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February 20, 2013

Robert Reinhart
US EPA Region 1
11 Technology Drive
North Chelmsford, MA 01863-2431

Subject: Brownfields Program Quality Assurance Project Plan Addendum NB-I
City of New Bedford Brownfields Program
Former Payne Cutlery Site
295 Phillips Avenue
New Bedford, Massachusetts

Dear Mr. Reinhart:

On behalf of the City of New Bedford, TRC Environmental Corporation is pleased to submit this Quality Assurance Project Plan (QAPP), Addendum NB-I for the above-referenced property located at 295 Phillips Avenue in New Bedford, Massachusetts (the "Site") for your review and approval. The attached QAPP Addendum presents the proposed scope of work for groundwater, sewer, and indoor air sampling to support the proposed remedial activities at the Former Payne Cutlery Site. This QAPP Addendum has been revised based upon comments received from EPA on February 5, 2013.

Please note that EPA previously approved QAPP Addendum NB-G in March 2012 (EPA RFA# 06135) also from this Site. In addition, QAPP Addendum NB-H was recently submitted to EPA for this Site but under a different Brownfields grant.

Please also note that TRC's Generic Brownfields QAPP (EPA RFA# 13028, Revision 2.0) is referenced throughout this QAPP Addendum.

If you have any questions, please contact either of the undersigned at (978) 970-5600.

Sincerely,

Alfred C. Leonard, LSP
Senior Project Engineer

Paul Arnold
Program Manager

Enclosure

cc: Cheryl Henlin, City of New Bedford
Laurie O'Connor, EPA
TRC Project File

L2013-027

Brownfields Program Quality Assurance Project Plan
Addendum NB-I
City of New Bedford

Former Payne Cutlery Site
295 Phillips Avenue
New Bedford, Massachusetts

Prepared for:

City of New Bedford
133 Williams Street
New Bedford, MA 02740

Prepared By:

TRC Environmental Corporation
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854

(978) 970-5600

February 2013

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Attachment A: ASTM Method for Measuring PNOD

1.0 FORM A – TITLE AND APPROVAL PAGE

Document Title: Brownfields Program Quality Assurance Project Plan (QAPP), Addendum NB-I, Former Payne Cutlery, 295 Phillips Avenue, New Bedford, Massachusetts.

EPA QA RFA Number: _____
(TRC's Generic QAPP: EPA RFA# 13028)

Prepared By:
TRC Environmental Corporation
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
Phone: (978) 970-5600

QAPP Date: 2/19/2013

QAPP Revision Number: 0

The signatures below indicate approval of this QAPP Addendum.

EPA QA Officer: _____
Signature

Robert Reinhart
Printed Name/Date

EPA Project Officer: _____
Signature

Laurie O'Connor
Printed Name/Date

TRC Project Manager: Alfred C. Leonard
Signature

Alfred Leonard 2/20/2013
Printed Name/Date

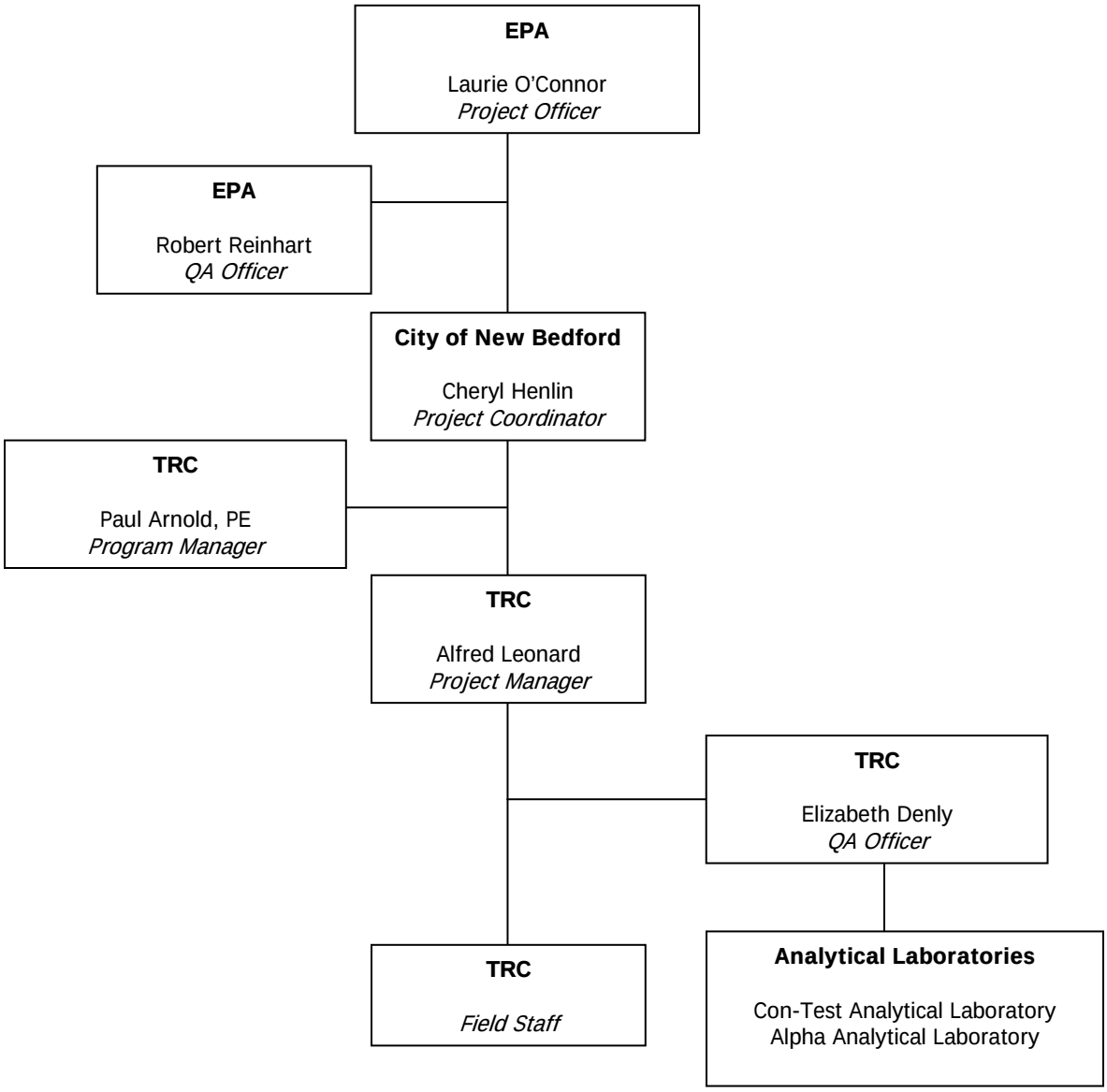
TRC Project QA Officer: Elizabeth Denly
Signature

Elizabeth Denly 2/20/13
Printed Name/Date

2.0 FORM B – PROJECT ORGANIZATION AND RESPONSIBILITY

2.1 Project Organization

The following chart presents the organizational structure for this program.



2.2 Project Responsibilities and Contact Information

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of project responsibilities and contact information for the EPA QA Officer, TRC Program Manager, TRC QA Officer, and the analytical laboratories. The laboratories selected for this program are Con-Test Analytical Laboratory of East Longmeadow, Massachusetts (Con-Test), and Alpha Analytical of Mansfield, Massachusetts (Alpha). Contact information for the remaining team members (EPA Project Officer, City of New Bedford Project Coordinator, and the TRC Project Manager is provided below.

EPA Project Officer:

Contact Information:

Contact:	Laurie O'Connor
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City of New Bedford Project Coordinator:

Contact Information:

Contact:	Cheryl Henlin
Address:	Office of Environmental Stewardship, City of New Bedford
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	New Bedford, MA 02740
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TRC Project Manager:

Contact Information:

Contact:	Alfred C. Leonard
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3.0 FORM C – PROBLEM DEFINITION

3.1 Background

The former Payne Cutlery Corporation (Payne) is located at 295 Phillips Avenue in New Bedford, Massachusetts (the "Site"). The Site is identified by the City of New Bedford Tax Assessor's Office on Map 98 as parcels 3, 23 and 264, and totals approximately 3.3 acres. A two-story brick building existed on the Site until 2000. The Site has a history of industrial use, dating from the early 1900s when it was developed for cotton fabric milling operations, until 1988 when the Site was used by Payne in the manufacture of shears and manicure implements. Payne occupied the site between 1963 and 1988. During this time, Site activities included cold pressing of steel, metal grinding, degreasing of metal with trichloroethene (TCE), as well as chromium and nickel electroplating. After Payne filed for bankruptcy in 1988, the Site was used for a number of activities, including a hazardous materials storage business and an automobile body repair facility. In 2010, the City of New Bedford constructed a parking lot in the southeastern portion of the Site.

Two Massachusetts Department of Environmental Protection (MassDEP) Release Tracking Numbers (RTNs) are associated with the Site. The first RTN (4-404) is associated with a reported release of petroleum-based oil in April 1987 prior to the establishment of the 1993 Massachusetts Contingency Plan (MCP; 310 CMR 40.0000) revisions. The Site was previously categorized as a *Transition Site* pursuant to the pre-1993 MCP. The second RTN (4-15373) is associated with a reported release of TCE in February 2001, which warranted the performance of an Immediate Response Action (IRA) at the Site under the MCP. An IRA Completion Report has not been submitted for this Site to date. The Site is in default under Tier Classification obligations relative to the MCP (310 CMR 40.0500) for both RTNs.

3.2 Previous Investigations

Hazardous substances formerly used and stored on the Site are consistent with metal plating operations and manufacture of rubber and plastic. A technical report by Roy F. Weston, Incorporated (Weston) included a 21-page table listing a complete inventory of the building conducted in 1992. Hazardous substances identified as part of this inventory appeared to be left over from metal plating processes or manufacture of polymers for plastic and rubber tool grips.

Previous investigations reported that one 20,000-gallon underground storage tank (UST) and one 8,500-gallon No. 4 fuel oil UST were removed from the Site in November 1962 and September 2000, respectively; however, their exact locations are unknown. Three aboveground storage tanks (ASTs) were identified by previous reports, including a 50-gallon heating oil tank and two ASTs of unspecified volume and contents. All tanks were reportedly removed as part of building demolition.

Two investigations in 1987 documented numerous drums containing potentially hazardous materials in the building. The earlier of these two investigations was performed by Mabbett, Capaccio, & Associates, Incorporated (MCA), and included a limited subsurface investigation beneath the concrete floor at the Site. This investigation concluded that Site soils were contaminated with TCE, chromium, nickel, lead, petroleum products, and acid (based on low pH readings). The report further

stated that "a significant potential exists for contamination of groundwater at the Site." MCA's 1987 report also noted several leaks in the roof of the building.

In September 1987, GHR Engineering Associates (GHR) produced an environmental assessment report documenting soil boring and well installation activities at the subject site. GHR reported the presence of TCE and nickel in subsurface soil. TCE was detected above current Method 1 soil cleanup standards. GHR also analyzed for the presence of polychlorinated biphenyls (PCBs) in soil, all results for which were non-detect except one sample with 1.44 milligrams per kilogram (mg/kg) PCBs, which is below current applicable MCP Method 1 soil cleanup standards. GHR's groundwater investigation detected copper, thallium, antimony, nickel, TCE, tetrachloroethene (PCE), and chloroform. TCE, PCE, and nickel were detected above the current applicable Method 1 groundwater cleanup standards.

During the 1990s, the Site building fell into further disrepair, with several reports noting large holes in the floor and roof of the structure. In 1992, prompted by City of New Bedford fire department requests, MassDEP made a request to the EPA for assistance in stabilizing the hazardous conditions at the Site. On August 20, 1992, EPA began actions to investigate contamination and to remove hazardous materials from the Site. The investigation named Joseph F. Oliveira (owner), A-1 Storage, Incorporated, Nu-Traffic, Incorporated, Erie Chemical Sales, and Payne Cutlery Corporation as respondents compelled to perform removal activities. On September 16, 1992, an inventory was conducted by an EPA Removal Team. The inventory indicated approximately 4,900 55-gallon drums, packages and various sized containers storing known and unknown substances, including hazardous materials. The containers were reportedly in varying states of deterioration, including some leaking and overturned drums. EPA supervised a two-part removal of hazardous materials at the Site from November 3, 1992 until the completion of the removal on July 20, 1993. The first part of the removal was funded by EPA and included removal of the materials associated with Payne Cutlery's operations. Following this removal, Erie Chemical Sales, as part of its agreement with EPA, completed the removal of materials associated with its operations at the Site.

In February 2000, Cygnus Group, Inc. (CGI) commenced a subsurface investigation at the Site funded by an EPA Brownfields Pilot Grant. CGI identified TCE contamination in Site soil and groundwater, as well as other volatile and extractable petroleum hydrocarbons (VPH and EPH). CGI identified a release or threat of release condition that warranted an IRA based on concentrations of total volatile organic compounds (VOCs) in groundwater greater than 5 milligrams per liter (mg/L) within 30 feet of an occupied residential structure, where groundwater is less than 15 feet below ground surface (approximate depth to groundwater at the Site ranges from 8 to 12 feet below ground surface.) TCE has been detected in groundwater (in monitoring well CGW-8) at concentrations of up to 89,000 micrograms per liter (ug/L) upgradient of residential buildings (e.g., Taber Mill). TCE has exceeded the 1-percent pure phase solubility threshold indicative of Dense Non-Aqueous Phase Liquids (DNAPLs) in several monitoring wells (including CDW-8, based on aqueous headspace field screening). Gas chromatographic (GC) aqueous headspace screening data were used by CGI to identify monitoring well installation locations. Refer to Figure C-2 in the March 2012 QAPP Addendum NB-G (EPA RFA# 06135) for the GC data and other historical groundwater sampling results.

As a result of these data and the proximity of occupied residences, indoor air quality samples were taken in downgradient homes using SUMMA-type passivated stainless steel canisters on March 27 and 29, 2000. A second round of indoor air quality sampling was conducted between March 27 and June 15, 2001 in select residences on Coffin Street (including Taber Mill). TCE and petroleum constituents were detected in several residences at concentrations greater than MassDEP Residential Threshold Values (TVs). MassDEP used the CGI air monitoring data to conduct an Imminent Hazard analysis and concluded that no conditions were identified which required immediate actions to protect the health and safety of the public. MassDEP did, however, recommend further investigation.

In March 2000, the City of New Bedford took possession of the Site for tax purposes. In May, 2000 Vanesse Hangen Brustlin (VHB), the general contractor for the building demolition, removed additional contents of the building that were reportedly disposed of as hazardous waste.

Between March 27 and June 15, 2001, CGI conducted additional subsurface investigation of the Site, including the installation of seven new monitoring wells (CGW-11 through CGW-`17). Soil and groundwater samples were collected for analysis from these well locations. Notable results from these and previous groundwater investigations at the Site are summarized in Figure C-2 of the March 2012 QAPP Addendum NB-G (EPA RFA# 06135).

In 2010, the City of New Bedford constructed a parking lot in a portion of the Site. In accordance with MCP regulations, soil management associated with this construction project was conducted as a Release Abatement Measure (RAM) under RTN 4-15373. The RAM Plan was filed in November 2009, soil management activities were completed in the spring and summer of 2010, and RAM Status Reports were filed in March and November 2010. A RAM Completion Report was filed in December 2012.

In 2012 TRC installed four new monitoring wells (TRC-1 through TRC-4) and collected groundwater, soil vapor, and indoor air samples. Groundwater samples were collected from 11 new and previously existing monitoring wells. Thirteen soil vapor sample points were installed in subsurface and subslab locations (within or adjacent to residences and within Taber Mill Apartments) and 24 soil vapor samples were collected during two different sampling events. Indoor air samples were collected from four locations within Taber Mill Apartments.

Tables C-1 and C-2 summarize the groundwater and indoor air data generated from 1987 through 2001. Tables C-3 and C-4 summarize the 2012 groundwater and indoor air analytical data. Figure C-1 shows historical soil boring and monitoring well locations and Figure C-2 shows historical indoor air sample locations and results. Historical soil and soil vapor data do not pertain to investigations under this QAPP and have therefore not been provided.

Based in part on the results of the indoor air and groundwater investigations performed in 2012, TRC prepared an Assessment of Brownfields Cleanup Alternatives (ABCA) which produced a recommendation for modifications to the existing basement ventilation system at Taber Mill and permanganate injection within the TCE source area. Both remedies will be implemented before March 31, 2013.

3.3 Purpose of Investigation

The objective of this project is to measure the effectiveness of remedial activities to mitigate potential exposures to chlorinated VOCs in groundwater and indoor air in the vicinity of the former Payne Cutlery Site. Testing activities addressed in this QAPP include groundwater, sewer, and indoor air sampling to measure the effectiveness of the remedial measures. The results will be presented in a public meeting to be conducted during the last week of March 2013.

The specific investigation tasks are as follows:

- Collect six groundwater samples from selected monitoring wells to provide baseline groundwater concentrations of VOCs before the initiation of permanganate injection;
- Collect eight aqueous samples from nearby storm and sanitary sewer systems to determine whether intrusion from these systems should be anticipated during permanganate injection;
- Collect three indoor air samples from the first floor of Taber Mill Apartments and one ambient air sample from an adjacent outdoor location to test the effectiveness of the ventilation system modifications in controlling migration of VOC vapors; and
- Collect six groundwater samples from selected monitoring wells subsequent to permanganate injection.

In February 2013, prior to the start of environmental measurement activities under the Brownfields Cleanup Grant that is associated with this QAPP, four monitoring wells (TRC-5 through TRC-8) will be installed under a Brownfields Assessment Grant. Two subsurface soil samples will be collected from TRC-5 for treatability analyses, including total organic carbon (TOC) and Permanganate Natural Oxidant Demand (PNOD). Up to one additional soil sample may be collected from boring locations TRC-6, TRC-7, or TRC-8 for VOC analysis if field observations indicate significant VOC impacts (i.e., greater than 20 ppmv jar headspace readings) at these locations. Details on the collection of these soil samples are provided in QAPP Addendum NB-H (February 2013). Collection of groundwater samples from new monitoring wells TRC-5 through TRC-8 and existing wells TRC-4 and CGW-8 will be performed under both of the Brownfields grants. Baseline (pre-injection) sampling and the first round of post-injection sampling will be conducted under the Brownfields Cleanup Grant and are discussed in this QAPP Addendum. The second round of post-injection sampling will be performed under the Brownfields Assessment Grant. This second sample round was previously discussed in QAPP Addendum NB-H and is not further discussed in this QAPP Addendum.

TABLE C-1
Summary of Analytical Results for Groundwater Samples - 1987 through 2001
Payne Cutlery
New Bedford, Massachusetts

Analysis	Analyte		Sample Location:	CGW-1	CGW-2	CGW-3	CGW-4	CGW-5	CGW-6	CGW-7	CGW-8	CGW-9	CGW-10	CGW-11	CGW-12	CGW-13	CGW-14	CGW-15	CGW-16	CGW-17		CW-1	CW-2
			Sample ID:	CGW-1	CGW-2	CGW-3	CGW-4	CGW-5	CGW-6	CGW-7	CGW-8	CGW-9	CGW-10	CGW-11	CGW-12	CGW-13	CGW-14	CGW-15	CGW-16	CGW-17	CGW-17	CW-1	CW-2
			Screeen Interval (ft.):										5-15	4-14	4-14	2-12	5-15	4-14	5-15	5-20	5-20	9-14	9.9-14.9
			Sample Date:	3/2/2000	3/2/2000	3/2/2000	3/2/2000	3/2/2000	3/2/2000	3/2-10/2000	3/2/2000	3/2/2000	6/15/2001	6/15/2001	6/15/2001	6/15/2001	6/15/2001	6/15/2001	6/15/2001	6/15/2001	6/15/2001	2/14/2001	2/14/2001
		GW-2	**GW-3**																		Field Dup		
VPH																							
(ug/L)	C5 to C8 Aliphatics	3,000	50,000	240 U	240 U	240 U	240 U	240 U	240 U	**950**	**29,000**	**4,000**	NA	NA	240 U	2400 U	240 U	240 U	240 U	**3,000**	**2,800**	NA	NA
	C9 to C12 Aliphatics	5,000	50,000	100 U	100 U	**240**	100 U	100 U	100 U	100 U	100 U	**3,800**	NA	NA	100 U	**1,300**	100 U	100 U	100 U	100 U	100 U	NA	NA
	C9 to C10 Aromatics	7,000	50,000	70 U	70 U	**200**	140 U	70 U	70 U	70 U	**300**	**5,700**	NA	NA	**5.4**	**320**	**5.1**	5 U	5 U	**16**	**17**	NA	NA
EPH																							
(ug/L)	C9 to C18 Aliphatics	5,000	50,000	38 U	38 U	**410**	56 U	31 U	NA	45 U	40 U	**7,900**	NA	NA	ND	ND	ND	ND	ND	ND	ND	NA	NA
	C19 to C36 Aliphatics	NS	50,000	51 U	51 U	51 U	48 U	42 U	NA	60 U	53 U	**20,000**	NA	NA	ND	ND	ND	ND	ND	ND	ND	NA	NA
	C11 to C22 Aromatics	50,000	5,000	110 U	110 U	**560**	100 U	88 U	NA	70 U	110 U	**4,000**	NA	NA	ND	ND	ND	ND	ND	ND	ND	NA	NA
VOCs																							
(ug/L)	Trichloroethylene	30	5,000	2 U	2 U	**1**	2 U	2 U	2 U	**2,100**	**89,000**	**2,400**	2 U	**22**	2 U	**15 J**	**120**	**94**	**140**	**8,400**	**8,700**	5 U	5 U
	Tetrachloroethylene	50	30,000	NA	NA	NA	NA	NA	NA	NA	2000 U	NA	NA	NA	NA	NA	NA	NA	NA	**110**	**140**	NA	NA
	Dichloroethylene, cis-1,2-	100	50,000	NA	NA	NA	NA	NA	NA	NA	2000 U	NA	NA	NA	NA	NA	NA	NA	NA	**240**	**240**	NA	NA

Note:
ug/L - micrograms per liter.
NA - Sample not analyzed for the listed analyte.
ND - Not detected; Reporting limit not provided.
NP - Not provided.
Values in **Bold** indicate the compound was detected.
Values shown in Bold and shaded type exceed one or more of the listed standards.
VPH - Volatile Petroleum Hydrocarbons.
EPH - Extractable Petroleum Hydrocarbons.
VOCs - Volatile Organic Compounds.

TABLE C-1
Summary of Analytical Results for Groundwater Samples - 1987 through 2001
Payne Cutlery
New Bedford, Massachusetts

Analysis	Analyte		Sample Location:	CW-3	CW-4	CW-5	CW-6	CW-7	CW-8	CW-9	CW-10	CW-11	BMW-1	MW-1	MW-2		MW-2A	MW-3A	MW-4	MW-5	SB-1	SB-2
			Sample ID:	CW-3	CW-4	CW-5	CW-6	CW-7	CW-8	CW-9	CW-10	CW-11	BMW-1	MW-1 (GHR)	MW-2 (GHR)	MW-2 (GHR)	MW-2A (GHR)	MW-3A (GHR)	MW-4 (GHR)	MW-5 (GHR)	SB-1	SB-2
			Screeen Interval (ft.):	9.3-14.3	8-13	10.6-15.6	10-15	9.5-14.5	9-14	9.5-15.4	9.3-14.3	9.5-14.5		4-14	19-29	22-27	5-15	10-20	5-15	5-15		
			Sample Date:	2/14/2001	2/14/2001	2/15/2001	2/15/2001	2/15/2001	2/15/2001	2/15/2001	2/15/2001	2/15/2001		7/14/1987	7/14/1987	7/14/1987	7/14/1987	7/14/1987	7/14/1987	7/14/1987	3/7/2000	3/7-10/2000
		GW-2	**GW-3**																			
VPH																						
(ug/L)	C5 to C8 Aliphatics	3,000	50,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	240 U	NA	NA	NA	NA	NA	NA	NA	240 U	240 U
	C9 to C12 Aliphatics	5,000	50,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	100 U	NA	NA	NA	NA	NA	NA	NA	100 U	100 U
	C9 to C10 Aromatics	7,000	50,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	70 U	NA	NA	NA	NA	NA	NA	NA	70 U	70 U
EPH																						
(ug/L)	C9 to C18 Aliphatics	5,000	50,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	31 U	NA	NA	NA	NA	NA	NA	NA	39 U	44 U
	C19 to C36 Aliphatics	NS	50,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	41 U	NA	NA	NA	NA	NA	NA	NA	53 U	59 U
	C11 to C22 Aromatics	50,000	5,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	87 U	NA	NA	NA	NA	NA	NA	NA	210 U	120 U
VOCs																						
(ug/L)	Trichloroethylene	30	5,000	5 U	5 U	5 U	5 U	**260**	**15,000**	**16**	5 U	**7,900**	**20**	**53,000**	NP	NP	NP	**3.2**	**26**	NP	2 U	**5**
	Tetrachloroethylene	50	30,000	NA	NA	NA	NA	NA	**140**	NA	NA	**180**	NA	**560**	NA	NA	NA	NA	NA	NA	NA	NA
	Dichloroethylene, cis-1,2-	100	50,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**6,290**	NA	NA	NA	NA	NA	NA	NA	NA

Note:
ug/L - micrograms per liter.
NA - Sample not analyzed for the listed analyte.
ND - Not detected; Reporting limit not provided.
NP - Not provided.
Values in **Bold** indicate the compound was detected.
Values shown in Bold and shaded type exceed one or more of the listed standards.
VPH - Volatile Petroleum Hydrocarbons.
EPH - Extractable Petroleum Hydrocarbons.
VOCs - Volatile Organic Compounds.

Table C-2
Summary of Analytical Results for Indoor Air Samples - 2000 and 2001
Payne Cutlery
New Bedford, Massachusetts

	Analyte	Address:	348 Coffin Street					350 Coffin Street				353 Coffin Street	
		Location:	Basement	Basement	1st Floor	Basement	1st Floor	Basement	1st Floor	Basement	Basement	Basement	1st Floor
		Sample ID:	348 Coffin St B	348 Coffin St A	348 Coffin St 1	348 B	348L	350C-1	350C-2	350V	350F	353C-1	353C-2
		Sample Date:	3/29/2000	3/29/2000	3/29/2000	3/28/2000	3/28/2000	3/27/2000	3/27/2000	4/3/2001	4/3/2001	3/27/2000	3/27/2000
		TVs											
Organics													
(ug/m3)	Freon-12	NS	**8.91**	**10.3**	**9.01**	**2.77**	**2.67**	**12.0**	**24.3**	**3.17**	**3.12**	**11.3**	**5.79**
	Vinyl Chloride	0.27	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^
	Freon-11	NS	1.48 U	**4.83**	**9.37**	3.15 U	**3.54**	**3.91**	**7.78**	**6.13**	**8.38**	**3.19**	**4.27**
	Freon-113	NS	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	2.47 U	4.67 U
	cis-1,2-dichloroethene	0.8	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^
	1,1,1-trichloroethane	3	**5.82**	**3.48**	**128**	2.18 U	2.18 U	**10.5**	**14**	2.18 U	**4.57**	2.18 U	**3.64**
	Benzene	2.3	**2.88**	**3**	**4.63**	2.88 U^	2.88 U^	**5.75**	**5.69**	**3**	**3.87**	**4.25**	**5.24**
	Trichloroethene	0.8	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	**5.46**	**2.73**	**3.43**	**6.27**	1.82 U^	1.82 U^
	Toluene	54	**7.38**	**7.38**	**19.5**	3.58 U	**7.83**	**44.4**	**44.4**	**11.8**	**15.8**	**5.50**	**14.7**
	Tetrachloroethylene	1.4	2.85 U^	2.85 U^	2.85 U^	2.85 U^	2.85 U^	**3.67**	**8.15**	2.85 U^	2.85 U^	2.85 U^	**4.01**
	Ethylbenzene	7.4	2.34 U	2.34 U	2.34 U	2.34 U	2.34 U	**24.3**	**4.94**	2.34 U	2.34 U	2.34 U	**4.03**
	m,p-xylene	20	**3.81**	**3.68**	**6.33**	1.65 U	1.65 U	**129**	**22.1**	**9.88**	**10.9**	**4.60**	**12.2**
	o-xylene	20	**2.04**	1.99 U	**3.12**	1.99 U	1.99 U	**62.9**	**10.8**	**3.73**	**3.94**	**2.38**	**5.51**
	1,3,5-trimethylbenzene	NS	3.14 U	**3.39**	3.14 U	3.14 U	3.14 U	**62.8**	**9.32**	3.14 U	3.14 U	3.14 U	3.14 U
	1,2,4-trimethylbenzene	NS	**10.1**	**10.0**	**9.57**	4.17 U	4.17 U	**233**	**34.4**	**5.01**	**5.94**	**5.35**	**5.94**
	1,4-dichlorobenzene	0.5	**6.01**	4.87 U^	**31**	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	**8.36**	**9.98**

Notes:

ug/m3 - micrograms per cubic meter.

ND - Not detected.

NS - No MassDEP TVs exist for this analyte.

U - Compound was not detected at specified quantitation limit.

Values in **Bold** indicate the compound was detected.

Values shown in Bold and shaded type exceed one or more of TV.

^ - The detection limit is higher than one or more of TV.

TV - MassDEP Residential Threshold Values, December 2011.

Table C-2
Summary of Analytical Results for Indoor Air Samples - 2000 and 2001
Payne Cutlery
New Bedford, Massachusetts

	Analyte	Address:	357 Coffin Street				358 Coffin Street		362 Coffin Street				364 Coffin Street	
		Location:	Basement	1st Floor	Basement	1st Floor	Basement	1st Floor	Basement	1st Floor	Basement	1st Floor	Basement	1st Floor
		Sample ID:	357C-1	357C-2	357B	357L	92530	92529	362C-1	362C-2	362B	362L	364C-1	364C-2
		Sample Date:	3/27/2000	3/27/2000	4/3/2001	4/3/2001	3/29/2000	3/29/2000	3/27/2000	3/27/2000	3/28/2001	3/28/2001	3/27/2000	3/27/2000
		TVs												
Organics														
(ug/m3)	Freon-12	NS	**6.48**	**8.36**	2.03 U	**2.82**	**12.4**	**14.7**	**13.6**	**8.56**	**3.56**	**2.87**	**27.0**	**589**
	Vinyl Chloride	0.27	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^
	Freon-11	NS	**2.64**	**2.80**	3.15 U	3.15 U	**4.06**	**4.01**	**3.35**	**3.62**	3.15 U	3.15 U	**5.83**	**117**
	Freon-113	NS	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U
	cis-1,2-dichloroethene	0.8	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^
	1,1,1-trichloroethane	3	**7.78**	**3.05**	**4.19**	2.18 U	**6.69**	**4.79**	**86.5**	**12.3**	**16.6**	2.18 U	2.18 U	**5.49**
	Benzene	2.3	**11**	**19.1**	2.88 U^	**4.54**	**12.7**	**5.46**	**39**	**44.1**	**6.77**	**5.46**	**14.4**	**13**
	Trichloroethene	0.8	**1.88**	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^
	Toluene	54	**33.7**	**56.5**	**7.08**	**18.2**	**75.3**	**13.8**	**168**	**32.2**	**30.4**	**8.29**	**62.5**	**42.9**
	Tetrachloroethylene	1.4	**6.99**	**21.9**	2.85 U^	**9.78**	2.85 U^	**7.2**	**3.94**	2.85 U^	2.85 U^	2.85 U^	**37.8**	**7.74**
	Ethylbenzene	7.4	**12.6**	**12.9**	2.34 U	2.34 U	**14.9**	2.34 U	**32.8**	**2.9**	**4.64**	2.34 U	**12.1**	**6.29**
	m,p-xylene	20	**59.8**	**50.3**	**10.4**	**10.6**	**66.8**	**6.89**	**150**	**8.76**	**25.2**	1.65 U	**55.5**	**27.3**
	o-xylene	20	**26.7**	**22.8**	**4.21**	**3.77**	**26.2**	**3.60**	**55.9**	**3.94**	**6.85**	1.99 U	**19.7**	**10.4**
	1,3,5-trimethylbenzene	NS	**35.6**	**18.1**	**5.64**	3.14	**15.7**	3.14 U	**32.8**	**3.24**	3.14 U	3.14 U	3.14 U	**6.33**
	1,2,4-trimethylbenzene	NS	**114**	**57.9**	**11.6**	**6.72**	**61.3**	**8.34**	**135**	**10.3**	**7.17**	4.17 U	**46.0**	**24.6**
	1,4-dichlorobenzene	0.5	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	4.87 U^	**8.36**

Notes:

ug/m3 - micrograms per cubic meter.

ND - Not detected.

NS - No MassDEP TVs exist for this analyte.

U - Compound was not detected at specified quantitation limit.

Values in **Bold** indicate the compound was detected.

Values shown in Bold and shaded type exceed one or more of TV.

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TV - MassDEP Residential Threshold Values, December 2011.

Table C-2
Summary of Analytical Results for Indoor Air Samples - 2000 and 2001
Payne Cutlery
New Bedford, Massachusetts

	Analyte	Address:	6 Oneko Lane			8 Oneko Lane		12 Oneko Lane		Taber Mill					295 Phillips Ave
		Location:	Basement	Basement	1st Floor	Basement	1st Floor	Basement	1st Floor	Basement	1st Floor	Basement	Basement	1st Floor	Courtyard
		Sample ID:	6O-1	6O-3	6O-2	8 Oneko B	8 Onek 1st	12O-1	12O-2	Taber Mill B	Taber Mill 1st.	#107671	#107672	#107673	295P-1A
		Sample Date:	3/27/2000	3/27/2000	3/27/2000	3/29/2000	3/29/2000	3/27/2000	3/27/2000	3/29/2000	3/29/2000	3/28/2001	3/28/2001	3/28/200	3/27/2000
		TVs													
Organics															
(ug/m3)	Freon-12	NS	**8.21**	**8.61**	**8.31**	**13.1**	**18.1**	**9.20**	**10.29**	**12.0**	**11.2**	**4.60**	**4.6**	**2.67**	**10.0**
	Vinyl Chloride	0.27	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^	2.48 U^
	Freon-11	NS	**2.24**	**2.35**	**2.56**	1.48 U	**20.0**	**2.32**	**3.83**	**3.51**	**6.33**	3.15 U	3.15 U	3.15 U	**3.35**
	Freon-113	NS	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	4.67 U	**13.1**	4.67 U	4.67 U	4.67 U	4.67 U	**4.89**
	cis-1,2-dichloroethene	0.8	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	1.59 U^	**8.09**	**8.37**	1.59 U^	1.59 U^
	1,1,1-trichloroethane	3	2.18 U	2.18 U	2.18 U	**5.55**	**22.8**	2.18 U	2.18 U	**344**	**18.9**	**3.43**	**3.32**	2.18 U	2.18 U
	Benzene	2.3	**3.58**	2.88 U^	**4.38**	**3.8**	**12.8**	2.88 U^	**6.65**	**4.6**	**5.05**	**4.5**	**5.4**	2.88 U^	2.88 U^
	Trichloroethene	0.8	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^	**37.4**	**13.9**	**264**	**251**	**3.91**	1.82 U^
	Toluene	54	**6.86**	**7.04**	**35**	**13.1**	**43.7**	**5.69**	**19.5**	**10.9**	**16.9**	**250**	**244**	**57.6**	3.58 U
	Tetrachloroethylene	1.4	2.85 U^	2.85 U^	2.85 U^	2.85 U^	2.85 U^	2.85 U^	2.85 U^	2.85 U^	2.85 U^	**25.4**	**24.2**	2.85 U^	2.85 U^
	Ethylbenzene	7.4	2.34 U	2.34 U	**2.6**	**2.38**	**8.63**	2.34 U	**2.69**	2.34 U	**3.25**	**48.3**	**47.1**	2.34 U	2.34 U
	m,p-xylene	20	**4.42**	**4.68**	**8.06**	**9.15**	**26.6**	**5.59**	**8.15**	**7.28**	**11.7**	**225**	**218**	**5.94**	**3.55**
	o-xylene	20	**2.04**	**2.12**	**3.81**	**6.03**	**7.98**	**2.56**	1.99 U	**3.38**	**5.42**	**86**	**83.7**	**4.73**	1.99 U
	1,3,5-trimethylbenzene	NS	3.14 U	3.14 U	3.14 U	**18.8**	**6.33**	3.14 U	3.14 U	**6.63**	**10.0**	**73**	**71.2**	**10.2**	3.14 U
	1,2,4-trimethylbenzene	NS	**4.96**	**5.35**	**9.72**	**72.1**	**20.7**	**5.55**	**7.95**	**20.8**	**37.7**	**110**	**107**	**31.9**	**6.28**
	1,4-dichlorobenzene	0.5	4.87 U^	4.87 U^	4.87 U^	4.87 U^	**65.5**	4.87 U^	4.87 U^	**18.3**	**42**	4.87 U^	4.87 U^	4.87 U^	4.87 U^

Notes:

ug/m3 - micrograms per cubic meter.

ND - Not detected.

NS - No MassDEP TVs exist for this analyte.

U - Compound was not detected at specified quantitation limit.

Values in **Bold** indicate the compound was detected.

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TV - MassDEP Residential Threshold Values, December 2011.

Table C-3: Summary of for Groundwater Analytical Results -- April 2012
Payne Cutlery
New Bedford, Massachusetts

Analysis	Analyte	Sample ID:		CGW-8		CGW-10	CGW-11	CGW-14	CGW-15	CGW-16	CGW-17	TRC-1	TRC-2	TRC-3	TRC-4
		Sample Date:		4/5/2012	4/5/2012	4/5/2012	4/11/2012	4/5/2012	4/5/2012	4/5/2012	4/5/2012	4/4/2012	4/4/2012	4/4/2012	4/4/2012
		GW-2	GW-3		Field Dup										
VOCs															
(ug/L)	Acetone	50,000	50,000	5,000 U	5,000 U	10 U	50 U	**10**	10 U	10 U	10 U	10 U	20 U	200 U	200 U
	tert-Amyl Methyl Ether (TAME)	NS	NS	250 U	250 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U
	Benzene	2,000	10,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Bromobenzene	NS	NS	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Bromochloromethane	NS	NS	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Bromodichloromethane	6	50,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Bromoform	700	50,000	500 U	500 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Bromomethane	7	800	2,500 U	2,500 U	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	100 U	100 U
	2-Butanone (MEK)	50,000	50,000	5,000 U	5,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	200 U	200 U
	n-Butylbenzene	7,000[1]	50,000[1]	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	sec-Butylbenzene	7,000[1]	50,000[1]	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	tert-Butylbenzene	7,000[1]	50,000[1]	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	tert-Butyl Ethyl Ether (TBEE)	NS	NS	250 U	250 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U
	Carbon Disulfide	NS	NS	2,500 U	2,500 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	100 U	100 U
	Carbon Tetrachloride	2	5,000	500 U	500 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Chlorobenzene	200	1,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Chlorodibromomethane	20	50,000	250 U	250 U	0.50 U	5.0 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U
	Chloroethane	NS	NS	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	Chloroform	50	20,000	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	Chloromethane	NS	NS	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	2-Chlorotoluene	NS	NS	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	4-Chlorotoluene	NS	NS	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,2-Dibromo-3-chloropropane (DBCP	NS	NS	1,000 U	1,000 U	2.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	1,2-Dibromoethane (EDB)	2	50,000	250 U	250 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U
	Dibromomethane	NS	NS	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,2-Dichlorobenzene	2000	2,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,3-Dichlorobenzene	2,000	50,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,4-Dichlorobenzene	200	8,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Dichlorodifluoromethane (Freon 12)	NS	NS	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	1,1-Dichloroethane	1,000	20,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,2-Dichloroethane	5	20,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,1-Dichloroethylene	80	30,000	500 U	500 U	1.0 U	**1.5**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	cis-1,2-Dichloroethylene	100	50,000	**8,200**	**6,500**	1.0 U	**160**	1.0 U	1.0 U	**6.3**	**1.1**	1.0 U	**56**	**61**	**50**
	trans-1,2-Dichloroethylene	90	50,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,2-Dichloropropane	3	50,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,3-Dichloropropane	NS	NS	250 U	250 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U
	2,2-Dichloropropane	NS	NS	500 U	500 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,1-Dichloropropene	NS	NS	250 U	250 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U
	cis-1,3-Dichloropropene	10[2]	200[2]	200 U	200 U	0.40 U	2.0 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.80 U	8.0 U	8.0 U
	trans-1,3-Dichloropropene	10[2]	200[2]	200 U	200 U	0.40 U	5.0 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.80 U	8.0 U	8.0 U
	Diethyl Ether	NS	NS	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	Diisopropyl Ether (DIPE)	NS	NS	250 U	250 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U
	1,4-Dioxane	6,000	50,000	50,000 U	50,000 U	100 U	50 U	100 U	100 U	100 U	100 U	100 U	200 U	2,000 U	2,000 U
	Ethylbenzene	20,000	5,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Hexachlorobutadiene	1	3,000	250 U	250 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U
	2-Hexanone (MBK)	NS	NS	5,000 U	5,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	200 U	200 U
	Isopropylbenzene (Cumene)	7,000[1]	50,000[1]	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	p-Isopropyltoluene (p-Cymene)	7,000[1]	50,000[1]	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Methyl tert-Butyl Ether (MTBE)	50,000	50,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Methylene Chloride	10,000	50,000	2,500 U	2,500 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	100 U	100 U
	4-Methyl-2-pentanone (MIBK)	50,000	50,000	5,000 U	5,000 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	200 U	200 U
	Naphthalene	1,000	20,000	2,500 U	2,500 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	100 U	100 U
	n-Propylbenzene	7,000[1]	50,000[1]	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Styrene	100	6,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,1,1,2-Tetrachloroethane	10	50,000	500 U	500 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,1,2,2-Tetrachloroethane	9	50,000	250 U	250 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1.0 U	10 U	10 U

Table C-3: Summary of for Groundwater Analytical Results -- April 2012
Payne Cutlery
New Bedford, Massachusetts

Analysis	Analyte		Sample ID:	CGW-8		CGW-10	CGW-11	CGW-14	CGW-15	CGW-16	CGW-17	TRC-1	TRC-2	TRC-3	TRC-4
			Sample Date:	4/5/2012	4/5/2012	4/5/2012	4/11/2012	4/5/2012	4/5/2012	4/5/2012	4/5/2012	4/4/2012	4/4/2012	4/4/2012	4/4/2012
		GW-2	GW-3		Field Dup										
	Tetrachloroethylene	50	30,000	**740**	**750**	1.0 U	**2.5**	1.0 U	1.0 U	**1.9**	1.0 U	1.0 U	**18**	**68**	**20**
	Tetrahydrofuran	NS	NS	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	Toluene	50,000	40,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,2,3-Trichlorobenzene	NS	NS	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	1,2,4-Trichlorobenzene	2,000	50,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,1,1-Trichloroethane	4,000	20,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,1,2-Trichloroethane	900	50,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Trichloroethylene	30	5,000	**42,000**	**44,000**	1.0 U	**1,500**	**1.3**	**3.5**	**20**	**11**	**15**	**240**	**1,100**	**1,800**
	Trichlorofluoromethane (Freon 11)	NS	NS	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	1,2,3-Trichloropropane	NS	NS	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	1,2,4-Trimethylbenzene	7,000(1)	50,000(1)	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	1,3,5-Trimethylbenzene	7,000(1)	50,000(1)	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
	Vinyl Chloride	2	50,000	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	m+p Xylene	9,000	5,000	1,000 U	1,000 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	40 U	40 U
	o-Xylene	9,000	5,000	500 U	500 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	20 U	20 U
VPH															
(ug/L)	C5-C8 Aliphatics	3,000	50,000	**15,000**	**14,000**	100 U	**1,200**	NA	NA	NA	100 U	100 U	**130**	NA	**800**
	C9-C12 Aliphatics	5,000	50,000	1,000 U	1,000 U	100 U	100 U	NA	NA	NA	100 U	100 U	100 U	NA	100 U
	C9-C10 Aromatics	7,000	50,000	1,000 U	1,000 U	100 U	100 U	NA	NA	NA	100 U	100 U	100 U	NA	100 U
	Benzene	2,000	10,000	10 U	10 U	1.0 U	1.0 U	NA	NA	NA	1.0 U	1.0 U	1.0 U	NA	1.0 U
	Ethylbenzene	20,000	5,000	10 U	10 U	1.0 U	1.0 U	NA	NA	NA	1.0 U	1.0 U	1.0 U	NA	1.0 U
	Methyl tert-Butyl Ether (MTBE)	50,000	50,000	10 U	10 U	1.0 U	1.0 U	NA	NA	NA	1.0 U	1.0 U	1.0 U	NA	1.0 U
	Naphthalene	1,000	20,000	50 U	50 U	5.0 U	5.0 U	NA	NA	NA	5.0 U	5.0 U	5.0 U	NA	5.0 U
	Toluene	50,000	40,000	10 U	10 U	1.0 U	1.0 U	NA	NA	NA	1.0 U	1.0 U	1.0 U	NA	1.0 U
	m+p Xylene	9,000	5,000	20 U	20 U	2.0 U	2.0 U	NA	NA	NA	2.0 U	2.0 U	2.0 U	NA	2.0 U
	o-Xylene	9,000	5,000	10 U	10 U	1.0 U	1.0 U	NA	NA	NA	1.0 U	1.0 U	1.0 U	NA	1.0 U
EPH															
(ug/L)	C9-C18 Aliphatics	5,000	50,000	100 U	100 U	NA	100 U	NA	NA	NA	NA	100 U	100 U	NA	100 U
	C19-C36 Aliphatics	NS	50,000	100 U	100 U	NA	100 U	NA	NA	NA	NA	100 U	100 U	NA	100 U
	C11-C22 Aromatics	50,000	5,000	100 U	100 U	NA	100 U	NA	NA	NA	NA	100 U	100 U	NA	100 U
	Acenaphthene	NS	6,000	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Acenaphthylene	10,000	40	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Anthracene	NS	30	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Benzo(a)anthracene	NS	1,000	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Benzo(a)pyrene	NS	500	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Benzo(b)fluoranthene	NS	400	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Benzo(g,h,i)perylene	NS	20	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Benzo(k)fluoranthene	NS	100	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Chrysene	NS	70	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Dibenz(a,h)anthracene	NS	40	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Fluoranthene	NS	200	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Fluorene	NS	40	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Indeno(1,2,3-cd)pyrene	NS	100	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	2-Methylnaphthalene	2,000	20,000	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Naphthalene	1,000	20,000	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Phenanthrene	NS	10,000	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U
	Pyrene	NS	20	2.0 U	2.0 U	NA	2.0 U	NA	NA	NA	NA	2.0 U	2.0 U	NA	2.0 U

Notes:

ug/L - micrograms per liter.

NA - Sample not analyzed for the listed analyte.

NS - No MassDEP standards exist for this analyte.

U - Compound was not detected at specified quantitation limit.

Values in **Bold** indicate the compound was detected.

Values shown in Bold and shaded type exceed one or more of the listed MassDEP Method 1 standards.

VOCs - Volatile Organic Compounds.

VPH - Volatile Petroleum Hydrocarbons.

EPH - Extractable Petroleum Hydrocarbons.

(1) - MassDEP Method 1 standards for C9-C10 aromatic hydrocarbons used.

(2) - MassDEP Method 1 standards for 1,3-Dichloropropene used.

Table C-4:
Summary of Indoor and Ambient AirAnalytical Results from Taber Mill -- June 2012
Former Payne Cutlery
New Bedford, Massachusetts

Analysis	Analyte	Sample ID:	TM IAQ-1	TM IAQ-B		TM-CRAWLSPACE-1	TM-CRAWLSPACE-2	AAQ
		Sample Date:	6/29/2012	6/29/2012	6/29/2012	6/29/2012	6/29/2012	6/29/2012
		IATV			Field Dup			
APH								
(ug/m3)	1,3-Butadiene	NS	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
	Methyl tert butyl ether	39	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
	Benzene	2.3	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
	Toluene	54	**3.30**	**9.60**	**9.90**	**3.60**	**4.50**	**2.30**
	Ethylbenzene	7.4	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
	p/m-Xylene	20	4.00 U	**4.10**	**4.20**	4.00 U	4.00 U	4.00 U
	o-Xylene	20	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
	Naphthalene	0.61	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U
	C5-C8 Aliphatics	58	**130**	**84.0**	**90.0**	**48.0**	**55.0**	**24.0**
	C9-C12 Aliphatics	68	**68.0**	**40.0**	**40.0**	**16.0**	**23.0**	14.0 U
	C9-C10 Aromatics	10	10.0 U	**13.0**	**14.0**	10.0 U	10.0 U	10.0 U
TO-15								
(ug/m3)	Vinyl chloride	0.27	0.511 U	0.511 U	0.511 U	0.511 U	0.511 U	0.511 U
	Bromomethane	0.6	0.777 U	0.777 U	0.777 U	0.777 U	0.777 U	0.777 U
	Acetone	91	**64.4**	**34.7**	**33.5**	**26.8**	**25.2**	**15.1**
	1,1-Dichloroethene	0.8	0.793 U	0.793 U	0.793 U	0.793 U	0.793 U	0.793 U
	Methylene chloride	5	4.86 U	4.86 U	4.86 U	4.86 U	4.86 U	4.86 U
	trans-1,2-Dichloroethene	0.8	0.793 U	0.793 U	0.793 U	0.793 U	0.793 U	0.793 U
	1,1-Dichloroethane	0.8	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U
	Methyl tert butyl ether	39	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U
	2-Butanone	12	**3.18**	**10.40**	**8.76**	**4.48**	**2.41**	**2.06**
	cis-1,2-Dichloroethene	0.8	0.793 U	0.793 U	0.793 U	0.793 U	0.793 U	0.793 U
	Chloroform	1.9	0.977 U	0.977 U	0.977 U	0.977 U	0.977 U	0.977 U
	1,2-Dichloroethane	0.09	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	0.809 U
	1,1,1-Trichloroethane	3	1.09 U	**1.14**	**1.27**	1.09 U	1.09 U	1.09 U
	Benzene	2.3	**0.891**	**0.805**	**0.866**	**0.789**	**0.939**	0.639 U
	Carbon tetrachloride	0.54	1.26 U	1.26 U	1.26 U	1.26 U	1.26 U	1.26 U
	1,2-Dichloropropane	0.13	0.924 U	0.924 U	0.924 U	0.924 U	0.924 U	0.924 U
	Bromodichloromethane	0.14	1.34 U	1.34 U	1.34 U	1.34 U	1.34 U	1.34 U
	1,4-Dioxane	0.59	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	0.721 U
	Trichloroethene	0.8	1.07 U	**1.27**	**1.72**	1.07 U	1.07 U	1.07 U
	cis-1,3-Dichloropropene	0.6	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U
	4-Methyl-2-pentanone	2.2	0.820 U	0.820 U	0.820 U	0.820 U	0.820 U	0.820 U
	trans-1,3-Dichloropropene	0.6	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	0.908 U
	1,1,2-Trichloroethane	0.15	1.09 U	1.09 U	1.09 U	1.09 U	1.09 U	1.09 U
	Toluene	54	**2.80**	**8.44**	**8.74**	**3.48**	**4.14**	**2.14**
	Dibromochloromethane	0.1	1.70 U	1.70 U	1.70 U	1.70 U	1.70 U	1.70 U
	1,2-Dibromoethane	0.011	1.54 U	1.54 U	1.54 U	1.54 U	1.54 U	1.54 U
	Tetrachloroethene	1.4	1.36 U	1.36 U	1.36 U	1.36 U	1.36 U	1.36 U
	Chlorobenzene	2.3	0.921 U	0.921 U	0.921 U	0.921 U	0.921 U	0.921 U
	Ethylbenzene	7.4	0.869 U	**1.18**	**1.20**	0.869 U	0.869 U	0.869 U
	p/m-Xylene	20	1.74 U	**4.00**	**3.96**	**2.48**	**2.67**	1.74 U
	Bromoform	2.2	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	2.07 U
	Styrene	1.4	0.852 U	0.852 U	0.852 U	0.852 U	0.852 U	0.852 U
	1,1,2,2-Tetrachloroethane	0.041	1.37 U	1.37 U	1.37 U	1.37 U	1.37 U	1.37 U
	o-Xylene	20	0.869 U	**1.42**	**1.48**	**0.899**	**1.00**	0.869 U
	1,3-Dichlorobenzene	0.6	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U
	1,4-Dichlorobenzene	0.5	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U
	1,2-Dichlorobenzene	0.72	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	1.20 U
	1,2,4-Trichlorobenzene	3.4	1.48 U	1.48 U	1.48 U	1.48 U	1.48 U	1.48 U
	Naphthalene	0.61	**0.383 J**	**0.802 J**	**0.734 J**	1.05 U	1.05 U	1.05 U
	Hexachlorobutadiene	4.6	2.13 U	2.13 U	2.13 U	2.13 U	2.13 U	2.13 U

Notes:

ug/m3 - micrograms per cubic meter.

J - Estimated value.

NS - No MassDEP Standards exist for this analyte.

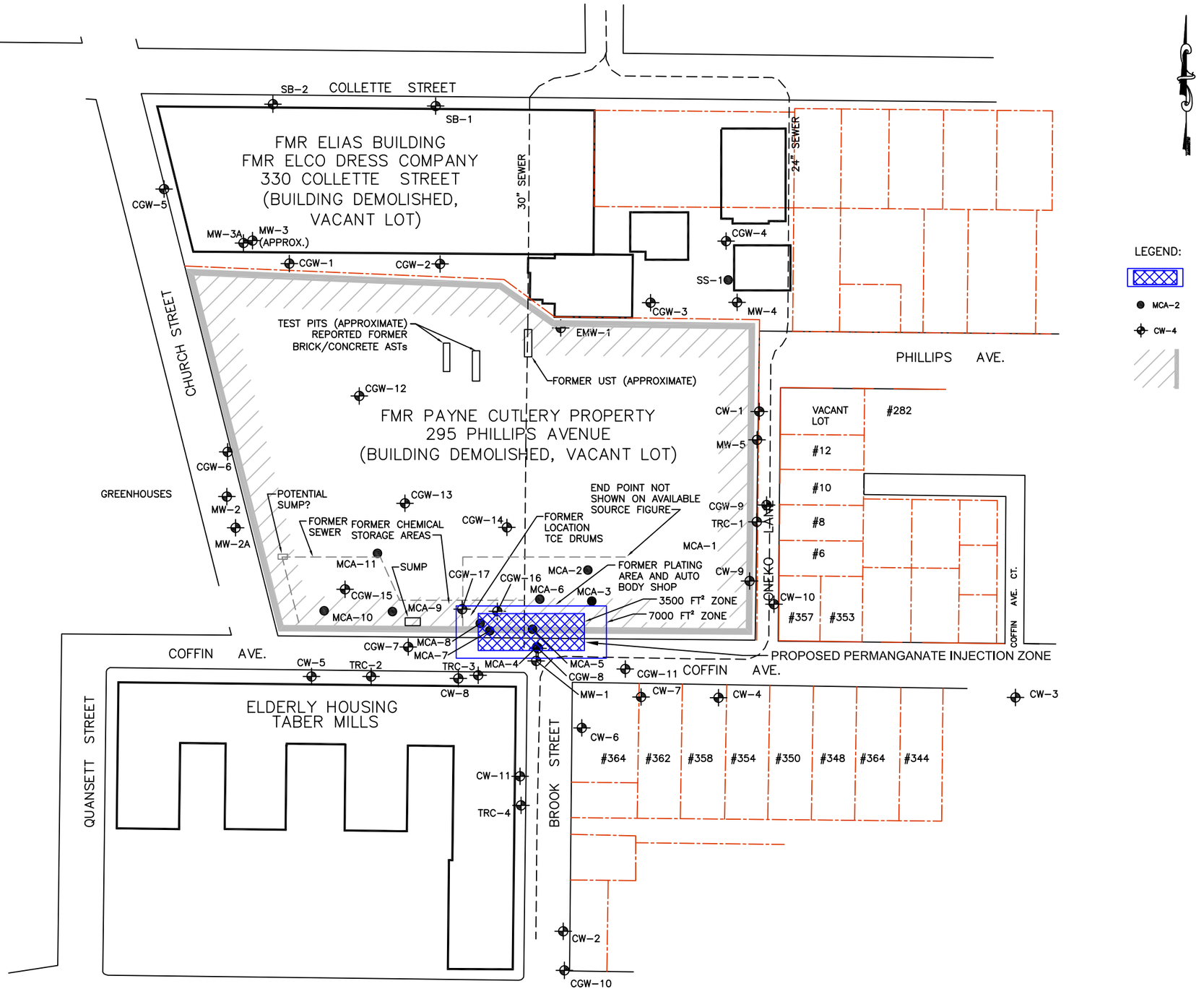
U - Compound was not detected at specified quantitation limit.

Values in **Bold** indicate the compound was detected.

APH - Air-Phase Petroleum Hydrocarbons.

TO - Toxic organics.

IATV - MassDEP, Indoor Air Threshold Values (IATV), Vapor Intrusion Guidance - Interim Final, December 2011.



LEGEND:

- PROPOSED PERMANGANATE INJECTION ZONE
- MCA-2 — SOIL BORINGS BY OTHERS
- CW-4 — GROUNDWATER MONITORING WELLS
- DELINEATES APPROXIMATE BOUNDARY OF FORMER PAYNE CUTLERY PROPERTY.

APPROXIMATE GRAPHIC SCALE

0' 50' 100' 200'

FORMER PAYNE CUTLERY
295 PHILLIPS AVENUE
NEW BEDFORD, MA.

HISTORICAL SOIL BORING AND MONITORING WELL LOCATIONS

TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
(978) 970-5600

DRAWN BY: HWB
CHECKED BY: ECW
DATE: FEB 2013

FIGURE C-1

FILE: T:\E_CAD\172744\HIST SOIL BORING & MW LOCS 2013-02-07.dwg

362 Coffin Avenue	Basement 362C-1 3/27/2000	1st Floor 362C-2 3/27/2000	Basement 362B 3/28/2001	1st Floor 362L 3/28/2001
tol	168	32.2	30.4	8.29
C5-C8 Al	NT	NT	NT	NT
C9-C12 Al	NT	NT	NT	NT
C9-C10 Ar	NT	NT	NT	NT
Acetone	NT	NT	NT	NT
2-Butanone	NT	NT	NT	NT
1,2-DCA	NT	NT	NT	NT
1,1,1-TCA	86.5	12.3	16.6	2.18 U
benz	39	44.1	6.77	5.46
C. Tetrachloride	NT	NT	NT	NT
TCE	1.82 U^	1.82 U^	1.82 U^	1.82 U^
ethbenz	32.8	2.9	4.64	2.34 U
m,p-X	150	8.76	25.2	1.65 U
o-X	55.9	3.94	6.85	1.99 U
1,4-DCB	4.87 U^	4.87 U^	4.87 U^	4.87 U^
Napthalene	NT	NT	NT	NT

295 Phillips Ave	Courtyard 295P-1A 3/27/2000
tol	3.58 U
C5-C8 Al	NT
C9-C12 Al	NT
C9-C10 Ar	NT
Acetone	NT
2-Butanone	NT
1,2-DCA	NT
1,1,1-TCA	2.18 U
benz	2.88 U^
C. Tetrachloride	NT
TCE	1.82 U^
ethbenz	2.34 U
m,p-X	3.55
o-X	1.99 U
1,4-DCB	4.87 U^
Napthalene	NT

12 Oneko Lane	Basement 12O-1 3/27/2000	1st Floor 12O-2 3/27/2000
tol	5.69	19.5
C5-C8 Al	NT	NT
C9-C12 Al	NT	NT
C9-C10 Ar	NT	NT
Acetone	NT	NT
2-Butanone	NT	NT
1,2-DCA	NT	NT
1,1,1-TCA	2.18 U	2.18 U
benz	2.88 U^	6.65
C. Tetrachloride	NT	NT
TCE	1.82 U^	1.82 U^
ethbenz	2.34 U	2.69
m,p-X	5.59	8.15
o-X	2.56	1.99 U
1,4-DCB	4.87 U^	4.87 U^
Napthalene	NT	NT

8 Oneko Lane	Basement 8 Oneko B 3/28/2000	1st Floor 8 Onek 1st 3/28/2000
tol	13.1	43.7
C5-C8 Al	NT	NT
C9-C12 Al	NT	NT
C9-C10 Ar	NT	NT
Acetone	NT	NT
2-Butanone	NT	NT
1,2-DCA	NT	NT
1,1,1-TCA	5.55	22.8
benz	3.8	12.8
C. Tetrachloride	NT	NT
TCE	1.82 U^	1.82 U^
ethbenz	2.38	8.63
m,p-X	9.15	26.6
o-X	6.03	7.98
1,4-DCB	4.87 U^	65.5
Napthalene	NT	NT

6 Oneko Lane	Basement 6O-1 3/27/2000	Basement 6O-3# 3/27/2000	1st Floor 6O-2 3/27/2000
tol	6.86	7.04	35
C5-C8 Al	NT	NT	NT
C9-C12 Al	NT	NT	NT
C9-C10 Ar	NT	NT	NT
Acetone	NT	NT	NT
2-Butanone	NT	NT	NT
1,2-DCA	NT	NT	NT
1,1,1-TCA	2.18 U	2.18 U	2.18 U
benz	3.58	2.88 U^	4.38
C. Tetrachloride	NT	NT	NT
TCE	1.82 U^	1.82 U^	1.82 U^
ethbenz	2.34 U	2.34 U	2.6
m,p-X	4.42	4.68	8.06
o-X	2.04	2.12	3.81
1,4-DCB	4.87 U^	4.87 U^	4.87 U^
Napthalene	NT	NT	NT

364 Coffin Avenue	Basement 364C-1 3/27/2000	1st Floor 364C-2 3/27/2000
tol	62.5	42.9
C5-C8 Al	NT	NT
C9-C12 Al	NT	NT
C9-C10 Ar	NT	NT
Acetone	NT	NT
2-Butanone	NT	NT
1,2-DCA	NT	NT
1,1,1-TCA	2.18 U	5.49
benz	14.4	13
C. Tetrachloride	NT	NT
TCE	1.82 U^	1.82 U^
ethbenz	12.1	6.29
m,p-X	55.5	27.3
o-X	19.7	10.4
1,4-DCB	4.87 U^	8.36
Napthalene	NT	NT

Taber Mill	AAQ Outdoor Ambient 6/29/2012
tol	2.30
C5-C8 Al	24.0
C9-C12 Al	14.0 U
C9-C10 Ar	10.0 U
Acetone	15.1
2-Butanone	2.06
1,2-DCA	0.081 U
1,1,1-TCA	1.09 U
benz	0.639 U
C. Tetrachloride	0.352
TCE	0.640
ethbenz	0.869 U
m,p-X	1.74 U
o-X	0.869 U
1,4-DCB	0.120 U
Napthalene	0.262 U

Taber Mill	TM IAQ-1 First Floor 6/29/2012
tol	3.30
C5-C8 Al	130
C9-C12 Al	68.0
C9-C10 Ar	10.0 U
Acetone	64.4
2-Butanone	3.18
1,2-DCA	0.134
1,1,1-TCA	1.09 U
benz	0.891
C. Tetrachloride	0.358
TCE	0.274
ethbenz	0.869 U
m,p-X	1.74 U
o-X	0.869 U
1,4-DCB	0.120 U
Napthalene	0.383 J

Taber Mill	TM-CRAWLSPACE-2 Crawlspace 6/29/2012
tol	4.50
C5-C8 Al	55.0
C9-C12 Al	23.0
C9-C10 Ar	10.0 U
Acetone	25.2
2-Butanone	2.41
1,2-DCA	0.142
1,1,1-TCA	1.09 U
benz	0.939
C. Tetrachloride	0.352
TCE	0.677
ethbenz	0.869 U
m,p-X	2.67
o-X	1.00
1,4-DCB	0.120 U
Napthalene	0.262 U

Taber Mill	TM-CRAWLSPACE-1 Crawlspace 6/29/2012
tol	3.60
C5-C8 Al	48.0
C9-C12 Al	16.0
C9-C10 Ar	10.0 U
Acetone	26.8
2-Butanone	4.48
1,2-DCA	0.085
1,1,1-TCA	1.09 U
benz	0.789
C. Tetrachloride	0.352
TCE	0.338
ethbenz	0.869 U
m,p-X	2.48
o-X	0.899
1,4-DCB	0.120 U
Napthalene	0.262 U

Taber Mill	Basement Taber Mill B 3/28/2000	1st Floor Taber Mill 1st. 3/28/2000	Basement #107671 3/28/2001	Basement #107672 3/28/2001	1st Floor #107673 3/28/2001
tol	10.9	16.9	250	244	57.6
C5-C8 Al	NT	NT	NT	NT	NT
C9-C12 Al	NT	NT	NT	NT	NT
C9-C10 Ar	NT	NT	NT	NT	NT
Acetone	NT	NT	NT	NT	NT
2-Butanone	NT	NT	NT	NT	NT
1,2-DCA	NT	NT	NT	NT	NT
1,1,1-TCA	344	18.9	3.43	3.32	2.18 U
benz	4.6	5.05	4.5	5.4	2.88 U^
C. Tetrachloride	NT	NT	NT	NT	NT
TCE	37.4	13.9	264	251	3.91
ethbenz	2.34 U	3.25	48.3	47.1	2.34 U
m,p-X	7.28	11.7	225	218	5.94
o-X	3.38	5.42	86	83.7	4.73
1,4-DCB	18.3	42	4.87 U^	4.87 U^	4.87 U^
Napthalene	NT	NT	NT	NT	NT

Taber Mill	TM IAQ-B Basement 6/29/2012
tol	9.90
C5-C8 Al	90
C9-C12 Al	40.0
C9-C10 Ar	14
Acetone	33.5
2-Butanone	8.76
1,2-DCA	0.125
1,1,1-TCA	1.27
benz	0.866
C. Tetrachloride	0.377
TCE	1.72
ethbenz	1.20
m,p-X	4.20
o-X	1.48
1,4-DCB	0.126
Napthalene	0.734 J

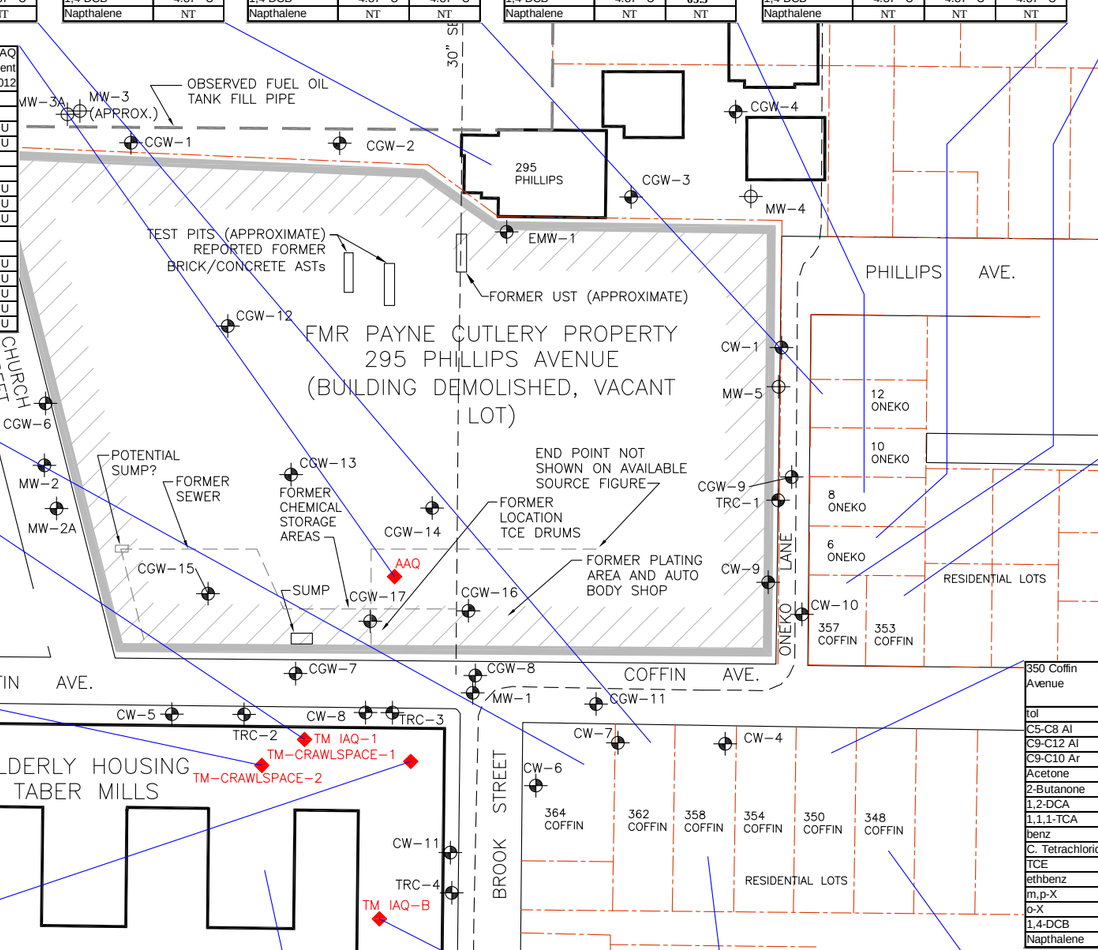
358 Coffin Avenue	Basement 92530 3/29/2000	1st Floor 92529 3/29/2000
tol	75.3	13.8
C5-C8 Al	NT	NT
C9-C12 Al	NT	NT
C9-C10 Ar	NT	NT
Acetone	NT	NT
2-Butanone	NT	NT
1,2-DCA	NT	NT
1,1,1-TCA	6.69	4.79
benz	12.7	5.46
C. Tetrachloride	NT	NT
TCE	1.82 U^	1.82 U^
ethbenz	14.9	2.34 U
m,p-X	66.8	6.89
o-X	26.2	3.60
1,4-DCB	4.87 U^	4.87 U^
Napthalene	NT	NT

348 Coffin Avenue	Basement 348 Coffin St B 3/28/2000	Basement 348 Coffin St A 3/28/2000	1st Floor 348 Coffin St 1 3/28/2000	Basement 348 B 3/28/2001	1st Floor 348L 3/28/2001
tol	7.38	7.38	19.5	3.58 U	7.83
C5-C8 Al	NT	NT	NT	NT	NT
C9-C12 Al	NT	NT	NT	NT	NT
C9-C10 Ar	NT	NT	NT	NT	NT
Acetone	NT	NT	NT	NT	NT
2-Butanone	NT	NT	NT	NT	NT
1,2-DCA	NT	NT	NT	NT	NT
1,1,1-TCA	5.82	3.48	128	2.18 U	2.18
benz	2.88	3	4.63	2.88 U^	2.88
C. Tetrachloride	NT	NT	NT	NT	NT
TCE	1.82 U^	1.82 U^	1.82 U^	1.82 U^	1.82 U^
ethbenz	2.34 U	2.34 U	2.34 U	2.34 U	2.34 U
m,p-X	3.81	3.68	6.33	1.65 U	1.65 U
o-X	2.04	1.99 U	3.12	1.99 U	1.99 U
1,4-DCB	6.01	4.87 U^	31	4.87 U^	4.87 U^
Napthalene	NT	NT	NT	NT	NT

357 Coffin Avenue	Basement 357C-1 3/27/2000	1st Floor 357C-2 3/27/2000	Basement 357B 4/3/2001	1st Floor 357L 4/3/2001
tol	33.7	56.5	7.08	18.2
C5-C8 Al	NT	NT	NT	NT
C9-C12 Al	NT	NT	NT	NT
C9-C10 Ar	NT	NT	NT	NT
Acetone	NT	NT	NT	NT
2-Butanone	NT	NT	NT	NT
1,2-DCA	NT	NT	NT	NT
1,1,1-TCA	7.78	3.05	4.19	2.18 U
benz	11	19.1	2.88 U^	4.54
C. Tetrachloride	NT	NT	NT	NT
TCE	1.88	1.82 U^	1.82 U^	1.82 U^
ethbenz	12.6	12.9	2.34 U	2.34 U
m,p-X	59.8	50.3	10.4	10.6
o-X	26.7	22.8	4.21	3.77
1,4-DCB	4.87 U^	4.87 U^	4.87 U^	4.87 U^
Napthalene	NT	NT	NT	NT

353 Coffin Avenue	Basement 353C-1 3/27/2000	1st Floor 353C-2 3/27/2000
tol	5.50	14.7
C5-C8 Al	NT	NT
C9-C12 Al	NT	NT
C9-C10 Ar	NT	NT
Acetone	NT	NT
2-Butanone	NT	NT
1,2-DCA	NT	NT
1,1,1-TCA	2.18 U^	3.64
benz	4.25	5.24
C. Tetrachloride	NT	NT
TCE	1.82 U^	1.82 U^
ethbenz	2.34 U	4.03
m,p-X	4.60	12.2
o-X	2.38	5.51
1,4-DCB	8.36	9.98
Napthalene	NT	NT

350 Coffin Avenue	Basement 350C-1 3/27/2000	1st Floor 350C-2 3/27/2000	Basement Unfinished 350V 4/3/2001	Basement Finished 350F 4/3/2001
tol	44.4	44.4	11.8	15.8
C5-C8 Al	NT	NT	NT	NT
C9-C12 Al	NT	NT	NT	NT
C9-C10 Ar	NT	NT	NT	NT
Acetone	NT	NT	NT	NT
2-Butanone	NT	NT	NT	NT
1,2-DCA	NT	NT	NT	NT
1,1,1-TCA	10.5	14	2.18 U	4.57
benz	5.75	5.69	3	3.87
C. Tetrachloride	NT	NT	NT	NT
TCE	5.46	2.73	3.43	6.27
ethbenz	24.3	4.94	2.34 U	2.34 U
m,p-X	129	22.1	9.88	10.9
o-X	62.9	10.8	3.73	3.94
1,4-DCB	4.87 U^	4.87 U^	4.87 U^	4.87 U^
Napthalene	NT	NT	NT	NT



LEGEND:

LABORATORY DATA SUMMARY

Compound Name	Address	Location/Sample ID/Date	
	353 Coffin Avenue	Basement 353C-1 3/27/2000	1st Floor 353C-2 3/27/2000
Toluene	tol	5.50	14.7
C5-C8 Aliphatics	C5-C8 Al	NT	NT
C9-C12 Aliphatics	C9-C12 Al	NT	NT
C9-C10 Aromatics	C9-C10 Ar	NT	NT
Acetone	Acetone	NT	NT
2-Butanone	2-Butanone	NT	NT
1,2-Dichloroethane	1,2-DCA	NT	NT
1,1,1-trichloroethane	1,1,1-TCA	2.18 U	3.64
benzene	benz	4.25	5.24
Carbon Tetrachloride	C. Tetrachloride	NT	NT
trichloroethene	TCE	1.82 U^	1.82 U^
ethylbenzene	ethbenz	2.34 U	4.03
m,p-Xylenes	m,p-X	4.60	12.2
o-Xylene	o-X	2.38	5.51
1,4-dichlorobenzene	1,4-DCB	8.36	9.98
Napthalene	Napthalene	0.61	NT

COMPOUND ABBREVIATION

OTHER NOTATIONS/SYMBOLS

2.88 U^	DETECTION LIMIT IS HIGHER THAN THE MASSDEP RESIDENTIAL THRESHOLD VALUE
2.18 U	UNDETECTED
1.74	CONCENTRATION FOUND (ug/m^3)
0.274	COMPOUND DETECTED
NT	NOT TESTED
0.383 J	ESTIMATED

(ug/m^3) – MICROGRAMS PER CUBIC METER

MASSDEP REGULATORY THRESHOLDS

Compound Name	Abbreviation	Screening Value
Toluene	tol	54
C5-C8 Aliphatics	C5-C8 Al	58
C9-C12 Aliphatics	C9-C12 Al	68
C9-C10 Aromatics	C9-C10 Ar	10
Acetone	Acetone	91
2-Butanone	2-Butanone	12
1,2-Dichloroethane	1,2-DCA	0.09
1,1,1-trichloroethane	1,1,1-TCA	3
benzene	benz	2.3
Carbon Tetrachloride	C. Tetrachloride	0.54
trichloroethene	TCE	0.8
ethylbenzene	ethbenz	7.4
m,p-Xylenes	m,p-X	20
o-Xylene	o-X	20
1,4-dichlorobenzene	1,4-DCB	0.5
Napthalene	Napthalene	0.61

DELINEATES BOUNDARY OF FORMER PAYNE CUTLERY PROPERTY. HASH MARKS ON INSIDE OF PROPERTY BOUNDARY.

EXISTING MONITORING WELL

2012 INDOOR AIR SAMPLE LOCATION (TRC)

LOT LINES

APPROX. LOCATION OF SEWER LINE

APPROX. LOCATION OF FORMER SEWER LINE

NOTES:
1. BASE MAP WAS DIGITIZED FROM A COPY OF AN UNDATED PLAN ENTITLED "SITE PLAN" PREPARED BY CYGNUS GROUP OF SOUTHBOROUGH MA. FIG 2, ORIGINAL SCALE 1"=50'.

APPROXIMATE GRAPHIC SCALE

0' 50' 100' 200'

FORMER PAYNE CUTLERY
295 PHILLIPS AVENUE
NEW BEDFORD, MA

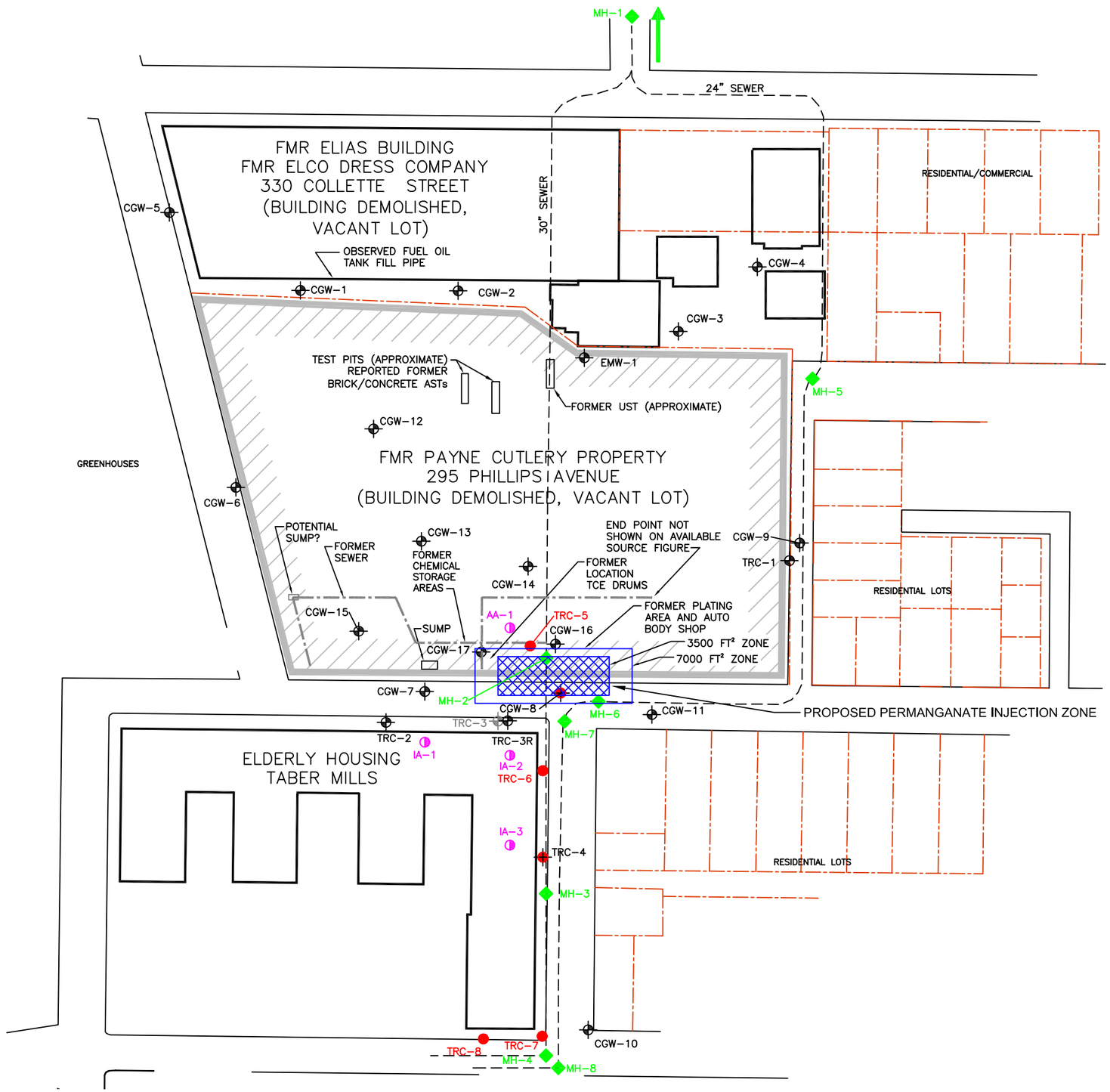
HISTORICAL INDOOR AIR SAMPLE LOCATIONS AND RESULTS

TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
(978) 970-5600

DRAWN BY: HWB
CHECKED BY: ACL
DATE: JAN 2013

FIGURE C-2

FILE: T:\E_CAD\172744\PAYNE HISTORICAL INDOOR AIR RESULTS 1-13.dwg
THIS DRAWING REFERENCES BUT IS NOT LINKED TO T:\E_CAD\172744\JULY 2012 INDOOR AIR SAMPS.xlsx



LEGEND:

- PROPOSED PERMANGANATE INJECTION ZONE
- CGW-4 GROUNDWATER MONITORING WELL
- TRC-3 MONITORING WELL DAMAGED/REPLACED
- MH-2 PROPOSED SEWER SAMPLE LOCATION
- IA-3 PROPOSED INDOOR AIR OR AMBIENT AIR SAMPLE LOCATION
- TRC-6 PROPOSED GROUNDWATER SAMPLE LOCATION
- APPROX. LOCATION OF SEWER LINE
- APPROX. LOCATION OF FORMER SEWER LINE

NOTE:

BASE MAP WAS DIGITIZED FROM A COPY OF AN UNDATED PLAN ENTITLED "SITE PLAN" PREPARED BY CYGNUS GROUP OF SOUTHBOROUGH, MA. FIG 2 ORIGINAL SCALE 1"=50'.

APPROXIMATE GRAPHIC SCALE

0' 50' 100' 200'

FORMER PAYNE CUTLERY
295 PHILLIPS AVENUE
NEW BEDFORD, MA

PROPOSED GROUNDWATER, SEWER, AND AIR SAMPLING LOCATIONS

TRC
Wannalancit Mills
650 Suffolk Street
Lowell, MA 01854
(978) 970-5600

FIGURE
C-3

DRAWN BY: HWB
CHECKED BY: ECW
DATE: FEB 2013

FILE: T:\E_CAD\172744\GW_SEWER_AIR_SAMP_LOCS 2013 02 07.dwg

4.0 FORM D – PROJECT OBJECTIVES AND SCHEDULE

4.1 Project Objectives

The objective of this project is to implement modifications to the existing ventilation system at Taber Mill Apartments and perform permanganate injection within the source area of TCE in groundwater. Environmental measurements addressed in this QAPP include groundwater, sewer, and indoor air sampling to support these remedial activities.

4.1.1 Environmental Investigation Activities

Preparation of a Site-Specific Health and Safety Plan

Prior to initiating subsurface assessment fieldwork, TRC will prepare a site-specific Health and Safety Plan (HASP) to ensure the safety of TRC employees performing environmental investigation activities on-site. The HASP will be developed in accordance with the requirements set forth in 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*. Specifically, the HASP will identify and detail potential site hazards, appropriate action limits for each hazard, required task-specific personal protective equipment, decontamination procedures, and proper protocols for emergency events if encountered. The HASP will be provided to project personnel and will be adhered to during onsite investigation activities. A copy of the HASP will be on-Site at all times during investigation activities.

Groundwater Samples

Prior to the permanganate injection and, again, following the permanganate injection, groundwater samples will be collected from six monitoring wells (TRC-4, TRC-5, TRC-6, TRC-7, TRC-8 and CGW-8). The samples will be submitted to a laboratory for laboratory analysis of VOCs. Refer to Table E-1 for the proposed groundwater samples to be collected.

Groundwater Elevation Survey and Non-Aqueous Phase Liquid (NAPL) Measurement

TRC will conduct a relative elevation survey of the wells. Top of well riser elevations will be surveyed to an arbitrary benchmark. Depth to groundwater from the top of the well riser will be measured using an oil/water interface probe to concurrently monitor for the presence of NAPL. The elevation survey information, in conjunction with the depth to groundwater measurements, will be used to further assess the shallow groundwater flow across the Site.

Storm Sewer and Sanitary Sewer Samples

Prior to the permanganate injection, aqueous samples will be collected from manholes connected to a storm sewer and a sanitary sewer that pass through the proposed permanganate injection zone. The samples will be submitted to a laboratory for laboratory analysis of VOCs. Refer to Table E-1 for the proposed samples to be collected.

In addition, to address MassDEP's concerns regarding the permanganate injected at the Site entering a surface water pathway, TRC will monitor the storm and sewer manholes located closest to the permanganate injection zone (MH-2 and MH-6) during permanganate injection activities for visual evidence of permanganate (indicated by a purple tint). If significant amounts of permanganate are observed in the manholes, water samples from the manholes will be field screened to determine approximate permanganate concentrations and injection activities will be discontinued.

Indoor Air Samples

Three indoor air samples will be collected in the first floor of the Taber Mills apartment complex. Prior to indoor air sampling, the hallway and immediate surrounding area will be inspected to assess for other potential sources of VOCs (i.e., oil tanks, gasoline cans, paints, thinners, dirty rags, etc.) not related to the Site.

An outdoor ambient air sample will also be collected during the same time frame as the indoor air samples to evaluate background conditions at the time of sampling, and a duplicate sample will be collected at one indoor location for QC purposes. All air samples will be collected in pre-cleaned, evacuated, passivated stainless steel canisters and analyzed for VOCs via TO-15 and APH. A summary of the indoor air sampling program is provided in Table E-1.

4.2 Project Deliverables

Following implementation of the remedial activities and performance of post-injection groundwater sampling, TRC and representatives of the City of New Bedford will conduct a public meeting to discuss the project status.

4.3 Project Timeline

Activities	Project Start	Project End
QAPP Addendum Submission	1/21/13	1/29/13
EPA Approval	1/29/13	2/26/13
Field Work	2/26/13	3/22/13
Public Meeting	3/25/13	3/29/13

4.4 Regulatory Standards/Criteria

Groundwater sample results will be compared to the applicable MCP Method 1 GW-2/GW-3 cleanup standards in an effort to evaluate contaminant conditions and provide a current basis for determining future investigation needs.

Indoor air sample results will be compared to Indoor Air Residential Threshold Values from the MassDEP Interim Final Vapor Intrusion Guidance, December 2011.

5.0 FORM E – SAMPLING DESIGN AND SITE FIGURES

5.1 Proposed Activities

The proposed sample locations, analyses to be performed, and rationale for sample locations are summarized in Table E-1. Proposed groundwater, sewer, and indoor air sampling locations are depicted on Figure C-3. The locations of the proposed indoor air sampling points may be adjusted based upon access limitations, utility locations, or other field constraints.

Baseline Groundwater Sampling

Groundwater samples will be collected from wells TRC-4, TRC-5, TRC-6, TRC-7, TRC-8, and CGW-8. Samples will be obtained using low-flow sampling techniques with adjustable rate submersible pumps. Any non-dedicated submersible equipment that is put down a well will be decontaminated between locations. Furthermore, well development, gauging and sampling activities will proceed from the least contaminated location to the most contaminated location. Refer to Table E-1 for an overview of the proposed groundwater samples to be collected, which includes the proposed chemical analyses for each sample. The locations of the proposed groundwater sample locations are illustrated on Figure C-3.

Headspace measurement of VOCs will be made on purged groundwater using the field screening equipment. If the headspace VOC reading exceeds 10 ppmv, the purge water will be drummed or containerized until the groundwater sample test results are obtained to evaluate disposal options. If the headspace VOC readings are less than 10 ppmv, the purge water will be returned to the ground surface in the source area.

Sewer Line and/or Surface Water Drainage Line Sampling

TRC will screen the mouth of the sewer and storm drain lines through access manholes within Brook Street and adjacent intersections using a photoionization detector (PID). Targeted storm sewer manholes, identified as MH-1 through MH-4 on Figure C-3, include MH-1 located upstream from Payne Cutlery at the intersection of Brook Street and Davis Street, MH-2 at the intersection of Brook Street and Coffin Avenue, MH-3 in the sidewalk adjacent to the western side of Brook Street, and MH-4 at the intersection of Brook and Deane Streets. Sanitary sewer manholes include: MH-5 at the intersection of Oneko Lane and Phillips Avenue, MH-6 and MH-7 located at the intersection of Brook Street and Coffin Avenue, and MH-8 located at the intersection of Brook and Deane Streets.

TRC will collect eight water samples from these locations for VOC analysis to determine whether the lines are acting as preferential pathways for the chlorinated solvent plume. TRC will collect representative grab water samples using a peristaltic pump or equivalent. Samples will be collected during a period of dry weather, optimally following at least three days of minimal or no precipitation.

The sewer line sampling is intended to identify the presence or absence of VOCs in the sewer line contents to assess whether the line may be acting as a preferential pathway for off-Site migration of the groundwater plume. Sampling results from upgradient of the Site (MH-1/MH-5) will be

compared against downgradient results (MH-3/MH-7) and the sewer line data will also be compared to groundwater results from monitoring wells near the sewer line. Should chlorinated VOCs attributable to the Site be detected (i.e., similar constituents as detected in Site groundwater rather than petroleum related VOCs such as BTEX compounds which were not identified above the laboratory reporting limits in the April 2012 sampling event), TRC will notify the City of New Bedford Department of Public Infrastructure (operator of the sewer line and the waste water treatment plant to which the sewer line discharges) of the groundwater plume intrusion. In addition, TRC and/or the City of New Bedford Department of Environmental Stewardship would notify MassDEP of the findings and the related Condition of Substantial Release Migration per the Massachusetts Contingency Plan (MCP; 310 CMR 40.0000).

In addition, to address MassDEP's concerns regarding the permanganate injected at the Site entering a surface water pathway, TRC will monitor the storm and sewer manholes located closest to the permanganate injection zone (MH-2 and MH-6) during permanganate injection activities for visual evidence of permanganate (indicated by a purple tint). If significant amounts of permanganate are observed in the manholes, water samples from the manholes will be field screened to determine approximate permanganate concentrations and injection activities will be discontinued at that location.

Post-Injection Groundwater Sampling

The proposed permanganate injection zone is shown on Figures C-1 and C-3. Post-injection groundwater sampling will be conducted one to three weeks after the permanganate injection.
After purging and prior to sample collection, groundwater from each well will be examined for visual evidence or residual permanganate (a purple tint) and screened for residual permanganate using a spectrophotometer. If permanganate is found to be present in the groundwater collected from a monitoring well, granular ascorbic acid will be gradually added to the groundwater sample until the permanganate has been neutralized and the water is clear. The addition of ascorbic acid to neutralize residual permanganate was recommended in a 2012 EPA report on In-Situ Chemical Oxidation authored by Saebom Ko, Scott Huling and Bruce Pivetz (EPA/600/R-12/049, August 2012).

Samples will be obtained using low-flow sampling techniques with adjustable rate submersible pumps. Any non-dedicated submersible equipment that is put down a well will be decontaminated between locations. Furthermore, well development, gauging and sampling activities will proceed from the least contaminated location to the most contaminated location. Refer to Table E-1 for an overview of the proposed groundwater samples to be collected, which includes the proposed chemical analyses for each sample. The locations of the proposed groundwater sample locations are illustrated on Figure C-3.

Headspace measurement of VOCs will be made on purged groundwater using the field screening equipment. If the headspace VOC reading exceeds 10 ppmv, the purge water will be drummed or containerized until the groundwater sample test results are obtained to evaluate disposal options. If the headspace VOC readings are less than 10 ppmv, the purge water will be returned to the ground surface in the source area.

Indoor Air Sampling

Three indoor air samples will be collected in first floor locations within the Taber Mill apartment complex between seven and 14 days following the completion of modifications to the ventilation system and restarting of the system. In general, indoor air sampling will be performed in accordance with MassDEP's Bureau of Waste Site Cleanup *Standard Operating Procedure for Indoor Air Contamination*, August 2007. Prior to collecting indoor air samples, a pre-sampling inspection will be performed to evaluate the physical layout and conditions of the Site buildings being investigated, to identify conditions that may affect or interfere with the proposed sampling, and to prepare the buildings for sampling**.**

In general, indoor air samples will be collected in the following manner:

- Sample duration and conditions will reflect the exposure scenario being evaluated without compromising the detection limit or sample collection flow rate. The air samples will be collected for four hours. Effort will be made to limit the opening and closing of doors and windows of the subject buildings during air sampling to ensure that the air sampling effort will represent a worse-case exposure scenario. Therefore, a four-hour sampling duration is deemed sufficient;
- Sample flow rates will conform to the specifications in the sample collection method and, if possible, will be consistent with the flow rates for the concurrent outdoor air sample; and
- Samples will be collected using conventional sampling methods, in a pre-cleaned, evacuated, passivated, stainless steel canister that is certified clean by the laboratory. The canister will be placed at a height reflective of the approximate breathing zone.

The indoor air samples will be hand-delivered to an off-site laboratory (Alpha Analytical) for APH and TO-15 analyses.

An outdoor ambient air sample will also be collected from an upwind location during the same time frame as the indoor air samples to evaluate background conditions at the time of sampling, and a duplicate sample will be collected at one indoor location for QC purposes. A summary of the indoor air sampling program is provided in Table E-1. Proposed indoor air sample locations are depicted on Figure C-3.

5.2 Completeness

Field completeness, which measures the amount of 1) valid measurements obtained from all the measurements taken in the project and 2) valid samples collected, will have an objective of 100 percent. Laboratory completeness, which measures the amount of valid measurements obtained from all valid samples submitted to the laboratory, will have an objective of greater than 95 percent.

Table E-1: Proposed Groundwater, Sewer and Indoor Air Sampling Program
Former Payne Cutlery, New Bedford, MA

Sample ID[1]	Description	Target Sample Depth Interval	Analyses	Rationale / Notes
Proposed Sewer and Surface Water Drainage Line Sampling				
MH-1	Proposed Upstream Storm Sewer Sample	NA	VOCs	To evaluate the potential for the storm sewer line within Brook Street to be acting as a preferential pathway for the chlorinated solvent plume.
MH-2	Proposed Storm Sewer Sample	NA	VOCs	To evaluate the potential for the storm sewer line within Brook Street to be acting as a preferential pathway for the chlorinated solvent plume.
MH-3	Proposed Storm Sewer Sample	NA	VOCs	To evaluate the potential for the storm sewer line within Brook Street to be acting as a preferential pathway for the chlorinated solvent plume.
MH-4	Proposed Downstream Storm Sewer Sample	NA	VOCs	To evaluate the potential for the storm sewer line within Brook Street to be acting as a preferential pathway for the chlorinated solvent plume.
MH-5	Proposed Upstream Sanitary Sewer Sample	NA	VOCs	To evaluate the potential for the sanitary sewer line within Brook Street to be acting as a preferential pathway for the chlorinated solvent plume.
MH-6	Proposed Sanitary Sewer Sample	NA	VOCs	To evaluate the potential for the sanitary sewer line within Brook Street to be acting as a preferential pathway for the chlorinated solvent plume.
MH-7	Proposed Sanitary Sewer Sample	NA	VOCs	To evaluate the potential for the sanitary sewer line within Brook Street to be acting as a preferential pathway for the chlorinated solvent plume.
MH-8	Proposed Downstream Sanitary Sewer Sample	NA	VOCs	To evaluate the potential for the sanitary sewer line within Brook Street to be acting as a preferential pathway for the chlorinated solvent plume.
Proposed Groundwater Sampling (Baseline)				
CGW-8	Existing monitoring well location	Screen interval 5 to 15 ft.	VOCs	To establish baseline conditions prior to the permanganate injection.
TRC-4	Existing monitoring well location	Screen interval 4 to 14 ft.	VOCs	
TRC-5	Existing monitoring well location	TBD[2]	VOCs	
TRC-6	Existing monitoring well location	TBD[2]	VOCs	
TRC-7	Existing monitoring well location	TBD[2]	VOCs	
TRC-8	Existing monitoring well location	TBD[2]	VOCs	

Table E-1: Proposed Groundwater, Sewer and Indoor Air Sampling Program Former Payne Cutlery, New Bedford, MA

Sample ID[1]	Description	Target Sample Depth Interval	Analyses	Rationale / Notes
Proposed Groundwater Sampling (Post-Injection)				
CGW-8	Existing monitoring well location	Screen interval 5 to 15 ft.	VOCs and Permanganate[3]	To measure the effectiveness of the remedial measure after the permanganate injection
TRC-4	Existing monitoring well location	Screen interval 4 to 14 ft.	VOCs and Permanganate[3]	
TRC-5	Existing monitoring well location	TBD[2]	VOCs and Permanganate[3]	
TRC-6	Existing monitoring well location	TBD[2]	VOCs and Permanganate[3]	
TRC-7	Existing monitoring well location	TBD[2]	VOCs and Permanganate[3]	
TRC-8	Existing monitoring well location	TBD[2]	VOCs and Permanganate[3]	
Proposed Ambient and Indoor Air Sampling				
AA-1	Proposed outside (ambient) air sampling location	Upwind location (TBD at the time of the indoor air sampling event).	TO-15 and APH	To evaluate background conditions at the time of sampling.
IA-1	Proposed indoor air sampling location	Occupied first floor of elderly housing facility	TO-15 and APH	To evaluate indoor air conditions following the implementation of ventilation system modifications.
IA-2	Proposed indoor air sampling location	Occupied first floor of elderly housing facility	TO-15 and APH	To evaluate indoor air conditions following the implementation of ventilation system modifications.
IA-3	Proposed indoor air sampling location	Occupied first floor of elderly housing facility	TO-15 and APH	To evaluate indoor air conditions following the implementation of ventilation system modifications.

Notes:
TBD – to be determined
VOCs – volatile organic compounds
[1]– Actual sampling locations may be adjusted based upon field observations.
[2]– TBD – To be determined after wells are installed per the QAPP Addendum NB-H, recently submitted to EPA.
[3]–Permanganate will be screened in the field using a spectrophotometer.

6.0 FORM F – SAMPLING AND ANALYTICAL METHODS REQUIREMENTS

Table F-1: Sampling and QA Summary
Former Payne Cutlery, New Bedford, MA

Field Sample Matrix	Parameter	Sample Type[(A)]	Estimated Number of Samples	Preparation /Analytical Method References	SOP Reference No.[(B)]	MassDEP CAM No.	Sample Preservation	Holding Time from Collection	Container
Indoor Air/Ambient Air	TO-15	Field Sample, Field Duplicate, and Laboratory Duplicate	4 samples, 1 FD, and 1 LD	EPA Method TO-15	Prep and analysis: 33a (Lab: Alpha Analytical)	NA	None	30 days to analysis	1 6-liter pre-cleaned, evacuated, passivated stainless steel canister
Indoor Air/Ambient Air	APH	Field Sample, Field Duplicate, and Laboratory Duplicate	4 samples, 1 FD, and 1 LD	MassDEP Method (December 2009) Rev. 1	Prep and analysis: 32a (Lab: Alpha Analytical)	NA	None	30 days to analysis	1 6-liter pre-cleaned, evacuated, passivated stainless steel canister
Groundwater	VOCs	Field Sample, Field Duplicate and Trip Blank	6 Samples, 1 FD, and 1 Trip Blank[(D)]	SW-846 5030B/8260B	Prep: 2a Analysis: 3a (Lab: Con-Test Analytical)	WSC-CAM-IIA	HCl to pH <2[(C)] and Cool to 4°C	14 days to analysis	2-40 mL VOA vials
Groundwater	Permanganate	Field Sample, Instrument Blank, Field Replicate, Duplicate Reading[(E)]	6 Samples, 1 Instrument Blank, 1 Field Replicate, and 1 Duplicate Reading	See Section 7.1 of QAPP Addendum	NA	NA	Cool to 4°C	Not specified	1L amber glass w/Teflon lined cap
Sewer	VOCs	Field Sample, Field Duplicate and Trip Blank	8 Samples, 1 FD, and 1 Trip Blank	SW-846 5030B/8260B	Prep: 2a Analysis: 3a (Lab: Con-Test Analytical)	WSC-CAM-IIA	HCl to pH <2 and Cool to 4°C	14 days to analysis	2-40 mL VOA vials

[(A)]FD = field duplicate samples; LD = laboratory duplicate samples
[(B)]SOP Reference No. from Section 7.2 of TRC's Generic QAPP
[(C)]If samples show evidence of permanganate, granular ascorbic acid will be added until water is clear. Refer to Section 5.1 of the QAPP Addendum.
[(D)]Estimated number of samples for each round of sampling (baseline post-injection)
[(E)] Refer to Section 12.1 for a description of the field QC samples.
CAM – compendium of analytical methods
PNOD – permanganate natural oxidant demand

7.0 FORM G – METHOD AND SOP REFERENCE TABLES

7.1 Field SOP References

Attachment A of the Generic QAPP (EPA RFA# 13028; November 2012) contains copies of all field SOPs. SOPs which will be used during this investigation are as follows:

SOP #	SOP Title	Revision #	Date of SOP
TRC SOP-001	Groundwater Sampling	0	October 2012
TRC SOP-004	Equipment Decontamination Procedures	0	August 2003
TRC SOP-012	Water Level and Product Measurement	0	August 2003
TRC SOP-014	Packaging and Shipping of Environmental Samples	1	November 2003
TRC SOP-016	Headspace Field Screening Procedure	0	August 2003
TRC SOP-018	Sample Chain of Custody	0	May 2003
TRC SOP-021	Field Activity Documentation	0	April 2003
TRC SOP-024	Calibration of Field Instruments for Water Quality Parameters	0	December 2003

Procedures for the field analysis of potassium permanganate in groundwater are provided below.

Low Concentration Samples (samples with no color or light purple color)

1. For most accurate results, pass the groundwater through a 0.22 micron Millipore GSWP or equivalent filter. This is solution "A".

2. Turn on the Hach DR890 and enter User Method 101. It should read mg/L KMnO4.

3. Zero the DR890 with lab grade or dilution water.

4. Read the concentration of solution "A" in mg/L.

High Concentration Samples (Samples with dark purple color)

1. Prepare a 1 mL to 1000 mL (1L) dilution of the groundwater in lab grade or demand free water and then mix well. For most accurate results, pass this solution through a 0.22 micron Millipore GSWP or equivalent filter. This is solution "A".

2. Turn on the Hach DR890 and enter User Method 102. It should read mg/L KMnO4.

3. Zero the DR890 with lab grade or dilution water.

4. Read the concentration of solution "A" in mg/L.

7.2 Laboratory Method and SOP References

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a list of the methods and SOPs used by the analytical laboratories. A full copy of the laboratory SOPs is included as Attachment C of the Generic QAPP. Table F-1 clarifies which SOPs and which laboratories are being used for this program. These methods and SOPs are also summarized below.

Preparatory and Analytical Method References:	Prep	Analysis	Alpha Analytical SOP	Con-Test Analytical SOP	Preparatory Method Associated with
2a. USEPA. Purge-and-Trap for Aqueous Samples. SW846 Method 5030B, Revision 2. December 1996.	X		NA	*Volatile Organics by GC/MS (Method EPA 8260)*, 5/29/12, Revision 7 (Appendix B, revised 8/25/10)	3a
3a. USEPA. Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry. SW846 Method 8260B, Revision 2. December 1996.		X			NA
32a. MassDEP. Method for the Determination of Air-Phase Petroleum Hydrocarbons (APH). Revision 1, December 2009.	X	X	*Determination of Air-Phase Petroleum Hydrocarbons (APH) in Ambient Air Using Specially-Prepared Canisters and Analyzed by GC/MS*, 4/27/2012, Rev. No 3 (SOP 2187)	NA	NA
33a. USEPA. Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS), Method TO-15, Second Edition, January 1999.	X	X	*Determination of Volatile Organic Compounds in Ambient Air Using Specially-Prepared Canisters and Analyzed by GC/MS*, 5/25/2012, Rev. No 3 (SOP 2186)	NA	NA

8.0 FORM H – FIELD EQUIPMENT CALIBRATION AND CORRECTIVE ACTION

Calibration procedures, frequency of calibration, calibration acceptance criteria, and corrective actions are provided in TRC SOPs which were included in Attachment A of TRC's Generic QAPP (EPA RFA #13028; November 2012). The following field equipment will be used for this site investigation:

- **Photoionization detector:** Refer to TRC SOP-016.
- **GPS Unit:** Refer to Section 8.0 of TRC's Generic QAPP.
- **Water-level meter and product interface probe:** Refer to TRC SOP-012.
- **Turbidimeter:** Refer to TRC SOP-024.
- **YSI (or equivalent) water quality probe** (includes pH, dissolved oxygen, oxidation-reduction potential, temperature, and specific conductance): Refer to TRC SOP-024.
- **Hach DR 890 Spectrophotometer (or equivalent):** See calibration procedures below.

8.1 Spectrophotometer Calibration Procedures for Potassium Permanganate

The Hach DR 890 spectrophotometer, or equivalent, will be used for this site investigation. The DR 890 allows storage of up to five user-entered programs (101-105). User **Method 101** has been selected for reading "**Low** Range Potassium Permanganate Concentrations" in mg/L $KMnO_4$. User **Method 102** has been selected for reading "**High** Range Potassium Permanganate Concentrations" in mg/L $KMnO_4$. The procedure uses a low range potassium standard of 5 mg/L and a high range standard of 10 mg/L. Each standard will be analyzed prior to sample analysis and must show recovery within 80-120% of the true value. If outside of this range, the manufacturer will be contacted for resolution.

9.0 FORM I – LABORATORY EQUIPMENT CALIBRATION AND CORRECTIVE ACTION

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a list of the calibration requirements for the analytical methods being used by Con-Test Analytical and Alpha Analytical laboratories during this investigation.

10.0 FORM J – SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for routine procedures that will be followed in preparing field samples for transport to the laboratory.

11.0 FORM K – ANALYTICAL SENSITIVITY AND PROJECT CRITERIA

Analyses of groundwater samples will be performed by Con-Test Analytical of East Longmeadow, Massachusetts. Air analyses will be performed by Alpha Analytical Laboratory of Mansfield, Massachusetts. A copy of Con-Test Analytical and Alpha Analytical laboratory SOPs was provided as Attachment C of TRC's Generic QAPP (EPA RFA #13028; November 2012).

Tables K-1 through K-5b of TRC's Generic QAPP summarize the method detection limits (MDLs) and reporting limits (RLs) from Alpha and Con-test laboratories for typical analyses performed for Brownfields investigations compared to the project action levels for this program. A summary of the RLs and project action levels for this program is provided in the tables below for each matrix (Table K-Aqueous and K-Air). As of the date of this site-specific QAPP addendum, the current MassDEP Method 1 groundwater standards and Indoor Air Residential Threshold Values have been incorporated into each table and the reporting limits and the stated MassDEP standards have been reviewed for accuracy.

Table K-Aqueous: (Groundwater and Sewer Samples)
Summary of Target Analytes, RLs, and Project Action Levels
Former Payne Cutlery, New Bedford, MA

Analysis	Analyte	RLs	MCP Method 1	
			GW-2	GW-3
VOCs				
(ug/L)	Acetone	10	50,000	50,000
8260B	tert-Amylmethyl Ether	0.50	NS	NS
	Benzene	1.0	2,000	10,000
	Bromobenzene	1.0	NS	NS
	Bromochloromethane	1.0	NS	NS
	Bromodichloromethane	1.0	6	50,000
	Bromoform	1.0	700	50,000
	Bromomethane	2.0	7	800
	2-Butanone (MEK)	10	50,000	50,000
	n-Butylbenzene	1.0	7,000(1)	50,000(1)
	sec-Butylbenzene	1.0	7,000(1)	50,000(1)
	tert-Butylbenzene	1.0	7,000(1)	50,000(1)
	tert-Butylethyl Ether	0.5	NS	NS
	Carbon Disulfide	5.0	NS	NS
	Carbon Tetrachloride	1.0	2	5,000
	Chlorobenzene	1.0	200	1,000
	Chlorodibromomethane	0.50	20	50,000
	Chloroethane	2.0	NS	NS
	Chloroform	2.0	50	20,000
	Chloromethane	2.0	NS	NS
	2-Chlorotoluene	1.0	NS	NS
	4-Chlorotoluene	1.0	NS	NS
	1,2-Dibromo-3-Chloropropane	2.0	NS	NS
	1,2-Dibromoethane	0.50	2	50,000
	Dibromomethane	1.0	NS	NS
	1,2-Dichlorobenzene	1.0	2,000	2,000
	1,3-Dichlorobenzene	1.0	2,000	50,000
	1,4-Dichlorobenzene	1.0	200	8,000
	Dichlorodifluoromethane	2.0	NS	NS
	1,1-Dichloroethane	1.0	1,000	20,000
	1,2-Dichloroethane	1.0	5	20,000
	1,1-Dichloroethylene	1.0	80	30,000
	cis-1,2-Dichloroethylene	1.0	100	50,000
	trans-1,2-Dichloroethylene	1.0	90	50,000
	1,2-Dichloropropane	1.0	3	50,000
	1,3-Dichloropropane	0.5	NS	NS
	2,2-Dichloropropane	1.0	NS	NS
	1,1-Dichloropropene	2.0	NS	NS
	cis-1,3-Dichloropropene	0.40	10(2)	200(2)
	trans-1,3-Dichloropropene	0.40	10(2)	200(2)

Table K-Aqueous: (Groundwater and Sewer Samples)
Summary of Target Analytes, RLs, and Project Action Levels
Former Payne Cutlery, New Bedford, MA

Analysis	Analyte	RLs	MCP Method 1	
			GW-2	GW-3
	Diethyl Ether	2.0	NS	NS
	Diisopropyl Ether	0.50	NS	NS
	1,4-Dioxane	50	6,000	50,000
	Ethyl Benzene	1.0	20,000	5,000
	Hexachlorobutadiene	0.50	1.0	3,000
	2-Hexanone	10	NS	NS
	Isopropylbenzene	1.0	7,000(1)	50,000(1)
	p-Isopropyltoluene	1.0	7,000(1)	50,000(1)
	MTBE	1.0	50,000	50,000
	Methylene Chloride	5.0	10,000	50,000
	MIBK	10	50,000	50,000
	Naphthalene	2.0	1,000	20,000
	n-Propylbenzene	1.0	7,000(1)	50,000(1)
	Styrene	1.0	100	6,000
	1,1,1,2-Tetrachloroethane	1.0	10	50,000
	1,1,2,2-Tetrachloroethane	0.50	9	50,000
	Tetrachloroethylene	1.0	50	30,000
	Tetrahydrofuran	2.0	NS	NS
	Toluene	1.0	50,000	40,000
	1,2,3-Trichlorobenzene	2.0	NS	NS
	1,2,4-Trichlorobenzene	1.0	2,000	50,000
	1,1,1-Trichloroethane	1.0	4,000	20,000
	1,1,2-Trichloroethane	1.0	900	50,000
	Trichloroethylene	1.0	30	5,000
	Trichlorofluoromethane	2.0	NS	NS
	1,2,3-Trichloropropane	2.0	NS	NS
	1,2,4-Trimethylbenzene	1.0	7,000(1)	50,000(1)
	1,3,5-Trimethylbenzene	1.0	7,000(1)	50,000(1)
	Vinyl Chloride	2.0	2	50,000
	m/p Xylene	2.0	9,000	5,000
	o-Xylene	1.0	9,000	5,000

Notes:
ug/L - micrograms per liter.
NS - No MassDEP standards exist for this analyte.
RLs - Reporting limits.
VOCs - Volatile Organic Compounds.
(1) - MassDEP Method 1 standards for C9-C10 aromatics used.
(2) - MassDEP Method 1 standards for 1,3-Dichloropropene used.

Table K-Air:
Summary of Target Analytes, RLs, and Project Action Levels
Former Payne Cutlery, New Bedford, MA

Analysis	Analyte	RLs**	Indoor Air Residential Threshold Values*
VOCs			
(ug/m3)	Acetone	2.36	91
TO-15	Benzene	0.64	2.3
	Bromodichloromethane	0.134/1.34	0.14[1]
	Bromoform	2.07	2.2
	Bromomethane	0.078/0.78	0.6[1]
	2-Butanone (MEK)	0.59	12
	Carbon Tetrachloride	0.126/1.26	0.54[1]
	Chlorobenzene	0.92	2.3
	Chloroform	0.98	1.9
	Chlorodibromomethane	**0.170**	0.1[1]
	1,2-Dibromoethane	**0.154**	0.011[1]
	1,2-Dichlorobenzene	0.120/1.2	0.72[1]
	1,3-Dichlorobenzene	0.120/1.2	0.6[1]
	1,4-Dichlorobenzene	0.120/1.2	0.5[1]
	1,1-Dichloroethane	0.81	0.8
	1,2-Dichloroethane	0.081/0.81	0.09[1]
	1,1-Dichloroethylene	0.79	0.8
	cis-1,2-Dichloroethylene	0.79	0.8
	trans-1,2-Dichloroethylene	0.79	0.8
	1,2-Dichloropropane	0.092/0.92	0.13[1]
	cis-1,3-Dichloropropene	0.091/0.91	0.6[1]
	trans-1,3-Dichloropropene	0.091/0.91	0.6[1]
	1,4-Dioxane	**0.72**	0.59
	Ethyl Benzene	0.87	7.4
	Hexachlorobutadiene	2.13	4.6
	MTBE	0.72	39
	Methylene Chloride	3.47	5
	MIBK	0.82	2.2
	Naphthalene	**1.05**	0.61
	Styrene	0.85	1.4
	1,1,2,2-Tetrachloroethane	**0.137/1.37**	0.04[1]
	Tetrachloroethylene	1.36	1.4
	Toluene	0.75	54
	1,2,4-Trichlorobenzene	1.48	3.4
	1,1,1-Trichloroethane	1.09	3
	1,1,2-Trichloroethane	0.109/1.09	0.15[1]
	Trichloroethylene	0.107/1.07	0.8[1]
	Vinyl Chloride	0.051/0.51	0.27[1]
	m/p Xylene	1.74	20
	o-Xylene	0.87	20

Table K-Air:
Summary of Target Analytes, RLs, and Project Action Levels
Former Payne Cutlery, New Bedford, MA

Analysis	Analyte	RLs**	Indoor Air Residential Threshold Values*
APH (ug/m3)	C5-C8 Aliphatics	12	58
	C9-C12 Aliphatics	14	68
	C9-C10 Aromatics	10	10
	1,3-Butadiene	2.0	NS
	Benzene	2.0	2.3
	Ethylbenzene	2.0	7.4
	MTBE	2.0	39
	Naphthalene	**2.0**	0.61
	Toluene	2.0	54
	m/p-Xylene	4.0	20
	o-Xylene	2.0	20

Notes:

ug/m3 -micrograms per cubic meters.

*MassDEP Interim Final Vapor Intrusion Guidance, December 2011.

**Listed RL is from SIM/full scan analyses. If only one RL provided, this is from the full scan analysis.

RLs - Reporting limits.

VOCs - Volatile Organic Compounds.

Bold highlighted cells indicate listed RL will not achieve the regulatory criteria.

[1]Will be analyzed using SIM in indoor air samples

12.0 FORM L – FIELD QUALITY CONTROL REQUIREMENTS

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of the typical field QC samples. Specific field QC samples planned for this investigation are included in Table F-1.

12.1 Spectrophotometer Field QC

The following additional QC requirements apply to the spectrophotometer analysis for permanganate.

- Instrument Blank: Place a deionized water sample in the cell holder and perform a test. Verify that permanganate is below the detection limit. If permanganate is detected above the detection limit, the instrument must be recalibrated according to the procedure described in Section 8.1.
- Duplicate Readings: Precision of spectrophotometer measurements on groundwater samples will be assessed by duplicate readings of investigative samples. Duplicate readings will be made at a frequency of one per 20 samples per day. Precision of these measurements will also be measured through the calculation of relative percent difference (RPD). The resulting information will be used to assess field analytical variability. The RPD of these readings must be $\leq$ 35 when both values are greater than 2x the detection limit. If one or both of these values are less than 2x the detection limit, the RPD is not assessed.
- Replicate Measurements: Precision of spectrophotometer measurements on groundwater will also be assessed by replicate measurements of samples. This will involve preparing each sample separately. Replicate measurements will be made at a frequency of one per 20 samples. The RPD of these measurements must be $\leq$ 35 when both values are greater than 2x the detection limit. If one or both values are less than 2x the detection limit, the RPD is not assessed.

13.0 FORM M – LABORATORY QUALITY CONTROL REQUIREMENTS

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of the laboratory QC requirements for the analytical methods being used during this investigation.

14.0 FORM N – DATA MANAGEMENT AND DOCUMENTATION

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of how project data and information will be documented, tracked and managed from their generation in the field to final use and storage in a manner that ensures data integrity and defensibility.

15.0 FORM O – ASSESSMENT AND RESPONSE ACTIONS

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of the assessment and response actions that may be performed.

16.0 FORM P – PROJECT REPORTS

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of the typical components of the final project report, the report frequency, and the report distribution.

A written project report will not be prepared for this project. The final deliverable will consist of a public meeting to be held in the city of New Bedford during the final week of March 2013. At this meeting, TRC and representatives of the City of New Bedford will discuss the status of the remedial activities with interested residents.

17.0 FORM Q – FIELD DATA EVALUATION

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of the field data evaluation procedures.

18.0 FORM R – LABORATORY DATA EVALUATION

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of the laboratory data evaluation procedures.

19.0 FORM S – DATA USABILITY AND PROJECT EVALUATION

Refer to TRC's Generic QAPP (EPA RFA# 13028; November 2012) for a summary of the data usability evaluation procedure.

Designation: D 7262 – 07

Standard Test Method for Estimating the Permanganate Natural Oxidant Demand of Soil and Aquifer Solids[1]

This standard is issued under the fixed designation D 7262; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the estimation of the permanganate natural oxidant demand (PNOD) through the determination of the quantity of potassium permanganate ($KMnO_4$) that organic matter and other naturally occurring oxidizable species present in soil or aquifer solids will consume under specified conditions as a function of time. Oxidizable species may include organic constituents and oxidizable inorganic ions, such as ferrous iron and sulfides. The following test methods are included:

Test Method A—48-hour Permanganate Natural Oxidant Demand

Test Method B—Permanganate Natural Oxidant Demand Kinetics

1.2 This test method is limited by the reagents employed to a permanganate natural oxidant demand (PNOD) of 60 g KMnO4 per kg soil or aquifer solids after a period of 48 hours (Method A) or two weeks (Method B).

1.3 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D 6026.

1.4 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 This standard does not purport to interpret the results of the data. It is the responsibility of the user of this standard to interpret the results obtained and to determine the applicability of these results prior to use.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 1193 Specification for Reagent Water

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D 4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

D 6026 Practice for Using Significant Digits in Geotechnical Data

D 6051 Guide for Composite Sampling and Field Subsampling for Environmental Waste Management Activities

D 6169 Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations

D 6282 Guide for Direct Push Soil Sampling for Environmental Site Characterizations

D 6286 Guide for Selection of Drilling Methods for Environmental Site Characterization

2.2 *Other Standards:*[3]

Method 4500—$KMnO_4$ Standard Methods for the Examination of Water and Wastewater, 20th Ed. 1998

ANSI/AWWA B603-03. Standard for Permanganates

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *permanganate natural oxidant demand ($PNOD_t$)*—the mass of potassium permanganate consumed per mass of soil or aquifer solids as a function of time.

3.1.2 *maximum permanganate natural oxidant demand ($PNOD_{max}$)*—the maximum mass of potassium permanganate consumed per mass of soil or aquifer solids over time.

3.1.3 *permanganate natural oxidant demand kinetics*—the rate at which potassium permanganate is consumed by soil or aquifer solids.

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Ground Water and Vadose Zone Investigations.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, http://www.awwa.org.

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4. Summary of Test Method

4.1 Many organic and reduced inorganic substances present in soil and aquifer solids can be oxidized by permanganate. A standard potassium permanganate solution is added to a specific amount of soil or aquifer solids and allowed to react for a period of 48 hours (Method A) or two weeks (Method B). The residual permanganate concentration is measured at prescribed sampling times and the difference in concentration is used to calculate the $PNOD_t$ at that time.

4.2 Many organic and reduced inorganic substances present in soil and aquifer solids can be oxidized by permanganate. However, some organic compounds react slowly and may not be completely oxidized within the test period while others may resist oxidation altogether.

5. Significance and Use

5.1 The test method is used to estimate the permanganate natural oxidant demand exerted by the soil or aquifer solids by determining the quantity of potassium permanganate that is consumed by naturally occurring species as a function of time. Typically the measurement of PNOD is used to screen potential sites for in situ chemical oxidation (ISCO) with permanganate (Test Method A) and provide information to aid in the design of remediation systems (Test Method B).

5.2 While some oxidizable species react relatively quickly (that is, days to weeks), others react more slower (weeks to months). Consequently, the $PNOD_t$ is expected to be some fraction of the $PNOD_{max}$.

5.3 Due to mass transport related issues at the field-scale it is reasonable to assume that the $PNOD_t$ measured using the test method may overestimate the demand exerted during ISCO applications.

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective testing/sampling/inspection/and so forth.

6. Interferences

6.1 Manganese oxides produced as a result of permanganate reduction may interfere with the analysis of permanganate (Method 4500-$KMnO_4$).

7. Apparatus

7.1 *Reactor Apparatus*—A 250 mL glass vial (Pyrex or equivalent) with an oxidant resistant screw cap is recommended. Zero headspace is not required.

7.2 *Apparatus for Drying Samples*—A laboratory oven capable of delivering sufficient controlled heat to maintain a temperature of 105°C.

7.3 *Balance Scales*—A balance having a minimum capacity of 100g and meeting the requirements of Guide D 4753, readable (with no estimation) to 0.1 % of the test mass or better.

8. Hazards

8.1 When performing laboratory analysis and handling chemicals, safety is a critical component. For this procedure, contact lenses may not be worn. Recommended personal protective equipment (PPE) for this procedure includes rubber gloves, safety glasses or goggles and a lab coat or rubber apron.

8.2 In the event of any chemical spill, refer to the specific MSDS for a proper clean-up procedure. In the case of solid potassium permanganate, sweep the solid into a clean container and dispose according to state and local regulations. A potassium permanganate spill should be diluted with water to less than 4 % strength, collected and disposed of in an approved manner. Paper or cloth towels should not be used to clean any permanganate spill.

8.3 Excess permanganate solutions can also be neutralized by sodium thiosulfate, citric acid, or other reducing agents. Solution concentrations must be less than 4 % prior to addition of any reducing agent. Excess heat can be generated and there is a potential for an unwanted reaction.[4]

9. Sampling

9.1 Collect the sample(s) in accordance with Practices D 6051, D 6169, D 6282, or D 6286. A minimum of 600 grams of soil or aquifer solids is required from each sampling location.

9.2 Samples can be preserved at 4°C for up to 28 days. However, it is the responsibility of the users of the test method to ensure the maximum holding time for their samples.

[4] Additional references on general laboratory safety and procedures can be found at: http://www.ceet.niu.edu/labs/safety.html, http://keats.admin.virginia.edu/lsm/home.html, and http://www.ehs.iupui.edu/ehs/prog_chemlabsafety.asp.

TEST METHOD A—48-HOUR PERMANGANATE NATURAL OXIDANT DEMAND

10. Scope

10.1 The test method is appropriate for the determination of the 48-hour permanganate natural oxidant demand of soil and aquifer solids. The test is designed to be used for site screening purposes only. Research has shown that a large percentage of the total permanganate natural oxidant demand can be expressed after a period of 48 hours. Consequently, this test method should not be used to determine the mass of oxidant required for the treatment of hazardous waste sites being considered for ISCO with permanganate.

11. Summary of Test Method

11.1 The sample and permanganate solutions are analyzed for permanganate after a 48-hour reaction period.

12. Reagents and Materials

12.1 *Purity of Reagents*—Reagent grade chemicals shall be used.

12.2 *Purity of Water*—Reference to water shall be understood to mean reagent grade water that meets the purity specifications of Type I or Type II water according to Specification D 1193.

12.3 *Potassium Permanganate Stock Solution (20 000 mg/L)*—Dissolve 20.0 g of potassium permanganate ($KMnO_4$) in water and dilute to 1 L. Mix the stock solution for a minimum of 2 hours to make certain the $KMnO_4$ crystals have completely dissolved.

NOTE 2—In place of potassium permanganate, sodium permanganate can be used. However, since the concentration of a commercially available NaMnO4 solution may vary, standardization is required. This may be accomplished using ANSI/AWWA B603-03.

13. Procedure

13.1 Dry each sample in the laboratory oven at 105°C for a period of 24 hours.

13.2 Homogenize the dried sample by gently mixing by hand. If large stones or rocks are present they should be removed prior to analysis using a No. 10 U.S. standard mesh sieve (2.00 mm).

13.3 Place 100 ml of 20 000 mg/l $KMnO_4$ stock solution in a 250 ml glass vial for the blank determination.

13.4 Place 50 g of dried sample in each of three 250 ml glass vials (each experiment is run in triplicate).

13.5 Place 100 ml of 20 000 mg/l KMnO4 stock solution in each of the three 250 ml glass vials containing the dried sample. Seal each of the vials and invert once to mix the reagents. Store vials at room temperature (20–22°C).

13.6 Sample each vial at 48 hours by removing a 1 ml sample aliquot. A centrifuge or oxidant resistant filter (20 µm) should be used to remove manganese oxides from the sample prior to analysis using Method 4500—$KMnO_4$.

14. Calculations

14.1 $PNOD_t$ values are expressed in units of mass of potassium permanganate per mass of dry aquifer solids using the following equation:

$$PNOD_t = \frac{V([KMnO_4]_0 - [KMnO_4]_t)}{m_{soil}} \quad (1)$$

where:

$PNOD_t$ = permanganate natural oxidant demand at time = t (g $KMnO_4$/kg soil or aquifer solids),
V = volume of the aqueous phase (l),
$[KMnO_4]_0$ = initial potassium permanganate concentration (g/l),
$[KMnO_4]_t$ = potassium permanganate concentration (g/l) at time = t, and
m_{soil} = mass of dry soil or aquifer solids (kg).

15. Precision and Bias

15.1 *Precision*—Test data on precision is not presented due to the nature of the soil and aquifer solids used by this test method. It is either not feasible or too costly at this time to have ten or more laboratories participate in a round-robin testing program. Also, it is either not feasible or too costly to produce multiple specimens that have uniform physical properties. Any variation observed in the data is just as likely to be due to specimen variation as to operator or laboratory testing variation.

15.2 The Subcommittee D18.21 is seeking any data from the users of this test method that might be used to make a limited statement on precision.

15.3 *Bias*—There is no accepted reference value for this test method, therefore, bias cannot be determined.

TEST METHOD B—PERMANGANATE NATURAL OXIDANT DEMAND KINETICS

16. Scope

16.1 The test method is appropriate for the determination of the permanganate natural oxidant demand kinetics for soil and aquifer solids. A curve fitting software package can be used to determine best-fit curves and kinetic parameters for each data set using the independent first-order model described below. The curve fitting software can also be used to predict the $PNOD_{max}$ of the soil or aquifer solids based on the kinetic data.

17. Summary of Test Method

17.1 The sample and permanganate solutions are analyzed for permanganate after reaction periods of 1, 3, 7, 24, 48, 168, and 336 hours.

18. Apparatus

18.1 *Reactor Apparatus*—A 250 mL glass vial (Pyrex or equivalent) with an oxidant resistant screw cap is recommended. Zero headspace is not required.

18.2 *Apparatus for Drying Sample*—A laboratory oven capable of delivering sufficient controlled heat to maintain a temperature of 105°C.

18.3 *Balances/Scales*—A balance having a minimum capacity of 100g and meeting the requirements of Guide D 4573, readable (with no estimation) to 0.1% of the test mass or better.

19. Reagents and Materials

19.1 *Purity of Reagents*—Reagent grade chemicals shall be used.

19.2 *Purity of Water*—Reference to water shall be understood to mean reagent grade water that meets the purity specifications of Type I or Type II water according to Specification D 1193.

19.3 *Potassium Permanganate Stock Solution (30 000 mg/L)*—Dissolve 30.0 g of potassium permanganate ($KMnO_4$) in water and dilute to 1 L. Mix the stock solution for a minimum of 2 hours to make certain the $KMnO_4$ crystals have completely dissolved.

19.4 *Potassium Permanganate Stock Solution (20 000 mg/L)*—Dilute 333.3 ml of 30 000 mg/L potassium permanganate stock solution to 500 ml.

19.5 *Potassium Permanganate Stock Solution (10 000 mg/L)*—P – Dilute 166.7 ml of 30 000 mg/L potassium permanganate stock solution to 500 ml.

20. Procedure

20.1 Dry each sample in the laboratory oven at 105°C for a period of 24 hours.

20.2 Homogenize the dried sample by gently mixing by hand. If large stones or rocks are present they should be removed prior to analysis using a No. 10 U.S. standard mesh sieve (2.00 mm).

20.3 Place 100 ml of 30 000 mg/l $KMnO_4$ stock solution in a 250 ml glass vial for the blank determination.

20.4 Place 50 g of dried sample in each of three 250 ml glass vials (each experiment is run in triplicate).

20.5 Place 100 ml of 30 000 mg/l KMnO4 stock solution in each of the three 250 ml glass vials containing the dried sample. Seal each of the vials and invert once to mix the reagents. Store vials at room temperature (20 - 22°C).

20.6 Sample each vial at 48 hours by removing a 1 ml sample aliquot. A centrifuge or oxidant resistant filter (20 µm) should be used to remove manganese oxides from the sample prior to analysis using Method 4500—$KMnO_4$.

20.7 Repeat 20.3 through 20.6 using the 20 000 and 10 000 mg/l $KMnO_4$ stock solutions.

21. Calculations

21.1 PNOD values are expressed in units of mass of potassium permanganate per mass of dry aquifer solids using the following equation:

$$PNOD_t = \frac{V([KMnO_4]_0 - [KMnO_4]_t)}{m_{soil}} \quad (2)$$

where:

$PNOD_t$	=	permanganate natural oxidant demand at time = t (g $KMnO_4$/kg soil or aquifer solids),
V	=	volume of the aqueous phase (l),
$[KMnO_4]_0$	=	initial potassium permanganate concentration (g/l),
$[KMnO_4]_t$	=	potassium permanganate concentration (g/l) at time = t, and
m_{soil}	=	mass of dry soil or aquifer solids (kg).

21.2 Permanganate concentration tends to decrease rapidly within the first 48 hours and more slowly thereafter. The independent first-order kinetic rate expression shown in Eq 3, with fast and slow reaction rate constants, can be used to model permanganate decay over time.

$$\frac{d[KMnO_4]}{dt} = -k_f a[KMnO_{4f}] - k_s b[KMnO_{4s}] \quad (3)$$

where:

$[KMnO_{4f}]$	=	the concentration of $KMnO_4$ involved in the fast reactions,
$[KMnO_{4s}]$	=	the concentration of $KMnO_4$ involved in the slow reactions,
k_f	=	the first-order reaction rate constant representing the fast reactions (s^{-1}),
k_s	=	the first-order reaction rate constant representing the slow reactions (s^{-1}),
a	=	the fraction of $KMnO_4$ involved in the fast reactions, and
b	=	the fraction of the $KMnO_4$ involved in the slow reactions.

A curve fitting software package should be used to determine best-fit curves and kinetic parameters for each data set using the independent first-order model. The curve fitting software can also be used to predict the $PNOD_{max}$ based on the kinetic data.

22. Precision and Bias

22.1 *Precision*—Test data on precision is not presented due to the nature of the soil and aquifer solids used by this test method. It is either not feasible or too costly at this time to have ten or more laboratories participate in a round-robin testing program. Also, it is either not feasible or too costly to produce multiple specimens that have uniform physical properties. Any variation observed in the data is just as likely to be due to specimen variation as to operator or laboratory testing variation.

22.2 The Subcommittee D18.21 is seeking any data from the users of this test method that might be used to make a limited statement on precision.

22.3 *Bias*—There is no accepted reference value for this test method, therefore, bias cannot be determined.

23. Keywords

23.1 Permanganate natural oxidant demand;*in situ* chemical oxidation; potassium permanganate

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