Table 1-1. Summary of Monitor Well Construction Details, UNC Airport Road Waste Disposal Area, Univesity of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

	Monitor Well Identification	Date of Installation	Measuring Point Elevation (Top of Casing) (ft msl)	Depth of Surface Casing (ft bls)	Total Drilled Depth (ft bls)	Screened Interval (ft bls)
	MW-1	INA	483.11	NA	28.3	INA
	MW-2	INA	484.30	NA	29	INA
	MW-3	INA	483.34	NA	20	INA
	MW-4	INA	472.18	NA	24.6	INA
	MW-5	INA	454.62	NA	15	INA
	MW-6	4/11/1995	472.55	NA	22	12.0-22.0
*	MW-7	4/21/1995	475.01	22	48	38.0-48.0
*	MW-9	4/21/1995	476.25	NA	43.5	20.0-35.0
*	MW-11	4/18/1995	472.78	NA	36	26.0-36.0
	MW-12	4/13/1995	464.21	NA	22	12.0-22.0
*	MW-13	4/19/1995	467.60	NA	23	13.0-23.0
*	MW-14	8/11/1995	481.67	29	175	165.0-175.0
*	MW-15	7/20/1995	465.04	40	60.5	50.0-60.0
*	MW-16	7/21/1995	467.14	16	82	22.0-42.0
*	MW-17	7/24/1995	478.99	26	71	60.0-70.0
	MW-18	7/19/1995	467.96	NA	16	5.0-15.0
	MW-19	7/19/1995	473.90	NA	10	5.0-10.0
	MW-20	7/27/1995	475.03	NA	25	14.0-24.0
*	MW-21	7/21/1995	463.28	NA	22	11.0-21.0
	MW-22	7/26/1995	460.78	NA	10	5.0-10.0
*	MW-23	8/17/1995	458.92	17	89	78.0-88.0
*	MW-24	1/19/1996	465.32	105	200	175.0-195.0
	MW-25	1/23/1996	458.74	NA	15	5.0-15.0
*	MW-26	2/5/1996	458.79	20	180	75.0-95.0
*	MW-28	1/15/1996	480.40	NA	46	36.0-46.0
*	MW-29	11/14/1996	480.73	55	170	160.0-170.0
*	MW-30	11/12/1996	468.57	NA	40	25.0-40.0
*	MW-31	11/13/1996	468.45	50	90	75.0-90.0
*	MW-32	11/12/1996	462.06	NA	43	28.0-43.0
*	MW-33	11/13/1996	461.46	50	85	70.0-85.0
*	MW-34	7/6/2004	464.65	NA	85	70.0-85.0
*	MW-35	7/6/2004	452.45	NA	75	60.0-75.0
*	MW-36	7/7/2004	466.90	NA	84	69.0-84.0
*	MW-37	7/6/2004	460.29	100	125	115.0-125.0
	VER-1	3/26/1998	INA	NA	25	5.0-25.0
*	RW-1	4/2/1998	INA	20	80	20.0-80.0

* Bedrock wells - This designation indicates that the entire screened interval is set in bedrock.
ft msl Feet above mean sea level.
NA Not Applicable.
ft bls Feet below land surface.
INA Information not available.
Note: Monitor Wells MW-8, MW-10, and MW-27 were not installed.
RW-1 is an open borehole.

Table 1-2. Historical Summary of Analytical Results for VOCs Detected in Groundwater Samples, UNC Airport Road Waste Disposal Area, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Constituent	Sample ID: / Date Sampled:	MW-1 05/15/98	MW-1 11/15/00	MW-1 10/31/02	MW-1 07/22/04	MW-2 05/15/98	MW-2 11/14/00	MW-2 10/31/02	MW-2 07/21/04	MW-3 05/15/98
Volatile Organics (USEPA Method 8260) ug/L	NCAC 2L GW Standard									
Acetone	700	<50	<5,000	**160,000**	**260,000**	<25,000	<5,000	**30,000**	<50000	<50
Benzene	1	**69,000**	**142,000**	**32,000**	**100,000**	**8,500**	**12,800**	**13,000**	**25,000**	<5.0
Chlorobenzene	50	**24**	**450**	**440**	<1000	<2,500	<200	**150**	<2000	<5.0
Chloroform	0.19	**90,000**	**273,000**	**89,000**	**190,000**	**46,000**	**102,000**	**85,000**	**130,000**	**8.7**
1,1-Dichloroethane	700	**5.2**	<200	**42**	<1000	<2,500	<200	**23**	<2000	<5.0
1,2-Dichloroethane	0.38	<50,000	**6,700**	**3,800**	**9,900**	<2,500	**4,140**	**4,400**	<2000	<5.0
cis-1,2-Dichloroethene	70	**9.0**	<200	**64**	<1000[1]	<2,500	<200	**8**	<4000[1]	<5.0
trans-1,2-Dichloroethene	70	NA	<200	**20**	NA	NA	<200	**4**	NA	NA
Diethyl ether	1,200*	**220,000**	**430,000**	**160,000**	**290,000**	**55,000**	**82,000**	**65,000**	**130,000**	**10**
Methylene chloride	5	**66,000**	**222,000**	**71,000**	**140,000**	**26,000**	**48,700**	**35,000**	**58,000**	<5.0
1,1,2,2-Tetrachloroethane	.055*	<5.0	<200	**2,600**	**8,000**	<2,500	<200	**63**	<2000	<5.0
Toluene	1,000	<50,000	**5,530**	**250**	<1000	<2,500	**650**	**510**	<2000	<5.0
Trichloroethene	2.8	<5.0	**4,960**	**1,600**	**14,000**	<2,500	**177**	**170**	<2000	<5.0
Vinyl chloride	0.015	**11**	<200	**3**	<1000	<5,000	<200	**3**	<2000	<10
Xylenes, Total	530	<50,000	**1,890**	**2,140**	**2,300**	<2,500	**470**	**290**	<4000	<5.0

Constituent	MW-3 11/14/00	MW-3 10/31/02	MW-3 07/21/04	MW-4 10/31/02	MW-4 07/20/04	MW-5 11/14/00	MW-5 10/30/02	MW-5 07/20/04	MW-6 05/14/98	MW-6 11/14/00
Acetone	<2.0	<50	<25	<50	<25	<50.0	<50	<25	<5,000	<50
Benzene	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	**500**	**834**
Chlorobenzene	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	<500	**2.1**
Chloroform	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	**1,100**	**963**
1,1-Dichloroethane	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	<500	<2.0
1,2-Dichloroethane	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	<500	**21.5**
cis-1,2-Dichloroethene	<2.0	<2.0	<2.0[1]	<2.0	<2.0[1]	<2.0	<2.0	<2.0[1]	<500	<2.0
trans-1,2-Dichloroethene	<2.0	<2.0	NA	<2.0	NA	<2.0	<2.0	NA	NA	**4.0**
Diethyl ether	<2.0	<2.0	16 U	<2.0	<2.0	<2.0	<2.0	**3.4**	**7,500**	**4,450**
Methylene chloride	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	**800**	**655**
1,1,2,2-Tetrachloroethane	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	<500	<2.0
Toluene	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	<500	<2.0
Trichloroethene	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	<500	**10.7**
Vinyl chloride	<2.0	<2.0	<1.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1,000	<2.0
Xylenes, Total	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<500	<2.0

ug/L Micrograms per liter.
< Constituent was not detected above the reporting limit.
J Constituent concentration is qualified as estimated.
NA Not analyzed
U Constituent concentration is qualified as nondetect due to blank contamination.
[1] Cis-1,2-Dichloroethene & trans-1,2-Dichloroethene were analyzed as one constituent (Cis/Trans-1,2-Dichloroethene)
* USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no NCAC 2L Groundwater Standard exists).
[shaded box] Indicates that the reported concentration exceeds the NCAC 2L Groundwater Standard or PRG.

Table 1-2. Historical Summary of Analytical Results for VOCs Detected in Groundwater Samples, UNC Airport Road Waste Disposal Area, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Constituent	Sample ID: / Date Sampled:	MW-6 10/31/02	MW-6 07/21/04	MW-7 05/14/98	MW-7 11/16/00	MW-7 10/29/02	MW-7 07/21/04	MW-9 05/14/98	MW-9 11/14/00	MW-9 10/31/02	MW-9 07/22/04	MW-11 05/13/98	MW-11 11/14/00	MW-11 10/31/02	MW-11 07/22/04	MW-12 05/14/98	MW-12 11/15/00	MW-12 10/29/02	MW-12 12/18/03	MW-12 07/21/04
Volatile Organics (USEPA Method 8260) ug/L	NCAC 2L GW Standard																			
Acetone	700	<50	<1200	<50	<50	<50	<5.0	<50	<50	<50	<25	<50	<50	<50	<1200	<5,000	<50	<50	<1200	<500
Benzene	1	**440**	**910**	<5.0	**140**	**4**	**2.7 U**	<5.0	< 3.4	**50**	<1.0	<5.0	<2.5	**6**	<50	**1,300**	**2,020**	**290 J**	**350**	**470**
Chlorobenzene	50	**2**	<50	<5.0	**15.1**	**5**	**8.3**	<5.0	<2.0	<2.0	<1.0	<5.0	**7.4**	**8**	<50	<500	**23.4**	**17**	<50	**23**
Chloroform	0.19	**140**	**470**	**16**	<2.7	<2.0	**6.9 U**	**5.1**	<2.0	<2.0	<1.0	**20**	<8.6	**12**	<50	**10,000**	**8,050**	**32**	<50	**21**
1,1-Dichloroethane	700	<2.0	<50	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<50	<500	<2.0	**4**	<50	<20
1,2-Dichloroethane	0.38	**16**	<50	**15**	**59.6**	**33**	**49**	<5.0	**2.4**	**5**	**1.2**	<5.0	**47.7**	**50**	**56**	<500	**585**	**330 J**	<50	**360**
cis-1,2-Dichloroethene	70	<2.0	<200[1]	<5.0	**4.1**	**2**	<2.0[1]	<5.0	<2.0	<2.0	<2.0[1]	<5.0	**3.2**	**2**	<100[1]	<500	**5.6**	**4**	<100	<40[1]
trans-1,2-Dichloroethene	70	**5**	NA	NA	<2.0	<2.0	NA	<5.0	<2.0	<2.0	NA	<5.0	<2.0	<2.0	NA	<500	<2.0	<2.0	<100	NA
Diethyl ether	1,200*	**5,400**	**12,000**	**64**	**2,480**	**930**	**2,300**	**120**	**160**	**720**	**140**	**1,400**	**1,790**	**1,600**	**3100**	**13,000**	**13,900**	**11,000**	**8,800**	**13,000**
Methylene chloride	5	**88**	**390**	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	**6**	<250	**5,700**	**4,160**	<5.0	<250	<100
1,1,2,2-Tetrachloroethane	.055*	<2.0	<50	<5.0	<5.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<50	<500	<2.0	<2.0	<50	<20
Toluene	1,000	<2.0	<50	<5.0	**2.1**	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<50	<500	**2.0**	<2.0	<50	<20
Trichloroethene	2.8	**13**	**28 J**	<5.0	**8.2**	**2**	**4.2**	<5.0	<2.0	<2.0	<1.0	**6.5**	**8.4**	**8**	<50	<500	**43**	**30**	**25 J**	**35**
Vinyl chloride	0.015	<2.0	<50	<10	**6.9**	**4**	**5.5**	<10	<2.0	<2.0	<1.0	**12**	**8.0**	**13**	<50	<1.000	<2.0	**4**	<50	<20
Xylenes, Total	530	<2.0	<100	<5.0	<2.0	<2.0	<2.0	<5.0	<2.0	<2.0	<2.0	<5.0	<2.0	<2.0	<100	<500	<2.0	<2.0	<100	<40

ug/L Micrograms per liter.
< Constituent was not detected above the reporting limit.
J Constituent concentration is qualified as estimated.
NA Not analyzed
U Constituent concentration is qualified as nondetect due to blank contamination.
[1] Cis-1,2-Dichloroethene & trans-1,2-Dichloroethene were analyzed as one constituent (Cis/Trans-1,2-Dichloroethene)
* USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no NCAC 2L Groundwater Standard exists).
[shaded box] Indicates that the reported concentration exceeds the NCAC 2L Groundwater Standard or PRG.

Table 1-2. Historical Summary of Analytical Results for VOCs Detected in Groundwater Samples, UNC Airport Road Waste Disposal Area, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Constituent	Sample ID: / Date Sampled:	MW-13 05/14/98	MW-13 11/14/00	MW-13 10/30/02	MW-13 07/21/04	MW-14 05/14/98	MW-14 11/15/00	MW-14 10/29/02	MW-14 07/21/04	MW-15 05/14/98	MW-15 11/15/00	MW-15 10/29/02	MW-15 12/18/03	MW-15 07/21/04	MW-16 05/14/98	MW-16 11/15/00	MW-16 10/29/02	MW-16 07/22/04	MW-17 11/14/00	MW-17 10/29/02
Volatile Organics (USEPA Method 8260) ug/L	NCAC 2L GW Standard																			
Acetone	700	<2,500	<50	<50	<120	<500	<50	<50	**170**	<5,000	<50	<50	<1200	**1,600**	<50	<50	<50	<25	<50	<50
Benzene	1	<250	< 18.1	**32**	**22**	**280**	< 3.8	**180**	**190**	**1,900**	**355**	**990**	**540**	**930**	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0
Chlorobenzene	50	<250	**15.6**	**4**	**8.2**	<50	<2.0	**2**	<5.0	<500	**5.3**	**18**	**17 J**	<50	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0
Chloroform	0.19	<250	<23.8	**8**	<5	**56**	<2.0	**97**	**53**	**10,000**	**606**	**1,000**	**220**	**180**	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0
1,1-Dichloroethane	700	<250	**2.7**	<2.0	<5	<50	<2.0	<2.0	<5.0	<500	<2.0	**4**	<50	<50	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0
1,2-Dichloroethane	0.38	<250	**211**	**42**	**96**	**63**	**4.7**	**47**	**50**	<500	**130**	**320 J**	**250**	**380**	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0
cis-1,2-Dichloroethene	70	<250	**5.0**	<2.0	<10[1]	<50	<2.0	<2.0	<40[1]	<500	<2.0	**5**	<100	<100[1]	<5.0	<2.0	<2.0	<2.0[1]	**2.9**	**27**
trans-1,2-Dichloroethene	70	<250	<2.0	<2.0	NA	<50	<2.0	<2.0	NA	<500	<2.0	<2.0	<100	NA	<5.0	<2.0	<2.0	NA	<2.0	<2.0
Diethyl ether	1,200*	**3,300**	**5,840**	**1,900**	**4,200**	**1,800**	<51	**1,900**	**1,800**	**13,000**	**2,670**	**11,000**	**8,500**	**14,000**	**7.7**	<2.0	**3.0**	**3.5**	<2.0	**77**
Methylene chloride	5	<250	<5.0	<5.0	<25	<50	<5.0	**6**	<25	**5,700**	**197**	**240**	**77 J**	<250	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2,2-Tetrachloroethane	.055*	<250	<2.0	<2.0	<5	<50	<2.0	<2.0	<5.0	<500	<2.0	<2.0	<50	<50	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0
Toluene	1,000	<250	<2.0	<2.0	<5	<50	<2.0	<2.0	<5.0	<500	<2.0	<2.0	<50	<50	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0
Trichloroethene	2.8	<250	**28**	**5**	<5	<50	<2.0	**10**	**10**	<500	**9.5**	**35**	**24 J**	<50	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0
Vinyl chloride	0.015	<500	**5.8**	**2**	<5	<100	<2.0	**2**	<5.0	<1000	<2.0	**4**	<50	<50	<10	<2.0	<2.0	<1.0	<2.0	**15**
Xylenes, Total	530	<250	<2.0	<2.0	<10	<50	<2.0	**3**	<10	<500	<2.0	<2.0	<100	<100	<5.0	<2.0	<2.0	<2.0	<2.0	<2.0

ug/L Micrograms per liter.
< Constituent was not detected above the reporting limit.
J Constituent concentration is qualified as estimated.
NA Not analyzed
U Constituent concentration is qualified as nondetect due to blank contamination.
[1] Cis-1,2-Dichloroethene & trans-1,2-Dichloroethene were analyzed as one constituent (Cis/Trans-1,2-Dichloroethene)
* USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no NCAC 2L Groundwater Standard exists).
[shaded box] Indicates that the reported concentration exceeds the NCAC 2L Groundwater Standard or PRG.

Table 1-2. Historical Summary of Analytical Results for VOCs Detected in Groundwater Samples, UNC Airport Road Waste Disposal Area, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Constituent	Sample ID: / Date Sampled:	MW-17 07/20/04	MW-18 11/14/00	MW-18 10/31/02	MW-18 07/20/04	MW-20 07/20/04	MW-21 05/13/98	MW-21 11/14/00	MW-21 10/30/02	MW-21 07/19/04	MW-22 05/14/98	MW-22 11/15/00	MW-22 10/29/02	MW-22 07/21/04	MW-23 05/13/98	MW-23 10/30/02	MW-23 07/20/04	MW-24 12/19/03	MW-24 07/22/04	MW-25 05/13/98
Volatile Organics (USEPA Method 8260) ug/L	NCAC 2L GW Standard																			
Acetone	700	<25	<50.0	<50	<25	<25	<50	<50	<50	<25	<50	<50	<50	<25	<50	<50	<25	<25	<25	<50
Benzene	1	<1.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	**160**	<2.0	<2.0	**1.2 U**	<5.0	<2.0	<1.0	<1.0	**1.1**	<5.0
Chlorobenzene	50	<1.0	**3.5**	**3**	**4.4**	<1.0	<5.0	<2.0	<2.0	<1.0	**13**	**12.1**	**10**	**17**	<5.0	<2.0	<1.0	<1.0	<1.0	<5.0
Chloroform	0.19	<1.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<1.0	<1.0	<1.0	<5.0
1,1-Dichloroethane	700	<1.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<1.0	<1.0	<1.0	<5.0
1,2-Dichloroethane	0.38	<1.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	**18.3**	**2**	**12**	<5.0	<2.0	<1.0	<1.0	<1.0	<5.0
cis-1,2-Dichloroethene	70	**22**[1]	<2.0	<2.0	<2.0[1]	<2.0[1]	<5.0	<2.0	<2.0	<2.0[1]	<5.0	<2.0	<2.0	<2.0[1]	<5.0	<2.0	<2.0[1]	<2.0	<2.0[1]	<5.0
trans-1,2-Dichloroethene	70	NA	<2.0	<2.0	NA	NA	<5.0	<2.0	<2.0	NA	<5.0	<2.0	<2.0	NA	<5.0	<2.0	NA	<2.0	NA	<5.0
Diethyl ether	1,200*	**110**	<34	<2.0	**49**	<2.0	<5.0	<2.0	<2.0	<2.0	**2,600**	**620**	**130**	**660 J**	<5.0	<2.0	<2.0	**4.8**	**6.4**	<5.0
Methylene chloride	5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,1,2,2-Tetrachloroethane	.055*	<1.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<1.0	<1.0	<1.0	<5.0
Toluene	1,000	<1.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<5.0	<2.0	<1.0	<1.0	<1.0	<5.0
Trichloroethene	2.8	**1.3**	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	**8.9**	**2.2**	<2.0	**1.4**	<5.0	<2.0	<1.0	<1.0	<1.0	<5.0
Vinyl chloride	0.015	**20**	<2.0	<2.0	<1.0	<1.0	<10	<2.0	<2.0	<1.0	<10	<2.0	<2.0	<1.0	<10	<2.0	<1.0	<1.0	<1.0	<10
Xylenes, Total	530	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	<2.0	<2.0	<2.0	<5.0	<2.0	<2.0	<2.0	<5.0	<2.0	<2.0	<2.0	<2.0	<5.0

ug/L Micrograms per liter.
< Constituent was not detected above the reporting limit.
J Constituent concentration is qualified as estimated.
NA Not analyzed
U Constituent concentration is qualified as nondetect due to blank contamination.
[1] Cis-1,2-Dichloroethene & trans-1,2-Dichloroethene were analyzed as one constituent (Cis/Trans-1,2-Dichloroethene)
* USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no NCAC 2L Groundwater Standard exists).
[shaded box] Indicates that the reported concentration exceeds the NCAC 2L Groundwater Standard or PRG.

Table 1-2. Historical Summary of Analytical Results for VOCs Detected in Groundwater Samples, UNC Airport Road Waste Disposal Area, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Constituent	Sample ID: / Date Sampled:	MW-25 11/14/00	MW-25 10/30/02	MW-25 07/21/04	MW-26 05/13/98	MW-26 11/15/00	MW-26 10/30/02	MW-26 07/22/04	MW-28 11/16/00	MW-28 10/31/02	MW-28 07/21/04	MW-29 11/15/00	MW-29 10/31/02	MW-29 07/21/04	MW-30 10/30/02	MW-30 07/20/04	MW-31 05/13/98	MW-31 11/14/00	MW-31 10/30/02	MW-31 07/20/04
Volatile Organics (USEPA Method 8260) ug/L	NCAC 2L GW Standard																			
Acetone	700	<50	<50	<25	<50	<50	<50	<25	<50.0	<50	<25	<25	<50	<25	<50	<25	<250	<50	<50	<25
Benzene	1	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<2.0	**2**	<1.0	<1.0	<2	<1.0	<2.0	<1.0	<25	<2.0	<2.0	**1.3**
Chlorobenzene	50	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1.0	<2	<1.0	<2.0	<1.0	<25	<2.0	**3**	**4.1**
Chloroform	0.19	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<2.0	**2**	<1.0	<1.0	**2**	<1.0	<2.0	<1.0	<25	<2.0	**3**	**2.1**
1,1-Dichloroethane	700	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1.0	<2.0	<1.0	<2.0	<1.0	<25	<2.0	<2.0	<1.0
1,2-Dichloroethane	0.38	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1.0	<2.0	<1.0	<2.0	<1.0	<25	**8.4**	**19**	**25**
cis-1,2-Dichloroethene	70	<2.0	<2.0	<2.0[1]	<5.0	<2.0	<2.0	<2.0[1]	<2.0	<2.0	<2.0[1]	<1.0	<2.0	<2.0[1]	<2.0	<2.0[1]	<25	<2.0	<2.0	<2.0[1]
trans-1,2-Dichloroethene	70	<2.0	<2.0	NA	<5.0	<2.0	<2.0	NA	<2.0	<2.0	NA	<1.0	<2.0	NA	<2.0	NA	<25	<2.0	<2.0	NA
Diethyl ether	1,200*	<43	<2.0	**45**	**5.2**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	**2.0**	<2.0	**480**	**215**	**770**	**2,000**
Methylene chloride	5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<2.5	<5.0	<5.0	<5.0	<5.0	<25	<5.0	<5.0	<5.0
1,1,2,2-Tetrachloroethane	.055*	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1.0	<2.0	<1.0	<2.0	<1.0	<25	<2.0	<2.0	<1.0
Toluene	1,000	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1.0	<2.0	<1.0	<2.0	<1.0	<25	<2.0	<2.0	<1.0
Trichloroethene	2.8	<2.0	<2.0	<1.0	<5.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1.0	<2.0	<1.0	<2.0	<1.0	<25	<2.0	**4**	**5.0**
Vinyl chloride	0.015	<2.0	<2.0	<1.0	<10	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<1.0	<2.0	<1.0	<2.0	<1.0	<50	<2.0	**5**	**5.4**
Xylenes, Total	530	<2.0	<2.0	<2.0	<5.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<25	<2.0	<2.0	<2.0

ug/L Micrograms per liter.
< Constituent was not detected above the reporting limit.
J Constituent concentration is qualified as estimated.
NA Not analyzed
U Constituent concentration is qualified as nondetect due to blank contamination.
[1] Cis-1,2-Dichloroethene & trans-1,2-Dichloroethene were analyzed as one constituent (Cis/Trans-1,2-Dichloroethene)
* USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no NCAC 2L Groundwater Standard exists).
[shaded box] Indicates that the reported concentration exceeds the NCAC 2L Groundwater Standard or PRG.

Table 1-2. Historical Summary of Analytical Results for VOCs Detected in Groundwater Samples, UNC Airport Road Waste Disposal Area, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Constituent	Sample ID: / Date Sampled:	MW-32 05/13/98	MW-32 11/13/00	MW-32 10/30/02	MW-32 12/19/03	MW-32 07/20/04	MW-33 05/13/98	MW-33 11/13/00	MW-33 10/30/02	MW-33 12/19/03	MW-33 07/20/04	MW-34 07/20/04	MW-35 07/20/04	MW-36 07/20/04	MW-37 07/20/04
Volatile Organics (USEPA Method 8260) ug/L	NCAC 2L GW Standard														
Acetone	700	<50	<50	<50	<25	<25	<50	<50	<50	<25	<25	<25	<25	<25	<25
Benzene	1	<5.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	50	<5.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	0.19	<5.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	700	<5.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	0.38	<5.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene	70	<5.0	<2.0	<2.0	<2.0	<2.0[1]	<5.0	<2.0	<2.0	<2.0	<2.0[1]	<2.0[1]	<2.0[1]	<2.0[1]	<2.0[1]
trans-1,2-Dichloroethene	70	<5.0	<2.0	<2.0	<2.0	NA	<5.0	<2.0	<2.0	<2.0	NA	NA	NA	NA	NA
Diethyl ether	1,200*	<5.0	<2.0	**15**	<2.0	<2.0	<5.0	<2.0	**13**	**18**	**30**	<2.0	<2.0	<2.0	<2.0
Methylene chloride	5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5
1,1,2,2-Tetrachloroethane	.055*	<5.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1
Toluene	1,000	<5.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1
Trichloroethene	2.8	<5.0	<2.0	<2.0	<1.0	<1.0	<5.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1
Vinyl chloride	0.015	<10	<2.0	<2.0	<1.0	<1.0	<10	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1
Xylenes, Total	530	<5.0	<2.0	<2.0	<2.0	<2.0	<5.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2

ug/L Micrograms per liter.
< Constituent was not detected above the reporting limit.
J Constituent concentration is qualified as estimated.
NA Not analyzed
U Constituent concentration is qualified as nondetect due to blank contamination.
[1] Cis-1,2-Dichloroethene & trans-1,2-Dichloroethene were analyzed as one constituent (Cis/Trans-1,2-Dichloroethene)
* USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no NCAC 2L Groundwater Standard exists).
[green box] Indicates that the reported concentration exceeds the NCAC 2L Groundwater Standard or PRG.

Table 1-3. Summary of Detectable Soil Sample Analytical Results, January 1996, UNC Airport Road Waste Disposal Area, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Constituents	East-Central North Carolina Background[1]	Soil Sample ID: / Depth: / Date Sample:	GP-2 (6-8') 1/27/1996	GP-3 (6-8') 1/28/1996	GP-5 (4-5') 1/28/1996	SB-1 (3-5') 1/27/1996	SB-2 (7-8.5') 1/27/1996
Volatile Organics by USEPA Method 8260 (µg/kg dw)							
Methylene Chloride	INA		ND	ND	ND	ND	10
Chloroform	INA		ND	ND	ND	8	20
Semivolatile Organics by USEPA Method 8270 (µg/kg dw)	INA		ND	ND	ND	ND	ND
Metals by USEPA Method 6010 (mg/kg dw)							
Aluminum	100000		11800	6660	3960	11500	7380
Arsenic	6.5		2.11	1.24	1.58	2.84	1.57
Barium	700		46	26.3	30	45	28.3
Beryllium	<1.00		0.953	ND	ND	ND	0.729
Calcium	7900		ND	ND	ND	2160	ND
Chromium	70		1.34	1.33	5.76	11	1.52
Cobalt	45		ND	ND	ND	10.7	ND
Copper	30		15.1	3.8	15.2	25.6	8.88
Iron	30000		27900	13400	12700	18400	17200
Lead	365		3.88	2.41	6.74	16	2.69
Magnesium	6000		4460	726	1330	3440	2700
Manganese	250		181	28.1	92.1	**295**	135
Nickel	20		ND	ND	**135**	7.03	ND
Potassium	45000		2490	ND	591	ND	ND
Selenium	0.30		**1.41**	ND	ND	ND	ND
Sodium	57500		ND	ND	ND	ND	683
Thallium	INA		1.36	ND	ND	ND	ND
Vanadium	325		36.6	17.3	11.5	43.3	25.3
Zinc	28		**52.7**	8.57	**30.9**	**51.3**	**47.9**
Cyanide by Method 9010A (mg/kg dw)							
Total Cyanide	INA		ND	ND	ND	ND	ND
Amenable Cyanide	INA		ND	ND	ND	ND	ND

mg/kg (ppm) Milligrams per kilogram on a dry weight basis (parts per million).
µg/kg (ppb) Micrograms per kilogram on a dry weight basis (parts per billion).
J Estimated; matrix spike recovery exceeds upper control limit.
ND Constituent was not detected.
NA Constituent was not analyzed.
INA Information not available.
[1] Values obtained from USGS, 1984. Values represent elemental concentrations of a single soil sample obtained from east-central North Carolina.
Note: All bold numbers represent data above background concentrations.

Table 1-4. Historical Summary of Diethyl Ether Detected in Surface Water Samples, UNC Airport Road Waste Disposal Area, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

	Sample ID:	SW-1	SW-1	SW-1	SW-1	SW-1	SW-1	SW-1	SW-2	SW-2	SW-2	SW-2	SW-2	SW-2	SW-2	SW-2	SW-2
	Date Sampled:	06/16/95	01/26/96	05/09/96	10/28/96	04/10/97	12/03/97	07/20/04	06/16/95	01/26/96	05/09/96	08/07/96	10/28/96	04/10/97	08/15/97	12/03/97	07/20/04
Constituent	Sampled by:	ARCADIS	UNC	UNC	UNC	UNC	UNC	ARCADIS	ARCADIS	UNC	UNC	UNC	UNC	UNC	UNC	UNC	ARCADIS
Volatile Organics	Screening Criteria																
(USEPA Method 8260) ug/L																	
Diethyl ether	1,200*	<100	<10	<10	<10	<10	<10	<2	**47**	<10	<10	<10	<10	<10	<10	<10	<2

	Sample ID:	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-3	SW-4	SW-4	SW-4	SW-4	SW-4	SW-4	SW-4	SW-4	SW-4
	Date Sampled:	06/16/95	01/26/96	05/09/96	08/07/96	10/28/96	04/10/97	08/15/97	12/03/97	07/20/04	06/16/95	01/26/96	05/09/96	08/07/96	10/28/96	04/10/97	08/15/97	12/03/97	07/20/04
Constituent	Sampled by:	ARCADIS	UNC	UNC	UNC	UNC	UNC	UNC	UNC	ARCADIS	ARCADIS	UNC	UNC	UNC	UNC	UNC	UNC	UNC	ARCADIS
Volatile Organics	Screening Criteria																		
(USEPA Method 8260) ug/L																			
Diethyl ether	1,200*	**6**	<10	<10	**10**	<10	<10	**12**	<10	**4.2**	**5**	<10	<10	<10	<10	<10	<10	<10	**4.0**

	Sample ID:	SW-5	SW-5	SW-5	SW-5	SW-5	SW-5	SW-5	SW-5	SW-5	SW-5	SW-6	SW-6	SW-6	SW-6	SW-6	SW-6	SW-6	SW-6	SW-6
	Date Sampled:	06/16/95	01/26/96	05/09/96	08/07/96	10/28/96	04/10/97	08/15/97	12/03/97	01/29/03	07/20/04	06/16/95	01/26/96	05/09/96	08/07/96	10/28/96	04/10/97	08/15/97	12/03/97	07/20/04
Constituent	Sampled by:	ARCADIS	UNC	UNC	UNC	UNC	UNC	UNC	UNC	UNC	ARCADIS	ARCADIS	UNC	UNC	UNC	UNC	UNC	UNC	UNC	ARCADIS
Volatile Organics	Screening Criteria																			
(USEPA Method 8260) ug/L																				
Diethyl ether	1,200*	**2**	<10	<10	<10	**10**	<10	<10	<10	<5.0	**2.4**	<100	<10	<10	<10	<10	<10	<10	<10	<2

ug/L Micrograms per liter.
< Constituent was not detected above the reporting limit.
* USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no surface water standard exists).

Table 2-1. Potential Regulatory Requirements, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Standard Requirements or Criteria	**Citation**	**Description**	**Probable Impact on Site Remediation/Status**
North Carolina Groundwater Standards	NCAC, Title 15A, Subchapter 2L	NC Water Classification and Standards - govern protection and restoration of groundwater resources. Subchapter 2L provides numerical standards for up to 141water-quality parameters for Class GA and GSA.	The groundwater standards are potentially applicable for the site and will influence the groundwater remediation process.
National Primary Drinking Water Standards	40 CFR Part 141	National Primary Drinking Water Standard MCLs are enforceable standards for contaminants in public water-supply systems. They are based on health, economic, and technical feasibility of removing a contaminant in water. MCLGs are nonenforceable guidelines that do not consider the technical feasibility of contaminant removal.	Surficial bedrock aquifer at the site is not being used as a current source of drinking water on the property. MCLs will be potentially enforceable when groundwater is used for drinking purposes. However, MCLs can be used conservatively, along with State Groundwater Standards, in establishing cleanup goals.
Clean Water Act Section 404	(33 CFR Part 320-330) Executive Order 11990 (Wetlands Protection) 40 CFR Part 230	Wetlands as defined by U.S Army Corps of Engineers (Reference Manual). To minimize destruction, loss, degradation of wetlands. Action to prohibit discharge of dredged or fill material into wetlands without permit. Action to prevent impacted storm water runoff from entering the wetlands.	The nearest upstream wetlands were identified 1 mile upstream of Crow Branch Creek in the NCDENR 1993 Site Inspection Prioritization Report. The nearest downstream wetlands frontage was found where Crow Branch Creek enters Eastwood Lake (approximately 1.8 to 1.9 miles). Remediation activities will consider impacts to any on-site wetlands, if any.
North Carolina Hazardous Waste Management Regulations	NCAC, Title 15A, Chapter 13A	USEPA has authorized State of North Carolina to implement RCRA program in the state. Standards for owners/operators of hazardous waste treatment, storage and disposal facilities. LDR restricts placement or disposal of certain wastes on the land unless they meet specified Best Demonstrated Available Technology treatment standards, which are expressed as concentration or as specified technologies for listed and characteristic hazardous wastes.	Potentially significant impact for response actions involving excavation, treatment, transportation, and disposal of wastes. Potentially relevant and appropriate requirement.
DOT Rules for Hazardous Materials Transport	49 CFR Parts 107, 17 1-179	Regulates transport of hazardous materials.	Potential impact on response actions involving off-site shipment of wastes for treatment/disposal.
Standards Applicable to Generators of Hazardous Waste	NCAC Title 15A, Chapter 13A.0007 (adopts 40 CFR Parts 262)	RCRA regulations pertaining to labeling, placarding, packaging, and spill reporting.	Potentially applicable if the excavated source material is a hazardous waste.

Table 2-1. Potential Regulatory Requirements, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Standard Requirements or Criteria	**Citation**	**Description**	**Probable Impact on Site Remediation/Status**
Standards Applicable to Transporters of Hazardous Waste	NCAC Title 15A, Chapter 13A.0007 (adopts 40 CFR Parts 263	RCRA regulations establish standard applicable to transportation of hazardous wastes. Additional requirements include manifest system and record keeping.	Potentially applicable for transporting excavated hazardous waste to a permitted treatment/disposal facility.
North Carolina Solid Waste Regulations	NCAC, Title 15A, Chapter 13B	Design, operation, and closure requirements for solid waste disposal facilities.	Potential impact on response actions involving on or off-site disposal of solid waste generated during remedial action.
North Carolina Water Pollution Control Regulations Classification and Water Quality Standards Applicable to the Surface Waters of North Carolina	NCAC, Title 15A, Chap. 2, Section .0100 NCAC Title 15A, Subchapter 2B	Regulates surface-water discharges and discharges to POTWs; implements NPDES permitting program. Establishes effluent limitations, in terms of both quantity and quality, for point discharges to surface bodies. Requires NPDES permits for discharge of pollutants into surface waters.	Potentially applicable for discharge of treated water, if the disposal is to a surface-water body (Crow Branch Creek) or a POTW. For surface-water discharges, an NPDES permit should be obtained.
Waste not Discharged to Surface Waters	NCAC, Title 15A, 2H.0200	State regulation requiring non-discharge permit for waste not discharged to surface waters.	This is applicable only if the treated groundwater is discharged to below land surface via infiltration galleries, spray irrigation, or drip irrigation.
Underground Injection Control (UIC)	NCAC 15A, Chapter 2C.0200	Underground Injection Control (UIC) program provides standards applicable to construction of injection wells and permit requirements to operate an injection well,	Potential impacts on response actions involving injection of chemicals/contaminated groundwater using injection wells (example: in-situ chemical oxidation).
North Carolina Air Pollution Control Requirements	NCAC, Title 1 5A, Chapter 2D	Air regulations in Chapter 2D are part of the federally approved State Implementation Plan for North Carolina or have been submitted for approval. State regulations adopt USEPA regulations by reference with USEPA authority delegated to the State by USEPA. Discusses air pollution control requirements.	Potential impact on treatment alternatives involving air emissions during source excavation/treatment and groundwater remediation. Generally, an air pollution control device, subsequently an air permit, is not required for emissions from groundwater and soil remediation systems. However, a registration with the Division of Air Quality is required.
North Carolina Air Quality Permit	NCAC, Title 15A, Subchapter 2H	Section .06 10 provides permit requirements for toxic air pollutants.	Potential impact on treatment alternatives involving emissions of air toxics during source excavation/treatment and groundwater remediation.

Table 2-1. Potential Regulatory Requirements, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Standard Requirements or Criteria	Citation	Description	Probable Impact on Site Remediation/Status
Occupational Safety and Health Administration (OSHA)	29 CFR Parts 1904, 1910, and 1926	OSHA requirements applicable to workers engaged in on-site work during implementation of remedial actions.	Potential impacts on response actions involving excavation, collection, treatment (all media), and disposal. Additionally, installation of recovery wells or trenching for piping installations in the hot spot may require appropriate PPE.
Location Standards: Flood Plains	40 CFR 264.18 (b)	Design, construct, operate, and maintain facilities to avoid washout of any hazardous waste by a 100-year flood.	According to Flood Insurance Map, the site is located in Zone C (areas of minimum flooding).
Protection of Flood Plains	40 CFR 6, Appendix A	Action occurring in a flood plain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas. Action to avoid adverse effects, minimize potential hann, restore and preserve natural and beneficial values.	According to Flood Insurance Map, the site is located in Zone C (areas of minimum flooding).

Table 2-2. Maximum Observed Concentrations of Constituents of Concern in Groundwater and Pertinent Groundwater/Drinking Water Standards, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Constituent of Interest	Maximum Observed Concentration in Groundwater	North Carolina 2L Groundwater Standard (for Class GA/GSA)	Federal Drinking Water Standard MCL[1]	Groundwater Remediation Goals
VOLATILES (µg/L)				
Acetone	260,000	700	NA	700
Benzene	142,000	1	5	1
Chlorobenzene	450	50	100	50
Chloroform	273,000	0.19	80[2]	0.19
1,2-Dichloroethane	9,900	0.38	5	0.38
cis-1,2-Dichloroethene	64	70	70	70
trans-1,2-Dichloroethene	20	70	100	70
Diethyl ether	430,000	1,200*	NA	1200
Methylene chloride	222,000	5	NA	5
1,1,2,2-Tetrachloroethane	8,000	0.055*	NA	0.055
Toluene	5,530	1,000	1,000	1000
Trichloroethene	14,000	2.8	5	2.8
Vinyl chloride	20	0.015	2	0.015
Xylenes, Total	2,300	530	10,000	530
SEMI-VOLATILES (µg/L)				
Phenol	290	300	NA	300
INORGANICS (µg/L)				
Barium	333	2,000	2,000	2,000
Chromium	28.3	50	100	50
Lead	19.8	15	15	15
Nickel	70	100	NA	100
Iron	2,380	300	300[3]	NA
Manganese	204	50	50[3]	NA
Zinc	1,700	2,100	5,000[3]	2,100

All concentrations in micrograms per liter (µg/L).

*USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no NCAC 2L Groundwater Standard exists).

1 Maximum Contaminant Level

2 Standard for total trihalomethanes.

3 Secondary Drinking Water Standards

Table 2-3. NCDENR Soil Remediation Goals for Constituents of Concern, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Constituent of Interest	Soil Remediation Goals[1]
Volatile Organics (mg/kg)	
Acetone	2800
Benzene	0.64
Chloroform	0.22
Chlorobenzene	30
Diethyl Ether	1360
1,2-Dichloroethane	0.28
Methylene Chloride	9.1
Trichloroethylene	0.053
Toluene	132
1,1,2,2-Tetrachloroethane	0.41
Vinyl Chloride	0.079
Semi-volatile Organics (mg/kg)	
Phenol	3600

All concentrations are in milligrams per kilogram (mg/kg).

[1]Adapted from Inactive Hazardous Sites Branch Soil Remediation Goals, Registered Environmental Consultant Program, January, 2005.

Table 2-4. Evaluation of Source Remediation Alternatives, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Criteria	Source Control Alternative 1 (SCA-1)	Source Control Alternative 2 (SCA-2)	Source Control Alternative 3 (SCA-3)	Source Control Alternative 4 (SCA-4)
Description	No Action for either Primary Source (waste material/ containers) or Secondary Source (contaminated soil underneath the primary source).	In-Situ Volatilization and Solidification of Primary and Secondary Sources	Excavation of Primary and Secondary Sources, Off-Site Treatment and Off-Site Disposal facility.	Excavation of Primary and Secondary Sources, Ex-Situ Mixing/Stabilization, Off-Site Treatment and Off-Site Disposal facility.
Protection of Human Health and the Environment	• Not protective of human health. • Impacts from continued release of chemicals into the environment.	• Expected to be protective of human health due to source control. • Threats of further chemical releases into the environment will be reduced due to source treatment/stabilization. • Contaminants may be released to groundwater during implementation due to breaking of containers.	• Expected to be protective of human health due to source control. • Threats of further chemical releases into the environment will be minimized due to source removal.	• Expected to be protective of human health due to source control. • Threats of further chemical releases into the environment will be minimized due to source removal.
Compliance with Regulatory Requirements	• Not expected to meet the Remedial Action Objectives (RAOs). • Does not comply with the State and Federal Requirements.	• Expected to meet RAOs. • May require State's water quality and air pollution control permits. • Required to meet OSHA requirements for PPE and excavation standards. • Required to comply with transportation and disposal requirements under DOT and RCRA regulations. • May need to meet treatment standards (LDRs) for the excavated waste. • In-situ treatment will not remove waste out of the ground; therefore, LDRs may not apply. • Soils in the source area are expected to meet the Remediation Goals (RG) listed in Table 2-3.	• Expected to meet RAOs. • May require State's water quality and air pollution control permits. • Required to meet OSHA requirements for PPE and excavation standards. • Required to comply with transportation and disposal requirements under DOT and RCRA regulations. • May need to meet treatment standards (LDRs) for the excavated waste. • Soils in the source area are expected to achieve Remediation Goals (RG) listed in Table 2-3.	• Expected to meet RAOs. • May require State's water quality and air pollution control permits. • Required to meet OSHA requirements for PPE and excavation standards. • Required to comply with transportation and disposal requirements under DOT and RCRA regulations. • May need to meet treatment standards (LDRs) for the excavated waste. • Soils in the source area are expected to achieve Remediation Goals (RG) listed in Table 2-3.

Table 2-4. Evaluation of Source Remediation Alternatives, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Criteria	Source Control Alternative 1 (SCA-1)	Source Control Alternative 2 (SCA-2)	Source Control Alternative 3 (SCA-3)	Source Control Alternative 4 (SCA-4)
Long-Term Effectiveness and Permanence	• Risks are not expected to be reduced. High potential for continued release of chemicals. • No Action will not be effective. Potential for natural attenuation of sources before impacting the receptor (groundwater) is very low.	• Risks are expected to be significantly reduced due to source treatment/stabilization. • Effectiveness assessment of the remedy can be measured by a comprehensive quality control sampling program. • Some residues may be left in the subsurface, and may continue to leach to groundwater from stabilized mass. • May need to maintain soil cover over the solidified material to prevent erosion.	• Risks are expected to be significantly reduced to source removal. • This option is a commonly used remedy which is expected to be highly effective. Quality control process can be used to ensure effective source removal. • Can optimize the degree of cleanup required (to meet RGs).	• Risks are expected to be significantly reduced to source removal. • This option is a commonly used remedy which is expected to be highly effective. Quality control process can be used to ensure effective source removal. • Can optimize the degree of cleanup required (to meet RGs).
Reduction of Toxicity, Mobility and Volume	• Does not reduce the mobility, toxicity or volume of contaminants, with the exception of natural attenuation (insignificant).	• Significant reduction in toxicity, mobility, and volume are expected through in-situ treatment processes. • May result in release of contaminants to groundwater during mixing process.	• Significant reductions in toxicity, mobility, and volume of source material are expected through removal and off-site treatment and disposal.	• Significant reductions in toxicity, mobility, and volume of source material are expected through removal and off-site treatment and disposal.
Short-Term Effectiveness	• No impact to community/ worker, since no construction activities/exposure.	• Potential impact from in-situ treatment (exposure vapor) can be reduced by using a shroud over the mixing area and treatment of off-gases. • In-situ process will be below ground which will reduce potential impacts from mixing of small quantities of incompatible chemicals. • Careful ambient monitoring is required during implementation.	• Potential threats to workers or community during implementation can be reduced by taking precautions such as using proper PPE and exclusion zones. • Efforts will be undertaken to minimize material exposure. • Careful ambient monitoring is required during implementation.	• Potential threats to workers or community during implementation can be reduced by taking precautions such as using proper PPE and exclusion zones. • Efforts will be undertaken to minimize material exposure. • High potential for reactions between incompatible materials during waste homogenizing process. • Careful ambient monitoring is required during implementation.

Table 2-4. Evaluation of Source Remediation Alternatives, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Criteria	Source Control Alternative 1 (SCA-1)	Source Control Alternative 2 (SCA-2)	Source Control Alternative 3 (SCA-3)	Source Control Alternative 4 (SCA-4)
Implementability	• Readily implementable (no disturbance of source material).	• In-situ treatment requires a specialized rig, which is available from very few vendors. • Can be implemented in a shorter time frame compared to SCA-3 and SCA-4 (2 months for both primary and secondary source treatment). • Potential exposure is reduced due to treatment performed below ground, (reduced chances of potential exposure). • No large size drums or buried utilities are expected at the site, so this technology is expected to be easily implementable. • Buried containers will be broken during the mixing process which may result in the release of contaminants to groundwater	• Conventional construction techniques and equipment can be used to excavate. • Labor intensive due to removal and segregation of soil/containers (primary source). • A very slow process and may require 4 - 6 months. • Requires extensive planning and permitting process. • Requires shoring/sheet piling, dewatering, treatment, etc. • Potential impacts due to vehicular traffic from the transportation of excavated material.	• Conventional construction techniques and equipment can be used to excavate. • Can be implemented in a shorter time frame than SCA-3. • Requires extensive planning and permitting process. • Requires shoring/sheet piling, dewatering, treatment, etc. • Potential impacts due to vehicular traffic from the transportation of excavated material. • Locating facility to accept stabilized bulk waste may be more difficult than if segregated.
Cost	• No capital costs. • Annual soil sampling and inspection will be required. • Opinion of probable present worth costs for sampling/inspection is estimated to be $193,600.	• Implementation cost lower than SCA-3 and SCA-4. • Opinion of probable present worth costs is estimated to be $5,728,800.	• High implementation cost. • Opinion of probable present worth costs is estimated to be $7,959,800.	• High implementation cost. • Opinion of probable present worth costs is estimated to be $8,314,019. • Cost is higher than SCA-3 due to elevated disposal fees for the homogenized material.
Community Acceptance	• Currently unknown.	• Currently unknown.	• Currently unknown.	• Currently unknown.

Table 2-5. Opinion of Probable Costs for SCA-1: No Action, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Cost[a]
Annual Review Costs		
Collection of 10 groundwater samples, analysis and reporting		$13,000
Contingency (20%)		$2,600
Subtotal		**$15,600**
TOTAL PRESENT WORTH COSTS b		**$193,600**

NOTES:

a Costs rounded to nearest $100.

b Present-worth costs were estimated using a 7% discount factor for a project life of 30 years.

Table 2-6. Opinion of Probable Costs for SCA-2: In-Situ Volatization and Solidification of Primary and Secondary Sources, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Qty	Unit	$/Unit	Cost[a]
Pre-excavation sampling of overburden (labor and analytical)	b	1	ls	$15,000	$15,000
Site Preparation/Mob	c	1	ls	$250,000	$250,000
Bench-Scale Test	d	1	ls	$100,000	$100,000
Pilot Scale Test	e	1	ls	$187,500	$187,500
Excavate and stockpile top 4' of soil	f	1940	CY	$11	$21,900
Full-Scale In-Situ Volatization	g	4365	CY	$375	$1,636,900
Full-Scale In-Situ Stabilization	h	4365	CY	$344	$1,500,500
Replace, grade, compact 4' of soil	i	1940	CY	$11	$21,900
Vapor Treatment Material cost &Disposal	j	1	ls	$312,500	$312,500
Water Treatment/Disposal	k	2000	gal	$3.13	$6,300
Health and Safety Equipment	l	1	ls	$187,500	$187,500
Miscellaneous Equipment Rental and contractor's ODCs	m	1	ls	$125,000	$125,000
Post-Remedation Sampling (labor and analytical)	n	1	ls	$30,000	$30,000
Construction Completion Report	o	1	ls	$30,000	$30,000
Subtotal					**$4,425,000**
Engineering/Oversight (30% excluding contractor cost)					$349,000
Contingency (20% of contractor and oversight costs)					$954,800
TOTAL PRESENT WORTH COSTS	p				**$5,728,800**

NOTES:

a Costs rounded to nearest $100.

b Assumes 2 days of geoprobe to collect samples at 2 depths from 30 points, including labor, equipment, analytical, and data analysis

c Assumes removal of 225 LF of 8' chain link fence, erection of 350 LF security fencing, building excavation equipment decon pad, exclusion

d Bench test to determine stabilization agents, assumes 5 mixes at 4 ratios for 20 tests

e Field pilot test to finalize design of vapor and stabilization. Assume large portable steam generator (5mm btu) as steam source

f Assume treatment area as showm on Figure 3-1 is 13,095 square feet, excavate top 4' and stockpile on site as below SRGs for future use as

g Assume treatment of 9 feet of soil over an area of 13,095 feet. Assume large portable steam generator (5mm btu) as steam source. Assume steam distribution through auger flight (hollow stem). Assume 20,000 scfm blower for vapor recovery ducted inside large shroud w/halon

h Assume treatment of 9 feet of soil over an area of 13,095 feet using 12 foot diameter augers with bulked materials remaining on site. Assume portland type I @ 20% admixture by volume recipe.

i Assume cover using stockpiled soils, grade to promote drainage

j Vapor collection/treatment including labor, equipment, utilities. Assumes 80,000lbs of vapor phase carbon for air.

k Assumes 80,000lbs carbon for water. Collection and T&D of condensed vapor liquid including characterization.assume industrial treatment

l Air monitoring (real time and off site quanataive and qualitative results set up w/ an inner and outer perimeter point to trigger action limits w/o expos. to public areas.) and all other H&S including prep of contractor's HASP

m Includes contractors project management and ODCs. Assume 750 kw portable generator w/backup and auto switch system.

n Assumes collection of one 5-point composite sample per 25 LF of sidewall half need to be sampled twice = 15 samples for VOCs, including

o Assumes tabulation of all sample data, photos, as-built, manifests, materials and methods (draft and final)

p Present-worth costs were estimated using a 7% discount factor.

Table 2-7. Opinion of Probable Costs for SCA-3: Excavation of Primary and Secondary Sources, Off-Site Treatment, and Off-Site Disposal, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Qty	Unit	$/Unit	Cost[a]
Pre-excavation sampling of overburden (labor and analytical)	b	1	ls	$15,000	$15,000
Site Preparation/Mob	c	1	ls	$125,000	$125,000
Dewatering (Collection and Disposal)	d	490000	gal	$1.25	$612,500
Excavation of 4' of overburden, stockpile on site (including prep/breakdown of stockpile area)	e	1940	CY	$11	$21,900
Excavation and characterization of material within pits taking care to keep all materials intact	f	533	CY	$375	$199,900
Excavation and characterization of soils between and beneath pits to water table	g	3832	CY	$50	$191,600
Segregate and overpack materials (non-shock sensitive)	h	7200	bottles	$38	$270,000
Segregate and overpack shock sensitive materials	i	1800	bottles	$75	$135,000
Backfill and compact with soils from overburden stockpile (Material, Equipment and Labor)	j	1940	CY	$9	$17,000
Backfill and compact with imported structural fill (Material, Equipment and Labor)	k	4365	CY	$23	$98,300
Sheet Piling/Removal	l	3375	SF	$3.75	$12,700
Confirmatory sampling of sidewalls of excavation	m	15	ea	$300	$4,500
Site restoration (grade, vegetate)		1	ls	$18,750	$18,800
Miscellaneaous Equipment Rental	n	1	ls	$12,500	$12,500
Health and Safety	o	1	ls	$62,500	$62,500
Survey excavation limits and confirmatory sample grid	p	1	ls	$5,000	$5,000
Construction completion reporting	q	1	ls	$75,000	$75,000
Trans./Treat./Disposal of Segregated Overpacked Like Source Material (non shock sensitive)	r	213	CY	$1,125	$239,900
Trans./Treat./Disposal of Segregated Overpacked Like Source Material (shock sensitive)	s	53	CY	$5,625	$299,900
Trans./Treat./Disposal of Bulked Unlike Source Material	t	267	CY	$1,125	$299,900
Trans./Treat./Disposal of Impacted Soils (Hazardous)	u	3832	CY	$875	$3,353,000
Subtotal					**$6,069,900**
Engineering/Oversight (30% excluding T&D cost)					$563,000
Contingency (20%)					$1,327,000
TOTAL PRESENT WORTH COSTS	w				**$7,959,900**

NOTES:

a Costs rounded to nearest $100.

b Assumes 2 days of geoprobe to collect samples at 2 depths from 30 points, including labor, equipment, analytical, and data analysis

c Assumes removal of 225 LF of 8' chain link fence, erection of 350 LF security fencing, building excavation equipment decon pad, exclusion

d Assumes 5 feet of water collect in excavation (13095 SF); assumes non-hazardous, including analytical

e Assume treatment area as showm on Figure 3-1 is 13,095 square feet, excavate top 4' and stockpile on site as below SRGs for future use as

f Level B, assume 18 pits with average dimensions 10 x 20 x 4 feet deep containing 500 bottles each of which 100 bottles are shock sensitive, to be segregated by like-materials.

g Level B, assumes balance of volume to depth of 13 feet, no bottles, but impacted and assumed hazardous soil to be disposed off-site including characterization.

h Assumes 400 bottles from each of 18 pits are not shock sensitive

i Assumes 100 bottles from each of 18 pits are shock sensitive

j Assumes soils below SRGs will go back into excavation

k Assumes clean structural fill including analytical to demonstrate source fill is below SRGs

l Assumes sheetpile installed around perimiter of impacted soils (225 LF) to a depth of 15 feet

m Assumes collection of one 5-point composite sample per 25 LF of sidewall half need to be sampled twice = 15 samples for VOCs, including

n Assumes grade to promote positive drainage, revegetate by hydroseeding to prevent erosion

o Air monitoring (real time and off site quantitative and qualitative results set up w/ an inner and outer perimeter point to trigger action limits

p Survey limits of excavation and stake and survey confirmatory sample grid

q Assumes tabulation of all sample data, photos, as-built, manifests, materials and methods (draft and final)

r Assumes half of excavated materials from pits can be sorted by like materials and overpacked for disposal and 80% is non-shock sensitive.

s Assumes half of excavated materials from pits can be sorted by like materials and overpacked for disposal and 20% is shock sensitive. Shock sensitive material assumes total consumption during detonation w/o further residue management.

t Assumes half of excavated materials from pits cannot be sorted and is bulked for disposal and must go subtitle c incineration. Depending on wastestreams, ash from incineration process may require special handling and disposal at additional cost.

u Assumes all excavated soils from between and beneath the pits is hazardous and sub c landfill w/minimal treatment. Dioxins, if present, will require additional disposal in Canada.

v Present-worth costs were estimated using a 7% discount factor.

Table 2-8. Opinion of Probable Costs for SCA-4: Excavation of Primary and Secondary Sources, Ex-Situ Homogenizing, Stabilization, and Off-Site Disposal

Items/Description	Notes	Qty	Unit	$/Unit	Cost[a]
Pre-excavation sampling of overburden (labor and analytical)	b	1	ls	$15,000	$15,000
Site Preparation/Mob	c	1	ls	$25,000	$25,000
Dewatering (Collection and Disposal)	d	392000	gal	$1.50	$588,000
Excavation of 4' of overburden, stockpile on site (including prep/breakdown of stockpile area)	e	1940	CY	$11	$21,825
Excavation, homogenizing, and stabilization of materials and soils within pits as one waste stream	f	4365	CY	$219	$954,844
Collect and drum liquid waste from roll-offs	g	90	drums	$156	$14,100
Backfill and compact with soils from overburden stockpile (Material, Equipment and Labor)	h	1940	CY	$11	$21,825
Backfill and compact with imported structural fill (Material, Equipment and Labor)	i	4365	CY	$23	$98,300
Sheet Piling/Removal	j	3400	SF	$15	$51,000
Confirmatory sampling of sidewalls of excavation	k	15	ea	$300	$4,500
Site restoration (grade, vegetate)	l	1	ls	$18,750	$18,750
Miscellaneaous Equipment Rental		1	ls	$25,000	$25,000
Health and Safety	m	1	ls	$93,750	$93,750
Survey excavation limits and confirmatory sample grid	n	1	ls	$5,000	$5,000
Construction completion reporting	o	1	ls	$75,000	$75,000
Transportation/Treatment/Disposal of Homogenized Source Material	p	4365	CY	$975	$4,255,875
Transportation/Treatment/Disposal of Liquids (Hazardous)	p	90	drums	$625	$56,250
Subtotal					**$6,324,019**
Engineering/Oversight (30% excluding T&D cost)					$604,000
Contingency (20%)					$1,386,000
TOTAL PRESENT WORTH COSTS	q				**$8,314,019**

NOTES:

a Costs rounded to nearest $100.

b Assumes 2 days of geoprobe to collect samples at 2 depths from 30 points, including labor, equipment, analytical, and data analysis

c Assumes removal of 225 LF of 8' chain link fence, erection of 350 LF security fencing, building excavation equipment decon pad, exclusion and decon zones, erosion control.

d Assumes 5 feet of water collect in excavation (13095 SF); assumes non-hazardous, including analytical

e Assume treatment area as showm on Figure 3-1 is 13,095 square feet, excavate top 4' and stockpile on site as below SRGs for future use as

f Level B, assume 18 pits with average dimensions 10 x 20 x 4 feet deep containing 500 bottles each of which 100 bottles are shock sensitive, to be segregated by like-materials. Assumes use of a small drum shredder w/halon system. Includes characterization.

g Assume 400 out of 500 5-liter bottles are intact per each of 18 pits and 50% of the liquid settles to bottom of roll-offs

h Assumes soils below SRGs will go back into excavation

i Assumes clean structural fill including analytical to demonstrate source fill is below SRGs

j Assumes sheetpile installed around perimiter of impacted soils (225 LF) to a depth of 15 feet. Assumes HDPE style piling, vibratory hammer,

k Assumes collection of one 5-point composite sample per 25 LF of sidewall half need to be sampled twice = 15 samples for VOCs, including labor and analytical

l Assumes grade to promote positive drainage, revegetate by hydroseeding to prevent erosion

m Air monitoring (real time and off site quantitative and qualitative results set up w/ an inner and outer perimeter point to trigger action limits

n Survey limits of excavation and stake and survey confirmatory sample grid

o Assumes tabulation of all sample data, photos, as-built, manifests, materials and methods (draft and final)

p Assumes treatment at disposal facility, tranpsortation not greater than 600 miles, disposal

q Present-worth costs were estimated using a 7% discount factor.

Table 2-9. Evaluation of Groundwater Remediation Alternatives, The University of North Carolina, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Criteria	**Groundwater Alternative 1 (GWA-l)**	**Groundwater Alternative 2 (GWA-2)**	**Groundwater Alternative 3 (GWA-3)**	**Groundwater Alternative 4 (GWA-4)**
Description	• No Action (no active remediation)	• Vacuum-Enhanced Recovery (VER) of Shallow Groundwater (Hot-Spot), and Conventional Recovery of Downgradient Shallow and Bedrock Groundwater, Treatment, and Disposal. • Conventional recovery of downgradient shallow and bedrock groundwater to contain the plume near the creek. • Air Stripping and carbon polishing are selected groundwater treatment components, as needed. • Disposal of treated water to Crow Branch Creek or POTW.	• Funnel and gate for Shallow Hot Spot Groundwater Remediation, and Conventional Recovery of Bedrock Groundwater, Treatment, and Disposal. • Funnel-&-gate using air sparge curtain and vapor extraction. • Conventional recovery of bedrock groundwater for plume containment near the creek. • Air Stripping and carbon polishing for groundwater treatment, as needed. • Disposal of treated water to Crow Branch Creek or POTW.	• In-situ Chemical Treatment of Shallow and Bedrock Hot Spot Groundwater, Conventional Recovery of Bedrock Groundwater, Treatment, and Disposal. • Chemical oxidation using hydrogen peroxide or other appropriate oxidizer. • Plume containment in the bedrock near the creek using conventional recovery wells. • Air stripping and carbon polishing for treatment of recovered groundwater, as needed. • Disposal of treated water to Crow Branch Creek or POTW.
Protection of Human Health and the Environment	• Not protective of human health or the environment. • Will not meet the Remedial Action Objectives (RAOs). • No reduction of risks is expected.	• Protective of human health and the environment. • Expected to meet RAOs. • Proper implementation will contain and remediate groundwater. • Will reduce further migration of the contaminant plume and potential threat/risk to the environment (example: Crow Branch Creek).	• Protective of human health and the environment. • Expected to meet RAOs. • Proper implementation will contain and remediate groundwater. • Will reduce further migration of the contaminant plume and potential threat/risk to the environment (example: Crow Branch Creek).	• Protective of human health and the environment. • Expected to meet RAOs. • Proper implementation will contain and remediate groundwater. • Will reduce further migration of the contaminant plume and potential threat/risk to the environment (example: Crow Branch Creek).

Table 2-9. Evaluation of Groundwater Remediation Alternatives, The University of North Carolina, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Criteria	Groundwater Alternative 1 (GWA-l)	Groundwater Alternative 2 (GWA-2)	Groundwater Alternative 3 (GWA-3)	Groundwater Alternative 4 (GWA-4)
Compliance with Appropriate Laws and Regulations	• Violates North Carolina Groundwater Standards (NCGWS). • Will not meet Inactive Hazardous Sites Program requirements. • Will not meet groundwater Remediation Goals (RGs) listed in Table 2-2.	• Expected to remediate to NCGWS. • Disposal of treated groundwater may require NPDES or approval from POTW. • Air emissions should meet requirements of NCAC Title l5A, Chapter 2D and 2H. • Air emissions from the groundwater recovery and treatment process may not require a control device (generally accepted practice by NC Division of Air Quality [DAQ]); therefore, an air permit is not required. • Requires a recovery well construction permit. • Need to meet groundwater RGs (Table 2-2).	• Expected to remediate to NCGWS. • Disposal of treated groundwater may require NPDES permit or approval from POTW. • Air emissions should meet requirements of NCAC Title 15A, Chapter 2D and 2H. • Air emissions from the groundwater recovery and treatment process may not require a control device (generally accepted practice by NC Division of Air Quality [DAQ]); therefore, an air permit is not required. • Requires a recovery well construction permit. • Need to meet groundwater RGs (Table 2-2).	• Expected to remediate to NCGWS. • Disposal of treated groundwater may require NPDES permit or approval from POTW. • Air emissions should meet requirements of NCAC Title 15A, Chapter 2D and 2H. • Air emissions from the groundwater recovery and treatment process may not require a control device (generally accepted practice by NC Division of Air Quality [DAQ]); therefore, an air permit is not required. • Requires an injection well permit to inject chemical oxidation chemicals into the ground as required by NCAC Title 15A, Chapter 2C. • Requires a recovery well construction permit. • Need to meet groundwater RGs (Table 2-2).

Table 2-9. Evaluation of Groundwater Remediation Alternatives, The University of North Carolina, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Criteria	Groundwater Alternative 1 (GWA-l)	Groundwater Alternative 2 (GWA-2)	Groundwater Alternative 3 (GWA-3)	Groundwater Alternative 4 (GWA-4)
Long-Term Effectiveness and Permanence	• No action alternative will not reduce risks and has potential to impact the environment (surface water). • Limited natural attenuation will assist in reducing contaminant concentrations.	• Expected to reduce long- term risk and potential threats. • Expected to meet RAOs. • Potential for air emissions from the remediation system can be reduced by using a suitable control device. • Shallow hot-spot remediation (VER system) is expected to significantly reduce groundwater contamination due to accelerated mass recovery. • Pump-and-treat system will require long-term operation.	• Expected to reduce long- term risk and potential threats. • Expected to meet RAOs. • Potential for air emissions from the remediation system can be reduced by using a suitable control device. • Funnel and gate is a passive remediation system, and therefore, accelerated mass reductions cannot be expected. • Pump-and-treat system will require long-term operation.	• Expected to reduce long- term risk and potential threats. • Expected to meet RAOs. • Potential for air emissions from the remediation system can be reduced by using a suitable control device. • If the oxidation system can be effectively implemented, significant contaminant reduction can be achieved in a short period. • Expected to accelerate the mass removal of contaminants in both shallow and deep hot spots. • Pump-and-treat may require long-term operation.
Reduction of Toxicity, Mobility, and Volume	• Will not reduce toxicity, mobility, or volume of contaminated groundwater except for a portion, which may naturally attenuate. • Contaminant migration will continue to occur.	• Expected to significantly reduce toxicity, mobility, and volume due to active remediation. • Will reduce further downgradient migration	• Expected to significantly reduce toxicity, mobility, and volume due to active remediation. • Will reduce further downgradient migration	• Expected to significantly reduce toxicity, mobility, and volume due to active remediation. • Will reduce further downgradient migration. • Based on the effectiveness of in-situ oxidation process, project life can be significantly reduced.

Table 2-9. Evaluation of Groundwater Remediation Alternatives, The University of North Carolina, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Criteria	Groundwater Alternative 1 (GWA-l)	Groundwater Alternative 2 (GWA-2)	Groundwater Alternative 3 (GWA-3)	Groundwater Alternative 4 (GWA-4)
Short-Term Effectiveness	• Since no action alternative will not involve construction, no impact during its implementation.	• Impact during construction is expected to be negligible with proper personnel protection (standard construction technique will be used). • No impact to community or environment is anticipated.	• Impact during construction is expected to be negligible with proper personnel protection (standard construction technique will be used). • High potential for workers exposure to soil vapors during construction of a funnel and gate system and may require shoring/dewatering. • No impact to community or environment is anticipated.	• Impact during construction is expected to be negligible with proper personnel protection (standard construction technique will be used). • In-situ chemical oxidation process, if not properly designed, can cause reactions which will be uncontrollable and may impact on-site workers. • No impact to community is anticipated.
Implementation	• No construction is involved.	• The pump-and-treat system construction involves use of traditional well drilling and construction techniques. • Easy to implement. • An aquifer test and VER test have already been conducted at the site which indicated pumping is a viable alternative.	• The pump-and-treat system construction involves use of the traditional well drilling and construction techniques. • Funnel and gate system (a sheet pile wall and a permeable gate) requires trenching, shoring, and sheet piling. • An aquifer test has already been conducted at the site which indicates pumping of bedrock aquifer is a viable alternative.	• The pump-and-treat system construction involves use of traditional well drilling and construction techniques. • In-situ oxidation achieved using chemical oxidation. • Chemical oxidation technology can be implemented in a short time frame. However, the recovery and treatment system requires a long-term operation and maintenance. • Requires a pilot test for evaluating the effectiveness of the oxidation process. • An aquifer test has already been conducted at the site which indicates pumping of bedrock aquifer is a viable alternative.

Table 2-9. Evaluation of Groundwater Remediation Alternatives, The University of North Carolina, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Criteria	Groundwater Alternative 1 (GWA-l)	Groundwater Alternative 2 (GWA-2)	Groundwater Alternative 3 (GWA-3)	Groundwater Alternative 4 (GWA-4)
Costs	• No capital costs. • Annual groundwater sampling may be required. Opinion of probable present worth costs for sampling/ inspection is estimated to be $193,600.	• High capital costs. • Assumed project life of 30 years. • Opinion of probable present worth costs for sampling/inspection is estimated to be $2,176,800.	• High capital costs. • Low O&M for funnel and gate system. • Assumed project life of 30 years. • Opinion of probable present worth costs for sampling/inspection is estimated to be $3526,200.	• High capital costs for in-situ oxidation and pump-and- treat system. • No O&M associated with chemical oxidation process. • High potential for reduced project life due to mass contaminant removal by oxidation process. • Assumed groundwater recovery project life of 10 years. • Opinion of probable present worth costs for sampling/inspection is estimated to be $3,061,100.
Community Acceptance	• Currently unknown.	• Currently unknown.	• Currently unknown.	• Currently unknown.

Table 2-10. Opinion of Probable Costs for GWA-1: No Action, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Cost[a]
Annual Review Costs		
Collection of 10 groundwater samples, analysis and reporting		$13,000
Contingency (20%)		$2,600
Subtotal		**$15,600**
TOTAL PRESENT WORTH COSTS b		**$193,600**

NOTES:

a Costs rounded to nearest $100.

b Present-worth costs were estimated using a 7% discount factor for a project life of 30 years.

Table 2-11. Opinion of Probable Costs for GWA-2: Groundwater Recovery, Air Stripping, and Disposal to OWASA Sanitary Sewer, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Cost[a]
Capital Costs		
Permitting	b	$5,000
Recovery Wells Installation (3 deep wells to 85 feet and 7 shallow wells to 25 feet)	c	$191,000
Remedial System Construction (Treatment System, Piping, Electrical, etc. procure and install)	d	$370,000
Subtotal		**$566,000**
Engineering/Oversight (20%)		$113,200
Contingency (20%)		$113,200
Total Capital Costs		**$792,400**
Operation, Maintenance, and Monitoring (OMM) Costs		
First Year Costs (Shallow and Bedrock Operation, Maintenance and Quarterly Monitoring)		
Analytical (Monthly discharge, quarterly all wells for VOCs)	e	$24,600
Utilities	f	$44,300
Labor (Weekly first 2 months then Monthly Maintenance, Quarterly Sampling, Monitoring)	g	$44,800
Equipment and Field Expenses	h	$6,000
Reporting	i	$32,000
Repairs	j	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$29,200
Subtotal Year 1 Annual Costs		**$185,900**
Present-Worth of OMM Costs (Yr. 1)	k	**$173,800**
Year 2 and 3 Costs (Shallow and Bedrock Operation, Maintenance, and Semi-Annual Monitoring)		
Analytical (Monthly discharge, semi-annual all wells for VOCs)	l	$13,200
Utilities	f	$44,300
Labor (Monthly Maintenance, Semi-Annual Sampling, Monitoring)	m	$24,800
Equipment and Field Expenses	h	$3,000
Reporting	i	$16,000
Repairs	j	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$19,700
Subtotal Year 2 and 3 Annual Costs		**$126,000**
Present-Worth of OMM Costs (Yr. 2-3)	k	**$213,000**
Year 4-10 Costs (Shallow and Bedrock Operation, Maintenance, and Annual Monitoring)		
Analytical (Monthly discharge, annual all wells for VOCs)	n	$7,500
Utilities	f	$44,300
Labor (Monthly Maintenance, Annual Sampling, Monitoring)	o	$17,200
Equipment and Field Expenses	h	$3,000
Reporting	i	$16,000
Repairs	j	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$17,000
Subtotal Year 4-10 Annual Costs		**$110,000**
Present-Worth of OMM Costs (Yr. 4-10)	k	**$484,000**

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Table 2-11. Opinion of Probable Costs for GWA-2: Groundwater Recovery, Air Stripping, and Disposal to OWASA Sanitary Sewer, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Cost[a]
Year 11-30 Costs (Bedrock Operation, Maintenance, and Annual Monitoring)		
Analytical (Monthly discharge, annual all wells for VOCs)	n	$7,500
Utilities	p	$40,059
Labor (Monthly Maintenance, Annual Sampling, Monitoring)	o	$17,200
Equipment and Field Expenses	h	$3,000
Reporting	i	$8,000
Repairs	j	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$14,600
Subtotal Year 11-30 Annual Costs		**$95,359**
Present-Worth of OMM Costs (Yr. 11 - 30)	k	**$513,600**
TOTAL PRESENT WORTH CAPITAL AND OMM COSTS		**$2,176,800**

NOTES:

a Costs rounded to nearest $100.
b OWASA Discharge permitting
c Installation of 4 bedrock recovery wells, 4 shallow recovery wells, and 4 shallow VER wells
d Procurement and installation of system including all wellheads, piping, pumps, treatment system, building, etc.
e Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells quarterly
f Assumes system total discharge is 20.2 gpm, OWASA commodity discharge sewer-onl fee is $3.60/1000 gal plus electricity
g One day per month maintenance weekly for first two months then monthly plus 2 hours per point, 38 points quarterly
h Assumes $1500 per event for sampling equipment
i Assumes $8000 per report
j Annual repairs for system and well parts
k Present-worth costs were estimated using a 7% discount factor.
l Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells semi-annually
m One day per month maintenance plus 2 hours per point, 38 points semi-annually
n Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells annually
o One day per month maintenance weekly for first two months then monthly plus 2 hours per point, 38 points annually
p Assumes bedrock wells only, 18 gpm discharge, OWASA commodity discharge sewer-onl fee is $3.60/1000 gal plus electricity

Table 2-12. Opinion of Probable Costs for GWA-3: Funnel-and-Gate for Hot Spots Remediation, and Conventional Groundwater Recovery of Bedrock, Air Stripping, Carbon Polishing, and Disposal to Crow Branch Creek, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Cost[a]
Capital Costs		
Funnel and Gate System Construction	b	$644,600
Permitting	c	$5,000
Recovery Wells Installation (3 deep wells to 85 feet)	d	$105,000
Remedial System Construction (Treatment System, Piping, Electrical, etc. procure and install)	e	$180,100
Subtotal		$934,700
Engineering/Oversight (20%)		$186,900
Contingency (20%)		$186,900
Total Capital Costs		**$1,308,500**
Operation, Maintenance, and Monitoring (OMM) Costs		
First Year Costs (F&G and Bedrock Operation, Maintenance and Quarterly Monitoring)		
Analytical (Monthly discharge, quarterly all wells for VOCs)	f	$24,600
Liquid Phase Carbon Polishing System	g	$40,500
Utilities	h	$6,000
Labor (Weekly first 2 months then Monthly Maintenance, Quarterly Sampling, Monitoring)	i	$44,800
Equipment and Field Expenses	j	$6,000
Reporting	k	$32,000
Repairs	l	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$21,500
Subtotal Year 1 Annual Costs		**$180,400**
Present-Worth of OMM Costs (Yr. 1)	m	**$168,600**
Year 2 and 3 Costs (F&G and Bedrock Operation, Maintenance, and Semi-Annual Monitoring)		
Analytical (Monthly discharge, semi-annual all wells for VOCs)	n	$13,200
Liquid Phase Carbon Polishing System	g	$40,500
Utilities	h	$6,000
Labor (Monthly Maintenance, Semi-Annual Sampling, Monitoring)	o	$24,800
Equipment and Field Expenses	j	$3,000
Reporting	k	$16,000
Repairs	l	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$12,000
Subtotal Year 2 and 3 Annual Costs		**$120,500**
Present-Worth of OMM Costs (Yr. 2-3)	m	**$203,700**
Year 4-30 Costs (F&G and Bedrock Operation, Maintenance, and Annual Monitoring)		
Analytical (Monthly discharge, annual all wells for VOCs)	p	$7,500
Liquid Phase Carbon Polishing System	g	$40,500
Utilities	h	$6,000
Labor (Monthly Maintenance, Annual Sampling, Monitoring)	q	$17,200
Equipment and Field Expenses	j	$3,000
Reporting	k	$16,000
Repairs	l	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$93,400
Subtotal Year 4-30 Annual Costs		**$188,600**
Present-Worth of OMM Costs (Yr. 4-30)	m	**$1,845,400**
TOTAL PRESENT WORTH CAPITAL AND OMM COSTS		**$3,526,200**

(See Notes Next Page)

Table 2-12. Opinion of Probable Costs for GWA-3: Funnel-and-Gate for Hot Spots Remediation, and Conventional Groundwater Recovery of Bedrock, Air Stripping, Carbon Polishing, and Disposal to Crow Branch Creek, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

NOTES:

a	Costs rounded to nearest $100.
b	Assumes 900 feet of cutoff wall 25 feet deep and 100 feet of permeable barrier 25 feet deep.
c	NPDES Discharge permitting
d	Installation of 3 bedrock recovery wells
e	Procurement and installation of system including all wellheads, piping, pumps, treatment system, building, etc.
f	Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells quarterly
g	Assumes disposable 35 gpm carbon drums changed out every other month
h	Assumes bedrock wells only, 18 gpm discharge electricity at $500/month
i	One day per month maintenance weekly for first two months then monthly plus 2 hours per point, 38 points quarterly
j	Assumes $1500 per event for sampling equipment
k	Assumes $8000 per report
l	Annual repairs for system and well parts
m	Present-worth costs were estimated using a 7% discount factor.
n	Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells semi-annually
o	One day per month maintenance plus 2 hours per point, 38 points semi-annually
p	Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells annually
q	One day per month maintenance weekly for first two months then monthly plus 2 hours per point, 38 points annually

Table 2-13. Opinion of Probable Costs for GWA-4: In-Situ Chemical Treatment of Hot Spots, and Recovery Bedrock Groundwater Recovery, Air Stripping, Carbon Polishing, and Disposal to Crow Branch Creek, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Cost[a]
Capital Costs		
In-Situ Chemical Oxidation		
Workplan/Permitting		$20,000
Bench-Scale Test		$5,000
Pilot Test		$65,000
Full-Scale Design/Implementation		$723,000
Subtotal	b	$813,000
Groundwater Recovery/Treatment System		
Permitting	c	$5,000
Recovery Wells Installation (3 deep wells to 85 feet)	d	$105,000
Remedial System Construction (Treatment System, Piping, Electrical, etc. procure and install)	e	$180,100
Subtotal		$290,100
Engineering/Oversight (20%)		$220,600
Contingency (20%)		$220,600
Total Capital Costs		**$1,544,300**
Operation, Maintenance, and Monitoring (OMM) Costs		
First Year Costs (Bedrock Operation, Maintenance and Quarterly Monitoring)		
Analytical (Monthly discharge, quarterly all wells for VOCs)	f	$24,600
Liquid Phase Carbon Polishing System	g	$40,500
Utilities	h	$6,000
Labor (Weekly first 2 months then Monthly Maintenance, Quarterly Sampling, Monitoring)	i	$44,800
Equipment and Field Expenses	j	$6,000
Reporting	k	$32,000
Repairs	l	$5,000
Contingency (20%)		$31,800
Subtotal Year 1 Annual Costs		**$190,700**
Present-Worth of OMM Costs (Yr. 1)	m	**$178,300**
Year 2 and 3 Costs (Bedrock Operation, Maintenance, and Semi-Annual Monitoring)		
Analytical (Monthly discharge, semi-annual all wells for VOCs)	n	$13,200
Liquid Phase Carbon Polishing System	g	$40,500
Utilities	h	$6,000
Labor (Monthly Maintenance, Semi-Annual Sampling, Monitoring)	o	$24,800
Equipment and Field Expenses	j	$3,000
Reporting	k	$16,000
Repairs	l	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$21,700
Subtotal Year 2 and 3 Annual Costs		**$130,200**
Present-Worth of OMM Costs (Yr. 2-3)	m	**$220,100**

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Table 2-13. Opinion of Probable Costs for GWA-4: In-Situ Chemical Treatment of Hot Spots, and Recovery Bedrock Groundwater Recovery, Air Stripping, Carbon Polishing, and Disposal to Crow Branch Creek, The University of North Carolina at Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina.

Items/Description	Notes	Cost[a]
Year 4-30 Costs (Bedrock Operation, Maintenance, and Annual Monitoring)		
Analytical (Monthly discharge, annual all wells for VOCs)	p	$7,500
Liquid Phase Carbon Polishing System	g	$40,500
Utilities	h	$6,000
Labor (Monthly Maintenance, Annual Sampling, Monitoring)	q	$17,200
Equipment and Field Expenses	j	$3,000
Reporting	k	$16,000
Repairs	l	$5,000
Contingency (20% of analytical, utilities, labor, & reporting)		$19,100
Subtotal Year 4-30 Annual Costs		**$114,300**
Present-Worth of OMM Costs (Yr. 4-30)	m	**$1,118,400**
TOTAL PRESENT WORTH CAPITAL AND OMM COSTS		**$3,061,100**

NOTES:

a Costs rounded to nearest $100.
b Assumes 20 wells, 5,000 lb peroxide per well per month for 6 months
c NPDES Discharge permitting
d Installation of 3 bedrock recovery wells
e Procurement and installation of system including all wellheads, piping, pumps, treatment system, building, etc.
f Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells quarterly
g Assumes disposable 35 gpm carbon drums changed out every other month
h Assumes bedrock wells only, 18 gpm discharge electricity at $500/month
i One day per month maintenance weekly for first two months then monthly plus 2 hours per point, 38 points quarterly
j Assumes $1500 per event for sampling equipment
k Assumes $8000 per report
l Annual repairs for system and well parts
m Present-worth costs were estimated using a 7% discount factor.
n Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells semi-annually
o One day per month maintenance plus 2 hours per point, 38 points semi-annually
p Assumes VOCs only for discharge on a monthly basis and 11 shallow, 6 surface water, and 21 bedrock wells annually
q One day per month maintenance weekly for first two months then monthly plus 2 hours per point, 38 points annually