COVER SHEET

SITE NAME: Iowa-Nebraska Light & Power Co

EPA ID No. NED986373678

Contact Persons

EPA Contact: Preston Law
U.S. Environmental Protection Agency (EPA), Region 7
11201 Renner Blvd.
Lenexa, Kansas 66219
(913) 551-7097

Documentation Record: David Zimmermann, Tetra Tech START

Pathways, Components, or Threats Not Scored

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

HRS DOCUMENTATION RECORD

Name of Site:	Iowa-Nebraska Light & Power Co
EPA Region:	7
Date Prepared:	September, 2015
Street Address of Site*:	102-104 South 7th Street (Ref. 33)
City, County, State, ZIP:	Norfolk, Madison County, Nebraska, 68701 (Ref. 33)
General Location in the State:	The site is located in the northeastern portion of Nebraska, about 115 miles northwest of the Omaha metropolitan area (Ref. 5, p. 5) (Figure 1).
Topographic Map:	The location of the INL&P Site is shown on the Norfolk, Nebraska, Quadrangle, U.S. Geological Survey, 7.5-Minute Series Topographic Map (Ref. 3).
Latitude:	42° 01' 56.28" N. (Ref. 4)
Longitude:	97° 25' 01.30" W. (Ref. 4)

The latitude and longitude listed above is the approximate geographic location as measured from within the area of contaminated soil (Source 1), specifically within the gas holder on the facility property (Ref. 4; Figure 2 of this HRS documentation record).

Scores

Ground Water Migration Pathway	81.60
Surface Water Migration Pathway	Not scored
Soil Exposure Pathway	Not scored
Air Migration Pathway	Not scored
HRS SITE SCORE	**40.80**

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

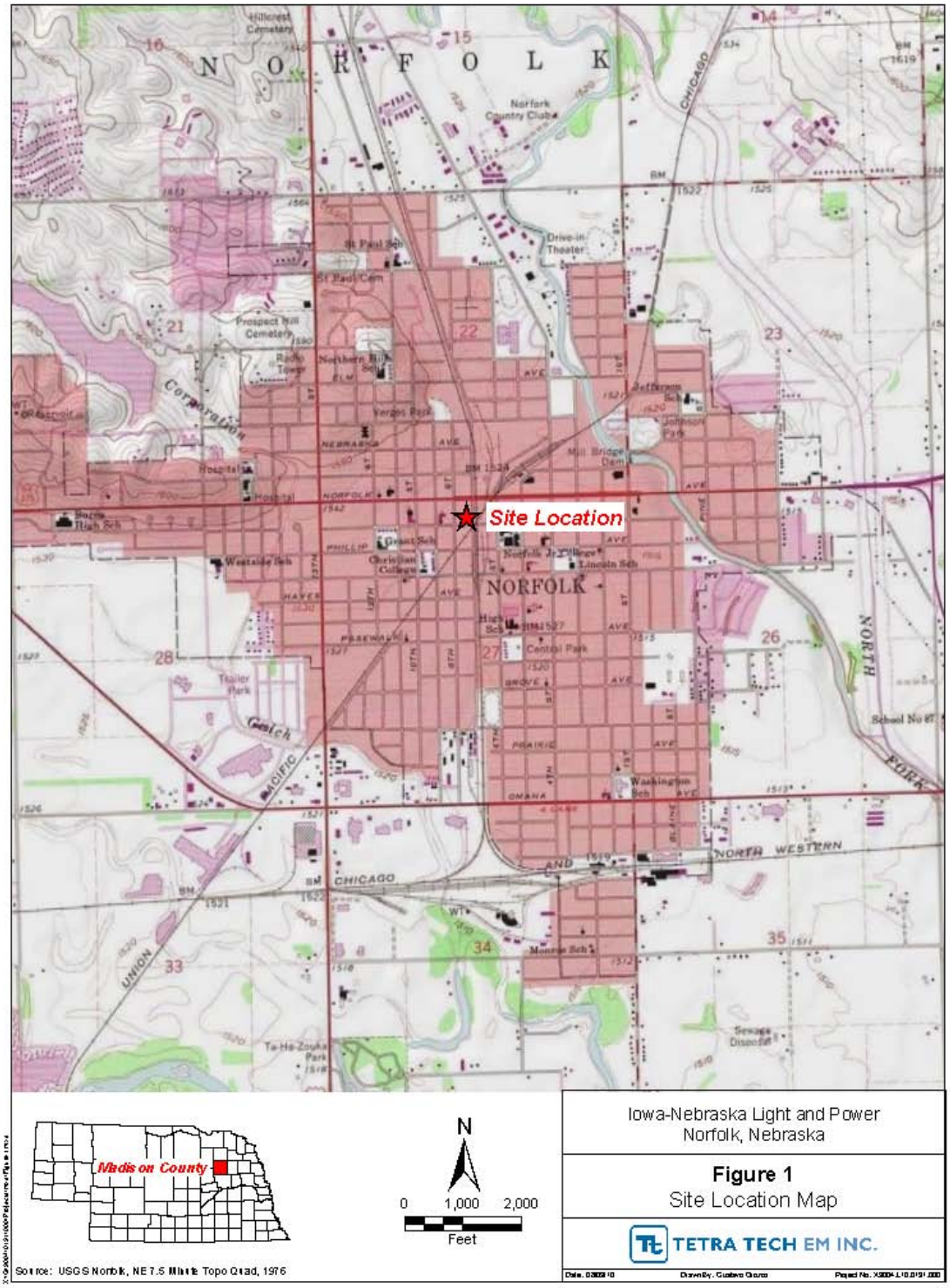
WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw})	81.60	6,658.56
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	Not Scored	
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	Not Scored	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	Not Scored	
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	Not Scored	
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	Not Scored	
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		6,658.56
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root	**40.80**	

HRS TABLE 3-1 – GROUND WATER MIGRATION PATHWAY SCORESHEET
IOWA-NEBRASKA LIGHT & POWER SITE

Factor Categories and Factors	Maximum Value	Value Assigned
Likelihood of Release to an Aquifer:		
1. Observed Release	550	550
2. Potential to Release:		
2a. Containment	10	NE
2b. Net Precipitation	10	NE
2c. Depth to Aquifer	5	NE
2d. Travel Time	35	NE
2e. Potential to Release [lines 2a(2b + 2c + 2d)]	500	NE
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	10
6. Waste Characteristics	100	18
Targets:		
7. Nearest Well	50	18
8. Population:		
8a. Level I Concentrations	b	Not Scored
8b. Level II Concentrations	b	Not Scored
8c. Potential Contamination	b	637
8d. Population (lines 8a + 8b + 8c)	b	637
9. Resources	5	5
10. Wellhead Protection Area	20	20
11. Targets (lines 7 + 8d + 9 + 10)	b	680
Ground Water Migration Score for an Aquifer:		
12. Aquifer Score [(lines 3 x 6 x 11)/82,500][c]	100	81.60
Ground Water Migration Pathway Score:		
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated)	100	81.60

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer
NE Not Evaluated


NORFOLK
Site Location
Madison County
N
0
1,000
2,000
Feet
Source: USGS Norfolk, NE 7.5 Minute Topo Quad, 1976
Iowa-Nebraska Light and Power
Norfolk, Nebraska
Figure 1
Site Location Map
TETRA TECH EM INC.

4

REFERENCES

Reference Number	Description of the Reference
1.	U.S. Environmental Protection Agency (EPA). Hazard Ranking System (HRS): Final Rule. Title 40 of the *Code of Federal Regulations* (CFR), Part 300; *Federal Register*, Volume 55, No. 241. Excerpt. On-Line Address: http://www.epa.gov/superfund/sites/npl/hrsres/rule/hrsrule.pdf. December 14, 1990. One page.
2.	EPA. Superfund Chemical Data Matrix (SCDM). Excerpt. (Note: A complete copy of SCDM is available at On-Line Address: http://epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm). June 2014. 25 pages.
3.	U.S. Geological Survey (USGS). Norfolk (1976), Hoskins (1976), Madison (1976), Enola (1976). One sheet modified by Tetra Tech to show distance rings and municipal well locations.
4.	Tetra Tech Inc. (Tetra Tech). Project Note Regarding Latitude and Longitude for the Iowa-Nebraska Light and Power (INL&P). Prepared by David Zimmermann, Program Manager. July 14, 2015. One page.
5.	Tetra Tech. Expanded Site Inspection Report for the Iowa-Nebraska Light & Power Company Site. Task Order Number 013. March 30, 2001. 237 pages.
6.	Ecology and Environment, Inc. (E&E). "Preliminary Assessment of Former Coal Gasification Site." EPA Region 7 Field Investigation Team, TDD F-07-9007-013, Overland Park, Kansas. December 11, 1990. 14 pages.
7.	HDR Engineering, Inc. "Site Investigation Report Former CENTEL, Inc., Manufactured Gas Plant Site, Norfolk, Nebraska." October 1992. 175 pages.
8.	CDM Federal Programs Corporation. "Site Status Determination and Review of Site Investigation Results as Conducted by HDR Engineering for Minnegasco Iowa/Nebraska Light and Power Company Norfolk, Nebraska." Performed under EPA Contract 68-W9-0021, Work Assignment Number 013-79ZZ. April 12, 1993. 26 pages.
9.	Brown's Directory of American Gas Companies, Selected Records for the Subject Site from 1907 through 1957. 36 pages.
10.	State of Nebraska. "Well Logs for Municipal and Irrigation Wells in the Norfolk, Nebraska Area." Well Registration Numbers, G-29258, G-29259, G-49057, G-49058, G-49312, G-49313, G-59331, G-70112, G-70113, G-70114, G-70115, G-70116, G-7308, and G-72272. Multiple dates. 95 pages.
11.	U. S. Department of Agriculture, Soil Conservation Service. 1984. "Soil Survey of Madison County, Nebraska." 1984. Excerpt. 11 pages.
12.	U.S. Census Bureau. "Norfolk (city) QuickFacts from the US Census Bureau," Accessed on March 25, 2015. On-Line Address: http://quickfacts.census.gov/qfd/states/31/3134615.html. Two pages.

Reference Number	Description of the Reference
13.	E&E. "Quality Assurance Project Plan for the Expanded Site Inspection Phase I at the Iowa-Nebraska Light and Power Company Site, Norfolk, Nebraska." TDD S07-9903-026, Overland Park, Kansas. February 14, 2000. 82 pages.
14.	Reference Number Reserved.
15.	E&E. Memorandum with attachments: "Trip Report for Expanded Site Inspection/Remedial Investigation (ESI/RI) Field Work at the Iowa-Nebraska Light and Power Site, Norfolk, Nebraska." TDD S07-9903-026. April 26, 2000. 10 pages.
16.	Nebraska Health and Human Services (NHHS) Drinking Water Branch Water System details for the City of Norfolk Water System, Water System Number NE3111910. Accessed on 3/26/2015. Three pages.
17.	NHHS Safe Drinking Information System. Public Water System Facilities and Public Water System Facilities Detail for the City of Norfolk Water System, Public Water System ID NE3111910. Accessed on September 27, 2004. 16 pages.
18.	Brogden, Robert E., F. Butler Shaffer, and Richard A. Engberg. "Water Resources of Pierce County, Nebraska." Nebraska Water Survey Paper Number 41. February 1976. Six pages.
19.	Edison Electric Institute. "Handbook on Manufactured Gas Plant Sites." Prepared for Utility Solid Waste Activities Group, Superfund Committee. Cover page, and portions of Chapter 3. September 1984. 32 pages.
20.	E&E. Memorandum with attachments: "Trip Report for Site Reconnaissance: Iowa-Nebraska Light and Power Co. Site, Norfolk, Nebraska." TDD S07-9903-026. December 30, 1999. Seven pages.
21.	State of Nebraska Well Registration System. Database printout of registered wells in Madison County, Nebraska, for Township 23 North, Range 1 West; and Township 24 North Range 1 West. Dated July 18, 1990. Five pages.
22.	Reference Number Reserved.
23.	Reference Number Reserved.
24.	Education Support Services, Nebraska Department of Education. "Statistics and Facts about Nebraska Schools, 2013-2014." July 2015. 10 pages excerpted. Full report can be found at the found at the following Online Address: http://drs.education.ne.gov/quickfacts/Pages/DistrictandSchoolInformation.aspx?RootFolder=%2Fquickfacts%2FDistrict%20and%20School%20Information%2FStatistics%20and%20Facts%20about%20Nebraska%20Schools&FolderCTID=0x012000308E78E48EF70A4A969441D8F8732146&View={687391D6-980C-4AEA-BA91-FEF54153E36D}
25.	NHHS Safe Drinking Water Branch. Water System Facility Detail Water System Facility

Reference Number	Description of the Reference
	Detail for the City of Norfolk Water System, Water System ID Number NE3111910. Accessed on July 29, 2015. 66 pages.
26.	2013 Nebraska Higher Education Progress Report. Appendix 1. March 14. . On-Line Address for full report: http://www.ccpe.state.ne.us/publicdoc/ccpe/reports/progressReport/2012/default.asp. 9 pages (excerpted and numbered).
27.	City of Norfolk Nebraska Water Division Homepage. Water System Overview. Accessed on August 17, 2010. On-Line Address: http://www.ci.norfolk.ne.us/water/. One page.
28.	Nebraska Department of Natural Resources, Registered Ground Water Wells Data Retrieval. Search for all wells in Township 24 North, Range 1 West. Processed November 28, 2001. 65 pages.
29.	State of Nebraska Source Water Assessment Program. Undated. The program document can be found at the following On-Line Address: http://deq.ne.gov/NDEQProg.nsf/OnWeb/SWAP. 39 pages.
30.	Terracon (Terracon). "Preliminary Subsurface Assessment Report, Unknown - Norfolk City Wells. Prepared for the Nebraska Department of Environmental Quality. UG No. 031398-DB-1300. May 13, 1998." Selected Figures. Seven pages.
31.	Nebraska Department of Environmental Quality (NDEQ) - Ground Water Unit, Wellhead Protection Program. Letter from Bryant Reynolds, Compliance Specialist NDEQ to David Zimmermann, Tetra Tech EM Inc., regarding wellhead protection information with attached wellhead protection maps for community systems in and around Norfolk, Madison County, Nebraska. July 28, 2004. Nine pages.
32.	NHHS Safe Drinking Water Information System. Water System Details for the Norfolk Regional Center, Public Water System Number NE3111901; Madison County SID #5, Water System Number NE3111912; Madison County SID #3-Sunny Meadow, Water System Number NE3111909; Covidien (former Kendal Company), Water System Number NE3150471; and Sleepy Hollow Acres Water System Number NE3111918. Accessed on July 30, 2015. Nine pages.
33.	EPA. CERCLIS. Accessed on August 17, 2010. On-Line Address: http://oaspub.epa.gov/enviro/cerclis_web.report?pgm_sys_id=NED986373678. Two pages.
34.	Black and Veatch. "Engineering Evaluation/Cost Evaluation (EECA) Site Characterization Report. Iowa-Nebraska Light and Power Site (Norfolk Former Manufactured Gas Plant Site). Prepared for Centel Corporation." March 2010. 650 pages.
35.	Northeast Community College, Norfolk Campus. Accessed on August 17, 2010. On-Line Address: http://www.northeast.edu/Norfolk/. One page.

Reference Number	Description of the Reference
36.	Tetra Tech Inc. Project Note Regarding Population Verification for Schools and Public Water System in Norfolk, Nebraska. Prepared by David Zimmermann, Project Manager. August 21, 2015. One page.
37.	Black and Veatch. "EE/CA Investigation Field Sampling Plan. Iowa-Nebraska Light and Power. Prepared for Centel Corporation." June 2007. 56 pages.
38.	Black and Veatch. "Quality Assurance Project Plan. Prepared for Centel Corporation." June 2007. 38 pages.
39.	EPA. "Administrative Settlement and Agreement and Order on Consent for Engineering Evaluation/Cost Analysis. In the Matter of Iowa-Nebraska Light & Power Site, Norfolk, Madison County, Nebraska, Aquila, Inc., and Centel Corporation, Respondents." April 5, 2007. 56 pages.
40.	EPA. "Memorandum Regarding Iowa-Nebraska Light and Power Manufactured Gas Plant Site, Norfolk, Madison County, Nebraska (SSID NO. A778), Administrative Settlement Agreement and Order on Consent for Engineering Evaluation and Cost Analysis." From Barbara L. Peterson, Assistant Regional Counsel. To Cecilia Tapia, Director, Superfund Division. April 3, 2007. Two pages.
41.	NHHS Drinking Water Branch Water System Facilities Detail for the City of Norfolk Water System, Water System Number NE3111910. Accessed on August 17, 2010. Two pages.
42.	Agency for Toxic Substances and Disease Registry (ATSDR). Polycyclic Aromatic Hydrocarbons (PAHs): Public Health Statement. August 1995. Accessed on July 14, 2010. On-Line Address: http://www.atsdr.cdc.gov/PHS/PHS.asp?id=120&tid=25. Seven pages.
43.	Tetra Tech. Record of Telephone Conversation Regarding the City of Norfolk Water Supply System. To Alicia Shultz, HRS Specialist. From Dennis Watts, Water Supervisor. July 28, 2010. Six pages.
44.	EPA. "Using Qualified Data to Document an Observed Release and Observed Contamination. EPA 540-F-94-028, OSWER 9285.7-14FS, PB94-963311." November 1996. 18 pages.
45.	EPA. HRS Analytical Results Supplement. ASR Number: 539. August 25, 2010. 208 pages.
46.	Black and Veatch. "Soil Removal Summary Report. Norfolk, Nebraska, Former Manufactured Gas Plant Site. Prepared for Centel Corporation." May 2015. 873 pages.
47.	Tetra Tech. Project Note Regarding Population Verification for Large Employers Served by City of Norfolk Public Water System, Norfolk, Nebraska. Prepared by Jenna Mead, Tetra Tech, Inc. August 27, 2015. One page.

Reference Number	Description of the Reference
48.	Nebraska Public Power District. Community "Fast Facts" Profiles, Norfolk, Nebraska. 2012. Accessed on August 27, 2015. On-Line Address: http://econdevtools.nppd.com/aedc/fastfacts.asp?city=Norfolk. 11 pages.

SITE DESCRIPTION

The Iowa-Nebraska Light & Power Co (INL&P) site consists of a contaminated soil source resulting from former gas manufacturing operations and an associated observed release of hazardous substances to shallow ground water as documented in monitoring wells (see sections 2.2 and 3.1.1 of the HRS documentation record). The primary targets scored for the site are municipal and community wells subject to potential contamination and located within 4 miles of the source (see section 3.3.2.4).

INL&P is located in downtown Norfolk, Madison County, Nebraska. The INL&P facility is located on a city block west of 7th Street between Norfolk and Madison Avenues and includes the alley running east-west between 7th and 8th Streets. INL&P is roughly divided into two sections: the eastern portion north of the alley, as well as the northeastern portion of the area south of the alley (BH Parcel), is currently owned by Black Hills (BH); and the remaining southern portion of the property (NPPD Parcel), owned by Nebraska Public Power District (NPPD) (Refs. 34, pp. 7, 71, 72) (see Figure 1). The Norfolk Light and Fuel Company Manufactured Gas Plant was constructed between 1903 and 1909. A water gas process was used to manufacture gas. The Central West Service Company purchased INL&P in 1927. In 1931, INL&P purchased the property and switched to a carbureted water gas process. In February 1945, the property was purchased by the Central Electric and Gas Company, but ceased operations before the end of the decade (Refs. 6, p. 3; 34, p. 8). In 1941, NPPD acquired the property from Central Electric and Gas Company, excluding those portions of the property where manufactured gas plant (MGP) operations were conducted, which includes the BH Parcel (Ref. 34, pp. 8, 9). Minnegasco, Inc., purchased the BH parcel in 1976 and sold the northern portion to the People's Natural Gas Company (subsequently known as UtiliCorp United and Aquila) (Refs. 6, p. 3; 34, pp. 8, 9). Black Hills purchased certain assets of Aquila, including the BH Parcel, in 2008 (Ref. 34, p. 9).

Some of the waste resulting from the production of the manufactured gas, including coal tar, was sold. Some wastes were disposed of at the facility (Ref. 39, p. 7). Coal tar is primarily composed of polycyclic aromatic hydrocarbons (PAHs), phenolic compounds, light aromatic compounds, various inorganics and various sulfides (Refs. 8, p. 9; 39, pp. 6, 7). In December 1990, Ecology and Environment, Inc. (E&E), conducted a preliminary assessment (PA) at INL&P to assess potential sources of contamination. The PA provided site-related background information, estimates of possible waste quantities produced, and a summary of nearby targets. No samples were collected as part of the PA (Ref. 6, pp. 1 to 4). The PA postulated that PAH and cyanide waste may have been disposed of to the ground (Ref. 6, p. 8). Specific waste disposal practices at the former facility are unknown (Ref. 8, p. 9). Sampling of soil near former facility operating units and ground water in the vicinity of the property has documented the release of hazardous substances to the environment as described below and throughout this HRS documentation record.

In June 1992, HDR Engineering Inc. (HDR) of Omaha, Nebraska, conducted a site investigation (SI) of INL&P for Minnegasco, Inc. Eighteen soil samples were collected from six soil borings, and four ground water samples were collected from three monitoring wells installed during field operations. The six borings referred to as NOR-101 through NOR-106, were located near former facility features to investigate the possibility that releases of associated wastes to soil had occurred in the past (Ref. 7, pp. 7, 8). Both ground water and subsurface soil samples were found to contain PAH, aromatic volatile organics, and metals (Ref. 7, pp. 9, 10, 23, 30, 47, 88, 134 and Appendix H [Laboratory Reports]). Maximum concentrations of some PAHs detected in soil samples include naphthalene up to 1,400 milligrams per kilogram (mg/kg), 2-methylnaphthalene up to 860 mg/kg, acenaphthene up to 340 mg/kg, phenanthrene up to 520 mg/kg, and pyrene up to 200 mg/kg. Maximum concentrations of volatile organic compounds (VOC) detected in soil samples include acetone up to 2.50 mg/kg, benzene up to 18 mg/kg, ethylbenzene up to 70 mg/kg, toluene up to 16 mg/kg, and xylene (total) up to 47 mg/kg (Ref. 7, p. 23 and Appendix H). Maximum concentrations of PAHs detected in ground water samples include

acenaphthene up to 0.550 milligrams per liter (mg/L); fluoranthene up to 0.210 mg/L; fluorene up to 0.310 mg/L; 2-methylnaphthalene up to 2.70 mg/L; naphthalene up to 9.20 mg/L; phenanthrene up to 0.900 mg/L; and pyrene up to 0.320 mg/L. Maximum concentrations of VOCs detected in ground water samples include benzene up to 3.20 mg/L, ethylbenzene up to 2.20 mg/L, toluene up to 1.90 mg/L, and xylene up to 2.40 mg/L (Ref. 7, p. 30 and Appendix H).

In March 2001, Tetra Tech EM Inc. prepared an expanded site inspection (ESI) report for INL&P based on field activities performed by E&E in March 2000 (Refs. 5; 15, p. 1). During the ESI field work, 62 soil, 20 direct push technology ground water, five municipal well, four private well, and one on-facility monitoring well samples were collected and analyzed using the Superfund Technical Assistance and Response Team (START) mobile laboratory. Further, 32 soil samples, 15 direct push ground water samples, all the potable municipal and private well samples, and the on-facility monitoring well samples were submitted to the U.S. Environmental Protection Agency (EPA) Region 7 laboratory for confirmation analysis (Ref. 5, p. 13). Results from the EPA Region 7 laboratory analysis of on-facility subsurface soil samples documented the following PAHs at the indicated maximum concentrations: acenaphthene (240 mg/kg); anthracene (33 mg/kg); benzo(a)anthracene (2.8 mg/kg); benzo(a)pyrene (2.3 mg/kg); benzo(b)fluoranthene (3.0 mg/kg); benzo(g,h,i)perylene (0.94 mg/kg); benzo(k)fluoranthene (2.5 mg/kg); chrysene (2.9 mg/kg); fluoranthene (140 J mg/kg); fluorene (130 mg/kg); indeno(1,2,3-cd)pyrene (1.2 mg/kg); 2-methylnaphthalene (410 mg/kg); naphthalene (600 mg/kg); phenanthrene (500 mg/kg); and pyrene (220 mg/kg) (Ref. 5, pp. 171, 180, 181, 183, 184). In addition, the following aromatic VOCs and their maximum concentrations were reported in on-facility soil samples: benzene (39 mg/kg), ethylbenzene (91 mg/kg), toluene (14 mg/kg), and total xylenes (130 mg/kg) (Ref. 5, pp. 165, 178, 179, 182). The majority of these contaminants were also detected in on-facility ground water samples. One sample from an on-facility fixed monitoring well contained 11,455 micrograms per liter (µg/L) total PAH and 710 µg/L total aromatic hydrocarbons, including 250 µg/L of benzene (Ref. 5, pp. 35, 36, 158 - 160).

During the ESI, 10 ground water wells were sampled and analyzed for low detection limit VOCs, metals, cyanide, and semivolatile organic compounds (SVOC). Specifically, five downgradient municipal wells (municipal wells 1 through 5) located approximately 0.25 mile from the INL&P, and an upgradient municipal well (municipal well 10), two shallow private domestic wells, a food processing well, and the Norfolk Rescue Mission well were sampled. Benzene was found in all five nearby municipal wells at concentrations ranging from 0.14 to 3.8 µg/L (Refs. 5, pp. 36, 130, 149, 155; 15, pp. 6, 9, 10). Two of the municipal wells have been closed because of the benzene contamination (Ref. 5, pp. 11, 12, 31). The City of Norfolk operates a total of 11 municipal wells that serve the entire population (Ref. 5, p. 31). Based on further investigations, the likely source of the benzene contamination found in the municipal wells is a leaking underground storage tank site that is currently undergoing remediation through a state program (Ref. 34, pp. 12, 13, 74, 98 – 100, 111 – 112).

In April of 2007, Aquila, Inc. and Centel Corporation entered into an Administrative Settlement Agreement and Order on Consent for Engineering Evaluation/Cost Analysis (EE/CA) with the U.S. Environmental Protection Agency (Ref. 39, p. 1).

An EE/CA field investigation was conducted in November and December 2007, June and July 2009, and January 2010. The field investigation included advancing soil, electrical conductivity (EC), laser-induced fluorescence (LIF), and ground water probes; advancing soil borings; installing and developing monitoring wells; measuring ground water elevations; collecting samples of environmental media; and surveying. Sampling included collecting subsurface soil and ground water samples from direct-push probes and ground water samples from newly installed monitoring wells. A subsurface soil sample was also collected and submitted for geotechnical analysis. These field activities were designed to gather data to better define and characterize the subsurface geology and site hydrogeology and the approximate extent

of soil, dense nonaqueous phase liquid (DNAPL), and dissolved-phase ground water contamination at INL&P (Ref. 34, p. 14).

Eleven soil probes (SP-01 through SP-11) were advanced and subsurface soil samples collected for chemical analysis to supplement the existing EPA analytical data suitable for use in a baseline risk assessment. The samples were collected to define the approximate extent of soil contamination in the unsaturated zone (Ref. 34, pp. 15, 76). Fourteen ground water probes were advanced at INL&P, and three samples were collected from each probe (Ref. 34, pp. 17, 75). Monitoring wells were installed in soil borings. Two nested monitoring wells were installed at each location to monitor the upper and lower portions of the surficial aquifer (Ref. 34, pp. 18, 56, 75, 341 - 354). The soil and ground water samples confirm the release of VOCs and PAHs from former MGP operations to soil and ground water (Ref. 34, pp. 46, 47, 59, 60, and Appendices J [pp. 440-453] and K [pp. 454-541]).

Between November 2013 and June 2014 removal activities occurred at the site as required by the Administrative Settlement Agreement and Order on Consent for Removal Action established with the EPA. Contaminated soil and highly concentrated residuals (source material) were excavated, consolidated, and transported off the property for disposal at the Butler County Landfill. (Ref. 46, p. 4) Soil was excavated to depths ranging from 2.5 to 17 feet below ground surface across the majority of the property. The entire Northern portion of the property and the western 2/3 of the southern portion of the property were excavated to the ground water table, approximately 16 to 17 feet below ground surface (Ref. 46, pp. 4, 29). Approximately 10,425 tons of contaminated soil/small debris were excavated and transported to the Butler County Landfill (Ref. 46, p. 4). The extent of soil removed is presented on Figures 3-1 and 3-2 of the soil removal summary report (Ref, 46, pp. 37, 38). Following soil removal, confirmation soil samples were collected from the base and walls of the excavation to evaluate residual soil contamination (Ref. 46, pp. 4, 37, 38). In the final wall confirmation samples, benzo(a) anthracene, benzo(a)pyrene, benzo(b)fluoranthene and indeno(1,2,3-cd)pyrene remained at concentrations exceeding cleanup levels in two or more samples (Ref. 46, p. 28). In the base samples, nine collected from 2 to 10 feet bgs exceeded the benzo(a)pyrene cleanup level (Ref. 46, p. 31).

The residents in the area surrounding INL&P, including the City of Norfolk, obtain drinking water supplies from ground water drawn from the alluvium and Niobrara chalk aquifer underlying INL&P and the surrounding area (Refs. 3; 10, pp. 1 -11, 34, 35; 11, pp. 3, 9; 17; 27; 41; 43). As documented in Table 26 of this HRS documentation record, more than 35,900 persons obtain drinking water from the alluvium and Niobrara chalk aquifer. Also as documented in Table 26 of this HRS documentation record, one of the City of Norfolk's supply wells is located within the 0.25 to 0.50 target distance categories of INL&P. This well is one of the 11 wells that supplies drinking water to more than 34,397 residents, students and workers, as documented in Section 3.3.2.4 of this HRS documentation record.

2.2 SOURCE CHARACTERIZATION

2.2.1 SOURCE IDENTIFICATION

Name of source: Contaminated Soil associated with Facility Operations

Number of source: 1

Source Type: Contaminated Soil

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

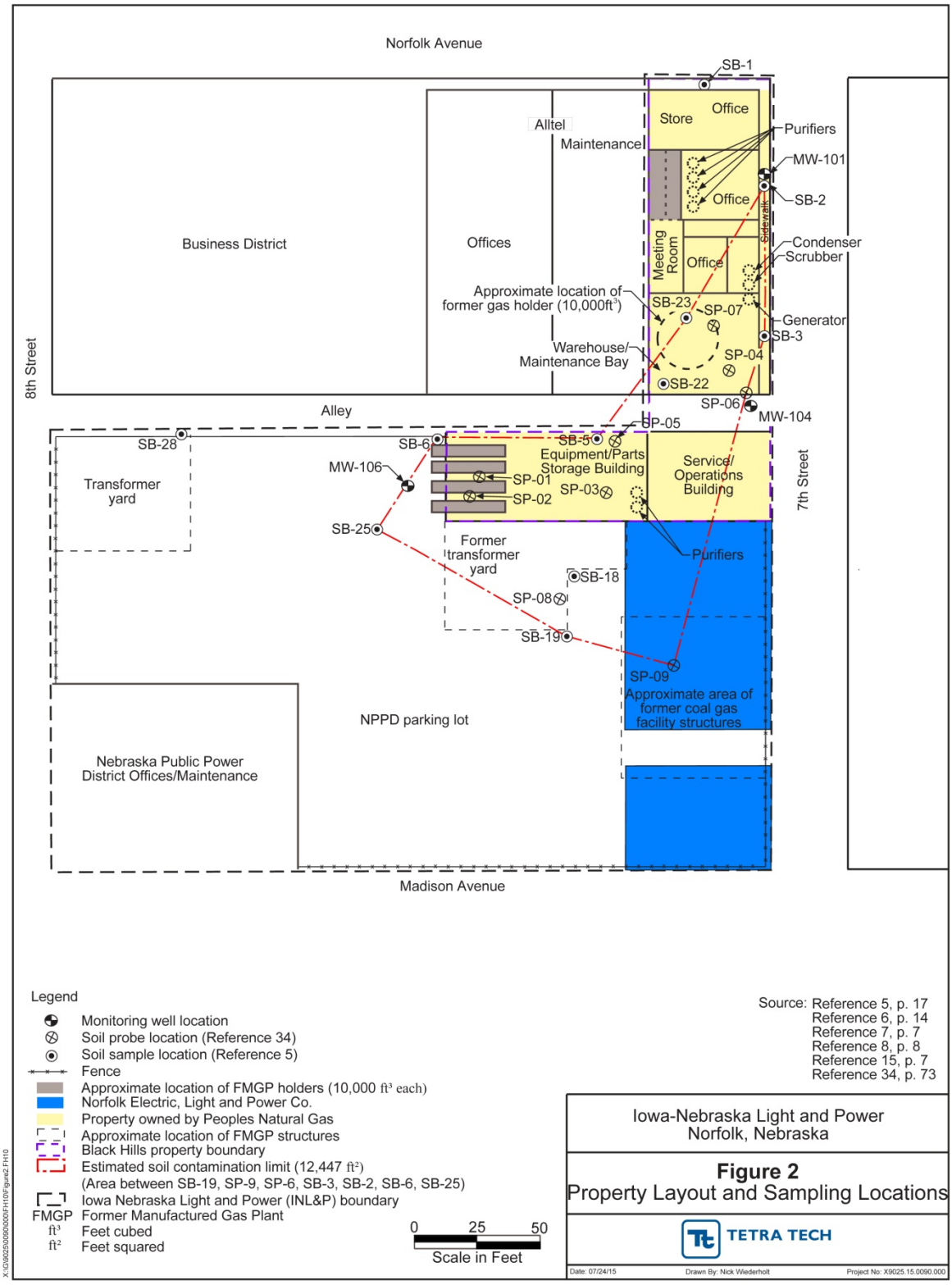
Source 1 consists of contaminated soil associated with the past production of manufactured gas. The facility produced coal gas from 1902 until 1948 using a water-gas process (Ref. 39, p. 6). Generators produced a combustible gas using coke, steam, and oil products (Ref. 39, p. 6). As the gas cooled through the production process, coal tar would fall from suspension in the gas and become a waste product (Ref. 39, p. 6). A scrubber was used to condense the gas (Ref. 39, p. 6). Coal tar was ultimately separated from the condensate water (Ref. 39, p. 6). Purifier boxes were used to remove sulfides and cyanides from the cool gas. Iron oxides were mixed with fluffing material (primarily wood chips, sawdust and corncobs) in the purifier boxes to provide for additional removal of water vapor and coal tar with the associated hydrogen sulfide and cyanide (Ref. 39, p. 6). After the gas was manufactured, it was stored in gas holders. Coal tar residuals were also present in the gas holders (Ref. 39, p. 6).

Some of the waste resulting from the production of the manufactured gas, including coal tar, was sold. Some wastes were disposed of at the facility (Ref. 39, p. 7). Coal tar is primarily composed of polycyclic aromatic hydrocarbons, phenolic compounds, light aromatic compounds, various inorganics and various sulfides (Ref. 39, pp. 6, 7). In December 1990, Ecology and Environment, Inc. (E&E), completed a preliminary assessment (PA) at INL&P to assess potential sources of contamination. The PA provided site-related background information, estimates of possible waste quantities produced, and a summary of nearby targets. No samples were collected as part of the PA (Ref. 6, pp. 1 to 4). The PA postulated that PAH and cyanide waste may have been disposed of to the ground (Ref. 6, p. 8). In June 1992, HDR Engineering Inc. (HDR) of Omaha, Nebraska, conducted a site investigation (SI) of INL&P for Minnegasco, Inc. (Ref. 7, pp. 1, 47, 88, 134). Eighteen soil samples were collected from six soil borings, and four ground water samples were collected from three monitoring wells installed during field operations (Ref. 7, pp. 7, 8, 47, 88, 134). The six borings referred to as NOR-101 through NOR-106, were located near former facility features to investigate the possibility that releases of associated wastes to soil had occurred in the past (Ref. 7, pp. 7, 8). PAHs were detected in soil samples from borings NOR-101, NOR-102, NOR-103, NOR-104, NOR-105 and NOR-106 consistent with coal tar. (Ref. 7, p. 23)

Two sampling events have occurred at INL&P that are used to characterize this source. Analytical results for soil samples from the 2000 ESI and the 2007 soil sampling conducted as part of an EE/CA were used to identify residual contamination in soil from processes associated with the production of manufactured gas (Refs. 13, pp. 17 - 19, 24; 34, pp. 6, 14, 15, 16). During the ESI, soil samples were collected at or near the following former MGP features: gas purifiers, condenser, scrubber, generator, and various 10,000-cubic-foot gas holders as well as additional locations to the south to define the approximate extent of contamination (Refs. 5, p. 17; 7, pp. 7, 8). The text below provides additional information on the history of the property and various investigations. It also introduces the results of the soil sampling. Soil sample locations are presented on Figure 2.

During the ESI, 32 soil samples were submitted to the EPA Region 7 laboratory for analysis. Results from the EPA Region 7 laboratory analysis of subsurface soil samples documented the following PAHs at the indicated maximum concentrations: acenaphthene (240 milligrams per kilogram [mg/kg]); anthracene (33 mg/kg); benzo(a)anthracene (2.8 mg/kg); benzo(a)pyrene (2.3 mg/kg); benzo(b)fluoranthene (3.0 mg/kg); benzo(g,h,i)perylene (0.94 mg/kg); benzo(k)fluoranthene (2.5 mg/kg); chrysene (2.9 mg/kg); fluoranthene (140 J mg/kg); fluorene (130 mg/kg); indeno(1,2,3-cd)pyrene (1.2 mg/kg); 2-methylnaphthalene (410 mg/kg); naphthalene (600 mg/kg); phenanthrene (500 mg/kg); and pyrene (220 mg/kg) (Ref. 5, pp. 171, 180, 181, 183, 184). In addition, the following aromatic VOCs, and their maximum concentrations, were reported in soil samples: benzene (39 mg/kg), ethylbenzene (91 mg/kg), toluene (14 mg/kg), and total xylenes (130 mg/kg) (Ref. 5, pp. 165, 178, 179, 182).

Between November 2013 and June 2014 removal activities occurred as required by the Administrative Settlement Agreement and Order on Consent for Removal Action established with the EPA. Contaminated soil and highly concentrated residuals (source material) were excavated, consolidated, and transported off the property for disposal (Ref. 46, p. 4). Soil was excavated to depths ranging from 2.5 to 17 feet below ground surface across the majority of the property (Ref. 46, p. 4, 29). Approximately 10,425 tons of contaminated soil/small debris were excavated and transported to the Butler County Landfill. The extent of soil removed is presented on Figures 3-1 and 3-2 of the soil removal summary report (Ref, 46, pp. 37, 38). Following soil removal, confirmation soil samples were collected from the base and walls of the excavation to evaluate residual soil contamination (Ref. 46, pp. 4, 37, 38). In the final wall confirmation samples, benzo(a) anthracene, benzo(a)pyrene, benzo(b)fluoranthene and indeno(1,2,3-cd)pyrene remained at concentrations exceeding cleanup levels in two or more samples (Ref. 46, p. 28), documenting that contamination still remains in site soils. In addition, releases from the source to shallow ground water were not addressed as part of the removal activities.


Norfolk Avenue
SB-1
Store
Office
Alltel
Maintenance
Purifiers
MW-101
SB-2
Office
Sidewalk
Business District
Offices
Meeting Room
Office
Condenser
Scrubber
Approximate location of former gas holder (10,000ft³)
SB-23
SP-07
Generator
SB-3
8th Street
Warehouse/ Maintenance Bay
SP-04
SB-22
SP-06
MW-104
Alley
SP-05
SB-28
SB-6
SB-5
Equipment/Parts Storage Building
Service/ Operations Building
7th Street
MW-106
SP-01
SP-03
SP-02
Transformer yard
SB-25
Former transformer yard
Purifiers
SB-18
SP-08
SB-19
SP-09
Approximate area of former coal gas facility structures
NPPD parking lot
Nebraska Public Power District Offices/Maintenance
Madison Avenue
Legend
Monitoring well location
Soil probe location (Reference 34)
Soil sample location (Reference 5)
Fence
Approximate location of FMGP holders (10,000 ft³ each)
Norfolk Electric, Light and Power Co.
Property owned by Peoples Natural Gas
Approximate location of FMGP structures
Black Hills property boundary
Estimated soil contamination limit (12,447 ft²)
(Area between SB-19, SP-9, SP-6, SB-3, SB-2, SB-6, SB-25)
Iowa Nebraska Light and Power (INL&P) boundary
FMGP Former Manufactured Gas Plant
ft³ Feet cubed
ft² Feet squared
0 25 50
Scale in Feet
Source: Reference 5, p. 17
Reference 6, p. 14
Reference 7, p. 7
Reference 8, p. 8
Reference 15, p. 7
Reference 34, p. 73
Iowa-Nebraska Light and Power
Norfolk, Nebraska
Figure 2
Property Layout and Sampling Locations
TETRA TECH
Date: 07/24/15
Drawn By: Nick Wiederholt
Project No: X9025.15.0090.000
X:\G\9025\0090\00\FH10\Figure2.FH10

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

The hazardous substances associated with the area of contaminated soil (Source 1) at INL&P are identified using analytical data for soil from the 2000 ESI and the 2007 EE/CA. The analytical data used to characterize Source 1 are described separately in the sections below.

2000 Expanded Site Inspection Soil Samples:

ESI field activities occurred between March 19 and 25, 2000, and were completed in accordance with the site-specific quality assurance project plan (QAPP) (Refs. 5, pp. 1, 13; 13). During the ESI field work, 62 soil samples were collected and analyzed using the mobile laboratory in accordance with the START Mobile Laboratory Program (MLP) QAPP (Ref. 5, pp. 13, 205-209). Thirty-two confirmatory soil samples were submitted to the EPA Region 7 laboratory for confirmation analysis (Ref. 5, pp. 13, 130, 131). Appendices B and C of Reference 5 provide copies of the field sheets, and analytical data for soil samples collected (Ref. 5, pp. 85-118, 130, 131, 163-165, 171- 194). Samples collected by START were analyzed by the EPA Region 7 laboratory under analytical services request (ASR) number 539, activity number TJC13 (Ref. 5, pp. 128-131). The laboratory analyzed the samples in accordance with EPA Region 7 Standard Operating Procedure (SOP) 1640.1A, EPA Region 7 Laboratory QAPP (Ref. 13, p. 29). SVOCs were analyzed in accordance the EPA Region 7 SOP 3230.2B for extraction and analysis of water and solids for SVOCs dated February 1995. The VOCs were analyzed in accordance with EPA Region 7 SOP 3230.1C, Gas Chromatography/Mass Spectrometry (GC/MS) Analysis for VOCs, dated October 1993. The metals were analyzed in accordance EPA Region 7 SOP 3122.2B, analysis for metals by TJA ICAP 61, April 1995 (Ref. 13, p. 31). The ASR for the sample analysis is provided on page 80 of Reference 13. The data were validated in accordance with procedures outlined in Section 6.5 of the QAPP (Refs. 13, p. 34; 5, p. 132). The chain-of custody forms for the samples collected during the ESI and sent to the EPA Region 7 laboratory are provided as Appendix B of Reference 5, pages 124 to 127. The logbook notes documenting sampling are provided as Appendix D of Reference 5, pages 211-237.

A modified grid system was established in the southern portion of the INL&P property to identify possible soil contamination from MGP operations. Surface and subsurface soil samples were collected within the grid. Soil sampling locations on the northern portion of the property were biased toward MGP features, such as gas holders (Ref. 5, pp. 13, 14).

The lithology of each borehole and sample depth were noted during the soil sampling to characterize the soil and near-surface lithology. The visual inspection, organic vapor analyzer readings of the borehole material, and initial field analytical data were used to select the depths of samples collection across the study area. Based on those data and observations, soil samples generally were collected within the intervals from 0 to 4 feet below ground surface (bgs), 7 to 11 feet bgs, and 13 to 16 feet bgs (Ref. 5, p. 14).

The locations of the soil samples on the property are shown in Figure 3-1, page 17, of Reference 5. Sampling locations off of the facility, including the background soil sampling locations, are shown in Figure 3-2, page 18, of Reference 5. Reference 15 summarizes the ESI field activities.

2000 Expanded Site Inspection - Background Concentrations:

During the ESI, seven designated background samples were collected at various depths (from 0 to 2 inches to 13 to 14 feet bgs) from a single direct push technology borehole location designated as GP-8. (Ref. 5, pp. 23, 131). All of these samples were analyzed by the EPA Region 7 laboratory (Ref. 5, pp. 14-16, 110-116). The location of the background sample is approximately three city blocks northwest and upgradient of the facility (Ref. 5, p. 18). The locations of the background and release samples are shown

in Figure 3-2, page 18, of Reference 5. The background and release samples were collected during the same period of time using the same sampling procedures (Ref. 5, p. 13), were analyzed using the same analytical methods (Ref. 5, pp. 14, 130-132), and were collected from the same soil association (Refs. 5, p. 18; 11, pp. 9- 11). In addition to the soil samples collected from GP-8, several other soil samples collected from the facility were analyzed and did not contain hazardous substances including SB-1, located north of the former facility and SB-28 located west of the former facility and north of a transformer yard (Ref. 5, pp 15, 17).

As documented in Tables 1 and 3 below, the ESI background and release samples were collected from the same relative depths. Field sheets were used to document sample locations, collection times, and dates. Field sheets are referenced in Table 1 and 3. Table 1 provides a summary of background soil samples and sampling dates. Table 2 summarizes the concentrations of hazardous substances detected in the background soil samples.

TABLE 1
ESI BACKGROUND SOIL SAMPLES

Sample Identification (depth)	Laboratory Sample Number	Sample Medium	Date	Reference
GP-8 (0-2")	226	Soil	3/24/00	5, pp. 18, 59, 110, 126, 131, 229, 233
GP-8 (1-2')	227	Soil	3/23/00	5, pp. 18, 59, 111, 126, 131, 229
GP-8 (3-4')	228	Soil	3/23/00	5, pp. 18, 59, 112, 126, 131, 229
GP-8 (4-7')	229	Soil	3/23/00	5, pp. 18, 59, 113, 126, 131, 229
GP-8 (8-10')	230	Soil	3/23/00	5, pp. 18, 59, 114, 126, 131, 229
GP-8 (11-13')	231	Soil	3/23/00	5, pp. 18, 59, 115, 126, 131, 229
GP-8 (13-14')	232	Soil	3/23/00	5, pp. 18, 59, 116, 126, 131, 229
SB-1 (11-13’)	211	Soil	3/21/00	5, pp. 17, 95, 124, 130
SB-28 (13-14’)	216	Soil	3/22/00	5, pp. 17, 100, 124, 130

Notes:
" Inches
' Feet
GP Geoprobe

TABLE 2
ESI BACKGROUND SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (sample depth)	Laboratory Sample Number	Hazardous Substance Concentration (µg/kg)	Sample Quantitation Limit (SQL)* (µg/kg)	Reference 5	Reference 45
Acenaphthene	GP-8 (0-2")	226	410 U	410	p. 186	p. 170
	GP-8 (1-2')	227	400 U	400	p. 186	p. 173
	GP-8 (3-4')	228	450 U	450	p. 189	p. 176
	GP-8 (4-7')	229	450 U	450	p. 189	p. 179
	GP-8 (8-10')	230	450 U	450	p. 189	p. 182
	GP-8 (11-13')	231	470 U	470	p. 189	p. 185
	GP-8 (13-14')	232	520 U	520	p. 192	p. 188
	SB-1 (11-13')	211	440 U	440	p. 174	p. 126
	SB-28 (13-14')	216	450 U	450	p. 180	p. 140
Anthracene	GP-8 (0-2")	226	410 U	410	p. 186	p. 170
	GP-8 (1-2')	227	400 U	400	p. 186	p. 173
	GP-8 (3-4')	228	450 U	450	p. 189	p. 176
	GP-8 (4-7')	229	450 U	450	p. 189	p. 179
	GP-8 (8-10')	230	450 U	450	p. 189	p. 182
	GP-8 (11-13')	231	470 U	470	p. 189	p. 185
	GP-8 (13-14')	232	520 U	520	p. 192	p. 188
	SB-1 (11-13')	211	440 U	440	p. 174	p. 126
	SB-28 (13-14')	216	450 U	450	p. 180	p. 140
Benzo(a) anthracene	GP-8 (0-2")	226	410 U	410	p. 186	p. 170
	GP-8 (1-2')	227	400 U	400	p. 186	p. 173
	GP-8 (3-4')	228	450 U	450	p. 189	p. 176
	GP-8 (4-7')	229	450 U	450	p. 189	p. 179
	GP-8 (8-10')	230	450 U	450	p. 189	p. 182
	GP-8 (11-13')	231	470 U	470	p. 189	p. 185
	GP-8 (13-14')	232	520 U	520	p. 192	p. 188
	SB-1 (11-13')	211	440 U	440	p. 174	p. 126
	SB-28 (13-14')	216	450 U	450	p. 180	p. 141
Benzo(a) pyrene	GP-8 (0-2")	226	410 U	410	p. 186	p. 170
	GP-8 (1-2')	227	400 U	400	p. 186	p. 173
	GP-8 (3-4')	228	450 U	450	p. 189	p. 176
	GP-8 (4-7')	229	450 U	450	p. 189	p. 179
	GP-8 (8-10')	230	450 U	450	p. 189	p. 182
	GP-8 (11-13')	231	470 U	470	p. 189	p. 185
	GP-8 (13-14')	232	520 U	520	p. 192	p. 188
	SB-1 (11-13')	211	440 U	440	p. 174	p. 126
	SB-28 (13-14')	216	450 U	450	p. 180	p. 141
Benzo(b) fluoranthene	GP-8 (0-2")	226	410 U	410	p. 186	p. 170
	GP-8 (1-2')	227	400 U	400	p. 186	p. 173
	GP-8 (3-4')	228	450 U	450	p. 189	p. 176
	GP-8 (4-7')	229	450 U	450	p. 189	p. 179
	GP-8 (8-10')	230	450 U	450	p. 189	p. 182
	GP-8 (11-13')	231	470 U	470	p. 189	p. 185
	GP-8 (13-14')	232	520 U	520	p. 192	p. 188
	SB-1 (11-13')	211	440 U	440	p. 174	p. 126
	SB-28 (13-14')	216	450 U	450	p. 180	p. 141

TABLE 2
ESI BACKGROUND SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (sample depth)	Laboratory Sample Number	Hazardous Substance Concentration (µg/kg)	Sample Quantitation Limit (SQL)* (µg/kg)	Reference 5	Reference 45
Benzo(g,h,i) perylene	GP-8 (0-2")	226	410 U	410	p. 186	p. 170
	GP-8 (1-2')	227	400 U	400	p. 186	p. 173
	GP-8 (3-4')	228	450 U	450	p. 189	p. 176
	GP-8 (4-7')	229	450 U	450	p. 189	p. 179
	GP-8 (8-10')	230	450 U	450	p. 189	p. 182
	GP-8 (11-13')	231	470 U	470	p. 189	p. 185
	GP-8 (13-14')	232	520 U	520	p. 192	p. 188
	SB-1 (11-13')	211	440 U	440	p. 174	p. 126
	SB-28 (13-14')	216	450 U	450	p. 180	p. 141
Benzo(k) fluoranthene	GP-8 (0-2")	226	410 U	410	p. 186	p. 170
	GP-8 (1-2')	227	400 U	400	p. 186	p. 173
	GP-8 (3-4')	228	450 U	450	p. 189	p. 176
	GP-8 (4-7')	229	450 U	450	p. 189	p. 179
	GP-8 (8-10')	230	450 U	450	p. 189	p. 182
	GP-8 (11-13')	231	470 U	470	p. 189	p. 185
	GP-8 (13-14')	232	520 U	520	p. 192	p. 188
	SB-1 (11-13')	211	440 U	440	p. 174	p. 126
	SB-28 (13-14')	216	450 U	450	p. 180	p. 141
Chrysene	GP-8 (0-2")	226	410 U	410	p. 187	p. 170
	GP-8 (1-2')	227	400 U	400	p. 187	p. 173
	GP-8 (3-4')	228	450 U	450	p. 190	p. 176
	GP-8 (4-7')	229	450 U	450	p. 190	p. 179
	GP-8 (8-10')	230	450 U	450	p. 190	p. 182
	GP-8 (11-13')	231	470 U	470	p. 190	p. 185
	GP-8 (13-14')	232	520 U	520	p. 193	p. 188
	SB-1 (11-13')	211	440 U	440	p. 175	p. 126
	SB-28 (13-14')	216	450 U	450	p. 181	p. 141
Fluoranthene	GP-8 (0-2")	226	410 U	410	p. 187	p. 171
	GP-8 (1-2')	227	400 U	400	p. 187	p. 174
	GP-8 (3-4')	228	450 U	450	p. 190	p. 177
	GP-8 (4-7')	229	450 U	450	p. 190	p. 180
	GP-8 (8-10')	230	450 U	450	p. 190	p. 183
	GP-8 (11-13')	231	470 U	470	p. 190	p. 186
	GP-8 (13-14')	232	520 U	520	p. 193	p. 188
	SB-1 (11-13')	211	440 U	440	p. 175	p. 126
	SB-28 (13-14')	216	450 U	450	p. 181	p. 141
Fluorene	GP-8 (0-2")	226	410 U	410	p. 187	p. 171
	GP-8 (1-2')	227	400 U	400	p. 187	p. 174
	GP-8 (3-4')	228	450 U	450	p. 190	p. 177
	GP-8 (4-7')	229	450 U	450	p. 190	p. 180
	GP-8 (8-10')	230	450 U	450	p. 190	p. 183
	GP-8 (11-13')	231	470 U	470	p. 190	p. 185
	GP-8 (13-14')	232	520 U	520	p. 193	p. 188
	SB-1 (11-13')	211	440 U	440	p. 175	p. 126
	SB-28 (13-14')	216	450 U	450	p. 181	p. 141

TABLE 2
ESI BACKGROUND SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (sample depth)	Laboratory Sample Number	Hazardous Substance Concentration (µg/kg)	Sample Quantitation Limit (SQL)* (µg/kg)	Reference 5	Reference 45
Indeno(1,2,3-cd)pyrene	GP-8 (0-2")	226	410 U	410	p. 187	p. 171
	GP-8 (1-2')	227	400 U	400	p. 187	p. 174
	GP-8 (3-4')	228	450 U	450	p. 190	p. 177
	GP-8 (4-7')	229	450 U	450	p. 190	p. 180
	GP-8 (8-10')	230	450 U	450	p. 190	p. 183
	GP-8 (11-13')	231	470 U	470	p. 190	p. 186
	GP-8 (13-14')	232	520 U	520	p. 193	p. 189
	SB-1 (11-13')	211	440 U	440	p. 175	p. 127
	SB-28 (13-14')	216	450 U	450	p. 181	p. 141
2-Methyl-naphthalene	GP-8 (0-2")	226	410 U	410	p. 187	p. 171
	GP-8 (1-2')	227	400 U	400	p. 187	p. 174
	GP-8 (3-4')	228	450 U	450	p. 190	p. 177
	GP-8 (4-7')	229	450 U	450	p. 190	p. 180
	GP-8 (8-10')	230	450 U	450	p. 190	p. 183
	GP-8 (11-13')	231	470 U	470	p. 190	p. 186
	GP-8 (13-14')	232	520 U	520	p. 193	p. 189
	SB-1 (11-13')	211	440 U	440	p. 175	p. 127
	SB-28 (13-14')	216	450 U	450	p. 181	p. 141
Naphthalene	GP-8 (0-2")	226	410 U	410	p. 187	p. 171
	GP-8 (1-2')	227	400 U	400	p. 187	p. 174
	GP-8 (3-4')	228	450 U	450	p. 190	p. 177
	GP-8 (4-7')	229	450 U	450	p. 190	p. 180
	GP-8 (8-10')	230	450 U	450	p. 190	p. 183
	GP-8 (11-13')	231	470 U	470	p. 190	p. 186
	GP-8 (13-14')	232	520 U	520	p. 193	p. 189
	SB-1 (11-13')	211	440 U	440	p. 175	p. 127
	SB-28 (13-14')	216	450 U	450	p. 181	p. 141
Phenanthrene	GP-8 (0-2")	226	410 U	410	p. 187	p. 171
	GP-8 (1-2')	227	400 U	400	p. 187	p. 174
	GP-8 (3-4')	228	450 U	450	p. 190	p. 177
	GP-8 (4-7')	229	450 U	450	p. 190	p. 180
	GP-8 (8-10')	230	450 U	450	p. 190	p. 183
	GP-8 (11-13')	231	470 U	470	p. 190	p. 186
	GP-8 (13-14')	232	520 U	520	p. 193	p. 189
	SB-1 (11-13')	211	440 U	440	p. 175	p. 127
	SB-28 (13-14')	216	450 U	450	p. 181	p. 142
Pyrene	GP-8 (0-2")	226	410 U	410	p. 187	p. 171
	GP-8 (1-2')	227	400 U	400	p. 187	p. 174
	GP-8 (3-4')	228	450 U	450	p. 190	p. 177
	GP-8 (4-7')	229	450 U	450	p. 190	p. 180
	GP-8 (8-10')	230	450 U	450	p. 190	p. 183
	GP-8 (11-13')	231	470 U	470	p. 190	p. 186
	GP-8 (13-14')	232	520 U	520	p. 193	p. 189
	SB-1 (11-13')	211	400 U	440	p. 175	p. 127
	SB-28 (13-14')	216	450 U	450	p. 181	p. 142

TABLE 2
ESI BACKGROUND SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (sample depth)	Laboratory Sample Number	Hazardous Substance Concentration (µg/kg)	Sample Quantitation Limit (SQL)* (µg/kg)	Reference 5	Reference 45

Notes:
* The SQL is the laboratory's contract required quantitation limit (CRQL), for analyses performed by CLP, or the laboratory's reporting limit (RL), for other laboratories, for that analyte with any dilution factor, volume adjustment, or percent solids for that sample analysis taken into account (Ref. 45, p. 1).
" Inches
' Feet
µg/kg Micrograms per kilogram or parts per billion
GP Geoprobe
U Not detected at or above the reporting limit shown (Ref. 5, p. 129)

2000 Expanded Site Inspection - Source Samples:

Soil samples collected from INL&P that contained concentrations of hazardous substances that are at concentrations significantly above background concentrations are presented in Table 3 below. These samples were identified as soil borings with the sample identification starting with "SB" and were collected using a direct push technology rig (Refs. 13, pp. 18, 19; 15, pp. 1, 3). The concentrations of hazardous substances detected in the source samples are summarized in Table 4.

TABLE 3
ESI SUMMARY OF SOURCE 1 SAMPLES

Sample Identification	Laboratory Sample Number	Sample Medium	Date	Reference
SB-18 (1-2')	221	Soil	03/22/00	5, pp. 17, 105, 124, 131
SB-19 (1-2')	223	Soil	03/22/00	5, pp. 17, 107, 125, 131
SB-22 (3-4')	218	Soil	03/21/00	5, pp. 17, 102, 124, 130
SB-22 (16-18')	214	Soil	03/21/00	5, pp. 17, 98, 124, 130
SB-23 (3-4')	219	Soil	03/21/00	5, pp. 17, 103, 124, 131
SB-23 (7-11')	217	Soil	03/21/00	5, pp. 17, 101, 124, 130
SB-5 (4-7')	202	Soil	03/21/00	5, pp. 17, 86, 124, 130
SB-5 (11-13')	203	Soil	03/21/00	5, pp. 17, 87, 124, 130
SB-3 (8-10')	206	Soil	03/21/00	5, pp. 17, 90, 124, 130
SB-3 (13-16')	205	Soil	03/21/00	5, pp. 17, 89, 124, 130
SB-25 (13-14')	213	Soil	03/22/00	5, pp. 17, 97, 124, 130
SB-2 (13-17')	212	Soil	03/21/00	5, pp. 17, 96, 124, 130
SB-6 (14-16')	209	Soil	03/22/00	5, pp. 17, 93, 124, 130

Notes:
' Feet
SB Soil boring

TABLE 4
ESI SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (sample depth)	Laboratory Sample Number	Background Sample [A] (see Table 2)	Background Conc. [B] (see Table 2) (µg/kg)	Hazardous Substance Conc. (µg/kg)	Sample Quantitation Limit (SQL)*(µg/kg)	Ref. 5	Ref. 45
Acenaphthene	SB-22 (3-4')	218	GP-8 (3-4')	450 U	84,000	54,000	p. 180	p. 146
	SB-22 (16-18')	214	GP-8 (13-14')	520 U	180,000	120,000	p. 177	p. 135
	SB-23 (3-4')	219	GP-8 (3-4')	450 U	13,000	8,800	p. 180	p. 149
	SB-23 (7-11')	217	GP-8 (8-10')	450 U	240,000	120,000	p. 180	p. 143
	SB-5 (4-7')	202	GP-8 (4-7')	450 U	4,100	1,700	p. 163	p. 101
	SB-3 (8-10)	206	GP-8 (8-10')	450 U	78,000	25,000	p. 171	p. 113
	SB-3 (13-16')	205	GP-8 (13-14')	520 U	42,000	13,000	p. 171	p. 110
	SB-2 (13-17')	212	GP-8 (13-14')	520 U	38,000	13,000	p. 177	p. 129
	SB-6 (14-16')	209	GP-8 (13-14')	520 U	54,000	26,000	p. 174	p. 120
Anthracene	SB-23 (3-4')	219	GP-8 (3-4')	450 U	9,800	8,800	p. 180	p. 149
	SB-5 (4-7')	202	GP-8 (4-7')	450 U	1,900	1,700	p. 163	p. 101
	SB-3 (8-10)	206	GP-8 (8-10')	450 U	33,000	25,000	p. 171	p. 113
	SB-3 (13-16')	205	GP-8 (13-14')	520 U	20,000	13,000	p. 171	p. 110
	SB-2 (13-17')	212	GP-8 (13-14')	520 U	15,000	13,000	p. 177	p. 129
Benzo(a) anthracene	SB-18 (1-2')	221	GP-8 (1-2')	400 U	2,800	1,700	p. 183	p. 155
	SB-19 (1-2')	223	GP-8 (1-2')	400 U	790	510	p. 183	p. 161
Benzo(a) Pyrene	SB-18 (1-2')	221	GP-8 (1-2')	400 U	2,300	1,700	p. 183	p. 155
	SB-19 (1-2')	223	GP-8 (1-2')	400 U	1,100	510	p. 183	p. 161
Benzo(b) fluoranthene	SB-18 (1-2')	221	GP-8 (1-2')	400 U	3,000	1,700	p. 183	p. 155
	SB-19 (1-2')	223	GP-8 (1-2')	400 U	2,400	510	p. 183	p. 161
Benzo(g,h,i) perylene	SB-19 (1-2')	223	GP-8 (1-2')	400 U	940	510	p. 183	p. 161
Benzo(k) fluoranthene	SB-19 (1-2')	223	GP-8 (1-2')	400 U	2,500	510	p. 183	p. 161
Chrysene	SB-18 (1-2')	221	GP-8 (1-2')	400 U	2,900	1,700	p. 184	p. 156
Fluoranthene	SB-18 (1-2')	221	GP-8 (1-2')	400 U	6,900	1,700	p. 184	p. 156
	SB-23 (3-4')	219	GP-8 (3-4')	450 U	12,000	8,800	p. 181	p. 150
Fluorene	SB-22 (3-4')	218	GP-8 (1-2')	400 U	57,000	54,000	p. 181	p. 147
	SB-23 (3-4')	219	GP-8 (3-4')	450 U	10,000	8,800	p. 181	p. 150
	SB-23 (7-11')	217	GP-8 (8-10')	450 U	130,000	120,000	p. 181	p. 144
	SB-5 (4-7')	202	GP-8 (4-7')	450 U	1,900	1,700	p. 164	p. 102
	SB-3 (8-10)	206	GP-8 (8-10')	450 U	29,000	25,000	p. 172	p. 114
	SB-3 (13-16')	205	GP-8 (13-14')	520 U	18,000	13,000	p. 172	p. 111
	SB-2 (13-17')	212	GP-8 (13-14')	520 U	13,000	13,000	p. 178	p. 129
2-Methyl-naphthalene	SB-19 (1-2')	223	GP-8 (1-2')	400 U	610	510	p. 184	p. 162
	SB-22 (3-4')	218	GP-8 (3-4')	450 U	63,000	54,000	p. 181	p. 147
	SB-22 (16-18')	214	GP-8 (13-14')	520 U	390,000	120,000	p. 178	p. 135
	SB-23 (3-4')	219	GP-8 (3-4')	450 U	36,000	8,800	p. 181	p. 150
	SB-23 (7-11')	217	GP-8 (8-10')	450 U	410,000	120,000	p. 181	p. 144
	SB-25 (13-14')	213	GP-8 (13-14')	520 U	13,000	1,800	p. 178	p. 133
	SB-5 (4-7')	202	GP-8 (4-7')	450 U	3,200	1,700	p. 164	p. 102
	SB-3 (8-10)	206	GP-8 (8-10')	450 U	130,000	25,000	p. 172	p. 114
	SB-3 (13-16')	205	GP-8 (13-14')	520 U	45,000	13,000	p. 172	p. 111
	SB-2 (13-17')	212	GP-8 (13-14')	520 U	47,000	13,000	p. 178	p. 130
	SB-6 (14-16')	209	GP-8 (13-14')	520 U	100,000	26,000	p. 175	p. 121
Indeno(1,2,3-cd)pyrene	SB-19 (1-2')	223	GP-8 (1-2')	400 U	1,200	510	p. 184	p. 162

TABLE 4
ESI SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (sample depth)	Laboratory Sample Number	Background Sample [A] (see Table 2)	Background Conc. [B] (see Table 2) (µg/kg)	Hazardous Substance Conc. (µg/kg)	Sample Quantitation Limit (SQL)*(µg/kg)	Ref. 5	Ref. 45
Naphthalene	SB-22 (16-18')	214	GP-8 (13-14')	520 U	570,000	120,000	p. 178	p. 136
	SB-23 (3-4')	219	GP-8 (3-4')	450 U	41,000	8,800	p. 181	p. 150
	SB-23 (7-11')	217	GP-8 (8-10')	450 U	600,000	120,000	p. 181	p. 144
	SB-25 (13-14')	213	GP-8 (13-14')	520 U	5,100	1,800	p. 178	p. 133
	SB-5 (4-7')	202	GP-8 (4-7')	450 U	11,000	1,700	p. 164	p. 102
	SB-3 (8-10)	206	GP-8 (8-10')	450 U	170,000	25,000	p. 172	p. 114
	SB-3 (13-16')	205	GP-8 (13-14')	520 U	70,000	13,000	p. 172	p. 111
	SB-2 (13-17')	212	GP-8 (13-14')	520 U	61,000	13,000	p. 178	p. 130
	SB-6 (14-16')	209	GP-8 (13-14')	520 U	130,000	26,000	p. 175	p. 121
Phenanthrene	SB-18 (1-2')	221	GP-8 (1-2')	400 U	8,200	1,700	p. 184	p. 156
	SB-19 (1-2')	223	GP-8 (1-2')	400 U	850	510	p. 184	p. 162
	SB-22 (3-4')	218	GP-8 (3-4')	450 U	170,000	54,000	p. 181	p. 148
	SB-22 (16-18')	214	GP-8 (13-14')	520 U	350,000	120,000	p. 178	p. 136
	SB-23 (3-4')	219	GP-8 (3-4')	450 U	37,000	8,800	p. 181	p. 150
	SB-23 (7-11')	217	GP-8 (3-4')	450 U	500,000	120,000	p. 181	p. 145
	SB-5 (4-7')	202	GP-8 (4-7)	450 U	6,800	1,700	p. 164	p. 102
	SB-3 (8-10)	206	GP-8 (8-10')	450 U	140,000	25,000	p. 172	p. 114
	SB-3 (13-16')	205	GP-8 (13-14')	520 U	80,000	13,000	p. 172	p. 111
	SB-2 (13-17')	212	GP-8 (13-14')	520 U	66,000	13,000	p. 178	p. 130
	SB-6 (14-16')	209	GP-8 (13-14')	520 U	87,000	26,000	p. 175	p. 121
Pyrene	SB-18 (1-2')	221	GP-8 (1-2')	400 U	6,000	1,700	p. 184	p. 156
	SB-19 (1-2')	223	GP-8 (1-2')	400 U	1,100	510	p. 184	p. 162
	SB-22 (16-18')	214	GP-8 (13-14')	520 U	140,000	120,000	p. 178	p. 136
	SB-23 (7-11')	217	GP-8 (3-4')	450 U	220,000	120,000	p. 181	p. 145
	SB-5 (4-7')	202	GP-8 (4-7)	450 U	2,400	1,700	p. 164	p. 102
	SB-3 (8-10)	206	GP-8 (8-10')	450 U	57,000	25,000	p. 172	p. 114
	SB-3 (13-16')	205	GP-8 (13-14')	520 U	31,000	13,000	p. 172	p. 111
	SB-2 (13-17')	212	GP-8 (13-14')	520 U	29,000	13,000	p. 178	p. 130
	SB-6 (14-16')	209	GP-8 (13-14')	520 U	31,000	26,000	p. 175	p. 121

Notes:

* The SQL is the laboratory's contract required quantitation limit (CRQL), for analyses performed by CLP, or the laboratory's reporting limit (RL), for other laboratories, for that analyte with any dilution factor, volume adjustment, or percent solids for that sample analysis taken into account (Ref. 45, p. 1).

A The background sample used for each source sample is the background sample collected at the same depth as the source sample. For source samples collected at the depths of 7 and 11 feet below ground surface, samples GP-8 (4-7'), GP-8 (8-10'), or GP-8 (11-13') could be used to establish background levels. As shown in Table 2 of this HRS documentation record, samples SB-1 (11-13') or SB-28 (13-14') could also be presented as they did not contain PAH compounds. The deepest background samples collected were at 13 to 14 feet bgs. Therefore, the background sample collected at 13 to 14 feet bgs was used as background for all soil samples collected at depths greater than 13 feet. Note that background contaminant levels are presented to show the relative increase of facility-related contaminants over background.

B The concentration in parenthesis is the detection limit as documented in Table 2 of this HRS documentation record.

' Feet

µg/L Micrograms per kilogram or parts per billion

Conc. Concentration

U Not detected at or above the reporting limit shown (Ref. 5, p. 129)

Ref. Reference

Also as part of the ESI field work, soil samples were analyzed in the field using the mobile laboratory (Ref. 5, p. 13). Soil samples were analyzed for PAH compounds including naphthalene, benzo(a)anthracene, benzo(b)fluoranthene / benzo(k)fluoranthene, and benzo(a)pyrene were analyzed using the solid phase microextraction (SPME) methodology (Ref. 5, p. 203).

Engineering Evaluation/Cost Analysis December 2007 Soil Sampling:

The EE/CA site characterization report for INL&P documents the field activities performed during the EE/CA investigation conducted between November 2007 and January 2010. The EE/CA was conducted by an environmental consultant for Centel Corporation and Black Hills Corporation in accordance with the EPA Administrative Settlement Agreement and Order on Consent Docked No. CERCLA-07-2006-0159 (Refs. 34, p. 6; 39). The analytical data for soil samples from the EE/CA are used to characterize Source 1, area of contaminated soil.

The EE/CA field activities were completed as specified in the work plan, technical memorandum 1, and field sampling plan (Refs. 37; 38; 40). Deviations from the planned work are summarized in Table 2-1, page 55 of Reference 34. The field investigation included advancing soil borings, collecting soil samples, and surveying sampling locations. Sampling included collecting subsurface soil from direct-push probes for chemical analysis. These field activities were designed to gather data to better define the approximate extent of soil contamination at INL&P (Ref. 34, p. 14).

During historical investigations, extensive soil probing and sampling shallow unsaturated soil was completed. However, the investigations did not completely define the approximate vertical extent of soil contamination. Therefore, additional investigation of subsurface soils was conducted during the EE/CA. In December 2007, 11 soil probes (SP-01 through SP-11) were advanced and subsurface soil samples collected for chemical analysis to supplement the existing EPA analytical data suitable for use in a baseline risk assessment (Ref. 34, pp. 14, 15). The soil samples delineated the approximate extent of soil contamination in the unsaturated zone. The locations of the probes are shown on Figure 2-2, page 76 of Reference 34, and soil probe logs are in Appendix C at page 276 of Reference 34 (Ref. 34, pp. 14, 15). According to the logs, the soil samples were collected in November and December 2007 (Ref. 34, pp. 276 to 294).

Soil probes were advanced with a hydraulic direct-push probing unit. All probes were sampled continuously and logged by a geologist to allow for accurate determination of stratigraphy and to screen for contamination. Photoionization detector (PID) field screening results are included on the logs (Ref. 34, pp. 15, 277 - 315).

Soil samples collected from probes SP-01 through SP-09 were submitted for chemical analysis of PAHs by SW-846 Method 8270-Selective Ion Monitoring (SIM), VOCs by SW-846 Method 8260B, and arsenic by SW-846 Method 6010B. The samples were collected from the zone that was the most visibly contaminated or that exhibited the highest PID reading in the 1 to 6 foot, 6 to 12 foot, and 12 to 18 foot bgs intervals. The soil samples were collected from the midpoint of the interval if visible contamination was not present or the soil exhibited no PID reading in the sample interval. A duplicate sample was collected from probe SP-1 from 8.5 to 10.0 feet bgs, and a matrix spike/matrix spike duplicate (MS/MSD) sample was collected from probe SP-3 from 8.0 to 8.6 feet bgs. No soil samples were collected from soil probes SP-10 and SP-11 for chemical analysis (Ref. 34, pp. 15, 16).

All results received from the analytical laboratory for samples collected during the EE/CA were reviewed, evaluated, and validated. Data validation reports are included as Appendix O of the EE/CA report (Ref. 34 pp. 596-650). Data were evaluated using EPA's *Functional Guidelines for Evaluating Organics/Inorganics Analyses* (EPA 1999, 1994) (Ref. 34, p. 27). Reference 38 provides the work plan followed for sample validation.

Visible contamination, odors, or PID readings identified during probing or well installation were recorded on the logs presented in Appendix D of Reference 34. Figure 2-2 on page 76 of Reference 34 shows the soil probe locations. Table 4-1 page 58 of Reference 34 summarizes the field observations recorded (such

as visible tar, tar odors, and VOCs detected by the PID) during soil probing. A summary of Table 4-1 is provided in Table 5 of this HRS documentation record. Indications of contamination were present in all soil probes except in probe P-10, which was advanced along 5th Street, approximately two blocks east of INL&P (Ref. 34, pp. 28, 58).

TABLE 5
OBSERVATONS OF CONTAMINATION IN SOIL PROBES
ENGINEERING EVALUTION/COST EVALUTION

Sample Identification	Odors	PID Reading Greater than 1 ppm	Observations	Reference
SP-01	Tar odor entire depth.	Range from 11.9 to 1,724 ppm from 0.5 to 19 feet bgs. Peak reading at 16 feet bgs.	Tar coating on sampling sleeve/sample tar coated from 10 to 16 feet bgs. Tar saturated from 15.2 to 15.8 feet bgs. Sand tar coated from 18.7 to 20 feet bgs.	34, pp. 58, 277
SP-02	Faint tar odor from 0.5 to 5 feet bgs. Tar odor from 5 to 12 feet bgs.	Range from 8.8 to 634 ppm from 0.5 to 17 feet bgs. Peak reading at 13 feet bgs.	Tar coated from 13.6 to 16 feet bgs.	34, pp. 58, 278
SP-03	Strong tar odor from 10 to 20 feet bgs.	Range from 8.7 to 649 ppm from 4 to 17 feet bgs. Peak reading at 127 feet bgs.	Tar coated from 16.6 to 20 feet bgs.	34, pp. 58, 279
SP-04	Tar odor from 5 to 10 feet bgs.	Range from 12.1 to 295 ppm from 0.5 to 19 feet bgs. Peak reading at 19 feet bgs.	Tar coated from 12.6 to 12.9 feet bgs. Sampling sleeve had a tar smear from 18 to 20 feet bgs.	34, pp. 58, 280
SP-05	Strong tar odor from 5 to 21 feet bgs. Petroleum odor from 35 to 46 feet bgs.	Range from 5.9 to 1,503 ppm from 0.5 to 54 feet bgs. Peak reading at 18 feet bgs.	Visible tar from 7 to 10 feet bgs. Tar coated from 10 to 17.7 feet bgs in clay. Tar coated from 20 to 21 feet bgs in sand. Tar staining begins grading out at 27 feet bgs. Tar stained from 35 to 35.5 feet bgs.	34, pp. 58, 281, 282
SP-06	Petroleum odor at 8 feet bgs.	Range from 1.1 to 175 ppm from 9 to 31 feet bgs. Peak reading at 18 feet bgs.	Petroleum saturated 24.7 feet bgs. Petroleum coated seam from 27 to 27.1 feet bgs and 27.7 to 27.8 feet bgs.	34, pp. 58, 283, 284
SP-07	None recorded.	Range from 40.2 to 271 ppm from 0.5 to 5 feet bgs. Peak reading at 5 feet bgs.	Tar saturated from 5 to 7 feet bgs.	34, pp. 58, 286

TABLE 5 (Continued)
OBSERVATONS OF CONTAMINATION IN SOIL PROBES
ENGINEERING EVALUTION/COST EVALUTION

Sample Identification	Odors	PID Reading greater than 1 ppm	Observations	Reference
SP-08	Tar odor from 18 to 19.2 feet bgs. Strong tar odor at 25.6 feet bgs. Faint gas odor above glacial till.	Range from 1.1 to 92.6 ppm from 7 to 32 feet bgs. Peak reading at 25 feet bgs.	Tar stained at 25.6 feet bgs and from 27 to 27.8 feet bgs.	34, pp. 58, 287, 288
SP-09	None.	None.	None. Probe refusal at 7 feet bgs.	34, pp. 58, 289
SP-10	None.	PID measurements less than 1 ppm throughout probe.	No contamination evident	34, pp. 58, 290, 291, 292
SP-11	Petroleum odor at 16.7 to 17.9 feet bgs, petroleum odor from 20.3 to 21.3 feet bgs.	Range from 1.0 to 19 ppm from 18 to 21 feet bgs. Peak reading at 18 feet bgs.	Black staining from 16.7 to 17.9 and 20.3 to 21.3 feet bgs.	34, pp. 58, 293

Notes:
bgs Below ground surface
PID Photoionization detector
ppm Parts per million

Engineering Evaluation/Cost Analysis - Background and Release Concentrations:

The background concentrations for soil samples from 2000 were used to supplement background concentrations for the soil samples collected in 2007 during the EE/CA soil investigation. These locations collected during the ESI documented an absence of contamination at locations away from the source. Documentation on the background soil samples from the ESI is provided in Tables 1 and 2 of this HRS documentation record. Additionally, Table 5-2, page 66 of Reference 34 provides background concentrations for PAHs from various publications. No off-property soil samples were collected as part of the EE/CA, rather all samples were located on the facility (Ref. 34, p. 76). However, one location (SP-08) sampled during the EE/CA was located outside the historic structure footprint at the former MGP (Ref. 34, p. 76). This sample contained significantly lower concentrations of PAH compounds when compared to samples collected near or within areas where historic structures were located (Ref. 34, pp. 59, 76). The results for two samples collected from SP-08 are presented in Table 7 below.

TABLE 6
EE/CA BACKGROUND SOIL SAMPLES

Sample Identification (feet below ground surface)	Laboratory Sample Number	Sample Medium	Date	Reference
SP-8 (5-6)	6032085007	Soil	11/30/2007	34, p. 287, 621
SP-8 (7-8)	6032085008	Soil	11/30/2007	34, p. 287, 621

TABLE 7
EE/CA BACKGROUND SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (sample depth)	Laboratory Sample Number	Hazardous Substance Concentration (mg/kg)	Method Detection Limit (MDL) (mg/kg)	Reference 34
Acenaphthene	SP-8 (5-6)	6032085007	ND	0.0013	p. 449
	SP-8 (7-8)	6032085008	ND	0.00024	
Acenaphthylene	SP-8 (5-6)	6032085007	0.0641	0.0026	p. 449
	SP-8 (7-8)	6032085008	ND	0.00048	
Anthracene	SP-8 (5-6)	6032085007	0.0723	0.0032	p. 449
	SP-8 (7-8)	6032085008	0.0020	0.00061	
Benzo(a)anthracene	SP-8 (5-6)	6032085007	0.232	0.0026	p. 449
	SP-8 (7-8)	6032085008	ND	0.00048	
Benzo(a)pyrene	SP-8 (5-6)	6032085007	0.134	0.0038	p. 449
	SP-8 (7-8)	6032085008	ND	0.00073	
Benzo(b)fluoranthene	SP-8 (5-6)	6032085007	0.422	0.0045	p. 449
	SP-8 (7-8)	6032085008	ND	0.00085	
Benzo(g,h,i)perylene	SP-8 (5-6)	6032085007	0.113	0.0026	p. 449
	SP-8 (7-8)	6032085008	ND	0.00048	
Chrysene	SP-8 (5-6)	6032085007	0.202	0.0019	pp. 449, 450
	SP-8 (7-8)	6032085008	ND	0.00036	
Fluoranthene	SP-8 (5-6)	6032085007	0.321	0.0045	pp. 449, 450
	SP-8 (7-8)	6032085008	ND	0.00085	
Fluorene	SP-8 (5-6)	6032085007	ND	0.0019	pp. 449, 450
	SP-8 (7-8)	6032085008	ND	0.00036	
Indeno(1,2,3-cd)pyrene	SP-8 (5-6)	6032085007	0.112	0.0038	pp. 449, 450
	SP-8 (7-8)	6032085008	ND	0.00073	
Naphthalene	SP-8 (5-6)	6032085007	0.214	0.0019	pp. 449, 450
	SP-8 (7-8)	6032085008	ND	0.00036	
Phenanthrene	SP-8 (5-6)	6032085007	0.548	0.0038	pp. 449, 450
	SP-8 (7-8)	6032085008	0.0100	0.00073	
Pyrene	SP-8 (5-6)	6032085007	0.35	0.0032	pp. 449, 450
	SP-8 (7-8)	6032085008	ND	0.00061	

Notes:

*	The SQL is the laboratory's method detection limit (MDL) (Ref. 34, pp. 449, 450).
"	Inches
'	Feet
µg/kg	Micrograms per kilogram or parts per billion
GP	Geoprobe

Twenty-two subsurface soil samples were collected from the nine soil probes advanced on facility during the EE/CA field investigation. The sampling locations are shown in Reference 34, page 75. The complete analytical data are presented in Appendix J of Reference 34. Soil samples collected from

INL&P with hazardous substances that are used in delineating the approximate extent of source 1 are summarized in Table 8, and the locations are shown on Figure 2 of this HRS documentation record (Ref. 1, Section 2.3). The concentrations of hazardous substances detected in the source samples are summarized in Table 9 of this HRS documentation record. Visible contamination (waste) was observed in the soil samples (see Table 5 in this HRS documentation record). The soil samples were collected from biased locations, where former MGP structures were located and known to have contained hazardous substances (Ref. 34, Figure 2-2, p. 76). The hazardous substances detected in the source samples such as PAHs are not naturally occurring but are created from a variety of anthropogenic activities (Ref. 42).

TABLE 8
ENGINEERING EVALUTION/COST ANALYSIS
SUMMARY OF SOURCE 1 SAMPLES - 2007

Sample Identification (feet below ground surface)*	Laboratory Sample Number	Sample Medium	Date	Reference
SP-1 (4-5) SP01S0104-05P	6032561010	Soil	12/06/2007	34, p. 277, 637
SP-1 (8.5-10) SP01S0208.5-10P	6032561011	Soil	12/06/2007	34, p. 277, 637
SP-1 (15-16) SP01S0315-15P	6032561012	Soil	12/06/2007	34, p. 277, 637
SP-2 (4-5) SP02S0104-05P	6032561014	Soil	12/06/2007	34, p. 278, 637
SP-2 (9-10) SP02S0209-10P	6032561015	Soil	12/06/2007	34, p. 278, 637
SP-3 (4.5-5.5) SP03S0104.5-05.5P	6032561017	Soil	12/06/2007	34, p. 279, 637
SP-3 (8-8.6) SP03S0208-08.6P	6032561018	Soil	12/06/2007	34, p. 279, 638
SP-3 (12-13) SP03S0312-13P	6032561019	Soil	12/06/2007	34, p. 279, 638
SP-4 (12.5-13.4) SP04S0112.5-13.4P	6032561005	Soil	12/05/2007	34, p. 280, 637
SP-5 (2.5-3.5) SP05S0102.5-03.5P	6032561007	Soil	12/06/2007	34, p. 281, 637
SP-5 (8-9) SP05S0208-09P	6032561008	Soil	12/06/2007	34, p. 281, 637
SP-5 (11-12) SP05S0311-12P	6032561009	Soil	12/06/2007	34, p. 281, 637
SP-6 (3-4) SP06S0103-04P	6032085004	Soil	11/28/2007	34, p. 283, 621
SP-6 (9-10) SP06S0109-10P	6032085005	Soil	11/28/2007	34, p. 283, 621
SP-7 (5-6) SP07S0105-06P	6032561006	Soil	12/06/2007	34, p. 286, 637

Sample Identification (feet below ground surface)*	Laboratory Sample Number	Sample Medium	Date	Reference
SP-9 (3-4) SP09SO103-04P	6032085009	Soil	11/30/2007	34, p. 289, 622

Notes:
* The SP-X designation is used for displaying the sample on figures and in tables. The longer sample designation is how the sample is named on boring logs and in the data validation reports.
SP Soil probe

TABLE 9
ENGINEERING EVALUTION/COST ANALYSIS
2007 SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (ft bgs)[A]	Background Sample (ft bgs)[B]	Background Concentration (MDL mg/kg)[C]	Hazardous Substance Concentration (mg/kg)	Method Detection Limit (MDL) (mg/kg)	Reference 34
Acenaphthene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	13	0.0246	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	40.4	0.0241	p. 441
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	92.4	0.126	p. 442
	SP-2 (9-10)	GP-8 (8-10)	ND (0.450)	2.06	0.0024	p. 443
	SP-2 (12-12.5)	GP-8 (11-13)	ND (0.470)	1.9	0.0024	p. 443
	SP-3 (8-8.6)	GP-8 (8-10)	ND (0.450)	1.93	0.0024	p. 444
	SP-3 (12-13)	GP-8 (11-13)	ND (0.470)	0.577	0.0026	p. 445
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	13.8	0.122	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00024)	31.8	0.119	p. 445
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	17.4	0.0266	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	32.3	0.025	p. 446
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	143	0.121	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	18.7	0.125	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	18.3	0.0121	p. 448
	SP-7 (5-6)	SP-08 (5-6)	ND (0.0013)	628	2.99	p. 448
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	0.542	0.0011	p. 450
Acenaphthylene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	6.34	0.0492	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	8.46	0.0482	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	19.7	0.253	p. 442
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	1.1	0.0049	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	2.94	0.244	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00048)	15.2	0.237	p. 445
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	3.59	0.0532	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	5.31	0.0501	p. 446
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	21	0.241	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	2.61	0.25	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	2.62	0.0243	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.0641 (0.0026)	215	5.98	p. 449

TABLE 9 (Continued)
ENGINEERING EVALUTION/COST ANALYSIS
2007 SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (ft bgs)[A]	Background Sample (ft bgs)[B]	Background Concentration (MDL mg/kg)[C]	Hazardous Substance Concentration (mg/kg)	Method Detection Limit (MDL) (mg/kg)	Reference 34
Anthracene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	7.41	0.0615	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	45.5	0.612	p. 441
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	38.7	0.316	p. 442
	SP-2 (9-10)	GP-8 (8-10)	ND (0.450)	0.82	0.006	p. 443
	SP-2 (12-12.5)	GP-8 (11-13)	ND (0.470)	0.72	0.0061	p. 443
	SP-3 (8-8.6)	GP-8 (8-10)	ND (0.450)	0.801	0.0061	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	14.6	0.305	p. 445
	SP-4 (7-8)	SP-08 (7-8)	0.0020 (0.00061)	77.2	0.297	p. 445
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	6.79	0.0665	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	11.8	0.0626	p. 446
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	49.3	0.301	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	8.69	0.312	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	10.9	0.0303	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.0723 (0.0032)	332	7.48	p. 449
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	0.73	0.0028	p. 450
Benzo(a) anthracene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	4.87	0.0492	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	12.7	0.0482	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	18.7	0.253	p. 442
	SP-2 (9-10)	GP-8 (8-10)	ND (0.450)	0.62	0.0048	p. 443
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	0.728	0.0049	p. 444
	SP-3 (8-8.6)	GP-8 (8-10)	ND (0.450)	0.601	0.0049	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	4.62	0.244	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00048)	43.5	0.237	p. 445
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	5	0.0532	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	6.39	0.0501	p. 446
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	29.5	0.241	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	2.6	0.25	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	8.2	0.0243	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.232 (0.0026)	206	5.98	p. 449
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	1.72	0.0022	p. 450

TABLE 9 (Continued)
ENGINEERING EVALUTION/COST ANALYSIS
2007 SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (ft bgs)[A]	Background Sample (ft bgs)[B]	Background Concentration (MLD mg/kg)[C]	Hazardous Substance Concentration (mg/kg)	Method Detection Limit (MDL) (mg/kg)	Reference 34
Benzo(a) pyrene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	2.21	0.0738	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	5.33	0.0724	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	9.39	0.379	p. 442
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	0.918	0.0073	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	2.6	0.366	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00073)	26.6	0.356	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	2.93	0.0798	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	3.42	0.0751	p. 446
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	15.7	0.362	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	2.55	0.375	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	6.18	0.0364	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.134 (0.0038)	114	8.89	p. 449
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	1	0.0033	p. 450
Benzo(b) fluoranthene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	2.86	0.0862	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	7.16	0.0844	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	12.2	0.443	p. 442
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	1.72	0.0085	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	4.51	0.427	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00085)	38.2	0.416	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	4.2	0.0931	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	5.11	0.0876	p. 446
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	21.7	0.422	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	2.75	0.437	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	9.47	0.0425	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.422 (0.0045)	174	10.5	p. 449
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	2.25	0.0039	p. 450

TABLE 9 (Continued)
ENGINEERING EVALUTION/COST ANALYSIS
2007 SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (ft bgs)[A]	Background Sample (ft bgs)[B]	Background Concentration (MDL mg/kg)[C]	Hazardous Substance Concentration (mg/kg)	Method Detection Limit (MDL) (mg/kg)	Reference 34
Benzo(g,h,i) perylene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	1.22	0.0492	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	1.87	0.0482	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	4.68	0.253	p. 442
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	0.708	0.0049	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	2.14	0.244	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00048)	12.1	0.237	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	1.32	0.0532	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	1.51	0.0501	p. 446
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	6.17	0.241	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	0.946	0.25	p. 447
	SP-6 (3-4)	GP-8 (3-4)	ND (0.450)	0.0025	0.021	p. 448
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	3.24	0.0243	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.113 (0.0026)	79.2	5.98	p. 449
Chrysene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	3.82	0.0369	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	9.70	0.0362	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	16.3	0.19	p. 442
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	0.914	0.0036	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	3.94	0.183	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00036)	31.8	0.178	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	3.96	0.0399	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	5.1	0.0376	p. 446
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	22.9	0.181	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	2.83	0.187	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	6.68	0.0182	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.202 (0.0019)	160	4.49	p. 449
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	1.29	0.0017	p. 450

TABLE 9 (Continued)
ENGINEERING EVALUTION/COST ANALYSIS
2007 SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (ft bgs)[A]	Background Sample (ft bgs)[B]	Background Concentration (MDL mg/kg)[C]	Hazardous Substance Concentration (mg/kg)	Method Detection Limit (MDL) (mg/kg)	Reference 34
Fluoranthene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	7.25	0.0862	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	17.4	0.0844	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	31.5	0.443	p. 442
	SP-2 (4-5)	GP-8 (4-7)	ND (0.450)	0.0234	0.00069	p. 443
	SP-2 (12-12.5)	GP-8 (11-13)	ND (0.470)	0.477	0.0086	p. 443
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	0.667	0.0085	p. 444
	SP-3 (8-8.6)	GP-8 (8-10)	ND (0.450)	0.997	0.0085	p. 444
	SP-3 (12-13)	GP-8 (11-13)	ND (0.470)	0.335	0.0092	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00085)	87	0.416	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	8.44	0.0931	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	10.7	0.0876	p. 447
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	46.8	0.422	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	5.36	0.437	p. 447
	SP-6 (9-10)	GP-8 (3-4)	ND (0.450)	16.5	0.0425	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.321 (0.0045)	298	10.5	p. 449
Fluorene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	12.1	0.0369	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	30.6	0.0362	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	55.9	0.19	p. 442
	SP-2 (9-10)	GP-8 (8-10)	ND (0.450)	1.45	0.0036	p. 443
	SP-2 (12-12.5)	GP-8 (11-13)	ND (0.470)	1.05	0.0037	p. 443
	SP-3 (8-8.6)	GP-8 (8-10)	ND (0.450)	1.52	0.0037	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	12.7	0.183	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00036)	69.9	0.178	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	9.90	0.0399	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	16.3	0.0376	p. 447
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	70	0.181	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	11.1	0.187	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	13.2	0.0182	p. 448
	SP-7 (5-6)	SP-08 (5-6)	ND (0.0019)	484	4.49	p. 449

TABLE 9 (Continued)
ENGINEERING EVALUTION/COST ANALYSIS
2007 SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (ft bgs)[A]	Background Sample (ft bgs)[B]	Background Concentration (MDL mg/kg)[C]	Hazardous Substance Concentration (mg/kg)	Method Detection Limit (MDL) (mg/kg)	Reference 34
Indeno(1,2,3-cd)pyrene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	0.795	0.0738	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	1.82	0.0724	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	3.26	0.379	p. 442
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	0.603	0.0073	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	1.36	0.366	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00073)	10.6	0.356	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	1.1	0.0798	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	1.29	0.0751	p. 447
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	6.11	0.362	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	2.8	0.0364	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.112 (0.0038)	47.8	8.98	p. 449
Naphthalene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	24.6	0.0369	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	77.1	0.0362	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	373	0.19	p. 442
	SP-2 (9-10)	GP-8 (8-10)	ND (0.450)	6.87	0.0036	p. 443
	SP-2 (12-12.5)	GP-8 (11-13)	ND (0.470)	9.02	0.0037	p. 444
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	0.932	0.0036	p. 444
	SP-3 (8-8.6)	GP-8 (8-10)	ND (0.450)	7.28	0.0037	p. 444
	SP-3 (12-13)	GP-8 (11-13)	ND (0.470)	3.42	0.0039	p. 445
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	45.7	0.183	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00036)	493	0.178	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	55.2	0.0399	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	89.9	0.0376	p. 447
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	385	0.181	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	79.4	0.187	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	11.8	0.0182	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.214 (0.0019)	1,950	4.49	p. 449
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	2.63	0.0017	p. 450

TABLE 9 (Continued)
ENGINEERING EVALUTION/COST ANALYSIS
2007 SOURCE 1 SOIL CONCENTRATIONS

Hazardous Substance	Sample Identification (ft bgs)[A]	Background Sample (ft bgs)[B]	Background Concentration (MDL mg/kg)[C]	Hazardous Substance Concentration (mg/kg)	Method Detection Limit (MDL) (mg/kg)	Reference 34
Phenanthrene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	31.4	0.0738	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	81.7	0.0724	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	177	0.379	p. 442
	SP-2 (9-10)	GP-8 (8-10)	ND (0.450)	3.88	0.0072	p. 443
	SP-2 (12-12.5)	GP-8 (11-13)	ND (0.470)	3.12	0.0073	p. 444
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	0.767	0.0073	p. 444
	SP-3 (8-8.6)	GP-8 (8-10)	ND (0.450)	3.71	0.0073	p. 444
	SP-3 (12-13)	GP-8 (11-13)	ND (0.470)	1.47	0.0079	p. 445
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	43.5	0.366	p. 445
	SP-4 (7-8)	SP-08 (7-8)	0.0100 (0.00073)	331	0.356	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	34.9	0.0798	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	53.5	0.0751	p. 447
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	221	0.362	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	24.9	0.375	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	42.7	0.0364	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.548 (0.0038)	1,230	8.98	p. 449
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	4.09	0.0033	p. 450
Pyrene	SP-1 (4-5)	GP-8 (4-7)	ND (0.450)	10.7	0.0615	p. 441
	SP-1 (8.5-10)	GP-8 (8-10)	ND (0.450)	34	0.0603	p. 442
	SP-1 (15-16)	GP-8 (13-14)	ND (0.520)	44.3	0.316	p. 442
	SP-2 (9-10)	GP-8 (8-10)	ND (0.450)	1.55	0.006	p. 443
	SP-2 (12-12.5)	GP-8 (11-13)	ND (0.470)	0.775	0.0061	p. 444
	SP-3 (4.5-5.5)	GP-8 (4-7)	ND (0.450)	1.94	0.0061	p. 444
	SP-3 (8-8.6)	GP-8 (8-10)	ND (0.450)	1.4	0.0061	p. 444
	SP-4 (2-2.5)	GP-8 (3-4)	ND (0.450)	15.7	0.305	p. 445
	SP-4 (7-8)	SP-08 (7-8)	ND (0.00061)	105	0.297	p. 446
	SP-4 (12.5-13.4)	GP-8 (11-13)	ND (0.470)	10.8	0.0665	p. 446
	SP-5 (2.5-3.5)	GP-8 (3-4)	ND (0.450)	15.1	0.0626	p. 447
	SP-5 (8-9)	GP-8 (8-10)	ND (0.450)	67.3	0.301	p. 447
	SP-5 (11-12)	GP-8 (11-13)	ND (0.470)	8.34	0.312	p. 447
	SP-6 (9-10)	GP-8 (8-10)	ND (0.450)	20.4	0.0303	p. 448
	SP-7 (5-6)	SP-08 (5-6)	0.35 (0.0032)	449	7.48	p. 449
	SP-9 (3-4)	GP-8 (3-4)	ND (0.450)	2.37	0.0028	p. 450

Notes:

[A] The sample identifications are different on the figures, in the text of the report, and on the sample data sheets. The figures and text provide only the soil probe sample location, such as SB-1 (Ref. 34, pp. 58, 76). The soil probe sample identification on the sample data sheets is given as the sample location, such as SP01, followed by a sample number, such as SP01**01**, followed by the sample depth, such as SP0101**04-05**. The sample identification in the above table provides the soil probe location, such as SB-1 for example, followed by the sample depth in feet in parenthesis, for example SB-1 (4-5).

[B] Background sample documentation for ESI samples collected in 2000 is provided in Table 1.

[C] Background sample concentration documentation for ESI samples collected in 2000 is provided in Table 2. The values in Table 2 were presented in micrograms per kilogram (µg/kg) and are displayed in this table as milligrams per kilogram (mg/kg) for consistency. To convert micrograms to milligrams, one must divide micrograms by 1,000 .

mg/kg Milligrams per kilogram
bgs Below ground surface
ft Feet
MDL Method detection limit
ND Not detected
SP Sampling point
GP Geoprobe point

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Containment values are based on an observed release from source area to ground water and the absence of any documented containment features. Much of the subsurface soil contamination is covered by buildings or gravel or concrete pavement (Ref 34, p. 47). The containment factor values for Source 1 are provided in Table 10.

TABLE 10
CONTAINMENT SOURCE 1

Containment Description	Containment Factor Value	References
Gas release to air:	Not scored	
Particulate release to air:	Not scored	
Release to ground water: Monitoring well samples provide evidence of hazardous substance migration from the source area, and none of the following is known to be present, nor were documented by deep soil borings, at the source: liner, maintained engineered cover, functioning and maintained run-on control system and runoff management system, or functioning leachate collection and removal system immediately above a liner. The depth to water at the site ranges from 10.6 to 13.8 feet below the top of monitoring well casings (Ref. 34, p. 57). Potential dense non-aqueous phase liquids (DNAPL) were found from approximately 8 to 34.5 feet below ground surface in the vicinity of source 1 (Ref. 34, pp. 36, 91). The tool used to detect DNAPL was designed specifically to detect tar in the subsurface (Ref. 34, p. 17). This suggests DNAPL tar is present below the water table.	10	5, pp. 18, 20, 27, 28, 33, 34, 35; 34, pp. 58, 60, 86, 88, 91, 277-294
Release through overland migration:	Not scored	

2.4.2 HAZARDOUS WASTE QUANTITY

2.4.2.1.1 Hazardous Constituent Quantity

The hazardous constituent quantity for Source 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances in the source is not known and cannot be estimated with reasonable confidence [Ref. 1, pp. 51590-51591 (Section 2.4.2.1.1)]. There are insufficient historical and current data (Manifests, PRP records, State records, Permits, Waste concentration data, etc.) available to adequately calculate the total or partial mass of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source No. 1 with reasonable confidence.
Hazardous Constituent Quantity Assigned Value: Not scored

2.4.2.1.2 Hazardous Wastestream Value

The hazardous wastestream quantity for Source 1 could not be adequately determined according to the HRS requirements; that is, the mass of the hazardous wastestreams and CERCLA pollutants and contaminants in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, pp. 51591 (Section 2.4.2.1.2)]. There are insufficient historical and current data (Manifests, PRP records, State records, permits, etc.) available to adequately calculate the total or partial mass of all hazardous wastestreams and CERCLA pollutants and contaminants in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous wastestream quantity for Source No. 1 with reasonable confidence.
Hazardous Wastestream Quantity Assigned Value: Not scored

2.4.2.1.3 Volume

The information available is not sufficient to adequately support evaluation of the volume for Source 1 as the full depth of contamination was not determined by sampling.
Volume Assigned Value: 0 (Ref. 1, Section 2.4.2.1.3).

2.4.2.1.4 Area

As documented in Tables 4 and 9 of this HRS documentation record, soil samples collected from Source 1 revealed the presence of numerous PAH compounds at concentrations above background levels, documenting an area of soil contamination. Table 5 of this HRS documentation record summarizes observations of contaminated soil. Prior to the November 2013 and June 2014 removal activities, the area of contaminated soil was estimated to be 12,447 square feet, as shown on Figure 2 of this HRS documentation record and using the samples summarized in Tables 4 and 9 of this HRS documentation record.

Because contaminated soils were excavated during the November 2013 and June 2014 removal activities in accordance with the Administrative Settlement Agreement and Order on Consent for Removal Action (Ref. 46, pp. 4, 9, 28, 37, 38), a conservative value of unknown, but greater than 0 is assigned as the Source 1 area assigned value to account for an unknown amount of soil contamination remaining at the source, as well as releases from the source to shallow ground water that were not addressed as part of the removal activities.

Area of Source (ft^2): Unknown, but >0

Equation for Assigning Value (Table 2-5): A/34,000
Area Assigned Value: >0

2.2.4.3 Source Hazardous Waste Quantity Value

The source hazardous waste quantity value is assigned the value for area of contaminated soil.

Highest assigned value assigned from Table 2-5: >0

Table 11 provides a summary of the Source 1 hazardous waste quantity factor value and containment factor values.

TABLE 11
SUMMARY OF SOURCE DESCRIPTIONS

Source Number	Source Hazardous Waste Quantity Value	Source Hazardous Constituent Quantity Complete? (Y/N)	Containment Factor Value by Pathway				
				SW		Air	
			GW (Table 3-2)	Overland/flood (Table 4-2)	GW to SW (Table 3-2)	Gas (Table 6-3)	Particulate (Table 6-9)
1	>0	N	10	NS	NS	NS	NS

Notes:
GW = Ground water
NS = Not scored
SW = Surface water

Description of Other Possible Sources

There are no other known source areas at the INL&P facility.

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 GENERAL CONSIDERATIONS

Site Geology

The EE/CA completed for INL&P included an investigation of ground water and site geology. Electrical conductivity (EC) probing was conducted to delineate the lithology of the subsurface of INL&P. EC probing is able to distinguish fine-grained from coarse-grained unconsolidated material that may indicate preferential pathways for contaminant migration. The probes were intended to be advanced to bedrock; however, bedrock was not encountered before refusal within glacial till. The depth to till is between 14.6 and 31.1 feet bgs (Ref. 34, p. 15).

The geology at INL&P is described in the EE/CA as follows: Alluvium and glacial till underlay INL&P. The upper portion of the alluvium consists mostly of stiff, low plasticity sandy or silty clay. The lower portion of the alluvium is composed of a medium- to course-grained sand with a few discontinuous clay lenses. One particular clay lens is present within the sand layer underneath a portion of INL&P at approximately 26 feet bgs. This clay lens was identified in EC probes EC-9 and EC-3 and was also observed in the soil boring for monitoring well MW-2B. The probes and monitoring well locations are shown in Figure 2-1, page 75 of Reference 34. However, the lens was not identified in any other EC probe or soil boring, which indicates the lens is not continuous throughout INL&P. Underlying the alluvium is glacial till composed mostly of very stiff sandy or silty clay. Soft, sandy clay was encountered below the sandy alluvium at monitoring well MW-3B. This material was distinctly different than the glacial till encountered at all of the other monitoring well locations. Based on the response of probe EC-02, it appears this material is approximately 8 feet thick. Because of the high clay content, this material is likely not a preferential pathway and does not alter the general site conceptual model (Ref. 34, p. 23). Geologic cross sections developed from boring and EC logs are shown on Figures 3-1, page 77, and 3-2, page 78 of Reference 34.

Geotechnical testing conducted as part of the EE/CA indicates that the bulk density and hydraulic conductivity of the shallow soil at the facility as determined from a sample collected from 5 to 7 feet bgs using American Society for Testing and Materials (ASTM) Method D5084-00 was lean clay with an average hydraulic conductivity of 3.73×10^{-5} centimeters per second (cm/sec) and a bulk density of 95.6 pounds per cubic foot (Ref. 34, p. 24). The laboratory data sheet associated with the geotechnical testing is located in Appendix I (page 438) of Reference 34.

Ground water levels were measured in all the INL&P monitoring wells during the EE/CA field investigation in July 2009. The depth to ground water at each well relative to the top of casing and the corresponding ground water elevation are presented in Table 3-1, page 57 of Reference 34. The ground water levels were used to generate potentiometric surface maps for water levels measured from both the "A" and "B" wells, Figure 3-3, page 79 of Reference 34, and Figure 3-4, page 80 of Reference 34. These maps indicate an east/southeast direction of ground water flow in the surficial aquifer across INL&P. The water levels indicate a negligible vertical gradient at wells MW-1A/B, MW-4A/B, and MW-6A/B. There is a slight upward gradient at wells MW-2A/B and MW-3A/B, indicating that the screened intervals are separated by a less permeable layer. This thin clay layer was observed and recorded in the boring logs. A slight downward gradient exists at wells MW-5A/B and MW-7A/B, which are the two southernmost wells. A downward gradient is typical of an area of recharge within the aquifer and indicates downward flow (Ref. 34, p. 26).

The EE/CA included a slug test data evaluation to calculate hydraulic conductivity. Calculated hydraulic conductivity ranges from 1.41×10^{-3} cm/sec in well MW-1A to 2.11×10^{-1} cm/sec in well MW-5B. The

average hydraulic conductivity of the upper portion of the alluvial sand is 9.18×10^{-3} cm/sec and 1.56×10^{-2} cm/sec for the lower portion of the alluvial sand. The horizontal flow velocities were calculated to be 45 feet per year in the upper portion of the alluvial sand and 86 feet per year in the lower portion of the alluvial sand (Ref. 34, p. 26). The slug test and ground water calculation sheets are presented in Appendix H (page 386) of Reference 34.

Ground Water Migration Pathway Description

Aquifer/Stratum 1 (uppermost): Surficial Alluvial Deposits

The soils at INL&P are classified as Muir silty clay loam. These soils are nearly level (0 to 1 percent slopes) on low stream terraces. The Muir silty clay loams are well drained, have surface runoff classified as slow, and have moderate permeability. These soils formed from silty alluvium in the flood plain of the Elkhorn River (Ref. 11, pp. 7, 9, 10, 11).

Norfolk is located on the alluvial plains of the Elkhorn River and its tributary, the North Fork of the Elkhorn River (Refs. 3; 11, p. 9). The unconsolidated materials underlying Norfolk consist of Quaternary age stream alluvium (sand, gravel, and silty clay) deposited by the Elkhorn River and North Fork of the Elkhorn River (Ref. 11, p. 3). Static water level measured during the ESI conducted in 2000 was approximately 14 feet bgs (Ref. 5, pp. 57, 58). The northwestern portion of Norfolk is underlain by glacial till and loess deposits, creating gently sloping to steep hills (Ref. 11, pp. 3, 9, 11). The unconsolidated materials are of Quaternary age and have an approximate thickness of 40 to 50 feet in the North Fork Elkhorn River flood plain (Refs. 3; 10, pp. 34, 35; 11, p. 3). The alluvial and glacial deposits form a surficial aquifer, from which nearby private wells and municipal wells near the West Water Treatment Plant draw potable water supplies. The primary sources of ground water in Madison County are the sands and gravels of the surficial alluvial deposits that overlie the bedrock through most of the county. Well depths in the Elkhorn Valley commonly range from 50 to 150 feet. Depths to water generally range from 10 to 20 feet near the Elkhorn River to as much as 50 feet along the valley sides. In the upland, as much as 200 feet of loess and till may overlie the sand and gravel of the surficial alluvial deposits. Wells depths in the uplands generally range from 175 to 300 feet and water levels generally range from 75 to 175 feet (Ref. 11, p. 3).

Aquifer/Stratum 2 (lowest): Niobrara Chalk

The unconsolidated sands and gravels of the surficial alluvial deposits are underlain by Cretaceous age Niobrara chalk (Refs. 11, p. 3; 10, pp. 12, 35). This unit is estimated to be from 100 to 200 feet thick and consists of marine chalky shale and chalk that is light- to medium-gray and yellow (Ref. 18, pp. 3, 4). Ground water is derived from open fractures, crevices, and solution cavities within the chalk, and the water withdrawn from the chalk is replaced by recharge from the overlying unconsolidated surficial alluvial deposits (Refs. 18, p. 3; 11, p. 4). The Niobrara chalk is not extensively used for water supplies (Ref. 11, p. 4). The unconsolidated sands and gravels of the surficial alluvial deposits and the chalk formation are considered interconnected and will be evaluated as one hydrologic unit. Municipal well logs for G-49313 (west), G-70116 (east) indicate that sands directly over lie chalk rock or are separated by a thin (less than three-feet-thick) stringer of clay(Refs. 10, pp. 12, 34, 35, 87, 88, 93) A generalized stratigraphic column of the local geology is presented as Figure 5-1 in the ESI report (Ref. 5, p. 30). Table 12 provides a summary of aquifers evaluated at the site.

As shown in Reference 3, all target wells within the four mile target distance limit are within the broad alluvial floodplains of the North Fork Elkhorn River and the Elkhorn River. There are no known geologic features that completely transect the surficial alluvial deposits and Niobrara Chalk formation.

TABLE 12
SUMMARY OF AQUIFER(S) BEING EVALUATED

Aquifer Number	Aquifer Name	Is Aquifer Interconnected with Upper Aquifer within 2 miles? (Y/N/NA)	Is Aquifer Continuous within 4-mile TDL? (Yes/No)	Is Aquifer Karst? (Yes/No)
1	Surficial Alluvial Deposits (Alluvium)	Not applicable	Yes	No
2	Niobrara Chalk	Yes	Yes	No

3.1 LIKELIHOOD OF RELEASE

3.1.1 OBSERVED RELEASE

Direct Observation

Soil borings collected from the facility contained tar. The depth to water at the site ranges from 10.6 to 13.8 feet below the top of monitoring well casings (Ref. 34, p. 57). Potential dense non-aqueous phase liquids (DNAPL) were found from approximately 8 to 34.5 feet below ground surface in the vicinity of Source 1 (Ref. 34, pp. 36, 91). The tool used to detect DNAPL was designed specifically to detect tar in the subsurface (Ref. 34, p. 17). This suggests DNAPL tar is present below the water table.

Chemical Analysis

Establishing an observed release by chemical analysis requires analytical evidence of a hazardous substance in the medium at a concentration significantly above the background level. 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. If the SQL cannot be established, the EPA contract-required quantitation limit (CRQL) is used in place of the SQL for samples analyzed under the EPA Contract Laboratory Program (CLP), or the detection limit for sample not analyzed under the EPA CLP (Ref. 1, Section 2.3, Table 2-3). All hazardous substances listed in the ground water observed release tables meet these criteria.

Basis for Chemical Analysis:

Data collected during the ESI and the EE/CA ground water investigation from on-facility monitoring wells and temporary monitoring wells document an observed release by chemical analysis to the interconnected shallow surficial alluvial deposits (alluvium) and Cretaceous age Niobrara chalk aquifer systems (Refs. 5; 34, p. 85). The data from the ESI and EE/CA investigations used to document an observed release to the interconnected shallow surficial alluvial deposits and Cretaceous age Niobrara chalk systems are discussed in the sections below. This aquifer system will be referred to as the interconnected alluvium and Niobrara chalk aquifer system.

An observed release by chemical analysis also is supported by the 1992 sampling conducted by HDR Engineering, Inc. During the 1992 sampling, three monitoring wells (MW-101, MW-104, and MW-106) were sampled and analyzed for VOCs, SVOCs, metals, and cyanides (Ref. 7, pp. 7, 18, 30, 45, 47, 58-74). However, this investigation is not used to document an observed release to the aquifer because the data are more than 15 years old.

Expanded Site Inspection: Observed Release by Chemical Analysis:

As documented in the sections below, the data collected during the ESI documents an observed release to the interconnected alluvium and Niobrara chalk aquifer systems by extensive distribution of clean background temporary monitoring wells screened in the same aquifer at similar depths as the release wells (Ref. 5, pp. 19, 56-64, 68-72, 130). The ESI field activities were conducted by E&E between March 19 and 25, 2000, and were completed in accordance with the site-specific QAPP (Refs. 5, p. 13; 13). During the ESI field work, 20 ground water samples were collected and analyzed using the mobile laboratory in accordance with the START MLP QAPP. Fourteen DPT ground water confirmatory samples were submitted to the EPA Region 7 laboratory for confirmation analysis (Ref. 5, pp. 13, 18, 19, 56-64, 68-72, 83, 130, 206 - 209). All municipal well samples and private well samples were submitted for analysis (Ref. 5, pp. 13, 130). Appendices B and C of Reference 5 provide a copy of the chain-of-custody form, field sheets, and analytical data (Ref. 5, pp. 55 - 210). Samples collected by START were analyzed by the EPA Region 7 laboratory under ASR number 539, activity number TJC13 (Ref. 5, pp.

128, 131). The laboratory analyzed the samples in accordance with EPA Region 7 SOP 1640.1A, EPA Region 7 Laboratory Quality Assurance Project Plan (Ref. 13, p. 29). SVOCs were analyzed in accordance the EPA Region 7 SOP 3230.2B for extraction and analysis of water and solids for SVOC, dated February 1995. VOCs were analyzed in accordance with EPA Region 7 SOP 3230.1C, GC/MS Analysis for VOCs, dated October 1993. The metals were analyzed in accordance the EPA Region 7 SOP 3122.2B, analysis for metals by TJA ICAP 61, April 1995 (Ref. 13, p. 31). The data were validated in accordance with procedures outlined in Section 6.5 of Reference 13 (Ref. 13, p. 34). The chain-of custody form for the samples collected during the ESI and sent to the EPA Region 7 laboratory is provided as Appendix B of Reference 5, pages 124 to 127. The logbook notes documenting sampling are provided as Appendix D (page 211) of Reference 5.

During the ESI, ground water samples were collected from six municipal wells (wells 1 through 5, and 10), and four private or commercial wells (Ref. 15, pp. 1, 2, 9). All samples from private and municipal wells were analyzed by the EPA Region 7 laboratory for drinking water VOCs (Refs. 5, pp. 128, 130, 132, 149, 155, 160; 15, pp. 2, 9). In addition, ground water samples were collected from temporary monitoring wells. Twenty locations were sampled from a 4-foot-long screen at depths of either 18 to 22, 29 to 33, 33 to 37, or 36 to 40 feet bgs (Ref. 15, pp. 2, 6). A ground water sample was collected at each location and analyzed by an on-site field laboratory for benzene and target PAH compounds including naphthalene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)pyrene (Ref. 15, p. 2). Fourteen samples from 12 of these locations were also submitted to the EPA Region 7 laboratory for confirmation analysis (Ref. 15, p. 9). A ground water sample was also collected from monitoring well PG-1. It is believed that this well is the same as well MW-101 that was installed and sampled as part of the 1992 investigation (Refs. 15, pp. 2, 6, 9; 13, p. 20; 7, p. 7). The other two monitoring wells installed previously could not be located during the ESI (Ref. 5, p. 19).

Expanded Site Inspection Background Concentrations:

During the ESI, background concentrations in temporary monitoring wells are represented by wells GP-4, GP-5, GP-8, GP-11, and GP-30. As shown on Figure 3-2 of the ESI report, wells GP-4, GP-5, and GP-8 are all located west- northwest of INL&P (Ref. 5, p. 18). GP-11 is located northeast and GP-30 is located south (Ref. 5, p. 18). Temporary wells GP-4, GP-5, GP-11, and GP-30 were screened at a depth of 18 to 22 feet bgs and well GP-8 was screened at a depth of 33 to 37 feet bgs (Ref. 5, pp. 57, 58, 59, 70, 72). The temporary wells were not surveyed; therefore, an elevation of the screened interval is not provided. The field sheets documenting the sample collection date and time are provided in Appendix B of Reference 5 (Ref. 5, p. 55). Appendix B also provides the chain-of-custody records for the background samples.

These wells were chosen as background wells because they are upgradient or in some cases side gradient of Source 1 (Refs. 15, Figure 2, p. 6; 5, pp. 18, 19, 21, 29, 31, 41; 34, pp. 79, 80). Temporary wells GP-4, GP-5, GP-11, GP-8, and GP-30 are located approximately, 0.06, 0.04, 0.14, 0.19 and 0.04 mile upgradient/cross-gradient from Source 1, respectively. (See Figure 2 of this HRS documentation record; Ref. 15, p. 6) The ground water samples collected from the background and release wells were collected from similar depths in the aquifer (screened intervals), as documented in Tables 13 and 15 below. The field sheets rather than logbooks were used to document sample collection time and locations in Tables 13 and 15. The samples were collected during the same time frame using the same sample collection procedures and analytical methods (Ref. 5, pp. 19, 21). The construction details for the background monitoring wells are provided in Table 13 below. Table 14 below summarizes the concentrations of hazardous substances detected in the background wells. The samples were assigned laboratory sample numbers on the chain-of-custody form (Ref. 5, pp. 124 - 127; 15, pp. 9, 10). The laboratory sample numbers are used on the analytical data sheets to identify the sample.

TABLE 13
2000 EXPANDED SITE INSPECTION
BACKGROUND MONITORING WELL CONSTRUCTION DETAILS

Sample Identification	Laboratory Sample Identification	Screened Interval (ft bgs)	Date	Reference
GP-4	2	18 - 22	3/22/00	5, pp. 57, 130
GP-5	3	18 - 22	3/22/00	5, pp. 58, 130
GP-11	15	18 - 22	3/25/00	5, pp. 70, 130
GP-30	17	18 - 22	3/25/00	5, pp. 72, 130, 234
GP-8	4	33 - 37	3/24/00	5, pp. 59, 130, 216, 229, 233

Notes:
bgs Below ground surface
ft Feet
GP Geoprobe

TABLE 14

2000 EXPANDED SITE INSPECTION BACKGROUND CONCENTRATIONS

Sample Identification	Hazardous Substance	Concentration (µg/L)	Sample Quantitation Limit (µg/L)	References
GP-4 (Laboratory Sample 2)	Acenaphthene	2.0 U	2.0	5, pp. 57, 124, 130, 133, 134, 135; 45, pp. 4, 5
	Acenaphthylene	2.0 U	2.0	
	Anthracene	2.0 U	2.0	
	Benzo(a)anthracene	2.0 U	2.0	
	Benzo(a)pyrene	2.0 U	2.0	
	Benzo(b)fluoranthene	2.0 U	2.0	
	Benzo(g,h,i)perylene	2.0 U	2.0	
	Benzo(k)fluoranthene	2.0 U	2.0	
	Chrysene	2.0 U	2.0	
	Fluoranthene	2.0 U	2.0	
	Fluorene	2.0 U	2.0	
	Indeno(1,2,3-c,d)pyrene	2.0 U	2.0	
	2-Methylnaphthalene	2.0 U	2.0	
	Naphthalene	2.0 U	2.0	
	Phenanthrene	2.0 U	2.0	
	Pyrene	2.0 U	2.0	
GP-5 (Laboratory Sample 3)	Acenaphthene	2.0 U	2.0	5, pp. 58, 124, 130, 133, 134; 45, pp. 7, 8
	Acenaphthylene	2.0 U	2.0	
	Anthracene	2.0 U	2.0	
	Benzo(a)anthracene	2.0 U	2.0	
	Benzo(a)pyrene	2.0 U	2.0	
	Benzo(b)fluoranthene	2.0 U	2.0	
	Benzo(g,h,i)perylene	2.0 U	2.0	
	Benzo(k)fluoranthene	2.0 U	2.0	
	Chrysene	2.0 U	2.0	
	Fluoranthene	2.0 U	2.0	
	Fluorene	2.0 U	2.0	
	Indeno(1,2,3-c,d)pyrene	2.0 U	2.0	
	2-Methylnaphthalene	2.0 U	2.0	
	Naphthalene	2.0 U	2.0	
	Phenanthrene	2.0 U	2.0	
	Pyrene	2.0 U	2.0	

TABLE 14

2000 EXPANDED SITE INSPECTION BACKGROUND CONCENTRATIONS

Sample Identification	Hazardous Substance	Concentration (µg/L)	Sample Quantitation Limit (µg/L)	References
GP-11 (Laboratory Sample 15)	Acenaphthene	2.0 U	2.0	5, pp. 70, 127, 130, 143, 144, 217; 45, p. 41, 42
	Acenaphthylene	2.0 U	2.0	
	Anthracene	2.0 U	2.0	
	Benzo(a)anthracene	2.0 U	2.0	
	Benzo(a)pyrene	2.0 U	2.0	
	Benzo(b)fluoranthene	2.0 U	2.0	
	Benzo(g,h,i)perylene	2.0 U	2.0	
	Benzo(k)fluoranthene	2.0 U	2.0	
	Chrysene	2.0 U	2.0	
	Fluoranthene	2.0 U	2.0	
	Fluorene	2.0 U	2.0	
	Indeno(1,2,3-c,d)pyrene	2.0 U	2.0	
	2-Methylnaphthalene	2.0 U	2.0	
	Naphthalene	2.0 U	2.0	
	Phenanthrene	2.0 U	2.0	
	Pyrene	2.0 U	2.0	
GP-30 (Laboratory Sample 17)	Acenaphthene	2.0 U	2.0	5, pp. 72, 130, 147, 148; 45, pp. 47, 48
	Acenaphthylene	2.0 U	2.0	
	Anthracene	2.0 U	2.0	
	Benzo(a)anthracene	2.0 U	2.0	
	Benzo(a)pyrene	2.0 U	2.0	
	Benzo(b)fluoranthene	2.0 U	2.0	
	Benzo(g,h,i)perylene	2.0 U	2.0	
	Benzo(k)fluoranthene	2.0 U	2.0	
	Chrysene	2.0 U	2.0	
	Fluoranthene	2.0 U	2.0	
	Fluorene	2.0 U	2.0	
	Indeno(1,2,3-c,d)pyrene	2.0 U	2.0	
	2-Methylnaphthalene	2.0 U	2.0	
	Naphthalene	2.0 U	2.0	
	Phenanthrene	2.0 U	2.0	
	Pyrene	2.0 U	2.0	

TABLE 14

2000 EXPANDED SITE INSPECTION BACKGROUND CONCENTRATIONS

Sample Identification	Hazardous Substance	Concentration (µg/L)	Sample Quantitation Limit (µg/L)	References
GP-8 (Laboratory Sample 4)	Acenaphthene	2.0 U	2.0	5, pp. 59, 130, 133, 134; 45, pp. 10, 11
	Acenaphthylene	2.0 U	2.0	
	Anthracene	2.0 U	2.0	
	Benzo(a)anthracene	2.0 U	2.0	
	Benzo(a)pyrene	2.0 U	2.0	
	Benzo(b)fluoranthene	2.0 U	2.0	
	Benzo(g,h,i)perylene	2.0 U	2.0	
	Benzo(k)fluoranthene	2.0 U	2.0	
	Chrysene	2.0 U	2.0	
	Fluoranthene	2.0 U	2.0	
	Fluorene	2.0 U	2.0	
	Indeno(1,2,3-c,d)pyrene	2.0 U	2.0	
	2-Methylnaphthalene	2.0 U	2.0	
	Naphthalene	2.0 U	2.0	
	Phenanthrene	2.0 U	2.0	
	Pyrene	2.0 U	2.0	

Notes:

GP Geoprobe ground water sample
ND Not detected
µg/L Micrograms per liter
U Not detected at or above the reportable level shown (Ref. 5, p. 129).

2000 Expanded Site Inspection - Contaminated Samples:

During the ESI, releases of hazardous constituents related to INL&P were reported in municipal, monitoring, and temporary monitoring wells, all located hydrologically downgradient of INL&P. During the ESI, temporary and permanent monitoring well samples were analyzed for low detection limit VOCs, dissolved metals, total cyanide, and SVOCs (Ref. 15, p. 9). Samples from private and municipal wells were analyzed for drinking water VOCs, ethylene dibromide (EDB), dibromochloropropane (DBCP), total and dissolved metals, total cyanide, SVOCs, and PAHs (Ref. 15, p. 9). The temporary monitoring wells that contained elevated levels of contaminants were GP-3, GP-23, and GP-28. All of these wells were located east and downgradient of INL&P (see Figure 2 page 6 of Reference 15) (Ref. 15, p. 6). Temporary wells GP-23, and GP-28 were screened at a depth of 18 to 22 feet bgs (Ref. 5, pp. 60, 62). The temporary wells were not surveyed; therefore, an elevation of the screened interval is not provided. The construction details for the release monitoring wells are provided in Table 15 below. Table 16 below summarizes the concentrations of hazardous substances detected in the release wells. The samples were assigned laboratory sample numbers on the chain-of-custody (Refs. 5, pp. 124 - 127; 15, pp. 9, 10). Direction of ground water flow at INL&P is east-southeast (Ref. 5, pp. 29, 31). Therefore, the release wells are located hydrologically downgradient of Source 1. The sample identifications are used on the analytical data sheets to identify the sample.

TABLE 15
2000 EXPANDED SITE INSPECTION
RELEASE MONITORING WELL CONSTRUCTION DETAILS

Sample Identification	Laboratory Sample Number	Screened Interval (ft bgs)	Date	References
GP-3	1	20 - 24	3/21/00	15, pp. 6, 9; 5, pp. 56, 130
GP-23	5	18 - 22	3/24/00	15, pp. 6, 9; 5, pp. 60, 130
GP-28	7	18 - 22	3/24/00	15, pp. 6, 9; 5, pp. 62, 130

Notes:
bgs Below ground surface
ft Feet
GP Geoprobe ground water sample
MW Monitoring well

TABLE 16
2000 EXPANDED SITE INSPECTION RELEASE CONCENTRATIONS

Sample Identification	Hazardous Substance	Concentration	Sample Quantitation Limit (SQL)	Background Concentration[A] (SQL) (see Table 14)	References
		Units: **(µg/L)**			
GP-3 (Laboratory Sample 1)	Acenaphthene	360	10	ND (2)	5, pp. 56, 130, 133, 134; 45, pp. 1, 2
	Acenaphthylene	700	10	ND (2)	
	Anthracene	300	10	ND (2)	
	Benzo(a)anthracene	160	10	ND (2)	
	Benzo(a)pyrene	130	10	ND (2)	
	Benzo(b)fluoranthene	60	10	ND (2)	
	Benzo(g,h,i)perylene	43	10	ND (2)	
	Benzo(k)fluoranthene	77	10	ND (2)	
	Chrysene	190	10	ND (2)	
	Fluoranthene	310	10	ND (2)	
	Fluorene	230	10	ND (2)	
	Indeno(1,2,3-c,d)pyrene	42	10	ND (2)	
	2-Methylnaphthalene	140	10	ND (2)	
	Naphthalene	400	10	ND (2)	
	Phenanthrene	1,200	10	ND (2)	
	Pyrene	530	10	ND (2)	
GP-23 (Laboratory Sample 5)	Acenaphthene	33	2.0	ND (2)	5, pp. 60, 130, 136, 137, 138; 45, pp. 13, 14
	Acenaphthylene	5.4	2.0	ND (2)	
	Naphthalene	49	2.0	ND (2)	
GP-28 (Laboratory Sample 7)	Acenaphthene	290	10	ND (2)	5, pp. 62, 130, 136, 137, 138; 45, pp. 19, 20, 21
	Acenaphthylene	280	10	ND (2)	
	Anthracene	85	10	ND (2)	
	Benzo(a)anthracene	21	10	ND (2)	
	Benzo(a)pyrene	25	10	ND (2)	
	Benzo(k)fluoranthene	15	10	ND (2)	
	Chrysene	25	10	ND (2)	
	Fluoranthene	69	10	ND (2)	
	Fluorene	130	10	ND (2)	
	2-Methylnaphthalene	92	10	ND (2)	
	Naphthalene	690	10	ND (2)	
	Phenanthrene	280	10	ND (2)	
	Pyrene	97	10	ND (2)	

Notes:

[A] The background concentrations and sample quantitation limits (SQL) are documented in Table 14 of this HRS documentation record. As documented in Table 14, the SQL for the semivolatile organic compounds such as acenaphthene is 2 µg/L.

GP Geoprobe ground water sample

ND Not detected

µg/L Micrograms per liter

Ground Water Sampling - Engineering Evaluation/Cost Analysis (EE/CA)

The EE/CA field investigation occurred in November and December 2007, June and July 2009, and January 2010. The field activities were completed as specified in the work plan, technical memorandum 1, and field sampling plan (Refs. 37; 38; 40). Table 2-1 outlines significant deviations to the planned work (Ref. 34, pp. 14, 55).

The ground water field investigation included advancing laser-induced fluorescence (LIF) and ground water probes; installing and developing monitoring wells; measuring ground water elevations; collecting ground water samples; and surveying. Sampling included collection of ground water samples from direct-push probes and from newly installed monitoring wells for chemical analysis. The EE/CA field activities were designed to gather data to better define and characterize the subsurface geology and site hydrogeology and the approximate extent of DNAPL and dissolved-phase ground water contamination at the INL&P (Ref. 34, p. 14). Aquifer testing also was performed (Ref. 34, p. 16).

Fourteen ground water probes were advanced on INL&P and three samples were collected from each probe, for a total of 42 ground water samples, to delineate the horizontal and approximate vertical extent of ground water contamination (Ref. 34, pp. 17, 29). The samples were analyzed for PAHs by SW-846 Method 8270-SIM and for VOCs by SW-846 Method 8260B. All PAH data were reported as Level II quality data. Figure 2-1, page 75 of Reference 34 shows the probe locations (Ref. 34, p. 17).

In November and December 2007, ground water probes were advanced to refusal within the glacial till. An attempt was made to collect a sample at the refusal depth. If no water was present, the probe was retracted and a sample was collected at the interface of the sand and till. The probe was then retracted to the midpoint of the sand unit or to a depth where potential DNAPL was indicated by LIF probing to collect the "intermediate" sample. The probe was retracted a third time to collect the sample at the top of the sand unit. This procedure was used for the ground water probes advanced west of 6th Street. Although the potentiometric surface was measured at approximately 12 feet bgs, it was within a silty clay unit that did not produce much water. Therefore, the shallow sample was collected at the top of the sand unit (Refs. 34, pp. 17, 18, 85, 277 - 294).

Water was present in the till unit for ground water probe samples collected east of 6th Street. Therefore, the "deep" sample was collected from the point of probe refusal in the till. The probe was then retracted and a sample was collected from the interface of the sand and till to evaluate whether contamination was sinking and pooling on top of the till downgradient from the site. The probe was again retracted to the top of the sand, where the third, shallow sample was collected (Ref. 34, p. 18).

Monitoring wells were installed in soil borings with 8½-inch outside diameter (OD), 4¼-inch inside diameter hollow stem augers. Each boring was continuously sampled by driving 2-foot split-spoon samplers. The borings were logged to record stratigraphy and visible contamination and were screened for VOCs with a PID and the results recorded on the boring logs. Two nested monitoring wells were installed at each location to monitor the upper and lower portions (designated with the letters "A" and "B") of the surficial aquifer. Table 2-2, page 56 of Reference 34 lists the depth and screened interval for each newly installed well. All wells are constructed of 2-inch OD Schedule 40 polyvinyl chloride pipe with 0.010-inch wide factory slots. Shallow wells have 9.5-foot screens and the deep wells have 4.8-foot screens (Ref. 34 p. 18). Ground water samples were collected in July 2009 (Ref. 34, pp. 85, 295 – 315, 341 – 354).

The EE/CA ground water sampling investigation was performed in July 2009. All monitoring wells were purged and sampled in accordance with the QAPP (Ref. 38) using low-flow sampling procedures. Before sampling, the wells were allowed to equilibrate with the surrounding formation and ground water levels were measured. In addition, wells MW-2A and MW-2B were measured for light and dense nonaqueous

phase liquid. Also during purging, field measurements [dissolved oxygen (DO), oxidation-reduction potential (ORP), pH, temperature, turbidity, and specific conductivity were recorded. No field parameters were measured for wells where there was an oily sheen on the water (wells MW-2A and MW-2B) (Ref. 34, p. 19). The ground water sampling forms for each well are presented in Appendix G of Reference 34.

After wells were purged, ground water samples were collected from each monitoring well for chemical analysis of VOCs by SW-846 Method 8260B, PAHs by SW-846 Method 8270 - SIM, selected total metals (arsenic, barium, cadmium, chromium, and lead) by SW-846 Method 6010B, and total and amenable cyanide by SM 4500CN-E/4500CN-G. All BTEX, PAH, and cyanide data were reported as Level IV quality data. Existing monitoring well MW-104 was not found during the EE/CA field investigation (Ref. 34, pp. 19, 20).

Fifteen ground water samples were collected from 14 ground water monitoring wells. All samples were analyzed for BTEXs, PAHs, and inorganic constituents (arsenic, barium, cadmium, chromium, lead, and cyanide) (Ref. 34, p. 29). The analytical results from the monitoring well samples are used to document an observed release to ground water. The samples collected from the ground water probes are not used to document an observed release to ground water because the ground water samples were not collected from properly installed monitoring wells. The ground water probe samples contained VOCs and PAHs (Ref. 34, pp. 30, 31).

EE/CA DNAPL Delineation:

The EE/CA also included delineation of the approximate horizontal and vertical extent of potential DNAPL in the saturated portion of the subsurface. The delineation involved advancing 18 probes equipped with a LIF tool designed specifically to detect tar in the subsurface. The LIF tool detects tar by emitting a laser light that causes electrons in the tar to excite and fluoresce. A sensor on the LIF tool then measures the intensity of the fluorescence to provide a qualitative result on the amount present. In general, the stronger the signal, the more likely tar is present. The LIF probe locations were selected based on the locations of historical MGP structures from Sanborn Maps and historical investigation results (Refs. 34, p. 17; 37, p. 8). The locations of the LIF probes are shown on Figure 2-1, page 75 of Reference 34, and the LIF logs and data files are included in Appendix D of Reference 34. In addition, three soil probes (SP-5, SP-6, and SP-8) were advanced and continuously sampled and logged to verify data obtained with the LIF probes (Ref. 34, p. 17).

Probes LIF-01, LIF-03, LIF-06, LIF-07, LIF-08, and LIF-09 were advanced near historical MGP structures. As shown in Table 4-6, page 63 of Reference 34, these probes indicate potential DNAPL from approximately 8 to 34.5 feet bgs. No DNAPL was identified below approximately 25 feet in the probes advanced south of the alley that bisects INL&P, likely a result of the presence of the clay lens identified during EC probing and previously discussed. However, probes LIF-02, LIF-04, LIF-14, and LIF-15, east of INL&P, indicate potential DNAPL below 25 feet. Probes LIF-02, LIF-04, LIF-14, and LIF-15 are located approximately 60 feet, 112 feet, 130 feet, and 135 feet from Source 1 (Figure 2 of this HRS documentation record; Ref. 34, p. 75). This finding suggests that the clay layer is not continuous east of 7th Street. The thickness of the potential DNAPL indicated by the LIF probes decreases significantly east of INL&P. No DNAPL was indicated in probes LIF-05, LIF-10, LIF-11, LIF-12, LIF-13, LIF-16, LIF-17, or LIF-18, indicating that DNAPL has not migrated downgradient of these locations and is confined to INL&P (Ref. 34, pp. 36, 37). The LIF logs are presented in Appendix C of Reference 34.

The approximate extent of DNAPL contamination as of 2009 is shown in Figure 4-11, page 91 of Reference 34.

Background Concentrations:

Each monitoring well was installed as nested pairs one well screened in the shallow and one screened in the deeper portions of the alluvium during the 2009 EE/CA ground water investigation. Monitoring wells screened in the shallow portion of the alluvium were assigned the prefix A, and the monitoring wells screened in the deeper portion have the prefix B. Well MW-1A is the background well for the shallow portion of the alluvium, and MW-1B is the background well for the deep portion of the alluvium. The locations of the monitoring wells are shown in Reference 34, Figure 2-1 page 75. These wells were chosen as background because they are upgradient of Source 1 (Ref. 34, Figure 3-3, p. 79 and Figure 3-4, p. 80). The ground water samples from the background and release wells were collected from similar depths in the aquifer (screened intervals), as documented in Table 17 below. The samples were collected during the same time frame using the same sample collection procedures and analytical method (Refs. 34, p. 19; 37; 38). The construction details for both the background and the release monitoring wells are provided in Table 17 below.

The concentrations of hazardous substances detected in the background wells are summarized in Table 18 for the wells screened in the shallow portion of the aquifer and in Table 19 for the wells screened in the deeper portion of the aquifer.

TABLE 17
EE/CA MONITORING WELL DEPTH AND SCREENED INTERVAL

Monitoring Well[A]	Sample Date	Total Depth (ft bgs)	Screened Interval (ft bgs)	Screened Interval (ft above msl)	TOC Elevation (msl)	Depth to Water (ft btoc)	Ground Water Elevation (msl)	Reference 34
MW-1A	07/08/2009	20.2	10.3–19.8	1502.9 – 1512.4	1522.35	10.62	1511.73	pp. 56, 57, 295, 341, 372
MW-1B	07/08/2009	28.0	23–27.8	1495.0 – 1499.8	1522.31	10.60	1511.71	pp. 56, 57, 296, 297, 342, 373
MW-2A	07/07/2009	26.4	16.5–26	1495.9 - 1505.4	1521.43	11.41	1510.02	pp. 56, 57, 298, 343, 374
MW-2B	07/07/2009	34.5	29.5–34.3	1487.9 – 1492.7	1521.55	11.41	1510.14	pp. 56, 57, 299, 300, 344, 375
MW-3A	07/06/2009	26.1	16.2–25.7	1498.1 – 1507.6	1523.00	13.73	1509.27	pp. 56, 57, 301, 345, 376
MW-3B	07/06/2009	38.0	32.8–37.6	1486.2 – 1491.0	1523.48	13.67	1509.81	pp. 56, 57, 302, 303, 346, 377
MW-4A	07/07/2009	25.0	15.1–24.6	1499.1 – 1508.6	1523.22	13.73	1509.49	pp. 56, 57, 304, 347, 378
MW-4B	07/07/2009	33.0	28–32.8	1490.8 – 1495.6	1523.23	13.72	1509.51	pp. 56, 57, 305, 306, 348, 378
MW-5A	07/07/2009	20.3	10.4–19.9	1502.9 – 1512.4	1522.40	13.77	1508.63	pp. 56, 57, 307, 349, 380
MW-5B	07/07/2009	35.6	30.6–35.4	1487.4 – 1492.2	1522.34	13.80	1508.54	pp. 56, 57, 308, 309, 350, 381
MW-6A	07/07/2009	23.2	13.3–22.8	1498.0 – 1507.5	1520.54	12.75	1507.79	pp. 56, 57, 310, 351, 382
MW-6B	07/07/2009	32.3	27.3–32.1	1488.7 – 1493.5	1520.51	12.71	1507.80	pp. 56, 57, 311, 312, 352, 383
MW-7A	07/07/2009	23.1	13.2–22.7	1496.8 – 1506.3	1519.17	11.76	1507.41	pp. 56, 57, 313, 353, 384
MW-7B	07/07/2009	32.5	27.5–32.3	1487.2 – 1492.0	1519.11	11.84	1507.27	pp. 56, 57, 314, 315, 354, 385

Notes:

[A] Wells designated with an "A" monitor ground water within the upper portion of the surficial aquifer. Wells designated with a "B" monitor ground water at the base of the surficial aquifer. MW-1A is the background well for wells screened in the shallow portion of the alluvium, and well MW-1B is the background well for wells screened in the deeper portion of the alluvium.

bgs Below ground surface
btoc Below top of casing
ft Feet
msl Mean sea level
MW Monitoring well
TOC Top of casing

TABLE 18
EE/CA BACKGROUND CONENTRATION – SHALLOW GROUND WATER

Sample Identification	Laboratory Sample Identification	Hazardous Substance	Concentration (µg/L)	Method Detection Limit (µg/L)	Reference 34
MW-1A	MW1AWOP1P	Benzo(a)pyrene	ND	0.051	p. 544
MW-1A	MW1AWOP1P	Benzo(b)fluoranthene	ND	0.051	p. 544
MW-1A	MW1AWOP1P	Benzo(g,h,i)perylene	ND	0.051	p. 544
MW-1A	MW1AWOP1P	Dibenzo(a,h)anthracene	ND	0.051	p. 544
MW-1A	MW1AWOP1P	Fluoranthene	0.12	0.051	p. 544
MW-1A	MW1AWOP1P	Phenanthrene	ND	0.051	p. 544

Notes
< Analyte was not detected at or above the method detection limit, which is presented.
MW Monitoring well
µg/L Microgram per liter
ND Analyte was not detected at or above the method detection limit (Ref. 34, p. 60)

TABLE 19
EE/CA BACKGROUND CONENTRATION – DEEP GROUND WATER

Sample Identification	Laboratory Sample Identification	Hazardous Substance	Concentration (µg/L)	Method Detection Limit (µg/L)	Reference 34
MW-1B	MW1BWOP1P	Acenaphthene	ND	0.05	p. 546
MW-1B	MW1BWOP1P	Acenaphthylene	ND	0.05	p. 546
MW-1B	MW1BWOP1P	Benzo(a)anthracene	ND	0.05	p. 546
MW-1B	MW1BWOP1P	Benzo(a)pyrene	ND	0.05	p. 546
MW-1B	MW1BWOP1P	Benzo(b)fluoranthene	ND	0.05	p. 546
MW-1B	MW1BWOP1P	Benzo(g,h,i)perylene	ND	0.05	p. 546
MW-1B	MW1BWOP1P	Benzo(k)fluoranthene	ND	0.05	p. 546
MW-1B	MW1BWOP1P	Fluoranthene	0.087	0.05	p. 547
MW-1B	MW1BWOP1P	Naphthalene	0.13	0.05	p. 547
MW-1B	MW1BWOP1P	Phenanthrene	ND	0.05	p. 547

Notes:
< Analyte was not detected at or above the method detection limit, which is presented.
MW Monitoring well
µg/L Microgram per liter
ND Analyte was not detected at or above the method detection limit (Ref. 34, p. 60)

Release Concentrations:

The concentrations of hazardous substances that meet the criteria for documenting an observed release to ground water are summarized in Table 20for wells screened in the shallow portion of the alluvium and in Table 21 for wells in the deep portion of the alluvium. Tar-saturated sand was encountered in the soil boring retrieved from well MW-2B (Ref. 34, pp. 299, 300). Tar was encountered in the boring from well MW-6B (Ref. 34, p. 311).

TABLE 20
EE/CA RELEASE CONENTRATION – SHALLOW GROUND WATER
(Background Monitoring Well MW-1A)

Sample Identification	Hazardous Substance	Concentrations (adjusted concentration) (µg/L)	Method Detection Limit (µg/L)	Background Concentration (µg/L) (see Table 18)	Reference 34
MW-2A	Benzo(a)pyrene	1.4	0.052	<0.051	p. 550
MW-6A		0.090	0.051		p. 568
MW-2A	Benzo(b)fluoranthene	1.4	0.052	<0.051	p. 550
MW-6A		0.10	0.051		p. 568
MW-2A	Benzo(g,h,i)perylene	0.57	0.052	<0.051	p. 550
MW-2A	Dibenzo(a,h)anthracene	0.12	0.052	<0.051	p. 551
MW-2A	Fluoranthene	10.9	0.052	0.12	p. 551
MW-3A		1.6	0.051		p. 555
MW-4A		3.8	0.054		p. 559
MW-6A		0.80	0.051		p. 568
MW-7A		0.58	0.05		p. 572
MW-2A	Phenanthrene	37.6J (3.76)	0.052	<0.051	p. 551
MW-3A		11.7	0.051		p. 555
MW-4A		37.1J (3.71)	0.054		p. 559
MW-6A		3.2	0.051		p. 568

Notes:
MW-1A is the background well for these wells. The background and release wells are screened in the shallow portion of the alluvium.
The ground water samples with estimated concentrations (J laboratory data qualified) are adjusted according to the EPA fact sheet *Using Qualified Data to Document an Observed Release and Observed Contamination,* Reference 44. The concentrations are divided by the adjustment factor value because the bias is unknown (Ref. 44, p. 8). The adjustment factors are benzene 1.64 and phenanthrene 10 (Ref. 44, pp. 11, 14, 15). The concentration in parenthesis is the adjusted concentrations.

< Analyte was not detected at or above the method detection limit, which is presented.
( ) Adjusted concentration (Ref. 44)
J Estimated concentration (Ref. 34, pp. 60, 615), the concentration in parenthesis is the adjusted concentration (Ref. 44).
MW Monitoring well
µg/L Microgram per liter

TABLE 21
EE/CA RELEASE CONENTRATION – DEEP GROUND WATER
(Background Monitoring Well MW-1B)

Sample Identification	Hazardous Substance	Concentrations (adjusted concentration) (µg/L)	Method Detection Limit (µg/L)	Background Concentration (µg/L) (see Table 19)	Reference 34
MW-2B	Acenaphthene	30.3J (8.34)	0.052	<0.05	p. 553
MW-4B		86.3J (23.77)	0.054		p. 561
MW-5B		0.81	0.053		p. 566
MW-7B		77.8J (21.43)	0.052		p. 574
MW-2B	Acenaphthylene	20.8	0.052	<0.05	p. 553
MW-3B		1.6	0.052		p. 557
MW-4B		4.5	0.054		p. 561
MW-5B		0.055	0.053		p. 566
MW-7B		3.8	0.052		p. 574
MW-2B	Benzo(a)anthracene	0.45	0.052	<0.05	p. 553
MW-2B	Benzo(a)pyrene	0.18	0.052	<0.05	p. 553
MW-2B	Benzo(b)fluoranthene	0.19	0.052	<0.05	p. 553
MW-2B	Benzo(g,h,i)perylene	0.073	0.052	<0.05	p. 553
MW-2B	Fluoranthene	9.5	0.052	0.087	p. 553
MW-3B		0.37	0.052		p. 557
MW-4B		2.8	0.054		p. 561
MW-7B		0.61	0.052		p. 574
MW-2B	Naphthalene	5.4	0.052	0.13	p. 553
MW-4B		48.9J (4.89)	0.054		p. 561
MW-7B		19.1	0.052		p. 574
MW-2B	Phenanthrene	42.5	0.052	<0.05	p. 553
MW-3B		1.3	0.052		p. 557
MW-4B		38.9J (3.89)	0.054		p. 561
MW-5B		0.41	0.053		p. 566
MW-7B		21.2J (2.12)	0.052		p. 574

Notes:
MW-1B is the background well for these monitoring wells. The background and release wells are screened in the deep portion of the alluvium.
The ground water samples with estimated concentrations (J laboratory data qualified) are adjusted according to the EPA fact sheet *Using Qualified Data to Document an Observed Release and Observed Contamination*, Reference 44. The concentrations are divided by the adjustment factor value because the bias in unknown (Ref. 44, p. 8). The adjustment factors are acenaphthene 3.63; naphthalene 10; and phenanthrene 10 (Ref. 44, pp. 14, 15).
< Analyte was not detected at or above the method detection limit, which is presented.
( ) Adjusted concentration (Ref. 44)
J Estimated concentration (Ref. 34, pp. 60, 615), the concentration in parenthesis is the adjusted concentration (Ref. 44).
MW Monitoring well
µg/L Microgram per liter

Attribution

The Iowa-Nebraska Light and Power Company operated under numerous names in Norfolk, Nebraska, from about 1907 through the mid- to late-1940s (Refs. 6, p. 3; 8, pp. 8, 9; 9. During this time, the facility operated as a manufactured gas plant (Ref. 7, pp. 3, 5). Operations at the facility used fossil fuel (coal and oil) as a feedstock to produce a combustible gaseous product that was used for lighting and heating (Refs. 8, p. 9; 9, pp. 3-5). The manufacturing process generated several byproducts including tars, sludges, tar liquors and ammonia liquor, spent iron oxide ash, slag, and clinkers (Ref. 19, pp. 3 - 32). The coal tars are composed of polycyclic aromatic hydrocarbons (PAHs), phenolic compounds, light aromatic compounds, and small quantities of inorganic constituents (Refs. 8, pp. 9, 11; 19, pp. 9 through 14). In the early years from 1900 to 1924, the facility used a Tenney and Springer process (Ref. 9, pp. 2 - 24). Between 1926 and 1930, the process was described as water gas (Ref. 9, pp. 25 - 29). Between 1932 and 1935, the process was described as carbureted water gas (Ref. 9, pp. 30 - 33).

Generators produced a combustible gas using coke, steam, and oil products (Ref. 39, p. 6). As the gas cooled through the production process, coal tar would fall from suspension in the gas and become a waste product (Ref. 39, p. 6). A scrubber was used to condense the gas (Ref. 39, p. 6). Coal tar was ultimately separated from the condensate water (Ref. 39, p. 6). Purifier boxes were used to remove sulfides and cyanides from the cool gas. Iron oxides were mixed with fluffing material (primarily wood chips, sawdust and corncobs) in the purifier boxes to provide for additional removal of water vapor and coal tar with the associated hydrogen sulfide and cyanide (Ref. 39, p. 6). After the gas was manufactured, it was stored in gas holders. Coal tar residuals were also present in the gas holders (Ref. 39, p. 6).

Some of the waste resulting from the production of the manufactured gas, including coal tar, was sold. Some wastes were disposed of at the facility (Ref. 39, p. 7). Coal tar is primarily composed of PAHs, phenolic compounds, light aromatic compounds, various inorganics and various sulfides (Ref. 39, pp. 6, 7). In December 1990, Ecology and Environment, Inc. (E&E), completed a preliminary assessment (PA) at INL&P to assess potential sources of contamination. The PA provided site-related background information, estimates of possible waste quantities produced, and a summary of nearby targets (Ref. 6, pp. 1 to 4). The PA postulated that PAH and cyanide waste may have been disposed of to the ground (Ref. 6, p. 8). In June 1992, HDR Engineering Inc. (HDR) of Omaha, Nebraska, conducted a site investigation (SI) of INL&P for Minnegasco, Inc. Eighteen soil samples were collected from six soil borings, and four ground water samples were collected from three monitoring wells installed during field operations. The six borings referred to as NOR-101 through NOR-106, were located near former facility features to investigate the possibility that releases of associated wastes to soil had occurred in the past (Ref. 7, pp. 6, 7, 8). As documented in Section 2 of this HRS documentation record, soil samples collected at the facility contained elevated concentrations of the same constituents as were reported in ground water samples collected from on-site monitoring wells and temporary monitoring wells. Background wells did not indicate other potential sources of coal tar related hazardous constituents in the immediate site vicinity. There are no other known source areas at the INL&P facility. The EE/CA described 29 leaking underground storage tank sites within 0.5 mile of the facility and 16 underground storage tanks within 0.25 mile (Ref. 34, pp. 12, 13, 98, 99, 100). These leaking underground storage tanks may be contributing petroleum related constituents to area. Ground water flow is to the east, south east (Ref. 34, pp. 79, 80, 85-88). Most of the USTs and/or LUST sites are located downgradient of both the source and temporary wells used to establish the observed release and/or are located upgradient of background samples used in the scoring (Ref. 34, p. 105; Figure 2 of this HRS documentation record).

Evidence of releases from the former MGP operations to ground water is evidenced in the presence of DNAPL in ground water underlying and downgradient of the contaminated soil source, as documented in

the EE/CA ground water investigation (Ref. 34, pp. 36, 37). The approximate extent of DNAPL contamination is shown in Figure 4-11, page 91 of Reference 34.

Hazardous Substances Released

Acenaphthene	Benzo(a)pyrene	Chrysene	2-Methylnaphthalene
Acenaphthylene	Benzo(b)fluoranthene	Fluorene	Naphthalene
Anthracene	Benzo(g,h,i)perylene	Fluoranthene	Phenanthrene
Benzo(a)anthracene	Benzo(k)fluoranthene	Indeno(1,2,3-c,d)pyrene	Pyrene

Ground Water Observed Release Factor Value: 550

3.2 WASTE CHARACTERISTICS

3.2.1 Toxicity/Mobility

Table 22 summarizes the toxicity and mobility values and combined factor value for the hazardous substances associated with Source 1. All hazardous substances listed in Table 22 have been documented in either soil or ground water samples from Source 1. These hazardous substances were detected at concentrations significantly exceeding background levels.

TABLE 22
TOXICITY/MOBILITY FACTOR VALUES

Hazardous Substance	Source Number	Toxicity Factor Value	Mobility Factor Value*	Does Hazardous Substance Meet Observed Release?**	Toxicity/ Mobility Factor Value (Ref. 1, Table 3-9)	Reference
Acenaphthene	1	10	1*	Yes	10	2, p. 3
Acenaphthylene	1	1	1*	Yes	1	2, p. 3
Anthracene	1	10	1*	Yes	10	2, p. 3
Benzo(a)anthracene	1	1,000	1*	Yes	1,000	2, p. 3
Benzo(a)pyrene	1	10,000	1*	Yes	10,000	2, p. 4
Benzo(b)fluoranthene[+]	1	---	1*	Yes	---	2, p. 4
Benzo(g,h,i)perylene	1	0	1*	Yes	0	2, p. 4
Benzo(k)fluoranthene	1	100	1*	Yes	100	2, p. 4
Chrysene	1	10	1*	Yes	10	2, p. 5
Fluoranthene***	1	100	1*	Yes	100	2, p. 4
Fluorene	1	100	1*	Yes	100	2, p. 7
Indeno(1,2,3-c,d)pyrene	1	1,000	1*	Yes	1,000	2, p. 9
2-Methylnaphthalene	1	1,000	1*	Yes	1,000	2, p. 9
Naphthalene	1	1,000	1*	Yes	1,000	2, p. 9
Phenanthrene	1	1	1*	Yes	1	2, p. 10
Pyrene	1	100	1*	Yes	100	2, p. 10

Notes:

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

** See section 3.1.1 of this HRS documentation record

*** This compound is listed as its synonym benzo(j,k)fluorene in Reference 2

[+] Compound not listed in Reference 2

Benzo(a)pyrene is the hazardous substances with the highest toxicity and mobility factor value, of 10,000.

Toxicity/Mobility Factor Value: $1x10^4$
(Ref. 1, Table 3-9)

3.2.2 Hazardous Waste Quantity

Table 23 provides a summary of the source hazardous waste quantity values.

TABLE 23
SUMMARY OF SOURCE HAZARDOUS WASTE QUANTITY VALUES

Source Number	Source Type	Source Hazardous Waste Quantity
1	Contaminated Soil	>0

Sum of Values: >0

In accordance with Section 2.4.2.2, a minimum value of 10 was used for the Hazardous Waste Quantity Factor Value because Hazardous Constituent Quantity has not been adequately determined for Source 1, and none of the targets for the ground water pathway is subject to Level I or Level II concentrations (Ref. 1, Sec. 2.4.2.2).

Hazardous Waste Quantity Factor Value: 10
(Ref. 1, Section 2.4.2.2)

3.2.3 Waste Characteristics Factor Category Value

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

Toxicity/Mobility Factor Value ×
Hazardous Waste Quantity Factor Value: 100,000 or 1×10^5

Waste Characteristics Factor Category Value: 18
(Ref. 1, Table 2-7)

3.3 TARGETS

The public water supplies for the City of Norfolk are provided by the City of Norfolk public water supply system consisting of two water treatment plants supplied by two well fields. The two fields have a total of 11 active wells (Refs. 17, pp. 1, 2; 27; 41; 43). The water treatment plants are referred to as the east and west water treatment plants (Refs. 17, p. 1; 41, p. 1). Wells serving the west water treatment plant range in depth from 50 to 65 feet below ground surface (Ref. 17, pp. 1 - 8, 14). The last right-hand column of Reference 17, pages 1 and 2, identifies the plant that receives the flow from the supply wells. Number 001 indicates the east water treatment plant (facility number 001) and number 002 indicates the west water treatment plant (facility number 002) (Ref. 17, pp. 1, 2). Wells serving the east water treatment plant range in depth from 101 to 120 feet below ground surface (Ref. 17, pp. 2, 11 - 13). Wells serving the west water treatment plant are screened in unconsolidated sands and gravel (Ref. 10, pp. 1 – 12, 40-48, 62, 63). A boring log for a well serving the east water treatment plant indicates that the well is finished as an uncased and unscreened hole in chalk formation (Ref. 10, pp. 34, 35).

Eight municipal wells (wells 681, 682, 692, 691, 752, 751, 921, and 20031) are associated with the west treatment plant, and three wells (wells 281, 471, and 551) are associated with the east treatment plant (Refs. 17, pp. 1, 2; 43, pp. 3, 4). Two other municipal wells (wells 291 and 301) formerly were associated with the east treatment plant and have been taken out of service because of contamination thought to be associated with a leaking underground storage tank (LUST) (Refs. 43, pp. 1, 2, 3; 20, p. 2; 34, pp. 12, 13, 74, 98 - 100; 10, pp. 18, 22). Municipal 291 is currently being used as a remediation well, and municipal well 301 was idled because of benzene contamination (Refs. 20, p. 2; 43, p. 1). According to the City Water superintendent, there are 9,352 service connections (Ref. 36). According to the City Water superintendent, the population served is 24,210 (Refs. 12, p. 1; 36). The City also sells water to two subdivisions outside the city limit, the Eastern Heights, subdivision where water is provided to about 80 homes and the Suburban Acres subdivision where the city provided water to about 30 homes (Ref. 36). In total the city provides water to a city and subdivision population of 24,472 (Ref. 36). Table 24 presents information for the City of Norfolk municipal wells.

TABLE 24
CITY OF NORFOLK WATER SUPPLY WELLS

State Registration Number	Other Identifier	Status, Water Treatment Plant Served	Location Township, Range, Section	Total Depth (feet)	Screen depth (feet bgs)	Capacity (gpm)	Date Drilled	References
G-029258	68-1 (681) Well 7	Active, West	24N, 2W, 25ad	50.67	30'8" - 50'8"	750	03/09/68	17, pp. 1, 3; 10, pp. 1, 2
G-029259	68-2 (682) Well 1	Active, West	24N, 2W, 25ad	59	29 – 59	1,000	03/12/68	17, pp. 1, 4; 10, pp. 3, 4
G-049057	69-2 (692) Well 9	Active, West	24N, 1W, 30cb	57	27 – 57	1,000	10/30/69	17, pp. 2, 5; 10, pp. 5 - 7; 21, p. 4
G-049058	69-1 (691)	Active, West	24N, 1W, 30cb	57	27 – 57	1,000	10/29/69	17, pp. 2, 6; 10, pp. 8, 9;
G- 049312	75-2 (752)	Active, West	24N, 1W, 30cd	55.5	20 – 56	1,000	04/18/75	17, pp. 2, 7; 10, pp. 10, 11, 61; 21, p. 4

TABLE 24 (Continued)
CITY OF NORFOLK WATER SUPPLY WELLS

State Registration Number	Other Identifier	Status, Water Treatment Plant Served	Location Township, Range, Section	Total Depth (feet)	Screen depth (feet bgs)	Capacity (gpm)	Date Drilled	References
G-049313	75-1 (751) Well 10	Active, West	24N, 1W, 30ca	55.5	–Unknown	1,000	04/24/75	17, pp. 2, 8; 10, pp. 12, 13; 21, p. 4
G-070112	21-1 (291) Well 1	Inactive, East	24N, 1W, 26bb	130	Not Reported	930	08/29/29	17, pp. 2, 9; 10, pp. 18 - 21; 21, p. 4
G-070113	30-2 (301) Well 2	Inactive, East	24N, 1W, 26bb	127	Not Reported	860	10/14/30	17, pp. 2, 10; 10, pp. 22 - 25; 21, p. 4
G-070114	26-3 (281) Well 3	Active, East	24N, 1W, 26bb	94 (120)	Not Reported	520	08/21/28	17, pp. 2, 11; 10, pp. 26 - 29; 21, p. 4
G-070115	47-4 (471) Well 4	Active, East	24N, 1W, 26bb	101	Not Reported	670	10/11/47	17, pp. 2, 12; 10, pp. 30 - 33; 21, p. 4
G-070116	54-1 (551) Well 5	Active, East	24N, 1W, 26bb*	117	45 – 117	1,220	02/05/55	17, pp. 2, 13; 10, pp. 34, 35; 21, p. 4
G-074818	(921) (Well 12)	Active, West	24N, 1W, 31	65	40 – 60	800	03/04/92	17, pp. 2, 14; 10, pp. 40, 41, 42, 47, 48
G-122246	(20031)	Active, West	24N, 1W, 31	69.5	60 – 67	4,000	08/17/02	17, pp. 2, 15; 10, pp. 62, 63

Notes:

* The well registration form indicates the well is in section 27 (Ref. 10, p. 34). The wells location in section 27 is substantiated by the off-site sample location map in the ESI (Ref. 5, p. 18) and by other consultants work in Norfolk (Refs. 30, pp. 2 – 7; 31, p. 2).

bgs Below ground surface

gpm Gallons per minute

In addition to the city population served, the Norfolk public water supply also serves the primary and secondary schools of the Norfolk public school system (Refs. 22; 25, pp. 13, 17, 18, 19, 20, 23, 24, 28, 31, 41, 47, 48, 50, 51, 53, 54, 58, 59, 60, 61, 66). (Note: Reference 25 provides the sampling points [SP] for the City of Norfolk distribution system.) According to on-line data from 2013-2014, the Norfolk school district has a student enrollment of 4,162 students and 270 staff (Ref. 24, pp. 3, 5). Current information for students, faculty and staff indicates a population of 4,814 (Ref. 36). The system also serves the Norfolk Catholic Schools, with a 2013-2014 enrollment of 639 students and a staff of 40 (Refs. 24, p. 4, 6; 25, pp. 12, 27, 49, 58, 60). Current staff and student population is 669 (Ref. 36). The system serves St. Paul Lutheran Elementary school (2013-2014 enrollment of 98 students and 4 staff) (Refs. 24,

p. 8; 25, p. 10). Current staff and student population is 154 (Ref. 36). In addition, the following post-secondary education institutions are served by the system: the Northeast Community College (enrollment of 5,035) (Refs. 25, p. 20; 26, p. 9). The student population presented for Northeast Community college also includes several satellite campuses. Current student enrollment for the Norfolk campus is 2,954, and faculty and staff is 1,100 for a total of 4,054 (Ref. 36). Northeast Community College is identified as Tech College in Reference 25. The college is located in the City of Norfolk and is served by the City of Norfolk public water supply system (Ref. 35). In total, the system serves at least 34,163 residents and students and staff in the City of Norfolk. This number represents the city and two subdivision populations served by the system (24,472) and the sum of the students and staff provided above (Ref. 36).

According to the city, water from the east and west treatment plants is part of a common distribution system. The combined pumping capacity for the system is 10,000 gallons per minute (Refs. 27; 43, p. 1). Based on the well capacities presented in Table 24 above, no one well contributes more than 40 percent of the total demand to the system; therefore, the population served by each well is apportioned equally among the 11 active wells, for a population per well of 3,105 (Ref. 1, Section 3.3.2). All 11 wells were considered eligible. The two closed wells were not considered. It should be noted that the capacities listed for the wells in Table 24 were reported on well registration forms completed at the time of installation and may not correspond to the actual current pumping rates of the wells (Ref. 27).

Other public drinking water supply wells serve the area outside of the City of Norfolk. Information obtained from the well logs for those wells is summarized in Table 25 below. These wells are shown on Reference 3. As shown on Reference 3, all wells are located within the same alluvial floodplain as the city of Norfolk wells. A review of the well logs provided in Reference 10 shows that the drinking water supply wells within a 4 mile radius of INL&P are completed or screened within alluvium, the alluvium and chalk, or chalk. Because ground water moves freely between the alluvium and chalk, the ground water within both of these formations is evaluated as a single hydrologic unit, the interconnected alluvium and Niobrara chalk aquifer system, as documented earlier in the HRS documentation record. Therefore, the populations served by each of the public water supply wells obtain drinking water supplies from the interconnected alluvium and Niobrara chalk aquifer system. The populations served by each well are summarized in Section 3.3.2.4, Table 27.

TABLE 25
PUBLIC WATER SUPPLIES WITHIN 4 MILES OF SOURCE 1
(EXCLUDING THE CITY OF NORFOLK SUPPLY WELLS)

Owner	State Registration Number	Other Identifier	Total Depth	Screen depth (feet bgs)	Capacity (gpm)	Date Drilled	Reference
Norfolk Regional Center	G-068492	Well #5	94 feet 3 inches	69 - 94	390	06/11/1956	10, pp. 64, 66
Norfolk Regional Center	G-068493	Well #7	66 feet	50 - 66	470	08/31/1967	10, pp. 68, 70
Norfolk Regional Center	G-068494	Well #6	56 feet	40 - 56	520	08/29/1967	10, pp. 72, 74, 75
Madison County SID#3	G-073538	Well 681	90 feet	38 - 90	75	09/28/1968	10, pp. 76, 78, 79
Madison County SID#3	G-043601	Well 751	96 feet	60 - 96	500	12/19/1974	10, pp. 80, 82
Sherwood Medical (currently Covidien)	G-102698	Well 621	69 feet	59 - 69	350	05/1962	10, pp. 83, 84, 85, 86, 87, 88

TABLE 25
PUBLIC WATER SUPPLIES WITHIN 4 MILES OF SOURCE 1
(EXCLUDING THE CITY OF NORFOLK SUPPLY WELLS)

Owner	State Registration Number	Other Identifier	Total Depth	Screen depth (feet bgs)	Capacity (gpm)	Date Drilled	Reference
Sherwood Medical (currently Covidien)	G-102699	Well 751	70 feet	53 - 67	100	11/1975	10, pp. 89, 90, 91, 92, 93
Sleepy Hollow Acres	G-119312	--	NA	NA	20	1996	10, p. 94

Notes:
bgs Below ground surface
gpm Gallons per minute
NA Not available

3.3.1 Nearest Well

The closest drinking water well to the INL&P is Norfolk municipal well 5, registration number G0700116 (Ref. 15, p. 6). Reference 30 page 2 clearly shows that city water well 5 is located between First and Second Street and Norfolk avenue and Madison Avenue. This well was measured at 2,530 feet or 0.48 mile east of the Source 1 (Refs. 3; 30, p. 2 29).

Well ID: Municipal Well 5
Level of Contamination (I, II, or potential): Potential
If potential contamination, distance from the source in miles: The Norfolk Municipal well 5 is located between 1st and 2nd Streets and Norfolk and Madison Avenues (Ref. 15, p. 6). The location of the well is more precisely shown on figures from a 1998 preliminary subsurface assessment report prepared for the Nebraska Department of Environmental Quality (Ref. 30, pp. 2 - 7). The distance from this well to sample location SB-3 at the eastern edge of the INL&P is 2,530 feet or 0.48 mile (Ref. 29). In accordance with Section 3.3.1 and Table 3-11 of the HRS rule, a nearest well factor value of 18 is assigned (Ref. 1, Section 3.3.1).

Nearest Well Factor Value: 18
(Ref. 1, Table 3-11)

3.3.2 POPULATION

3.3.2.1 Level of Contamination

No Level I or Level II concentrations attributable to the site have been documented at this time.

3.3.2.2 Level I Concentrations

Not Scored.

3.3.2.3 Level II Concentrations

Not scored.

3.3.2.4 Potential Contamination

The public water supply system for the City of Norfolk includes 11 active permanent municipal wells (Refs. 17, pp. 1, 2; 27; 41). These wells are reported to range in depth from 50 to 130 feet bgs (Ref. 17, pp. 3 - 14). The city has two water treatment facilities referred to as the east and west treatment plants (Refs. 17, p. 1; 41, p. 1). Eight municipal wells (wells 681, 682, 692, 691, 752, 751, 921, and 20031) are associated with the west treatment plant, and three wells (wells 281, 471 and 551) are associated with the east treatment plant (Ref. 17, pp. 1, 2). Two other municipal wells (wells 291 and 301) formerly were associated with the east treatment plant and have been taken out of service because of contamination thought to be associated with a LUST (Refs. 17, p. 2; 20, p. 2; 10, pp. 18, 22; 34, pp. 12, 13, 74, 98 – 100; 43). Municipal well 1 is currently being used as a remediation well, and municipal well 2 was idled because of benzene contamination (Ref. 20, p. 2). The municipal water supply serves the entire population of Norfolk (Ref. 12, p. 1). According to the City Water superintendent, the population served is 24,210 (Refs. 12, p. 1; 36). The City also sells water to two subdivisions outside the city limit, the Eastern Heights, subdivision where water is provided to about 80 homes and the Suburban Acres subdivision where the city provided water to about 30 homes (Ref. 36). In total the city provided water to 24,472 people (Ref. 36).

In addition to the city population served, the Norfolk public water supply also serves the primary and secondary schools of the Norfolk public school system (Refs. 22; 25, pp. 13, 17, 18, 19, 20, 23, 24, 28, 31, 41, 47, 48, 49, 50, 51, 53, 54, 58, 59, 60, 61, 66). (Note: Reference 25 provides the sampling points [SP] for the City of Norfolk distribution system. According to on-line data from 2013-2014, the Norfolk school district has a student enrollment of 4,162 students and 270 staff (Ref. 24, pp. 3, 5). Current information for students, faculty and staff indicates a population of 4,814 (Ref. 36). The system also serves the Norfolk Catholic Schools, with an enrollment of 639 students and a staff of 40 (Refs. 24, p. 4, 6; 25, pp. 12, 27, 49, 58, 60). Current staff and student population is 669 (Ref. 36). The system serves St. Paul Lutheran Elementary school (2013-2014 enrollment of 98 students and 4 staff) (Refs. 24, p. 8; 25, p. 10). Current staff and student population is 154 (Ref. 36). In addition, the following post-secondary education institutions are served by the system: the Northeast Community College (enrollment of 5,035) (Refs. 25, p. 20; 26, p. 9). The student population presented for Northeast Community college also includes several satellite campuses. Current student enrollment for the Norfolk campus is 2,954, and faculty and staff is 1,100 for a total of 4,054 (Ref. 36). Northeast Community College is identified as Tech College in Reference 25. The college is located in the City of Norfolk that is served by the City of Norfolk public water supply system (Ref. 35). In total, the system serves at least 34,163 residents and students and staff in the City of Norfolk. This number represents the city and two subdivision populations served by the system (24,472) and the sum of the students and staff provided above (Ref. 36).

According to the city, water from the east and west treatment plants is part of a common distribution system. The combined pumping capacity for the system is 10,000 gallons per minute (Ref. 27). Based on the well capacities presented in Table 24 in Section 3.3, no one well contributes more than 40 percent of the total demand to the system; therefore, the population served by each well is apportioned equally among the 11 active wells, for a population per well of 3,105 (Ref. 1, Section 3.3.2). This population is entered into Table 26 below for each Norfolk well. All 11 wells were considered eligible. The two closed wells were not considered.

In addition to the City of Norfolk wells, there are numerous other community water supplies within the 4-mile radius of the INL&P facility. The locations of the wells serving these water supplies are documented in Reference 31 and are shown on Reference 3. The populations served by these systems come from Reference 32. Because all wells for each of these systems fall within the same distance ring, apportionment of population has not been determined.

In addition to the populations included in this scoring, there are numerous additional worker populations present within the City of Norfolk community (Refs. 47, 48).

TABLE 26
POPULATIONS SERVED BY GROUND WATER

Distance Category (miles)	Well (Well Registration Number)	Population	Reference	Distance-Weighted Population Value (Ref. 1, Table 3-12)
0 - ¼	None Known			
¼ - ½	Norfolk Municipal Wells Well #5 (G-070116) **Total ¼ -½**	 3,105 **3,105**	1, Section 3.3.2.4; 3; 31, p. 2	 3,233
½ - 1	Norfolk Municipal Wells Well #3 (G-070114) Well #4 (G-070115) **Total ½ - 1**	 3,105 3,105 **6,210**	1, Section 3.3.2.4; 3; 31, p. 2	 1,669
1 – 2	Norfolk Regional Center Well #5 (G-068492) Well #7 (G-068493) Well #6 (G-068494) Madison Co. SID No. 5 Well 022 Well 021 **Total 1 - 2**	 158 158 158 65 65 **604**	1, Section 3.3.2.4; 3; 31, pp. 5, 6; 32, pp. 1 - 4	 94
2 – 3	Madison Co. SID No. 3 Well 681 (G-073538) Well 751 (G-043601) Kendall (Covidien) Company Well 3 (G-102698) Well 6 (G-102699) **Total 2 - 3**	 187 188 215 215 **805**	1, Section 3.3.2.4; 3; 31, pp. 7, 8; 32, pp. 5 - 8	 68
3 – 4	Norfolk Municipal Wells Well 681 (G-029258) Well 682 (G-029259) Well 692 (G-049057) Well 691 (G-049058) Well 752 (G-049312) Well 751 (G-049313) Well 921 (G-074818) Well 20031 (G-122246) Sleepy Hollow Acres Well 21 (G-119312) **Total 3 - 4**	 3,105 3,105 3,105 3,105 3,105 3,105 3,105 3,105 120 **24,960**	1, Section 3.3.2.4; 3; 31, pp. 3, 9; 32, p. 9	 1,306
Sum of the Distance-Weighted Population Values:				6,370

Sum of Distance-Weighted Population Values: 6,370
Sum of Distance-Weighted Population Values/10: 637
(Ref. 1, Section 3.3.2.4)

Potential Contamination Factor Value: 637

3.3.3 RESOURCES

Ground water within the target distance limit is used for irrigation and commercial food preparation (Refs. 5, p. 224; 28, pp. 16, 24, 25, 59, 66; 10 pp. 36 - 39). The pages cited on Reference 28 indicate irrigation wells irrigate at least five acres of land.

Resources Factor Value: 5

3.3.4 WELLHEAD PROTECTION AREA

Observed ground water contamination lies within the State of Nebraska Department of Environmental Quality-designated wellhead protection area for the east well field (Ref. 31, p. 2). The wellhead protection program is approved by EPA (Ref. 29, p. 8).

Wellhead Protection Area Factor Value: 20
(Ref. 1, Section 3.3.4)