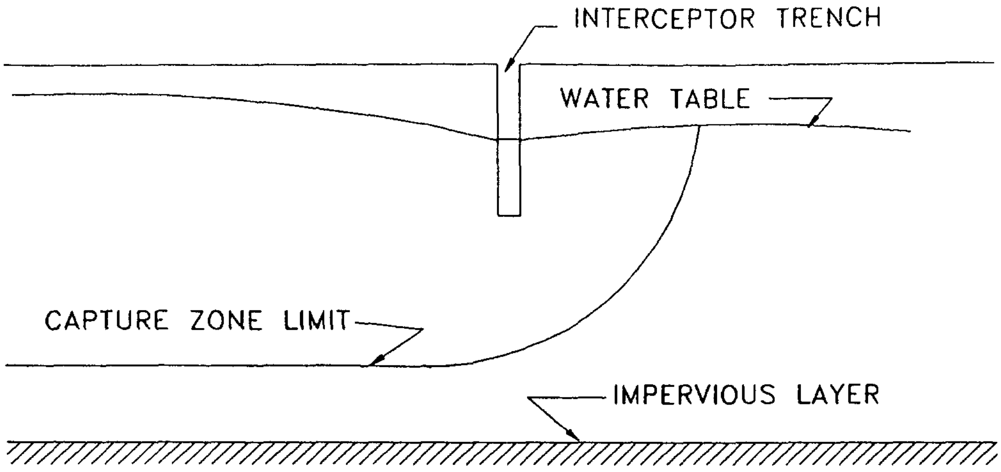

Figure 1. **Conceptual Model of Flow to a Trench and Depiction of the Dividing Streamline**

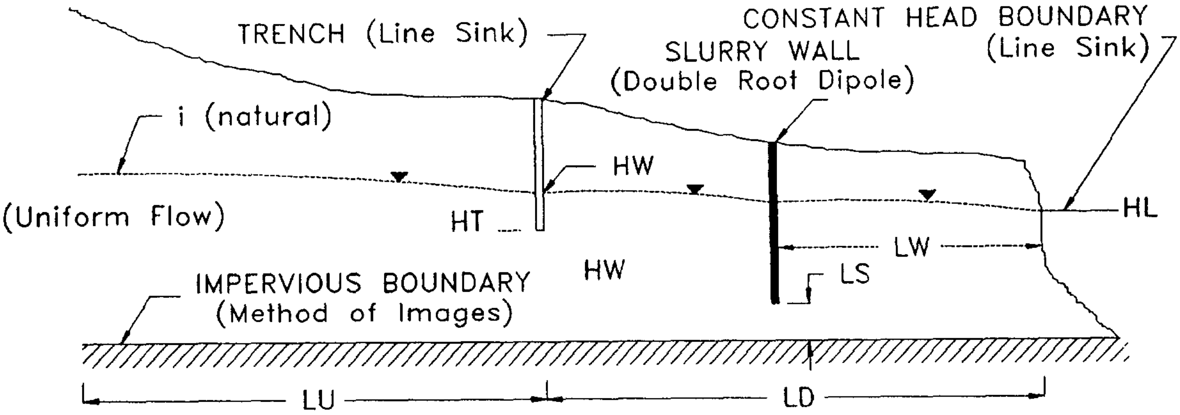

Figure 2. **Hydrogeologic Conditions and Variables Used in the Proposed Analytical Approach**

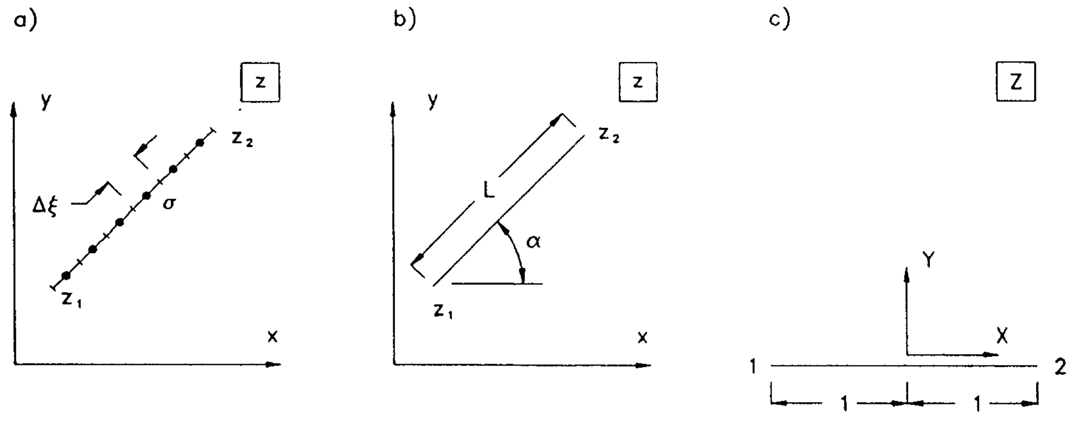

Figure 3a. Coordinate Transform Used for Line Sink Element

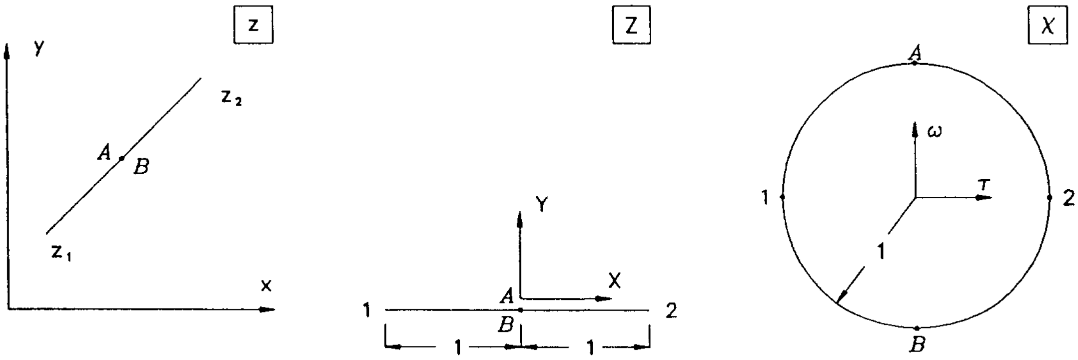

Figure 3b. Coordinate Transform Used for Double-Root-Dipole Element

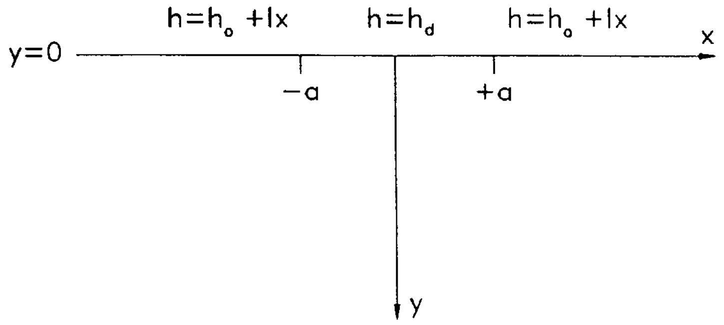

Figure 4. Coordinate System Used for Method After Zheng et. al. (1988)

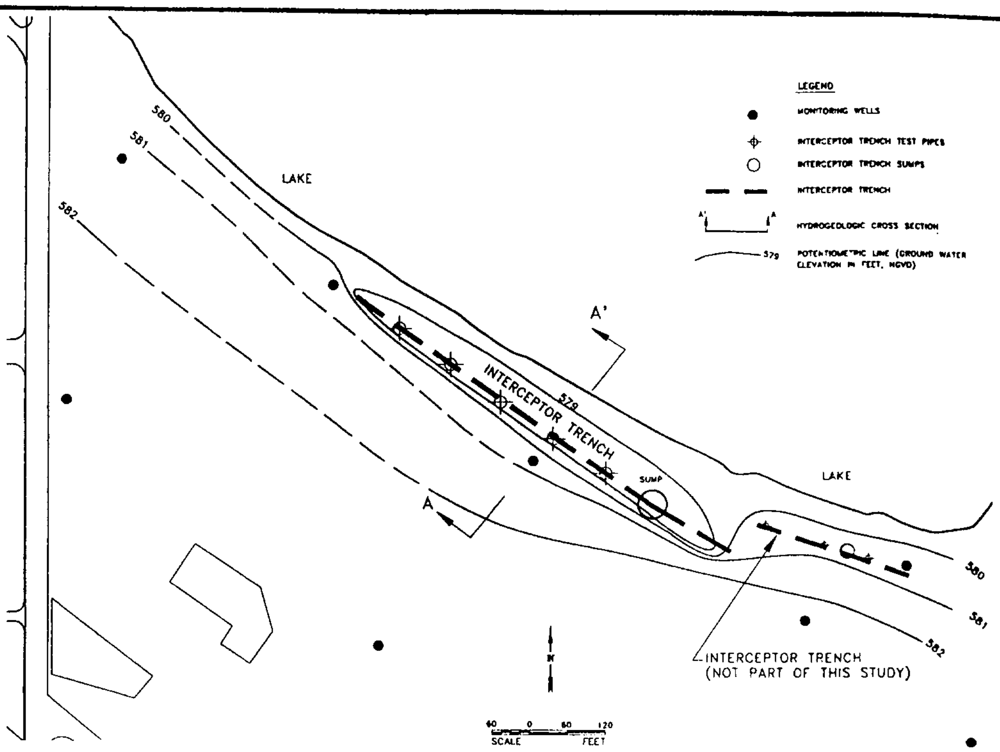

Figure 5. Site Location Map

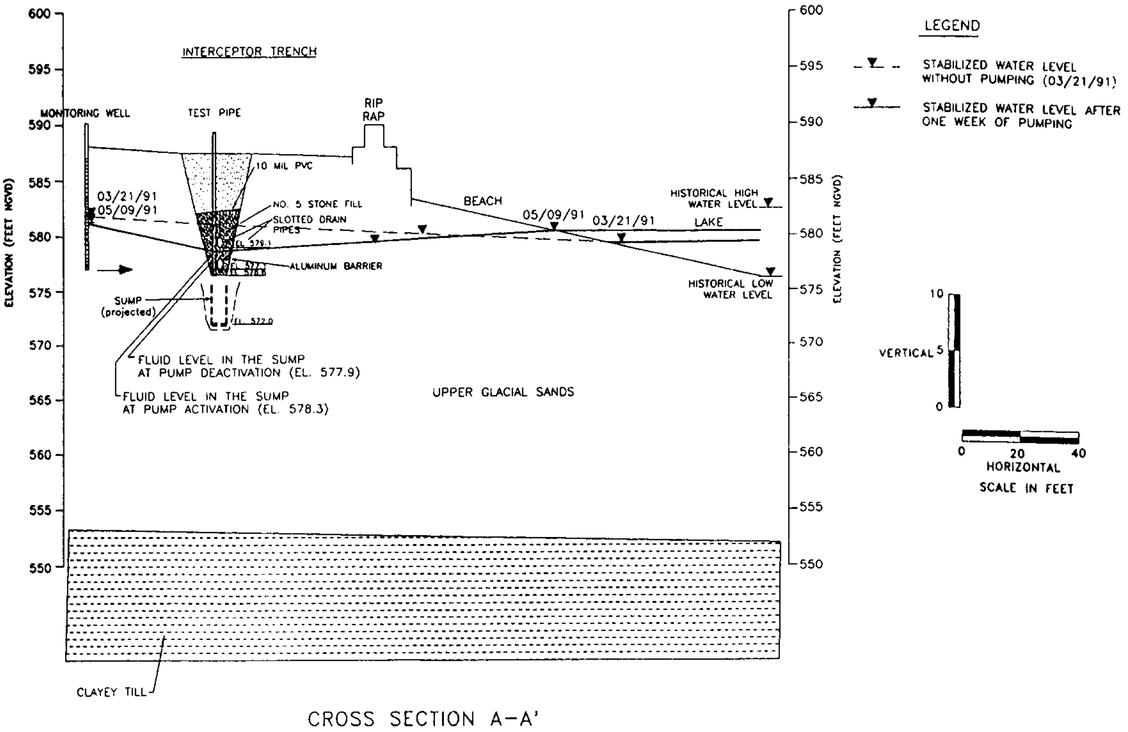

Figure 6. Baseline Conditions for Interceptor Trench at Case Site

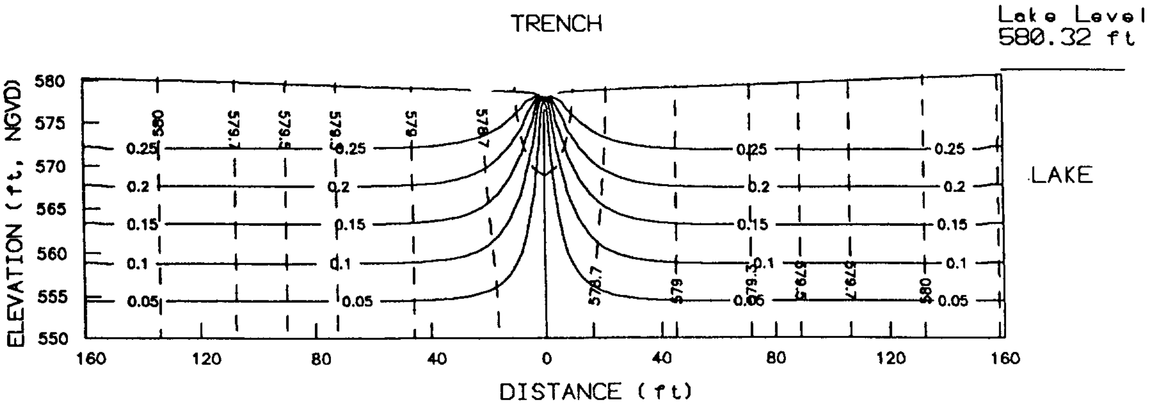

Figure 7. Case 1: Simulation of Baseline Conditions Using Proposed Analytical Model

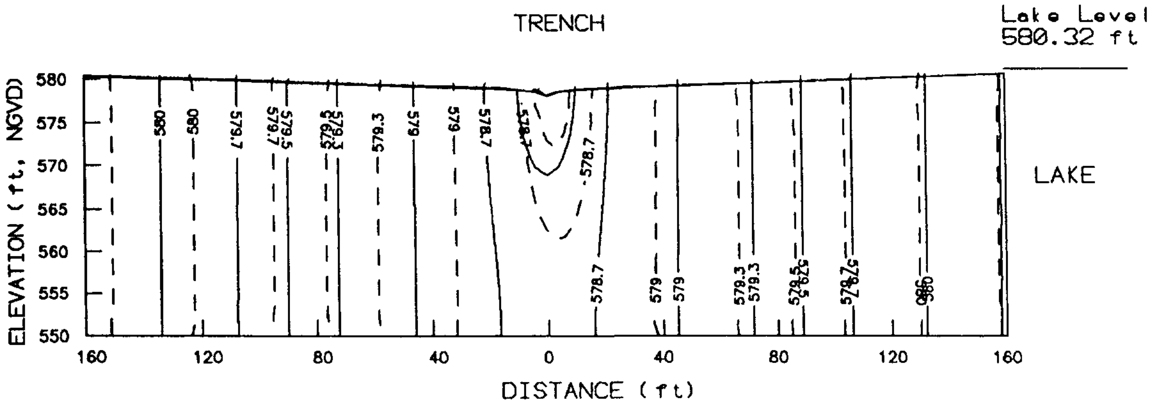

Figure 8. Comparison of Hydraulic Head Distribution Predictions Given by Numerical (---), and Proposed Analytical (—) Models

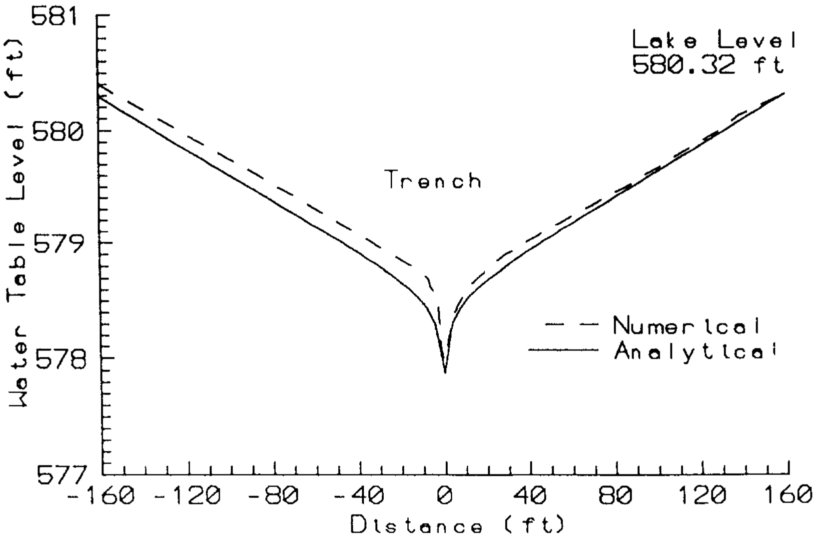

Figure 9. Comparison of Hydraulic Head/Water Table Predictions Given by Numerical (---), and Proposed Analytical (—) Models

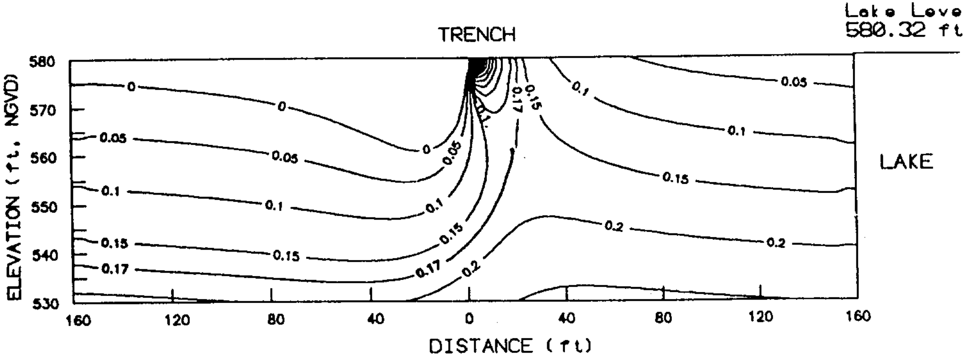

Figure 10. Case 1: Simulation of Baseline Conditions Using Method After Zheng et. al. (1988)

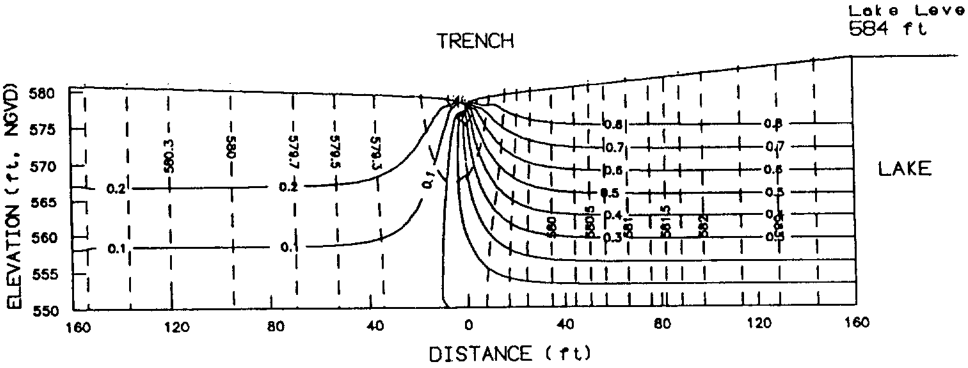

Figure 11. Case 2: Simulation of High Lake Water Level Conditions

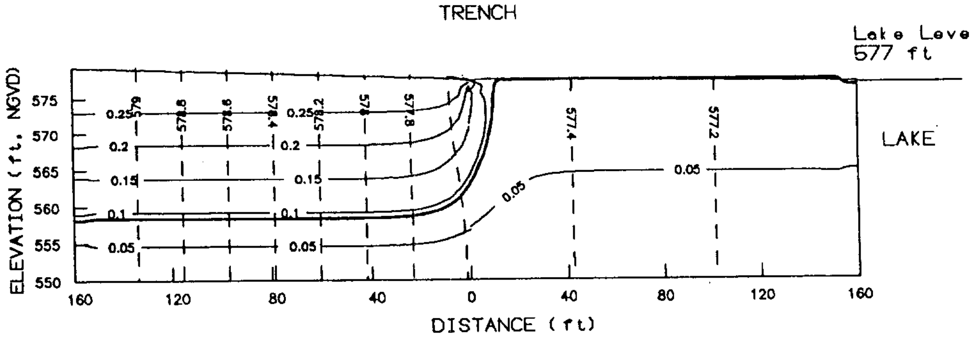

Figure 12. Case 3: Simulation of Low Lake Water Level Conditions

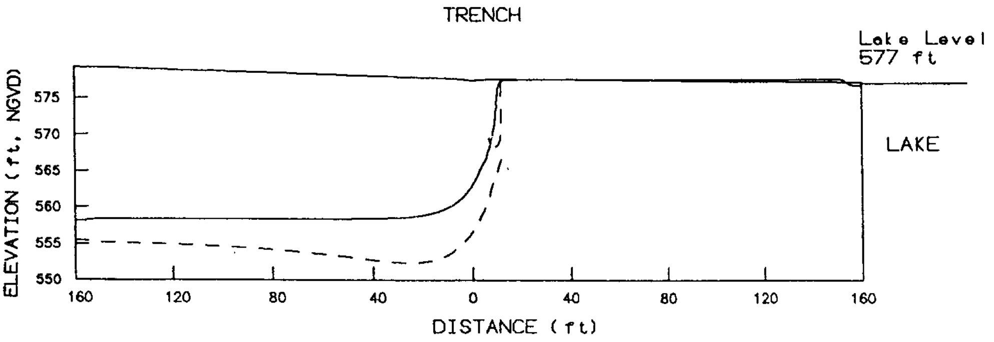

Figure 13. Case 3: Capture Zone Predictions by the Proposed Analytical Model (—), and the Method After Zheng et. al. (1988) (---).

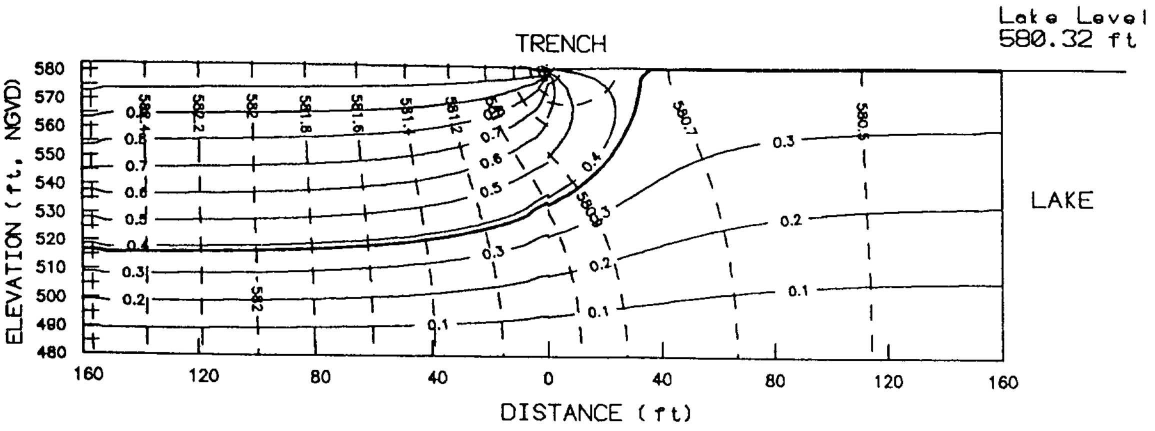

Figure 14. **Case 4: Simulation of Thick Aquifer Conditions**

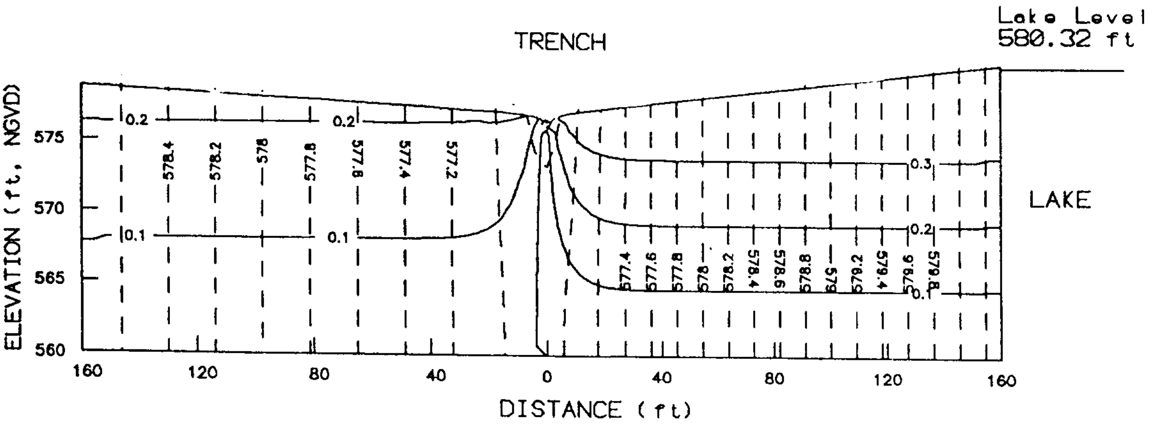

Figure 15. **Case 5: Simulation of Thin Aquifer Conditions**

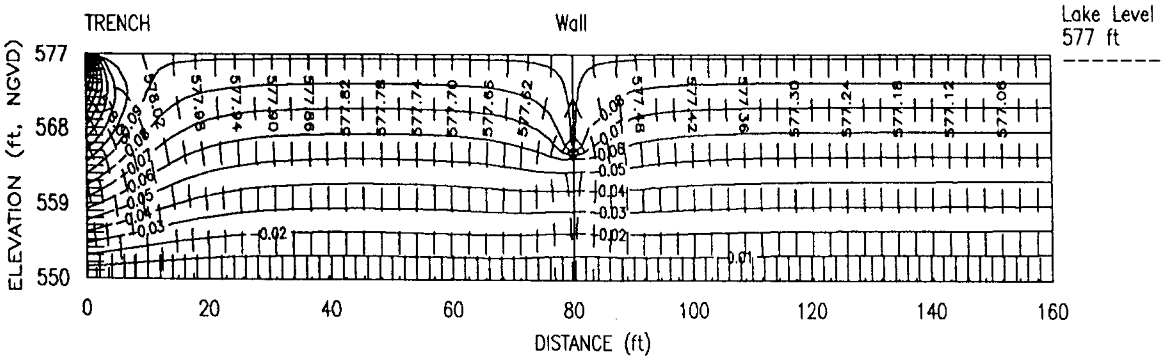

Figure 16. Case 6: Simulation of a Partially Penetrating Slurry Wall Located Downgradient of Trench

TABLE 1
SUMMARY OF MAY 1991 SITE CONDITIONS

Lake Level	580.3 ft NGVD
Distance from Lake to Interceptor Trench	160 ft
Bottom of Interceptor Trench	576.6 ft NGVD
Bottom of Collection Sump	572.0
Natural Horizontal Hydraulic Gradient	0.00045 ft/ft
Induced Horizontal Hydraulic Gradient	0.011 ft/ft
Average Horizontal Hydraulic Conductivity	20 ft/day (7.1 x 10^{-3} cm/sec)
Average Thickness of Saturated Zone	30 ft
Depth of top of Clayey Till Unit	35 ft bgs (550 ft NGVD)
Average Drawdown Within Interceptor Trench	2.5 to 3.0 ft (578.5 ft NGVD)
Average Daily Discharge Rate from Collection Sump	50 gpm
Length of Interceptor Trench	700 ft
Width of Interceptor Trench	3.0 ft

NGVD = National Geodetic Vertical Datum

TABLE 2
INVESTIGATED HYDROGEOLOGIC SCENARIOS
USING NEW ANALYTICAL MODEL

Case	i ft/ft	Q (ft^3 day)	LU (ft)	LD (ft)	LW (ft)	HL (ft)	HT (ft)	HW (ft)	LS (ft)
1	0.011	13.7	160	160	--	580.3	576.6	578.0	--
2	0.011	30	160	160	--	584.0	576.6	578.3	--
3	0.011	4	160	160	--	577.0	576.6	577.3	--
4	0.011	13.7	160	160	--	580.3	576.6	580.0	--
5	0.011	13.7	160	160	--	580.3	576.6	576.4	--
6	0.011	13.7	1670	160	80	580.3	576.6		15

TABLE 3
SUMMARY OF ANALYSIS OF MAY 1991 DATA
(Using Zheng et al. (1988) and Dupuit (1863)

<table>
<tr><th colspan="5">UPGRADIENT ANALYSIS</th></tr>
<tr><th>Anistropy Ratio K_x/K_y</th><th>Depth to Dividing Stream Line(1)</th><th colspan="2">Stagnation Point</th><th>Average Discharge Rate(2)</th></tr>
<tr><td></td><td></td><td>X</td><td>Y</td><td></td></tr>
<tr><td>1</td><td>38 ft</td><td>16.8</td><td>16.8</td><td>24.7 gpm</td></tr>
<tr><td>1.5</td><td>27.4 ft</td><td>16.8</td><td>13.7</td><td>21.0 gpm</td></tr>
<tr><td>2.0</td><td>23.7 ft</td><td>16.8</td><td>11.8</td><td>18.3 gpm</td></tr>
<tr><td>3.0</td><td>19.6 ft</td><td>16.8</td><td>9.7</td><td>14.9 gpm</td></tr>
<tr><th colspan="5">DOWNGRADIENT ANALYSIS</th></tr>
<tr><td colspan="5">After Dupuit (1863), q = flow per unit length = 0.04 gpm
Total flow, Q = 28 gpm</td></tr>
</table>

(1)Below Water Table

(2)Total flow for 700 ft interceptor trench

Appendix N.5

PETROLEUM HYDROCARBON REMEDIATION OF THE SUBCUTANEOUS ZONE OF A KARST AQUIFER, LEXINGTON, KENTUCKY

PETROLEUM HYDROCARBON REMEDIATION OF THE SUBCUTANEOUS ZONE OF A KARST AQUIFER, LEXINGTON, KENTUCKY

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Investigation of karst aquifers using dye tracing techniques has reached widespread acceptance in the hydrogeologic community. These techniques have only recently been applied to tracing the release of contamination from a point source. These studies fail, however to provide suggestions for the remediation of the karst aquifer affected by the release.

Following the release of 1300 gallons of gasoline from an Underground Storage Tank an interceptor trench was installed and recovered approximately 800 gallons of the lost product. A subsequent tracer study from the loss location indicated flow through the subcutaneous zone at 400 ft/day and discharge to the ultimate resurgence, 1.75 miles away, in 67 days. Ground water samples collected at the spring resurgence indicated non-detectable levels of petroleum hydrocarbons. Residual soil and ground water contamination still remained in the subcutaneous zone at the release location. This residual contamination acted as a continuing source of ground water contamination into the karst conduit drainage network and resulted in gasoline vapors in local businesses.

A remediation system was designed to remove the residual gasoline contamination through the use of soil vapor extraction, in-situ soil washing and standard pump & treat technology. The system was put on line during April 1991. The recovery and treatment system continues to remove gasoline contamination from the subcutaneous zone and reintroduce treated ground water--mimicking constant precipitation event.

INTRODUCTION

Tracer investigation in karst regimes has become an exact and well defined technique to determine conduit drainage network boundaries and conduit flow paths. Tracer techniques have recently been used to trace the transport fate of contaminants from a point source release location within the conduit drainage network. Studies of this type have been used to estimate the residence times of the contaminants in the aquifer but fail to address remedial options for the affected portions of the aquifer. Releases of contaminants are often times to the overburden and subcutaneous zone of the aquifer rather than directly to the well developed conduit drainage.

Remedial options for karst aquifers are often not considered due to the fact that they are applied to the conduit system and fail to address contamination of the subcutaneous zone. This study presents information collected using classical contaminant investigative techniques for unconsolidated overburden materials and using dye tracing techniques and how is is applied applied design and implement a remediation plan of the subcutaneous zc for the case study presented.

The subject area is located at the corner of South Limestone Street and Gazette Avenue in Lexington, Kentucky (Figure 1 & 2). The site lies in the Inner Blue Grass Physiographic Province of central Kentucky. North of the site are office buildings and houses, the University of Kentucky is to the east, office buildings and a residence to the west, apartment buildings to the southwest, and a bank, convenience store, and restaurant to the south.

SITE HISTORY

The site has been a gasoline station and convenience store for at least 20 years. A map showing the former, Shop-N-Go (Super America station), surrounding businesses and residences is included as Figure 2. On April 12, 1986, the Shop-N-Go reported a sudden loss of 1,300 gallons of gasoline from an underground storage tank. On April 13, 1986 gasoline was detected in the basement of Mr. Gatti's Pizza Restaurant, located approximately 400 feet to the south. Because the detection of gasoline occurred approximately 24 hours after the loss, the gasoline apparently originated at the Shop-N-Go site.

Several remedial activities were undertaken in response to this loss. Activities included excavation and removal of leaki underground storage tanks, removal of contaminated soils, a removal of liquid phase hydrocarbons (LPH) from the tank basin at the Shop-N-Go site. A recovery trench system was installed adjacent to Mr. Gatti's Pizza Restaurant and has been in operation since April 1986. Initial remedial activities resulted in the recovery of nearly 800 gallons of gasoline and the excavation of 350 cubic yards of contaminated soil from the site. Additional gasoline was reported to have discharged to the storm water sewers at the site. Approximately 800 gallons of the gasoline was recovered during the first few weeks after the reported spill. No LPH has been detected in the recovery sump since December 1986; however, contaminated ground water has been recovered since remediation was initiated.

GEOLOGY AND HYDROGEOLOGY

GEOLOGY

The site is situated within the Inner Bluegrass Physiographic Province of central Kentucky. This area is characterized by flat lying to very gently dipping limestones, dolostones and shales of Ordovician Age. Strata beneath the site consists of limestones and thin shales of the Lexington Limestone. Members of this formation show an intertonguing relationship throughout the Lexington area. The members underlying the site are, in descending order, the

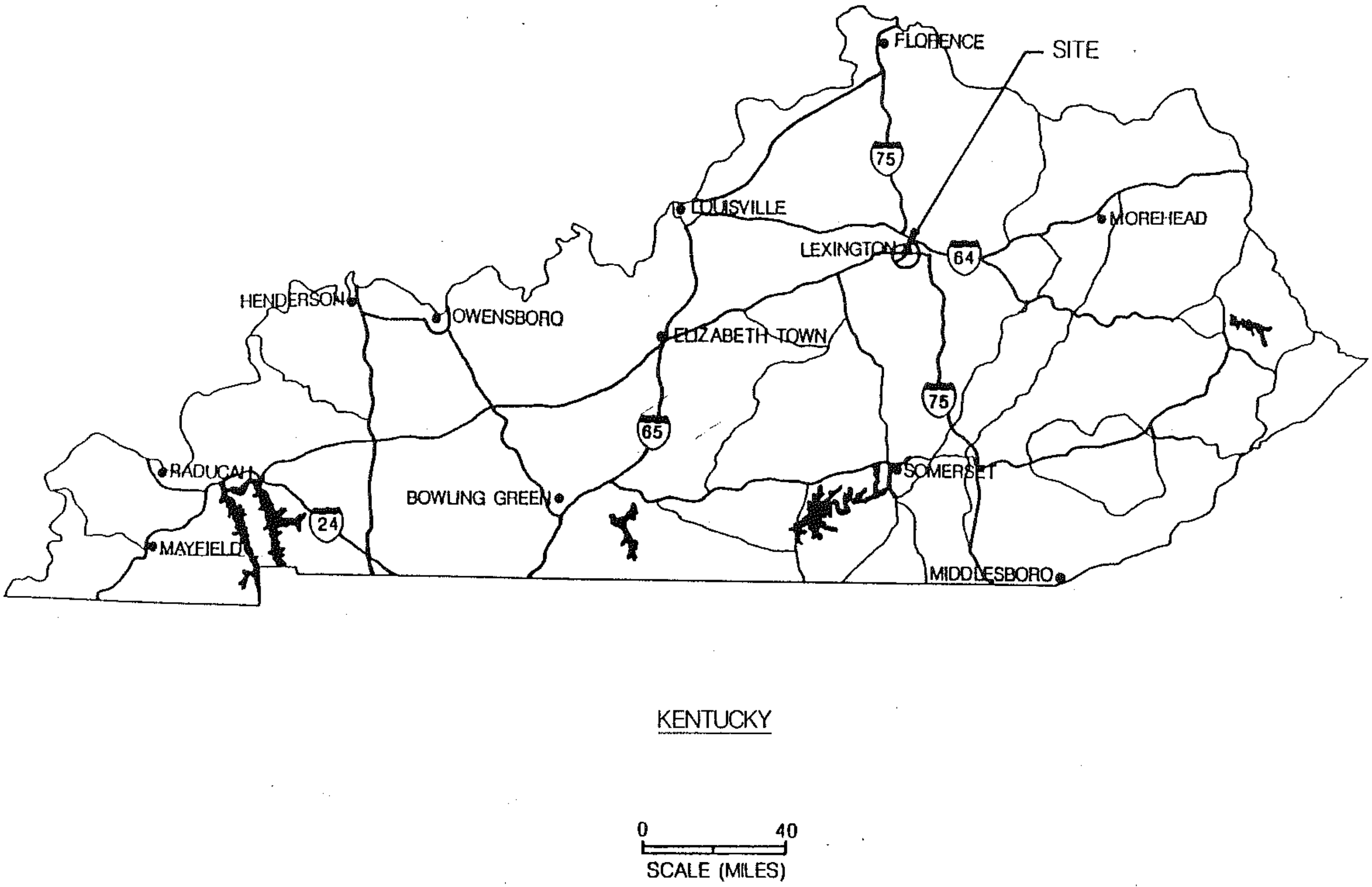


Figure 1. Site Location

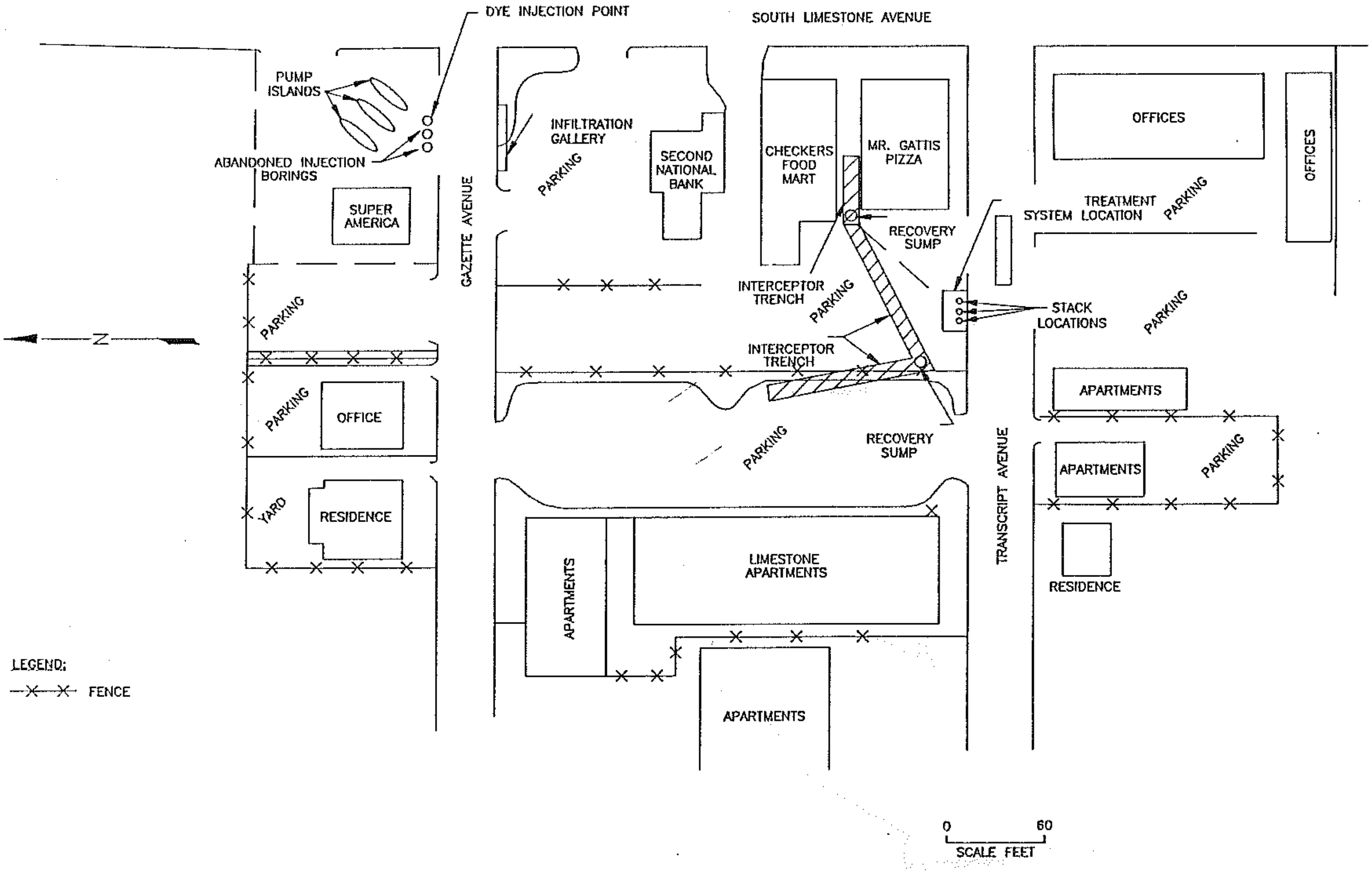


Figure .. Site Map

Tanglewood, Brannon and Grier Members of the Lexington Limestone. The Tanglewood and Grier Members are characterized by thinly bedded argillaceous limestones with very minor and isolated shale partings. These limestones are subject to solutional modification by ground water flow as evidenced by solutional features along road cuts as well as abundant closed surface depressions in the area. The Brannon Member is characterized as argillaceous limestone containing shale and chert beds and solutional modification is uncommon (Miller, 1967).

A total of 36 test borings were drilled during November 1987 and twenty three additional borings were advanced by Delta in February 1988 and May 1990. The boring locations are shown in Figures 3 and 4. Material beneath the site consists of lean to fat unconsolidated overburden with minor amounts of chert and limestone rock fragments increasing with depth. The depth to the Tanglewood Member ranges from 8.5 to 16 feet below grade.

Soil was screened with a PID and soil samples were collected from the 14 borings advanced in May 1990.

Soil screening and analytical results indicate that elevated levels of petroleum hydrocarbons are concentrated at the soil/bedrock interface over a large area. Levels appear to be higher in a small area west of Mr. Gatti's Pizza Restaurant. The approximate extent of elevated hydrocarbon levels in soil is shown in Figure 5.

HYDROGEOLOGY

Ground water was not encountered during the boring programs, therefore, there have been no static measurements of ground water at this location. Flow mainly occurs along the soil bedrock interface through tiny channels and solutionally enhanced joints and bedding planes known as the subcutaneous or epikarstic zone.

Ground Water Tracer Study

In order to determine the ultimate pat for ground water and, hence, contaminant movement, it was necessary to conduct a dye trace from the areA of the gasoline loss.

After initial reconnaissance on April 15, 1989, the following observations were made:

1) Directly underlying the site is the Tanglewood Member of the Lexington Limestone. The Tanglewood is karstifiable, as evident by many area sinkholes.

2) Most area springs are discharged from the Grier Member of the Lexington Limestone.

3) Between the Tanglewood and Grier is the Brannon Member which, although contains some shale beds and chert, is considered a semi-permeable unit.

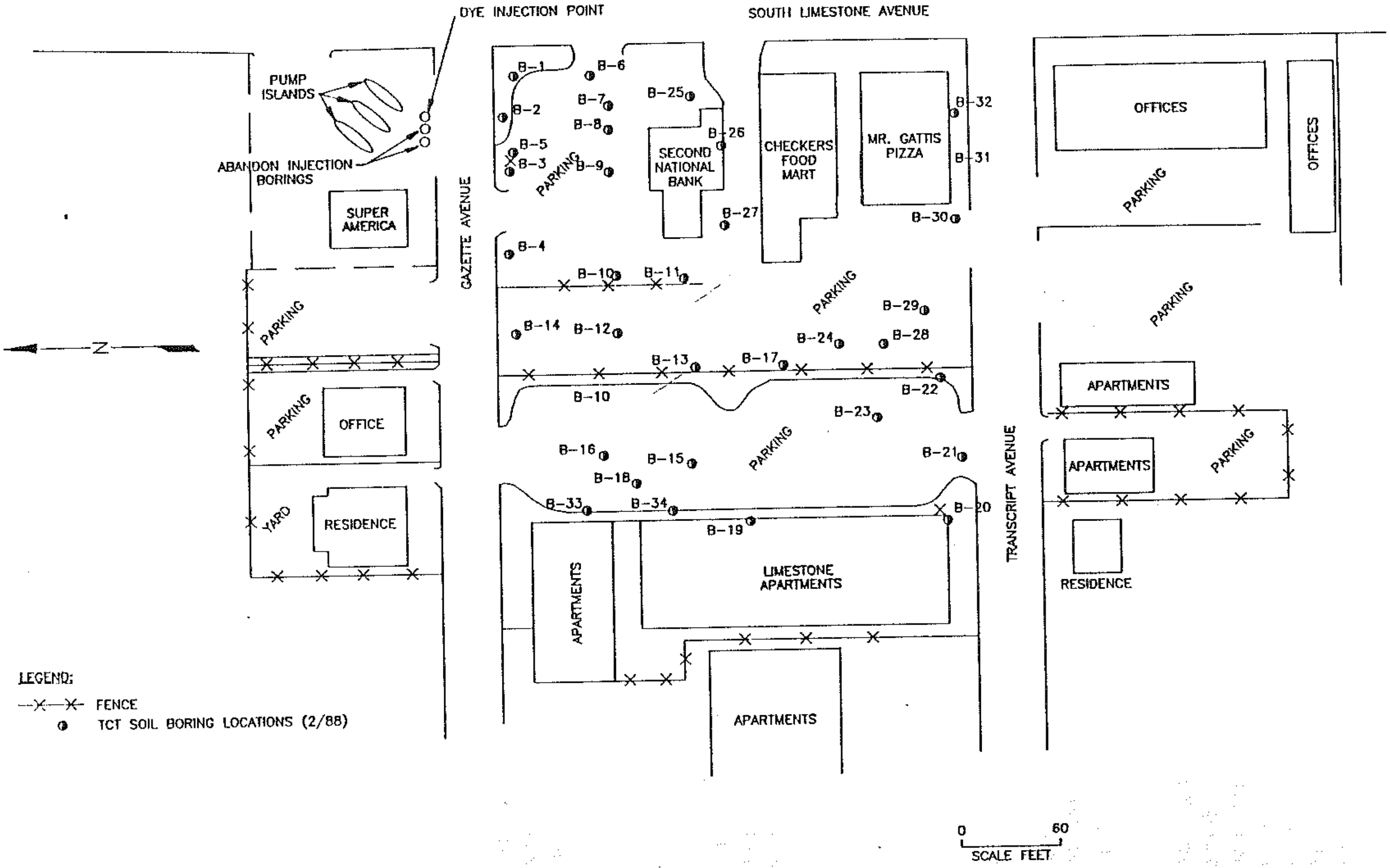


Figure 3. Borin_ advanced during 1987

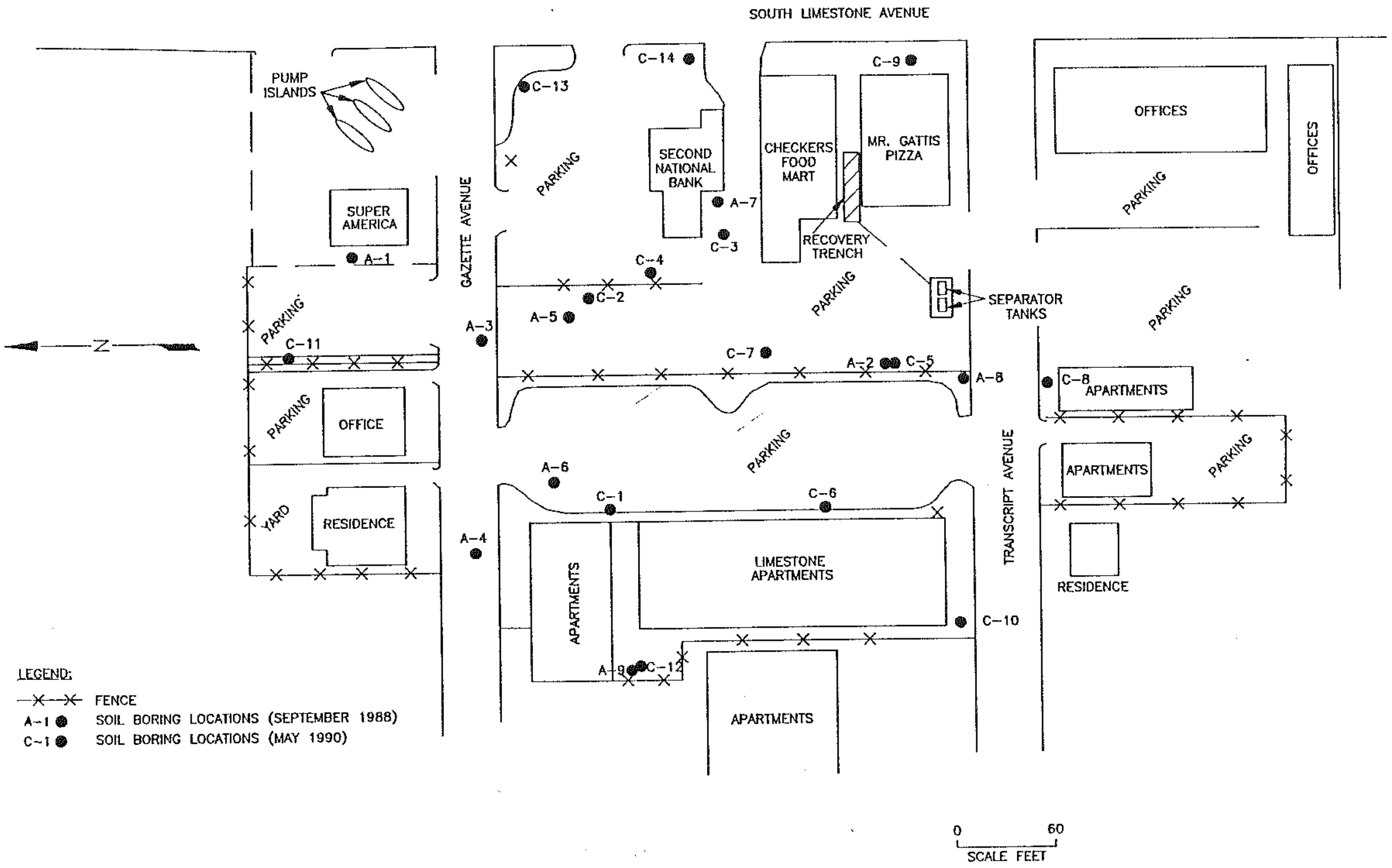


Figure 4. Borings advanced during 1988 and 1990.

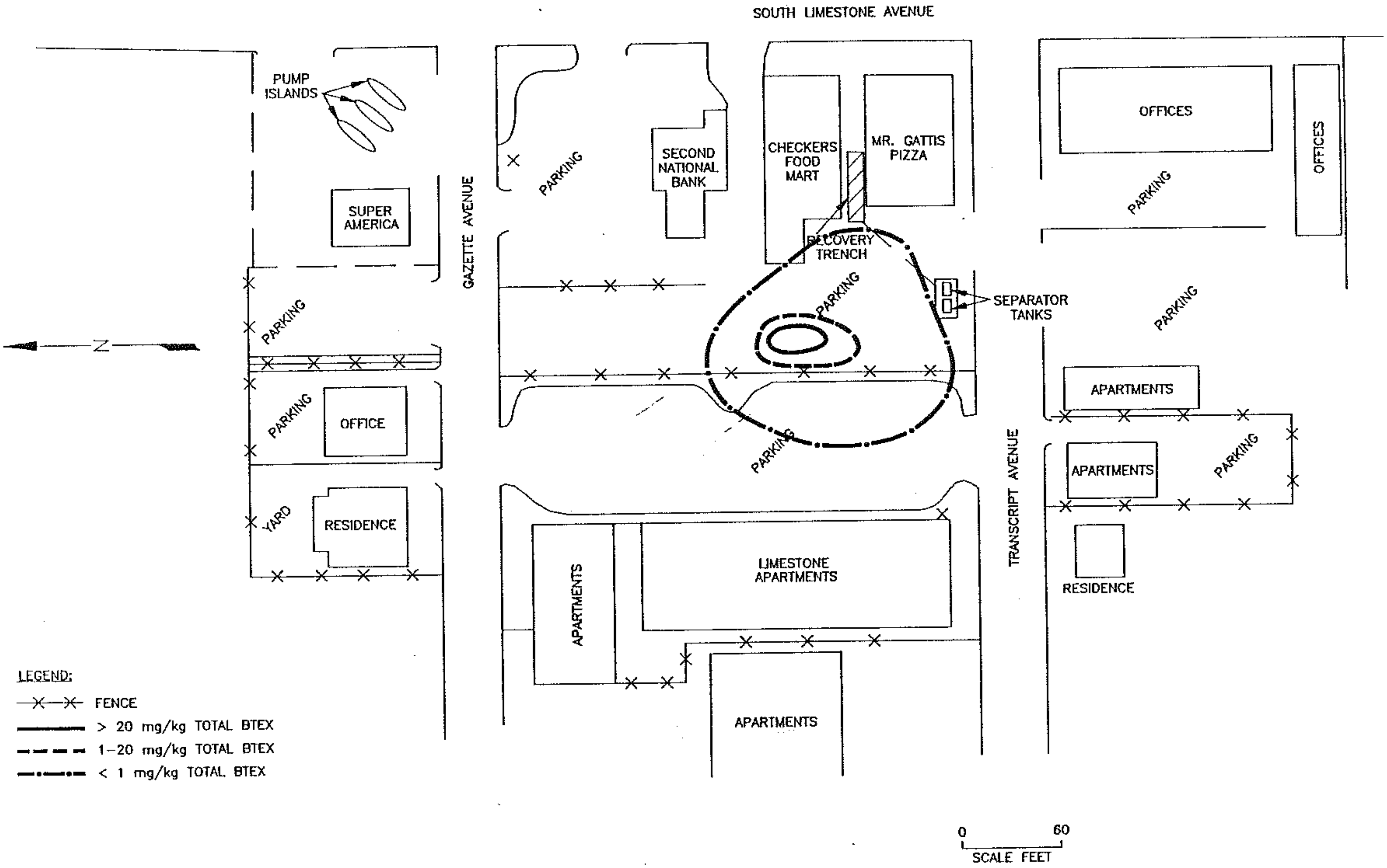


Figure 5. Estimated extent of soil contamination based on soil boring information.

Table 1

Detector Locations	Location Codes
Recovery Trench	RT
Mr. Gatti's Sump	MG
Storm Sewer	SS
Storm Sewer at Railroad Culvert	RR
Big Elm Country Club	BE
Wolf Run	WR
Vaughn's Branch	VB
Town Branch	TB
Hickman Creek	HC
McConnell Spring	MS
Preston's Cave Spring	PS

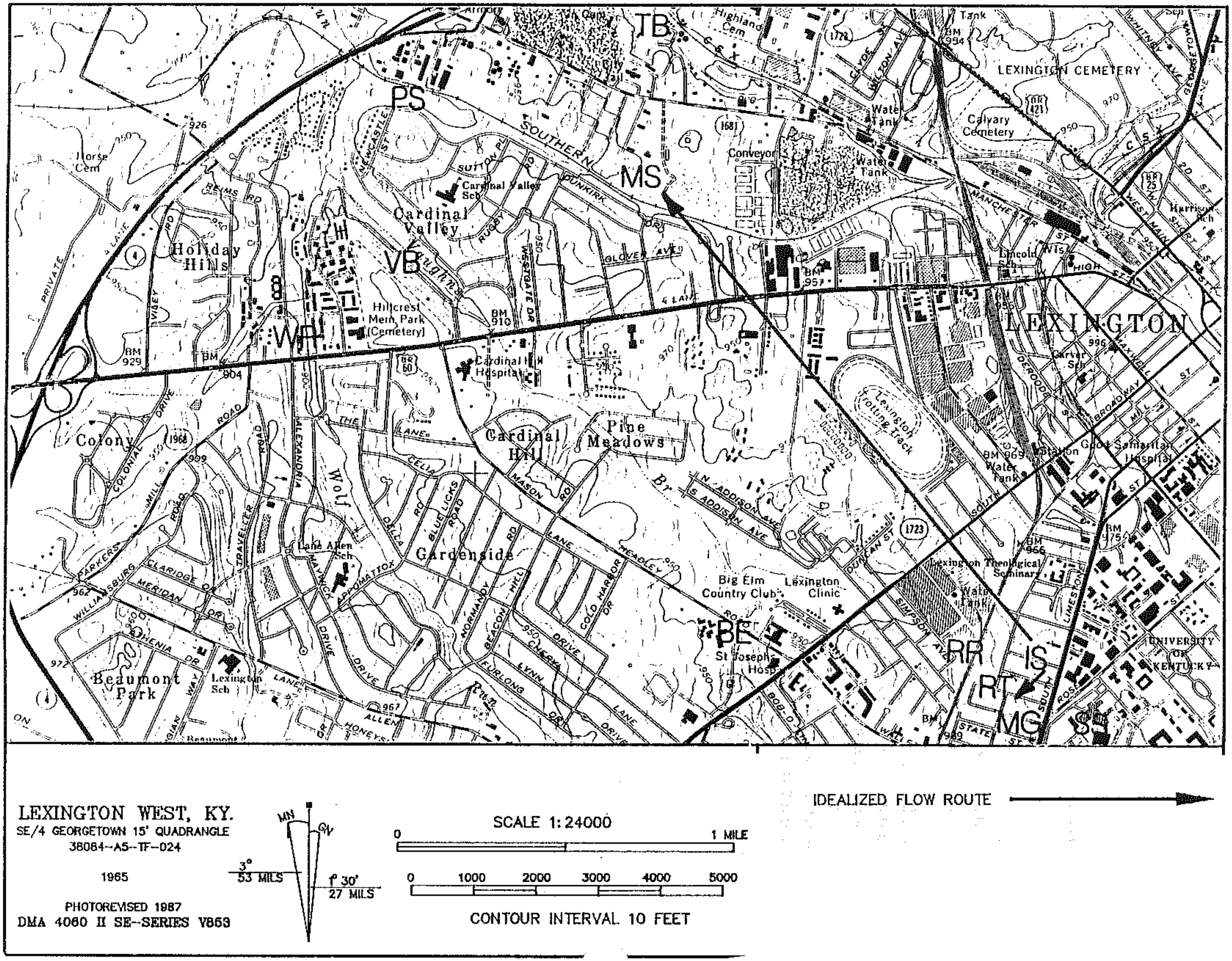


Figure 6. Dye detector locations and tracer results.

4) Local dip is to the northwest at approximately 20 feet per mile. There are no mapped faults in the immediate area of the site.

5) The storm sewer (later used as a dye detector site) which passes the site and receives water from the separator tank, ultimately discharges in Vaughn Branch (also later used as a detector site).

6) Dye detector locations chosen are included in Table 1 and shown in Figure 6.

Dye Background

Prior to dye tracer studies, an analysis for the presence of background levels of fluorescent dyes is necessary. Dye detector sites were chosen (Table 1 and Figure 6). Background detectors were deployed and analyzed on two occasions. These detectors, collected on July 14, 1989 and July 21, 1989 indicated the presence of extremely weak concentrations of fluorescein dye in the storm sewer and McConnell Spring sites. The dye was determined to be of insignificant concentrations to negate the use of fluorescein for the tracer study.

Dye Injection

On July 21, 1989 at approximately 11:00 a.m., fluorescein dye (acid llow 73) was injected into a fresh 10 inch diameter soil boring at the Shop-N-Go site. The location of the boring is shown in Figure 2. The boring encountered bedrock at approximately 12 feet. Prior to the boring of the injection well, two additional borings were drilled approximately 3 and 6 feet from the injection well (Figure 2). These wells have a total depth of 9 and 10 feet, respectively, and would not effectively take a slug of water. The injection well readily accepted over 100 gallons in a period of less than 10 minutes. After the initial slug of water, 3 pounds of fluorescein mixed with 2 gallons of water was injected into the well. The dye was then followed with approximately 200 gallons of water.

Dye Recovery

Dye detectors were retrieved at weekly intervals throughout the course of the study. Dye detectors were eluted in a solution of potassium hydroxide and isopropyl alcohol and analyzed on a spectrofluorophotometer. Detector analysis results can be found in Table 2.

Dye Trace Results

The first sampling point to yield a confirmed positive was the sump in the basement of Mr. Gatti's. The dye was present on the etector collected July 27, 1989. The second round of detector

Table 2

SITE	7/14	7/21	7/27	8/3	8/9	8/16	8/24	9/1	9/9	9/15	9/26	10/10	10/19	10/27	11/5
RT	-	-	-	+V	+VB	+VB	X	X	X	X	X	X	X	X	X
MG	-	-	+	+VB	+VB	+VB	X	X	X	X	X	X	X	X	X
SS	VW	-	-	-	-	-	LS	+	+	+	+	+	+	-	+
RR	-	-	-	-	-	W	-	-	-	-	W	-	-	-	W
BE	-	-	-	-	-	+	+	-	-	+	-	-	-	-	-
WR	-	-	-	-	-	-	LS	-	-	-	-	-	LS	LS	-
VB	-	-	-	-	-	-	-	LS	-	-	LS	+	LS	LS	-
TB	-	-	-	-	-	+	-	LS	LS	-	LS	+	-	-	+
HC	-	-	-	-	-	-	LS	-	-	-	-	-	-	-	-
MS	-	VW	-	-	+	-	+	+	-	-	+	+	+	+	+
PC	-	-	-	-	-	-	-	-	+	-	+	W	+	+	+

DETECTOR RESULTS

- = dye not detected

VW = very weak

W = possible dye detected, weak

\+ = dye detected

+VB = dye detected, very strong

X = detector not collected as past + confirmed

LS = detector lost or stolen

DATE = detector collection date

NOTE: Test was conducted 7/14/89 to 11/15/89 collection on August 3, 1989 showed positive at Mr. Gatti's and in the recovery trench. The rapid movement of the dye to these two rby sites demonstrates the relatively high ground water flow locity associated with the solutionally enhanced upper bedrock (the epikarstic zone), which was the horizon of injection.

In the weeks following the initial confirmed positive at Mr. Gatti's and the recovery trench, there were a few "false positives". These false positives of fluorescein dye can be expected when tracing in urban areas since fluorescein in the coloring agent in many popular anti-freezes. These false positives are not a problem in a tracer study of this design. Since a large amount of fluorescein was injected upon the epikarst, one may expect a rather extended dispersal period over a large lateral area. Additionally, the detectors were retrieved at weekly intervals and a positive was not assumed until dye was detected for at least four continuous weeks at any particular site. Thus, false positives can be detected and noted accordingly.

There were several false positives during the course of this study. For example, detectors at Big Elm, Town Branch, and McConnell Spring showed false positives on several occasions. All false positives in the above sites were followed with negative readings in subsequent weeks. The storm sewer also displayed false positives throughout much of the study period. This site was adjacent to a road with heavy traffic, and undoubtedly encountered many urban-induced fluorescein spills. These spills were not great enough to cause positive readings at the railroad storm sewer a rter mile directly downstream.

One focus of this study was to determine the ultimate resurgence of the injected dye. The detectors collected on September 26, 1989 marked the arrival of the first confirmed positive of the dye at McConnell Spring and Preston's Cave Spring sites. This first confirmed positive occurred some 67 days following the dye injection. The connection of McConnell Spring to Preston's Cave Spring was first documented by James Rebmann of the Lexington-Fayette Urban County Government in January 1988.

Dye introduced at the soil-bedrock interface moved very rapidly through the epikarst toward Mr. Gatti's and the recovery trench. The epikarst is noted for its rapid ground water flow velocity and wide lateral dispersion of recharge. After passing through the epikarst, it appears that the dye moved very slowly through a poorly developed conduit system toward McConnell Spring. After passing through McConnell Spring, the dye resurged at Preston's Cave Spring.

Ground Water Contamination

Ground water contamination, as detected at Mr. Gatti's and in the recovery sump has decreased from the presence of free product in April 1986 to dissolved contamination in the low parts per million nge in December 1989. Fluctuations in contaminant levels have been documented during this time period. Increases can be attributed to heavy periods of recharge where ground water moving along poorly developed conduits in the epikarstic zone leac residual soil contamination. Decreases are marked by dry perio where precipitation has little effect in leaching residual soil contamination.

REMEDIATION DESIGN AND IMPLEMENTATION

In order to properly remediate the subcutaneous zone of this location, an approach different from classical pump and treat was needed. The design had to be specifically matched with the geological and hydrogeological conditions of the subcutaneous zone, satisfy state requirements of remeditaion to background, and satisfy the third party landowner that every possible avenue to remediation was being attempted using the fastest technology available.

When designing this recovery system we had to account for:

- contaminated soil above the soil/bedrock interface that was contributing to contamination;
- inaccessible contaminated soil in solutionally enlarged pore space of the subcutaneous zone;
- quickflow of contaminated ground water in poorly developed conduits of the subcutaneous zone;
- observed increases in BTEX concentration in ground water with an increase in recharge;
- available space and property boundaries; and,
- the possibility of volatile organic vapors in buildings.

SELECTED TECHNOLOGIES AND APPLICATION

Soil Excavation

Elevated levels of gasoline constituents were identified in an area of soils west of Mr. Gatti's Pizza Restaurant as outlined in Figure 5. Approximately 1960 tons of this soil was excavated from the area and transported to the Lexington-Fayette County Municipal Landfill.

Soil Flushing

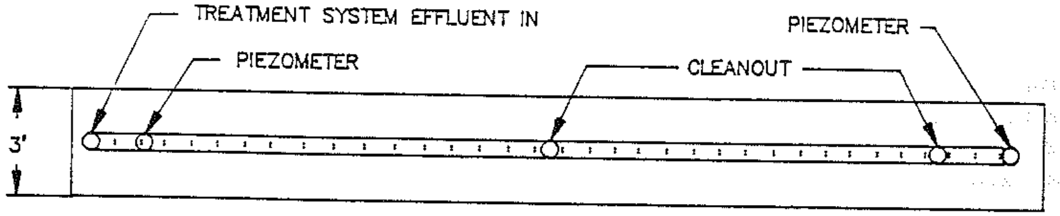
Soil flushing was selected for this site for several reasons. The nature of flow along the soil bedrock interface is likely quick flow through poorly developed open and soil filled solution channels in the subcutaneous zone. Levels of dissolved gasoline components in ground water have shown a sharp rise following periods of heavy recharge from precipitation. Reinfiltration of treated ground water was designed to mimic a constant recharge to this zone, thereby continually flushing contaminants from the soil the epikarstic zone. Soil flushing is also very cost effective, vides an option for the fate of the treated ground water and can increase and enhance ground water flow to the interceptor trench.

An infiltration gallery was designed to accept and reinfiltrate the volume of discharge generated by the ground water recovery and treatment system. At this site discharge will be the result of ground water recovered from a maximum of two continuously operational recovery sumps.

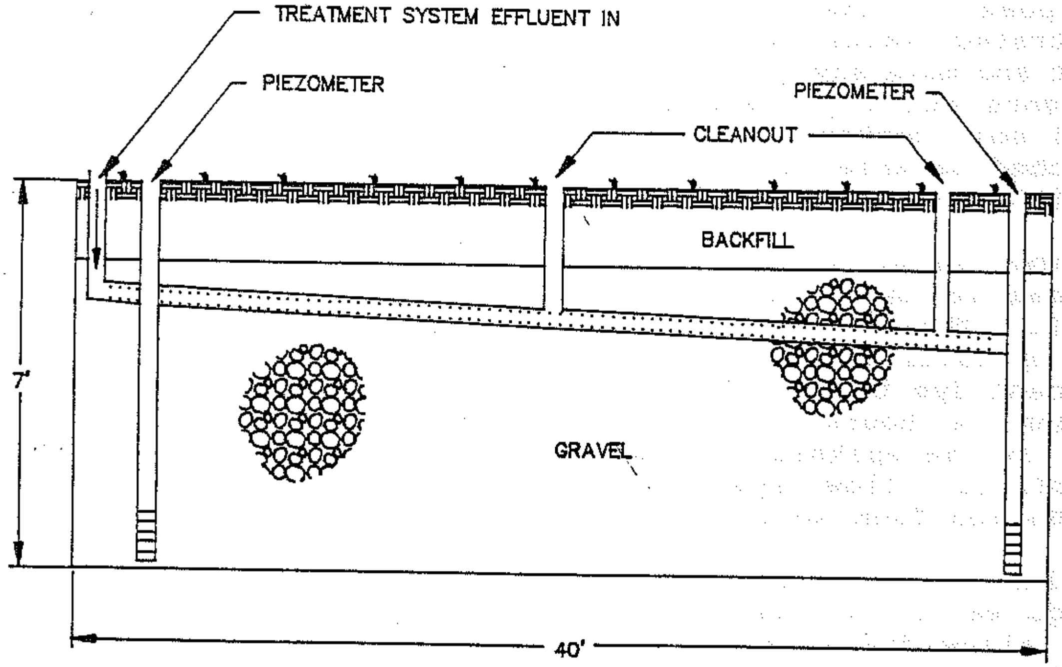
The purpose of the infiltration gallery is two fold. First reinfiltrated water serves to recharge the perched surficial epikarst and move any ground water contamination to the interceptor trench more quickly. Second, reinfiltrated ground water flushes residual soil contamination at the soil bedrock interface causing the leached material to become mobile in ground water for removal at the interceptor trench.

During the tracer study conducted July 1989, a small conduit was discovered at the soil bedrock interface at a location shown on Figure 2. This conduit was easily able to accept at least 100 gallons of water instantaneously. This conduit was also traced by fluorescent dye to the location of the present recovery trench in less than 24 hours. The infiltration gallery intersects the conduit in the epikarst therefore providing constant recharge to the surficial flow system and constant flushing of residual ntamination from soil.

The gallery is 40 feet long, 3 feet wide and 7 feet deep. The discharge water is introduced by means of 4" diameter perforated pipe to allow drainage across the entire trench. The trench is backfilled with washed gravel to allow for even percolation of the treated ground water. Two clean-out ports have been placed on the perforated pipe to remedy any sediment, clogs or biofouling. Two piezometers were installed at opposite ends of the infiltration gallery to monitor its efficiency in reintroducing ground water. Emergency high level floats keep the infiltration gallery from over flowing if its capacity is exceeded. A schematic of the infiltration gallery is shown in Figure 7. The gallery was installed during the second week of January 1991. To ensure the gallery was hydraulically "connected" to water flow in the epikarstic zone approximately 1000 gallons of water was introduced to the open hole after it was excavated. The water quickly flowed from the gallery and into the subcutaneous zone.



PLAN VIEW



CROSS SECTION

Figure 7. Infiltration gallery design.

Soil Venting

Soil venting was also a selected technology for implementation at this site for this site for several reasons. Soil venting allows for remediation of the residual soil contaminants with minimal disturbance of surface structures and roads. Soil venting is a cost-effective and field proven technology for remediating soil contaminated with petroleum hydrocarbons. Application of a vacuum to the interceptor trench should also increase the hydraulic yield of the trench and enhance the rate of ground water remediation. The primary reason, through, was to remove hydrocarbons from soil is the epikarst that could not be removed by excavation.

The soil vapor extraction system consists of a regenerative blower connected via 2-inch schedule 40 PVC piping to the ground water recovery/vapor extraction trench. The trench is screened through the vadose zone to accommodate the vapor removal. Depression of the potentiometric surface due to pumping of the ground water also increases the volume of contaminated soil exposed for remediation by venting.

Soil Remediation System Equipment

Figure 8 presents the layout for the equipment of the soil venting system which consists of a regenerative blower connected to the recovery well via the previously described PVC piping, an inlet filter to remove particulates from the air stream entering the blower, and a coalescing unit to remove moisture from the air stream entering the blower. The effluent from the blower will be discharged to the atmosphere via a 2-inch schedule 40 PVC pipe. As the liquid level in the coalescing unit reservoir increases, it activates a sensor which turns off the blower and opens a solenoid valve in the coalescer, thereby allowing the condensate to gravity drain into the diffused aeration tanks. A timer in the control panel reactivates the blower and closes the solenoid valve after all condensate has drained.

GROUND WATER RECOVERY AND TREATMENT

Ground Water Recovery Equipment

The ground water recovery system installed in 1986 at the Lexington [illegible]ce consisted of a ground water interceptor trench and one recovery sump. The former interceptor trench was extended and an additional recovery sump be added as shown in Figure 9. The ground water recovery system consists of two total fluids recovery pumps installed in the recovery sumps of the enlarged interceptor trench. The pumps intercept and pull contaminated ground water towards the interceptor trench. A cross section of the trench construction is shown in Figure 10.

The static depth to ground water in the recovery sump installed in 1986 was approximately 8 feet below grade. Both recovery pumps are positioned at a depth of 11 feet. The depression pump on/off floats are positioned at 11 feet and 10 feet below grade respectively in order to establish a maintained drawdown of approximately 2 feet in the interceptor trench. The operation of the total fluids pump is controlled by high and low level on/off sensors in order to facilitate the efficient removal of contaminated ground water from the soil bedrock interface.

Ground Water Treatment Equipment

The ground water treatment technology implemented at this site is a three step process:

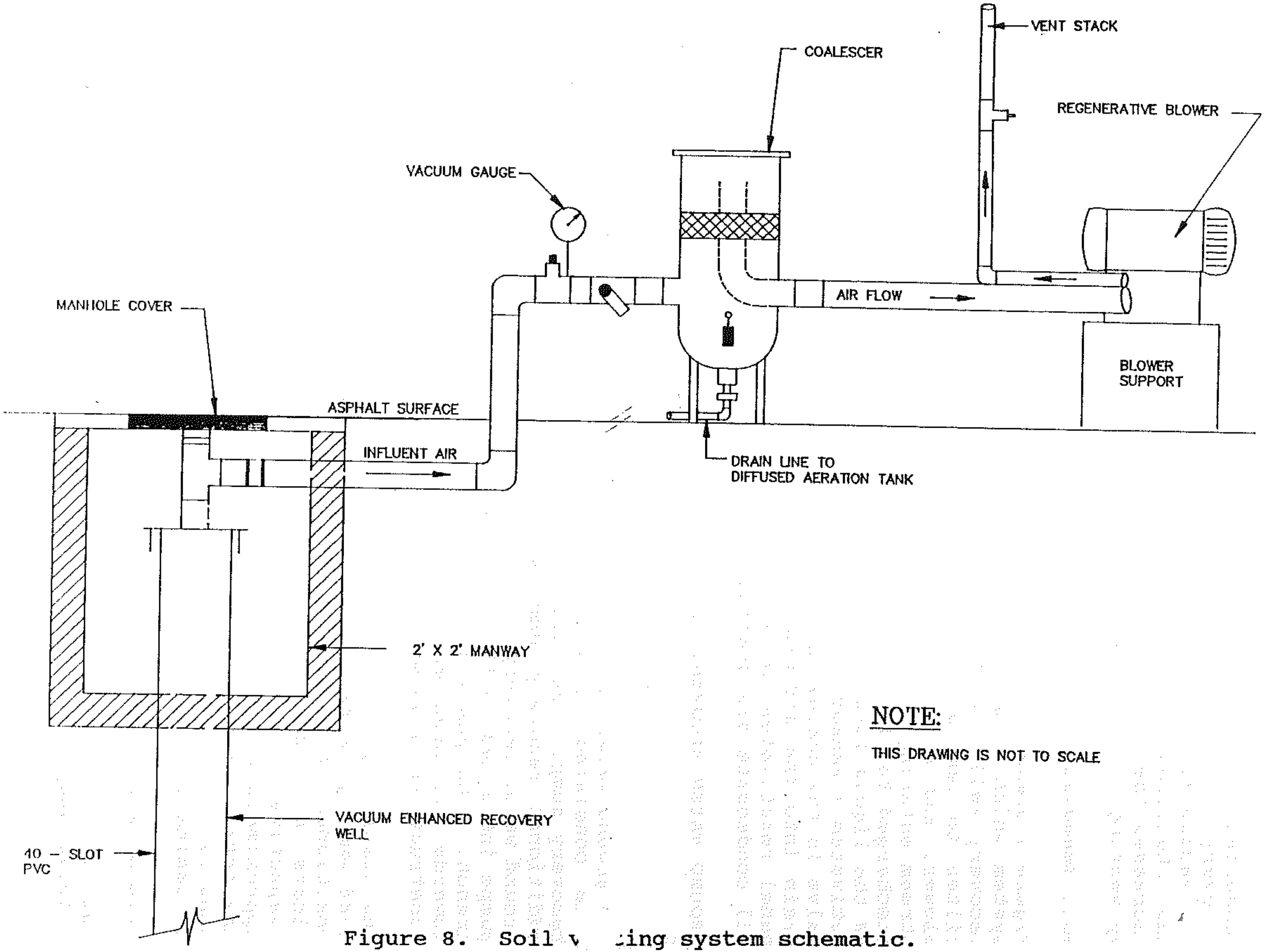


Figure 8. Soil venting system schematic.

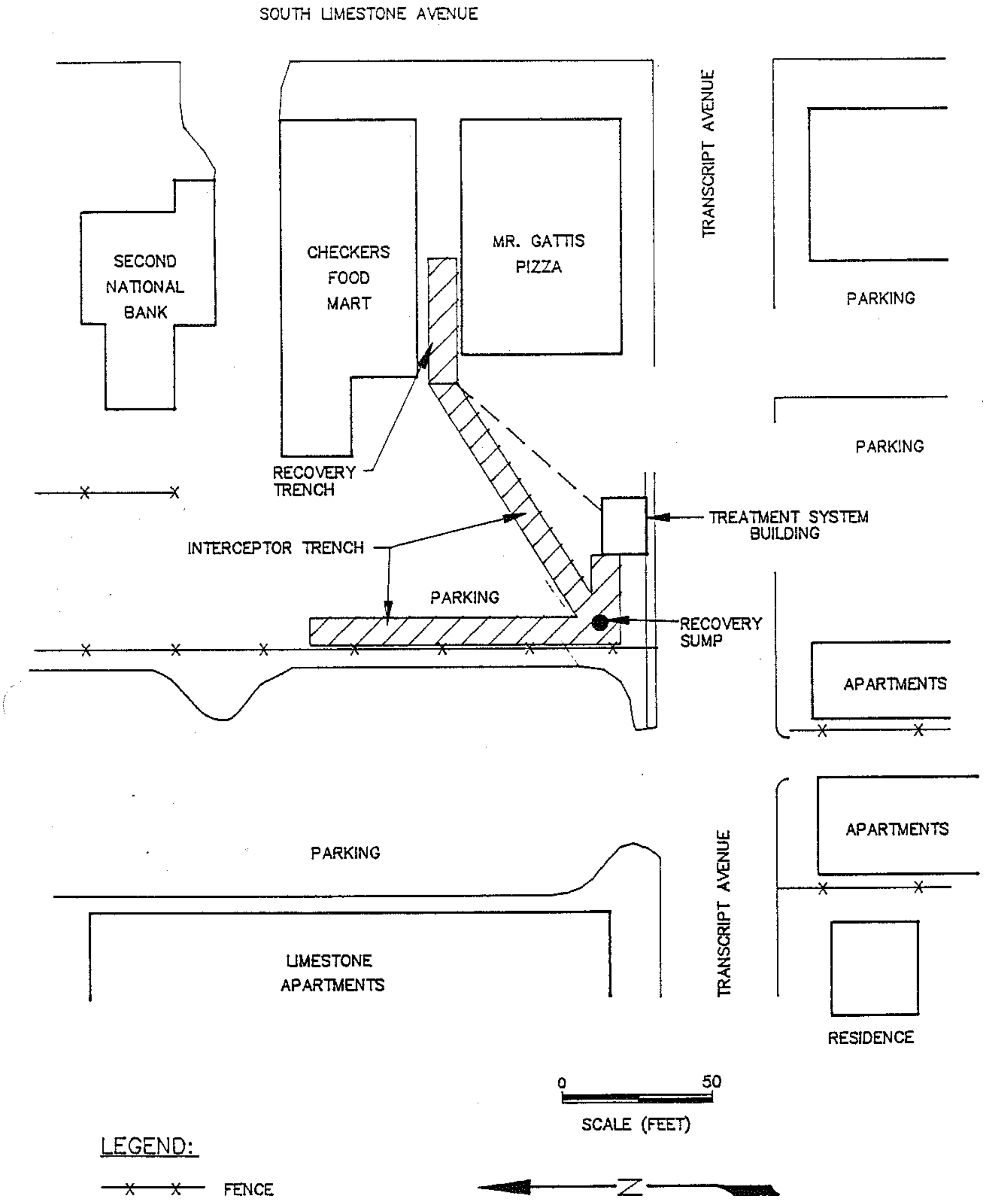
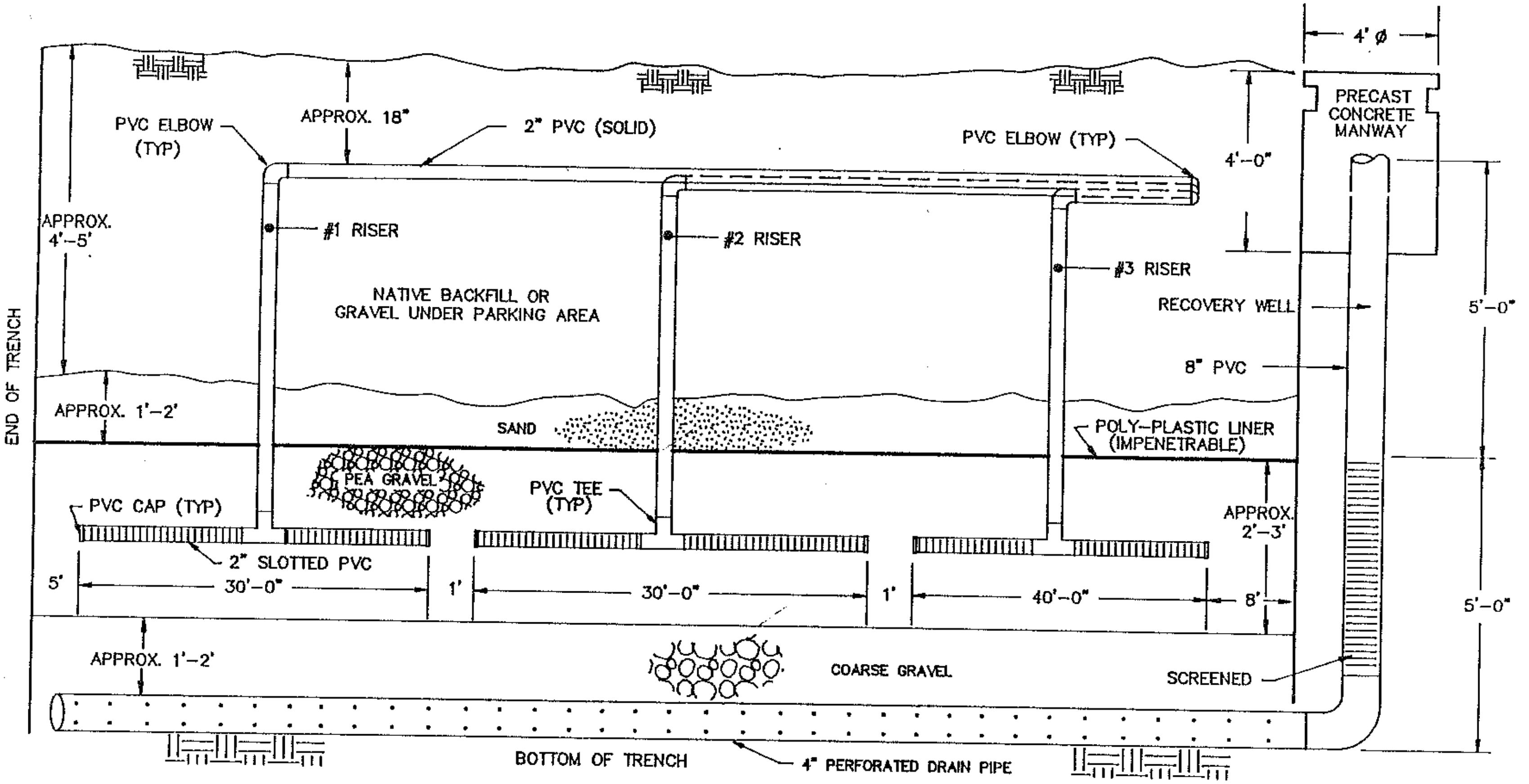


Figure 9. Recovery trench and treatment system location.



NOTE: DRAWING IS NOT TO SCALE.
ALL PVC IS SCHEDULE 40

Figure 10. Recovery Trench construction details.

1) particulate filtration as a pretreatment step to remove suspended solids;

2) LPH/water gravity separation as a pretreatment step to provide for the flotation separation of LPH and flow equalization; and

3) diffused aeration to remove the dissolved volatile organic compounds.

Pretreatment Process

The ground water pretreatment system consists of an in-line particulate filter followed by an LPH/water separator tank. Figure 11 presents the treatment system lay out.

The ground water recovery pumps transfers ground water through an in-line filter to a 1000 gallon LPH/water separator tank to allow for flotation separation of the LPH from the ground water and particulate settling. A totalizing flow meter installed at the intake of the separator tank continuously records the amount of ground water and LPH that has been pumped.

Effluent from the separator tank flows by gravity through a contact chlorine chamber containing solid calcium hypochlorite tablets. This process reduces biological build up in the treatment system. The chlorination step inhibits the growth of biological microorganisms that could potentially cause the lines in the ration tanks to become clogged.

Diffused Aeration Equipment

Effluent from the contact chlorine chamber will flow by gravity into a channeled diffused aeration tank. This tank will be four feet wide by six feet long by two feet deep. A 2 hp, 230V, single phase pressure blower will introduce air into the aeration tanks through perforated PVC pipes to facilitate stripping of the dissolved volatile organics.

Effluent from the diffused aeration tanks flows by gravity into a 120 gallon transfer tank. This transfer tank is equipped with a submersible electric sump pump with a nominal operating flow rate of 10 gpm. The sump pump moves the treated ground water from the transfer tank to an infiltration gallery located upgradient from the interceptor trench.

Soil Venting and Ground Water Remediation System Security

The soil venting and ground water remediation equipment are housed inside a pre-fabricated building located at a location shown in Figure 9.

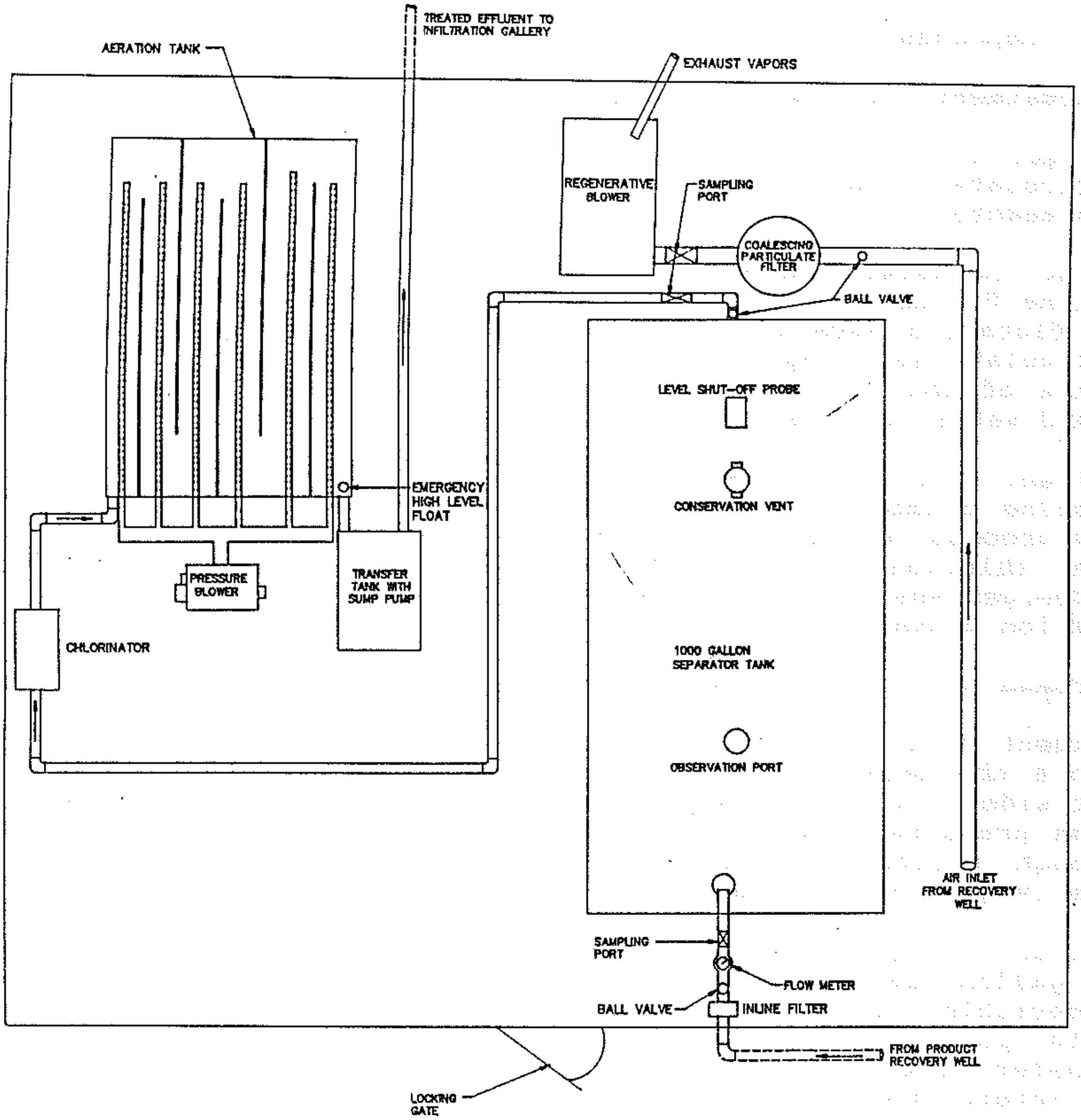


Figure 11. Treatment system layout.

RESULTS TO DATE

lytical results from water samples collected from the former emergency sump and the current ground water recovery system are plotted against time in Figure 12, illustrating a wide variation in contaminant concentrations since recovery operations have begun. Maximum dissolved concentrations of approximately 15,000 ug/L total benzene, toluene, ethylbenzene and total xylenes (BTEX) have been recorded. Although flow readings do not exist for the early recovery system, a general correlation between recharge events and increasing contaminant concentratons has been made. The emergency recovery sump was taken off line from July 1989 through February 1990 to conduct the dye tracer study.

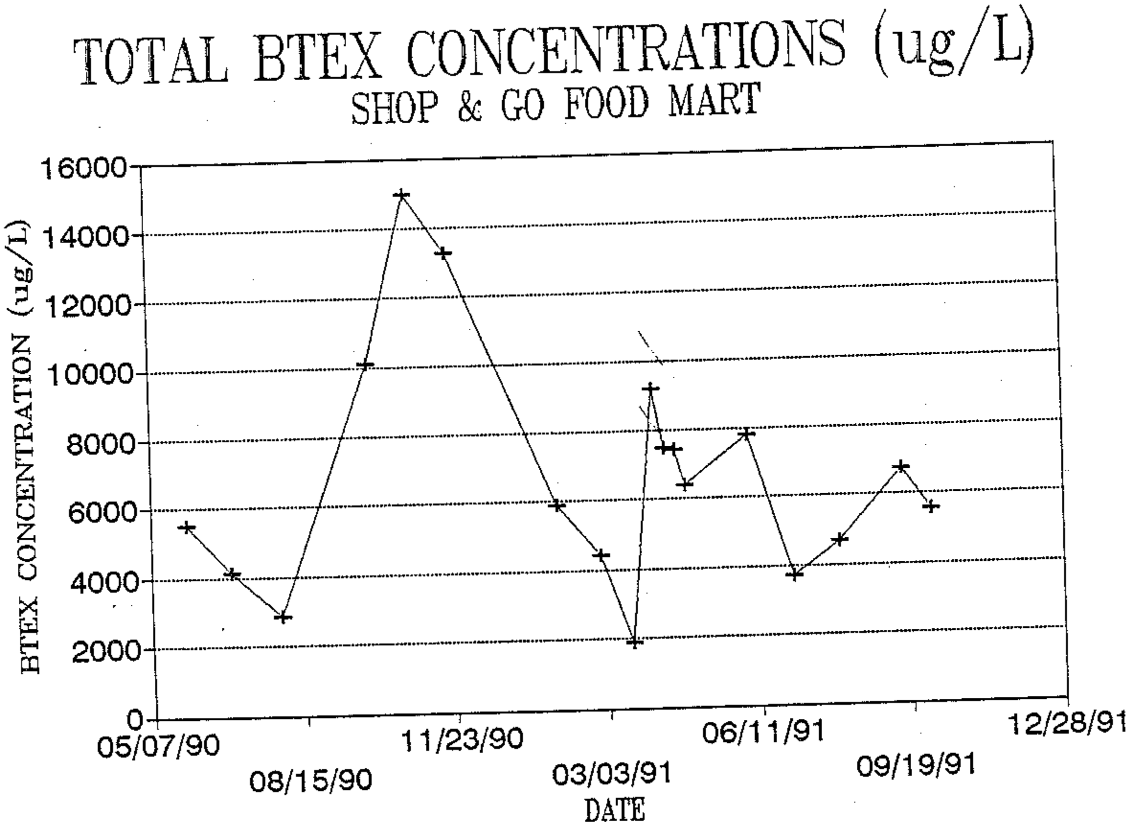


Figure 12. Total BTEX concentrations in treatment system influent since May, 1990.

The current ground water remediation system was monitored monthly to verify that the system is operating properly. Sample ports are provided at several locations along the treatment system. Water from the treatment system influent and effluent sampling ports are collected monthly, and analyzed for volatile organic constituents.

from the treatment system influent and effluent sampling ports are collected monthly, and analyzed for volatile organic constituents. A totalizing flow meter is installed to document the total volume of ground water being pumped from each recovery sump.

Plots of flow volume over time from both recovery sumps are presented as Figures 13 and 14. These illustrations verify the flashy nature of flow in the subcutaneous zone. Flow rates vary from recovery well 1 from almost negligible to approximately 5500 gallons per day. Flow variations from recovery well 2 are even more dramatic ranging from 3000 to almost 25,000 gallons per day. This information also correlates with periods of observed heavy rainfall events through that time period.

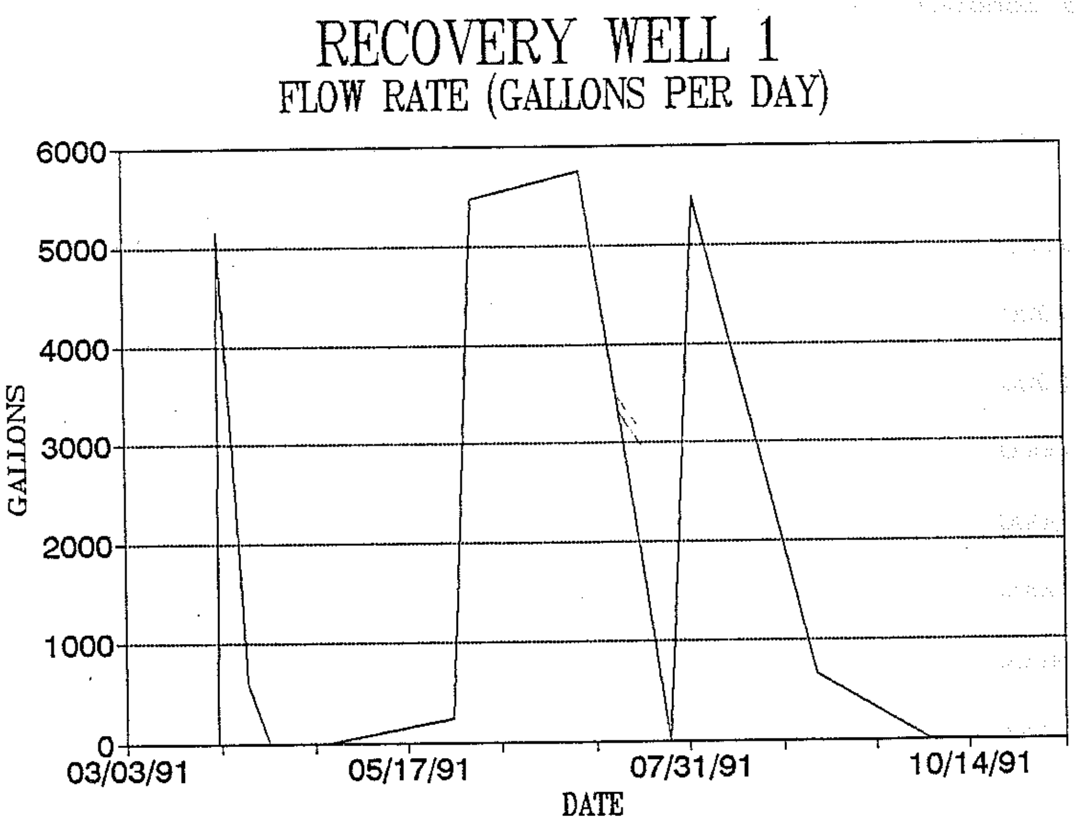


Figure 13. Flow in gallons per day from Recovery Well 1 since system start-up.

A plot of BTEX concentration in the treatment system influent since the currently system was put on line included as Figure 15. Figure 15 shows that the concentration of total BTEX varies widely but the maximum measured levels have deceased since remediation began. The peak concentrations are also roughly similar to maximum times of flow or maximum recharge. This may suggests that more contamination is being leached from soils, mobilized and removed during times of heavy recharge and that the constant recharge from the infiltration gallery may aid in expediting this removal process.

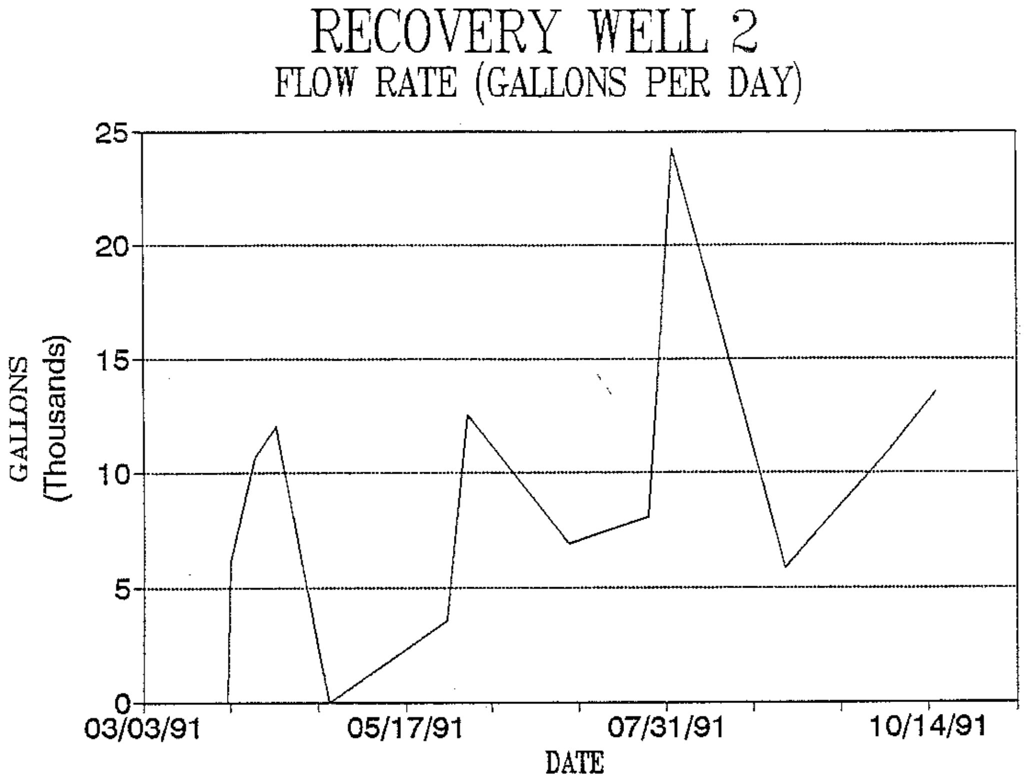


Figure 14. **Flow in gallons per day from recovery well 2 since system start-up.**

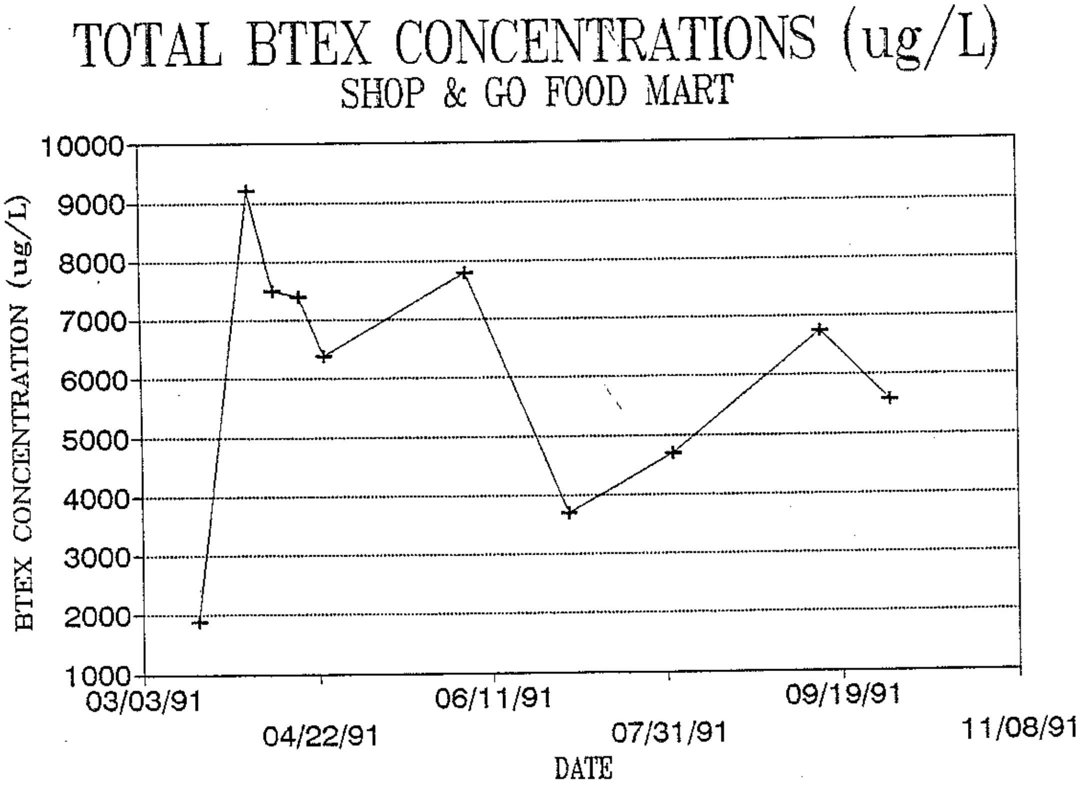


Figure 15. Total BTEX concentration in treatment system influent since system start-up.

The performance of the soil venting system is illustrated in Figure 16 as a plot of soil vapor concentration since the system was put on line. Soil vapor concentrations were at a maximum when th vacuum blower was first started and have decreased to no detectable since that time. The reason for the quick decrease is believed to be removal of BTEX laden soil vapor from the immediate area of the vapor extraction equipment. The system has since been turned off to allow equilibration of soil vapor with BTEX on soil particles. The system will then be put back on line and a decreased but similar pattern of soil vapor removal is expected.

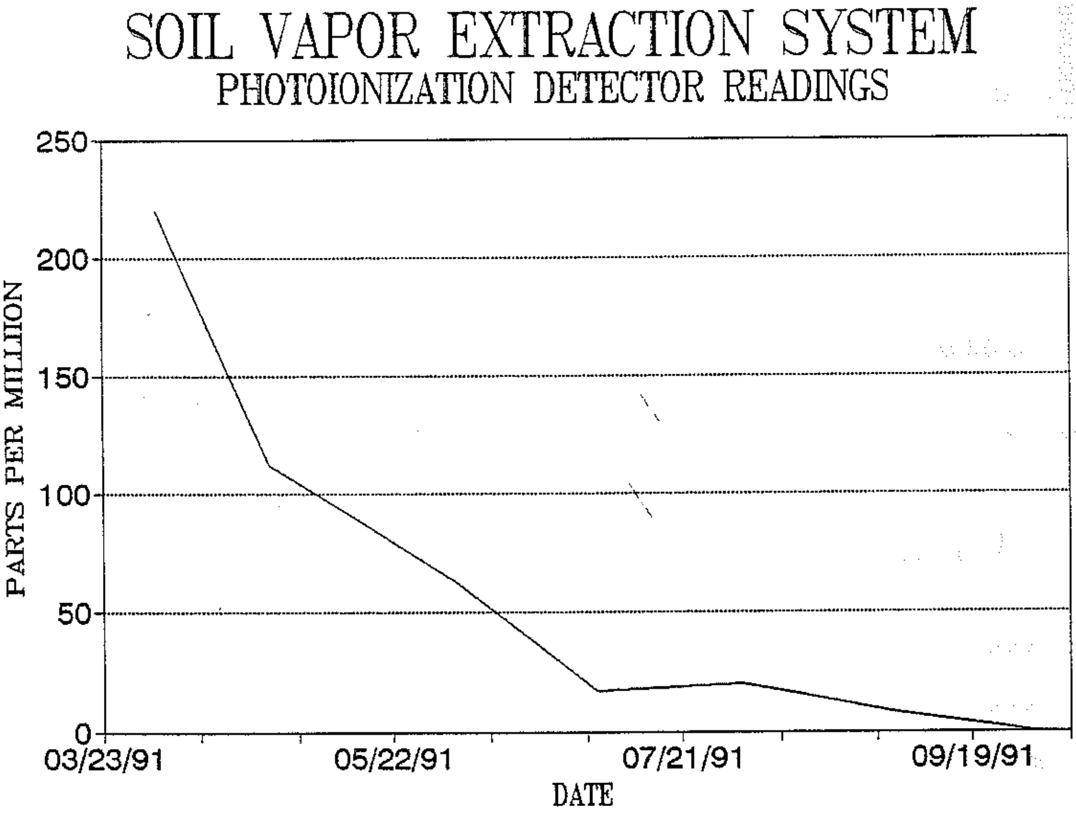


Figure 16. Photoionization detector readings of the soil vapor extraction emissions since initiation.

CONCLUSIONS

The likelihood of a release of contaminants directly into the conduit network of a karst aquifers is low. Most releases occur within the overburden and move into the subcutaneous zone of the aquifer thereby decreasing the quickflow components and increasing residence times in the intergranular overburden porosity and the poorly developed conduit system of the subcutaneous zone. The results of this effort have been presented as a site specific approach to remediate the subcutaneous zone of a karst aquifer. The remediation design was not arrived at using classical pump and treat, intergranular flow manner approach to the problem and set aside the notion that this karst aquifer was not "remediateable" as if it were conduit network contamination. A remediation system s designed around the specific characteristics of the surficial bcutaneous karst aquifer to be effective as a remediation tool in this setting. The use of excavation, soil flushing, soil venting and pump and treat has been shown effective at removing soil and ground water contamination from the s ubcutaneous zone as a decrease in maximum contaminant concentration over time. The system also appears to be working as designed by mimicking a constant recharge event thereby leaching residual soil contamination from the subcutaneous zone for removal by the interceptor trench. The system is currently operating as designed and data being collected for a future submittal concerning its efficiency and performance.

REFERENCES

Miller, R.D., 1967, Geologic Map of the Lexington West Quadrangle, Fayette and Scott Counties, Kentucky; United States Geological Survey Geological Quadrangle Map - GQ - 600.

BIOGRAPHICAL SKETCH

Scott A. Recker, a native of Cincinnati, completed a Bachelors Degree in geology at the University of Cincinnati in 1985 and received a Master of Science in hydrogeology from Eastern Kentudy University in 1990. Scott is a member of the National Speleological Society and his research centers around ground water low in the subcutaneous zone of karst aquifers. He is currently esiding in Charlotte, North Carolina and is employed as a consulting hydrogeollogist for Delta Environmental Consultants, Inc.

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PETROLEUM HYDROCARBON REMEDIATION OF THE SUBCUTANEOUS ZONE OF A KARST AQUIFER, LEXINGTON, KENTUCKY

Scott A. Recker
Delta Environmental Consultants, Inc.
Charlotte, North Carolina

1. Has the remediation effort been evaluated at the spring?

No, the spring showed non-detctable amounts of petroleum hydrocarbons during two sampling events. The spring has also been documented as the ulimate resurgence for a ground water basin which encompasses half of the City of Lexington. Remedial evaluations at the spring would therefore be unsuccessful due to the large amount of dilution and the presence of other potential petroleum hydrocarbon constributors.

TABLE M.1
Comparison of SWMU 13 Soil Concentrations to SSLs
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		Soil to Groundwater SSL$^{(1)}$	13-SS-04C	13-SS-05B	13-SS-05BFD*	13-SS-05C	13-SS-06B	13-SS-06C	13-SS-07B
SAMPLE DEPTH (ft bgs):	Units		14 - 15	3 - 5	3 - 5	11 - 13	4 - 6	9 - 11	9 - 11
Volatile Organics - SW8260C									
1,2,3-Trimethylbenzene	mg/Kg	0.31	0.022	--	--	--	--	0.064	0.44
1,2,4-Trimethylbenzene	mg/Kg	0.42	0.059	--	--	1.2	--	0.13	4.5
1,3,5-Trimethylbenzene	mg/Kg	3.3	--	--	--	--	--	--	2.0
2-Butanone	mg/Kg	24	--	--	--	--	--	--	0.12
4-Isopropyltoluene	mg/Kg	NA	--	--	--	0.35	--	0.082	0.74
Benzene	mg/Kg	0.0047	--	--	--	--	--	--	0.035
Carbon disulfide	mg/Kg	4.8	--	--	--	--	--	--	0.43
Cyclohexane	mg/Kg	260	--	--	--	--	--	--	--
Ethylbenzene	mg/Kg	0.034	--	--	--	0.43	--	0.031	0.60
Isopropylbenzene	mg/Kg	14.8	--	--	--	0.26	--	0.037	0.31
m,p-Xylene	mg/Kg	3.8	--	--	--	0.042	--	--	0.064
Naphthalene	mg/Kg	0.011	0.11	--	--	1.5	--	0.46	6.4
n-Butylbenzene	mg/Kg	64.6	0.044	--	--	0.89	--	--	--
n-Propylbenzene	mg/Kg	24.4	--	--	--	0.79	--	0.080	0.76
o-Xylene	mg/Kg	3.8	--	--	--	0.070	--	--	0.049
sec-Butylbenzene	mg/Kg	117	--	--	--	0.42	--	0.073	0.53
tert-Butylbenzene	mg/Kg	31.0	--	--	--	0.20	--	0.031	0.30
Toluene	mg/Kg	15.2	--	--	--	--	--	--	--

NOTES:

(1) Risk-based SSLs (USEPA, 2015) based on a dilution attenuation factor of 20
NA - SSL not available.
ft bgs - Feet below ground surface.
-- - Analyte not detected

🟩	Analyte exceeds SSL but in smear zone or below water table
🟨	Analyte exceeds SSL in soil above the smear zone

TABLE M.1
Comparison of SWMU 13 Soil Concentrations to SSLs
TOOELE ARMY DEPOT - SOUTH

SAMPLE ID:		Soil to Groundwater SSL$^{(1)}$	13-SS-07C	13-SS-07CFD*	13-SS-08B	13-SS-08C	13-SS-09B	13-SS-09C
SAMPLE DEPTH (ft bgs):	Units		12 - 14	12 - 14	3 - 5	10 - 12	3 - 5	12 - 14
Volatile Organics - SW8260C								
1,2,3-Trimethylbenzene	mg/Kg	0.31	--	--	--	0.30	--	0.27
1,2,4-Trimethylbenzene	mg/Kg	0.42	0.14	0.10	--	--	--	0.023
1,3,5-Trimethylbenzene	mg/Kg	3.3	2.3	1.3	--	0.090	--	--
2-Butanone	mg/Kg	24	--	--	--	--	--	--
4-Isopropyltoluene	mg/Kg	NA	1.2	0.87	0.026	0.13	--	--
Benzene	mg/Kg	0.0047	0.097	0.079	--	--	--	--
Carbon disulfide	mg/Kg	4.8	0.25	0.46	--	--	--	--
Cyclohexane	mg/Kg	260	--	--	--	0.60	--	0.11
Ethylbenzene	mg/Kg	0.034	1.2	0.83	--	--	--	--
Isopropylbenzene	mg/Kg	14.8	0.58	0.41	--	0.27	--	0.047
m,p-Xylene	mg/Kg	3.8	--	--	--	--	--	--
Naphthalene	mg/Kg	0.011	7.0	5.1	--	2.5	0.029	0.97
n-Butylbenzene	mg/Kg	64.6	--	--	0.048	0.65	--	0.21
n-Propylbenzene	mg/Kg	24.4	1.2	0.88	--	--	--	0.059
o-Xylene	mg/Kg	3.8	--	--	--	--	--	--
sec-Butylbenzene	mg/Kg	117	1.2	0.84	--	0.39	--	0.44
tert-Butylbenzene	mg/Kg	31.0	0.38	0.27	--	0.24	--	0.29
Toluene	mg/Kg	15.2	--	--	--	--	--	--

NOTES:

(1) Risk-based SSLs (USEPA, 2015) based on a dilution attenuation factor of 20
NA - SSL not available.
ft bgs - Feet below ground surface.
-- - Analyte not detected

🟩 Analyte exceeds SSL but in smear zone or below water table

🟨 Analyte exceeds SSL in soil above the smear zone

TABLE M.2

Fuel Constituent Over Time

TOOELE ARMY DEPOT - SOUTH

Naphthalene

	S-CAM-1	S-CAM-2	S-25-88	S-26-88	S-82-91
1993	200	200	30	200	10
2014	730/280	180	<0.15	<0.16	0.22

DRO

	S-CAM-1	S-CAM-2	S-25-88	S-26-88	S-82-91
1993	-	45,000	560	25,000	-
2014	110,000	49,000	580	5,200	-

Benzene

	S-CAM-1	S-CAM-2	S-25-88	S-26-88	S-82-91
1993	33	28	4.1	ND	ND
2014	15	3.4	<0.60	<0.60	<0.60

Ethylbenzene

	S-CAM-1	S-CAM-2	S-25-88	S-26-88	S-82-91
1993	24	3	ND	ND	ND
2014	64	5.6	<0.60	<0.60	<0.60

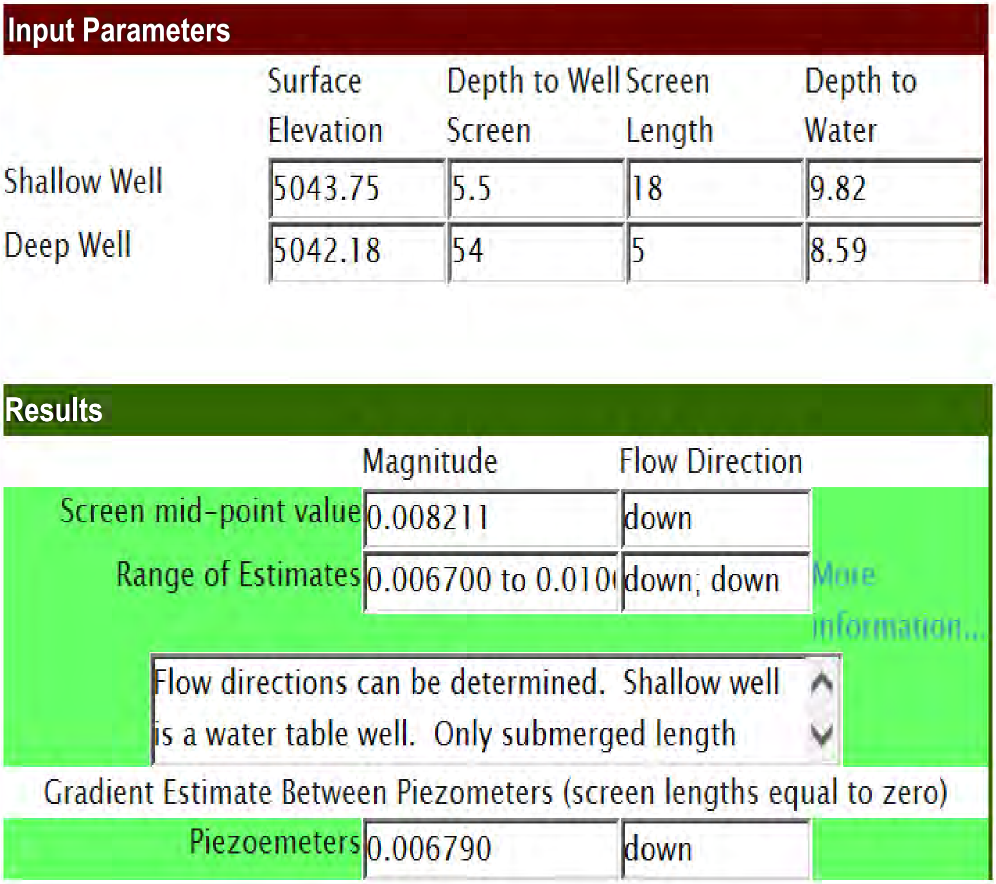
Trichloroethene

	S-78-91
1993	2.6
2014	3.1

🟩 Concentration has decreased from previous measurement
🟨 Concentration has increased from previous measurement
⬜ Concentration does not differ from previous measurement (allowing for analytical error)

APPENDIX O

VERTICAL GRADIENT CALCULATOR OUTPUT



Input Parameters

	Surface Elevation	Depth to Well Screen	Screen Length	Depth to Water
Shallow Well	5043.75	5.5	18	9.82
Deep Well	5042.18	54	5	8.59

Results

	Magnitude	Flow Direction	
Screen mid-point value	0.008211	down	
Range of Estimates	0.006700 to 0.010	down; down	More information...

Flow directions can be determined. Shallow well is a water table well. Only submerged length

Gradient Estimate Between Piezometers (screen lengths equal to zero)

Piezoemeters	0.006790	down