



Technical Memorandum

Date: November 10, 2006

To: Ed Waddles, MTD Products Inc.

cc: David Herrington
MTD Project Team

From: Britney Barnes

Project No.: 00-71360.20

Subject: Summary of *In situ* Groundwater Chemical Oxidation Pilot Study
MTD Products Inc. (MTD), Westfield, Massachusetts (Columbia Manufacturing Facility)

The purpose of this memorandum is to communicate the results of the sodium persulfate injection pilot study conducted at the Columbia Manufacturing facility (Site) in Westfield, Massachusetts during July and August 2006. The pilot study was designed to evaluate the effectiveness of sodium persulfate injections as an *in situ* treatment technology for reducing the concentration of chlorinated volatile organic compounds (CVOCs) in site groundwater. Health and safety issues that may be associated with the addition of catalyzed sodium persulfate solution into the groundwater (*e.g.*, excessive heat and/or toxic vapors) were also evaluated. The health and safety aspects of this treatment technology are critically important should the remedial approach be expanded to include groundwater beneath the buildings. Overall, the results of the pilot study were extremely positive. The concentration of CVOCs in groundwater was reduced by more than 90 percent within the treatment zone. There was also no evidence of excessive heat or organic vapor generation that would restrict application of catalyzed sodium persulfate injections within the footprint of the manufacturing buildings.

The discussion that follows provides a summary of the injection system layout and installation, the monitoring network, the sodium persulfate solution delivery system, and the performance monitoring results collected during the pilot study. Specific activities conducted during the pilot study are listed Table 1 (see Attachment 1).

Introduction

The sodium persulfate injection system and its related monitoring network were installed in the northern portion of the Site, just outside of Building #1, where high concentrations of CVOCs have historically been observed (Figure 1 in Attachment 2). As shown on the inset of Figure 1 (see Attachment 2, the pilot test was conducted in two areas of the northern groundwater plume. Both areas are located along the north side of Building #1. One of the areas is located in the vicinity of the existing dual phase extraction wells DPE-01 and DPE-03, on the western flank of the observed groundwater

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plume (Figure 1 in Attachment 2). This area is characterized by the presence of light non-aqueous phase liquids (LNAPL) (presumably cutting oils and hydraulic fluids) and elevated concentrations (>1 mg/L) of dissolved CVOCs. Because the configuration of the groundwater plume resembles a human hand, this portion of the plume has been informally referred to as the “thumb” area. The second area of treatment is located further to the east. This area is characterized by lower concentrations of dissolved CVOCs without any evidence of LNAPL and is informally referred to as the “fingers” area. Since these two areas of the northern plume are geochemically different, it was deemed important to determine the effectiveness of chemical oxidation in each area.

Injection System and Monitoring Network

RMT mobilized to the site in November 2005 and July 2006, first to install the infrastructure for the pilot system and finally to conduct the pilot study. Two injection methods were utilized during the pilot test, including a shallow horizontal injection trench and seven polyvinyl chloride (PVC) injection wells. Pilot test injections at the horizontal trench were conducted to determine the effectiveness of a catalyzed sodium persulfate solution on site-specific CVOCs and LNAPL constituents observed in the “thumb” area. Additionally, the trench system was used to evaluate the vertical mixing of sodium persulfate within the upper portions of the surficial aquifer. To facilitate vertical and horizontal distribution of sodium persulfate within the surficial aquifer new 2-inch diameter and existing 4-inch diameter injection wells were employed.

The horizontal injection trench, one new 2-inch injection well and two existing 4-inch wells were utilized in the “thumb” area, and two new 2-inch injection wells and two existing 4-inch wells were utilized in the “fingers” area. To evaluate the effectiveness of the pilot test activities, 10 new 1-inch groundwater monitoring points were installed to supplement the existing network of monitoring wells. Shallow and deep monitoring points were installed at various locations within the pilot test area to evaluate vertical mixing of the chemical oxidant across the saturated thickness of the aquifer. The well pairs were also used to assess whether paired injection wells with discrete screened intervals would be more efficient in distributing the chemical oxidant. The location of the injection trench, injection wells, and monitoring points are shown on Figure 1 (see Attachment 2). A summary of well construction details, for all of the existing and new wells used in the pilot study is provided in Table 2 (see Attachment 1).

In addition to establishing a groundwater monitoring network, an array of soil gas probes (referred to as Gore Sorbers) were installed to monitor the potential for generation of organic vapors as a byproduct of the oxidation process. Soil gas probes were deployed at strategic locations to establish baseline organic vapor concentrations and to monitor organic vapor concentrations both during and after the chemical oxidation process. Soil gas monitoring locations are shown on Figure 1 (see Attachment 2).

Oxidant Delivery System

The sodium persulfate oxidant and the sodium hydroxide catalyst were delivered to the site in liquid form and combined on the site to produce a mixture of 20 percent by weight solution sodium persulfate and 5 percent by weight solution sodium hydroxide. The injection system was connected via underground piping to two, 3,000-gallon polyethylene tanks via a 1-inch feeder line. The catalyzed sodium persulfate solution was pumped through the 1-inch feed line and into the respective injection

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wells and trench. The piping runs were routed such that the injections could be focused on each area independently or both simultaneously. Appropriate valves, connections, and flow control apparatus were added to each injection well.

Baseline Sampling Activities

Before sodium persulfate was injected into the aquifer, an array of soil gas probes were deployed and a round of groundwater samples was collected to establish baseline groundwater quality conditions and soil vapor concentrations. Soil vapor probes were deployed on June 29, 2006 and retrieved on July 12, 2006. Baseline groundwater samples were collected between July 10 and July 14, 2006. Groundwater samples were collected from the existing monitoring wells (MWs), new and existing monitoring points (MPs), and existing ozone performance monitoring points (PMPs), as shown on the Table 3 (see Attachment 1). Baseline soil gas and groundwater sampling results are summarized on Table 4 and Table 5 (see Attachment 1), respectively. A CVOC plume interpretation is depicted on Figure 1 (see Attachment 2). Overall, the distribution of CVOCs observed during the baseline sampling event is consistent with previous observations provided by RMT.

Sodium Persulfate Injection Activities

Sodium persulfate injections were conducted over a three week timeframe from July 24 through August 11, 2006. During this time, a total of 10,800 gallons of catalyzed sodium persulfate were injected into the subsurface area north of Building #1. Approximately 3,600 gallons of the oxidant were injected into each of the following: the horizontal trench, the three injection wells in the "thumb" area (combined), and the four injection wells in the "fingers" area (combined).

Thermo-couples were placed in select injection and monitoring wells to measure changes in temperature resulting from possible exothermic oxidation reactions. The maximum observed change in temperature recorded within any injection point was 18 degrees Fahrenheit (65° to 83°F), while the maximum temperature change recorded in the aquifer immediately adjacent the chemical injections was less than 2°F.

Post-Injection Performance Monitoring Results

Post-injection performance groundwater samples were collected between August 21 and August 23, 2006. An isoconcentration map, prepared using the post-injection CVOC concentrations is provided as Figure 2 (see Attachment 2). In addition, pre- and post-injection performance groundwater sampling results, broken down by compound, are presented on Figure 3 through Figure 6 (see Attachment 2). The following items capture significant findings based on evaluation of these data:

- With the exception of the concentrations of CVOCs observed in samples collected from MP-16, PMP-1, and MW-20C, which are located outside of the pilot test treatment areas, the CVOC concentrations declined significantly following the injection of sodium persulfate. The change in concentrations from baseline to the post injection sampling is presented on Figure 3 through Figure 6 (see Attachment 2). The spatial distribution of the CVOCs is shown on Figure 1 and Figure 2 (see Attachment 2).

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- Although some variability in CVOC reduction was noted between shallow and deep monitoring pairs (MP-25S, MP-25D, MP-26S, and MP-26D), the groundwater quality data clearly demonstrates that sodium persulfate was being distributed across the entire saturated thickness of the aquifer. This observation holds true in the vicinity of the shallow trench as well as within the area of influence of the vertical injection points.
- Increases in specific conductivity and sulfate, as well as the decrease in CVOC concentrations in the new monitoring points indicate that the spacing of the injection wells was sufficient in treating the targeted areas of the plume.
- No significant temperature increases or generation of organic vapors were observed during the injection process. This suggests to RMT that there should be no adverse health and safety issues to preclude use of the catalyzed sodium persulfate as a treatment technology beneath building structures.

Based on RMT's evaluation of the groundwater quality data and soil vapor analyses from pre- and post-injection, catalyzed sodium persulfate injection appears to represent an effective treatment technology for reducing CVOC concentrations in groundwater. CVOC concentration, within the treatment area was reduced by more than 90 percent without generating excessive heat or organic vapors that might otherwise preclude the application of catalyzed sodium persulfate injections as a treatment technology underneath the existing buildings.

RMT is currently assessing the applicability and implement ability of this technology beneath the former degreasing room in Building #1. This area of the facility is a confirmed source area for CVOCs and represents a crucial target to reduce the mass of residual CVOCs source materials.

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Attachment 1 Tables

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Table 1
Summary of Pilot Study Activities and Implementation Schedule
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

EVENT	DATE
Installation of injection trench and vertical injection wells	November 2005 and July 2006
Soil gas sampling (pre-oxidant injection)	June 29 – July 12, 2006
Baseline groundwater sampling	July 10 – July 14, 2006
Active oxidant injections	July 24 – August 11, 2006
Soil gas sampling (during oxidant injections)	July 28 – August 14, 2006
Soil gas sampling (post oxidant injections)	August 14 – August 23, 2006
Performance groundwater sampling	August 21 – August 23, 2006

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Table 2
Summary of Injection Well and Monitoring Point Construction Details
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

WELL NAME	CONSTRUCTION MATERIALS	TOTAL DEPTH (feet bls)	SCREEN LENGTH	WELL USE
DPE-01	4-inch Schedule 40 PVC	12.5	10	Injection
DPE-03	4-inch Schedule 40 PVC	12.5	10	Injection
DPE-05	4-inch Schedule 40 PVC	12.5	10	Injection
DPE-07	4-inch Schedule 40 PVC	12.5	10	Injection
INJ-1	2-inch Schedule 40 PVC	14	10	Injection
INJ-2	2-inch Schedule 40 PVC	17	10	Injection
INJ-3	2-inch Schedule 40 PVC	16.5	10	Injection
MP-25S	1-inch Schedule 40 PVC	8.5	5	Performance Monitoring
MP-25D	1-inch Schedule 40 PVC	14	5	Performance Monitoring
MP-26S	1-inch Schedule 40 PVC	8.5	5	Performance Monitoring
MP-26D	1-inch Schedule 40 PVC	13.6	5	Performance Monitoring
MP-27	1-inch Schedule 40 PVC	14.8	10	Performance Monitoring
MP-28S	1-inch Schedule 40 PVC	11.8	5	Performance Monitoring
MP-28D	1-inch Schedule 40 PVC	16.3	5	Performance Monitoring
MP-29S	1-inch Schedule 40 PVC	11.8	5	Performance Monitoring
MP-29D	1-inch Schedule 40 PVC	16.7	5	Performance Monitoring
MP-30	1-inch Schedule 40 PVC	18.5	10	Performance Monitoring

bls below land surface

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Table 3
Summary of Pilot Test Monitoring Program
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

WELL NAME	ANALYTICAL CONSTITUENTS	FIELD PARAMETERS
"Thumb" Area MP-3, MP-4, MP-5, MP-6, MP-16, MP-17, MP-25S, MP-25D, PMP-1, MW-20B, MW-20C, DPE-03	VOCs tetrachloroethene, trichloroethene, <i>cis</i> -1,2-dichloroethene, and vinyl chloride	Temperature, pH, and Specific Conductivity
"Fingers" Area MP-1, MP-2, MP-13, MP-14, MP-27, MP-28S, MP-28D, MP-29S, MP-29D, PMP-2, MW-24S, DPE-05, DPE-07	Inorganics sulfate	

Table 4
Summary of Constituents of Concern in Soil
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

SAMPLE ID	SAMPLE DATE/CONSTITUENT AND RESULT (ppb)			GENERAL LOCATION AT SITE
	JULY 2006 (pre injection)	AUGUST 2006 (during injection)	AUGUST 2006 (post injection)	
TPH				
GS1	1.13	0.36	0.05	Finger - vicinity of MP-01 and just north of PMP-02
GS2	18.20	0.13	0.20	Finger - vicinity of DPE-07
GS3	2.62	12.36	2.25	Finger - vicinity of DPE-05
GS4	1.70	17.63	8.66	Thumb - between DPE-03 and MP-04 (south of inj. trench)
GS5	0.18	0.07	0.06	Thumb - north of MP-04 (either at eastern end of inj. trench or just to north of trench)
GS6	3.04	0.64	0.07	Thumb - northeast of MP-26S/D pair, south of MW-20C
BTEX				
GS1	nd	nd	nd	Finger - vicinity of MP-01 and just north of PMP-02
GS2	0.00	0.27	0.26	Finger - vicinity of DPE-07
GS3	0.02	0.93	0.38	Finger - vicinity of DPE-05
GS4	nd	nd	0.03	Thumb - between DPE-03 and MP-04 (south of inj. trench)
GS5	nd	nd	nd	Thumb - north of MP-04 (either at eastern end of inj. trench or just to north of trench)
GS6	0.00	nd	0.03	Thumb - northeast of MP-26S/D pair, south of MW-20C
BENZENE				
GS1	nd	nd	nd	Finger - vicinity of MP-01 and just north of PMP-02
GS2	bdl	0.27	0.26	Finger - vicinity of DPE-07
GS3	0.02	0.91	0.38	Finger - vicinity of DPE-05
GS4	nd	nd	0.03	Thumb - between DPE-03 and MP-04 (south of inj. trench)
GS5	nd	nd	nd	Thumb - north of MP-04 (either at eastern end of inj. trench or just to north of trench)
GS6	nd	nd	0.03	Thumb - northeast of MP-26S/D pair, south of MW-20C

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	JULY 2006 (pre injection)	AUGUST 2006 (during injection)	AUGUST 2006 (post injection)	
C11, C13, and C15 (combo of diesel range alkanes)				
GS1	0.01	nd	nd	Finger - vicinity of MP-01 and just north of PMP-02
GS2	0.71	nd	nd	Finger - vicinity of DPE-07
GS3	0.03	0.46	0.03	Finger - vicinity of DPE-05
GS4	nd	nd	nd	Thumb - between DPE-03 and MP-04 (south of inj. trench)
GS5	nd	nd	nd	Thumb - north of MP-04 (either at eastern end of inj. trench or just to north of trench)
GS6	0.08	0.42	nd	Thumb - northeast of MP-26S/D pair, south of MW-20C
cis -12DCE				
GS1	nd	nd	0.06	Finger - vicinity of MP-01 and just north of PMP-02
GS2	0.58	0.09	0.07	Finger - vicinity of DPE-07
GS3	9.28	1.63	1.10	Finger - vicinity of DPE-05
GS4	0.41	0.07	0.47	Thumb - between DPE-03 and MP-04 (south of inj. trench)
GS5	0.04	0.03	nd	Thumb - north of MP-04 (either at eastern end of inj. trench or just to north of trench)
GS6	nd	0.04	nd	Thumb - northeast of MP-26S/D pair, south of MW-20C
111-TCA				
GS1	0.10	0.07	0.08	Finger - vicinity of MP-01 and just north of PMP-02
GS2	0.63	0.23	0.27	Finger - vicinity of DPE-07
GS3	0.31	0.10	0.18	Finger - vicinity of DPE-05
GS4	0.26	0.10	0.21	Thumb - between DPE-03 and MP-04 (south of inj. trench)
GS5	nd	nd	nd	Thumb - north of MP-04 (either at eastern end of inj. trench or just to north of trench)
GS6	nd	nd	nd	Thumb - northeast of MP-26S/D pair, south of MW-20C

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SAMPLE ID	SAMPLE DATE/CONSTITUENT AND RESULT (ppb)			GENERAL LOCATION AT SITE
	JULY 2006 (pre injection)	AUGUST 2006 (during injection)	AUGUST 2006 (post injection)	
TCE				
GS1	3.66	10.42	28.58	Finger - vicinity of MP-01 and just north of PMP-02
GS2	183.57	84.21	60.14	Finger - vicinity of DPE-07
GS3	103.47	35.00	10.86	Finger - vicinity of DPE-05
GS4	2.12	10.64	69.27	Thumb - between DPE-03 and MP-04 (south of inj. trench)
GS5	0.80	0.86	0.25	Thumb - north of MP-04 (either at eastern end of inj. trench or just to north of trench)
GS6	0.75	8.58	3.26	Thumb - northeast of MP-26S/D pair, south of MW-20C
PCE				
GS1	1.55	2.69	5.23	Finger - vicinity of MP-01 and just north of PMP-02
GS2	32.52	29.84	23.99	Finger - vicinity of DPE-07
GS3	13.92	5.58	2.29	Finger - vicinity of DPE-05
GS4	0.07	0.58	2.67	Thumb - between DPE-03 and MP-04 (south of inj. trench)
GS5	0.10	0.12	0.06	Thumb - north of MP-04 (either at eastern end of inj. trench or just to north of trench)
GS6	0.09	1.09	0.62	Thumb - northeast of MP-26S/D pair, south of MW-20C

nd - not detected

Table 5
Summary of Groundwater Analytical Results
Constituents of Concern - Thumb Area
July - August 2006
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE									
	DPE-03	MP-03			MP-04			MP-05		
	07/11/06	07/11/06	08/10/06	08/22/06	07/11/06	08/10/06	08/22/06	07/11/06	08/10/06	08/22/06
Volatile Organics										
Tetrachloroethene	0.02	0.0615	NA	<0.025	0.053	NA	<0.05	0.0012	NA	<0.025
Trichloroethene	4.42	6.98	NA	0.025	14.4	NA	0.37	0.0151	NA	<0.025
<i>cis</i> -1,2-Dichloroethene	2.22	1.32	NA	<0.025	0.78	NA	<0.05	0.157	NA	<0.025
Vinyl chloride	0.199	0.141	NA	<0.025	0.0615	NA	<0.05	0.0321	NA	<0.025
Wet Chemistry										
Sulfate	425	462	3910	9920	213	8220	8810	59.0	24700	24000

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE									
	(DU-06103)				MP-16		MP-17			
	MP-06									
	07/11/06	07/11/06	08/10/06	08/22/06	07/13/06	08/22/06	07/11/06	08/10/06	08/22/06	
Volatile Organics										
Tetrachloroethene	0.0011	0.001	NA	<0.01	<0.05	<0.2	0.0083	NA	<0.02	
Trichloroethene	0.0063	0.0141	NA	<0.01	6.23	29.4	0.337	NA	<0.02	
<i>cis</i> -1,2-Dichloroethene	0.0312	0.0331	NA	<0.01	0.538	2.11	0.21	NA	<0.02	
Vinyl chloride	0.0162	0.0168	NA	<0.01	0.0535	<0.2	0.0596	NA	<0.02	
Wet Chemistry										
Sulfate	33.2	35.8	13200	8780	181	139	910	8660	10600	

⁽¹⁾ Analytical results are reported in milligrams per liter (mg/L) unless otherwise noted.

< - Concentration less than the Quantitation Limit.

NA - Not analyzed.

Table 5
Summary of Groundwater Analytical Results
Constituents of Concern - Thumb Area
July - August 2006
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE								
	MP-25S			MP-25D			MP-26S		
	07/12/06	08/10/06	08/22/06	07/12/06	08/10/06	08/22/06	07/12/06	08/10/06	08/22/06
Volatile Organics									
Tetrachloroethene	<0.02	NA	<0.05	0.051	NA	<0.02	<0.001	NA	<0.001
Trichloroethene	0.975	NA	0.0785	6.79	NA	2.37	0.0184	NA	0.0055
<i>cis</i> -1,2-Dichloroethene	0.951	NA	<0.05	0.624	NA	0.0902	0.379	NA	0.0868
Vinyl chloride	0.0826	NA	<0.05	0.108	NA	<0.02	0.0954	NA	0.123
Wet Chemistry									
Sulfate	130	37400	25700	122	2320	4990	60.6	512	1130

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE								
	MP-26D			MW-20B			MW-20C		
	07/12/06	08/10/06	08/22/06	07/12/06	08/10/06	08/22/06	07/12/06	08/10/06	08/22/06
Volatile Organics									
Tetrachloroethene	0.0499	NA	<0.02	0.0522	NA	0.0939	0.0114	NA	0.0189
Trichloroethene	1.11	NA	<0.02	0.079	NA	0.0767	0.436	NA	0.702
<i>cis</i> -1,2-Dichloroethene	0.529	NA	<0.02	0.162	NA	0.108	0.226	NA	0.406
Vinyl chloride	0.113	NA	<0.02	0.0438	NA	0.058	0.0468	NA	0.107
Wet Chemistry									
Sulfate	103	21100	18400	22.8	768	7840	89.6	301	159

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Constituents of Concern - Thumb Area
July - August 2006
Columbia Manufacturing Facility, Westfield, Massachusetts
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PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE		
	PMP-01		
	07/11/06	08/10/06	08/22/06
Volatile Organics			
Tetrachloroethene	0.0016	NA	<0.005
Trichloroethene	0.113	NA	0.0864
<i>cis</i> -1,2-Dichloroethene	0.109	NA	0.0977
Vinyl chloride	0.0181	NA	0.0925
Wet Chemistry			
Sulfate	812	1830	3070

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Table 5
Summary of Groundwater Analytical Results
Constituents of Concern - Finger Area
July - August 2006
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE							
	DPE-05	DPE-07	MP-01			MP-02		
	07/11/06	07/10/06	07/10/06	08/10/06	08/21/06	07/11/06	08/10/06	08/21/06
Volatile Organics								
Tetrachloroethene	0.0988	0.0698	0.0198	NA	0.0145	0.113	NA	0.0171
Trichloroethene	1.75	1.15	0.41	NA	0.148	1.71	NA	0.226
<i>cis</i> -1,2-Dichloroethene	0.278	0.21	0.0428	NA	0.118	0.25	NA	0.245
Vinyl chloride	0.042	0.0296	<0.005	NA	0.0472	0.027	NA	0.0594
Wet Chemistry								
Sulfate	539	409	262	898	1440	232	268	259

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE								
	MP-13			MP-14			MP-27		
	07/11/06	08/10/06	08/22/06	07/11/06	08/10/06	08/21/06	07/13/06	08/10/06	08/21/06
Volatile Organics									
Tetrachloroethene	0.0054	NA	0.0058	0.0267	NA	0.0381	0.0276	NA	0.0086
Trichloroethene	0.0846	NA	0.07	0.48	NA	0.583	0.477	NA	0.186
<i>cis</i> -1,2-Dichloroethene	0.261	NA	0.332	0.118	NA	0.283	0.149	NA	0.0333
Vinyl chloride	0.107	NA	0.263	<0.005	NA	0.132	0.0226	NA	<0.005
Wet Chemistry									
Sulfate	419	307	316	251	463	653	811	4040	3240

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< - Concentration less than the Quantitation Limit.

NA - Not analyzed.

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Constituents of Concern - Finger Area
July - August 2006
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE								
	MP-28S			MP-28D			MP-29S		
	07/13/06	08/10/06	08/21/06	07/13/06	08/10/06	08/21/06	07/13/06	08/10/06	08/21/06
Volatile Organics									
Tetrachloroethene	0.0515	NA	0.0052	0.458	NA	0.0778	0.033	NA	<0.005
Trichloroethene	1.07	NA	0.152	5.06	NA	0.847	0.588	NA	0.0741
<i>cis</i> -1,2-Dichloroethene	0.45	NA	0.106	0.27	NA	0.0738	0.313	NA	0.234
Vinyl chloride	0.0923	NA	0.0153	<0.05	NA	<0.01	0.0536	NA	0.0885
Wet Chemistry									
Sulfate	641	1550	1580	243	1380	1080	535	1400	1040

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE								
	MP-29D			MP-30			MW-24S		
	07/13/06	08/10/06	08/21/06	07/13/06	08/10/06	08/21/06	07/11/06	08/10/06	08/21/06
Volatile Organics									
Tetrachloroethene	0.43	NA	0.0422	0.23	NA	0.0422	0.159	NA	0.119
Trichloroethene	4.61	NA	0.412	2.12	NA	0.42	1.9	NA	1.21
<i>cis</i> -1,2-Dichloroethene	0.276	NA	0.0663	0.208	NA	0.344	0.115	NA	0.109
Vinyl chloride	<0.05	NA	0.012	0.183	NA	0.344	0.118	NA	0.165
Wet Chemistry									
Sulfate	354	2060	1930	850	1680	1750	488	388	477

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< - Concentration less than the Quantitation Limit.

NA - Not analyzed.

Table 5
Summary of Groundwater Analytical Results
Constituents of Concern - Finger Area
July - August 2006
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.

PARAMETER ⁽¹⁾	LOCATION/SAMPLE DATE		
	PMP-02		
	07/11/06	08/10/06	08/21/06
Volatile Organics			
Tetrachloroethene	0.103	NA	0.009
Trichloroethene	1.57	NA	0.0994
<i>cis</i> -1,2-Dichloroethene	0.237	NA	0.0403
Vinyl chloride	0.122	NA	0.0097
Wet Chemistry			
Sulfate	730	1770	2520

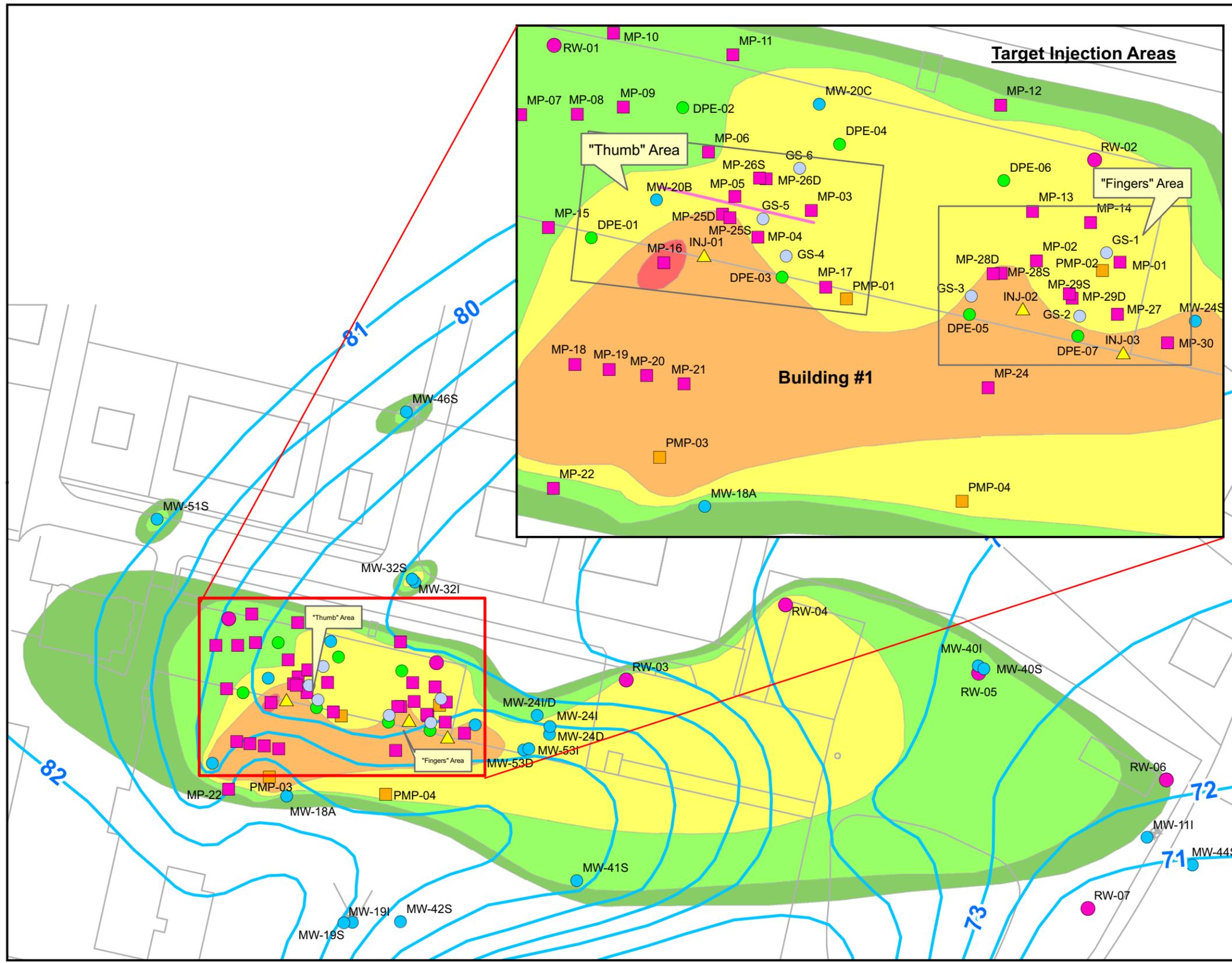
⁽¹⁾ Analytical results are reported in milligrams per liter (mg/L) unless otherwise noted.

< - Concentration less than the Quantitation Limit.

NA - Not analyzed.

Technical Memorandum

Attachment 2 Figures



LEGEND

- Monitoring Point
- Performance Monitoring Point
- Monitoring Well
- Recovery Well
- ▲ Injection Well
- Dual Phase Extraction Well
- Soil Gas
- Water Table - August 2006
- Injection Trench

Dissolved Chlorinated Ethene Concentration (mg/L)

- ≤0.005
- >0.005 - 0.01
- >0.01 - 0.1
- >0.1 - 1
- >1 - 10

3.				
2.				
1.				
NO.	BY	DATE	REVISION	APP'D.
MTD PRODUCTS, INC. WESTFIELD, MASSACHUSETTS				
DISSOLVED SOLVENTS IN GROUNDWATER NORTH END OF SITE, AUGUST 2006				
DRAWN BY: TLH		SCALE AS NOTED		PROJECT NO.: 00-71391.01
CHECKED BY: BCB		DATE PRINTED:		FILE NO.:
APPROVED BY: MAM		DATE: SEPTEMBER 2006		FIGURE NO.: 2

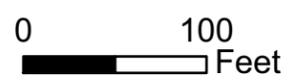
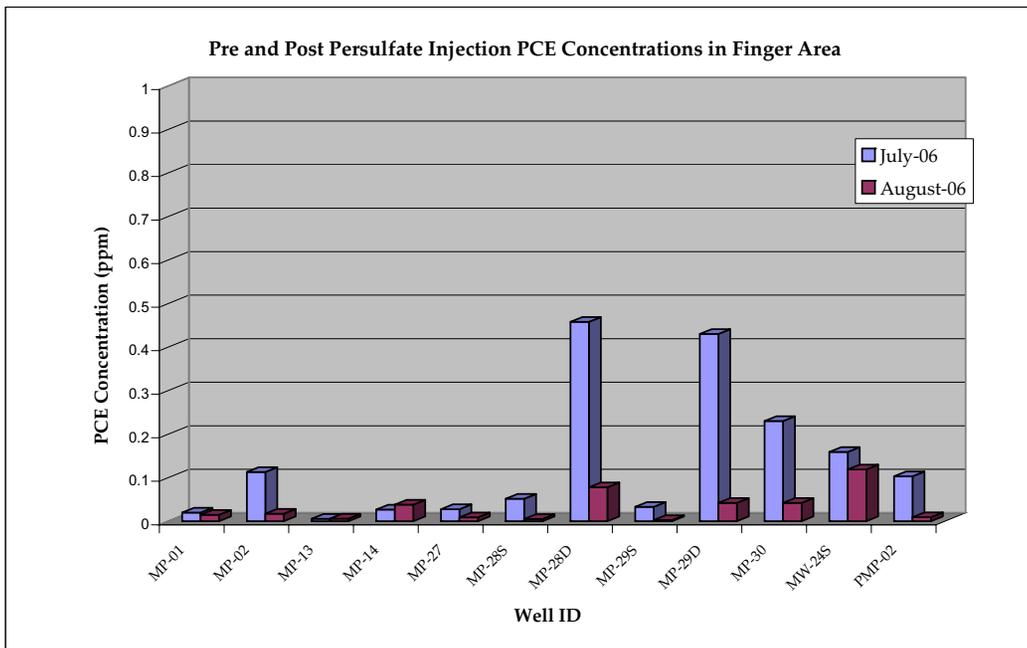
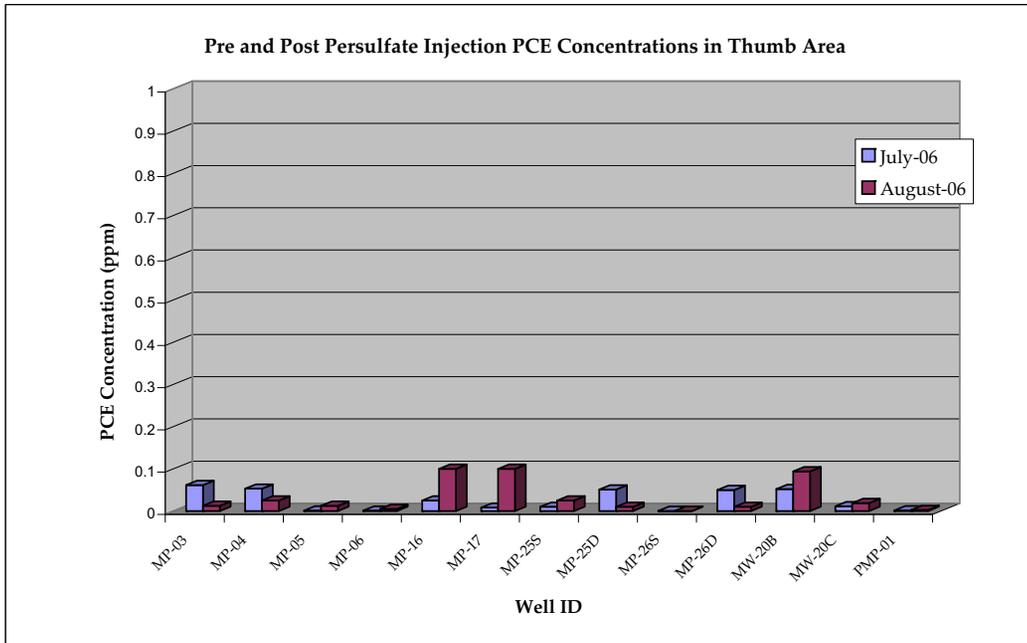


Figure 3
Tetrachloroethene
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.



STATION	TETRACHLOROETHENE (mg/L)	
	BASELINE	
	Jul-06	Aug-06
DPE-03	0.02	NA
DPE-05	0.0988	NA
DPE-07	0.0698	NA
MP-01	0.0198	0.0145
MP-02	0.113	0.0171
MP-03	0.0615	<0.025
MP-04	0.053	<0.05
MP-05	0.0012	<0.025
MP-06	0.0011	<0.01
MP-13	0.0054	0.0058
MP-14	0.0267	0.0381
MP-16	<0.05	<0.2
MP-17	0.0083	<0.02
MP-25D	0.051	<0.02
MP-25S	<0.02	<0.05
MP-26D	0.0499	<0.02
MP-26S	<0.001	<0.001
MP-27	0.0276	0.0086
MP-28D	0.458	0.0778
MP-28S	0.0515	0.0052
MP-29D	0.43	0.0422
MP-29S	0.033	<0.005
MP-30	0.23	0.0422
MW-20B	0.0522	0.0939
MW-20C	0.0114	0.0189
MW-24S	0.159	0.119
PMP-01	0.0016	<0.005
PMP-02	0.103	0.009

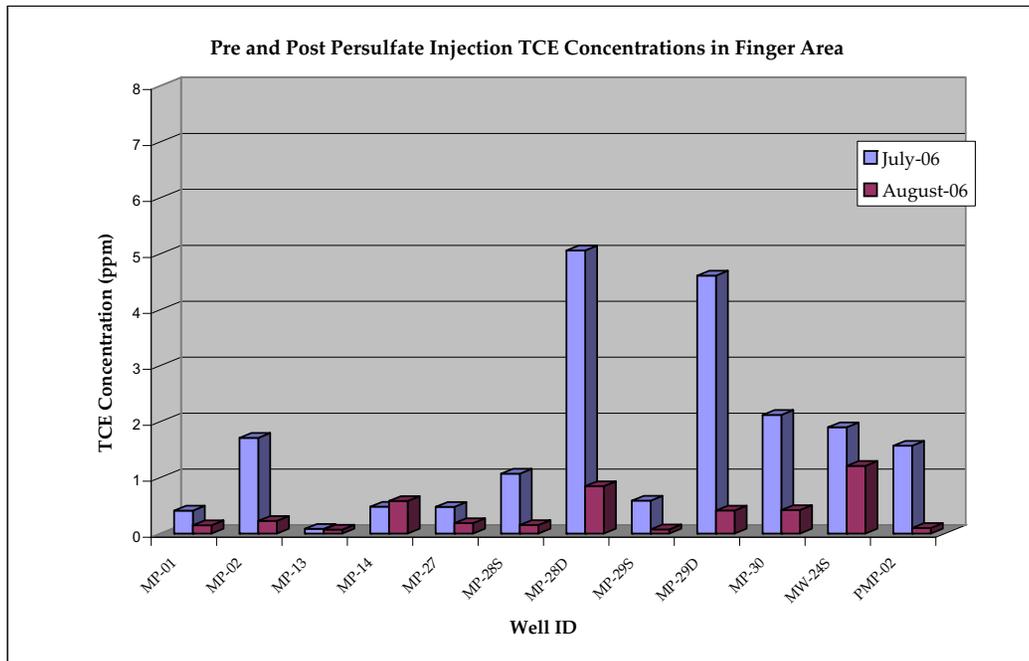
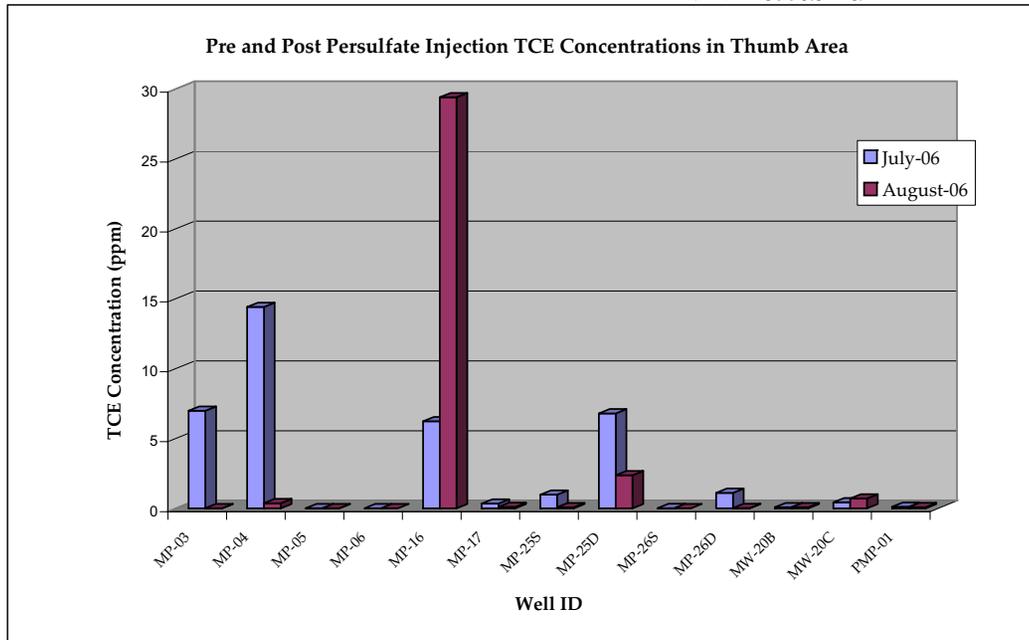
< - Concentration less than the Quantitation Limit.

NA - Not analyzed.

Bolding indicates sample detection.

Note: Non Detects (<) are graphed at half the detection limits listed on the above table

Figure 4
Trichloroethene
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.



STATION	TRICHLOROETHENE (mg/L)	
	BASELINE	
	Jul-06	Aug-06
DPE-03	4.42	NA
DPE-05	1.75	NA
DPE-07	1.15	NA
MP-01	0.41	0.148
MP-02	1.71	0.226
MP-03	6.98	0.025
MP-04	14.4	0.37
MP-05	0.0151	<0.025
MP-06	0.0063	<0.01
MP-13	0.0846	0.07
MP-14	0.48	0.583
MP-16	6.23	29.4
MP-17	0.337	<0.02
MP-25D	6.79	2.37
MP-25S	0.975	0.0785
MP-26D	1.11	<0.02
MP-26S	0.0184	0.0055
MP-27	0.477	0.186
MP-28D	5.06	0.847
MP-28S	1.07	0.152
MP-29D	4.61	0.412
MP-29S	0.588	0.0741
MP-30	2.12	0.42
MW-20B	0.079	0.0767
MW-20C	0.436	0.702
MW-24S	1.9	1.21
PMP-01	0.113	0.0864
PMP-02	1.57	0.0994

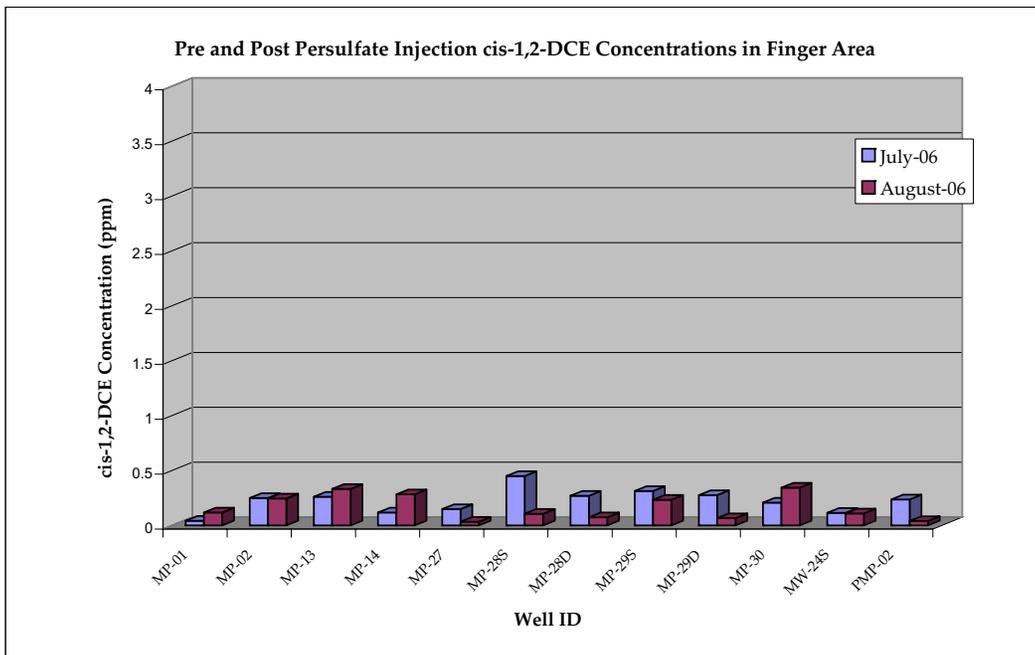
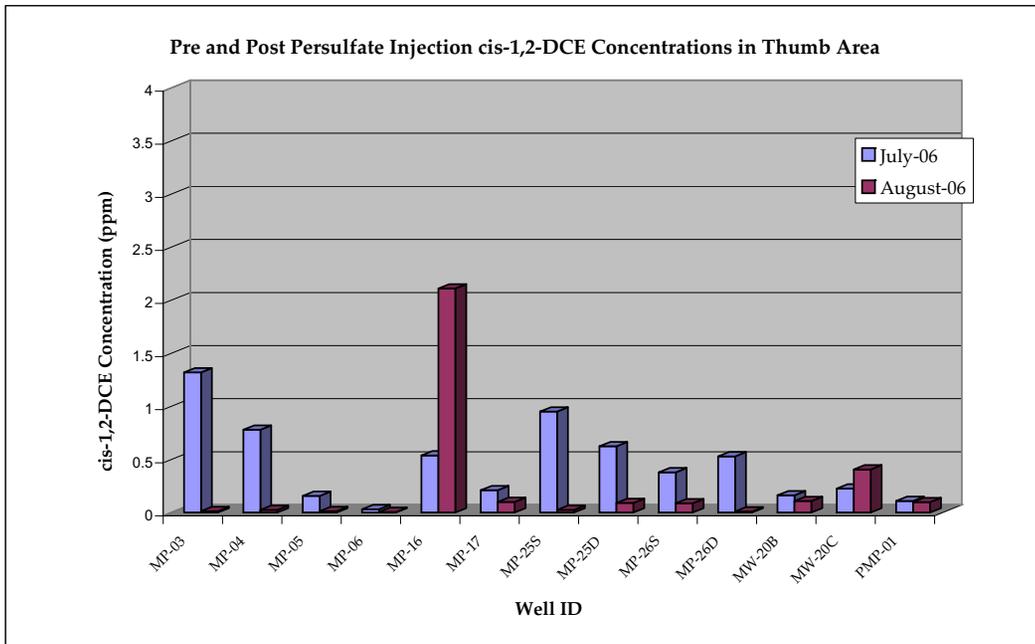
< - Concentration less than the Quantitation Limit.

NA - Not analyzed.

Bolding indicates sample detection.

Note: Non Detects (<) are graphed at half the detection limits listed on the above table

Figure 5
cis-1,2-Dichloroethene
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.



STATION	cis-1,2-DICHLOROETHENE (mg/L)	
	BASELINE	
	Jul-06	Aug-06
DPE-03	2.22	NA
DPE-05	0.278	NA
DPE-07	0.21	NA
MP-01	0.0428	0.118
MP-02	0.25	0.245
MP-03	1.32	<0.025
MP-04	0.78	<0.05
MP-05	0.157	<0.025
MP-06	0.0312	<0.01
MP-13	0.261	0.332
MP-14	0.118	0.283
MP-16	0.538	2.11
MP-17	0.21	<0.02
MP-25D	0.624	0.0902
MP-25S	0.951	<0.05
MP-26D	0.529	<0.02
MP-26S	0.379	0.0868
MP-27	0.149	0.0333
MP-28D	0.27	0.0738
MP-28S	0.45	0.106
MP-29D	0.276	0.0663
MP-29S	0.313	0.234
MP-30	0.208	0.344
MW-20B	0.162	0.108
MW-20C	0.226	0.406
MW-24S	0.115	0.109
PMP-01	0.109	0.0977
PMP-02	0.237	0.0403

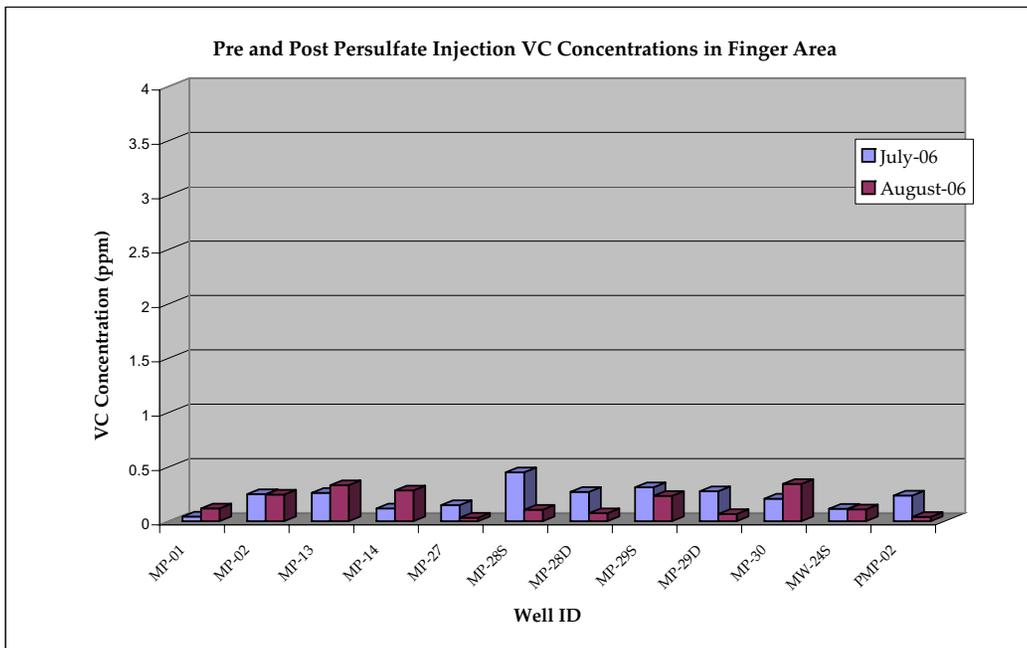
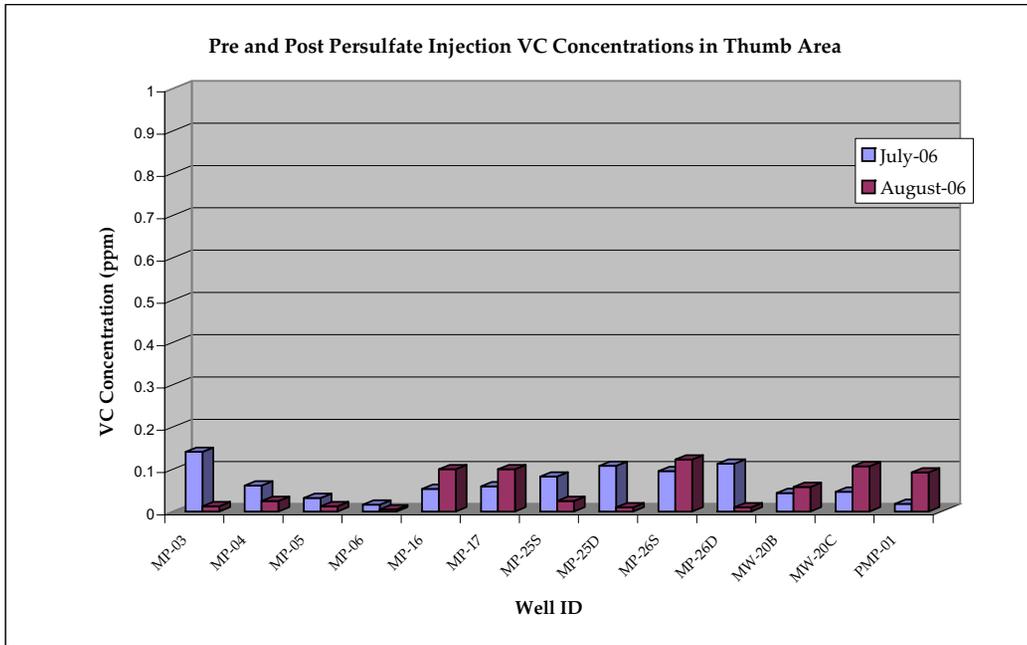
< - Concentration less than the Quantitation Limit.

NA - Not analyzed.

Bolding indicates sample detection.

Note: Non Detects (<) are graphed at half the detection limits listed on the above table

Figure 6
Vinyl Chloride
Columbia Manufacturing Facility, Westfield, Massachusetts
MTD Products Inc.



STATION	VINYL CHLORIDE (mg/L)	
	BASELINE	
	Jul-06	Aug-06
DPE-03	0.199	NA
DPE-05	0.042	NA
DPE-07	0.0296	NA
MP-01	<0.005	0.0472
MP-02	0.027	0.0594
MP-03	0.141	<0.025
MP-04	0.0615	<0.05
MP-05	0.0321	<0.025
MP-06	0.0162	<0.01
MP-13	0.107	0.263
MP-14	<0.005	0.132
MP-16	0.0535	<0.2
MP-17	0.0596	<0.02
MP-25D	0.108	<0.02
MP-25S	0.0826	<0.05
MP-26D	0.113	<0.02
MP-26S	0.0954	0.123
MP-27	0.0226	<0.005
MP-28D	<0.05	<0.01
MP-28S	0.0923	0.0153
MP-29D	<0.05	0.012
MP-29S	0.0536	0.0885
MP-30	0.183	0.344
MW-20B	0.0438	0.058
MW-20C	0.0468	0.107
MW-24S	0.118	0.165
PMP-01	0.0181	0.0925
PMP-02	0.122	0.0097

< - Concentration less than the Quantitation Limit.

NA - Not analyzed.

Bolding indicates sample detection.

Note: Non Detects (<) are graphed at half the detection limits listed on the above table