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Table 1. Regional and Site Pumping, RACER Trust, Moraine, Ohio.

Well ID	2011 Pumping Rate	
	gpm	MGD
POINT WEST	1.41E+00	2.03E-03
APPLETON PAPERS	4.88E+03	7.03E+00
WEST CARROLLTON CITY PWS	6.75E+02	9.72E-01
MORAINE COUNTRY CLUB	2.30E+01	3.31E-02
NCR COUNTRY CLUB	6.83E+01	9.84E-02
BARRETT PAVING-WEST CARROLLTON PLANT	3.60E+02	5.18E-01
MILLER-VALENTINE GROUP	1.23E+03	1.78E+00
MONTGOMERY COUNTY-WESTERN REG WW PLANT	3.19E+01	4.60E-02
DPL ENERGY-TAIT ELECTRIC GENERATING STATION	3.25E+00	4.68E-03
MOTORS LIQUIDATION CO-MORAINE (TW-2)	9.46E+01	1.36E-01
DN-13	5.93E+02	8.54E-01

The pumping rates are reported to Ohio Department of Natural Resources (ODNR) for the 2011 time period.
The rate for DN-13 is an estimate based on flow rates measured in 2011.
gpm - Gallons per minute.
MGD - Millions of gallons per day.

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Table 2. Monitoring Well Construction Details, RACER Trust, Moraine, Ohio.

	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
Well	ft. msl	ft. msl	inches	ft. bls	ft. bls	ft. msl	ft. msl	ft. bls	Northing, y	Easting, x	Modifiers
Upper Aquifer Wells											
W-1-N	737.61	739.02	4	35	70	703	668	70	625116.2043	1483946.9943	UA:TT
W-2-N	729.68	731.68	4	35	60	695	670	60	623865.9104	1483351.6742	UA
W-3-N	731.98	733.66	4	32	57	700	675	57	623695.8796	1483607.3111	UA
W-4-N	729.88	731.63	4	40	65	690	665	65	623651.9134	1483795.0108	UA:TT
HR-1	730.10	732.71	2	47	57	683	673	57	621967.7490	1483378.1275	UA:TT
HR-2	732.62	734.75	2	47	57	686	676	58	623649.3090	1484030.9226	UA:TT
HR-3	734.31	736.75	2	50	60	684	674	61	623612.1403	1484238.0984	UA:TT
HR-4	740.61	742.60	2	55	65	686	676	67	624582.0074	1484003.5860	UA:TT
HR-5	730.95	734.27	2	44	54	687	677	59	623354.8172	1483478.6541	UA:TT
HR-6	730.18	732.66	2	43	53	687	677	59	622588.6622	1483298.8965	UA:TT
HR-7	731.00	731.73	2	47	57	684	674	58	623373.8266	1483168.5266	UA:TT
HR-8	740.84	743.42	2	54	64	687	677	76	625177.0505	1484566.7534	UA
HR-9	741.00	743.51	2	58	68	683	673	75	626071.2019	1484648.1158	UA
HR-11	740.90	743.33	2	60	70	681	671	75	625682.4858	1485262.9762	UA
HR-16	724.60	727.01	4	42	62	683	663	70	621167.6648	1482171.8435	UA:TT
HR-17	725.40	726.43	4	27	47	698	678	56	621128.4488	1482780.5158	UA:TT
W-1-S	728.23	729.29	4	25	60	703	668	60	621396.0291	1482990.4046	UA:TT
W-2-S	725.01	726.64	4	30	65	695	660	65	620618.7813	1482078.7622	UA:TT
W-3-S[1]	NM	729.17	4	36	76	691	651	76	620466.6686	1482207.4451	UA
W-4-S	726.66	727.92	4	30	70	697	657	70	620394.9579	1482564.2035	UA
GM-2[1]	NM	735.81	2	45	55	688	678	55	619586.2208	1483427.9998	UA
4S[1]	NM	731.36	4	30	65	699	664	65	619578.3226	1483129.6378	UA
GM-6[1]	NM	730.27	2	35	45	696	686	45	619627.6172	1482930.9571	UA:TT
GM-8	735.17	735.17	2	40	50	695	685	50	619866.4552	1482965.5535	UA:TT
GM-10[1]	NM	723.90	2	40	50	681	671	50	618762.6410	1482667.7306	UA:TT
GM-16[1]	NM	725.30	2	48	58	678	668	58	619420.5576	1482149.1466	UA
GM-17[1]	NM	723.84	2	40	50	684	674	50	619311.8761	1482697.0210	UA:TT
GM-18[1]	NM	723.80	2	45	55	679	669	55	619229.5883	1482505.4542	UA
GM-19S[1]	NM	730.92	2	47	57	691	681	57	620339.5683	1483017.2551	UA:TT
GM-21	725.36	725.00	2	45	55	680	670	55	619920.5937	1483764.5951	UA:TT
GM-22	731.84	731.63	2	44	54	688	678	54	620840.4209	1484226.5683	UA:TT
GM-23[1]	NM	731.07	2	24	34	674	664	34	623699.2336	1484619.9213	UA:TUT
GM-24	747.61	747.29	2	58	68	690	680	70	625945.0802	1486991.6971	UA
GM-25	747.05	746.17	2	48	58	699	689	58	622786.2705	1486599.6865	UA:TT

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Table 2. Monitoring Well Construction Details, RACER Trust, Moraine, Ohio.

	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
Well	ft. msl	ft. msl	inches	ft. bls	ft. bls	ft. msl	ft. msl	ft. bls	Northing, y	Easting, x	Modifiers
Upper Aquifer Wells											
GM-26	722.29	722.29	2	50	60	672	662	60	617729.9788	1482129.0695	UA
GM-27	731.03	730.57	2	40	50	691	681	58	623696.6136	1484630.7659	UA:TT
GM-28(1)(2)	NM	736.46	2	22	32	715	705	32	623392.3799	1484436.8617	UA:TUT
GM-29	731.31	731.37	2	28	38	703	693	38	623534.4471	1484535.0727	UA:TUT
GM-30(1)(3)	NM	734.79	2	28	38	707	697	38	623876.3465	1484609.5933	UA:TUT
GM-31(3)	732.05	732.13	2	51	61	681	671	62	621336.9337	1483965.1322	UA:TT
GM-32	732.47	732.08	2	51	61	681	671	61	620114.2493	1483379.9656	UA:TT
GM-33	730.30	729.77	2	48	58	682	672	58	620761.9955	1483714.2282	UA:TT
GM-34	731.06	730.56	2	26	36	705	695	36	620753.8480	1483727.5719	UA:WT
GM-35	731.56	731.27	2	57	67	675	665	70	620389.3810	1483279.5201	UA:TT
GM-36	731.44	731.11	2	25	35	706	696	35	620383.2312	1483300.8386	UA:WT
GM-37	730.36	730.05	2	46	56	684	674	56	620407.3595	1483456.0282	UA:TT
GM-38	730.31	729.88	2	24	34	706	696	34	620403.1387	1483471.6479	UA:WT
GM-43	729.41	729.00	2	40	50	689	679	54	622192.2046	1483441.3723	UA:TT
GM-44	729.30	728.77	2	51	61	678	668	62	621686.3425	1483331.5124	UA:TT
GM-45	730.03	729.75	2	50	60	680	670	60	621409.1769	1483266.9285	UA:TT
GM-46	728.13	727.79	2	19.8	29.8	708	698	29.8	623393.7601	1484777.0271	UA:TUT
GM-47	727.03	726.75	2	49.4	59.4	678	668	59.4	620060.6143	1482479.3608	UA:TT
GM-48	728.98	728.67	2	63.2	73.2	666	656	73.2	619488.4287	1481740.8154	UA:TT
GM-49	728.28	727.88	2	66.9	76.9	661	651	76.9	618643.7266	1481742.8231	UA:TT
GM-50	727.03	726.56	2	29.7	39.7	697	687	39.7	620065.0482	1482445.8840	UA:WT
GM-51	728.82	728.30	2	34.3	44.3	695	685	44.3	619465.2399	1481753.1472	UA:WT
GM-52	728.16	727.62	2	34	44	694	684	44	618604.5296	1481740.7235	UA:WT
GM-53	730.53	730.35	2	23	33	708	698	33	621184.8324	1484855.6876	UA:TT
GM-55	719.90	719.86	2	25	35	695	685	35	618008.2839	1482441.5719	UA:WT
GM-57(4)	719.41	721.74	2	25	35	694	684	35	617724.0851	1482132.1351	UA:WT
GM-59	732.46	732.25	2	25	35	707	697	35	622761.5281	1484712.7729	UA:WT
GM-60	732.46	732.24	2	42	52	690	680	52	622761.3002	1484712.7809	UA:TT
GM-62(5)	722.17	722.11	2	50	60	672	662	60	618397.3774	1482818.1330	UA
GM-63	726.21	725.79	2	30	40	696	686	40	620283.7218	1482686.3290	UA:WT
GM-64	726.38	725.95	2	50	60	676	666	60	620284.6106	1482681.2885	UA:TT
GM-65S	723.94	723.58	2	42	52	682	672	52	617392.2259	1481382.4271	UA
GM-66	733.50	733.22	2	45	55	688	678	57	622780.3860	1484091.5572	UA:TT
GM-67S	732.54	732.06	2	44	54	689	679	54	623050.0533	1484547.2174	UA:TT
GM-68S	732.48	732.18	2	39.5	49.5	693	683	49.5	622326.2125	1484652.8528	UA:TT
GM-71	737.19	736.82	2	21	31	716	706	37	622633.7567	1485222.9070	UA:TUT

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Table 2. Monitoring Well Construction Details, RACER Trust, Moraine, Ohio.

Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
	ft. msl	ft. msl	inches	ft. bls	ft. bls	ft. msl	ft. msl	ft. bls	Northing, y	Easting, x	Modifiers
Upper Aquifer Wells											
GM-72	737.05	736.78	2	52	62	685	675	67	622633.7567	1485233.9320	UA:TT
GM-74S	732.52	732.17	2	40	50	693	683	50	622444.5430	1484733.8601	UA:TT
GM-75S	738.26	737.69	2	42	52	696	686	52	622790.6745	1485039.3503	UA:TT
GM-76S	739.49	739.00	2	27	37	712	702	37	623538.7809	1485313.4176	UA:TT
GM-77S	741.49	741.14	2	33	43	708	698	43	621576.9342	1485892.0315	UA:TT
GM-78	721.58	721.18	2	40	50	682	672	70	618257.5787	1483035.5947	UA
GM-79	718.54	717.91	2	45	55	674	664	60	618970.9862	1481045.8893	UA:TT
GM-80	716.23	715.82	2	15	25	701	691	25	617951.2997	1480939.3277	UA:WT
GM-81	715.80	715.31	2	50	60	666	656	90	617934.8895	1480934.7439	UA
GM-83S	726.44	725.84	2	44	54	682	672	54	622568.7465	1482112.9569	UA:TT
EAST	NM	730.98	2	NA	NA	NA	NA	71	620545.6947	1483674.2190	UA:TT
WEST	NM	731.08	2	NA	NA	NA	NA	52	620509.6228	1483299.0985	UA:TT
WSU-17	726.93	726.18	2	11.69	66.9	715.2	659.3	67	619558.2279	1482898.5384	UA:TT
WSU-18	734.18	733.52	2	29.2	69.2	705.0	664.3	69	619554.9290	1483096.6469	UA:TT
WSU-19	727.28	726.62	2	33.4	63.4	693.9	663.2	63	619736.8872	1482880.3995	UA:TT
WSU-22	726.21	726.49	2	NA	NA	NA	NA	52	620311.4363	1482687.2293	UA:TT
WSU-23	724.65	724.90	2	NA	NA	NA	NA	58	620381.0854	1481978.6336	UA:TT
WSU-24	725.10	724.82	2	NA	NA	NA	NA	66	619124.1425	1483169.1107	UA:TT
TW-2[(1)]	NM	733.38	10	35	45	696	686	45	619568.4036	1482942.6663	UA:TT
ME-2[(3)]	732.38	732.08	2	27	37	705	695	37	621327.2669	1484014.6258	UA:WT
ME-3[(3)]	732.23	731.73	2	29	39	703	693	39	621288.3532	1483969.5620	UA:WT
ME-4[(3)]	732.05	732.24	2	26	36	706	696	36	621321.4422	1483952.3693	UA:WT
ME-6[(3)]	733.09	732.68	2	29	39	704	694	39	621706.9517	1484057.0461	UA:WT
MW-1[(6)]	713.60	715.53	2	61.2	71.2	652	642	71.7	621420.6144	1480209.1127	UA:TT
MW-4[(6)]	707.45	707.19	2	19.6	39.6	688	668	40	619035.3250	1478050.0733	UA
MW-5[(6)]	709.59	709.34	2	22.5	42.5	687	667	43	618787.9839	1478971.6197	UA
MW-9[(6)]	713.16	712.85	2	63	73	650	640	73.5	617169.4849	1478747.1452	UA
GM-1	NM	735.74	2	90	100	NA	NA	100	619570.7118	1483421.8130	LA
GM-3	NM	730.44	2	90	100	NA	NA	100	619621.9727	1482926.3542	LA
GM-4	NM	731.46	2	140	150	NA	NA	150	619602.7099	1482922.7333	LA
GM-5	NM	731.29	2	90	100	NA	NA	100	619588.6213	1483126.6107	LA
GM-7R	NM	735.61	2	80	90	NA	NA	91	619863.8298	1482962.1340	LA
GM-9	NM	724.07	2	90	100	NA	NA	100	618771.8670	1482674.1902	LA
GM-11	NM	723.71	2	90	100	NA	NA	100	619318.6270	1482694.0524	LA

Table 2. Monitoring Well Construction Details, RACER Trust, Moraine, Ohio.

Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
	ft. msl	ft. msl	inches	ft. bls	ft. bls	ft. msl	ft. msl	ft. bls	Northing, y	Easting, x	Modifiers
Lower Aquifer Wells											
GM-13	NM	723.82	2	90	100	NA	NA	100	619239.1943	1482501.6168	LA
GM-14	NM	723.50	2	140	150	NA	NA	150	619244.0886	1482515.5184	LA
GM-15	NM	725.23	2	90	100	NA	NA	100	619427.7004	1482156.5128	LA
GM-19D	NM	730.73	4	145	150	NA	NA	150	620339.8625	1483063.5273	LA
GM-20D	NM	727.26	4	87	92	NA	NA	92	619177.7271	1483236.8889	LA
GM-39	731.15	730.95	2	106	116	625	615	116	623705.5364	1484609.0626	LA
GM-40	727.28	727.04	2	140	150	587	577	150	621693.8055	1483084.8121	LA
GM-41	731.22	733.65	2	104	114	627	617	114	621635.7801	1484818.4021	LA
GM-42	729.48	729.16	2	140	150	589	579	150	620810.1968	1483562.5296	LA
GM-54	730.51	730.29	2	70	80	661	651	80	621182.1891	1484848.6752	LA
GM-56	719.75	719.52	2	75	85	645	635	85	618006.1752	1482448.5647	LA:NTP
GM-58	735.59	735.46	2	72	82	664	654	82	621541.9882	1485308.7468	LA:BT
GM-61	732.48	732.23	2	70	80	662	652	80	622762.6947	1484707.4691	LA:BT
GM-65D	723.83	723.54	2	85	95	639	629	108	617389.5183	1481380.4746	LA:NTP
GM-67D	732.64	732.19	2	70	80	663	653	121	623053.5624	1484533.4779	LA:BT
GM-68D	732.46	732.27	2	64	74	668	658	150	622327.5383	1484645.8862	LA:BT
GM-69	732.42	732.08	2	90	100	642	632	140	621314.8199	1484401.6371	LA
GM-70	737.47	737.19	2	72	82	665	655	120	621944.0370	1485505.8829	LA
GM-73	737.34	736.97	2	85	95	652	642	120	622635.9765	1485216.5022	LA
GM-74D	732.49	732.04	2	69	79	663	653	120	622450.0123	1484735.6502	LA:BT
GM-75D	738.13	737.68	2	85	95	653	643	120	622793.2406	1485027.5873	LA
GM-76D	739.48	738.94	2	70	80	669	659	120	623535.2043	1485312.4245	LA:BT
GM-77D	741.52	740.93	2	75	85	667	657	100	621574.4283	1485889.3662	LA:BT
GM-82	732.55	732.14	2	85	95	648	638	119.5	621972.7146	1484304.7894	LA
GM-83D	726.41	725.77	2	110	120	616	606	120	622568.1953	1482120.4685	LA
GM-84	740.44	739.92	2	96.5	106.5	644	634	120	620619.4561	1485522.1487	LA:BT
RMW-85(7)	736.28	736.65	2	85	95	651	641	105	622914.0083	1484978.1674	LA
RMW-86(7)	728.85	729.22	2	70	80	659	649	105	620409.7071	1483253.2715	LA:BT
RMW-87(7)	727.69	728.01	2	67	77	661	651	100	621671.6198	1483277.4116	LA:BT
RMW-88(7)	738.57	739.11	2	90	100	649	639	100	625051.9881	1484580.6683	LA
HR-10	740.90	742.81	4	115	125	626	616	125	626078.4125	1484653.5358	LA:NTP

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Table 2. Monitoring Well Construction Details, RACER Trust, Moraine, Ohio.

Well	Surface Elevation	TOC Elevation	Well Diameter	Screened Interval				Borehole Depth	State Plane Coordinates		Geologic
	ft. msl	ft. msl	inches	ft. bls	ft. bls	ft. msl	ft. msl	ft. bls	Northing, y	Easting, x	Modifiers
Lower Aquifer Wells											
HR-12	741.00	742.64	4	120	130	621	611	130	625702.3993	1485250.0490	LA
HR-13	733.20	735.03	4	75	85	658	648	85	623616.8315	1484215.3411	LA:BT
HR-14	729.90	731.63	4	78	88	652	642	88	623675.4267	1483782.2839	LA
HR-15	732.10	733.74	4	88	98	644	634	98	623712.7941	1483595.9072	LA
M73C	NM	716.55	NA	NA	NA	NA	NA	NA	618973.2537	1482114.3309	LA
MT69(8)	719.84	722.71	8	NA	NA	NA	NA	158	617749.1907	1482121.3945	LA
MT576M	750.00	751.46	5	NA	NA	NA	NA	114	622940.2909	1487799.4686	LA
MT596M*	759.18	757.73	5	NA	NA	NA	NA	89	624057.1091	1488849.1418	LA
DN-13	724.09	727.54	20	110	170	614	554	170	619196.1959	1482267.5426	LA
11B	744.50	742.56	NA	NA	NA	NA	NA	158	622501.4801	1485799.6814	LA
12A	740.86	742.39	18	104	144	637	597	154	622804.0361	1485951.2100	LA
A	NM	739.00	20	155	205	NA	NA	205	624325.4108	1484805.7949	LA
31	NM	734.05	20	90	122	NA	NA	122	623727.4107	1485049.2752	LA
34	NM	733.46	20	107	140	NA	NA	140	622178.4664	1485017.7925	LA
39	NM	732.07	20	117	142	NA	NA	145	623442.4628	1484987.5777	LA
44	733.91	734.62	24	128	166	606	568	NA	624519.7322	1483988.8824	LA
FW-1A	NM	739.89	24	105	166	NA	NA	169	625357.5160	1486090.3366	LA
FW-2	NM	737.48	20	NA	150	NA	NA	160	622516.4369	1485616.6642	LA
FW-3	NM	739.26	20	NA	141	NA	NA	200	622675.0394	1484968.9430	LA
FW-4	NM	731.62	14	NA	136	NA	NA	160	620605.0473	1484338.1137	LA

TOC - Top of casing.
ft msl - Feet above mean sea level.
ft bls - Feet below land surface.
(1) - Elevations estimated.
(2) - Well flush mount damaged and obstructed at depth.
(3) - Depth of screened interval and total well depth have been modified from the well log due to Site construction.
(4) - Well above grade construction damaged in 2011.
(5) - Abandoned well to be replaced.
(6) - City of Moraine monitoring wells.
(7) - TOC elevation is calculated based on adjacent well elevations and field measurements on November 26, 2012.
(8) - Well unusable - collapsed screen.
* Measuring point is top of cement housing.
Site coordinates based on site-specific benchmarks.
State plane coordinates in NAD 83 Ohio South.

UA - Upper aquifer.
LA - Lower aquifer.
TT - Top of till (regional clay till).
TUT - Top of upper till (upper clay till).
BT - Below till (regional clay till).
NTP - No till present.
NA - Not available.
NM - Not measured.
WT - Water table (screened across the watertable interface).

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Table 3. Groundwater Level Measurements Collected During 2012, RACER Trust, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Total Depth (feet)	Groundwater Elevation (AMSL)
Upper Aquifer Wells				
W-1-N	739.02	30.70	72.80	708.32
W-2-N	731.68	23.84	59.50	707.84
W-3-N	733.66	25.82	57.50	707.84
W-4-N	731.63	23.68	64.60	707.95
HR-1	732.71	25.82	59.10	706.89
HR-2	734.75	26.78	58.60	707.97
HR-3	736.75	28.74	62.40	708.01
HR-4	742.60	34.28	66.80	708.32
HR-5	734.27	26.61	57.60	707.66
HR-6	732.66	25.63	55.20	707.03
HR-7	731.73	24.25	57.20	707.48
HR-8	743.42	NM	NM	NM
HR-9	743.51	NM	NM	NM
HR-11	743.33	34.35	69.06	708.98
HR-16	727.01	20.76	64.50	706.25
HR-17	726.43	19.91	48.20	706.52
W-1-S	729.29	22.54	58.30	706.75
W-2-S	726.64	20.87	67.20	705.77
W-3-S	729.17	23.35	73.60	705.82
W-4-S	727.92	21.84	70.80	706.08
GM-2	735.81	29.68	56.49	706.13
4S[6]	731.36	25.51	96.20	705.85
GM-6	730.27	24.61	46.33	705.66
GM-8	735.17	29.49	51.53	705.68
GM-10	723.90	18.61	49.90	705.29
GM-16[6]	725.30	19.98	57.20	705.32
GM-17	723.84	18.35	50.10	705.49
GM-18[6]	723.80	18.44	44.80	705.36
GM-19S	730.92	24.65	56.20	706.27
GM-21	725.00	NM	NM	NM
GM-22	731.63	24.52	56.30	707.11
GM-23	731.07	22.86	31.85	708.21
GM-24	747.29	37.73	88.24	709.56
GM-25	746.17	37.93	55.97	708.24
GM-26	722.29	17.34	59.20	704.95
GM-27	730.57	22.36	46.40	708.21
GM-28	736.46	NM	NM	NM
GM-29[6]	731.37	23.10	32.84	708.27
GM-30	734.79	26.33	36.10	708.46
GM-31	732.13	25.32	63.40	706.81
GM-32	732.08	25.83	56.79	706.25
GM-33	729.77	23.10	54.10	706.67
GM-34	730.56	23.88	35.00	706.68
GM-35	731.27	25.09	65.60	706.18
GM-36	731.11	24.79	34.20	706.32

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Table 3. Groundwater Level Measurements Collected During 2012, RACER Trust, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Total Depth (feet)	Groundwater Elevation (AMSL)
Upper Aquifer Wells				
GM-37	730.05	23.46	34.20	706.59
GM-38	729.88	23.61	55.80	706.27
GM-43	729.00	22.02	49.30	706.98
GM-44	728.77	22.08	60.70	706.69
GM-45	729.75	22.45	59.80	707.30
GM-46	727.79	18.69	27.59	709.10
GM-47	726.75	21.22	60.10	705.53
GM-48	728.67	23.56	72.10	705.11
GM-49	727.88	23.19	75.20	704.69
GM-50	726.56	21.04	39.70	705.52
GM-51	728.30	23.31	44.00	704.99
GM-52	727.62	22.92	43.80	704.70
GM-53	730.35	23.23	32.48	707.12
GM-55	719.86	14.89	35.40	704.97
GM-57[2]	NM	NM	NM	NA
GM-59	732.25	24.53	34.40	707.72
GM-60	732.24	24.56	50.45	707.68
GM-62[3]	NM	NM	NM	NA
GM-63	725.79	19.98	39.20	705.81
GM-64[6]	725.95	20.17	58.40	705.78
GM-65S	723.58	19.44	52.20	704.14
GM-66	733.22	25.77	54.00	707.45
GM-67S	732.06	27.28	53.64	704.78
GM-68S	732.18	24.59	49.19	707.59
GM-71	736.82	28.97	61.48	707.85
GM-72	736.78	28.96	31.18	707.82
GM-74S	732.17	24.47	49.00	707.70
GM-75S[6]	737.69	29.95	51.20	707.74
GM-76S	739.00	30.58	36.70	708.42
GM-77S	741.14	33.42	42.30	707.72
GM-78	721.18	15.74	49.80	705.44
GM-79	717.91	13.39	54.70	704.52
GM-80	715.82	11.82	24.40	704.00
GM-81	715.31	11.23	60.30	704.08
GM-83S	725.84	18.96	53.10	706.88
EAST	730.98	24.33	71.00	706.65
WEST	731.08	24.58	51.70	706.50
WSU-17	726.18	20.43	65.25	705.75
WSU-18	733.52	27.69	60.65	705.83
WSU-19	726.62	22.39	63.00	NM
WSU-23	724.90	19.38	57.90	705.52
WSU-24[6]	724.82	19.03	55.90	705.79
TW-2[6]	733.38	22.13	55.39	711.25
ME-2	732.08	25.15	35.40	706.93
ME-3	731.73	24.92	36.40	706.81
ME-4	732.24	25.46	27.50	706.78
ME-6	732.68	25.96	35.50	706.72

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Table 3. Groundwater Level Measurements Collected During 2012, RACER Trust, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Total Depth (feet)	Groundwater Elevation (AMSL)
Lower Aquifer Wells				
GM-1	735.74	29.84	101.97	705.90
GM-3	730.44	24.99	100.99	705.45
GM-4	731.46	26.02	137.95	705.44
GM-5	731.29	25.68	101.00	705.61
GM-7R	735.61	29.43	93.08	706.18
GM-9	724.07	19.03	101.10	705.04
GM-11	723.71	18.65	100.00	705.06
GM-13	723.82	19.18	100.30	704.64
GM-14[4]	723.50	18.87	NM	704.63
GM-15	725.23	20.78	99.80	704.45
GM-19D[4]	730.73	24.42	NM	706.31
GM-20D	727.26	21.29	101.90	705.97
GM-39	730.95	22.68	117.66	708.27
GM-40[4]	727.04	20.70	NM	706.34
GM-41	733.65	26.29	116.10	707.36
GM-42[4]	729.16	22.97	NM	706.19
GM-54	730.29	22.98	79.09	707.31
GM-56	719.52	14.58	86.70	704.94
GM-58	735.46	27.84	81.65	707.62
GM-61	732.23	24.41	78.30	707.82
GM-65D	723.54	19.41	96.50	704.13
GM-67D	732.19	24.31	79.20	707.88
GM-68D	732.27	24.63	74.40	707.64
GM-69	732.08	25.10	99.19	706.98
GM-70	737.19	29.34	82.42	707.85
GM-73	736.97	NM	95.60	NA
GM-74D	732.04	24.37	79.65	707.67
GM-75D	737.68	29.68	94.10	708.00
GM-76D[1]	738.94	NM	NM	NM
GM-77D	740.93	33.04	86.36	707.89
GM-82	732.14	24.91	95.41	707.23
GM-83D[4]	725.77	19.38	NM	706.39
GM-84	739.92	32.79	107.80	707.13
RMW-85[5]	736.65	28.61	94.30	708.04
RMW-86[5]	729.22	23.20	79.00	706.02
RMW-87[5]	728.01	21.43	76.10	706.58
RMW-88[5]	739.11	NM	NM	NM
HR-10	742.81	NM	NM	NM
HR-12[6]	742.64	33.69	132.70	708.95
HR-13[6]	735.03	26.93	87.50	708.10
HR-14	731.63	23.72	91.40	707.91
HR-15[4]	733.74	25.98	NM	707.76
M73C[4]	716.55	11.91	NM	704.64
MT576M	751.46	NM	NM	NM
MT596M[6]	757.73	47.58	71.20	710.15

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Table 3. Groundwater Level Measurements Collected During 2012, RACER Trust, Moraine, Ohio.

Well	Measuring Point Elevation	Depth-to-Water (feet)	Total Depth (feet)	Groundwater Elevation (AMSL)
Production and Fire Wells				
DN-13 (County Well) [ON]	727.78	NM	NM	NA
11B	742.56	34.60	NM	707.96
12A[1]	742.39	34.23	NM	708.16
31[1]	734.05	NM	NM	NA
34	733.46	25.95	143.5	707.51
39[1]	732.07	NM	NM	NA
A	739.00	29.08	NM	709.92
FW-1A	739.89	31.81	NM	708.08
FW-2	737.48	29.38	NM	708.10
FW-3	739.26	31.28	NM	707.98
FW-4	731.62	25.12	NM	706.50
IRZ Wells				
RZ-3MM	726.92	21.68	48.00	705.24
RZ-4A	725.71	19.22	55.60	706.49
RZ-4D[6]	727.07	20.60	54.76	706.47
RZ-4L	727.54	21.62	58.90	705.92
Moraine City				
MW-1	715.53	NM	NM	NM
MW-4[6]	707.19	6.65	33.60	700.54
MW-5	709.34	7.12	29.90	702.22
MW-9	712.85	11.49	71.90	701.36

Measuring point is to top of the well casing or surveyed measuring point.
Groundwater elevations are reported in feet above mean sea level (AMSL).
Groundwater levels were measured from September 24 to 25, 2012 using an electronic water level indicator (more than one meter was used and groundwater elevations reflect a calibration factor).
Groundwater level measurements are reported in feet below the measuring point.
1 - Well could not be located.
2 - Well damaged.
3 - Well was abandoned (GM-62) or damaged (GM-57) by Ohio Department of Transportation (ODOT) during reconstruction of the I-75 interchange.
4 - Unable to measure deep wells greater than 100 feet due to equipment issues.
5 - Top of casing elevation is calculated based on adjacent well elevations and field measurements on November 26, 2012.
6 - Water level measurements from 2012 are inconsistent with historical values.
NM - Not measured.
NA - Not applicable.

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Table 4. Horizontal Gradients for Upper/Lower Aquifer Well Pairs in 2012, RACER Trust Moraine, Ohio.

Average Hydraulic Gradients for Upper Well Pairs	***Horizontal Gradients - September 24 and 25, 2012***
W-2-N/W-1-S	4.4E-04
W-3-N/HR-1	5.4E-04
HR-5/HR-1	5.7E-04
HR-6/W-1-S	2.3E-04
HR-4/HR-1	6.0E-04
HR-8/HR-3	NA
HR-7/W-1-S	3.7E-04
W-3-N/HR-6	7.0E-04
HR-5/W-1-S	4.6E-04
HR-9/HR-3	NA
HR-9/HR-8	NA
HR-6/W-4-S	4.0E-04
HR-1/GM-16	5.6E-04
GM-75S/GM-68S	2.6E-04
GM-53/4S	5.3E-04
Average Hydraulic Gradient	**4.7E-04**
Average Hydraulic Gradients for Upper Well Pairs (former Oil House Area)	
GM-30/GM-28	NA
GM-23/GM-28	NA
GM-29/GM-28	NA
GM-30/GM-29	5.4E-04
GM-23/GM-29	NU
GM-30/GM-23	1.4E-03
Average Hydraulic Gradient	**9.9E-04**
Average Hydraulic Gradient for all Upper Wells	**5.4E-04**
Average Hydraulic Gradient for Lower Wells	
GM-58/GM-20D	5.3E-04
GM-39/GM-1	5.1E-04
HR-15/GM-3	5.6E-04
HR-14/GM-5	5.6E-04
GM-67D/RMW-87	6.8E-04
Average Hydraulic Gradient for Deep Wells	**5.7E-04**

NU - Not used for report.
NA - Not applicable.
Note: All gradients in feet per feet.

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Table 5. Vertical Gradients in 2012, RACER Trust Moraine, Ohio.

	Vertical Gradients - September 24 and 25, 2012	
Upper/Lower Wells	**Direction**	**Gradient (ft/ft)**
Upgradient		
HR-9/HR-10	NM	NM
HR-11/HR-12	D	-5.0E-04
On-Site		
W-3-N/HR-15	D	-1.6E-03
W-4-N/HR-14	D	-1.3E-03
HR-3/HR-13	U	3.6E-03
GM-2/GM-1	D	-5.1E-03
GM-6/GM-3	D	-3.8E-03
4S/GM-5	D	-5.1E-03
GM-68S/GM-68D	U	2.2E-03
GM-75S/GM-75D	U	6.0E-03
Former Oil House Area		
GM-23/GM-27(1)	NA	0.0E+00
GM-23/GM-39	D	-1.5E-03
Off-Site/Downgradient		
GM-10/GM-9	D	-5.0E-03
GM-16/GM-15	D	-2.1E-02
GM-18/GM-13	D	-1.6E-02
GM-17/GM-11	D	-8.6E-03
GM-55/GM-56	D	-6.8E-04
GM-65S/GM-65D	D	-2.3E-04

(1) - Vertical gradient from upper aquifer above the upper clay till (GM-23) to the upper aquifer below the upper clay till.

D - Downward gradient (-).

U - Upward gradient (+).

NA - Not applicable.

ft/ft - Feet per feet.

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Table 6. Soil Characteristics and Chemical Properties, RACER Trust, Moraine, Ohio.

Soil Properties:		
Moisture content, M, (mass fraction)	0.2000	
Water saturation, S, (volume fraction)	1	
Water filled porosity, n_W, (volume fraction)	0.3985	
Total porosity, n_T, (volume fraction)	0.40	
Soil bulk density, r_b, (g/cc)	1.59	
Total organic carbon, TOC, (mg/kg)	1000.0	
Fraction of organic carbon, f_{oc}, (mass fraction)	0.001	
Chemical Properties:	**PCE**	**TCE**
Organic/carbon partition coefficient, K_{oc}, (cm^3/g)	364	100
Solubility, $C_{sol,}$ (mg/L)	150	1100
DNAPL density, rDNAPL, (g/mL)	1.62	1.46

g/cc - Grams per cubic centimeter.
mg/kg - Milligrams per kilogram.
cm^3/g - Cubic centimeters per gram.
mg/L - Milligrams per liter.
g/mL - Grams per milliliter.
DNAPL - Dense non-aqueous phase liquid.
PCE - Tetrachloroethene.
TCE - Trichloroethene.

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Table 7. Soil Pore Water Concentration Calculations, RACER Trust, Moraine, Ohio.

	Location Code	PSA-3	PSA-4	PSA-5	PSA-5	PSA-6	PSA-6	PSA-6	PSA-7	PSA-7	PSA-8
	Sample Label	PSA-3(56-58)-S/07162012/	PSA-4(58-60)-S/07252012/	PSA-5(54-56)-S/07172012/	PSA-5(60-62)-S/07172012/	PSA-6(50-52)-S/07272012/	PSA-6(58-60)-S/07272012/	PSA-6(66-68)-S/07272012/	PSA-7(50-52)-S/07292012/	PSA-7(52-54)-S/07292012/	PSA-8(56-58)-S/07312012/
	Sample Date	7/16/2012	7/25/2012	7/17/2012	7/17/2012	7/27/2012	7/27/2012	7/27/2012	7/29/2012	7/29/2012	7/31/2012
Measured Concentration in Saturated Soil	**Units**										
Tetrachloroethene	µg/kg	< 280 U	< 30 U	1200 J	45000	4000 J	2400000 J	9200	< 2700 U	46 J	270000 J
Trichloroethene	µg/kg	5800	560	44000	8300	130000	150000 J	8800	93000	20000	15000 J
Soil Pore Water Concentration											
Tetrachloroethene	µg/L	456	49	1954	73290	6515	Saturated	14984	4397	75	Saturated
Trichloroethene	µg/L	16571	1600	125714	23714	371429	428571	25143	265714	57143	42857

µg/kg - Micrograms per kilogram.
µg/L - Micrograms per liter.
PSA - Process Sump Area.
Location Code - boring identification
< - Chemical of concern not detected above laboratory reporting limit shown
U - Chemical of concern not detected above laboratory reporting limit shown
J - Value estimated.
Shaded Soil Pore Water Concentration is greather than 10% of respective solubility indicating residual dense non-aqueous phase liquid. Shaded cells with the term saturated reflects that the soil pore water concentration is above the solubility of that species (solubility of tetrachloroethene is assumed to be 1.5×10^6 µg/L and trichloroethene solubility is assumed to be 1.1×10^6 µg/L).

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Table 8. Estimated Remaining DNAPL Mass, RACER Trust, Moraine, Ohio.

DNAPL Saturation (%)	**0.31**	**0.50**	**1.0**
Fraction of Pore Space Occupied by DNAPL (%)	0.12	0.20	0.40
Approximate Mass of Residual PCE DNAPL (lb)	26,558	43,434	86,867
Approximate Mass of Residual TCE DNAPL (lb)	24,588	40,211	80,423

% - Percent.
lb - pounds.
DNAPL - Dense Non-Aqueous Phase Liquid.
PCE - Tetrachloroethene.
TCE - Trichloroethene.
DNAPL Saturation is equal to the fraction of pore space occupied by DNAPL divided by the total porosity, as a percent (%).
Assumes the extent of DNAPL has a volume of:

-PCE: 215,186 cubic feet
-TCE: 221,054 cubic feet

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Table 9. 2011 Triangular Irregular Network Horizontal Hydraulic Gradient, RACER Trust, Moraine, Ohio.

TIN Cell	Monitoring Well Groundwater Elevations (ft. AMSL)			Hydraulic Gradient	Flow Direction Azimuth (degrees)
TIN A	GM-19D	GM-4	GM-1	1.4E-03	218
	708.3	**707.38**	**707.77**		
TIN B	GM-1	GM-4	GM-20D	1.1E-03	318
	707.77	**707.38**	**707.96**		
TIN C	GM-4	GM-20D	GM-14	1.7E-03	273
	707.38	**707.96**	**706.71**		
TIN D	GM-14	GM-20D	GM-9	1.7E-03	277
	706.71	**707.96**	**707.08**		
TIN E	GM-9	GM-14	M73C	8.1E-04	317
	707.08	**706.71**	**706.65**		
TIN F	GM-4	GM-14	GM-15	1.3E-03	217
	707.38	**706.71**	**706.62**		
TIN G	GM-19D	GM-15	GM-4	1.3E-03	213
	708.3	**706.62**	**707.38**		

TIN - Triangular irregular network.
ft. - Feet.
AMSL- Above mean sea level.

Table 10. 2012 Triangular Irregular Network Horizontal Hydraulic Gradient, RACER Trust, Moraine, Ohio.

TIN Cell	Monitoring Well Groundwater Elevations (ft. AMSL)			Hydraulic Gradient	Flow Direction Azimuth (degrees)
TIN A	GM-19D	GM-4	GM-1	1.0E-03	225
	706.31	**705.44**	**705.9**		
TIN B	GM-1	GM-4	GM-20D	1.0E-03	304
	705.9	**705.44**	**705.97**		
TIN C	GM-4	GM-20D	GM-14	2.0E-03	266
	705.44	**705.97**	**704.63**		
TIN D	GM-14	GM-20D	GM-9	2.0E-03	278
	704.63	**705.97**	**705.04**		
TIN E	GM-9	GM-14	M73C	1.0E-03	327
	705.04	**704.63**	**704.64**		
TIN F	GM-4	GM-14	GM-15	ND	ND
	705.44	**704.63**	**704.45**(1)		
TIN G	GM-19D	GM-15	GM-4	ND	ND
	706.31	**704.45**(1)	**705.44**		

TIN - Triangular irregular network.

ft. - Feet.

AMSL - Above mean sea level.

1 - Elevation determined to be anomolous by interpretation of lower aquifer potentiometric surface map (Figure 6).

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Table 11. Corrective Measure Technology Screening, Process Sump Area, Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
In-Situ Stabilization and Treatment (ISST)	Moderate to High – Very effective in binding and encapsulating residual mass and non-aqueous phase liquid (NAPL) in a solid matrix that reduces groundwater flux and contact with contaminants. Combination with treatment agents (e.g., oxidizing or reducing agents) further reduces contaminant in soil and groundwater. Bench scale mixing and treatability testing are required to develop mixing design for successful and effective implementation.	Low to Moderate – Requires large area of staging of mixing equipment and raw material. Would require demolition of existing industrial building and foundation. Deep soil mixing can reduce the structural stability of disturbed soils, potentially limiting future site development over the remediation footprint. Deep mixing may be challenging at the site given the depth of impacts (e.g., 60 feet below land surface) and existing above ground features. Would require Underground Injection Control (UIC) permits and possibly local construction permits.	Significant reduction in mobility via binding and encapsulating contaminants with stabilization agents. Moderate to high reduction in toxicity and volume of waste by chemical destruction of contaminants via oxidizing or reducing treatment processes.	Low to Moderate sustainability - Low material use and high waste generation (bulking of mixed soil and construction debris from existing structure demolition) during construction. Moderate short-term fuel and energy consumption during construction. Low long-term fuel and energy demand (i.e., no long-term maintenance required).	Significant reduction in mobility within months.	High capital costs for building demolition, remedial construction, deep mixing and agents for stabilization and/or treatment. Minimum operation and maintenance (O&M) cost for post-treatment groundwater monitoring.	Not retained – Moderate to high effectiveness and sustainable. However, low to moderate implementability because of existing industrial building and foundation.
Enhanced Reductive Dechlorination (ERD)	Moderate – Proven effective at the site for the destruction of dissolved phase site-specific contaminants through existing interim measures (IMs). Includes the injection of organic carbon substrates to stimulate growth and biological activities of native microbial population for ERD. Enhances NAPL dissolution through biotic and abiotic processes. Effectiveness will be limited by the rate of mass transfer from the NAPL phase to the dissolved phase and the potential for contaminant storage within fine-grain soils.	High – Proven implementable at the site through existing IMs. May need to be combined with other source removal technologies depending on the volume of NAPL present. Would not require demolition of the existing industrial building or foundation. Would require UIC permit modifications and may require local construction permits if a semi-automated injection system is implemented.	Moderate to high reduction in mobility and toxicity through biological degradation of dissolved phase constituents. Moderate effectiveness at reducing the volume of waste on the volume of NAPL present and contaminant storage within fine-grain soils.	Moderate to High sustainability - In-situ biological treatment uses renewable biological resources. Organic carbon substrates used for injection have a smaller carbon footprint when compared to other injection reagents (i.e. chemical oxidants, zero-valent iron). Waste generation is minimized as soil and groundwater are treated in-situ. Requires the operation of some fuel-powered equipment during the installation of infrastructure. High concentrations would require higher material use to sustain the biological population and achieve complete reduction. The increased number of injections would also increase the water use for mixing and injection of the carbon substrate.	Approximately 1 to 3 years to achieve control of contaminant migration. Estimated to be 10 to 15 years of total remediation time based on existing ERD performance at the former Oil House and engineering experience in similar geology. The timeframe is strongly dependent on quantity of NAPL present.	Low capital costs to install injection wells for implementation. Moderate capital costs for installation of semi-automated injection system (if necessary). Moderate long term O&M costs to continue carbon source introduction and periodic injection infrastructure maintenance and biofouling control.	Retained - Proven effective for dissolved phase site-specific contaminants of concern, implementable, and sustainable. Not as aggressive as ISST or in-situ thermal treatment (ISTT) for NAPL remediation. Could be used as source area polishing step subsequent to implementation of an aggressive technology for NAPL remediation, if necessary.

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Table 11. Corrective Measure Technology Screening, Process Sump Area, Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
In-Situ Thermal Treatment with Hot Air/Steam Injection (ISTT) with Soil-Vapor Extraction (SVE)	High – Very aggressive source mass removal and destruction technique. Hot air or steam is injected below the contaminated zone to heat up contaminated saturated and/or vadose zone soil resulting in the destruction and volatilization of volatile organic compounds (VOCs). Would increase volatilization in saturated zone soil and vadose zone soil (although not required). Soil-gas created from implementation of the technology would be addressed with a SVE system. Effective remediation technique for all phases of residual contaminant mass (e.g., NAPL, dissolved, adsorbed, etc.). Technology effectiveness is not significantly impacted by heterogeneous geology and the presence of fine-grain soils.	Moderate – Proven technology for rapid removal of VOCs. Vapor capture and treatment of the volatilized compounds is required. Requires significant infrastructure and installation of a temporary on-site treatment facility. Would require air permits, local construction permits, and UIC permits. Would not require demolition of the existing industrial building or foundation.	Highest reduction in toxicity, mobility, and volume of waste when compared to all technologies via vaporization, collection, and treatment of contaminants.	Low to Moderate sustainability - High energy consumption for heating of the water and for operation of the extraction equipment. Moderate to High water use for steam generation and the extraction of the water vapors). High materials use and waste generation for off-gas treatment with media. Large carbon footprint associated with the production, transport and treatment media or on-site treatment (thermal oxidation). Reduced timeframe shortens the environmental overburden of the impacts and restores the aquifer to beneficial use.	Normally within 6 to12 months treatment time for both dissolved phase and NAPL depending on treatment volume and quantity of mass to be removed.	High capital costs for installation of thermal injection, collection and treatment systems, and high short term O&M costs. Requires significant energy to generate the heat/steam used for remediation.	Retained –Highly effective at removing dissolved and NAPL phase mass irrespective of geology and implementable. Would result in the highest mass removal within the shortest timeframe.
In-Situ Chemical Oxidation (ISCO)	Low to Moderate – Proven and widely applied technology for rapid non-selective destruction of VOCs via direct chemical oxidation of dissolved phase contaminants. Effectiveness is dependent on achieving proper contact of injected reagents with contaminants. Effectiveness will be limited due to the potential for contaminant storage within fine-grained soils and the presence of NAPL. Will not attack NAPL directly and does not enhance NAPL dissolution (i.e., only treats dissolved phase contamination).	Low to Moderate – Installation of reagent injection infrastructure is achievable, however, adequate contact between reagents and contaminants will be limited due to contaminant storage within fine-grain soils. Bench-scale treatability testing and pilot injection testing are required for oxidant dosing estimate, selection of activation methods and design information for optimal performance. Would require UIC permits for injections. Would not require demolition of the existing industrial building or foundation.	Moderate to high reduction in mobility and toxicity through chemical oxidation of dissolved phase constituents. Moderate effectiveness at reducing the volume of waste dependent on the presence or absence of NAPL and contaminant storage within fine-grain soils.	Moderate sustainability - Oxidants used for treatment have a much higher carbon footprint than organic carbon substrates used in enhanced bioremediation. Requires the operation of some fuel-powered equipment during the installation of infrastructure. High concentrations would require higher material use to achieve complete oxidation. The increased number of injections or injection volumes would also increase the water use for mixing and injection of the oxidizing chemicals.	Generally 1-2 years for dissolved phase plumes. Could be greater than 5 years and require multiple injections to remediate areas containing NAPL.	Low capital cost for injection well installation for implementation. Relative high O&M cost is anticipated primarily due to the cost of oxidant for treatment.	Not retained – Not effective for the remediation of NAPL. Could be used as a source area polishing step subsequent to implementation of an aggressive technology for NAPL remediation, if necessary.

Table 11. Corrective Measure Technology Screening, Process Sump Area, Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
Groundwater and Land Use Restrictions	Low effectiveness at meeting the corrective measures objectives (CMOs); however, effective for eliminating potential for human exposure to contaminated groundwater and soils and restricting future land use as required.	High - Easily implemented on-site through completion of an Environmental Covenant.	Low – This corrective measure protects human health and the environment, but does not reduce toxicity, mobility, or volume of contaminants as a stand-alone technology.	High sustainability - As a standalone technology. Requires no energy consumption and produces no additional wastes. However restrictions extend the environmental overburden and prevent the beneficial use of groundwater.	Can generally be implemented within 1 year.	Low – costs are primarily limited to engineering and legal fees.	Retained – Technology is effective for eliminating the potential for human exposure to contamination and restricting future land use. Would be required to be implemented in conjunction with active remedial measures to meet the overall CMOs.

Table 12. Corrective Measure Technology Screening, Former Oil House Area, Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
In-Situ Stabilization and Treatment (ISST)	Moderate to High – Very effective in binding and encapsulating residual mass in a solid matrix that reduces groundwater flux and contact with contaminants. Combination with treatment agents (e.g., oxidizing or reducing agents) further reduces contaminant in soil and groundwater. Bench scale mixing and treatability testing are required to develop mixing design for successful and effective implementation.	Moderate – Requires large area of staging of mixing equipment and raw material. Deep soil mixing can reduce the structural stability of disturbed soils, potentially limiting future site development over the remediation footprint. Deep mixing may be challenging at the site given the depth of impacts (e.g., 60 feet below land surface) and existing above ground features. Would require Underground Injection Control (UIC) permits and possibly local construction permits.	Significant reduction in mobility via binding and encapsulating contaminants with stabilization agents. Moderate to high reduction in toxicity and volume of waste by chemical destruction of contaminants via oxidizing or reducing treatment processes.	Moderate to High sustainability - Some material use and waste generation (bulking of mixed soil) during construction. Moderate short-term fuel and energy consumption during construction. Low long-term fuel and energy demand (i.e., no long-term maintenance required).	Significant reduction in mobility within months.	High capital costs for construction, deep mixing and agents for stabilization and/or treatment. Minimum operation and maintenance (O&M) cost for post-treatment groundwater monitoring.	Retained –High effectiveness, implementable, and sustainable. Quickly eliminates mobility of contaminants. However, technology is likely over aggressive for the nature (dissolved phase only) and quantity of mass at the former Oil House Area.
Enhanced Reductive Dechlorination (ERD)	High – Proven effective at the former Oil House Area for the destruction of dissolved phase site-specific contaminants through existing interim measures (IMs). Includes the injection of organic carbon substrates to stimulate growth and biological activities of native microbial population for ERD.	High – Proven implementable at the site through existing IMs. Would require UIC permit modifications and may require local construction permits if a semi-automated injection system is implemented.	Moderate to high reduction in mobility and toxicity through biological degradation of dissolved phase constituents.	Moderate to High sustainability - In-situ biological treatment uses renewable biological resources. Organic carbon substrates used for injection have a smaller carbon footprint when compared to other injection reagents (i.e. chemical oxidants, zero-valent iron). Waste generation is minimized as soil and groundwater are treated in-situ. Requires the operation of some fuel-powered equipment during the installation of infrastructure. Reduced timeframe shortens the environmental overburden of the impacts.	Approximately 1 to 3 years to achieve control of contaminant migration. Estimated to be 10 to 15 years of total remediation time based on existing ERD performance at the former Oil House Area and engineering experience in similar geology. Duration will depend on quantity of mass storage within fine-grain soils.	Low capital costs to install injection wells for implementation. Can use existing IM infrastructure, where applicable. Moderate capital costs for installation of semi-automated injection system (if necessary). Moderate long term O&M costs to continue carbon source introduction and periodic injection infrastructure maintenance and biofouling control.	Retained - Proven effective for dissolved phase site-specific contaminants at the former Oil House Area, implementable, and sustainable.

Table 12. Corrective Measure Technology Screening, Former Oil House Area, Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
Air Sparging/Soil Vapor Extraction (AS/SVE)	Moderate – Effectiveness is dependent on achieving proper contact of injected air with contaminants. Effectiveness may be limited due to the potential for contaminant storage within fine-grain soils. Would have additional benefit of remediating residual vadose zone impacts, if necessary.	Low to Moderate – The ability to confidently capture generated soil vapor will be limited due to the presence of the Upper Clay Till. Requires treatment of extracted soil vapor. Would require air permits, local construction permits, and UIC permits. Oxidation of elevated concentrations of reduced forms of alternate electron acceptors (e.g., iron) generated through the existing IMs may cause aquifer plugging and reduce implementability.	Moderate to high reduction in mobility and toxicity through physical stripping of dissolved phase constituents.	Low sustainability - High energy consumption associated with equipment operation. High materials use and waste generation for off-gas treatment media (assuming treatment with activated carbon). Large carbon footprint associated with the production, transport and treatment of the media. Reduced timeframe shortens the environmental overburden of the impacts.	Generally 1 to 3 years for dissolved phase plumes. Duration will depend on quantity of mass storage within fine-grain soils.	Moderate capital costs depending on the numbers of AS/SVE points and length of trenching and subsurface piping. Moderate long term O&M costs when Granual Activated Carbon (GAC) is selected for off-gas treatment, which requires periodic changeout and/or regeneration.	Not retained – Likely not implementable in a safe manner due to the presence of the upper clay till and low sustainability when compared to other technologies. Oxidation of elevated concentrations of reduced forms of alternate electron acceptors (e.g., iron) generated through the existing IMs may cause aquifer plugging and reduce implementability.
In-Situ Thermal Treatment with Hot Air/Steam Injection (ISTT) with Soil-Vapor Extraction (SVE)	High – Very aggressive source mass removal and destruction technique. Hot air or steam is injected below the contaminated zone to heat up contaminated saturated and/or vadose zone soil resulting in the destruction and volatilization of volatile organic compounds (VOCs). Would increase volatilization in saturated zone soil and vadose zone soil (although not required). Soil-gas created from implementation of the technology would be addressed with a SVE system. Technology effectiveness is not significantly impacted by heterogeneous geology and the presence of fine-grain soils. Would have additional benefit of remediating residual vadose zone impacts, if necessary.	Moderate – Proven technology for rapid removal of VOCs. Vapor capture and treatment of the volatilized compounds is required. Requires significant infrastructure and installation of a temporary on-site treatment facility. Would require air permits, local construction permits, and UIC permits.	Significant reduction in toxicity, mobility, and volume of waste via vaporization and extracted groundwater and off-gas treatment.	Low Sustainability - High energy consumption for heating of the water and for operation of the extraction equipment. Moderate to high water use for steam generation and the extraction of the water vapors. High materials use and waste generation for off-gas treatment with media. Large carbon footprint associated with the production, transport and treatment of media or on-site treatment (thermal oxidation). Reduced timeframe shortens the environmental overburden of the impacts and restores the aquifer to beneficial use.	Normally within 6 to12 months	High capital costs for installation of thermal injection, collection and treatment systems, and high short term O&M costs. Requires significant energy to generate the heat/steam used for remediation.	Retained –Highly effective at removing dissolve phase mass irrespective of geology and implementable. Would result in the highest mass removal within the shortest timeframe. Would have additional benefit of remediating residual vadose zone impacts, if necessary. However, technology is the least sustainable option and likely over aggressive for the nature (dissolved phase only) and quantity of mass at the former Oil House Area.

Table 12. Corrective Measure Technology Screening, Former Oil House Area, Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
In-Situ Chemical Oxidation (ISCO)	Low to Moderate – Proven and widely applied technology for rapid non-selective destruction of VOCs via direct chemical oxidation of dissolved phase contaminants. However, ISCO using Fenton's chemistry was previously implemented at the former Oil House Area and had only moderate effectiveness. Effectiveness is dependent on achieving proper contact of injected reagents with contaminants. Effectiveness may be limited due to the potential for contaminant storage within fine-grain soils. Existing ERD IM will generate a high natural oxidant demand (NOD); limiting the systems effectiveness until the NOD is overcome through oxidation.	Moderate – Installation of reagent injection infrastructure is achievable, however, adequate contact between reagents and contaminants could be limited due to contaminant storage within fine-grain soils. Bench-scale treatability testing and pilot injection testing are required for oxidant dosing estimate, selection of activation methods and design information for optimal performance. Would require UIC permits for injections.	Moderate to high reduction in mobility and toxicity through chemical oxidation of dissolved phase constituents. Moderate effectiveness at reducing the volume of waste dependent on the degree of contaminant storage within fine-grain soils.	Moderate sustainability - Oxidants used for treatment have a much higher carbon footprint than organic carbon substrates used in enhanced bioremediation. Requires the operation of some fuel-powered equipment during the installation of infrastructure. Reduced timeframe shortens the environmental overburden of the impacts.	Generally 1to 2 years for dissolved phase plumes. Will require multiple injections to overcome NOD generated by existing ERD IM.	Low capital cost for injection well installation for implementation. Relative high O&M cost is anticipated primarily due to the cost of oxidant for treatment.	Not Retained – Only moderate effectiveness observed during previous implementation of the technology. Historical long-term operation of the existing ERD IM will generate a high NOD which will limit effectiveness and require multiple injections; limiting cost effectiveness.
Groundwater and Land Use Restrictions	Low effectiveness at meeting the corrective measures objectives (CMOs); however, effective for eliminating potential for human exposure to contaminated groundwater and soils and restricting future land use as required.	High - Easily implemented on-site through completion of an Environmental Covenant.	Low – This corrective measure protects human health and the environment, but does not reduce toxicity, mobility, or volume of contaminants as a stand-alone technology.	High sustainability - As a standalone technology. Requires no energy consumption and produces no additional wastes. However restrictions extend the environmental overburden and prevent the beneficial use of groundwater.	Can generally be implemented within 1 year.	Low – costs are primarily limited to engineering and legal fees.	Retained – Technology is effective for eliminating the potential for human exposure to contamination and restricting future land use. Would be required to be implemented in conjunction with active remedial measures to meet the overall CMOs.

Table 13. Corrective Measure Technology Screening, Diffuse Groundwater (Off-Site; Lower Aquifer), Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
Monitored Natural Attenuation (MNA)	Moderate –Effective for the remediation of low concentrations of chlorinated volatile organic compounds (CVOCs) through biotic and abiotic degradation processes, degradation, dilution and sorption. If source area treatment is implemented an effective technology for offsite groundwater when combined with groundwater, land use restrictions, and engineering controls.	High – MNA can be easily implemented using primarily the existing monitoring well network. Would not require construction or remediation permits.	Low to moderate reduction in toxicity, mobility, and volume of contaminants are reduced through natural attenuation processes (e.g., biodegradation, dispersion, dilution and adsorption).	High sustainability – Uses naturally occurring processes. Longer life-cycle promotes the continued use of materials, creation of waste and use of fuel for site related activities. Has the longest useful life extending the environmental overburden and preventing the beneficial use of groundwater.	Generally greater than 10 years; however significantly dependent on the initial contaminant concentrations, site-specific rate of naturally occurring attenuation processes and source area treatment.	No capital costs if using existing monitoring well network. Low long term operation and maintenance (O&M) costs.	Retained –Can be effective for the remediation of low CVOC concentrations, implementable, and sustainable. Could be used as a polishing step subsequent to implementation of more aggressive/active remedial technologies, if necessary. Can be used as the primary remediation technology if the concentration of CVOCs is stable to decreasing at off-site monitoring locations and on-site source treatment is in-place and effective.
Enhanced Reductive Dechlorination (ERD)	High – Proven effective in the on-site upper aquifer for the destruction of dissolved phase site-specific contaminants through existing interim measures (IMs). Includes the injection of organic carbon substrates to stimulate growth and biological activities of native microbial population for ERD.	Low to Moderate – Proven implementable at the site through existing IMs; however, there is the potential for the migration of reduced forms of alternate electron acceptors (e.g., methane, dissolved iron) to reach the Miami Shores Well Field which would limit implementability. Would require Underground Injection Control (UIC) permit modifications and may require local construction permits if a semi-automated injection system is implemented. Would require access negotiations for remedy construction.	Moderate to high reduction in mobility and toxicity through biological degradation of dissolved phase constituents.	Low to Moderate sustainability – In-situ biological treatment uses renewable biological resources. Organic carbon substrates used for injection have a smaller carbon footprint when compared to other injection reagents (i.e. chemical oxidants, zero-valent iron). Waste generation is minimized as soil and groundwater are treated in-situ. Requires the operation of some fuel-powered equipment during the installation of infrastructure. The relatively larger diffuse nature of the off-site impacts would require increased material usage both for infrastructure and for implementation. Reduced timeframe shortens the environmental overburden of the impacts; However, potential exists for reduced forms of alternate electron acceptors to reach the Miami Shores Well Field which could impact the off-site lower	Generally 1 to 2 years for dissolved phase mass to achieve MCLs and establish a clean water front. Total treatment duration will be dependent on spacing between treatment transects and source area treatment.	Low capital costs to install injection wells for implementation. Moderate capital costs for installation of semi-automated injection system (if necessary). Moderate long term O&M costs to continue carbon source introduction and periodic injection infrastructure maintenance and biofouling control.	Not Retained – Although proven effective at the site, there is the potential for the migration of reduced forms of alternate electron acceptors (e.g., methane, dissolved iron) to reach the Miami Shores Well Field which would limit implementability and not meet the associated corrective measures objective (CMO) for the lower aquifer.

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Table 13. Corrective Measure Technology Screening, Diffuse Groundwater (Off-Site; Lower Aquifer), Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
				aquifers ability to be used as public supply water.			
Air Sparging/Soil Vapor Extraction (AS/SVE)	Low to Moderate – Effectiveness is dependent on achieving proper contact of injected air with contaminants. Effectiveness may be limited due to the potential for contaminant storage within fine-grain soils.	Low to Moderate – The ability to confidently capture generated soil vapor will be limited due to the presence of the regional clay till. May require treatment of extracted soil vapor. Would require air permits, local construction permits, and UIC permits. Would require access negotiations for remedy construction.	Moderate to high reduction in mobility and toxicity through physical stripping of dissolved phase constituents. Volume of mass removal will be dependent on rate of mass transport through the target zone.	Low sustainability - High energy consumption associated with equipment operation. Requires the operation of some fuel-powered equipment during the installation of infrastructure. The relatively larger diffuse nature of the off-site impacts would require increased infrastructure. High materials use and waste generation for off-gas treatment media (if required). Large carbon footprint associated with the production, transport and treatment of the media. Reduced timeframe shortens the environmental overburden of the impacts.	Generally 1 to 2 years to establish a clean water front for dissolved phase plumes. Total treatment duration will be dependent on spacing between treatment transects and source area treatment.	Moderate to high capital costs depending on the numbers of AS/SVE points and length of trenching and subsurface piping. Moderate to high long term O&M costs for system maintenance and off-gas treatment.	Not retained – Not implementable in a safe manner due to regional clay till, low sustainability, and high cost when compared to other technologies.
In-Situ Chemical Oxidation (ISCO)	Moderate – Proven and widely applied technology for rapid non-selective destruction of volatile organic compounds (VOCs) via direct chemical oxidation of dissolved phase contaminants. Effectiveness is dependent on achieving proper contact of injected reagents with contaminants.	Low to Moderate – Installation of reagent injection infrastructure is achievable; however, adequate contact between reagents and contaminants could be limited due to contaminant storage within fine-grain soils. In addition, there is the potential for the migration of residual chemical oxidant, or incomplete oxidant byproducts to reach the Miami Shores Well Field which would limit implementability. Bench-scale treatability testing and pilot injection testing are required for oxidant dosing estimate, selection of activation methods and design information for optimal performance. Would require UIC permits for injections. Handling and injection of potentially hazardous chemicals within the residential neighborhood would require special safety considerations. Would require access negotiations for remedy construction.	Moderate to high reduction in mobility and toxicity through chemical oxidation of dissolved phase constituents. Volume of mass removal will be dependent on rate of mass transport through the ISCO target zone.	Low to Moderate sustainability - Oxidants used for treatment have a much higher carbon footprint than organic carbon substrates used in enhanced bioremediation. Requires the operation of some fuel-powered equipment during the installation of infrastructure. The relatively larger diffuse nature of the off-site impacts would require increased material usage both for infrastructure and for implementation. Reduced timeframe shortens the environmental overburden of the impacts. The potential exists for the migration of residual chemical oxidant, or incomplete oxidant byproducts to reach the Miami Shores Well Field which could impact the off-site lower aquifers ability to be used as public supply water.	Generally 1 to 2 years to establish a clean water front for dissolved phase plumes. Total treatment duration will be dependent on spacing between treatment transects and source area treatment.	Low capital cost for injection well installation and implementation. Relative high O&M cost is anticipated primarily due to the cost of oxidant for treatment.	Not Retained –Not cost effective in this hydrogeology and/or for the remediation of diffuse groundwater plumes. In addition, there is the potential for the migration of residual chemical oxidant, or incomplete oxidant byproducts to reach Miami Shores Well Field which would limit implementability and not meet the associated CMO for the lower aquifer.

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Table 13. Corrective Measure Technology Screening, Diffuse Groundwater (Off-Site; Lower Aquifer), Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
In-Well Air Stripping (IWAS)	Moderate – Proven technology for similar site conditions and contaminants. Fresh air is injected into a specially constructed well that allows air-lifting/pumping of contaminated groundwater. The water is physically stripped of VOCs through contact with the air and is reinjected into a shallow/upper well screen within the same well.	Moderate – Installation of remedial well transects/curtains achievable. Would require air permits, local construction permits, and UIC permits. Would require installation of significant and infrastructure for delivery of in-well stripping air, vapor recovery system, and vapor treatment. Would require access negotiations for remedy construction.	Moderate to high reduction in mobility by transferring contaminants from groundwater to treatment air. Toxicity reduction is achieved through treatment of remediation exhaust, if necessary. Volume of mass removal will be dependent on rate of mass transport through the IWAS treatment zone.	Low sustainability - High energy consumption associated with equipment operation. Requires the operation of some fuel-powered equipment during the installation of infrastructure. The relatively smaller radius of influence (ROI) of the wells would require increased infrastructure resulting in higher waste creation and materials use compared to other technologies. High materials use and waste generation for off-gas treatment media. High materials use and waste generation for off-gas treatment media. Reduced timeframe shortens the environmental overburden of the impacts.	Generally 1 to 2 years to establish a clean water front for dissolved phase plumes. Total treatment duration will be dependent on spacing between treatment transects and source area treatment.	Moderate to high capital costs for installation of remedial wells and equipment and length of trenching and subsurface piping. Moderate to high long term O&M costs for system maintenance and off-gas treatment.	Not Retained – Low sustainability and relatively high capital and O&M cost.
Permeable Reactive Barrier (PRB)	Moderate to high – Proven and widely applied technology for rapid non-selective destruction of CVOCs via direct chemical reduction of dissolved phase contaminants with a reactive media such as zero-valent iron.	Low to moderate – Will require installation of non-traditional techniques through vertical aquifer fracturing due to depth of treatment zone. Vertical aquifer fracturing techniques are capable of generating a maximum wall thickness of 4 to 9 inches. Therefore, multiple PRBs would be required in parallel to achieve the desired treatment objective. Requires bench-scale treatability testing to obtain reactive media dosing demand, thickness of barrier and potential reactive media change-out frequency for optimal full-scale performance. Would require UIC permits and possibly local construction permits. Would require access negotiations for remedy construction.	High reduction in mobility and toxicity of contaminants through direct reductive dechlorination. Volume of mass removal will be dependent on rate of mass transport through the PRB.	Moderate sustainability – Moderate to high short-term fuel and energy consumption for infrastructure installation. Moderate material use and waste creation to place the media. Low long-term fuel and energy demand (i.e., no long-term maintenance required).	Establishment of clean water front will be immediate for properly designed/constructed systems. Total treatment duration will be dependent on spacing between treatment transects and source area treatment.	High capital and minimal O&M costs. May require media change-out approximately every 30 years. Will likely require multiple PRBs to be installed in parallel to meet treatment objectives.	Not retained – would require the use of non-traditional techniques using vertical aquifer fracturing which would limit the constructible wall thickness of the PRB. May require multiple PRBs to be installed in parallel to meet treatment objectives.

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Table 13. Corrective Measure Technology Screening, Diffuse Groundwater (Off-Site; Lower Aquifer), Racer Trust, Moraine, Ohio.

Corrective Measure Technologies	Effectiveness	Implementability	Toxicity, Mobility & Volume of Waste	Sustainability	Estimated Timeframe	Relative Cost	Conclusions
Groundwater Extraction	High – Proven and effective technology for hydraulic control to prevent off-site migration of impacted groundwater in the lower off-site aquifer through pumping at existing lower aquifer extraction well DN-13. Extracted water could potentially be beneficially reused to establish a clean water lense in the shallow aquifer as a means of lowering and mitigating the off-site vapor intrusion risk.	High – the remedy is already implemented, operating and based on downgradient groundwater quality data proven to be effective.	Moderate to high reduction in mobility by transferring contaminants from groundwater to treatment air. No reduction in toxicity. Volume of mass removal will be dependent on rate of mass transport to the extraction well.	Moderate sustainability - High Energy Consumption associated with equipment operation. High water use associated with the extraction of groundwater. Existing infrastructure eliminates the material use and waste generation associated with infrastructure installation in the short term. Additionally the comparatively larger ROI of the extraction well reduces the potential materials use and waste creation associated with a modified treatment area in the long term.	Total treatment duration will be dependent on time for clean water from treated source areas to reach the extraction wells and implementation of on-site diffuse plume and source area remedies.	No capital costs, remedy is already in-place and functional. Low to Moderate long term O&M costs for system utilities and maintenance.	Retained – Technology is already implemented and effective. Moderate sustainability, no capital cost, and low to moderate O&M cost.
Groundwater Use Restrictions	Low effectiveness at meeting CMOs; however, effective for eliminating potential for human exposure to contaminated groundwater use as required.	Low to moderate – While some covenants may be put in place, it will be difficult to get access/deed restrictions for all required off-site residential properties.	Low – This corrective measure protects human health and the environment, but does not reduce toxicity, mobility, or volume of contaminants as a stand-alone technology.	High sustainability - As a standalone technology. Requires no energy consumption and produces no additional wastes. However restrictions extend the environmental overburden and prevent the beneficial use of groundwater.	Can generally be implemented within 1 year. May require additional time for negotiations with residential parcels.	Low – costs are primarily limited to engineering and legal fees.	Retained – Technology is effective for eliminating the potential for human exposure to contamination and restricting future land use. May be required to be implemented in conjunction with active remedial measures to meet the overall CMOs.

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Table 14. Corrective Measures Proposal Cost Estimate , RACER Trust, Moraine, Ohio.

Final Proposed Corrective Measure	Capital Costs [1]	Annual O&M Costs [1]	Years in Operation	Estimated Cost [1]
1. Source Area Corrective Measures (Former Oil House Area)				
Enhanced Reductive Dechlorination (ERD) for source treatment	$579,000	$118,000 see footnote [2]	10	**$1,287,000**
2. Source Area Corrective Measures (Process Sump Area)				
Enhanced Reductive Dechlorination (ERD) for source treatment	$3,011,000	$333,000 see footnote [3]	15	**$5,009,000**
3. O&M Lagoons, Landfills, Groundwater Monitoring, and Reporting	--	$100,000 to $105,000	25	**$2,595,000**
Groundwater sampling for upper and lower aquifers and reporting[4]				
Operation and Maintenance of the Lagoons and Landfills				
4. Vapor Intrusion Corrective Measures				
Operation the vapor intrusion system in residential area for 25 years	$1,401,000	$40,500 to $63,100 see footnote [5]	25	**$2,457,000**
5. Engineering/Institutional Controls				
Land and groundwater use restrictions for 25 years	$25,000	$3,500	25	**$113,000**
6. Lower Aquifer Hydraulic Containment				
Operate DN-13 recovery well, monthly sampling, and reporting.	$0	$41,000	25	**$1,025,000**
7. Private Well Abandonment				
Abandonment of wells located at 3571/3573 Dryden Road and 2651 Blanchard Avenue	$152,000	--	--	**$152,000**
8. Remedial Systems and Well Abandonment				
System and wells (remediation wells) abandonment at year 25	$364,000	--	--	**$364,000**
TOTAL				**$13,002,000**

Notes:
The final proposed corrective measures are based on the Corrective Measures Proposal.
Capital costs include system design, well installation, equipment purchase, and system construction activities.
O&M - Operation and maintenance
(1) All costs are feasibility study level with ranges of -30%/+50% of listed numbers.
(2) Annual O&M cost for ERD are shown for the first year operation (injection of molasses solution and performance monitoring); annual costs are reduced for subsequent years at reduced O&M activity frequencies.
(3) Costs shown assume emulsified vegetable oil injections will occur every 3 years for 15 years for a total of 5 injection and related monitoring events.
(4) Costs for groundwater sampling is based on the current monitoring program. This program will be modified in the future to more appropriately monitor the final corrective measures.
(5) Costs for vapor intrusion corrective measure include installation of vapor intrusion mitigation systems (28 remaining properties), post-installation proficiency sampling, operation and maintenance, and reimbursement of electrical costs at all appropriate properties (54 properties) within the Riverview Plat neighborhood. Initial sub-slab and indoor air sampling and post-installation proficiency sampling (30-day, 180-day, and 360-day) costs are included in the year one capital costs.