HRS DOCUMENTATION RECORD--REVIEW COVER SHEET

Name of Site:	Keystone Corridor Ground Water Contamination
U.S. EPA ID No.:	INN000510399
Date Prepared:	May 2013

Contact Persons

Site Investigation:	Mark Jaworski, Indiana Department of Environmental Management (IDEM), Site Investigation Program, (317) 233-2407
Documentation Record:	Nuria Muniz, United States Environmental Protection Agency (EPA), Region V, (312) 886-4439
	Mark Jaworski, Indiana Department of Environmental Management (IDEM), Site Investigation Program, (317) 233-2407

Pathways, Components, or Threats Not Scored

Surface Water Migration Pathway, Soil Exposure Pathway, and Air Migration Pathway
The Surface Water Migration Pathway, Soil Exposure Pathway, and Air Migration Pathways were not scored as part of this Hazard Ranking System (HRS) evaluation. These pathways were not included because a release to this media does not significantly affect the overall site score and because the ground water pathway produces an overall site score above the minimum required for the site to qualify for inclusion on the National Priorities List (NPL).

HRS DOCUMENTATION RECORD

Name of Site:	Keystone Corridor Ground Water Contamination
EPA Identification No.:	INN000510399
U. S. EPA Region:	5
Date Prepared:	May 2013
Street Address of Site:	The address of the site is at the intersection of N. Keystone Ave. and E. Fall Creek Pkwy N. Drive Indianapolis, Marion County, Indiana 46205 (Ref. 136, p. 2)
General Location in the State:	Central Indiana (Figure 1-1 of this HRS documentation record; Ref. 122, p. 1; 130, p. 1)
Topographic Map:	Indianapolis East, Indiana Quad (7.5') (Ref. 3, p. 1)
Latitude:	39°50'05" N (Ref. 78, p. 41; 137, p. 2)
Longitude:	-86°07'18" W (Ref. 78, p. 41; 137, p. 2)
Site Reference Point:	Approximate center of the ground water plume
Congressional District:	07

*Note: The street addresses, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations that U. S. EPA (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, placed, or disposed, 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 the Comprehensive Environmental Response, Compensation, and Liability Act (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.

SITE SCORING SUMMARY

Pathway Scores:

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

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (Sgw) (from Table 3-1, line 13)	100.00	10,000.00
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	NS	
2b.	Ground Water to Surface Water Migration Component	NS	
2c.	Surface Water Migration Pathway Score (Ssw) Enter the larger of lines 2a and 2b as the pathway score.	NS	
3.	Soil Exposure Pathway Score (Ss)	NS	
4.	Air Migration Pathway Score (Sa)	NS	
5.	Total of $Sgw^2 + Ssw^2 + Ss^2 + Sa^2$		10,000.00
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root		50.00

NS Not Scored

TABLE 4-1
GROUND WATER MIGRATION COMPONENT SCORESHEET

Factor Categories and Factors	Maximum Value	Value Assigned
Ground Water		
Likelihood of Release to an Aquifer		
1. Observed Release	550	550
2. Potential to Release		
2a. Containment	10	NS
2b. Net Precipitation	10	NS
2c. Depth to Aquifer	5	NS
2d. Travel Time	35	NS
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500	NS
3. Likelihood of Release (higher of lines 1 and 2e)	550	550
Waste Characteristics		
4. Toxicity/Mobility	a	10,000
5. Hazardous Waste Quantity	a	100
6. Waste Characteristics	100	32
Targets		
7. Nearest Well	b	50
8. Population		
8a. Level I Concentrations	b	9100
8b. Level II Concentrations	b	NS
8c. Potential Contamination	b	1008
8d. (Population (lines 8a + 8b + 8c)	b	10108
9. Resources	5	0
10. Wellhead Protection Area	20	20
11. Targets (lines 7 + 8d + 9 + 10)	b	10178
Factor Categories and Factors	Maximum Value	Value Assigned
Ground Water Migration Score for an Aquifer		
12. Aquifer Score [(Lines 3 x 6 x 11)/82,500] c	100	100.00
Ground Water Migration Pathway Score		
13. Pathway Score (Sgw) (highest value from line 12 for all aquifers evaluated) c	100	100.00

a Maximum value applies to waste characteristics category.
b Maximum value not applicable.
c Do not round to nearest integer
NS Not Scored

Plume Location - State of Indiana
Keystone Corridor Ground Water Contamination
Indianapolis, Marion County, Indiana

Keystone Corridor Ground Water Contamination
State Boundary
County Boundary
Interstate
Lake Michigan

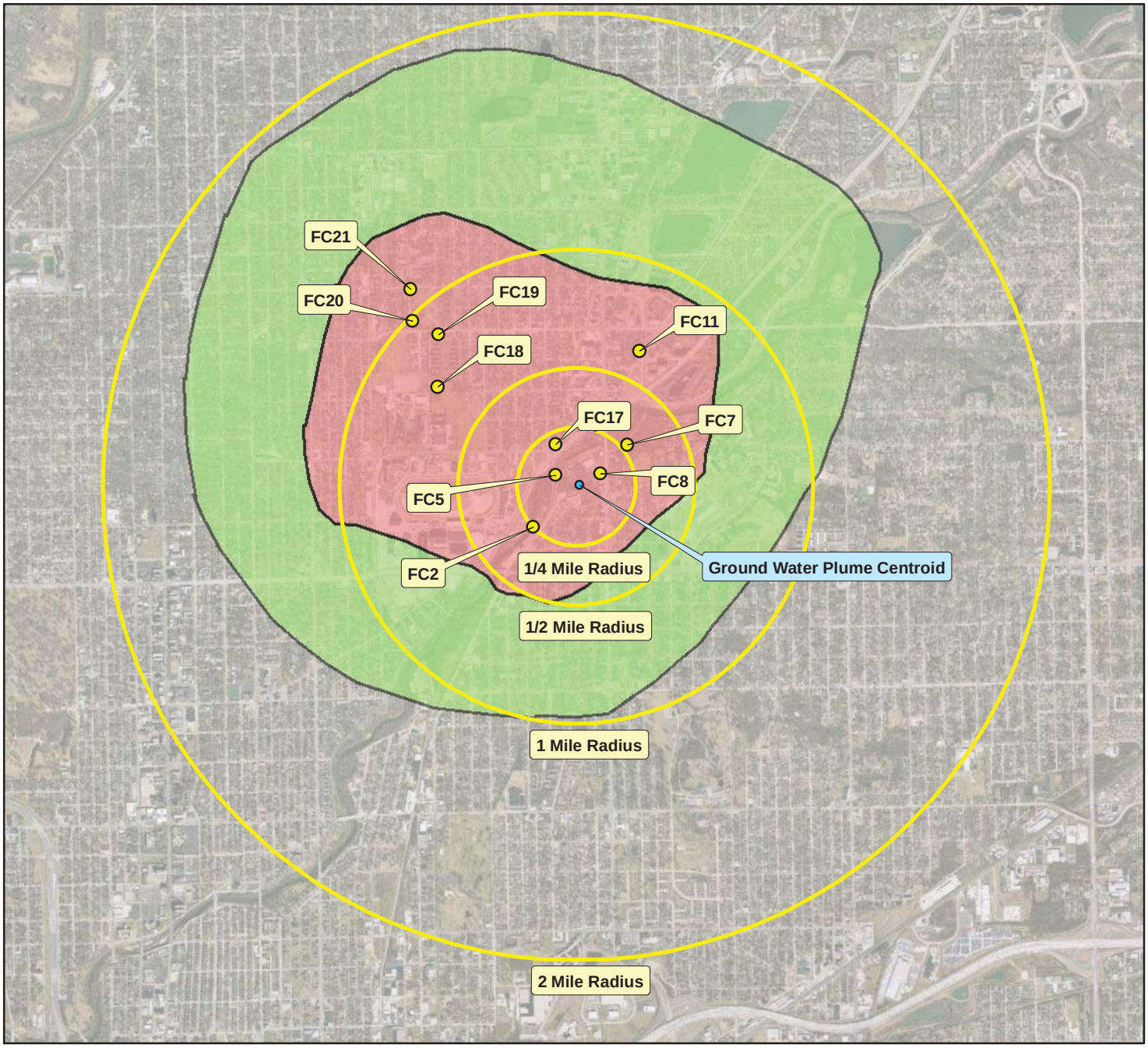
Mapped By: Mike Hill, Office of Land Quality
Date: February 26, 2013

Sources:
Non Orthophotography Data
- Obtained from the State of Indiana Geographic Information Office (GIO) Data Library
Map Projection: UTM Zone 16 N **Map Datum:** NAD83

N
W E
S

Figure 1-1

Keystone Corridor Ground Water Contamination
Distance from Ground Water Plume Centroid to Municipal Wells



Mapped By: Mike Hill, IDEM, Office of Land Quality, Science Services Branch, Engineering & GIS Services, February 28, 2013

Sources: -Non-orthophotography data obtained from the State of Indiana Geographic Information Officer's (GIO) data library.

Orthophotgraphy: 2009 Marion County Orthophotography Project (6 inch resolution)

Map Projection Info: UTM Zone 16N, meters, NAD83

The source documentation for the location of the following wells in the Fall Creek Wellfield; FC2, FC5, FC7, FC8, FC11, FC17, FC18, FC19, FC20, and FC21 is based on the GIS layer GIO.WaterWithdraw_DNR_Water_IN. The state agency responsible for the creation and maintenance of this layer is the Indiana Department of Natural Resources, Division of Water.

WELL	DISTANCE FROM PLUME CENTROID
FC2	1318'
FC5	519'
FC7	1471'
FC8	611'
FC11	3329'
FC17	1045'
FC18	3802'
FC19	4564'
FC20	5184'
FC21	5734'

- Ground Water Plume Centroid
- Fall Creek Wellfield Wells
- Radius Buffer
- WHPA 1yr
- WHPA 5yr

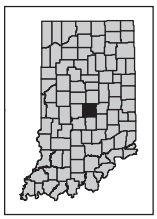
IDEM

N W E S

0 0.5 1 Miles

0 0.5 1 Kilometers

Marion County



Project Area

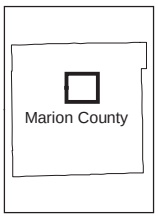
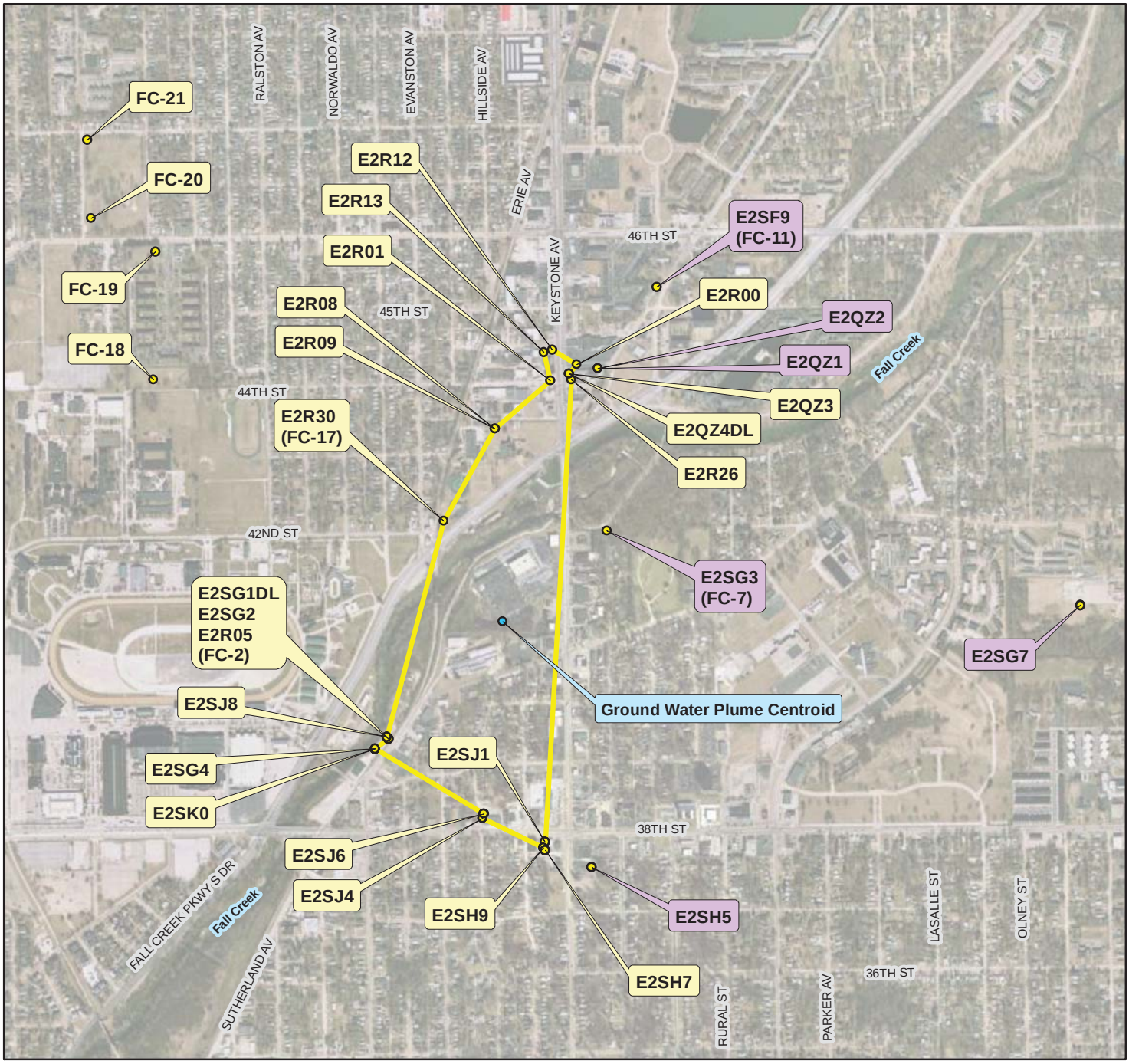


Figure 1-2

Ground Water Plume Boundary - Keystone Corridor Ground Water Contamination
Indianapolis, Marion County, Indiana



Mapped By:	Lorraine Wright and Mike Hill, IDEM, Office of Land Quality, Science Services Branch, Engineering & GIS Services, March 5, 2013
Sources:	-Non-orthophotography data obtained from the State of Indiana Geographic Information Office (GIO) data library. -The Ground Water Plume Boundary was digitized by connecting The ground water sample locations that meet observed release criteria. -Background samples are shown in a purple text. callout.
Orthophotography:	2009 Marion County Orthophotography Project (6 inch resolution)
Map Projection:	UTM Zone 16N, meters
Map Datum:	NAD83
References:	Obtained from Keystone Corridor Ground Water Contamination HRS Documentation Record -Background Ground Water Sample Table (Obtained from two established monitoring wells) -Background Ground Water Monitoring Well Sample Table (Obtained via a Direct Push Method) -Background Ground Water Well Sample Table (Obtained from operating Municipal Wells) -Contaminated Ground Water (Obtained by Direct Push) Sample Table -Contaminated Ground Water Obtained From Established Monitoring Wells Sample Table 1 -Fall Creek Municipal Well FC17 -Contaminated Ground Water Sample Table 2 (Municipal Well FC2) -Level I Samples (Fall Creek Municipal Well FC2) Table

- Ground Water Sample Location
- Ground Water Plume Centroid
- Ground Water Plume Boundary

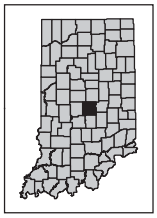
IDEM

N W E S

0 750 1,500 Feet

0 250 500 Meters

Marion County



Project Area

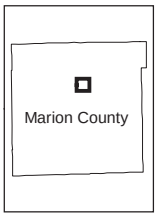
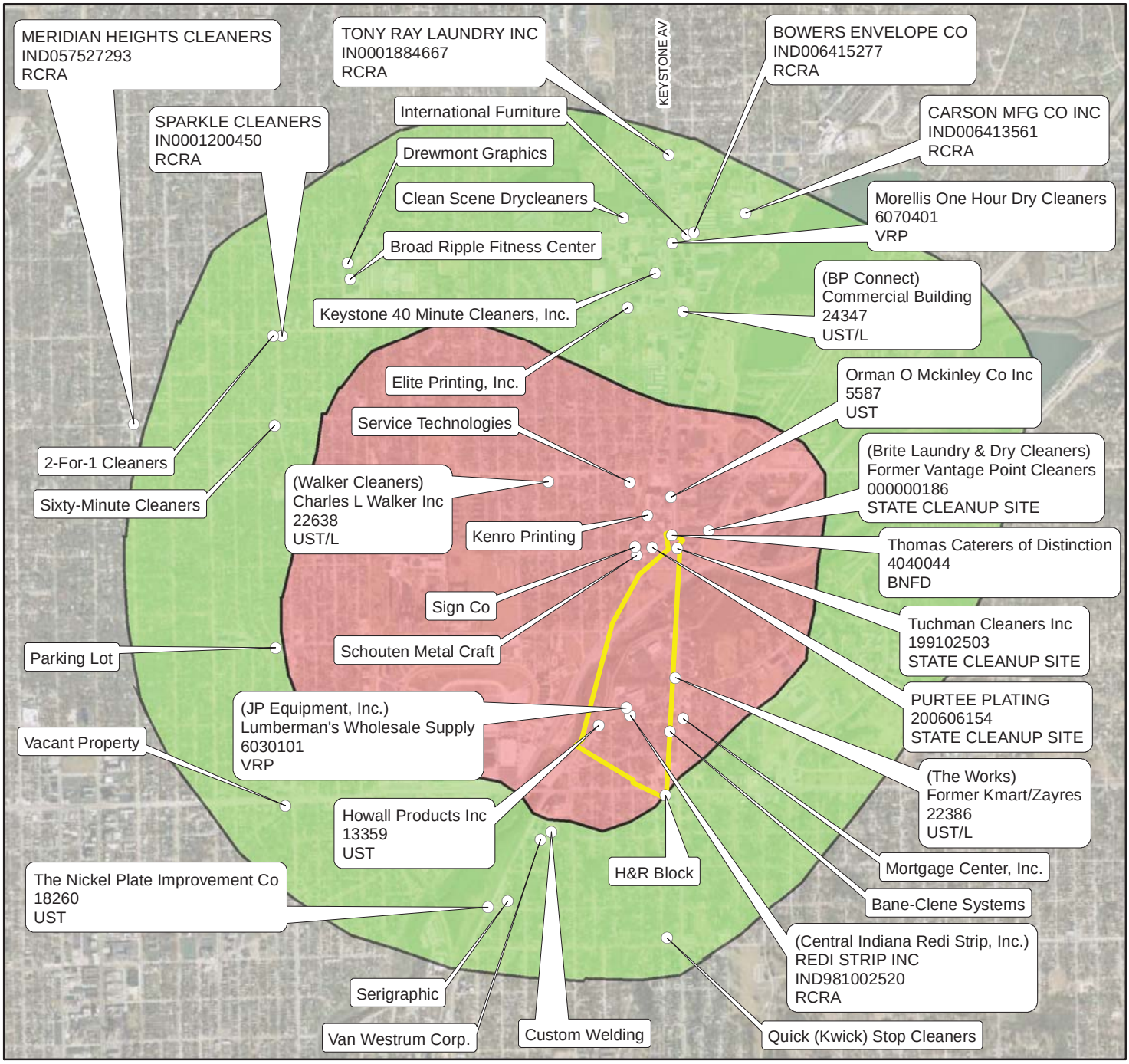


Figure 1-3

Potential Sources - Keystone Corridor Ground Water Contamination
Indianapolis, Marion County, Indiana



Mapped By: Mike Hill and Lorraine Wright, IDEM, Office of Land Quality, Science Services Branch, Engineering and GIS Services, March 4, 2013

Sources:

-Non-orthophotography data obtained from the State of Indiana Geographic Information Office (GIO) data library.

-Potential Source locations obtained from "Phase I - Revised Indianapolis Water Wellhead Protection Plan, dated March 2007, revised September 2007, prepared for Indianapolis Water, Table 3-9 Potential Source Inventory - Fall Creek Wellhead Protection Area" (Ref. 116, pp. 47 to 57): Ref 129, pp. 2,3

-Potentail Source locations for IDEM regulated facilites from GIO data layer "GIO.OLQ_All_DATA".

-Ulrich Chemical, 3111 North Post Road, from the above list is not in the WHPA.

-Ground Water Plume Boundary copied from "Ground Water Plume Boundary Map, Keystone Corridor Ground Water Contamination" dated 1-29-13, Figure 1-3 of the HRS documentaion record.

Potential Source Label: (Site Name) - from Indianapolis Water Wellhead Protection Plan
IDEM Facility Name
IDEM Facility Number
IDEM Regulatory Program

Orthophotography: 2009 Marion County Orthophotography Project (6 inch resolution)

Map info: UTM Zone 16N, NAD83, meters

- Potential Source
- Ground Water Plume Boundary
- WHPA 1yr
- WHPA 5yr

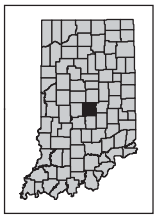
IDEM

N W E S

0 1,500 3,000 Feet

0 500 1,000 Meters

Marion County



Project Area

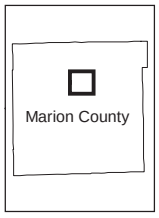


Figure 1-4

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12.	Indiana Department of Environmental Management, Uniform Hazardous Waste Manifest, Vantage Point Cleaners, April 18, 1991. 2 pages.
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SITE SUMMARY
Keystone Corridor Ground Water Contamination

The Keystone Corridor Ground Water Contamination is a ground water plume with commingled contamination that has released to the water in one (1) municipal water well, FC2 (Ref. 101, p. 1; 122, p. 1; 130, p. 1; Figure 1-3 and Section 3.1.1 of this HRS documentation record). The aquifer in which the plume is located is a combined aquifer consisting of an outwash aquifer and a karst aquifer. Although the aquifers have different physical properties, they can be considered a single combined aquifer due to their clear connectivity (Ref. 102, p. 24 and Section 3.0.1 of this HRS documentation record). Eight other active municipal wells (FC5, FC7, FC8, FC11, FC18, FC19, FC20, and FC21) that are located in the immediate area have a potential to become contaminated (see Section 3.3.2.4 and Figure 1-2 of this HRS documentation record). The plume consists of chlorinated solvents, specifically tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), and cis-1, 2-dichloroethene (cis-1, 2 DCE) (see Contaminated Ground Water (Obtained by Direct Push) Sample Table of this HRS documentation record; Contaminated Ground Water Obtained From Established Monitoring Wells Sample Table 1 of this HRS documentation record**;** Fall Creek Municipal Well FC17 Table of this HRS documentation record**;** Contaminated Ground Water Sample Table 2 (Municipal Well FC2) of this HRS documentation record).

TCE, VC, and cis-1,2 DCE are degradation products of PCE (Ref. 19, pp. 1–5). The extent of the ground water plume is depicted by municipal wells and monitoring wells known to contain volatile organic compounds at concentrations meeting observed release criteria (Ref. 1, Table 2-3, Figure 1-3 and Section 3.1.1 of this HRS documentation record; 122, p. 1; 130, p. 1). The plume currently measures approximately 4500 feet long (north to south) and approximately 1500 feet wide (east to west) (Ref. 122, p. 1; 130, p. 1; Figure 1-3 of this HRS documentation record). The plume and wells are located in the same combined aquifer (Sections 3.0.1 and 3.1.1 of this HRS documentation record).

Over forty known users or handlers of solvents have been identified by name as possible sources in this HRS documentation record (Ref. 129, pp. 1-3; 116, pp. 48-57; Figure 1-4 of this HRS documentation record; 122, p. 1; 130, p. 1). Due to the complex geology and high number of known and potential sources of chlorinated volatile organic compounds in the project area, it is not feasible to directly link any source to the contaminants encountered in the plume (Ref. 7, pp. 3, 5; Figure 1-4 of this HRS documentation record; 122, p. 1; 130, p. 1; Description of Other Possible Sources Section and Section 3.0.1 of this HRS documentation record).

Fall Creek Municipal Wells

Citizens Water utility operates nine (9) active municipal wells in the Fall Creek well field of Indianapolis, Indiana, as part of the Citizens Water system (Ref. 106, p. 4). The well field is located in the northeast sector of the city and supplies water to approximately 122,744 people (Ref. 3, p. 1; 106, p. 3; 102, p. 21; 122, p. 1; 130, p. 1; Figure 1-2 of this HRS documentation record). Two (2) of the nine (9) active municipal ground water supply wells (FC2 and FC5), have had historical detections of various volatile organic compounds (VOCs), notably chlorinated solvents (Ref. 75, p. 4; 78, pp. 124, 125, 203-205; 75, pp. 3, 4; 86, pp. 1, 4, 7, 8, 10, 19, 20, 22, 23, 28, 29, 31, 32, 34-45, 49, 51, 60; 87, pp. 1, 2; 88, p. 1; 89, pp. 1, 2, 5; 102, pp. 12–18, 23). Municipal well FC2 (E2SG1) contained concentrations of vinyl chloride above the Maximum Contaminant Level (MCL) of 2 µg/l set by the U.S. Environmental Protection Agency (U.S. EPA) (Ref. 2, p. 12; 79, p. 205; 80 pp. 5, 7, 56-57; 111, p. 2; 112, p. 10). FC5 contained levels of TCE below the MCL (Ref. 78, pp. 205; 96, pp. 1, 5, 6, 17, 18, 39, 113-115). The use of municipal well FC17 was restricted because the well's location was in the path of a ground water plume (Ref. 90, p. 10; 102, p. 23; 139, p. 1).

Investigating Potential Ground Water Plume Sources

Assessing potential ground water plume sources began with investigating the former Tuchman Cleaners facility, located at 4401 North Keystone Avenue, Indianapolis, Indiana, which operated from 1952 through 2008 (Ref. 4, p. 4; 8. p. 5; 10, p. 5; 20, p. 2; 23 p. 10; 60, p. 2; 110, pp. 1, 2; 123, pp. 1, 2; 139, p. 1). The facility used PCE, generated PCE waste, and had several PCE spills on the property (Ref. 10, pp. 10, 11; 12, p. 1). In May 1989, elevated levels of VOCs were detected in two soil borings collected near an underground tank as part of a subsurface investigation (Ref. 6, p. 5; 11, pp. 2, 3, 4, 6). In 1989, a soil gas survey was conducted on the property as a means to survey the extent of subsurface contamination at the facility (Ref. 10, p. 1). The investigation concluded that it was possible that the plume has migrated off the property to the south/southeast (Ref. 10, pp. 1, 9). Four (4) monitoring wells were subsequently installed on the property, which detected elevated levels of TCE (1,330 µg/l), vinyl chloride (21,900 µg/l), and PCE (6,500 µg/l) in the ground water (Ref. 5, pp. 12, 20, 21, 23-26, 31, 36). Another Phase II Investigation/Remediation report was completed in January of 1996 to evaluate the nature of the source area and how best to remediate VOCs (Ref. 8, pp. 2, 5; 123, pp. 1, 2; 139, p. 1). Elevated levels of vinyl chloride, TCE, PCE,

and other breakdown products were detected in the water from most of the wells (Ref. 8, pp. 19, 20; 19, pp. 2, 3; 123, pp. 1, 2; 139, p. 1). Water samples were also collected in the drycleaner's wash-water containment pits to pinpoint any sources of contamination. Analysis revealed elevated levels of PCE in the pits (Ref. 16, pp. 7, 12, 25). Elevated levels of TCE and PCE were detected in soils and elevated levels of PCE were detected in ground water as part of a Stage I investigation, which comprised twenty-six (26) direct push borings and nineteen (19) discrete ground water samples (Ref. 20, pp. 2, 3; 123, pp. 1, 2;). The target potentially susceptible to the ground water contamination at Tuchman Cleaners was identified as the Indianapolis Fall Creek Well Field, specifically municipal wells FC2, FC5, FC7, FC8, FC11, FC17, FC18, FC19 (Ref. 26, p. 15; 123, pp. 1, 2).

A feasibility study to remediate the contaminant plumes underneath the Tuchman Cleaners facility was conducted and recommended soil venting and pump and treatment of ground water (Ref. 74, p. 1). A Corrective Action Plan to remediate the contamination at the Tuchman facility was proposed to IDEM on July 2, 1990 (Ref. 69, pp. 1–30). A soil vapor extraction system and a pump and treat system were installed in October 1990 (Ref. 15, pp. 1, 3). By 2003, twenty-two (22) monitoring wells had been installed on the property (Ref. 23, pp. 68, 69, 85-96; 123, pp. 1, 2). Monitoring of the wells on the property revealed continuous detections of PCE (Ref. 21, pp. 1-3, 6-7; 24, pp. 1-3, 6-9; 28, pp. 1-3, 7; 30, pp. 1-4, 6, 7, 9, 10, 11,13, 15; 31, pp. 1-3, 6, 8; 32, pp. 1-3, 5, 7; 33, pp. 1-4, 6, 8; 34, pp. 1-8; 35, pp. 1-3, 6-7; 36, pp. 1-3, 6; 37, pp. 1-4, 5-7; 38, pp. 1-4, 8; 39, pp. 1-8; 40, pp. 1-3, 6-7; 41, pp. 1-3, 6-8; 67, pp. 6-10, 24-25; 73, pp. 9-15; 76, pp. 1-7). A Remedial Investigation Report indicated that there has been migration of PCE and its associated degradation products from the Tuchman Property (Ref. 27, p. 1; 19, pp. 1-5). As a result, IDEM required that a Remedial Investigation Work Plan addressing the migration from the property be submitted (Ref. 27, p. 1). Contaminated soils were also detected in the upper few feet under the western two-thirds of the plant building and in the outside waste storage area (Ref. 23, p. 59; 123, pp. 1, 2).

In September 2004, IDEM issued a request for information notice to Tuchman Cleaners to identify the activities, materials, and parties that may have contributed to the contamination on the property (Ref. 72, pp. 1, 2). On July 7, 2008, the parent company of Tuchman Cleaners declared Chapter 11 bankruptcy (Ref. 107, p. 5).

In 1996, a Phase I Environmental Assessment was conducted at a vacant lot located northeast of the Tuchman Cleaners (Ref. 45, p. 1; 46, pp. 5, 7, 10, 65). Ground water monitoring wells were installed on the property, and elevated levels of PCE were detected in some of these wells (Ref. 45, p. 3; 46, p. 4).

Vantage Point Cleaners operated a dry cleaner from December 1986 through February 1997, using and disposing of PCE waste (Ref. 12, p. 1; 42, pp. 1-68; 43, pp. 1-21; 44, pp. 1-47). In 2007, a Phase II Site Investigation was conducted on the property to determine if there was any contribution to PCE ground water impacts to the vacant lot located between Vantage Point Cleaners and Tuchman Cleaners (Ref. 51, pp. 2, 3, 15). The investigation determined that elevated levels of PCE were detected on the Vantage Point Cleaners property (Ref. 51, pp. 10, 11).

From October 19 through 29, 2009, IDEM Site Investigation staff conducted a Site Inspection (SI) (Ref. 78, p. 18). A total of nine (9) subsurface soils and twenty-eight (28) ground water samples were collected for the SI (Ref. 78, pp. 18, 22). Elevated levels of PCE and TCE were detected in soil and ground water samples collected on the Tuchman Cleaners and the Thomas Caterers properties (Ref. 78, pp. 56, 57, 58, 62, 116-121, 124-127, 162-167; 101, p. 1). Elevated levels of vinyl chloride (above the MCL) were detected in municipal well FC2 (Ref. 78, p. 59).

On July 9, 2010, IDEM's State Cleanup Section issued a Special Notice of Liability letter to the registered agent of Mayco Holdings LLC, Vantage Point Cleaners, stating that a release of hazardous substances was documented from the Vantage Point Cleaners property and that the facility was responsible to perform a response action (Ref. 52, pp. 1-4). On January 28, 2011, a consultant for Mayco Holdings, LLC, began investigating the vapor intrusion pathway at a nearby church at the request of IDEM's State Cleanup Section (Ref. 53, pp. 1, 2). On February 16, 2012, IDEM issued a Commissioners Order to Vantage Point Cleaners' responsible parties to conduct necessary response actions in order to address the ground water contamination (Ref. 54, pp. 1, 3).

Thomas Caterers of Distinction, located northwest of Tuchman Cleaners, housed a former rug cleaner operation prior to 1970 (Ref. 63, p. 1; 64, p. 7; 139, p. 1). A Phase 2 was conducted on the property in January 2010 (Ref. 64, pp. 2, 5). Analyses indicated elevated levels of PCE and associated breakdown products in the ground water from all monitoring wells and soil samples (Ref. 64, pp. 23, 24, 26-30; 19, pp. 1, 2).

Purtee Plating, 2300 East 44th Street, Indianapolis, Indiana, historically operated as both metal plating and automotive repair/restoration businesses (Ref. 82, p. 6). Elevated levels of PCE, TCE, VC, and various metals were detected in the surface soils (Ref. 82, p. 22, 36-39). Elevated levels of PCE and TCE were also detected in the

ground water in an up-gradient well (MW2), indicating that ground water underlying the property was being impacted by up-gradient sources (Ref. 82, p. 9).

On November 15 and 16, 2011, IDEM SI staff conducted an Expanded Site Inspection (ESI) (Ref. 79, pp. 5, 11). A total of ten (10) subsurface soils and ten (10) ground water samples were collected for the ESI (Ref. 79, pp. 11, 15). Elevated levels of PCE were detected in soil and ground water samples that were collected on the property of the former S&K Dry Cleaner which had been located at 2321 E. 38th Street (Ref. 79, p. 39, 40, 41; 109, p. 1; 101, p. 1). Elevated levels of vinyl chloride above MCL at 12 µg/l (ground water sample E2SG1DL) were detected in municipal well FC2 (Ref. 2, p. 12; 79, pp. 43, 44, 205; 101, p.1; 112, p. 10).

2.2 SOURCE CHARACTERIZATION

Municipal wells FC17, FC11, FC7, and FC2, lie along a portion of Fall Creek in Indianapolis, Indiana (Ref. Figures 1-2 and 1-3 of this HRS documentation record; 122, p. 1; 130, p. 1). The source(s) of the Keystone Corridor Ground Water Contamination ground water plume are undetermined because too many facilities are located nearby the municipal wells to attribute the ground water plume to any one source or sources (Ref. 129, pp. 1-3; Description of Other Possible Sources Section and Figure 1-4 of this HRS documentation record). Due to the complex geology and high number of known and potential sources of chlorinated volatile organic compounds in the project area and because the contamination is commingled, it is not feasible to directly link any source to the contaminants encountered in the plume (Ref. 7, pp. 3, 5; 85, p. 36; 101, p. 1; Figures 1-3 and 1-4 of this HRS documentation record; Description of Other Possible Sources Section and Section 3.0.1 of this HRS documentation record; 122, p. 1; 130, p. 1). Other potential sources known to have TCE, PCE, VC, etc., can be found in Description of Other Possible Sources Section of this HRS documentation record.

2.2.1 SOURCE IDENTIFICATION

Source Number: 1

HRS Source Type: Other (ground water plume with no identifiable single source)
The source is considered a ground water plume with commingled contamination due to the complex geology and high number of known and potential sources of chlorinated volatile organic compounds in the project area. It is not feasible to directly link any one source to the contaminants encountered in the plume (Ref. 17, p. 8; 16, p. 12; 78, pp. 32, 33; 79, pp. 32, 33; 82, p. 36; 101, p. 1; 116, pp. 48-57; 129, pp. 2, 3; Figure 1-4 of this HRS documentation record). The ground water samples used to delineate the outline of the plume were collected from the combined aquifer covering an approximately 101.2 acre area (Ref. 140, p. 2; 122, p. 1; 130, p. 1; Figure 1-3 of this HRS documentation record; Sections 3.0.1 and 3.1.1 of this HRS documentation record). The area of the ground water plume is based on available samples that meet the criteria for an observed release and the target distance limit is measured from the center of the area of observed ground water contamination (Ref. 1, pp. 45, 46; Section 3.1.1 of this HRS documentation record).

Description and Location of the Source:
The Keystone Corridor Ground Water Contamination consists of a ground water plume along Fall Creek in Indianapolis, Indiana at the intersection of N. Keystone Avenue and E. Fall Creek Parkway N. Drive (aerial representation of the ground water plume can be seen in Figure 1-3 of this HRS documentation record; 122, p. 1; 130, p. 1; 136, p. 2). While sampling was able to identify some contaminated soils, there are many businesses that may also be possible sources contributing to the ground water plume (Ref. 116, pp. 448-57; 129, pp. 1-3). Per the HRS, the plume itself will be considered the source (Ref. 1, Section 1.1, p. 61). The extent of this plume has not been completely delineated at this time but has been characterized by data from monitoring wells, municipal wells and samples obtained using the direct-push boring device (See Section 3.1.1 of this HRS documentation record).

Level of Effort by IDEM:
IDEM staff have been attempting to address soil and ground water contamination along Keystone Avenue since 1989 when elevated levels of VOCs were detected in two soil borings collected near an underground tank on the former Tuchman Cleaners property (Ref. 11, pp. 2, 3, 4, 6). The contamination lies within the Well Head Protection Area for the Fall Creek Well Field (Ref. 122, p. 1; 130, p. 1; Figure 1-4 of this HRS documentation record).

In 2009, the Keystone Corridor and Tuchman Cleaners were referred to the IDEM Site Investigation Section by the IDEM State Cleanup Program (Ref. 107, pp. 1-5; 108, p.1; Site Summary Section and Description of Other Possible Sources Section of this HRS documentation record, for summaries of investigations related to these facilities.) On June 19, 2009, IDEM Site Investigation staff visited the office of Veolia Water, formerly known as Indianapolis Water (IWC), to obtain any information regarding the Fall Creek well field (Ref. 78, p. 17). Site Investigation staff conducted a reconnaissance visit at the Fall Creek well field area on September 13, 2009, to determine strategic sampling locations for a site inspection (Ref. 78, p. 17). On October 19, 20, 21, 22, and 29, 2009, Site Investigation staff conducted an SI of the Keystone Corridor (Ref. 78, pp. 1, 11, 18-23). Elevated levels of PCE were detected in the ground water and soil samples collected from the Tuchman Cleaners and Thomas Caterers properties (Ref. 78, pp. 46, 48, 51, 117, 121, 165, 167, 177, 179, 211, 220, 221, 228, 229, 232- 234; 112, pp. 2-4, 6-8, 10, 11).

On November 15 and 16, 2011, IDEM Site Investigation staff conducted an ESI for the Keystone Corridor (Ref. 79, pp. 5, 11). A total of ten (10) subsurface soils and ten (10) ground water samples were collected for the ESI (Ref. 79, pp. 11, 15). Elevated levels of PCE were detected in soil and ground water samples collected on the property of a former dry cleaner located on East 38th Street (Ref. 79, pp. 12, 13, 17; 112, pp. 1- 4, 6-8, 10, 11). Elevated levels of vinyl chloride above the MCL (12 µg/l in E2SG1) in drinking water were also detected in well FC2 (Ref. 2, p. 12; 79, pp. 43, 44, 149; 112, p. 10).

Additionally, the 2007 Wellhead Protection Plan (Ref. 116) identified approximately 129 properties as possible sources of solvents in the 5-year time of travel for the Fall Creek Wellfield (Ref. 116, pp. 48-57; 129, p. 1). Of these, 40 properties were identified as known sources of chlorinated volatile organic compounds, and/or those properties where dry cleaning, commercial laundry, printing, metals manufacturing, or chemical distributors are/were located (Ref. 129, pp. 1-3).

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

Refer to Section 3.1.1 of this HRS documentation record for a list of ground water samples that were found to be contaminated. The hazardous substances include cis-1,2-DCE, trans-1,2-DCE, 1,1,1-TCA, PCE, TCE, and vinyl chloride.

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Containment Description	Containment Factor Value	References
Gas release to air:	Not Scored	
Particulate release to air:	Not Scored	
Release to ground water: Because there is an observed release of a hazardous substance to ground water a containment value of 10 has been assigned (See Section 3.1.1 of this HRS documentation record showing elevated levels of volatile organic compounds that were detected in ground water in the Keystone Ground Water Contamination, an observed release of hazardous substances by chemical analysis).	10	Ref. 1, Table 3-2, p. 70
Containment Description	Containment Factor Value	References
Release via overland migration and/or flood:	Not scored	

Notes: The Containment Factor Value for the ground water migration pathway was evaluated for "All Sources" for evidence of hazardous substance migration from source area (i.e., source area includes source and any associated containment structures). The applicable containment factor value was determined based on existing analytical evidence of hazardous substances in ground water samples (Ref. Section 3.1.1 of this HRS documentation record). Based on an observed release of a hazardous substance to ground water a containment value of 10 has been assigned (Ref. 1, Table 3-2, p. 70; Section 3.1.1 of this HRS documentation record).

2.4.2 HAZARDOUS WASTE QUANTITY

2.4.2.1.1 Hazardous Constituent Quantity (Tier A)

Description
The information available is not sufficient to evaluate Tier A source hazardous waste quantity; a sufficient number of samples were not collected that would statistically represent the range of contaminant concentrations throughout the source, therefore, hazardous constituent quantity is not scored (NS). As a result, the evaluation of hazardous waste quantity proceeds to the evaluation of Tier B, hazardous wastestream quantity (Ref. 1, Section 2.4.2.1.1, pp. 64, 65).

Hazardous Constituent Quantity Assigned Value: NS

2.4.2.1.2 Hazardous Wastestream Quantity (Tier B)

Description
The information available is not sufficient to evaluate Tier B source hazardous wastestream quantity. There are insufficient historical and current data (manifests, PRP records, State records, permits, etc.) available to adequately calculate the total mass of all hazardous wastestreams and CERCLA pollutants and contaminants in the source. As a result, the evaluation of Hazardous Waste Quantity proceeds to the evaluation of Tier C, Volume (Ref. 1, Section 2.4.2.1.2, p. 65).

Hazardous Wastestream Quantity Assigned Value: NS

2.4.2.1.3 Volume (Tier C)

Description
Horizontal and vertical extent of the plume 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. Therefore, the source volume is unknown, but greater than 0.

Volume Assigned Value: unknown, but >0

2.4.2.1.4 Area (Tier D)

Description
Area, Tier D, is not scored (NS) for source type "other" (Ref. 1, Table 2-5, p. 65).

Area Assigned Value: 0

2.4.2.1.5 Source Hazardous Waste Quantity Value

The source hazardous waste quantity value for Source 1 is unknown, but > 0 (Ref. 1, Section 2.4.2.1.5, p. 65).

Volume of ground water plume: unknown, but >0
Source Hazardous Waste Quantity Value: unknown, but >0

SUMMARY OF SOURCE DESCRIPTIONS

Source No.	Source Hazardous Waste Quantity Value	Source Hazardous Constituent Quantity Complete? (Y/N)	Containment Factor Value by Pathway				
			Ground Water (GW) (Ref. 1, Table 3-2)	Surface Water (SW)		Air	
				Overload/flood (Ref. 1, Table 4-2)	GW to SW (Ref. 1, Table 3-2)	Gas (Ref. 1, Table 6-3)	Particulate (Ref 1, Table 6-8)
1	Unknown, but >0	N	10	NS	NS	NS	NS

NS Not Scored

Description of Other Possible Sources:
There are several other possible sources of chlorinated solvents in the area. The names and descriptions of the possible sources are as follows:

Tuchman Cleaners
The former Tuchman Cleaners was located at 4401 Keystone Avenue, Indianapolis, Indiana (Ref. 4, p. 4; 8, p. 5; 20, p. 2; 23, p. 10; 10, p. 5; 110, p. 1; 123, pp. 1, 2; 139, p. 1; Figure 1-4 of this HRS documentation record). The facility used PCE, generated PCE waste, and had several PCE spills on-site (Ref. 10, pp. 10, 11; 12, p. 1). In May 1989, elevated levels of VOCs were detected in two (2) soil borings that were collected near an underground tank as part of a subsurface investigation (Ref. 11, pp. 2-4, 6). In 1989, a soil gas survey was conducted on the property to determine the extent of subsurface contamination at the facility (Ref. 10, p. 1). The investigation concluded that it was possible that the majority of the plume had migrated with the ground water to the south/southeast and had traveled off of the property (Ref. 10, pp. 1, 9). Exploratory borings performed in 1989 as part of a Phase II Investigation indicated that the subsurface soils and ground water on the property were contaminated with volatile organic compounds (Ref. 5, pp. 1, 5, 12, 13, 14). Four (4) monitoring wells were subsequently installed on the property, which detected elevated levels of TCE (1,330 µg/l), vinyl chloride (21,900 µg/l), and PCE (6,500 µg/l) in the ground water (Ref. 5, pp. 12, 20, 21, 23-26, 31). Another Phase II Investigation/Remediation report was completed in January of 1996 to evaluate the nature of the source area and to evaluate how best to remediate the VOCs (Ref. 8, pp. 2, 5; 123, pp. 1, 2; 139, p. 1). Elevated levels of vinyl chloride, TCE, PCE, and other breakdown products were detected in the water (Ref. 8, p. 20; 19, pp. 1, 2; 123, pp. 1, 2; 139, p. 1). Water samples were also collected in the wash-water containment pits of the drycleaner's operations in 1999 to pinpoint any sources of contamination, and analysis revealed elevated levels of PCE in the pits (Ref. 16, pp. 7, 12, 25). An additional Stage I investigation in July and August of 2000, which collected direct push borings and discrete ground water samples, also detected elevated levels of PCE in soils and ground water (Ref. 20, pp. 2, 8-14, 16-19).

Approximately 217.4 kilograms of VOCs have been removed from the shallow ground water zone via 82 months of pumping (no pumping in May 1996, January 1998, and February 1998) (Ref. 22. p. 7). According to another ground water monitoring report dated April 11, 2000, approximately 162 kg of VOCs have been removed from the aquifer (Ref. 16, pp. 1, 12). The report also stated that the remediation system was effective at blocking impacted ground water from flowing off of the property-site, but did not mention if any contaminated ground water left the facility prior to the installation of the remediation system (Ref. 16, p. 12). VOC concentrations decreased during the remediation activities, but data from monitoring well MW6 indicated that PCE had migrated onto the property (Ref. 17, pp. 9, 26; 18, p. 2). Information contained in a Remedial Investigation Report prepared for National Drycleaners, INC. indicated increased concentrations of PCE at monitoring well MW-6 which is located upgradient of the property (Ref. 23, p. 9; 123, pp. 1, 2). It was noted that this monitoring well was located immediately downgradient of a neighboring laundry facility on Allisonville Road that included dry cleaning operations that may have resulted in releases to the subsurface (Ref. 23, p. 9; 123, pp. 1, 2). In general, ground water flow was documented in a southwesterly direction (Ref. 13, p. 21; 123, pp. 1, 2). Localized variations in ground water flow direction have been documented (Ref. 24, p. 11; 28, p. 9, 10; 30, p. 18, 19, 20; 31, p. 10, 11, 12; 32, p. 9, 10. 11; 33, pp. 10, 11, 12; 34, p. 9, 10, 11; 35, p. 8, 9, 10; 36, p. 8, 9, 10; 37, p. 9, 10; 38, p. 10, 11, 12; 39, p. 9, 10, 11; 40, p. 9, 10, 11; 41, p. 9, 10, 11). Monitoring of the wells on the property from 2002 and 2003 and 2005 to 2008 revealed continuous detections of PCE, although VOC concentrations fluctuated in some of the wells (Ref. 21, pp. 1-3, 5-11; 22, pp. 4, 9-15; 24, pp. 1-3, 5-9; 28, pp. 1-7; 30, pp. 1-4, 6, 7, 9-16; 31, pp. 1-3, 5-9; 32, pp. 1-8; 33, pp. 1-9; 34, pp. 1-3, 5-8; 35, pp. 1-3, 5-7; 36, pp. 1-3, 5, 6; 37, pp. 1-3, 5, 6; 38, pp. 1-4, 6-8; 39, pp. 1-7; 40, pp. 1-3, 5-7; 41, pp. 1-3, 5-7; 59, pp. 5, 6; 18, pp. 5, 6). The RI Report indicated that there has been migration of PCE and its associated degradation products off of the Tuchman Property (Ref. 27, p. 1; 19, pp. 1-5).

In 2009, IDEM conducted a Site Inspection (Ref. 78, pp. 1, 11, 18-23). Levels of PCE as high as 18 µg/kg and TCE as high as 1.4 (J) µg/kg were also detected in many subsurface soils on the Tuchman Cleaners (Ref. 78, pp. 48, 51, 162, 163; 99, pp. 5, 8, 9, 36, 39, 42, 45).

Vantage Point Cleaners
Former Vantage Point Cleaners operated from approximately 1979 until 1997 (Ref. 54. p. 6). In 1996, Aldi, Inc. contracted an environmental consultant to conduct a Phase I Environmental Assessment at a vacant lot (Ref. 45, pp. 1-4) located at 4405 Allisonville Road, Indianapolis, Indiana, northeast of Tuchman Cleaners and was the former location of Vantage Point Cleaners (Ref. 61, p. 2; Figure 1-4 of this HRS documentation record). Elevated levels of PCE were detected in the ground water from two of three (3) monitoring wells that were installed on the property (Ref. 45, pp. 3, 4). The owner of the vacant lot, T&N Partnership, filed a lawsuit against Tuchman Cleaners and

Vantage Point Cleaners (a dry cleaner) (Ref. 48, pp. 1- 12; 55, pp. 1-15; 56, pp. 1-16; 57, pp. 1-18). According to the Summary Judgment, it was determined that the contamination found on the vacant lot did migrate from both Vantage Point Cleaners and Tuchman Cleaners (Ref. 58, pp. 5, 10). IDEM sent an Information Request Notice to the owners of the Vantage Point Cleaners property in January 2004 (Ref. 49, pp. 1-3). Vantage Point Cleaners operated as a dry cleaner, using and disposing of PCE waste (Ref. 12, p. 1; 42, pp. 1-68; 43, pp. 1-21; 44, pp. 1-47).

A Phase II Environmental Investigation was conducted on the Vantage Point property and four (4) monitoring wells were installed (Ref. 50, pp. 2, 6). Naphthalene was the only compound detected in the ground water at the Vantage Point Cleaners (Ref. 50, p. 9). In 2007, a Phase II Site Investigation was conducted by St. John-Mittelhauser & Associates, Inc. to determine if there was any contribution to PCE ground water impacts to the vacant lot located between Vantage Point Cleaners and Tuchman Cleaners (Ref. 51, pp. 1, 3). The investigation determined that elevated levels of PCE were detected on the Vantage Point Cleaners property (Ref. 51, pp. 10, 11). However the report indicated that a relation between the PCE at Vantage Point Cleaners and the vacant lot could not be made (Ref. 51, p. 12).

On July 9, 2010, IDEM State Cleanup Section issued a Special Notice of Liability letter to the registered agent of Mayco Holdings, LLC, former Vantage Point Cleaners (Ref. 52, pp. 1-4). The Special Notice of Liability stated that a release of hazardous substances was documented from the former Vantage Point Cleaners property and that the facility was responsible to perform a response action that was deemed necessary by IDEM (Ref. 52, p. 1). On January 28, 2011, a consultant for Mayco Holdings, LLC, prepared a work plan to investigate the vapor intrusion pathway at a nearby church at the request of IDEM State Cleanup Section (Ref. 53, pp. 1, 2). On February 16, 2012, IDEM issued a Commissioners Order to Vantage Point Cleaners' responsible parties to conduct necessary response actions in order to address the ground water contamination (Ref. 54, pp. 1-27). According to an investigation on an adjacent property located at 4405 Keystone, Vantage Point Cleaners was listed as a potential source of contamination (Ref. 6, pp. 1, 5).

Thomas Caterers of Distinction

The property located northwest of Tuchman Cleaners houses a former rug cleaner and dry cleaner prior to 1970 and currently operates as a catering facility (Ref. 63, p. 1; 139, p. 1; Figure 1-4 of this HRS documentation record). The facility is located at 4440 North Keystone Avenue, Indianapolis (Ref. 64, p. 1). In January 2010, Thomas Caterers of Distinction contracted an environmental consultant to conduct a Phase II Environmental Investigation on their property (Ref. 64, pp. 1, 5; 66, p. 1). Analysis of the ground water collected from all monitoring wells indicated elevated levels of PCE and TCE in the wells; all soil samples contained PCE (Ref. 65, pp. 1, 2; 66, p. 1, 2; 78, pp. 51, 82, 83, 148, 149, 164-167, 208, 209, 234; 139, p. 1). Soil samples that were obtained on the property during the Keystone Corridor Ground Water SI revealed elevated levels of PCE (0.046 mg/kg PCE for sample E2R21 and 0.160 mg/kg of PCE for sample E2R23) (Ref. 78, pp. 48, 51, 164-167, 232, 233). Soil samples obtained on the Thomas Caterers property were also found to contain elevated levels of chlorinated solvents (PCE as high as 160µg/kg in E2R23 and TCE as high 8.3 µg/kg) (Ref. 78, pp. 48, 51, 100-102, 164-167, 232-234; 99, pp. 5, 8-13, 17, 19, 57-59, 63-65).

Purtee Plating

The property located northwest of the ground water plume is located at 2300-2306 East 44th Street, Indianapolis, Indiana (Ref. 84, p. 4; Figure 1-4 of this HRS documentation record). The property has historically operated as both metal plating and automotive repair/restoration businesses (Ref. 84, p. 5). On March 24, 2006, IDEM staff conducted an inspection at the facility in response to a complaint alleging that nine (9) drums of nickel plating wastes were abandoned at the property (Ref. 14, p. 3). The inspection revealed that the drums were present and the owner was required to dispose of them (Ref. 14, pp. 3, 4). A series of subsurface investigations were conducted on the property showing elevated levels of PCE, cis-1, 2 DCE, and various metals in the surface soils (Ref. 83, p. 6, 7; 84, pp. 7-15, 28). The concentrations of PCE and TCE detected in the ground water indicate that the ground water on the property was being impacted by up-gradient sources because the concentrations were higher in wells upgradient of the property and downgradient of a known source of PCE and TCE (Tuchman Cleaners) (Ref. 83, pp. 7, 11; 84, pp. 13-15, 27).

S&K Laundry

The property is located at 2321 East 38th Street (Ref. 109, p. 1; Figure 1-4 of this HRS documentation record). The property has formerly housed several dry cleaning/laundromat facilities (Ref. 109, p. 1). From 1962-1974, the property was occupied by various names that included: B&B Norge Coin, Norge Clean and Laundry, and Smiths Norge (Ref. 109, p.1). From 1978 through 1979, the facility was operated under the name of Rain Barrel Laundry

(Ref. 109, p. 1). From 1981 to 1999, the facility operated under several variations of the S&K name; S&K Laundromat and Dry Cleaning, S&K Laundromat, and S&K Cleaning & Laundromat (Ref. 109, p. 1). Specific details regarding these cleaning operations are unknown.

On November 15 and 16, 2011, IDEM Site Investigation staff conducted an ESI (Ref. 79, pp. 5, 11, 12). A total of ten (10) subsurface soils and ten (10) ground water samples were collected for the ESI (Ref. 79, pp. 11, 15). Elevated levels of PCE were detected in soil samples E2SJ0 (25 µg/kg) and E2SH6 (810 µg/kg) that were obtained from the property at 2321 East 38th Street (Ref. 79, pp. 12, 93, 97; 81, pp. 9, 10, 15, 16, 40, 41; 103, p. 2). Additionally, elevated levels of PCE were detected in the ground water during the ESI on the S&K property (Ref. 79, pp. 210, 211, 212; 80, pp. 28, 29, 32, 33, 34, 63, 65; 111, pp. 3, 4; 112, p. 10).

Quick Stop Cleaners

The property is located at 2306 East 34th Street and is IDEM active State Cleanup project #0000-00-295 (Ref. 126, p. 1; Figure 1-4 of this HRS documentation record). A dry cleaning business operated on the property from 1967 to 1994 (Ref. 126, p. 3). The property is adjacent to a Marathon gas station (Ref. 126, p. 22). PCE was detected in subsurface soil samples collected from the property as high as 2,580 ug/mg and as high as 4,610 ug/mg on the adjacent Marathon property (Ref. 126, p. 4). PCE in groundwater samples were as high as 480 ug/l (Ref. 126, p. 7).

Walkers Cleaners

The property is located at 1841 East 46th Street (Ref. 124, p. 1; Figure 1-4 of this HRS documentation record) and was historically a dry cleaner (Ref. 124, p. 2). Reportedly, the cleaners used "a specialty blend of mineral spirits in its dry cleaning operations" and "never used chlorinated solvents" (Ref. 124, p. 2). The property is the location of IDEM Leaking Underground Storage Tank (LUST) incident #199812591 for a release of mineral spirits from regulated underground storage tanks (USTs) (Ref. 124, pp. 1, 2). Concentrations of PCE have also been detected in groundwater samples collected from this property as high as 86 ug/l (Ref. 124, pp. 2 and 18). Additionally, PCE was detected as high as 79.0 ug/l in wells located off and to the north of the property in grab samples collected in August 2011 (Ref. 124, pp. 38, 49). An unidentified source is attributed as the source of PCE in groundwater at the property (Ref. 124, pp. 2 and 3).

College 60 Minute Cleaners

The property is located at 4838 North College Avenue and is IDEM State Cleanup site 2010-04-202 (Ref. 125, p. 1; Figure 1-4 of this HRS documentation record). A release of dry cleaning solvent PCE has been documented (Ref. 124, p. 5). The property has been a dry cleaner since 1974 (Ref. 125, p. 7). Concentrations of PCE in subsurface soil samples and grab groundwater samples collected from the property were as high as 133,000 ug/mg (Ref. 125, p. 24) and 485 ug/l (Ref. 125, p. 25), respectively.

Morellis Dry Cleaners

The property is located at 5367 North Keystone Avenue and is IDEM Voluntary Remediation Site #6070401 (Ref. 127, p. 1; Figure 1-4 of this HRS documentation record). The facility has been a dry cleaner since at least 1955 (Ref. 127, p. 7). A ground water plume containing primarily PCE has been documented on and off of the property (Ref. 127, p. 7).

BP Connect

The property is located at 2450 East 52nd Street and is IDEM LUST incident #200007519 (Ref. 128, p. 1; Figure 1-4 of this HRS documentation record). The facility is a convenience store and gasoline station that encompasses combined parcels (Ref. 128, p. 1) where historical operations included a waste oil tank and an oil/water separator (Ref. 128, p. 2). Ground water samples collected from soil borings were contaminated with TCE, cis-1, 2-DCE, and VC above applicable default closure levels (Ref. 128, p. 2).

There are at least 40 different possible sources of the ground water plume that have been identified within less than 2 miles of the boundary of the plume (Ref. 129, pp. 2, 3; 116, pp. 48-57; Figure 1-4 of this HRS documentation record; 122, p. 1; 130, p. 1). A table that summarizes these 40 possible sources can be found on pages 2 and 3 in Reference 129.

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 GENERAL CONSIDERATIONS

Regional Geology/Aquifer Description

Most of the soils in the project area are part of the Genesee-Sloam association of deep, well drained and very poorly drained, nearly level soils formed in loamy alluvium (Ref. 132, pp. 3-4). The majority of the surface soil consists of Urban Land that is so altered and obscured by development that identification of the soils is not feasible (Ref. 132, pp. 5-8).

- Aquifer/Stratum 1 (uppermost): Outwash

Description

Three generalized types of glacial terrain are present in the area (Ref. 131, p. 3). Along Fall Creek, sand and gravel outwash is primarily encountered, which formed by meltwater routes formed in, on, or under the ice during deglaciation (Ref. 131, pp. 3-4; Ref. 133, p. 6). Thin discontinuous till units are present within the sand and gravel (Ref. 131, p. 4). North and south of Fall Creek, mixed sequences of outwash bodies and fans overlie and are intercalated with multiple till units (Ref. 131, pp. 3-4). Along the edges of the project area, loam till with locally small and medium-sized sand and gravel units, is present (Ref. 131, pp. 3-4).

Subsurface environmental investigations conducted in area of the ground water plume confirm the stratigraphy and geology in the area of the plume as discussed in the above paragraph (Ref. 23, pp. 33 to 37, 84, 88, 89; 82, pp. 24, 27; 83, pp. 13, 15; 125, pp. 27, 33, 34). These investigations also determined that the hydraulic conductivity of the sand and gravel aquifer is between 1.7×10^{-4} and 5.1×10^{-4} centimeters per second (Ref. 23, pp. 39, 136, 138).

- Aquifer/Stratum (deepest): Karst

Description

Below the unconsolidated materials, the bedrock consists of the Devonian-aged Muscatatuck Group of limestone and dolomite (Ref. 131, pp. 5-6). The carbonate rock gently dips to the southwest (Ref. 133, p. 5). Prior to glaciation, the top of the bedrock surface was exposed to weathering and underwent karst development (Ref. 133, p. 5). Therefore, the carbonate surface is characterized as relict karst, marked by sinkholes, small caves, and other solution features (Ref. 133, p. 5). The carbonate extends more than 200 feet deep (below an elevation of 500 feet msl) and is present throughout the entire project area (Ref. 131, pp. 5-6; 133, p. 5). A well log for a municipal test well in the project area displays evidence of karst, as it reports “crevice lost all fluid” at a depth of 139.5 to 140 feet below grade (Ref. 135, pp. 21-22). Geologic cross-sections prepared for the Wellhead Protection Plan delineation depict the generalized geology of the project area (Ref. 7, pp. 3, 34, 35).

Subsurface environmental investigations conducted in area of the ground plume confirm the stratigraphy and geology in the area of the plume as discussed in the above paragraph (Ref. 23, pp. 33 to 37, 84, 88, 89; 82, pp. 24, 27; 83, pp. 13, 15; 125, pp. 27, 33, 34). The hydraulic conductivity of the karst aquifer is estimated to be 10^{-2} centimeters per second (Ref. 1, Table 3-6).

- Aquifer Interconnection

Description

Ground water in the Keystone Corridor is present within the unconsolidated sand and gravel outwash as well as the carbonate bedrock (Ref. 116, pp. 24-25; 7, p. 3; 23, pp. 38–41). Static water levels are generally 20 to 50 feet below ground surface (Ref. 116, p. 23). As shown on the potentiometric surface map, the shallow ground water generally flows towards Fall Creek, so that north of Fall Creek ground water flows towards the south-southwest and south of Fall Creek water flows towards the west (Ref. 131, p. 7).

The outwash and carbonate bedrock (karst) aquifer are evaluated as a combined aquifer. Pump test data performed on the Tuchman Cleaners facility in 2004 demonstrated interconnection, i.e., when nearby municipal well FC 11, completed

351 feet below grade in the karst aquifer (Ref. 7, pp. 2, 31), was turned off, water levels rebounded close to 6 feet in both intermediate and deep wells in the outwash aquifer (Ref. 25, pp. 8, 23; 123, pp. 1, 2). Several well logs for the area show no continuous layer of clay or sandy/gravelly clay above the carbonate bedrock within two miles of the center of the ground water plume (Ref. 7, pp. 34, 35; 23, p. 15; 102, pp. 22, 24; 116, pp. 22, 24; 135, pp. 4, 5, 11, 16, 17, 26; Figures 1-3 and 1-4 of this HRS documentation record). All of the interconnected sand and gravel units act as a single, unified aquifer system (Ref. 133, p. 7). The carbonate rocks (karst aquifer) are recharged through the outwash (Ref. 116, p. 23). Therefore, the ground water in the project area is considered to be from the same, combined interconnected aquifer (Ref 7, pp. 5, 6).

Various concentrations of PCE, TCE, vinyl chloride, and cis-1, 2 DCE have been identified in municipal wells FC-2, FC-7, FC-8, and FC-11 of the City of Indianapolis' Fall Creek municipal well field (Ref. 82, pp. 2-62; Background Ground Water Well Sample Table and the Contaminated Ground Water Sample Table 2 (Municipal Well FC2) of this HRS documentation record). These wells are screened within the karst portion of the combined aquifer (Ref. 7, pp. 2, 3, 31, 32, 34, 35). Monitoring wells within the ground water plume and completed in both the outwash and karst aquifers contain concentrations of VOCs indicating that the clay lenses do not provide a hydraulic barrier to ground water flow between the outwash and karst aquifers (Ref. 20, pp. 15, 17, 18; 23, pp. 82, 84, 88, 89; 26, pp. 70, 72, 73; 125, pp. 27, 33, 34).

The Fall Creek municipal wells (targets for this HRS documentation record) are screened in the same combined aquifer (Ref. 116, pp. 24-25; 7, pp. 2; 135, pp. 2–5; 102, pp. 22, 23, 24). This aquifer is contaminated with elevated levels of PCE (Ref. 78, p. 203; 96, pp. 17-18, 39, 106-108; 79, p. 205, 206; 80 pp. 5-8, 9-12 56-59). This aquifer is utilized by the Indianapolis municipal well system (Ref. 116, pp. 24-25; 7, p. 2; 102, pp. 23, 24). Refer to the Fall Creek Municipal Well FC17 Table and Level I Samples (Fall Creek Municipal Well FC2) Table found in Section 3.1.1 of this HRS documentation record.

- Aquifer Discontinuities within Target Distance Limit

Description

There are no aquifer boundaries, or discontinuities, such as a mountain range, ocean (Ref. 3, p. 1; 134, p. 1), bedrock faults or fractures, (Ref. 131, p. 5; 7, pp. 3, 34, 35), etc., within 4-miles of the project area (Ref. 7, p. 3, 34, 35).

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	Outwash	NA	Y	N
2	Karst	Y	Y	Y

The combined (outwash and karst) aquifer is the aquifer being evaluated. The municipal wells in the study area are screened in this aquifer (Ref. 7, p. 2; 102, pp. 22-23; 135, pp. 2-5; Sections 2.2.2 and 3.1.1 of this HRS documentation record).

3.1 LIKELIHOOD OF RELEASE

3.1.1 OBSERVED RELEASE

Aquifer Being Evaluated: 1 Combined

Chemical Analysis:
Establishing an observed release by chemical analysis requires analytical evidence of a hazardous substance in the media significantly above background level (Ref. 1, Section 2.3, p. 63). If the background concentration is not detected (or is less than the detection limit), an observed release is established when the sample measurement equals or exceeds its own sample quantitation limit (SQL) and that of the background sample (Ref.1, Table 2-3, Section 2.3, p. 63). If the SQL cannot be established, the EPA contract- required quantitation limit (CRQL) is used in place of the SQL (Ref. 1, Section 2.3, Table 2-3, p. 63).

Contaminated Samples:
The extent of the ground water plume is depicted by samples from direct-push wells, municipal wells and monitoring wells known to contain volatile organic compounds at concentrations that meet observed release criteria (Ref. Figure 1-3 of this HRS documentation record; 122, p. 1; 130, p. 1). The plume currently measures approximately 4500 feet long (north to south) and approximately 1500 feet wide (east to west) (Ref. 122, p. 1; 130, p. 1; Figure 1-3 of this HRS documentation record).

The area of the ground water plume is based on available samples that meet the criteria for an observed release (Ref. Contaminated Ground Water (Obtained by Direct Push) Sample Table of this HRS documentation record; Contaminated Ground Water Obtained From Established Monitoring Wells Sample Table 1 of this HRS documentation record**;** Fall Creek Municipal Well FC17 Table of this HRS documentation record**;** Contaminated Ground Water Sample Table 2 (Municipal Well FC2) of this HRS documentation record; Section 3.1.1 of this HRS Documentation Record). The plume boundary was digitized by connecting wells that met observed release criteria (Ref. 122, p. 1; 130, p. 1; Figure 1-3 of this HRS documentation record).

Background wells were identified outside the boundaries of the plume (Ref. 131, p. 7; 139, p. 1; Background Ground Water Sample Tables found in Section 3.1.1 of this HRS documentation record; Figure 1-3 of this HRS documentation record; 122, p. 1; 130, p. 1).

In 2009 and 2011, IDEM's Site Investigation Section conducted SI and ESI activities at the Keystone Corridor (Ref. 78, pp. 1, 11, 18-23; 79, pp. 5, 11). The ground water obtained from monitoring wells and municipal wells was found to be contaminated with chlorinated VOCs (Ref. Sections 3.1.1, 3.3.2.2, and the Contaminated Ground Water (Obtained by Direct Push) Sample Table, Contaminated Ground Water Obtained From Established Monitoring Wells Sample Table 1, Contaminated Ground Water Sample Table 2 (Municipal Well FC2) found in Section 3.1.1 of this HRS documentation record). IDEM utilized the EPA Contract Laboratory Program (CLP) for sample analysis (Ref. 78, p. 18; 79, p. 11). Sample results showed that the concentrations of vinyl chloride were above background and above the EPA maximum contaminant level (MCL) of 2 µg/L in ground water samples obtained from FC2 (Ref. 2, p. 12; 78, p. 203; 96, pp. 17-18, 39, 106-108; 79, p. 205; 80 pp. 5, 7, 56-57). Concentrations of PCE were found to be as high as 210,000 µg/L, TCE as high as 1,300 µg/L, and vinyl chloride as high as 480 J µg/L (Ref. 78, pp. 46, 117, 118; Contaminated Ground Water Obtained From Established Monitoring Wells Sample Table 1).

The extent of this plume has not been completely delineated at this time but has been characterized by data from monitoring wells, grab samples obtained by direct-push methods, and municipal wells (Ref. Section 3.1.1of this HRS documentation record; Figure 1-3 of this HRS documentation record; 122, p. 1; 130, p. 1).

The following set of tables depicts the samples that meet the observed release criteria (Ref. 1, Table 2-3, p. 63). These tables list the organic hazardous substances with their concentrations and SQLs for each sample.

These samples were qualified as "releases" based on the criteria in the HRS (Ref. 1, Table 2-3, p. 63). The well locations are depicted on Figure 1-3 of this HRS documentation record (Ref. 78, pp. 46, 48; 79, pp. 32, 33).

The Contaminated Ground Water (Obtained by Direct Push) Sample Table lists ground water samples that were obtained from a direct push method that were found to be contaminated with elevated levels of chlorinated compounds meeting the

observed release criteria (Ref. 1, Table 2-3, p 63). All direct push instrument water samples in the area were collected in the shallow sands and gravels of the combined aquifer. During 2011 ESI, a soil boring log was completed for each direct push ground water sampling location. The soil sample number on the boring log corresponds to ground water sample number (Ref. 7, pp. 4, 5; 78, pp. 236-247; 79, pp. 15, 32, 33, 233-250).

Background Ground Water Samples:
On October 19, 20, 21, 22, and 29, 2009, IDEM SI staff conducted an SI at for the Keystone Corridor site (Ref. 78, pp. 1, 11, 18). On November 15 and 16, 2011, IDEM SI staff conducted an ESI (Ref. 79, p. 11). The background water samples were obtained from established monitoring wells, direct push methods, and municipal wells (Ref. 78, pp. 19, 53; 79, pp. 16, 18). The project area is underlain by a combined aquifer (Ref. 7, pp. 3, 5; 131, pp. 3-65). Background ground water samples that were obtained from monitoring wells were obtained from a shallow (43 feet below ground surface) portion and a deeper portion of sand and gravel deposits (68.5 feet below ground surface) of the combined aquifer (Ref. 7, pp. 3, 5; 78, pp. 19, 53, 64, 65, 261; Background Ground Water Sample Table (Obtained from two established monitoring wells) of this HRS documentation record). Background ground water samples that were obtained from direct push methods were also obtained from the shallow horizon (19.5-24 feet below ground surface) containing the sand and gravel deposits of the combined aquifer (Ref. 7, pp. 3, 5; 79, pp. 35, 248, 250; Background Ground Water Sample Table (Obtained via a Direct Push Method) of this HRS documentation record). The background ground water samples that were obtained from municipal wells FC 7 and FC11 were obtained from limestone bedrock, from which the wells are screened in the combined aquifer (Ref. 7, p. 2, 31, 32; 78, p. 255). Background ground water samples collected from the sand and gravel portion of the aquifer are compared to release ground water samples collected from the sand and gravel aquifer. Background samples collected from the karst portion of the aquifer are compared to release samples collected from the karst portion of the aquifer (see the tables in this section of the HRS documentation record documenting the depths of the background and release samples). The table on the following pages depicts the results of those background ground water samples.

The ground water samples obtained from the monitoring wells listed below were collected in three (3) 40-milliliter vials preserved with hydrochloric acid (HCL) (Ref. 78, p. 19). Nitrile gloves were worn and discarded between the collection of each sample (Ref. 78, p. 19). Monitoring wells were purged three (3) well volumes before sampling. Ground water was obtained from the monitoring by using bailers (Ref. 78, p. 19). Ground water was poured from the top of the bailer into the vials being careful so that no air bubbles were present in the sample (Ref. 78, p. 19). The vials were then labeled and placed in a cooler with ice (Ref. 78, p. 19).

Background Ground Water Sample Table
(Obtained from two established monitoring wells)

EPA CLP #	IDEM #	Control #	Sample Date	Location	Hazardous Substance	Sample Concentration	Contract Required Quantitation Limit	Depth (Feet) Below Ground Surface	Reference
E2QZ1	GW2	MW6i	10/19/09	Northeast side of Tuchman Cleaners; MW6i	Vinyl Chloride Cis-1,2-DCE Trans-1,2-DCE TCE PCE	0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L	43 feet deep	Ref. 23, pp. 85, 138-139; 78, pp. 46, 195; 96, pp. 13-14, 37, 75-77; 119, p. 199
E2QZ2	GW3	MW6d	10/19/09	Northeast side of Tuchman Cleaners; MW6d	Vinyl Chloride Cis-1,2-DCE Trans-1,2-DCE TCE PCE	0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L	68.5 feet deep	Ref. 23, pp. 85, 188-189; 78, pp. 46, 196; 96, pp. 13-14, 37, 82-84; 119, p. 199

The table below provides a summary of the background ground water samples that were obtained via a direct push method. The referenced samples in the following table were collected from the sand and gravel interval of combined aquifer (Ref. 7, pp. 5, 34, 35; 23, pp. 88, 89; 78, pp. 261, 262). The following describes how ground water was obtained from a direct push method. A stainless steel screen was utilized on the direct push method to obtain ground water. The stainless steel screen was attached to the drill pipe and pushed to a position below the water table as identified in the soil boring log and at the same location of the soil boring. When the desired depth was reached, water was allowed to flow through the stainless steel screen from the surrounding soil media. A plastic tube connected to a peristaltic pump was inserted down the drill pipe to a depth at the midpoint of the screen in order to bring the ground water up to the surface. Pumping of the water continued until the water became clear. After the water became clear, the water was allowed to flow directly into three (3) 40 ml vials that contained hydrochloric acid as a preservative. The vials were then labeled and placed in a cooler with ice (Ref. 143, p. 1).

Background Ground Water Sample Table
(Obtained via a Direct Push Method)

EPA CLP #	IDEM #	Control #	Sample Date	Location	Hazardous Substance	Sample Concentration (µg/L)	Contract Required Quantitation Limit	Depth (feet) Below Ground Surface	Reference
E2SH5	GW10	NA	11/15/11	Connies backlot, southeast corner of parking lot	PCE TCE Cis-1,2-DCE 1,1,1-TCA VC	0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L	21-24 feet	Ref. 79, pp. 32, 217, 248; Ref. 80, pp. 21-22, 60-61; Ref. 111, p. 3; Ref. 119, p. 199
E2SG7	GW11	NA	11/16/11	Church lot; 41st St. & Sherman	PCE TCE Cis-1,2-DCE 1,1,1-TCA VC	0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L 0.5 U µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L	19.5-23.5 feet	Ref. 79, pp. 32, 218, 250; Ref. 80, pp. 17-18, 60-61; Ref. 111, p. 5; Ref. 119, p. 199

The table below provides a summary of the background ground water samples that were obtained from municipal wells. All of these wells listed are completed in the karst interval of the combined aquifer (Ref. 7, pp. 2, 31, 32). Municipal well water samples obtained during the Keystone Corridor sampling in November 2011 were obtained from spigots located on the municipal well pump. Wells were purged for a short period (10-15 minutes) as all active wells that were sampled had been running continuously (from 3 hours to several days) prior to taking the sample. Samples were obtained by direct pour into three (3) 40-ml glass vials containing hydrochloric acid preservative. Samples were collected in a manner so that no air bubbles were present in the vial after securely closing the lid. Nitrile gloves were worn during the collection of all samples and the samples were placed directly into an ice-filled cooler (Ref. 142, p. 1).

Background Ground Water Well Sample Table
(Obtained from operating Municipal Wells)

EPA CLP #	IDEM #	Control #	Sample Date	Location	Hazardous Substance	Sample Concentration (µg/L)	Contract Required Quantitation Limit	Depth (Feet) Below Ground Surface	Reference
E2SG3	FC7	NA	11/15/11	Fall Creek Municipal Well FC7	VC Cis-1,2-DCE	0.50 µg/L 0.20 (J) µg/L	0.50 µg/L 0.5 µg/L	280	Ref. 79, pp. 32, 207; 80, pp. 13-14, 58; 7, pp. 2, 32; 111, p. 2; 112 p. 5; 119, p. 199
E2R31	FC11	NA	10/29/09	Fall Creek Municipal Well FC11	VC Cis-1,2-DCE	0.38 J µg/L 0.27 J µg/L	0.5 µg/L 0.5 µg/L	351	Ref. 78, pp. 59, 215; 95, p. 2; 98, pp. 6, 11, 12, 28, 65; 7, pp. 2, 31; 119, pp. 199-205

The table below provides a summary of the contaminated ground water samples that were obtained via a direct push method. The referenced samples in the following table were collected from the sand and gravel interval of the combined aquifer (Ref. 7, pp. 5, 34, 35; 79, pp. 236-246, 261, 262; 23, pp. 88, 89). The following describes how ground water was obtained from a direct push method. A stainless steel screen was utilized on the direct push method to obtain ground water. The stainless steel screen was attached to the drill pipe and pushed to a position below the water table as identified in the soil boring log and at the same location of the soil boring. When the desired depth was reached, water was allowed to flow through the stainless steel screen from the surrounding soil media. A plastic tube connected to a peristaltic pump was inserted down the drill pipe to a depth at the midpoint of the screen in order to bring the ground water up to the surface. Pumping of the water continued until the water became clear. After the water became clear, the water was allowed to flow directly into three (3) 40 ml vials that contained hydrochloric acid as a preservative. The vials were then labeled and placed in a cooler with ice (Ref. 143, p. 1).

Contaminated Ground Water (Obtained by Direct Push) Sample Table

EPA CLP #	IDEM #	Sample Date	Location	Hazardous Substance	Sample Concentration	Sample Quantitation Limit	Contract Required Quantitation Limit	Depth Below Ground Surface	References
E2SG4	GW10/GW20	11/16/11	Dup. of E2SK0	1,1,1-TCA	3.3 µg/L	0.5 µg/L	0.5 µg/L	26 ½ to 29 feet	Ref. 79, pp. 18, 32, 219, 246; Ref. 80, pp. 15, 58; Ref. 111, p. 5; Ref. 112, p. 10; Ref. 119, p. 199
E2SH7	GW3	11/15/11	Southwest corner of the ACE Cash Express parking lot; approximately 10 feet west of Ace Express bldg.	PCE	3.0 µg/L	0.5 µg/L	0.5 µg/L	21.5 to 24 feet	Ref. 79, pp. 17, 32, 212, 238; Ref. 80, pp. 27-28, 63; Ref. 111, p. 3; Ref. 112, p. 10; Ref. 119, p. 199
E2SH9/E2SH9DL	GW2	11/15/11	Ace Cash Express parking lot; 75 feet north of alley; about 8 feet east of west property line.	PCE	23 µg/L	1.0 µg/L	0.5 µg/L	21.5 to 24 feet	Ref. 79, pp. 17, 32, 211, 236; Ref. 80, pp. 30, 32, 62-63; Ref. 111, p. 3; Ref. 112, p. 10; Ref. 119, p. 199
E2SJ1	GW1	11/15/11	Ace Cash Express parking lot; 30 feet south of 38th Street, 15 feet west of bldg.	PCE, TCE	5.8 µg/L 1.5 µg/L	0.5 µg/L 0.5 µg/L	0.5 µg/L 0.5 µg/L	21.5 feet	Ref. 79, pp. 32, 210, 234; Ref. 80, pp. 33-34, 65; Ref. 111, p. 4; Ref. 112, p. 10; Ref. 119, p. 199

EPA CLP #	IDEM #	Sample Date	Location	Hazardous Substance	Sample Concentration	Sample Quantitation Limit	Contract Required Quantitation Limit	Depth Below Ground Surface	References
EDSJ4	GW4	11/16/11	Mosque; west side lot	PCE	2.0 µg/L	0.5 µg/L	0.5 µg/L	21 to 24 feet	Ref. 79, pp. 17, 32, 213, 240; Ref. 80, pp. 37-38, 65; Ref. 111, p. 5; Ref. 112, p. 11; Ref. 119, p. 19
E2SJ6	GW5	11/16/11	Mosque; northwest corner	PCE	8.4 µg/L	0.5 µg/L	0.5 µg/L	21.5 to 24 feet	Ref. 79, pp. 17, 32, 214, 242; Ref. 80, pp. 39-40, 65; Ref. 111, p. 5; Ref. 112, p. 11; Ref. 119, p. 199
E2SJ8	GW8	11/16/11	Rear of Thompson Contracting; east side by RR tracks	1,1,1-TCA	7.1 µg/L	0.5 µg/L	0.5 µg/L	26.5 to 29 feet	Ref. 79, pp. 17, 32, 215, 244; Ref. 80, pp. 41, 66; 111, p. 5; 112, p. 11; Ref. 119, p. 199
E2SK0	GW9	11/16/11	Thompson Contracting; south end of out bldg.	1,1,1-TCA	3.3 µg/L	0.5 µg/L	0.5 µg/L	26 ½ to 29 feet	Ref. 79, pp. 32, 216, 246; Ref. 80, pp. 43, 66; Ref. 111, p. 6; Ref. 112, p. 11; Ref. 119, p. 199

The following table lists ground water samples that were obtained from monitoring wells that meet the observed release criteria for chlorinated compounds (Ref. 1, Table 2-3). All monitoring well water samples in the area were collected in the combined aquifer (Ref. 7, pp. 3, 5; 78, p. 19, 20; 79, p. 15). The ground water samples obtained from the monitoring wells listed below were collected in three (3) 40-milliliter vials preserved with hydrochloric acid (HCL) (Ref. 78, p. 19). Nitrile gloves were worn and discarded between the collections of each sample (Ref. 78, p. 19). Monitoring wells were purged three (3) well volumes before sampling. Ground water was obtained from the monitoring by using bailers (Ref. 78, p. 19). Ground water was poured from the top of the bailer into the vials being careful so that no air bubbles were present in the sample (Ref. 78, p. 19). The vials were then labeled and placed in a cooler with ice (Ref. 78, p. 19).

Contaminated Ground Water Obtained From Established Monitoring Wells Sample Table 1

EPA CLP #	IDEM #	Sample Date	Location	Hazardous Substance	Sample Concentration	Sample Quantitation Limit	Contract Required Quantitation Limit	Depth Below Ground Surface	References
E2QZ3/ E2QZ3DL	GW-4	10/19/09	Monitoring well #2i; in front of Tuchman Cleaners; northwest	Cis-1,2-DCE PCE	550 µg/L 20000 µg/L	25 µg/L 1000 µg/L	0.5 µg/L 0.5 µg/L	42 feet	Ref. 78, pp. 53, 197; 96, pp. 6, 9-10, 37, 160-165; 112, p. 8; 119, p. 199; 23, p. 121
E2QZ4DL	GW-5	10/19/09	Duplicate of E2QZ3	PCE	210000 µg/L	10000 µg/L	0.5 µg/L	42 feet	Ref. 78, pp. 53, 198; 96, pp. 6, 9-10, 37; 112, p. 8; 119, p. 199; 26, p.
E2R00	GW-6	10/19/09	Monitoring well PZ10d north of Tuchman Cleaners on the side parking lot	Cis-1,2-DCE TCE	3.8 µg/L 3 µg/L	0.5 µg/L 0.5 µg/L	0.5 µg/L 0.5 µg/L	30 feet	Ref. 78, pp. 53, 199; 96, pp. 17-18, 37, 100; 112, p. 8; 119, p. 199; 26, p. 107
E2R01/E2R01DL	GW-7	10/19/09	Monitoring well across the street of the west of Tuchman Cleaners next to the Keystone pet Hospital @ W13	Cis-1,2-DCE TCE PCE	1300 µg/L 240 µg/L 3700 µg/L	500 µg/L 50 µg/L 500 µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L	45 feet	Ref. 78, p. 200; 96, pp. 6, 9-12, 38, 172-177; 112, p. 8; 119, p. 199; 23, p. 176
E2R26/E2R26DL	GW-37	10/29/09	Tuchman Cleaners MW 8	Vinyl Chloride Cis-1,2-DCE Trans-1,2-DCE TCE	260J µg/L (26 µg/L) 600 µg/L 1.6 µg/L 1.5 µg/L	25 µg/L 25 µg/L 0.5 µg/L 0.5 µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L	23	Ref. 78, p. 221; 98, pp. 4, 7, 9-10, 28, 31, 50-55; 112, p. 2; 118, pp 8, 12; 119, pp. 199-205; 23, pp. 87, 135
E2R12/E2R12DL	GW15	10/21/09	Northwest corner of Thomas Catering	Cis-1,2-DCE TCE PCE	3.1 µg/L 7.3 µg/L 45 µg/L	0.5 µg/L 0.5 µg/L 2.5 µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L	19.25	Ref. 78, p. 208; 97, pp. 6, 8-9, 18, 40-45; 112, p. 7; 119, p. 199; 64, p. 42

EPA CLP #	IDEM #	Sample Date	Location	Hazardous Substance	Sample Concentration	Sample Quantitation Limit	Contract Required Quantitation Limit	Depth Below Ground Surface	References
E2R13/E2R13DL	GW-16	10/21/09	MW3; Thomas Catering parking lot	Cis-1,2-DCE TCE PCE	3.6 µg/L 30 µg/L 460 µg/L	0.5 µg/L 0.5 µg/L 25 µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L	19.95	Ref. 78, p. 209; 97, pp. 6, 8-9, 18, 46-51; 112, p. 7; 119, p. 199; 64, p. 42
E2R08	GW-14	10/20/09	Indianapolis Water Company Well	PCE	0.68 µg/L	0.5 µg/L	0.5 µg/L	66 feet	Ref. 78, p.207; 96, pp. 19-20, 40-41, 116-118; 95, p 2; 119, p. 199
E2R09/E2R09DL	GW-13	10/20/09	Indianapolis Water Co. Well	Cis-1,2-DCE Trans-1,2-DCE TCE PCE	100 µg/L 2.2 µg/L 12 µg/L 540 µg/L	25 µg/L 0.5 µg/L 0.5 µg/L 25 µg/L	0.5 µg/L 0.5 µg/L 0.5 µg/L 0.5 µg/L	36 feet	Ref. 78, p. 206; 96, pp. 7, 19-20, 40-41, 119-121; 112, p. 8; 119, p. 199

J = E2R26 vinyl chloride result has an unknown bias due to an exceedance of the upper limit of the criteria window and adjusted using the procedure described in EPA 540-F-94-028, *Using Data to Document an Observed Release and Observed Contamination*, November 1996 (Ref. 118, pp. 8, 12; 98, p. 4; 145). The adjusted concentration is in parenthesis.

The following table lists the ground water sample that was obtained from Fall Creek Municipal Well FC17 that was found to contain elevated levels of VOCs. This well has not been in production for the past several years (Ref.106, p.4). The municipal well water samples were collected from the sand and gravel interval of the combined aquifer (Ref. 7, pp. 2, 3, 34-36). Municipal well water samples obtained from FC17 were obtained from a spigot located on the municipal well pump. Well FC17 was pumped for 30 minutes, then purged by removing 3 well volumes of water. Samples were obtained by direct pour into three (3) 40-ml glass vials containing hydrochloric acid preservative. Samples were collected in a manner so that no air bubbles were present in the vial after securely closing the lid. Nitrile gloves were worn during the collection of all samples and the samples were placed directly into an ice-filled cooler (Ref. 78, pp. 19, 20, 214).

Fall Creek Municipal Well FC17 Table

EPA CLP #	IDEM #	Control #	Sample Date	Location	Hazardous Substance	Sample Concentration	Contract Required Quantitation Limit	Depth Below Ground Surface	References
E2R30	GW30	NA	10/29/09	Municipal Well FC17	TCE	0.98J (0.59) µg/L	0.5 µg/L	82 feet	Ref. 98, pp. 5-6, 11-12, 28, 62-64; 95, p. 2; 118, pp. 8, 12; 119, pp. 199-205; 7, p. 36

J = The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample (Ref. 98, p. 8). The bias associated with the numerical value is unknown and adjusted using the procedure described in EPA 540-F-94-028, *Using Qualified Data to Document an Observed Release and Observed Contamination*, November 1996 (Ref. 118, pp. 8, 12; 98, p. 5; 145). The adjusted concentration is in parenthesis.

The following table lists the ground water samples that were obtained from Fall Creek Municipal Well FC2 that was found to contain elevated levels of VOCs at level I concentrations. The municipal well water samples were collected in the karst portion of the combined aquifer (Ref. 7, pp. 2, 3). Municipal well water samples obtained during the Keystone Corridor sampling in November 2011 were obtained from spigots located on the municipal well pump. Wells were purged for a short period (10-15 minutes) as all active wells that were sampled had been running continuously (from 3 hours to several days) prior to our taking the sample. Samples were obtained by direct pour into three (3) 40-ml glass vials containing hydrochloric acid preservative. Samples were collected in a manner so that no air bubbles were present in the vial after securely closing the lid. Nitrile gloves were worn during the collection of all samples and the samples were placed directly into an ice-filled cooler (Ref. 142, p. 1).

Contaminated Ground Water Sample Table 2 (Municipal Well FC2)

EPA CLP #	IDEM #	Control #	Sample Date	Location	Hazardous Substance	Sample Concentration	Sample Quantitation Limit	Contract Required Quantitation Limit	Depth Below Ground Surface	References
E2SG1DL	FC2	NA	11/15/11	Fall Creek Municipal Well FC2	Vinyl Chloride Cis-1,2-DCE	12 µg /L 49 µg /L	0.5 µg /L 2.5 µg /L	0.5 µg/L 0.5 µg/L	326	Ref. 79, p. 205; 80 pp. 7, 56; 111, p. 2; 112, p. 10; 119, p. 199; 7, p. 2, 32
E2SG2/ E2SG2DL	FC2	NA	11/15/11	Duplicate of E2SG1	Vinyl Chloride Cis-1,2-DCE	7.9 µg /L 41 µg /L	0.5 µg /L 2.5 µg /L	0.5 µg/L 0.5 µg/L	326	Ref. 79, 206; 80 pp. 9, 11, 58; 111, p. 2; 112, p. 10; 119, p. 199; 7, p. 2, 32
E2R05	GW-10	NA	10/20/09	Fall Creek Municipal Well FC2	Vinyl Chloride Cis-1,2-DCE	3.9 µg/L 16 µg/L		0.5 µg/L 0.5 µg/L	326	Ref. 78, p. 203; 96, pp. 17, 39, 106; 112, p. 8; 119, p. 199; 7, p. 2, 32

Level I Samples (Fall Creek Municipal Well FC2) Table

Sample ID	Hazardous Substance	Hazardous Substance Concentration (µg/L)	Benchmark Concentration (µg/L)	Benchmark	Reference for Benchmark
E2SG1DL	Vinyl Chloride	12 ug/L	0.017 ug/L	Cancer Risk	Ref. 2, p. 12; 80 pp. 7, 56
E2SG2	Vinyl Chloride	7.9 ug/L	0.017 ug/L	Cancer Risk	Ref. 2, p. 12; 80 pp. 9, 58
E2R05	Vinyl Chloride	3.9 µg/L	0.017 ug/L	Cancer Risk	Ref. 2, p. 12; 96, pp. 17, 39, 106

Since an observed release was determined by chemical analysis, a value of 550 is assigned.

Ground Water Observed Release Factor Value: 550

Attribution

The Keystone Corridor Ground Water Contamination is a documented release of PCE and degradation products TCE, cis-1,2-DCE, and VC to the ground water that has contaminated one (1) of the active Fall Creek municipal wells (FC2) (Ref. 19, pp. 1, 2; 78, p. 203; 96, pp. 17-18, 39, 106-108; 79, pp. 205, 206; 80, pp. 5, 7, 9, 11, 56-58; Figure 1-3 of this HRS documentation record; 122, p. 1; 130, p. 1).

The compounds found in the wells are manufactured chemicals, not thought to occur naturally, and non-detected concentrations in some background wells show that they are not ubiquitous throughout the region (Ref. 120, p. 1; 121, p. 1; Section 3.1.1, Background Ground Water Monitoring Well Sample Tables and Figure 1-3of this HRS documentation record). Chlorinated solvents (e.g., TCE, PCE, and carbon tetrachloride) are man-made compounds commonly used in commercial/industrial operations such as dry cleaning and metal degreasing, while other contaminants such as cis-1,2-DCE are common breakdown products of PCE and TCE (Ref. 19, pp. 1-5; 120, p. 1; 121, p. 1). The Keystone Corridor Ground Water Contamination is located in a heavily developed area consisting of industrial, commercial, and residential land, where a variety of past industrial and commercial activities could have resulted in the ground water contamination and where some contaminated properties have been identified (Ref. 129, pp. 1-3 and Figures 1-3 and 1-4 of this HRS documentation record). IDEM has made significant efforts to identify the specific source(s) of ground water contamination through CERCLA SI and ESI investigations (Ref. Section 2.2.1, Level of Effort, of this HRS documentation record). Soils containing PCE and TCE contamination are present in some possible sources as discussed in the Description of Other Possible Sources Section of the HRS documentation record. A plume of chlorinated VOC contamination is illustrated in Figure 1-3 of the HRS documentation record. Due to the complex geology and high number of known and potential sources of chlorinated volatile organic compounds in the project area, it is not feasible to directly link any source to the contaminants encountered in the plume (Ref. 7, pp. 3, 5; Figure 1-4 of this HRS documentation record; Description of Other Possible Sources Section of this HRS documentation record).

The following table lists the hazardous substances associated with the Keystone Corridor Ground Water Contamination.

Hazardous Substance Table

Hazardous Substances	Quantity	References
Tetrachloroethene (PCE)	Unknown	Ref. 19, pp. 1-5; 42, pp. 1-69; 43, pp. 1-21; 121, p. 1; Section 3.1.1 of this HRS documentation record
Trichloroethene (TCE)	Unknown (degradation product of PCE)	
Cis-1,2-Dichloroethene (Cis-1,2-DCE)	Unknown (degradation product of PCE)	
Vinyl Chloride (VC)	Unknown (degradation product of PCE)	

3.2 WASTE CHARACTERISTICS

3.2.1 TOXICITY/MOBILITY

The following toxicity, mobility and combined toxicity/mobility factor values have been assigned to those substances present in the observed release, which have a containment value greater than 0.

Hazardous Substance	Source No. (and/or Observed Release)	Toxicity Factor Value	Mobility Factor Value	Does Haz. Substance Meet Observed Release by Chemical Analysis? (Y/N)	Toxicity/ Mobility (Ref. 1, Table 3-9)	References
TCE	Observed Release	1,000	1	Y	1,000	Ref. 1, Section 3.2.1.3, p. 76; 2, p. 10
Cis-1,2-DCE	Observed Release	1,000	1	Y	1,000	Ref. 1, Section 3.2.1.3, p. 76; 2, p. 6
PCE	Observed Released	100	1	Y	100	Ref. 1, Section 3.2.1.3, p. 76; 2, p. 8
Vinyl Chloride	Observed Release	10,000	1	Y	10,000	Ref. 1, Section 3.2.1.3, p. 76; 2, p. 12

All hazardous substances that meet the criteria for an observed release by chemical analysis to one or more aquifers underlying the source(s) at the site, regardless of the aquifer being evaluated, are assigned a mobility factor value of 1 (Ref. 1, Section 3.2.1.2, p. 75).

Contaminant characteristic values for hazardous substances found in an observed release to the combined aquifer were derived from the Superfund Chemical Data Matrix (Ref. 2, pp. 5-12). The hazardous substance with the highest toxicity/mobility factor value available to the ground water migration pathway is vinyl chloride (10,000).

Toxicity/Mobility Factor Value: 10,000
(Ref. 1, Section 3.2.1.3, p. 76)

3.2.2 HAZARDOUS WASTE QUANTITY

Source No.	Source Type	Source Hazardous Waste Quantity
1	Other	Unknown, but >0

The Keystone Corridor Ground Water Contamination site has been scored as a site consisting of a ground water plume from commingled contamination with no identified source. According to Section 2.4.2.2 in the HRS (Ref. 1, p. 66), if any target for the migration pathway is subject to Level I (or Level II) concentrations and the hazardous constituent quantity is not adequately determined, assign either the value from Table 2-6 (Ref. 1, p. 65) or a value of 100, whichever is greater, as the hazardous waste quantity factor value for that pathway. Because Level I concentrations were present in a drinking water well (Ref. Section 3.3.2.2 of this HRS documentation record), a hazardous waste quantity factor value of 100 is assigned for the ground water pathway.

Hazardous Waste Quantity Factor Value: 100
(Ref. 1, Section 2.4.2.2, p. 66)

3.2.3 WASTE CHARACTERISTICS FACTOR CATEGORY VALUE

As specified in the HRS (Ref. 1, Section 3.2.3, p. 76), the Hazardous Waste Quantity Factor Value of 100 was multiplied by the highest Toxicity/Mobility Value of 10,000, resulting in a product of 1,000,000 (1.0E+06). Based on this product, a Waste Characteristics Factor Category Value of 32 was assigned from Table 2-7 of the HRS (Ref. 1, Section 2.4.3.1, p. 66).

Utilizing vinyl chloride which has the highest Toxicity/Mobility Factor Value of the substances listed in Section 3.2.1 of this HRS documentation record:

Toxicity/Mobility Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 100

Toxicity/Mobility Factor Value (10,000) X Hazardous Waste Quantity Factor Value (100) = 1,000,000 = 1×10^6

Waste Characteristics Factor Category Value: 32
(Ref. 1, Table 2-7, p. 66)

3.3 TARGETS

Ground water usage is high in the vicinity of the ground water plume (Ref. 106, p. 4; Figure 1-2 of this HRS documentation record). The City of Indianapolis' Fall Creek municipal wells, as well as private wells in the area, utilize ground water from the combined aquifer (Ref. 116, pp. 22-23; 135, pp. 1-26). The primary targets are Indianapolis's Fall Creek municipal wells FC2, FC5, FC7, FC8, FC11, FC17, FC18, FC19, FC20 and FC21. Currently FC2 is subject to Level I contamination. The remaining municipal wells are subject to potential contamination. There are 123,264 people known to be utilizing the water from these wells (Ref. 106, pp.1-3; Section 3.3.2 of this HRS documentation record).

3.3.1 NEAREST WELL

Sample IDs: E2SG1 (Municipal well FC2)
Level of Contamination (I, II, or potential): Level I
If potential contamination, distance from source in miles: Not Applicable

Samples E2SG1 and E2SG2 (duplicate of E2SG1) were obtained from Municipal Well FC2 on November 15, 2011.The water in Municipal Well FC2 was found to contain vinyl chloride above the background level and above the cancer risk screening concentration (Ref. 2, pp. 7, 12).

As specified in the HRS (Ref. 1, Table 3-11, p. 77), if one or more drinking water wells are subject to Level I concentrations a Nearest Well Factor Value of 50 is assigned. Level I concentrations have been documented in the ground water of FC2 (Ref. Section 3.3.2.2 of this HRS documentation record).

Nearest Well Factor Value: 50
(Ref. 1, Table 3-11, p. 77)

3.3.2 POPULATION

3.3.2.2 Level I Concentrations

One (1) municipal well (FC2) contains Level I concentrations of vinyl chloride. The well draws water from the combined aquifer (Ref 7, p. 2). The number of people served by this municipal well (910 people) is calculated below.

The following facts were acquired to calculate the number of people served by the Fall Creek Well Field:

The annual pumpage of drinking water in gallons was obtained from Reference 100.

The Fall Creek Treatment Plant is a blended system (Ref. 117, p. 1). In 2011, the Fall Creek system pumped 5,784,900,000 gallons (5784.9 million gallons) from the surface water intake and 1,559,800,000 gallons (1,559.8 million gallons) from the municipal wells for a total of 7,344,700,600 gallons with standby water available from other treatment plants within the Citizens Energy Group service area (Ref. 102, pp. 21, 23; 117, pp. 1-3; 144).The percentage of population served by each source is calculated by dividing the annual pumpage of each source (as shown below) by the total annual pumpage (7,344,700,600) in gallons for the entire Fall Creek system. Note that the surface water intake supplies 78.75 percent of total gallons pumped in 2011. Two examples showing this calculation are shown in Reference 79, page 259 for FC2 and FC11. The percentage of drinking water supplied by each source is shown in the table below using the calculation mentioned above.

The number of people served by all of Citizens Water Treatment facilities is 873,590 (Ref. 106, pp. 1, 3). The Fall Creek Treatment Plant supplies 14.11% of the people in 2011(Ref. 106, p. 3). According to Citizens Energy Group, 99.61% of the connections are residential usage (Ref. 106, p. 3). Therefore the number of people served by the Fall Creek Municipal wells is calculated by the following equation: 873,590 x 0.1411 equals 123,264 (plus or minus 10%) people (Ref. 106, pp.1, 3).

Since FC17 has been taken out of production, there are only nine (9) ground water wells that supply water from the Fall Creek Treatment Plant because municipal well FC17 has been restricted/discontinued (Ref. 106, p. 4; 139, p. 1).

As discussed in HRS Section 3.3.2, Population, if no single well or intake contributes more than 40 percent of the system's total water supply, the population served by a blended system is to be apportioned equally among the wells or intakes. Since the surface water intake, which is part of the Fall Creek System supplies over 40% (78.75%), a percentage of people was calculated for each source.

The number of people supplied by each source was calculated by multiplying the population served by the Fall Creek Treatment Plant (123,264 people) by the percentage calculated for each source as shown above. By using this calculation, the following number of people was attributed to each source.

People Served Table

Well ID	Annual pumpage of drinking water in thousands of gallons (Ref. 106, p. 4)	Percentage of Population Served per Each Well	Number of People Served Per Each Well
Intake	5,784,900	78.746194	97,085
FC2	54,200	0.737779	910
FC5	91,100	1.240087	1,529
FC7	366,500	4.988933	6,151
FC8	52,300	0.711927	878
FC11	355,500	4.839197	5966
FC17	0	0	0
FC18	1,900	0.025864	32

Well ID	Annual pumpage of drinking water in thousands of gallons (Ref. 106, p. 4)	Percentage of Population Served per Each Well	Number of People Served Per Each Well
FC19	48,700	0.662922	817
FC20	269,300	3.665811	4,520
FC21	320,400	4.361403	5,377
Total	7,344,800 gallons	100	123,264

Note: The number of persons served by each source was rounded to the nearest whole number.

FC2 Level I Table

Level I Samples	Aquifer	Population	References
E2SG1DL, E2SG2, E2R05	Combined	910	See calculation in 3.3.2.2 above

The sum of the population served by Municipal Well FC2 (910) was multiplied by 10 for a product of 9,100(Ref. 1, Section 3.3.2.2, p. 77).

Level I Concentrations Factor Value: 9,100

3.3.2.4 Potential Contamination

Potential contamination was calculated for this HRS documentation record.

The following municipal wells (FC5, FC7, FC8, FC11, FC18, FC19, FC20 and FC21) are considered to be subject to potential contamination (Ref. Figure 1-2 of this HRS documentation record; 122, p. 1; 130, p. 1). These wells draw water from the combined aquifer; the same as FC2 (Ref. 7, p. 2, 31, 32, 34, 35).

The center of the Keystone Corridor Ground Water Contamination is shown on Figure 1-2 of this HRS documentation record. From this point, the distance in feet to each municipal well was calculated (Figure 1-2; Ref. 122, p. 1; 130, p. 1; 141, p. 2). The measurements listed below depict those distances. The distances to each municipal well along with the corresponding number of people served was entered into Table 3-12 of 40 CFR, Part 300 (Ref. 1, p. 78). The following values for each municipal well were derived from Table 3-12:

Potential Contamination Table

Distance Category (miles)	Municipal wells	Distance From Center of Plume to Municipal Well (feet) (Figure 1-3 of this HRS documentation record)	Number of People Served Per Each Well Outwash aquifer	Number of People Served Per Each Well Karst aquifer	Distance-Weighted Population Value: Karst aquifer	Distance-Weighted Population Value: Outwash aquifer	Ref.
0 to ¼	FC5/FC8 (Karst)	519/611	NA	1,529 + 878= 2,407	1,633	NA	7, pp. 2, 3, 31, 32, 35; 141, p. 2

Distance Category (miles)	Municipal wells	Distance From Center of Plume to Municipal Well (feet) (Figure 1-3 of this HRS documentation record)	Number of People Served Per Each Well Outwash aquifer	Number of People Served Per Each Well Karst aquifer	Distance-Weighted Population Value: Karst aquifer	Distance-Weighted Population Value: Outwash aquifer	Ref.
¼ to ½	FC7 (Karst)	1,471	NA	6,151	3,233	NA	7, pp. 2, 32, 34; 141, p. 2
½ to 1	FC11(Karst)	3,329	NA	5,966	2,607	NA	7, pp. 2, 3, 31; 141, p. 2
½ to 1	FC18, FC19, FC20 (Outwash)	3,802/4,564/5,184	32 + 817 + 4,520 = 5,369	NA	NA	1669	7, pp. 2, 32, 35, 37, 38; 141, p. 2
1 to 2	FC21 (Outwash)	5,734	5,377	NA	NA	939	7, pp. 2, 31, 35, 39; 141, p. 2
2 to 3	NA	NA	NA		NA		
3 to 4	NA	NA	NA		NA		

These values are added (1,633 +3,233 + 2,607 + 1,669 + 939 =10,081). The total of 10,081 is multiplied by 0.1 to obtain the distance-weighted population value (Ref. 1, Section 3.3.2.4, p. 78).

The distance-weighted population value was calculated as follows:

10,081 X 0.1 = 1,008.1

Potential Contamination Factor Value: 1,008

3.3.3 RESOURCES

Resource use of the combined aquifer within the target distance limit does not include any of the Resource Factors. Therefore, a Resource Factor value of 0 is assigned (Ref. 1, Section 3.3.3, p. 78).

Resources Factor Value: 0

3.3.4 WELLHEAD PROTECTION AREA

The entire ground water plume lies within the Wellhead Protection Area of the City of Indianapolis's Fall Creek Well Field (Ref. 116, p. 4; 122, p. 1; 130, p. 1; Figure 1-2 of this HRS documentation record). The wellhead protection area designation is in accordance with Section 1428 of the Safe Drinking Water Act and is consistent with the requirements of 327 IAC 8-4.1(the "Indiana Wellhead Protection Rule" (Ref. 116, p. 4; Ref. 29, p. 1, 2). Therefore, the Wellhead Protection Area Factor Value of 20 is assigned (Ref. 1, Section 3.3.4, p. 78; 29, pp. 1, 2; 122, p. 1; 130, p. 1; Figure 1-3 of this HRS documentation record).

Wellhead Protection Area Value: 20