HRS DOCUMENTATION RECORD COVER SHEET

Name of Site:	PCE Former Dry Cleaner
EPA ID No.:	IAD039954300

Contact Persons

EPA Contact :	Susan Fisher, EPA Region 7 On-Scene Coordinator Todd Davis, Site Assessment Manager Preston Law, EPA Region 7 National Priorities List (NPL) Coordinator U.S. Environmental Protection Agency, Region 7 11201 Renner Boulevard Lenexa, Kansas 66219
Site Investigation:	US EPA Region 7 David Zimmermann, Tetra Tech, Inc.
Documentation Record:	David Zimmermann, Tetra Tech, Inc.

Pathways, Components, or Threats Not Scored

The air and surface water migration, and soil exposure pathways were not scored as part of this Hazard Ranking System (HRS) evaluation. These pathways or components were not included because a release to these media does not significantly affect the overall site score and because the ground water migration pathway alone produces an overall site score well above the minimum requirement for the site to qualify for inclusion on the National Priorities List (NPL). These pathways are of concern to EPA and may be evaluated during future investigations.

HRS DOCUMENTATION RECORD

Name of Site:	PCE Former Dry Cleaner
EPA Region:	7
Date Prepared:	September 2015
Street Address of Site*:	1205 East 7th Street (also known as U.S. Highway 6 and State Highway 83)
City, County, State, Zip Code:	Atlantic, Cass County, Iowa 50022
General Location in the State:	The site encompasses portions of Sections 4 and 9 of Township 76 North, Range 36 West as depicted on the 7.5-minute topographic quadrangle maps for Wiota (U.S. Geological Survey [USGS] 1971) (Figure 1 of this HRS documentation record; Ref. 3, p. 1)
Topographic Map:	The site is located in Atlantic, Iowa, in the southwestern portion of the state, about 75 miles west of Des Moines, Iowa and 50 miles east-northeast of Omaha, Nebraska. The location of the site and city is shown on the Wiota, Iowa, Quadrangle, U.S. Geological Survey, 7.5-Minute Series Topographic Maps (Ref. 3, p. 1).
Latitude*:	41º 24’ 13.38” North (Ref. 3, p. 1) (see Figure 1 of this HRS documentation record)
Longitude*:	94º 59’ 44.75” West (Ref. 3, p. 1) (see Figure 1 of this HRS documentation record)

The latitude and longitude coordinates listed above specify the approximate location of Source 1 (contaminated soils at the former Norge Dry Cleaning Village facility at 1205 East 7th Street). Figure 1 of this HRS documentation record shows the source location.

Scores	
Ground Water Migration Pathway	100.00
Surface Water Migration Pathway	Not Scored
Soil Exposure Pathway	Not Scored
Air Migration Pathway	Not Scored
HRS SITE SCORE	**50.00**

Note:

**The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, disposed, or placed, or has otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.*

WORKSHEET FOR COMPUTING HRS SITE SCORE

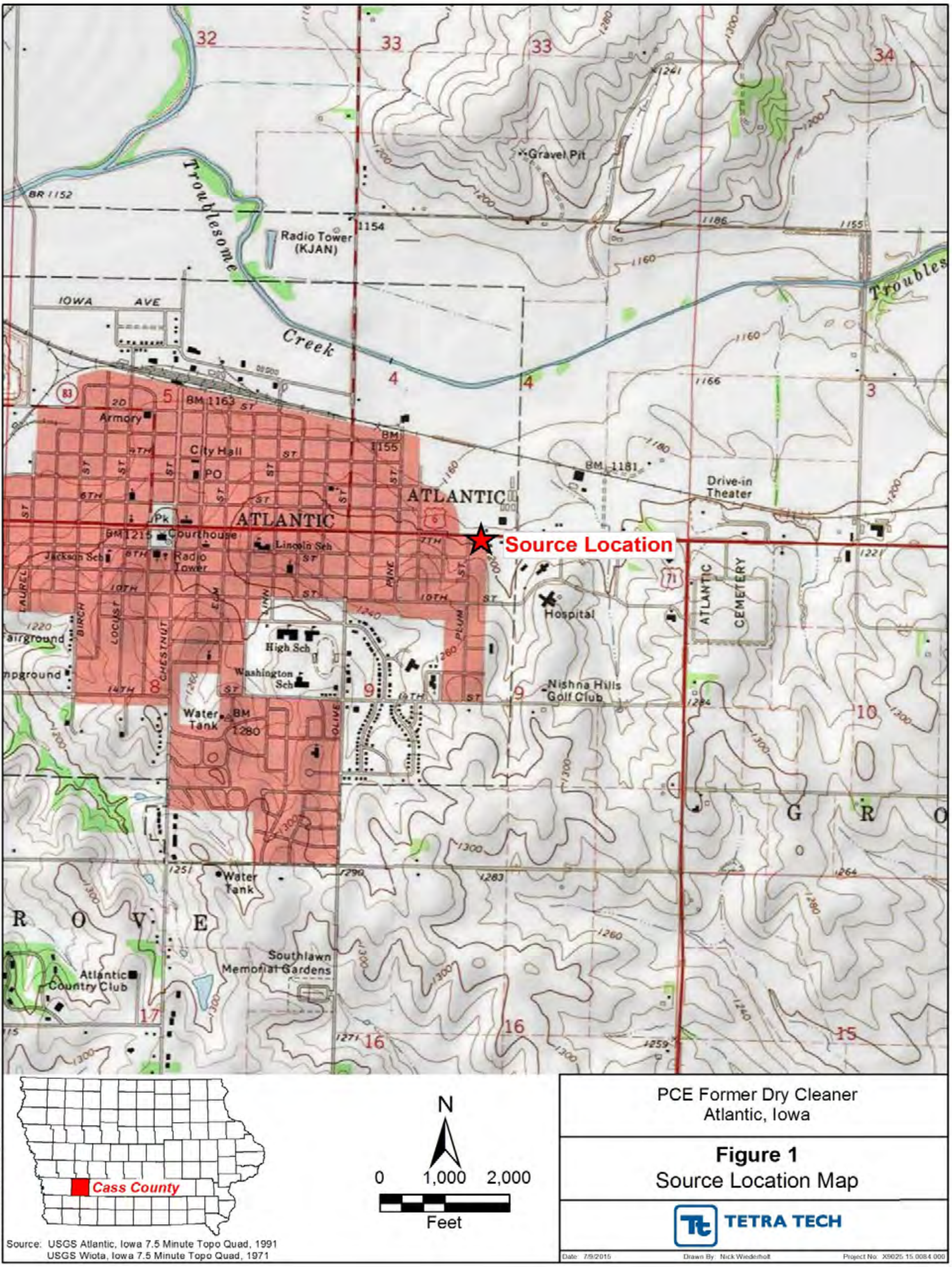
		S	**S^2**
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	100.00	10,000
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	Not Scored	Not Scored
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	Not Scored	Not Scored
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	Not Scored	Not Scored
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	Not Scored	Not Scored
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	Not Scored	Not Scored
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		10,000
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root	50.00	

TABLE 3-1– GROUND WATER MIGRATION PATHWAY SCORESHEET

Factor Categories and Factors	**Maximum Value**	**Value Assigned**
Likelihood of Release to an Aquifer:		
1. Observed Release:	550	550
2. Potential to Release:		
2a. Containment	10	Not Scored
2b. Net Precipitation	10	Not Scored
2c. Depth to Aquifer	5	Not Scored
2d. Travel Time	35	Not Scored
2e. Potential to Release [lines 2a x (2b + 2c + 2d)]	500	Not Scored
3. Likelihood of Release (higher of lines 1 and 2e)	550	550
Waste Characteristics:		
4. Toxicity/Mobility	a	1,000
5. Hazardous Waste Quantity	a	100
6. Waste Characteristics	100	18
Targets:		
7. Nearest Well	50	50
8. Population:		
8a. Level I Concentrations	b	8,596.9
8b. Level II Concentrations	b	Not Scored
8c. Potential Contamination	b	167
8d. Population (lines 8a + 8b + 8c)	b	8,763.9
9. Resources	5	5
10. Wellhead Protection Area	20	0
11. Targets (lines 7 + 8d + 9 + 10)	b	8,818.9
GROUND WATER MIGRATION SOURCE FOR AN AQUIFER		
12. Aquifer Source [(lines 3 x 6 x 11)/82,500][c]	100	100.00
GROUND WATER MIGRATION PATHWAY SCORE		
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)[c]	100	100.00

Notes:

[a] Maximum value applies to waste characteristics category
[b] Maximum value not applicable
[c] Do not round to nearest integer



PCE Former Dry Cleaner
Atlantic, Iowa

Figure 1
Source Location Map

TETRA TECH

Date: 7/9/2015 Drawn By: Nick Wiederholt Project No: X9025.15.0084.000

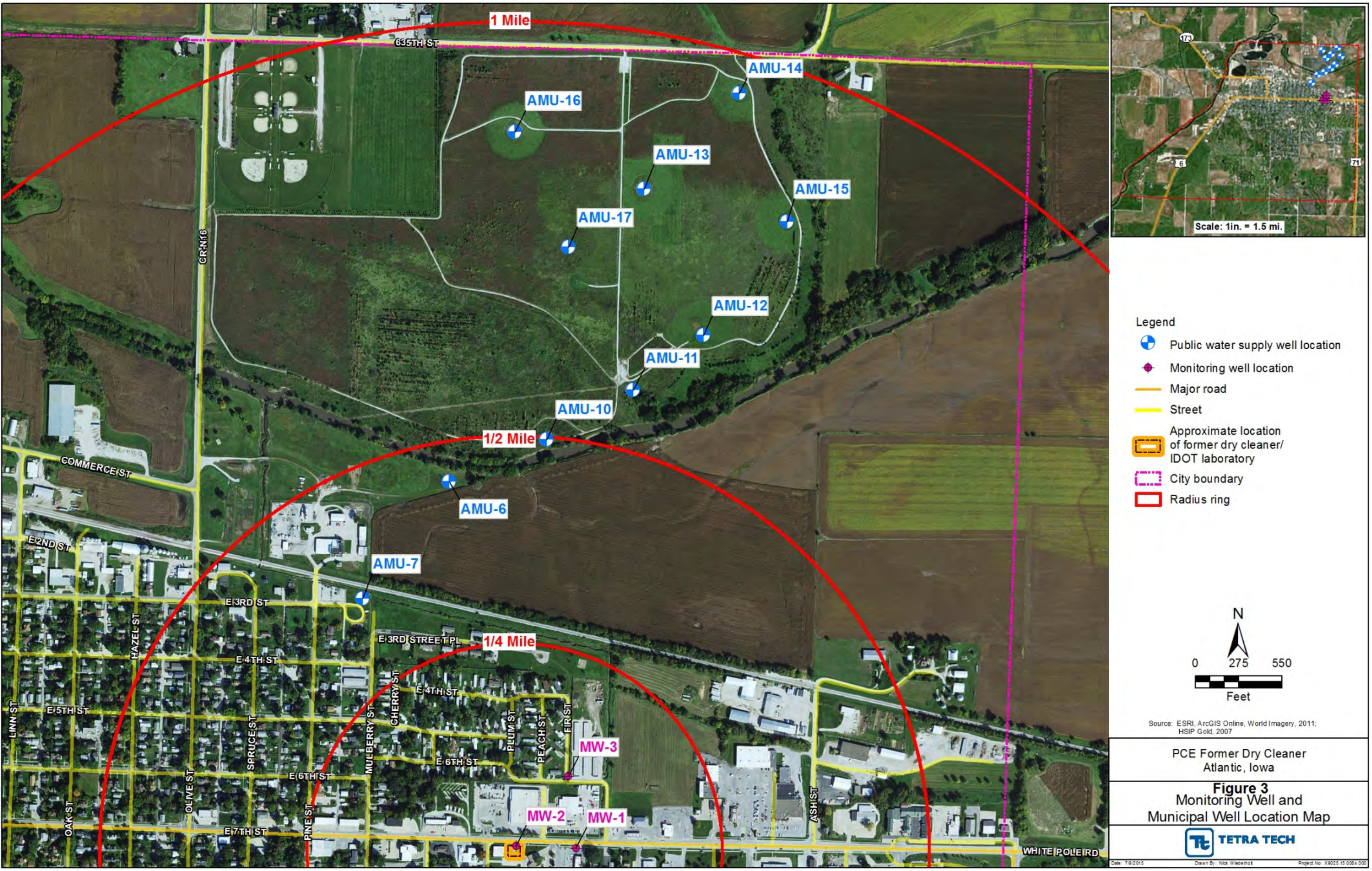
Source: USGS Atlantic, Iowa 7.5 Minute Topo Quad, 1991
USGS Wiota, Iowa 7.5 Minute Topo Quad, 1971

Source: ESRI, ArcGIS Online, World Imagery, 2014;
HSIP Gold, 2012

PCE Former Dry Cleaner
Atlantic, Iowa

Figure 2
Soil and Source Sampling Location Map

Date: 7/9/2015 Drawn By: Gustavo Orozco Project No: X9025.15.0084.000



Source: ESRI, ArcGIS Online, World Imagery, 2011; HSIP Gold, 2007

PCE Former Dry Cleaner
Atlantic, Iowa

Figure 3
Monitoring Well and
Municipal Well Location Map

Date: 7/9/2015 Drawn By: Nick Wiedemott Project No: X9025.15.0084.000

REFERENCES

Reference Number	Description of the Reference
1	U.S. Environmental Protection Agency (EPA). Hazard Ranking System, 55 FR 51533. December 14, 1990. Available Online at http://www.epa.gov/superfund/sites/npl/hrsres/index.htm#HRS%20Rule. Excerpt. 1 Page. [Note: A complete copy of the rule is available from the Region 7 Docket upon request.]
2	EPA. Superfund Chemical Data Matrix. January 30, 2014. [Note: A complete copy of SCDM is available at http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.] Excerpt. 5 Pages.
3	U.S. Department of Interior Geological Survey (USGS). 1971. Wiota, Iowa Quadrangle, Missouri, 7.5-Minute Series (topographic). 1 Page.
4	Iowa Department of Natural Resources (IDNR). 1999. Follow-up Investigations of PCE Contamination in Groundwater, Atlantic, Iowa – August & November 1998. February. 14 Pages.
5	Ecology and Environment, Inc. (E&E). 1988. Final Report: Site Investigation, Atlantic Public Water Supply, Atlantic, Iowa. TDD # F_07-8701-15. April 22. 137 Pages.
6	Tetra Tech EM, Inc. (Tetra Tech). 2004. Removal Site Evaluation Report: Atlantic Groundwater Site. Atlantic, Iowa. April 30. 289 pages.
7	Tetra Tech. 2012. Site Reassessment Inspection, Revision 1. Atlantic Water Supply Site, Atlantic, Cass County, Iowa. EPA ID: IAD039954300. February 24. 96 Pages.
8	EPA Region 7. 2014. HRS Analysis Results Supplement for ASR #1659 for the Atlantic Water Supply Site. December 4. 50 Pages.
9	U.S. Department of Agriculture (USDA) – Soil Conservation Service. 1969. Soil Survey of Cass County, Iowa. April. 87 Pages.
10	EPA Region 7. 2014. HRS Analysis Results Supplement for ASR #5613 for the Atlantic Water Supply Site. December 4. 28 Pages.
11	IDNR. 2012. Phase 1 Source Water Assessment for Atlantic (PWS#1509074) Dakota Aquifer. Report found online at: https://programs.iowadnr.gov/sourcewater/SystemDetail.aspx?pwsid=1509074. June 18. 10 Pages. [Note The date on this reference represents the date of the map on page 10.]
12	U.S. Geological Survey (USGS). 1992. Availability and Quality of Water from the Alluvial, Glacial-Drift, and Dakota Aquifers and Water Use in Southwest Iowa. USGS Water Resources Investigation Report 91-4156. 193 Pages.
13	Lockheed Martin Technology Services (Lockheed Martin). 2005. Hydrogeologic Investigation. Atlantic, Iowa Groundwater PCE Site, Atlantic, Iowa. Work Assignment 0-136. Technical Memorandum. November 3. 39 Pages.
14	Tetra Tech. 2013. Removal Reassessment Report, Revision 01. Atlantic Water Supply Site. July 26. 360 Pages.
15	Tetra Tech. 2012. Quality Assurance Project Plan. Atlantic Water Supply Site. May 30. 26 Pages.
16	Tetra Tech. 2013. Addendum to the Quality Assurance Project Plan. Atlantic Water Supply Site. February 25. 5 Pages.

REFERENCES

Reference Number	Description of the Reference
17	EPA Region 7. 2015. HRS Analysis Results Supplement for ASR #5905 for the Atlantic Water Supply Site. May 6. 33 Pages.
18	EPA Region 7. 2015. HRS Analysis Results Supplement for ASR #6045 for the Atlantic Water Supply Site. May 6. 36 Pages.
19	State of Iowa, Department of Natural Resources. 2012. Atlantic Municipal Utilities Water Supply Sanitary Survey, Public Water Supply ID # 1509074. August 21. 7 Pages.
20	U.S. Census Bureau. 2014. QuickFacts, Cass County, Iowa. Report found online at: http://www.census.gov/quickfacts/table/PST045214/19029,00. Accessed on August 13, 2015. 3 Pages.

SITE SUMMARY

The PCE Former Dry Cleaner site (the site) is in Atlantic, Iowa, a rural community in the northeastern portion of Cass County, about 75 miles west of Des Moines, Iowa, and 45 miles northeast of Council Bluffs, Iowa (Ref. 6, p. 5; Figure 1of this HRS documentation record). Soil and ground water used for drinking have been found contaminated with tetrachloroethene (PCE) (Tables 2, 8, and 9 of this HRS documentation record). The apparent source of contamination is contaminated soil at 1205 East 7th Street (Figure 2 of this HRS documentation record)—from either a former dry cleaning facility (the Norge Dry Cleaning Village), which operated at this location during the 1960s, or an Iowa Department of Transportation (IDOT) laboratory (Refs. 6, p. 5; 7, p. 6). Currently, nine active municipal wells serve the citizens in and around Atlantic, Iowa (Refs. 7, p. 23, 19, p. 2).

The area of contaminated ground water flows north-northwest from the contaminated soil source area toward the municipal well field (Refs. 6, pp. 17, 23-27, 95-116; 14, pp. 75, 76). The municipal water supply well field in Atlantic, Iowa, has been impacted by PCE (Refs. 6, pp. 6-7; 7, p. 6) at concentrations exceeding the 5 micrograms per liter (µg/L) maximum contaminant level (MCL) (Refs. 6, p. 6; 14, pp. 34, 36). Lesser concentrations of breakdown products such as trichloroethene (TCE), and 1,2-dichloroethene (DCE) have been reported sporadically (Refs. 6, pp. 6; 7, p. 6).

At the source, approximately 40 feet of silt and clay overlies fine- to coarse-grained friable sandstone from which the municipal water supply well field withdraws the City's potable water (Refs. 6, pp. 12-13, 95-116; 7, p. 6). PCE continues to migrate down into the sandstone aquifer at the source, and travel horizontally in this aquifer to the City's municipal well field. The well nearest to the source area, Atlantic Municipal Utilities well 7 (AMU-7), was first found to contain PCE in August 1982 (reported at concentration of 170 µg/L) (Figure 2 of this HRS documentation record; Ref. 5, pp. 8, 10-11; 6, p. 6; 7, p. 23). AMU-7 was disconnected from the system, and water in it is currently pumped continually to the AMU wastewater treatment plant to provide hydraulic control and protect nine other municipal wells from contamination. The well is showing signs of deterioration. Recent occurrence of PCE in AMU-6 (currently pumping to the system) indicates that the PCE plume is not fully contained by well AMU-7, and further deterioration of the well may acerbate the problem (Refs. 7, p. 23; 14, p. 16).

Currently, nine active municipal wells serve the citizens in and around Atlantic, Iowa. Eight municipal wells (AMU-10 through -17) are on the north side of Troublesome Creek between 0.5 and 1 mile from the former dry cleaner facility (Refs. 7, p. 23, 19, p. 2).

Following the detection of PCE in the municipal well field in 1982, environmental investigations to locate and characterize the source of ground water contamination occurred as part of a site inspection (SI) which was completed in July 1988 (Ref. 5), a follow-up investigation by the Iowa Department of Natural Resources (IDNR) in 1998 (Ref. 4), and a removal site evaluation (RSE) was completed in April 2004 (Ref. 6). In 2005, a hydrogeological investigation was completed for assessing the applicability of installing a permeable reactive barrier (PRB) for ground water treatment and protection (Ref. 13, p. 2). In 2011, a Site Reassessment Inspection was completed where nine municipal, three monitoring wells, and a former municipal well (AMU-7), now pumped to waste to contain the plume, were sampled (Refs. 7, p. 23; 19, p. 3). PCE (2,500 µg/L) and *cis*-1,2-DCE (3.8 µg/L) were identified in samples collected from monitoring well 2 (MW-2) at the suspected source area. In AMU-7, PCE and TCE were reported at 87 and 1.3 µg/L, respectively (Ref. 7, pp. 23-24, 28). In 2012 and 2013, the EPA conducted a Removal Reassessment that consisted of multiple mobilizations to quantify the volume of contaminated soil, assess ground water quality and determine the threats posed by the vapor intrusion pathway to nearby residents and workers (Ref. 14, pp. 6, 17). As part of this investigation, PCE at the source was found in soils at concentrations estimated as high as 3,400,000 micrograms per kilogram (µg/kg) and in ground water as high as14,000 microgram per liter (µg/L) (Ref. 14, pp. 29, 35). Also during this investigation, PCE was found in active municipal well AMU-6 at 15 µg/L, above the 5 µg/L MCL for PCE (Ref. 14, pp. 34, 35).

2.2 SOURCE CHARACTERIZATION

2.2.1 SOURCE IDENTIFICATION

Name of source: PCE Contaminated Soils

Number of source: 1

Source Type: Contaminated soil

Description and Location of Source (with reference to a map of the site): Figure 1

The source of contamination at the PCE Former Dry Cleaner site is at 1205 East 7th Street. A former dry cleaning facility, the Norge Dry Cleaning Village, operated at this location during the 1960s (Refs. 6, pp. 5, 30-38; 7, p. 6). This facility also was used from 1960 to 1974 by Shrauger Appliance as an appliance retailing facility. In 1974, IDOT leased the facility as a materials testing laboratory. The 1976 City Directory lists the State Department of Transportation Resident Maintenance Engineer's office at 1205 7th Street East and a materials laboratory at 1203 7th Street East. In 1982, the State Transportation Department Materials Laboratory was listed at 1203 7th Street East. IDOT relocated its operation in March 1986 to a location east of the City. It is suspected that the dry cleaning operations and IDOT routinely used solvents (Ref. 5, pp. 13, 44, 45). However, the type of solvent used the previous occupants is not documented. The former dry cleaning and IDOT laboratory facility no longer exists at this location. Based on the historical aerial photographs of the facility, the building was razed between 1982 and 1994 (Ref. 6, pp. 5, 34-38). The area is now occupied by a parking lot with a professional services office building directly west and the Rolling Hills Bank and Trust to the southeast (Refs. 6, pp. 5-6, 75-94; 7, p. 6).

Source 1 is contaminated soils identified via soil gas and soil sampling in 1988 and 1998 (Ref. 4, pp. 3-6, 9-10, 11, and 13), and confirmed by soil sampling in 2002 (Ref. 6, pp. 7-8, 11-13, 24-25, and 124-126), 2012 and 2013 (Ref. 14, pp. 29, 30, 74). In 2002, multiple soil samples were collected from 13 direct push technology (DPT) soil borings and three monitoring well borings (Ref. 6, p. 7). PCE was identified in DPT borings GP-1 and GP-4, and in monitoring well boring MW-2. All these samples were collected near or in the parking lot where the former dry cleaning facility and IDOT testing laboratory were located (Refs. 6, pp. 11-13, 24, 32-37; 14, p. 13).

In samples from DPT location GP-1, PCE was detected at depths of 9-10 and 21-22 feet below ground surface (bgs) at concentrations of 23 and 37 µg/kg, respectively (Ref. 6, pp. 12-13, 124). In GP-4, PCE was reported at 32 µg/kg in a sample collected at 34.5 to 35 feet bgs (Ref. 6, pp. 12, 124, and 130).

Soil samples from borings that were later developed as monitoring wells (MW-1) were collected from a five foot long split-barrel sampler advanced inside a hollow stem auger (Ref. 6, p. 8). Soil samples collected from the boring at MW-2 contained much higher concentrations of PCE. Four samples were collected from this boring at depths of 9, 19, 28, and 36 feet bgs (Ref. 6, pp.13, 24, 120, 124-126, 148, 151, 154-156). PCE concentrations ranged from an estimated 930 to 5,200 µg/kg, with concentrations increasing with depth (Refs. 6, p. 13; 14, p. 13).

In 2012 and 2013 EPA conducted a Removal Reassessment (Ref. 14, p. 17). General objectives of the Removal Reassessment were to more fully evaluate the extent of soil contamination at the former drycleaner/IDOT material testing laboratory, conduct ground water sampling activities to better define the horizontal extent of the PCE plume near the well field, and determine through sampling of ground water if other sources of PCE may be impacting the AMU well field (Ref. 14, p. 17). Additional soil samples were collected in October 2012, March 2013, and June 2013 (Ref. 14, pp. 17, 19-21, 23-25). During the October 2012 soil investigation, a membrane interface probe (MIP) was used on a grid system established at the source to provide a continuous log of chlorinated volatile organic compounds (VOCs) in soil (Ref. 14, pp. 19, 20, 21, 23). MIP logs are presented in Reference 14, pages 199 to 243. Following the MIP assessment, targeted soil samples were collected at intervals showing the greatest responses and were submitted to the EPA Region 7 laboratory for VOC analysis at low levels by gas chromatography/mass spectrometry (GC/MS) closed-system purge and trap (Ref. 14, pp. 20, 23, 291, 292). Additional subsurface soil sampling in March and June 2013 was conducted to better define the extent of contamination (Ref. 14, p. 20). In March 2013, 27 soil samples were collected from 10 borings and in June 2013, nine soil samples were collected from three soil borings (Ref. 14, pp. 20, 24, 25). Sample depths were typically at 8-9 feet bgs, 19-20 feet bgs, and 27-28 feet bgs at each location (Ref. 14, pp. 21, 24, 25). In March and June of 2013, soil samples were submitted for VOC analysis at low levels by GC/MS closed-system purge and trap (Ref. 14, pp. 21, 24, 25, 312, 313, 345, 346). Sample locations are presented on Figure 4 of the Removal Reassessment Report (Ref. 14, p. 72). Sampling was conducted in general accordance with the project specific quality assurance project plan (QAPP) dated May 30, 2012 and the QAPP Addendum dated February 25, 2013 (Refs. 15, 16).

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

All Source 1 samples were collected at the former Norge Dry Cleaning Village facility property (see Figure 1 of this HRS documentation record). PCE was documented in Source 1 soil samples (See Tables 1 and 2 of this HRS documentation record). The results presented from past source soil sampling activities suggest a confirmation of among other VOCs PCE contamination at the facility (Ref. 6, pp. 7-8, 11-13, 24-25, 120-121, 123-126).

Background Samples

No designated background sample was collected in support of the 2002 Removal Site Evaluation (RSE), or the 2013 Removal Reassessment, which were primarily designed to sample suspected source areas at the facility and nearby ground water contamination (Refs. 6, pp. 7, 12, 13, 24, 120, 123, 142, and 143; 14 pp. 19-21, 23-25, 28-30, 72). However, during both investigations, numerous locations around the perimeter of the contaminated soil source were sampled and documented by chemical analysis to contain no chlorinated solvents. During the 2002 RA, DPT locations surrounding the contaminated soil source, including GP-2, GP-3, GP-5, GP-6, GP-7, GP-8, and GP-13 are used as background locations (Ref. 6, p. 24). In addition soil samples that were collected from the boring that was later developed into monitoring well MW-1 were used as background (Ref. 6, p. 24; Table 1 of this HRS documentation record). These locations were collected in the same time period, by the same method, at about the same depths, and were analyzed using the same methods as the source samples (Ref. 6, pp. 7, 8, 12, 13, 120-123).

For the Removal Reassessment at least one background sample was designated per sampling event. For samples collected in October 2012 under Analytical Services Request (ASR) 5905, location MIP-15 (northwest of the contaminated soil source across east 7th Street) was chosen (Ref. 14, pp. 23, 72). For the samples collected in March 2013 under ASR 6045, locations SB-8 and SB-9 (west of the contaminated soil source) were chosen (Ref. 14, pp. 25, 72). These locations were collected in the same time period, by the same method, at about the same depths, and were analyzed using the same methods as the source samples (Ref. 14, pp. 19-21, 23-25, 291, 292, 312-314).

Table 1: Fixed Laboratory Analytical Results of Background Samples

Sample Location	Sample Number	Date Sampled	Sample Depth (ft bgs)	Hazardous Substance	Concentration (µg/kg)	Reporting Limit* (µg/kg)	References
GP-2	1659-3	09/17/2002	19 - 20	PCE	12 U	12	6, pp. 12, 24, 120, 123, 139, 144; 8, p. 4
	1659-4	09/17/2002	28 - 29	PCE	14 U	14	6, pp. 12, 24, 120, 123, 139, 145; 8, p. 5
GP-3	1659-27	10/08/2002	20 - 21	PCE	11 U	11	6, pp. 12, 24, 120, 129-130, 139, 171, 172; 8, p. 31
	1659-27FD	10/08/2002	20 - 21	PCE	12 U	12	
	1659-28	10/08/2002	34 - 35	PCE	10 U	10	6, pp. 12, 24, 120, 130, 139, 173; 8, p. 4
GP-5	1659-31	10/09/2002	14 - 14.5	PCE	13 U	13	6, pp. 12-13, 24, 120, 131, 141, 176; 8, p. 36
	1659-32	10/09/2002	35.5 - 36	PCE	11 U	11	6, pp. 12, 24, 120, 131, 141, 177; 8, p. 37
GP-6	1659-25	10/08/2002	18 - 18.5	PCE	14 U	14	6, pp. 12, 24, 120, 129, 141, 169; 8, p. 29
	1659-26	10/08/2002	33 - 34	PCE	10 U	10	6, pp. 12, 24, 120, 129, 141, 170; 8, p. 30
GP-7	1659-23	10/07/2002	14 - 15	PCE	13 U	13	6, pp. 12, 24, 120, 28, 141, 167; 8, p. 27
	1659-24	10/07/2002	33.5 - 34	PCE	11 U	11	6, pp. 12, 24, 120, 129, 141, 168; 8, p. 28
GP-8	1659-19	09/19/2002	9 - 10	PCE	11 U	11	6, pp. 12, 24, 120, 127, 140, 161; 8, p. 22
	1659-20	09/19/2002	32 - 33	PCE	11 U	11	6, pp. 12, 24, 120, 128, 140, 162; 8, p. 23
GP-13	1659-33	10/10/2002	7 - 8	PCE	14 U	14	6, pp. 12, 24, 120, 131, 141, 178; 8, p. 38
	1659-34	10/10/2002	34.5 - 35.5	PCE	11 U	11	6, pp. 12, 24, 120, 131, 141, 179; 8, p. 39
MW-1	1659-8	09/17/2002	19	PCE	11 U	11	6, pp. 12, 24, 120, 124, 139, 149; 8, p. 9
	1659-9	09/17/2002	27.5	PCE	12 U	12	6, pp. 12, 24, 120, 125,139, 150; 8, p. 10
MIP-15 —24-26’	5905-1	10/03/2012	24-26	PCE	6.4 U	6.4	14, pp. 29, 72, 111, 141, 291, 294; 17, p. 1
SB-9 — 8-9’	6045-22	3/12/2013	8 - 9	PCE TCE *cis*-1,2-DCE	5.8 U 5.8 U 5.8 U	5.8 5.8 5.8	14, pp. 25, 29, 72, 165, 173, 312, 325, 326; 18, pp. 1, 26, 27
SB-9 — 19-20’	6045-23	3/12/2013	19 - 20	PCE TCE *cis*-1,2-DCE	5.0 U 5.0 U 5.0 U	5.0 5.0 5.0	14, pp. 25, 29, 72, 166, 173, 312, 325, 326; 18, pp. 1, 27, 28
SB-9 — 27-28’	6045-24	3/12/2013	27 - 28	PCE TCE *cis*-1,2-DCE	8.2 U 8.2 U 8.2 U	8.2 8.2 8.2	14, pp. 25, 29, 72, 167, 173, 312, 325, 326; 18, pp. 1, 29
SB-8 — 8-9’	6045-25	3/13/2013	8 - 9	PCE TCE *cis*-1,2-DCE	5.4 U 5.4 U 5.4 U	5.4 5.4 5.4	14, pp. 25, 29, 72, 168, 174, 312, 328, 329; 18, pp. 1, 30
SB-8 — 19-20’	6045-26	3/13/2013	19 - 20	PCE TCE *cis*-1,2-DCE	7.0 U 7.0 U 7.0 U	7.0 7.0 7.0	14, pp. 25, 29, 72, 169, 174, 312, 328, 329; 18, pp. 1, 31

Notes:

*	The reporting limit is the laboratory reporting limit with any dilution factor, volume adjustment, or percent solids for each sample taken into account and is equivalent to the SQL as defined in the HRS (Refs. 1, Section 1.1, Definitions; 17, p. 1; 18, p. 1).
µg/kg	Micrograms per kilogram
cis-1,2-DCE	*cis*-1,2-Dichloroethene
N/A	Not Available
TCE	Trichloroethene
PCE	Tetrachloroethene
U	Not detected at or above the reportable level shown (Refs. 6, p. 119; 14, pp. 290, 311).

Contaminated Samples

The source hazardous substances are those hazardous substances documented in the source soil samples. As discussed in Section 2.2.1 and listed in Table 2 of this HRS documentation record, PCE was detected in multiple source samples collected at Source 1. In 2002, a total of 13 soil borings were advanced using DPT. Each boring was advanced to a depth ranging from 32 to 36 feet bgs except for boring GP-12, which was advanced to a total depth of 23 feet bgs (Ref. 6, p. 7). Placements of the borings were designed to determine the areal extent of the source area previously indicated during the 1998 Iowa Department of Natural Resources (IDNR) investigation (Ref. 4, pp. 8-14). At each soil boring location, the soil was continuously sampled using a 1.75-inch diameter, four feet long core barrel sampler with dedicated acetate liners. As each soil core was retrieved, the soil was screened with a hand-held photo-ionization detector (PID), and a description of the borehole lithology was recorded. Soil samples were collected for laboratory analysis of VOCs based on PID readings and changes in lithology (Ref. 6, pp. 7-8, 24). In 2002, soil samples were also collected from soil borings that would be completed as monitoring wells (Ref. 6, p. 8). These soil samples were collected from a five foot long split-barrel sampler advanced inside a hollow stem auger (Ref. 6, p. 8). These samples were submitted to the U.S. EPA Region 7 laboratory for analysis under ASR # 1659 (Ref. 6, pp. 118, 120-121). The laboratory analyzed for VOCs in soil at low levels by GC/MS Closed-System Purge-and-Trap (Ref. 6, p. 122). Associated chain-of-custody (COC) for the ASR is included on pages 139 through 141 of Reference 6. Reporting limits for samples in which an analyte was positively identified are not available for the 2002 samples (Ref. 8).

Table 2: Fixed Laboratory Analytical Results of Source 1 Samples

Sample Location	Sample Number	Date	Sample Depth (ft bgs)	Hazardous Substance	Concentration (µg/kg)	Reporting Limit* (µg/kg)	References
GP-1	1659-6	09/17/2002	9 - 10	PCE	23	N/A	6, pp. 12-13, 24, 120, 124, 139, 147; 8, p. 7
	1659-5	09/17/2002	21 - 22	PCE	37	N/A	6, pp. 12-13, 24, 120, 124, 139, 146; 8, p. 6
GP-4	1659-30	10/08/2002	34.5 - 35	PCE	32	N/A	6, pp. 12-13, 24, 120, 130, 139, 141, 175; 8, p. 35
MW-2	1659-7	09/17/2002	9	PCE	930 J[1]	N/A	6, pp. 12-13, 24, 120, 124, 139, 148; 8, p. 8
	1659-10	09/17/2002	19	PCE	4,600	N/A	6, pp. 12-13, 24, 120, 125, 139, 151; 8, p. 11
	1659-13	09/18/2002	28	PCE	5,100	N/A	6, pp. 12-13, 24, 120, 126, 139, 154; 8, p. 15
	1659-14	09/18/2002	36	PCE	5,000	N/A	6, pp. 12-13, 24, 120, 126, 139, 155-156; 8, p. 15
	1659-14FD	09/18/2002	36	PCE	5,200	N/A	6, pp. 12-13, 24, 120, 126, 139, 155-156; 8, p. 16
MIP-1 — 27-28’	5905-2	10/04/2012	27 - 28	PCE	26,000 J[2]	790	14, pp. 23, 72, 112, 141, 294; 17, pp. 1, 2
MIP-2 — 25-26’	5905-3	10/04/2012	25 - 26	PCE	3,400 J[2]	390	14, pp. 23, 72, 113, 141, 294; 17, pp. 1, 3
MIP-3 — 27-28’	5905-4	10/04/2012	27 - 28	PCE	670 J[3]	4.6	14, pp. 23, 72, 114, 141, 294; 17, pp. 1, 4
MIP-4 — 15-16’	5905-9	10/04/2012	15 - 16	PCE	240 J[3]	6.8	14, pp. 23, 72, 119, 143, 298; 17, pp. 1, 10
MIP-5 — 24-25’	5905-5	10/04/2012	24 - 25	PCE	1,200 J[2]	410	14, pp. 23, 72, 115, 141, 296; 17, pp. 1, 6
MIP-6 — 27-28’	5905-6	10/04/2012	27 - 28	PCE	8,100 J[2]	380	14, pp. 23, 72, 116, 141, 296; 17, pp. 1, 7
MIP-7 — 24-25’	5905-7	10/04/2012	24 - 25	PCE	3,400,000 J[2]	380,000	14, pp. 23, 72, 117, 141, 296; 17, pp. 1, 8
MIP-8 — 15-16’	5905-8	10/04/2012	15 - 16	PCE	440 J[2]	370	14, pp. 23, 72, 118, 143, 296; 17, pp. 1, 9
MIP-9 — 18-20’	5905-10	10/04/2012	18 - 20	PCE	1,400 J[2]	360	14, pp. 23, 72, 120, 143, 298; 17, pp. 1, 11
SB-2 — 8-9’	6045-4	3/12/2013	8 - 9	PCE	120	28	14, pp. 24, 72, 147, 173, 312, 315; 18, pp. 1, 5
SB-2 — 19-20’	6045-5	3/12/2013	19 - 20	PCE	320	7.5	14, pp. 24, 72, 148, 173, 312, 317; 18, pp. 1, 7
SB-2 — 27-28’	6045-6	3/12/2013	27 - 28	PCE	230	6.8	14, pp. 24, 72, 149, 173, 312, 317; 18, pp. 1, 8
SB-3 — 8-9’	6045-7	3/12/2013	8 - 9	PCE TCE	720 17	30 6.4	14, pp. 24, 72, 150, 173, 312, 317, 318; 18, pp. 1, 9
SB-3 — 19-20’	6045-8	3/12/2013	19 - 20	PCE TCE	980 13	29 6.2	14, pp. 24, 72, 151, 173, 312, 317, 318; 18, pp. 1, 10

Sample Location	Sample Number	Date	Sample Depth (ft bgs)	Hazardous Substance	Concentration (µg/kg)	Reporting Limit* (µg/kg)	References
SB-3 — 27-28’	6045-9	3/12/2013	27 - 28	PCE	370	5.4	14, pp. 24, 72, 152, 173, 312, 319; 18, pp. 1, 11
SB-4 — 8-9’	6045-10	3/12/2013	8 - 9	PCE	300	8.3	14, pp. 24, 72, 153, 173, 312, 319; 18, pp. 1, 13
SB-4 — 19-20’	6045-11	3/12/2013	19 - 20	PCE TCE	1,100 13	30 7.3	14, pp. 24, 72, 154, 173, 312, 319, 320; 18, pp. 1, 14
SB-4 — 27-28’	6045-12	3/12/2013	27 - 28	PCE	450	28	14, pp. 24, 72, 155, 173, 312, 319; 18, pp. 1, 15
SB-6 — 8-9’	6045-16	3/12/2013	8 - 9	PCE	280	5.8	14, pp. 24, 72, 159, 173, 312, 321; 18, pp. 1, 20
SB-6 — 19-20’	6045-17	3/12/2013	19 - 20	PCE TCE *cis*-1,2-DCE	4,600 27 14	310 6.7 6.7	14, pp. 24, 72, 160, 173, 312, 323, 324; 18, pp. 1, 21
SB-6 — 27-28’	6045-18	3/12/2013	27 - 28	PCE TCE *cis*-1,2-DCE	4,600 J[4] 15 7.0	6.0 6.0 6.0	14, pp. 24, 72, 161, 173, 312, 323, 324; 18, pp. 1, 22
SB-7 — 8-9’	6045-19	3/12/2013	8 - 9	PCE	460	6.3	14, pp. 24, 72, 162, 173, 312, 323; 18, pp. 1, 23
SB-7 — 19-20’	6045-20	3/12/2013	19 - 20	PCE	93	6.2	14, pp. 24, 72, 163, 173, 312, 323; 18, pp. 1, 24
SB-7 — 27-28’	6045-21	3/12/2013	27 - 28	PCE TCE	440 10	23 6.3	14, pp. 25, 72, 164, 173, 312, 325, 326; 18, pp. 1, 25

Notes

*	The reporting limit is the laboratory reporting limit with any dilution factor, volume adjustment, or percent solids for each sample taken into account and is equivalent to the SQL as defined in the HRS (Refs. 1, Section 1.1, Definitions; 17, p. 1; 18, p. 1)
µg/kg	Micrograms per kilogram
cis-1,2-DCE	*cis*-1,2-Dichloroethene
J[1]	The associated numerical value is an estimated quantity (Ref. 6, p. 119). The value was estimated because it was quantified below the level of the lowest calibration standard (Ref. 6, p. 122).
J[2]	The identification of the analyte is acceptable; the reported value is an estimate. Dilutions were necessary because of high levels of tetrachloroethene in samples -2, -3, -5, -6, -7, -8, and -10 for this analysis, therefore, these samples were analyzed at medium level outside holding times (6-7 days) and reported with elevated detection limits. Since the low level analyses were not reported for these samples which may have had positive results and analyzed outside holding times, all non-detect results were UJ-coded and positive results were J-coded as estimated results in these samples (Ref. 14, pp. 290, 292).
J[3]	The identification of the analyte is acceptable; the reported value is an estimate. Tetrachloroethene in samples -4 and -9 were above the calibration range and either diluted out or not diluted and reanalyzed, therefore, tetrachloroethene in samples -4 and -9 was J coded as estimated results (Ref. 14, pp. 290, 292).
J[4]	The identification of the analyte is acceptable; the reported value is an estimate. Although the analyte in question has been positively identified in the sample, the quantitation is an estimate due to the reported value exceeding the calibrated range of the instrument (Ref. 14, pp. 311, 314).
N/A	Not Available
TCE	Trichloroethene
PCE	Tetrachloroethene
U	Not detected at or above the reportable level shown (Refs. 6, p. 119; 14, pp. 290, 311).

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Table 3: Containment Factors for Source No. 1

Containment Description	Containment Factor Value	References
Gas release to air	Not Scored	N/A
Particulate release to air	Not Scored	N/A
Release to ground water: Source 1 has no liner. Therefore, based on available evidence, the highest ground water migration pathway containment factor value of 10 was assigned to Source Number 1 as specified in Table 3-2 of the HRS (Ref. 1, Section 3.1.2.1).	10	4, pp. 5-8; 7, pp. 9-12; 1, Table 3-2, Section 3.1.2.1
Release via overland migration and/or flood.	Not scored	N/A

Notes:

N/A	Not available

2.4.2 HAZARDOUS WASTE QUANTITY

2.4.2.1.1 Hazardous Constituent Quantity - Tier A

The Hazardous Constituent Quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, pp. 51590-51591 (Section 2.4.2.1.1)]. There are insufficient historical and current data (manifests, potentially responsible parties [PRPs] records, State records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the Hazardous Constituent Quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier B, Hazardous Wastestream Quantity (Ref. 1, p. 51591).

Hazardous Constituent Quantity Assigned Value: Not scored

2.4.2.1.2 Hazardous Wastestream Quantity – Tier B

The Hazardous Wastestream Quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the mass of hazardous wastestreams plus the mass of any of any CERCLA pollutants and contaminants in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, pp. 51591 (Section 2.4.2.1.2)]. There are insufficient historical and current data (manifests, PRP records, State records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass of the wastestream plus the mass of all CERCLA pollutants and contaminants in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the Hazardous Wastestream Quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume (Ref. 1, p. 51591).

Hazardous Wastestream Quantity Assigned Value: Not scored

2.4.2.1.3 Volume – Tier C

Horizontal and vertical extent of the source cannot be determined based on available sampling data; a sufficient number of samples are not available to statistically represent the range of contaminant concentrations throughout the source (Ref. 1, Section 2.4.2.1.3). During the Removal Reassessment, an estimated volume of soil was calculated using a 4 D interactive computer model, with inputs from the results from the membrane interface probe (MIP) investigation and subsequent analytical data (Ref. 14, pp. 31-33). This molded visualization of the data suggested a volume of 3,776 cubic yards of soil at concentrations above 46 µg/kg (Ref. 14, pp. 33, 73). This information is not used for scoring due to the uncertainty of using MIP data as the units it generates (micro-volts [µV]) are in terms of relative response (Ref. 14, p. 20). Source 1 has been assigned a value of 0 for the volume measure (Ref. 1, p. 51591). As a result, the evaluation of hazardous waste quantity proceeds to the evaluation of Tier D, Area (Ref. 1, p. 51591).

Volume Assigned Value: 0

2.4.2.1.4 Area – Tier D

Soil samples were collected from Source 1, as presented in Table 1 of this documentation record and shown in Figures 3 of the EPA Removal Site Evaluation report (Ref. 6, p. 24). These samples were collected from several soil boring locations. In addition to samples included in Table 1, historical data has shown the presence of Source 1-related contaminants in the area; however, the areal extent of the contamination cannot be accurately determined based on available sampling data (Ref. 5, pp. 12, 27, 34-41). It is not known whether contamination in Source 1 is continuous throughout and the extent of contamination is not defined. The area of Source 1 is unknown, but greater than zero square feet (Ref. 1, Section 2.4.2.1.4).

Sum (ft^2): unknown, but > 0

Equation for Assigning Value (Ref. 1, Table 2-5): Area (A)/34,000

Area Assigned Value: unknown, but > 0

Source Hazardous Waste Quantity Value

Highest assigned value assigned from Table 2-5 (Ref. 1, p. 51591): unknown, but > 0

SUMMARY OF SOURCE DESCRIPTIONS

Table 4: Summary of Sources Descriptions

Source No.	Source Hazardous Waste Quantity Value	Source Hazardous Constituent Quantity Complete? (Y/N)	Containment Factor Value by Pathway				
				Surface Water (SW)		Air	
			Ground Water (GW) (Ref. 1, Table 3-2)	Overland/flood (Ref. 1, Table 4-2)	GW to SW (Ref. 1, Table 3-2)	Gas (Ref. 1, Table 6-3)	Particulate (Ref. 1, Table 6-9)
1	> 0	No	10	Not Scored	Not Scored	Not Scored	Not Scored

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 GENERAL CONSIDERATIONS

Ground Water Migration Pathway Description

Regional Geology/Aquifer Description:
Atlantic Iowa is in the Southwestern Iowa Drift Plain landform that is a landscape of steeply rolling hills and incised valleys that has evolved since the end of the pre-Illinoian glaciation (Ref. 12, pp. 8-10). Topography in the general area is relatively flat, with a slight slope to the north. The elevation at the source is about 1,190 feet above mean sea level (MSL) (Ref. 3, p. 1). Most of the soils in the county formed under prairie and are dark colored and fertile (Ref. 9, p. 5). The main streams dissecting the county are the East Nishnabotna River and Turkey, Troublesome, and Indian Creeks (Ref. 9, p. 74); Troublesome Creek, which has an elevation of about 1,150 feet amsl, flows generally westward at the northern edge of Atlantic; it is located approximately 0.5 mile north of the former drycleaners (Ref. 3, p. 1).

Sources of ground water in Cass County include alluvial valley aquifers, glacial-drift aquifers, and the Dakota Formation (Refs. 13, p. 4; 12, pp. 16, 18, 19, 28, 29, 35, 36). The alluvial aquifers are primarily made up of deposits along existing river valleys (Refs. 7, p. 17; 12, pp. 16, 18). The nearest alluvial valley to Atlantic is the east fork of the Nishnabotna River and its tributary, Troublesome Creek (Refs. 3; 12, pp. 12, 18, 19). The Nishnabotna alluvial aquifer underlying the valley is relatively shallow, with an average thickness of 21 feet, and is comprised of fine-grained alluvial deposits (Refs. 12, pp. 18, 19; 13, p. 4). The thickness ranges from two to 43 feet (Refs. 12, pp. 18, 19; 13, p. 4). Ground water can also be obtained from shallow glacial-drift aquifers consisting of glacial and loess deposits over bedrock. In Cass County, these deposits range in thickness from 18 to 260 feet (Ref. 12, p. 175). Neither the alluvial nor the glacial-drift aquifers are used for ground water production in the Atlantic area (Refs. 12, p. 190; 13, p. 5).

Site Geology/Aquifer Description:
Site specific geology is characterized by borings installed at the site in 2002 (Ref. 6, pp. 8, 25, 49-74, 96-103), 2005 (Ref. 13, pp. 3, 4, 13, 15, 18-23), and 2013 (Ref. 14, pp. 19, 72, 245-259). At source 1, the boring log for MW-2 indicated a predominance of fat clay and lean clayey silt to a depth of 36.5 feet below grade (Ref. 6, pp. 25, 99, 100). Within the clay and silt at a depth of 15 to 16.5 feet below grade is a 1.5 thick layer of poorly graded sand that is discontinuous (Ref. 6, pp. 25, 27, 96, 97, 99). At 36.5 feet below grade, poorly graded sand is encountered that was continuous to the terminus of the boring which was 50 feet below grade (Ref. 6, pp. 25, 100, 101). This sand layer dips to the north (Ref. 6, p. 27). The

top of the water table was measured to be 40.16 feet below the top of casing in 2002 (Ref. 6, pp. 9, 25). In 2013, a deeper boring (SB-1) was installed at source 1 to determine the thickness of the sand layer which was believed to represent the Dakota Sandstone (Ref. 14, p. 19, 74, 253-259). In Boring SB-2, which was installed near MW-2, (Ref. 14, pp. 19, 74) sand was encountered at 35 feet below grade and continued to 43 feet below grade where a one foot thick layer of silty clay was encountered (Ref. 14, pp. 255, 256). At about 44.5 feet below grade, the geologist described the material as round to sub-round sand with some gravel and classified the material as belonging to the Dakota formation (Ref. 14, p. 256). This material was logged to about 79 feet below grade where stiff, pale brown clay was encountered (Ref. 14, pp. 256-259). The Dakota sandstone is about 34.5 feet thick beneath source 1. Shale was logged at 81 feet below grade (Ref. 14, pp. 256-259).

In 2005, a hydrogeologic investigation was conducted near the city well field to assess the applicability of installing a permeable reactive barrier for ground water treatment and protection (Ref. 13, pp. 2, 13). Six borings were installed, logged and sampled near municipal well 7 (Ref. 13, pp. 3, 4, 13). Based on the drilling logs, a general stratigraphic log was developed (Ref. 13, p. 15). This cross section shows that a confining layer of silt and clay (averaging 20 feet in thickness) overlies a thin interval of water bearing fine- to coarse-grained sand or sand and gravel (Ref. 13, pp. 6, 15). A thin seam of silt and clay was encountered in several of the borings beneath the sand (Ref. 13, pp. 6, 15, 19, 20, 21). On average, the Dakota sandstone extends from 28 to 75 feet bgs (Ref. 13, pp. 6, 15). Beneath the sandstone a dense hard mixture of silt, clay and gravel was encountered followed by a weathered shale or mudstone (Ref. 13, pp. 6, 15). Below the Dakota is an aquiclude of impermeable, calcareous, gray-blue-red shales, with interbedded limestones, belonging to the Missourian Series of Pennsylvanian age. These shales are encountered at 85 to 90 feet bgs and are approximately 725 feet thick in the Atlantic area (Ref. 13, p. 5). The top of the water table near municipal well 7 averaged 16 feet bgs in 2005 (Ref. 13, p. 7).

The City of Atlantic draws its water solely from the Dakota Formation (Refs. 12, pp. 35, 190; 13, p. 5). The Dakota is a fine- to coarse-grained sandstone, very poorly cemented (friable), part pebbly to conglomeratic (Refs. 7, p. 18; 12, p. 35; 13, p. 5). The formation is approximately 40 to 60 feet thick in the Atlantic wellhead protection area to the north, providing abundant pore space for ground water storage. In the wellhead protection area, the Dakota is upwardly confined by clay-rich glacial till (Refs. 7, p. 18; 13, p. 5).

Average hydraulic characteristics of the Dakota Formation in the wellhead protection area are:

- Transmissivity = 1,750 to 3,075 square feet per day

- Hydraulic conductivity = 35 to 60 feet per day
- Hydraulic gradient = 0.003 foot per foot (Refs. 7, p. 18; 12, p. 176; 13, p. 5).

Based on contaminant isoconcentration contours from ground water samples collected as part of the Removal Reassessment investigations and information presented in the 2005 hydrogeologic investigation, ground water flow is to the north, northwest (Refs. 14, p. 76; 13, p. 5).

- Aquifer/Stratum 1 (uppermost): Clay and silty Clay

Description:

This first stratum describes the unconsolidated material above the Dakota sandstone aquifer which is the sole aquifer used by the City of Atlantic (Refs. 12, p. 190; 13, p. 5). At source 1, the boring log for MW-2 indicated a predominance of fat clay and lean clayey silt to a depth of 36.5 feet below grade (Ref. 6, pp. 25, 99, 100). Within the clay and silt at a depth of 15 to 16.5 feet below grade is a 1.5 thick layer of poorly graded sand that is discontinuous (Ref. 6, pp. 25, 27, 96, 97, 99). At 36.5 feet below grade, poorly graded sand is encountered that was continuous to the terminus of the boring which was 50 feet below grade (Ref. 6, pp. 25, 100, 101). This sand layer dips to the north (Ref. 6, p. 27). The top of the water table was measured to be 40.16 feet below the top of casing in 2002 (Ref. 6, pp. 9, 25). In 2013, a deeper boring was installed at source 1 to determine the thickness of the sand layer that is believed to represent the Dakota Sandstone (Ref. 14, p. 19, 74, 253-259). In Boring SB-2, which was installed near MW-2, (Ref. 14, pp. 19, 74) clays with silt were logged to 35 feet bgs (Ref. 14, pp. 253-255). Similar to the MW-2 log, a one foot thick sand layer was observed at 16 to 17 feet bgs (Ref. 14, p. 254). Sand was encountered at 35 feet bgs and continued to 43 feet bgs where a one foot thick layer of silty clay was encountered (Ref. 14, pp. 255, 256). At about 44.5 feet below grade, the geologist described the material as round to sub-round sand with some gravel and classified the material as belonging to the Dakota formation (Ref. 14, p. 256).

Six borings were installed, logged and sampled near municipal well 7 (Ref. 13, pp. 3, 4, 13, 18-23). Based on the drilling logs, a general stratigraphic log was developed (Ref. 13, p. 15). This cross section shows that a confining layer of silt and clay (averaging 20 feet in thickness) overlies a thin interval of water bearing fine- to coarse-grained sand or sand and gravel (Ref. 13, pp. 6, 15). A thin seam of silt and clay was encountered in several of the borings (B-2, B-3 and B-4) beneath the sand (Ref. 13, pp. 6, 15, 19, 20, 21). The silt and clay was not continuous as shown in the drilling logs for B-1, B-5 and B-6 (Ref. 13, pp. 15, 19, 22, 23). The top of the water table was in the silt and clay layer at depths ranging from 15 to 18 feet bgs, averaging 16 feet bgs (Ref. 13, pp. 7, 15).

- Aquifer/Stratum 2 (deepest): Dakota Formation

Description:

In Boring SB-2, which was installed in 2013 near MW-2, (Ref. 14, pp. 19, 74) sand was encountered at 35 feet below grade and continued to 43 feet below grade where a one foot thick layer of silty clay was encountered (Ref. 14, pp. 255, 256). At about 44.5 feet below grade, the geologist described the material as round to sub-round sand with some gravel and classified the material as belonging to the Dakota formation (Ref. 14, p. 256). This material was logged to about 79 feet below grade where a stiff, pale brown clay was encountered (Ref. 14, pp. 256-259). The Dakota sandstone is about 34.5 feet thick beneath source 1. Shale was logged at 81 feet below grade (Ref. 14, p. 259).

Six borings were installed, logged and sampled near municipal well 7 (Ref. 13, pp. 3, 4, 13, 18-23). Based on the drilling logs, a general stratigraphic log was developed (Ref. 13, p. 15). All six borings penetrated the Dakota Formation (Ref. 13, p. 15). On average the Dakota sandstone extended from approximately 28 to 75 feet bgs (Ref. 13, p. 6). In most of the boreholes, a dense, hard mixture of silt, clay and gravel was encountered below the Dakota sandstone (Ref. 13, pp. 6, 19-23). In the deepest borehole B-1), drill cuttings suggest that weathered shale or mudstone exists beneath a depth of 80 feet bgs (Ref. 13, pp. 6, 7, 15, 19).

- Aquifer Interconnections/Distance from Source:

Description:

The only aquifer being evaluated in this HRS documentation record is the Dakota Formation because all municipal wells in Atlantic draw from the aquifer (Refs. 12, p. 190; 13, p. 5). The clays and silts described above do not form a confining layer to the Dakota Formation as shown by the levels of PCE contamination at depth beneath the source. As shown in Table 2 of this HRS Documentation record, PCE was reported at 5,000 µg/kg in sample 1659-14 from MW-2 at a depth of 36 feet below grade (Ref. 6, pp. 12-13, 24, 120, 126, 139, 155-156). This sample was collected directly above a sand layer that grades into the Dakota sandstone (Ref. 6, p. 25).

- Aquifer Discontinuities within Target Distance Limit:

Description:

No known discontinuities within the Dakota formation are known to exist within the Atlantic Iowa area, particularly between the source and the municipal well field (Ref. 12, p. 36). As shown in Figures 1 and 3 of this HRS Documentation Record, the well field is entirely in Section 4 of Township 76 North, Range 36 West (Ref. 3). Reference 12, page 36 presents a figure showing the extent and thickness of the Dakota aquifer and indicates that it is continuous. Near the Nishnabotna River to the west, the Dakota may be eroded (Refs. 3, p. 1; 12, pp. 8, 36; Figure 1 of this HRS documentation record).

SUMMARY OF AQUIFER(S) BEING EVALUATED

Aquifer No.	Aquifer Name	Is Aquifer Interconnected with Upper Aquifer within 2 miles? (Y/N/NA)	Is Aquifer Continuous within 4-mile TDL? (Y/N)	Is Aquifer Karst? (Y/N)
1	Dakota	Not applicable	Yes	No

3.1 LIKELIHOOD OF RELEASE

3.1.1 OBSERVED RELEASE

Aquifer Being Evaluated: Dakota

Chemical Analysis

Background Concentrations: Determining background level is necessary to establish an observed release (or observed contamination) by chemical analysis (Ref. 1, Section 2.3, Table 2-3). Based on contaminant isoconcentration contours from ground water samples collected as part of the Removal Reassessment investigations and information presented in the 2005 hydrogeologic investigation, ground water flow is to the north, northwest (Refs. 14, p. 76; 13, p. 5).

To establish an observed release for this site, contamination in multiple municipal and monitoring wells during the December 2011 and October 2012 sampling was considered (Ref. 7, pp. 12-16; 14, pp. 18-19, 23). The three monitoring wells (MW-1, MW-2, and MW-3) installed in 2002 were all flush mounted wells (Ref. 6, pp. 83, 88, 89). Review of current and historical data indicated the presence of elevated levels of VOCs associated with Source 1 in downgradient wells (see Tables 7 and 8 of this HRS documentation record; Ref. 6, p. 16). In the 2012 Site Reassessment, no VOCs were identified in the designated background wells; for HRS scoring purposes, fixed monitoring wells MW-1 and MW-3, and municipal wells AMU-10, AMU-11, and AMU-14 were considered as background (see Tables 5 and 6 of this HRS documentation record). These two monitoring wells and three municipal wells are side gradient to the known extent of ground water contamination (Ref. 14, pp. 70, 76). Additional shallow ground water above the Dakota sandstone was sampled in October 2012, and deep samples in the Dakota formation, at and upgradient of Source 1, were sampled in May 2013 (Ref. 14, pp. 18, 19, 23, 25, 72). These samples are discussed below but not included in the tables because they were all temporary locations.

Table 5: Select Background Ground Water Samples Collected at Municipal and Monitoring Wells

Sample ID	Total Depth (feet bgs)	Screened Length (feet)	Date Sampled	Location Description	References
Public Drinking Water Well					
5613-9	120	30	12/13/11	PWS Well AMU-14; located 0.95 mile north of the former dry cleaner facility; static water level of 52 feet bgs.	7, pp. 16, 19, 29, 59, 69, 82
5613-5 5905-116	82.5	25	12/13/11 10/05/12	PWS Well AMU-10; located 0.49 mile north of the former dry cleaner facility; static water level of 77 feet bgs.	5, pp. 101-102; 7, pp. 16, 19, 29, 59, 65, 82; 14, pp. 23, 136, 143, 291
5613-4 5905-117	86.3	30	12/13/11 10/05/12	PWS Well AMU-11; located 0.57 mile north, northeast of the former dry cleaner facility; static water level of 78 feet bgs.	7, pp. 16, 19, 29, 59, 64, 82; 14, pp. 23, 137, 143, 291
Monitoring Wells					
5613-101	44.65.	15	12/12/11	MW-1, located adjacent to the former dry cleaner facility at the northeast corner of the Burger King parking lot; depth to water level 31.50 feet bgs	7, pp. 11, 13, 16, 29, 32, 59, 73, 82; 6. pp. 9, 104
5613-102	39.12	15	12/13/11	MW-3, located in the southwest corner of the self-storage facility complex on the trailer park property; depth to water level 23.47 feet bgs	7, pp. 11, 13, 16, 29, 32, 59, 74, 82; 6, pp. 9, 106

Notes:

AMU	Atlantic Municipal Utilities
bgs	Below ground surface

Table 6: Select Background Ground Water Samples Results Collected by EPA

Sample ID (Well)	Hazardous Substance	Results	Reporting Limit (μg/L)[1]	References
5613-9 (AMU-14)	PCE TCE	0.50 U 0.50 U	0.50 0.50	7, pp. 16, 29, 82, 91; 10, pp. 1, 15-16
5613-5 (AMU-10)	PCE TCE	0.50 U 0.50 U	0.50 0.50	7, pp. 16, 29, 82, 89; 10, pp. 1, 9, 10;
5613-4 (AMU-11)	PCE TCE	0.50 U 0.50 U	0.50 0.50	7, pp. 16, 29, 82, 89; 10, pp. 1, 7, 8;
5905-116 (AMU-10)	PCE TCE	0.50 U 0.50 U	0.50 0.50	14, pp. 136, 291, 307, 308; 17, pp. 1, 29
5905-117 (AMU-11)	PCE TCE	0.50 U 0.50 U	0.50 0.50	14, pp. 137, 291, 307, 308; 17, pp. 1, 30, 31
5613-101 (MW-1)	PCE TCE	1.0 U 1.0 U	1.0 1.0	7, pp. 16, 29, 82, 94; 10, pp. 1, 21-22
5613-102 (MW-3)	PCE TCE	1.0 U 1.0 U	1.0 1.0	7, pp. 16, 29, 82, 94; 10, pp. 1, 22-23

Notes:

1	The reporting limit is the laboratory reporting limit with any dilution factor, volume adjustment, or percent solids for each sample taken into account and is equivalent to the SQL as defined in the HRS (Refs. 1, Section 1.1, Definitions; 10, p. 1; 17, p. 1).
AMU	Atlantic Municipal Utilities
μg/L	micrograms per liter
PCE	Tetrachloroethene
TCE	Trichloroethene
U	The analyte was not detected at or above the reporting limit.

As part of the 2012 Removal Reassessment, ground water samples were collected from 12 temporary wells installed with direct-push technology (DPT). At each DPT location, a ground water was collected from one depth directly above refusal, which was assumed to be competent Dakota sandstone. Samples from temporary wells were collected with a sampling apparatus with a 4-foot-long reusable stainless steel screen. Samples were collected through disposable polyethylene tubing utilizing a check valve placed at the bottom of the tubing. Collected samples were analyzed by the EPA Region 7 laboratory for VOCs in water by GC/ MS for low detection limits (Ref. 14, pp. 18, 23, 72).

In May 2013, five ground water samples were collected from two soil borings at and south of the apparent source of contamination (Ref. 14, pp. 19, 25, 72). These borings were installed to gain a better understanding of the geology below 50 feet, and also to determine if dense non-aqueous phase liquid (DNAPL) may be accumulating on less permeable layers within the source area. Two deep borings were installed and logged. The first was called SB-1 and was advanced south (upgradient) of the source area to 93 feet bgs. This boring was logged and two ground water samples were collected from 47 and 91 feet bgs. The second boring (SB-2) was advanced within the source area close to monitoring well MW-2, to 83 feet bgs, and was also logged (Ref. 14, pp. 19, 25, 72, 74). Three ground water samples were collected from SB-2 at 39, 63 and 83 feet bgs. The borings were advanced with a dual tube rotosonic drill rig. Ground water samples were collected by removing the inner casing of the rotosonic drill at the target depth, then lowering a 2-inch-diameter polyvinyl chloride (PVC), 5-foot-long screen and casing to the bottom of the hole, and then raising the outer 6-inch-diameter casing approximately 3 feet to expose the surrounding formation material. Water within the temporary casing was purged with a bailer and then sampled for VOCs (Ref. 14, p. 19).

These temporary well ground water samples and ground water samples collected from deep soil borings demonstrate that contaminants are not from other potential sites and are similar to the concentrations found in the background monitoring and municipal wells. PCE and TCE were not detected in ground water collected from TW-1, TW-5, TW-6 or TW-7 on the west side of the contaminant plume (Ref. 14, pp. 34, 72, 75, 76, 291, 300-304). PCE and TCE were not detected in ground water collected from TW-9, TW-10 or TW-11 on the east side of the contaminant plume (Ref. 14, pp. 34, 72, 75, 76, 291, 303-306).

In the ground water samples collected during May 2013, a background boring, SB-1, advanced south (upgradient) of the former dry cleaners was installed, logged, and sampled first (Ref. 14, pp. 37, 72, 74, 86). Two ground water samples were collected—the first at about 47 feet bgs and the second at the bottom of the Dakota sandstone at 91 feet bgs. PCE was reported in the ground water from 47 feet bgs but not in the sample from the base of the formation. In the 47 feet bgs sample, PCE was reported at 7.9 µg/L (Ref. 14, pp. 35, 37, 334, 338, 339). Ground water samples collected from SB-2 at source 1, approximately 70 feet north, contained PCE at 14,000 µg/L at 39 feet bgs, 340 µg/L at 63 feet bgs and 79 µg/L at 83 feet bgs (Ref. 14, pp. 35, 37, 74, 334, 339, 341),

Contaminated Samples

Numerous sampling efforts have taken place in the general site area since the 1980s (Ref. 7, pp. 9-12). Sampling efforts in support of the state of Iowa and EPA included a collection monitoring wells in the site vicinity and from the Atlantic public wells. In support of the 2012 Site Reassessment, the ground water migration pathway evaluation included sampling drinking water at nine active municipal wells (AMU-6 and AMU-10 through AMU-17), one former municipal well currently used to contain the plume (AMU-7), and three permanent monitoring wells (MW-1, MW-2, and MW-3) (Ref. 7, pp. 13, 14). In October 2012 three municipal wells closest to the known area of contamination (AMU-6, AMU-10 and AMU-11), were sampled due to a recent upward trend in the concentrations of PCE in AMU-6 (Ref. 14, pp. 15, 16, 18, 23). Locations of these wells are shown on Figure 2 of this HRS documentation record. Samples were submitted to EPA Region 7 Laboratory for analysis. Municipal well samples collected in

December 2011 were submitted for analysis for drinking water level VOCs by EPA Region 7 SOP 3230.09. Water samples from monitoring wells collected in December 2011 and temporary wells and municipal wells collected in October 2012 were submitted for analysis for low-level VOCs in an aqueous matrix by EPA Region 7 SOP 3230.13 (Refs. 7, pp. 12-16; 14, pp. 291, 292). Tables 7 and 8 of this HRS documentation record summarize contaminated ground water samples considered for the HRS soring purposes.

Municipal wells were sampled for the 2012 Site Reassessment. At each sampled municipal well, the well pump was activated and water pumped for 5 minutes before a sample was collected from a spigot in the pump house. Samples were collected into three 40-mL vials preserved with hydrochloric acid (HCl) for analysis for drinking water level VOCs. All samples were stored in coolers maintained at temperatures at or below 4 degrees Celsius (°C) pending submittal to the EPA Region 7 laboratory. Ground water samples were collected from monitoring wells MW-1, MW-2, and MW-3. Wells were hand-bailed using disposable polyvinyl chloride (PVC) bailers until three well casing volumes had been removed and the field parameters (temperature, pH, and specific conductivity) had stabilized. Samples were collected into four 40-mL vials preserved with HCl and submitted for VOC analysis at low detection limits by the EPA Region 7 laboratory (Figures 2 and 3 of this HRS documentation record; Ref. 7, pp. 13-14, 28-29).

PCE and its degradation products TCE and *cis*-1,2-DCE were detected in ground water samples collected at and downgradient of the former drycleaners facility. In December 2011, PCE was detected at a maximum concentration of 2,500 µg/L in the sample from MW-2 at the apparent source. Previous sampling of this well in July 2003 showed PCE at 5,300 µg/L (Refs. 6, pp. 16, 225, 230; 7, pp. 11, 15, 20, 28). Low levels (3.8 µg/L) of *cis*-1,2-DCE were also reported in MW-2; however, TCE was not reported (Figures 2 and 3 of this HRS documentation record; Refs. 6, pp. 16, 24; 7, p. 20).

PCE and TCE were detected at 87 µg/L and 1.3 µg/L in AMU-7, which is currently pumped to waste to contain the plume. PCE was first detected in AMU-7 in August 1982 at a concentration of 170 µg/L. Concentrations have been as high as 260 µg/L in August 1984, but have been gradually decreasing over time (Refs. 6, p. 6; 7, pp. 12, 20).

Table 7: Contaminated Ground Water Samples Collected by EPA

Sample ID	Total Depth (below ground surface)	Screened (feet)	Date Sampled	Location Description	References
Public Water Supply					
5613-10	75 feet	50-75 feet	12/13/2011	AMU-6	7, pp. 13, 19, 28-29, 59, 70, 82; 5, pp. 97, 98
5905-115			10/05/2012		14, pp. 23, 72, 135, 143, 291
5613-1	82.8 feet	57.8-82.5 feet	12/13/2011	AMU-7	7, pp. 13, 19, 28-29, 59-60, 82
5613-1 -FD	82.8 feet	57.8-82.5 feet	12/13/2011	AMU-7	7, pp. 13, 19, 28-29, 59, 61, 82
Monitoring Wells					
5613-103	49.37 feet	34.1-49.1 feet	12-14-2011	MW-2	7, pp. 11, 13-14, 16, 28-29, 59, 75, 82
5613-103 - FD	49.37 feet	34.1 – 49.1 feet	12-14-2011	MW-2	7, pp. 11, 13-14, 16, 28-29, 59, 76, 82

Notes:

FD	Field Duplicate

Table 8: Contaminated Ground Water Samples Results Collected by EPA

Sample Identification (Well)	Hazardous Substance	Results (µg/L)	Reporting Limit (µg/L)	References
5613-10 (AMU-6)	PCE	3.6	0.5	7, pp. 13, 16, 29, 59, 70, 82, 91; 10, p. 17
5905-115 (AMU-6)	PCE	15	0.50	14, pp. 23, 34, 135, 143, 291, 307; 17, pp. 1, 28
5613-1 (AMU-7)	TCE PCE	1.3 87	0.5 0.5	7, pp. 13, 16, 29, 59, 60, 82, 87; 10, pp. 1-2
5613-1 –FD (AMU-7)	TCE PCE	1.3 87	0.5 0.5	7, pp. 13, 16, 29, 59, 61, 82, 87; 10, pp. 3-4
5613-103 (MW-2)	PCE	2,500	100	7, pp. 13, 16, 29, 59, 75, 82, 94; 10, pp. 24-25
5613-103 –FD (MW-2)	PCE	2,400	100	7, pp. 13, 16, 29, 59, 76, 82, 96;10, pp. 25-26

Note:
The reporting limit is the laboratory reporting limit with any dilution factor, volume adjustment, or percent solids for each sample taken into account and is equivalent to the SQL as defined in the HRS (Refs. 1, Section 1.1, Definitions; 10, p. 1; 17, p. 1).

µg/L	Micrograms per liter
FD	Field duplicate
TCE	Trichloroethene
PCE	Tetrachloroethene

Level I Sample

Samples 5613-1 and 5613-1-FD (Field Duplicate) collected from Atlantic public drinking water well AMU-7 and listed in Table 9 of this HRS documentation record contained PCE at a concentration above its maximum contaminant level (MCL) and cancer risk screening concentration (CR) of 5 µg/L and 32 µg/L, respectively (Ref. 2, pp. 2-5). PCE was first detected in AMU-7 in August 1982 at a concentration of 170 µg/L. Concentrations have been as high as 260 µg/L in August 1984 (Refs. 6, p. 6; 7, pp. 12, 20). Similarly, samples 5613-1 and 5613-1 (FD) contained TCE above its CR of 1 µg/L. Sample 5905-115 collected from AMU-6 in October 2012 and listed in Table 9 of this HRS documentation record contained PCE at a concentration above its MCL of 5 µg/L. These samples met the observed release and Level I concentration criteria (Table 9 of this HRS documentation record; Ref. 1, Table 2-3, Table 3-10, and Section 2.5).

Municipal Drinking Water Wells

Table 9: Actual Contamination Drinking Water Wells

Laboratory Sample No.	Analyte	Results	Units	Sample Date	Well ID$_1$	References
Municipal Public Water Supply System Wells						
5613-10	PCE	3.6	µg/L	12/13/11	AMU-6	7, pp. 13-14, 19, 28-29, 59, 70; 10, p. 17
5613-1	TCE PCE	1.3 87	µg/L	12/13/11	AMU-7	7, pp. 13-14, 19, 28-29, 59-60; 10, pp. 1
5613-1-FD	TCE PCE	1.3 87	µg/L	12/13/11	AMU-7	7, pp. 13-14, 19, 28-29, 59, 61; 10, p. 3
5905-115	PCE	15	µg/L	10/05/2012	AMU-6	14, pp. 23, 34, 135, 143, 291, 307; 17, pp. 1, 28

Notes:
The MCL, CR, and RfD concentrations for TCE are 5 µg/L, 1 µg/L, and 7 µg/L, respectively. The MCL, CR, and RfD concentrations for PCE are 5 µg/L, 32 µg/L, and 90 µg/L, respectively (Ref. 2, pp. 2-5).

1	Well locations are depicted in Figures 2 and 3 of Reference 7, pp. 28-29 and Figure 2 and 3 of this HRS documentation record.
µg/L	Micrograms per liter
FD	Field duplicate
TCE	Trichloroethene
PCE	Tetrachloroethene

Attribution

During a water quality survey by the IDNR in August 1982, PCE was detected in the AMU water supply well AMU-7 at a concentration of 170 μg/L. Subsequent IDNR sampling detected PCE in AMU-7 at concentrations ranging from 11 μg/L in March 1995 to 260 μg/L in August 1984. From August 1982 to November 1987, water from AMU-7 was pumped at 80 gpm to Buttermilk Creek, an intermittent tributary of Troublesome Creek, in an attempt to restrict migration of the PCE contamination to other nearby drinking water supply wells. In December 1987, the discharge from AMU-7 to Buttermilk Creek was rerouted to the 3rd Street sanitary sewer line, about 150 feet southwest of the well, for treatment at the City of Atlantic's wastewater treatment facility (Refs. 5, pp. 10-11; 6, p. 6; 7, pp. 8-10).

In August 1987, an EPA contractor conducted a soil gas survey to delineate the approximate extent of PCE contamination (Refs. 5, p. 5; 7, p. 9). One of the objectives of this initial investigation was to assist the IDNR in evaluating the source of the ground water contamination in Atlantic, Iowa (Ref. 5, p. 5). A number of potential sources of contamination were targeted for the investigation included a power plant, commercial sites, a sewer line and railroad line (Ref. 5, pp. 13, 14). Soil-gas samples were collected from 5 to 6 feet bgs at 55 locations, beginning at the former dry cleaning and IDOT laboratory facility, and proceeding in the direction of ground water flow (north-northwest) toward the AMU well field (Refs. 5, pp. 25-27; 7, p. 9). Analytical results suggested the source area was just south of East 7th Street, about 250 feet east of the former dry cleaning and IDOT laboratory (Refs. 5, pp. 34-41; 7, p. 9). The report stated that a release of PCE likely had occurred at the former dry cleaning and IDOT laboratory, and had migrated through surface runoff and ground water flow to this topographic low near the former location of a Hardee's restaurant. According to the report, the migration of PCE from the source area may have followed the storm sewer system along the southern side of East 7th Street (Refs. 5, pp. 34-41; 7, p. 9).

In August and November 1998, IDNR conducted follow-up investigations of the PCE contamination to better define the source (Refs. 4, p. 3; 7, p. 9). During these investigations, 34 soil gas samples and 10 soil samples were collected for analysis. The soil samples were analyzed by IDNR for PCE by a mobile laboratory (Ref. 7, p. 9). The sampling focused on the area of the former dry cleaning and IDOT laboratory, and the source area identified during the 1987 investigation by E&E (Ref. 4, pp. 5, 13). Soil-gas data from the IDNR investigations confirmed the level of PCE contamination originally detected near a former Hardee's restaurant (currently Burger King) (Refs. 4, pp. 4-5, 7, p. 9). However, significantly higher PCE levels (greater than 10,000 parts per million) were detected near the former dry cleaning and IDOT laboratory. Based on these findings, IDNR concluded that the silty clayey soil beneath the former dry cleaners and IDOT laboratory was the predominant source of PCE contamination impacting the ground water (Refs. 4, pp. 5-6; 6, pp. 6-7, 17; 7, pp. 9-10). The report indicated that soils appeared to be contaminated to at least 20 feet bgs (Refs. 4, p. 5; 7, p. 10).

From 2002 through 2004, the Tetra Tech START conducted a removal site evaluation of the Atlantic Water Supply site. Field activities included advancement of 13 direct push technology soil borings to depths ranging from 23 to 36 feet bgs (Refs. 6, pp. 7-8; 7, p. 10). These borings were advanced around the previously identified source area and sampled to aid in determining the extent of contamination (Figure 2 of this HRS documentation record; Refs. 6, pp. 23-24; 7, p. 10). In addition, three permanent, flush-mounted monitoring wells were installed into the Dakota sandstone formation at depths ranging from 40.5 to 50 feet bgs. These wells were installed to assess ground water quality near the source area (Refs. 6, pp. 7-9, 24-27; 7, p. 10).

In soils, PCE was reported at its highest concentrations in the boring completed as monitoring well MW-2, installed near the former drycleaner. At this location, PCE was found at concentrations above the preliminary remediation goal (PRG) of 3,400 micrograms per kilogram (μg/kg) in samples collected from 19 to 36 feet bgs (Ref. 6, pp. 11-13). Of the three monitoring wells installed, MW-2 was the only one containing PCE in ground water at concentrations greater than 1 μg/L. PCE was reported at a maximum concentration of 5,300 μg/L in this well in July 2003 (Ref. 6, pp. 14-16; 7, p. 11). Numerous soil samples were collected from DPT locations and monitoring well borings to the east, south and west of MW-2, including DPT points, GP-2, GP-3, GP-5 through GP13 and MW-1 and MW-3, that did not contain PCE (Ref. 6, pp. 12, 13, 24).

In 2005, a hydrogeologic investigation was conducted at the site by personnel from the EPA Environmental Response Team (ERT) and the Response Engineering and Analytical Contract (REAC). The primary purpose of the investigation was to define the nature and extent of ground water contamination upgradient of the municipal well field in order to assess the applicability of installing a permeable reactive barrier (PRB) for ground water treatment and protection (Refs. 7, p. 11; 13, p. 2). As part of the investigation, six boreholes were advanced about 150 feet upgradient (south) of contaminated AMU-7 at the approximate centerline of the proposed PRB wall (Refs. 7, p. 11; 13, p. 13-15). Borehole depths ranged from 76 to 87.5 feet bgs, and were advanced into the upper sandstone bedrock using sonic drilling techniques (Refs. 7, p. 11; 13, pp. 3-4).

Multiple ground water samples were collected at each boring, beginning at about 20 to 25 feet bgs, and then at 20-foot intervals as the borings were advanced. A total of 28 ground water samples were collected. PCE was reported in water samples from all six borings, with the highest concentration

(446 µg/L) found in boring B-5, the farthest east. In addition to PCE, the breakdown product, TCE, was detected in ground water samples from each boring at concentrations as high as 21.3 µg/L (Ref. 13, pp. 10-11).

In 2012 and 2013 additional soil and ground water samples were collected to further define the extent of contaminated soil and gain a better understanding of the extent of ground water contamination (Ref. 14, p. 6). Multiple soil, ground water, sub-slab vapor, and indoor air samples were collected during this investigation (Ref. 14, pp. 23-25, 72). In soils, the approximate extent of PCE contamination was delineated at source 1 (Ref. 14, pp. 29, 30, 73, 74). In addition the width of the PCE contaminated ground water plume in unconsolidated sands was better defined, as was Dakota sandstone ground water at source 1 and immediately upgradient (south) of source 1 (Ref. 14, pp. 34-37, 75, 76).

In AMU-6, which currently produces water for the municipal well system, PCE and 1,2-dichloroethane (1,2-DCA) have been reported (Ref. 7, pp. 12, 21, 90-91). PCE was identified in the well 73 percent of the time, with concentrations reported below the 0.5 µg/L quantitation limit to 2.6 µg/L (Ref. 7, p. 12). 1,2-DCA was detected six times, each time at concentrations below 1 µg/L (Ref. 7, p. 12).

PCE and TCE have been reported in AMU-7, from which ground water is pumped to the waste water treatment plant. PCE was measured at a maximum concentration of 260 µg/L in August 1984. In July 2011, the PCE concentration was 76 µg/L (Ref. 7, p. 12). In AMU-7, TCE has never been reported above quantitation limits (Refs. 6, pp. 270-282; 7, p. 12).

<u>Hazardous Substances Released</u>: PCE, TCE

Ground Water Observed Release Factor Value: 550

3.1.2 POTENTIAL TO RELEASE

Not Evaluated

3.2 WASTE CHARACTERISTICS

3.2.1 TOXICITY/MOBILITY

Table 10: Toxicity/Mobility

Hazardous Substance	Source No.	Toxicity Factor Value	Mobility Factor Value*	Does Haz. Substance Meet Observed Release? (Y/N)	Toxicity/ Mobility (Ref. 1, Table 3-9)	Reference
Tetrachloroethene Trichloroethene	1	100 1,000	1* 1	Yes Yes	100 1,000	1, section 3.2.1.2; 2, pp. 2-5

Notes:

* Liquid, non-karst mobility factor value used, or if substance was found in an observed release to ground water, then a mobility factor value of 1 is assigned (Ref. 1, Sec. 3.2.1.2).

Toxicity/Mobility Factor Value: 1,000
(Ref. 1, Table 3-9)

3.2.2 HAZARDOUS WASTE QUANTITY

Table 11: Hazardous Waste Quantity Value

Source No.	Source Type	Source Hazardous Waste Quantity
1	Contaminated Soil	> 0

The hazardous constituent quantity for Source 1 is not adequately determined. Its source HWQ is unknown, but greater than zero. As specified in Reference 1, Section 2.4.2.2, a HWQ factor value of 100 was assigned because targets in the Ground Water Migration Pathway are subject to actual contamination at Level I concentrations (Ref. 1, Section 2.4.2.2).

Sum of Values: > 0
Hazardous Waste Quantity Factor Value: 100
(Ref. 1, Table 2-6)

3.2.3 WASTE CHARACTERISTICS FACTOR CATEGORY VALUE

As specified in the HRS (Ref. 1, Section 3.2.3), the Hazardous Waste Quantity Factor Value of 100 was multiplied by the highest toxicity/mobility value of 1,000 for TCE, resulting in a product of 100,000 (1.0E+05). Based on this product, a waste characteristics factor value (WCFV) of 18 was assigned from Table 2-7 of the HRS (Ref.1, Section 2.4.3.1).

Toxicity/Mobility Factor Value: 1,000
Hazardous Waste Quantity Factor Value: 100

Toxicity/Mobility Factor Value X Hazardous Waste Quantity Factor Value: 100,000
Waste Characteristics Factor Category Value: 18
(Ref. 1, Table 2-7)

3.3 TARGETS

3.3.1 NEAREST WELL

Well IDs: **AMU-6**

Level of Contamination (I, II, or potential): I

As documented in Section 3.1.1 above (see Tables, 7, 8, and 9 of this HRS documentation record), sample 5905-115 from municipal drinking water well AMU-6 contains PCE at a concentration that both meet the observed release criteria and is subject to Level I contamination. Therefore, in accordance with Reference 1, Section 3.3.1, Table 3-11, a nearest well factor value of 50 is assigned to the site.

Nearest Well Factor Value: 50
(Ref. 1, Table 3-11)

3.3.2 POPULATION

3.3.2.1 Level of Contamination

Presented below in Section 3.3.2.2 are the numbers of people drinking from wells that have documented actual contamination based on hazardous substance concentrations that meet the observed release criteria (see Section 3.1.1 of this document). Section 3.3.2.2 presents the number of people drinking from wells that contain hazardous constituents above a health-based benchmark.

3.3.2.2 Level I Concentrations (concentrations associated with Level I targets are presented in Section 3.1.1)

AMU-6 has concentrations of PCE above benchmarks, in the most recent sampling effort used for scoring purposes, sample 5905-115 from Atlantic public drinking water well AMU-6 – as listed in Tables 8 and 9 of this HRS documentation record – contained PCE at 15 µg/L that met the observed release criteria and exceeded its health-based benchmark (MCL which is 5 µg/L). The City of Atlantic draws its water solely from the Nishnabotna Member of the Dakota Formation (Refs. 13, p. 5; 11, pp. 1, 2). The formation is approximately 40 to 60 feet thick in the Atlantic wellhead protection area, providing abundant pore space for ground water storage. Within the wellhead protection area, the Dakota is upwardly confined by clay-rich glacial till (Ref. 7, p. 18).

Currently, nine active municipal wells serve the City of Atlantic and the surrounding area (Refs. 13, pp. 1, 2; 19, p. 2). As of 2012, there were 3,361 service connections in Atlantic and 140 outside the city (Ref. 19, p. 2). The Atlantic Municipal Utility supplies water to the city of Marne and several rural customers (including Milk Unlimited, a confinement dairy operation and Willow Heights, a convalescent home) (Ref. 19, p. 3). Eight municipal wells (AMU-10 through -17) are located on the north side of

Troublesome Creek between 0.5 and 1 mile from the former dry cleaners (see Figure 3 of this HRS documentation record; Ref. 7, pp. 7, 29). AMU-6 and inactive well AMU-7 are located on the south side of the creek. For the nine active municipal wells, total depths range from approximately 75 to 120 feet bgs, with an average of 90 feet bgs (Ref. 7, p. 19). AMU-6, located approximately 910 feet northeast of AMU-7, is also contaminated with PCE (see Section 3.1.1 of this HRS documentation record; Refs. 7, p. 19; 13, p. 5; 14, pp. 8). The well is still used as a drinking water well and is pumped approximately 15 to 20 hours per day at 300 to 350 gpm on average (Refs. 7, p. 19; 13, p. 5). The director of the City utility indicated that no single well produces more than 40 percent of the demand of the system (Ref. 7, pp. 49, 50). Water from the nine active municipal wells is initially blended, treated, and distributed to the system (Ref. 19, p. 3).

The total population served by the Atlantic Municipal Utility Water Supply is determined by adding the total number of service connections in Atlantic (3,361) to the total number of service connections outside of the city (140) and multiplying that sum by the average number of persons per household for Cass County (2.21) (Ref. 1, Section 3.3.2; 19, p. 2; 20, p. 2).

$$(3{,}361+140) \text{ x } 2.21 = 7{,}737.21$$

Because none of the wells contributes more than 40 percent of the total capacity to the system, the population served by each well is apportioned equally. Therefore, each of the nine municipal wells is assigned a population of 829.11 as follows:

$$\frac{\text{7,737.21 people served by the system}}{\text{9 municipal wells}} = \text{ 859.69 persons per well}$$

Because AMU-6, which is currently contributing to the system, contains PCE at concentrations above a health-based benchmark, the apportioned population served by that well is subject to actual Level I contamination. In accordance with Section 3.3.2.2 of the HRS, this population was multiplied by 10 to derive a Level I Concentrations Population factor value of 8,596.9.

Sum of Population Served by Level I Wells: 859.69
Sum of Population Served by Level I Wells x 10: 8,596.9
Level I Concentrations Factor Value: 8,596.9

3.3.2.3 Level II Concentrations

Not Scored.

Sum of Population Served by Level II Wells: Not scored
Level II Concentrations Factor Value: Not scored

3.3.2.4 Potential Contamination

The potential contamination (PC) target value was calculated based on Table 3-12 of the HRS. The distance weighted population values were determined using the distance category for non karst topography. AMU serves a population of 7,737.21 with nine municipal wells, one of which is subject to actual contamination. As shown in Figure 3 of this HRS documentation record, all eight non-contaminated municipal wells are located between 0.5 and 1.0 mile north of the former laundry. Using the apportioned population of 859.69 persons per well, 6,877.52 people use wells located between 0.5 and 1 mile of source 1. The distance-weighted population value from HRS Table 3-12 is 1,669. Because this population is subject to potential contamination, the distance weighted value of 1,669 is divided by 10 to obtain a potential contamination factor value of 166.9 (167 rounded to the nearest integer) (Ref. 1, Section 3.3.2.4).

Distance Weighted Population Value: 1,669
Distance Weighted Population Value/10: 167

Based on the actual contamination in AMU-6 and the potential contamination in the eight other wells, the population factor value is 8,473. Potential population outside the city limits served by domestic wells was not quantified, as the additional potential population served would not significantly impact the pathway score.

3.3.3 RESOURCES

This factor value was assigned a score of 5 because ground water is supplied by the Atlantic Municipal Utilities to Milk Unlimited, a confinement dairy operation (Ref. 19, p. 3).

Resources Factor Value: 5
(Ref. 1, Section 3.3.3)

3.3.4 WELLHEAD PROTECTION AREA

The City of Atlantic's Source Water Protection Area is presented in Reference 11, page 10. However a wellhead protection program designated according to Section 1428 of the Safe Drinking Water Act is not known to exist. Therefore, a Wellhead Protection Area Factor value of 0 is assigned.

Wellhead Protection Area Factor Value: 0
(Ref. 1, Section 3.3.4)