AMENDMENT TO THE RECORD OF DECISION

PEOPLES NATURAL GAS SUPERFUND SITE DUBUQUE, DUBUQUE COUNTY, IOWA

IAD980852578

September 2013

Prepared by

U.S. Environmental Protection Agency
Region 7
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PART I: DECLARATION

1.0 Site Name and Location

The Peoples Natural Gas site (Site) is located in the city of Dubuque, Dubuque County, Iowa. The Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) identification number for the Site is IAD 980852578. The Site is one operable unit (OU) identified as OU1.

2.0 Statement of Basis and Purpose

The original Record of Decision (ROD) for this Site was signed by the U.S. Environmental Protection Agency (EPA) on September 16, 1991. The remedy selected in the ROD included the following actions:

- excavation and incineration of contaminated soil from the surface to six feet below grade that exceeded 100 milligrams per kilogram (mg/kg) of carcinogenic polynuclear aromatic hydrocarbons (PAHs) and 500 mg/kg total PAHs;

- excavation and incineration of contaminated source soils that have visible coal tar contamination from six feet below grade to the surface of the upper confining unit (UCU);

- enhanced in situ bioremediation to treat the contaminated groundwater and contaminated source soils in the silty sand aquifer;

- groundwater extraction of both the silty sand and alluvial aquifers to reduce contaminant concentrations to levels established by the state of Iowa Administrative Code Chapter 133; and

- groundwater monitoring of both the silty sand and alluvial aquifers to ensure successful implementation of the groundwater treatment systems.

The ROD was modified by an Explanation of Significant Differences (ESD) dated March 1, 2000, when it was determined during the remedial design that the contaminant concentrations in the alluvial aquifer did not warrant installation of a groundwater extraction system in that aquifer. On December 23, 2004, the ROD was further modified by a second ESD when the groundwater cleanup level for benzene was changed from the negligible risk level of 1 microgram per liter (μg/L) to the Maximum Contaminant Level (MCL) of 5 μg/L pursuant to the Safe Drinking Water Act for public water supplies, and the health advisory level (HAL) for naphthalene at the time of the ROD of 20 μg/L to the revised HAL of 100 μg/L.

This decision document presents the selected amended remedy for the Peoples Natural Gas Site in Dubuque, Iowa. This amended remedy has been selected by the EPA in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the Administrative Record for the Site.

The state of Iowa concurs with the selected amended remedy for the Site.

3.0 Assessment of the Site

The response action selected in the ROD Amendment is necessary to protect the public health, welfare or the environment from actual or threatened releases of hazardous substances, pollutants and/or contaminants into the environment which may present an imminent and substantial endangerment.

4.0 Description of the Selected Remedy

The selected amended remedy is intended to be the final response action to address all contamination associated with the Site. Specifically, the selected amended remedy addresses the groundwater contamination at the Site, prevents future exposure to residual contamination in subsurface soil and vapor intrusion. The selected amended remedy is institutional controls in conjunction with a hydraulic containment and monitored natural attenuation (MNA). An important component of this remedy is a technical impracticability (TI) applicable or relevant and appropriate requirements (ARAR) waiver, commonly referred to as a TI waiver. A TI waiver is implemented for an area identified as the "TI zone." The TI zone for this site is a portion of the contaminated groundwater plume where it will not be technically practicable to meet the ARARs in a reasonable timeframe. The groundwater cleanup levels must be met outside the TI zone but not within that zone. Institutional controls will prevent exposure to contaminated groundwater in the TI zone. The institutional controls will also prevent exposure to residual contamination in subsurface soil and vapor intrusion. The hydraulic control system consists of extraction wells located between Kerper Boulevard and the levee to prevent migration of the downgradient plume. The extracted groundwater will be disposed to the sanitary sewer system for treatment at the city of Dubuque waste treatment facility under a permit with the city. Natural attenuation will continue to reduce contaminant concentrations in the dissolved plume, supporting plume stability. Monitoring will verify that this is occurring.

The contaminated groundwater at this site is not considered a principal threat waste but the dense nonaqueous phase liquid (DNAPL), which is found primarily in the silty sand aquifer, is a principal threat waste. The selected amended remedy does not significantly reduce the volume of DNAPL, so there is no treatment of principal threat wastes.

5.0 Statutory Determinations

The selected amended remedy is protective of human health and the environment; complies with federal and state requirements that are applicable or relevant and appropriate to the remedy, except as justified by a TI waiver; is cost-effective; and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected amended remedy does not satisfy the statutory preference for treatment as a principal element. Although a small amount of dissolved contamination will be removed by the hydraulic control system and treated at the city water treatment facility, the principal threat wastes remaining at the Site will not be removed or treated. At this time, a remedial alternative was not available that was capable of treating DNAPL without presenting a risk of spreading groundwater contamination.

Because this amended remedy will result in hazardous substances, pollutants or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will continue to be conducted to ensure that the remedy is, or will be, protective of human health and the environment.

6.0 ROD Date Certification Checklist

The following information is included in the Decision Summary section of the ROD Amendment. Additional information can be found in the Administrative Record (AR) for the Site.

- The contaminants of concern (COCs) and their respective concentrations – pages 13-16
- Baseline risk represented by the COCs – pages 19-21
- Cleanup levels for COCs and the basis for these levels – pages 23-24
- Source materials constituting principal threat wastes – page 35
- Current and future land use assumptions and current and future beneficial uses of groundwater – page 17
- Potential land and groundwater use available as a result of the selected amended remedy – pages 35-36
- Estimated costs and number of years used in estimates – page 34
- Key factors that led to choosing the selected amended remedy – pages 35-36

Cecilia Tapia, Director
Superfund Division

9-25-13
Date

PART II: DECISION SUMMARY

1.0 Site Name, Location and Description

The Peoples Natural Gas site (Site) is located in the city of Dubuque, Dubuque County, Iowa. The CERCLIS identification number for the Site is IAD 9980852578. The Site is one operable unit identified as OU1. The EPA is the lead agency for this site and the Iowa Department of Natural Resources (IDNR) is the support agency.

The Site occupies approximately five acres and is located near the intersection of East 11th Street and Kerper Boulevard in the eastern part of Dubuque (Figure 1). The Site is approximately 300 feet west of the Mississippi River and is protected by a 500-year flood protection levee. The eastern portion of the Site is owned by the city of Dubuque. The city previously operated a public works garage on the property and the building is still there. The city is currently leasing a part of the property to a tenant for storage of building materials. The western portion of the Site is owned by the Iowa Department of Transportation (IDOT). A section of U.S. Highway 61 was constructed on this part of the Site following completion of a removal action to address contaminated soil.

The Site is the location of a former manufactured gas plant (MGP) that operated from approximately the 1930s to 1954. Aboveground structures were dismantled in 1957. During operation of the plant, coal tar and cyanide-bearing wood chips were produced as byproducts of gas production and stored on site. Coal tar is a mixture of compounds including PAHs and volatile organic compounds (VOCs), particularly benzene, toluene, ethylbenzene and xylenes (collectively referred to as BTEX). Coal tar was stored in one underground tank and one aboveground tank on the Site. The wood chips were buried on the eastern portion of the Site.

2.0 Site History and Enforcement Activities

The MGP was originally owned and operated by Key City Gas Company. In approximately 1954, North Central Public Service Company acquired ownership of Key City Gas. Northern Natural Gas Company, which later became Peoples Natural Gas (PNG), acquired ownership of the Site in approximately 1957. PNG used the Site as a natural gas distribution, storage and maintenance facility. The city acquired the property in 1964 and constructed a public works garage on the eastern portion. IDOT acquired the western one-third of the Site in 1985.

In June 1988, the EPA proposed that the Site be listed on the National Priorities List (NPL), and on August 30, 1990, the Site was listed on the NPL. The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants or contaminants throughout the U.S. and its territories.

Contamination at the Site was first identified during a geotechnical investigation conducted by IDOT in preparation for construction of a new section of U.S. Highway 61 across the western portion of the Site. On April 19, 1989, the EPA issued an Administrative Order on Consent to Midwest Gas, a division of Iowa Public Service Company, the successor to North Central Public Service Company; IDOT; and the city of Dubuque, Iowa, requiring the parties to conduct a removal action and a remedial investigation and feasibility study (RI/FS). Midwest Gas later became known as MidAmerican Energy Company (MidAmerican Energy). Subsequent investigations performed by the EPA and MidAmerican Energy determined the nature and extent of contamination at the Site.

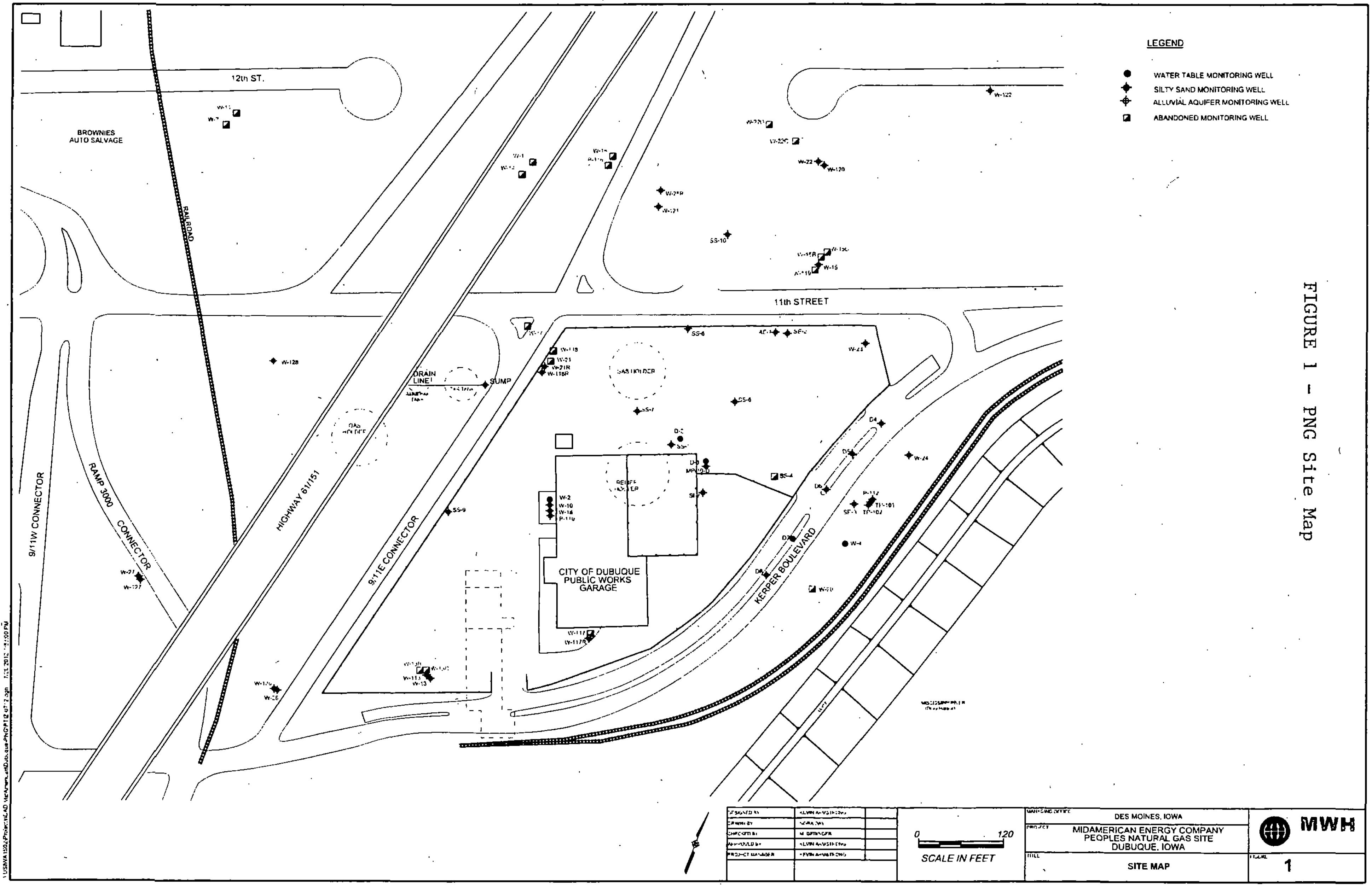

FIGURE 1 - PNG Site Map

A removal action was initiated in 1989 to address soil contamination in the area where the highway construction was to take place. During the removal action, 6,850 cubic yards of contaminated soil and wastes were excavated and destroyed by blending with coal and burning in a utility boiler. Institutional controls in the form of deed restrictions were implemented as a component of the removal action. Notices were placed on the deeds for the portions of the Site owned by IDOT and the city of Dubuque stating that "no disturbance or excavation at a depth of six or more feet may be conducted on the property unless appropriate employee safety and health training procedures have been implemented, and the work is conducted in a manner that does not release or threaten the release of the hazardous substances." Further it states that "under no circumstances may water supply wells or private wells be drilled on the property without the written approval of the Environmental Protection Agency and the city of Dubuque, Iowa."

In May 1991, MidAmerican Energy completed a RI/FS. This RI/FS described the nature and extent of contamination associated with the Site, the risks that were posed and alternatives for remediation of the contamination. Two groundwater units were identified and investigated at the Site. The shallowest, a thin, silty sand unit referred to in Site documents as the silty sand aquifer, lies between two clay-confining units referred to as the UCU and the lower confining unit (LCU). The UCU directly underlies the clay fill and clean granular fill at the surface of the Site. The alluvial aquifer of the Mississippi River underlies the LCU. The silty sand unit is present in a limited area in the vicinity of the Site and is actually part of the alluvial aquifer. The silty sand unit is referred to as the "silty sand aquifer" in Site documents and throughout this ROD Amendment for consistency, even though it is not a separate aquifer. Figure 2 depicts a model cross-section of the Site.

The EPA presented the preferred alternative for remediation of the Site to the public in a Proposed Plan and selected the remedy for the Site in a ROD dated September 16, 1991. The remedy selected in the ROD included the following actions:

- excavation and incineration of contaminated soil from the surface to six feet below grade that exceeded 100 mg/kg of carcinogenic PAHs and 500 mg/kg total PAHs;

- excavation and incineration of contaminated source soils that have visible coal tar contamination from six feet below grade to the surface of the UCU;

- enhanced in situ bioremediation to treat the contaminated groundwater and contaminated source soils in the silty sand aquifer;

- groundwater extraction of both the silty sand and alluvial aquifers to reduce contaminant concentrations to levels established by the state of Iowa Administrative Code Chapter 133; and

- groundwater monitoring of both the silty sand and alluvial aquifers to ensure successful implementation of the groundwater treatment systems.

On October 10, 1991, Midwest Gas; IDOT; the city of Dubuque, Iowa; and Enron Corporation entered into a Consent Decree to perform the remedial design and remedial action as well as pay past costs and response costs associated with the cleanup of the Site. MidAmerican Energy has conducted the work at the Site, including preparation of a remedial design and implementation of the remedial action, and payment of all past and response costs.

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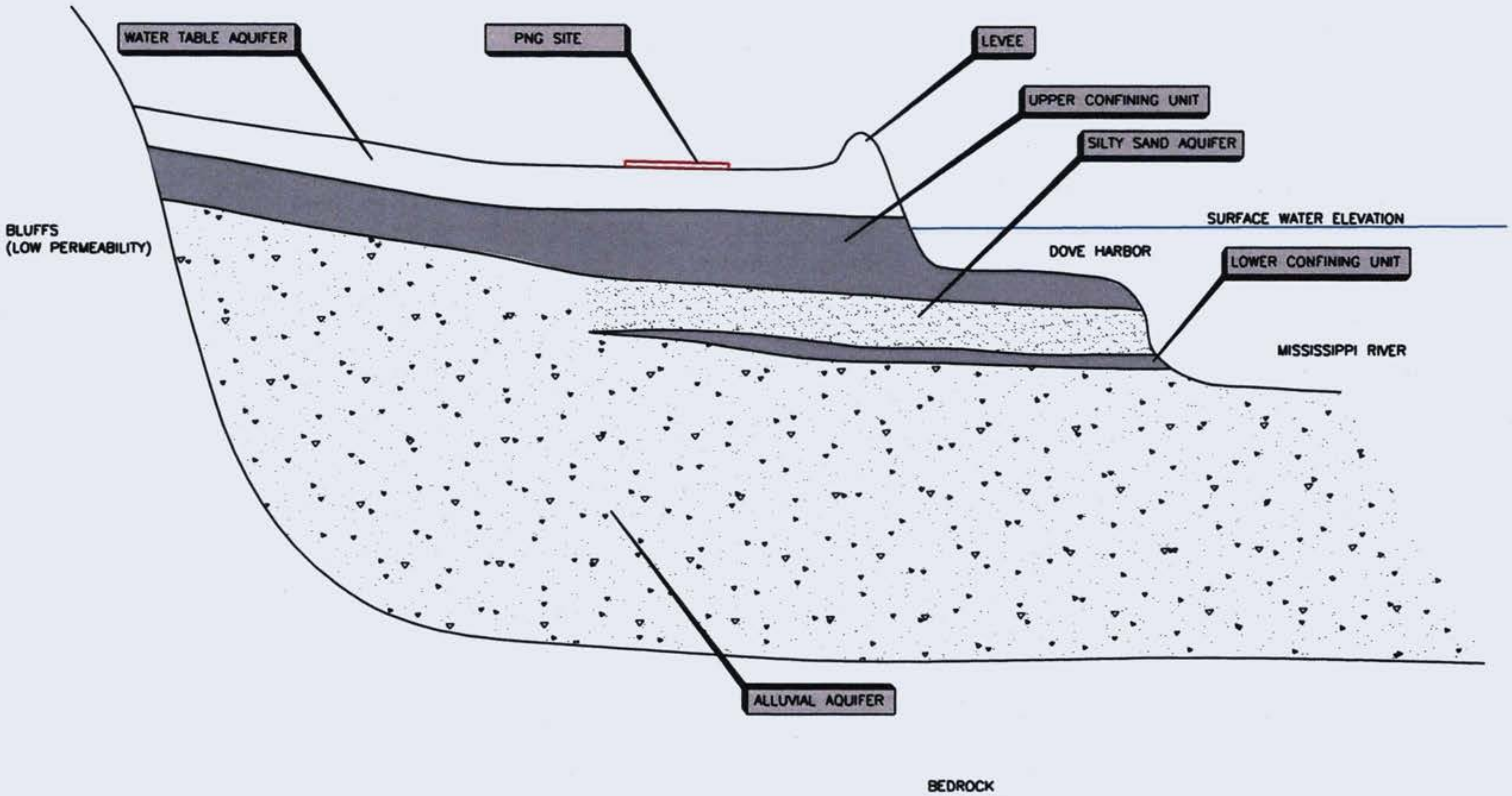
FIGURE 2 - Model Cross-Section of the Site



NOT TO SCALE

DESIGNED BY	TIM WINELAND	MANAGING OFFICE	DES MOINES, IOWA	MWH
DRAWN BY	NORA DAY	PROJECT	MIDAMERICAN ENERGY COMPANY PEOPLES NATURAL GAS SITE DUBUQUE, IOWA	
CHECKED BY	TIM WINELAND			
APPROVED BY	KEVIN ARMSTRONG	TITLE	CONCEPTUAL MODEL CROSS SECTION	FIGURE 1
PROJECT MANAGER	KEVIN ARMSTRONG			

It was determined during the remedial design that the contaminant concentrations in the alluvial aquifer did not warrant installation of a groundwater extraction system in that aquifer. Further, because there is communication between the more heavily contaminated silty sand aquifer and the alluvial aquifer, it was determined that pumping the alluvial aquifer might result in the movement of contaminants from the shallower silty sand to the deeper alluvial aquifer. This change in the remedy was documented in an ESD dated March 1, 2000.

In March 2004, MidAmerican Energy submitted a request to IDNR for support to modify the cleanup levels for benzene from the negligible risk level of 1 microgram per liter (µg/L) to the MCL of 5 µg/L pursuant to the Safe Drinking Water Act for public water supplies, and the health advisory level (HAL) for naphthalene at the time of the ROD of 20 to the revised HAL of 100 µg/L. The EPA received a letter from IDNR in April 2004 supporting these changes. It was determined at that time that the requested modifications were protective and consistent with federal ARARs, and the modifications were incorporated into a second ESD dated December 28, 2004.

As described previously, contaminated soil from the western portion of the Site was excavated during a removal action prior to initiation of the remedial action. A portion of the contaminated soil and wastes from the eastern portion of the Site were excavated during the removal action and co-burned with coal in a utility boiler during the remedial action. An additional 10,400 cubic yards of contaminated soil and wastes that were accessible were excavated during the remedial action. The areas excavated were backfilled with clean fill, thus eliminating direct contact with contaminated soil. All planned soil remediation was completed in 1998. Soil was not excavated from beneath the building and sewer main on-site since it was not readily accessible and did not pose a direct-contact threat. If at some time in the future these structures are removed and contaminated soil is found in these locations, additional soil remediation may be required consistent with the 1991 ROD.

The groundwater extraction system in the silty sand aquifer consisted of one extraction well and one interception trench, more commonly referred to as the "drain sump." Water was piped from the extraction well and the drain sump to an on-site water treatment facility which included an air stripper. The treated water was disposed of into the city of Dubuque sanitary sewer system for treatment at the municipal wastewater treatment facility. Installation of the groundwater extraction and treatment systems was completed in January 1996. Groundwater monitoring has been conducted regularly since that time.

From 1994 through 1999, several investigations and pilot studies were conducted to evaluate the appropriate method of in situ bioremediation to treat the contaminated groundwater and contaminated source soil in the silty sand aquifer. Ultimately, it was determined that ozone sparging in conjunction with soil vapor extraction (SVE) could effectively reduce contaminant concentrations in the groundwater. The SVE system removed vapors liberated from the silty sand aquifer into the vadose zone. These vapors were treated prior to discharge to the atmosphere. Construction of the ozone-sparging/SVE system was completed in September 2000. The system was operated until October 12, 2002. At that time, it was determined that the potential reductions in contaminant levels in the silty sand aquifer that would result from continued operation of the system were limited, while the cost of operation would remain quite high. Approximately 500 pounds of VOC contamination was removed during operation of the ozone sparging/SVE system.

Throughout the period of operation of the groundwater extraction and treatment system, high levels of dissolved solids and iron that naturally exist in the aquifer created fouling problems. Specifically, the rate of groundwater extraction would become significantly diminished when the well screens and the area surrounding the well screen became fouled. As the efficiency of the extraction system decreased, the ability of the system to capture the contaminated groundwater in the silty sand aquifer decreased. The dissolved solids and iron in the extracted groundwater also caused fouling of the air stripping equipment, which reduced that system's performance.

To address the persistent fouling, the extraction well and drain sump were cleaned repeatedly using both chemical and mechanical methods. Modifications to the groundwater treatment system were also made to optimize its performance. Eventually it was determined that fouling and scaling in the extraction well, lines and treatment system rendered them inoperable. The groundwater extraction and treatment system was shut down on March 17, 2003, and has not operated since that time. During the time the system operated, approximately 30 million gallons of groundwater was extracted and treated, removing 380 pounds of BTEX and 210 pounds of PAHs. Since this component of the remedy ceased operation, investigations have taken place to determine a feasible alternative. This ROD Amendment documents the selected amended remedy to address the residual groundwater contamination associated with the Site.

From June 2001 through March 2002, DNAPL, which had previously been identified in only two monitoring wells, flowed into the drain sump in significant quantities. During late 2004, an investigation was conducted using the Tar-Specific Green Optical Screening Tool (TarGOST™)/cone penetrometer to assess the location and estimate the volume of DNAPL present in the subsurface throughout the Site. Figure 3 shows the locations where DNAPL was detected. The majority of DNAPL has been identified in the silty sand unit between the UCU and the LCU, and downward movement appears to be limited by the LCU. The LCU is upward-sloping along the eastern edge of the site, limiting movement toward the Mississippi River. A detailed description of the location of DNAPL is included in section 5.5.2 of the TI Evaluation Report, which is included in the AR. As a result of this investigation, the total mass of PAHs and BTEX at the Site was estimated to be 608,380 and 5,910 pounds, respectively. The majority of this contaminant mass is DNAPL.

Numerous additional studies and investigations were conducted from 2004 to the present. They include assessment of the relief holder beneath the maintenance garage, installation of new monitoring wells and borings to monitor the downgradient plume and delineate the extent of the LCU, assessment of potential remedial alternatives, and abandonment and/or replacement of monitoring wells that were damaged or no longer needed.

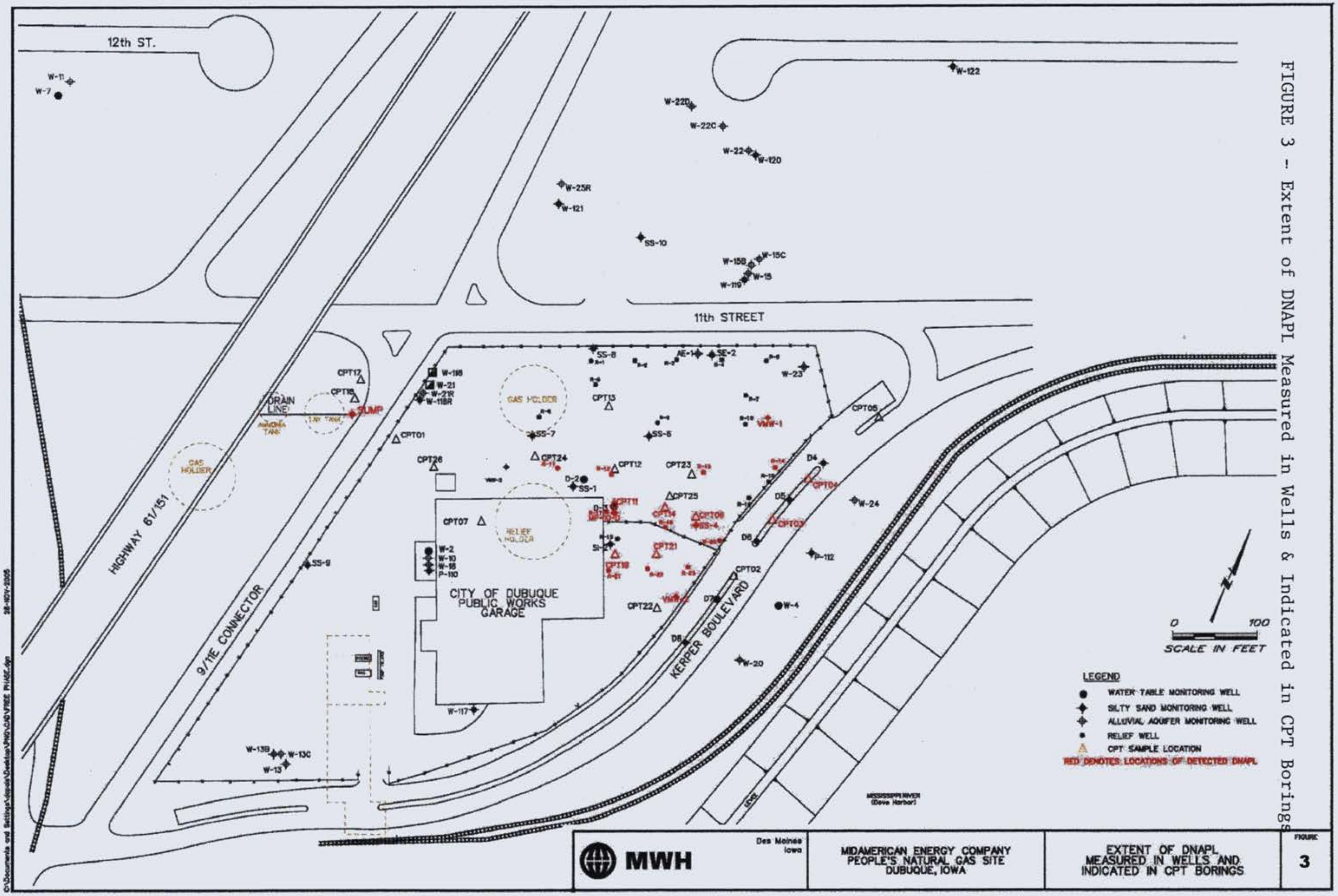


FIGURE 3 - Extent of DNAPL Measured in Wells & Indicated in CPT Borings

3.0 Community Participation

Community involvement activities have been conducted at the Site since it was proposed for inclusion on the NPL in 1988. For this ROD Amendment, the Proposed Plan presenting the EPA's preferred alternative was made available for public comment from June 26 through July 25, 2013. The Proposed Plan and the documents supporting the preferred alternative were made available to the public in the AR at the Carnegie-Stout Public Library in Dubuque, Iowa, and the EPA Region 7 office in Lenexa, Kansas. A public meeting was held at the Carnegie-Stout Public Library on July 8, 2013, where representatives of the EPA provided information about the Site and the preferred alternative. The EPA also offered the public the opportunity to ask questions and provide comments on the preferred alternative. A notice announcing the start of the public comment period, the availability of the AR for review and the public meeting was placed in the *Telegraph Herald*, and a fact sheet providing the same information was sent to those on the site mailing list. The EPA's responses to significant comments received during the public comment period are included in the Responsiveness Summary, which is part of this ROD Amendment.

Representatives of the city of Dubuque continue to keep the EPA apprised of plans for future uses of the Site and property in the vicinity of the Site. The city owns the property between the Site and the flood-control levee east of the Site.

4.0 Scope and Role of the Operable Unit or Response Action

The Site has only one operable unit which is identified as OU1. This action amends the 1991 ROD for the Site, which has previously been modified by ESDs in 2000 and 2004. The scope of the actions to be undertaken with this ROD Amendment will more effectively prevent unacceptable exposures to contaminated groundwater, limit migration of contaminated groundwater and mitigate potential vapor intrusion from groundwater at the Site. The removal and remedial actions already completed at the Site have addressed the soil contamination that is currently accessible.

5.0 Site Characteristics

Site Geology and Hydrogeology: The five-acre Site is located on the floodplain of the Mississippi River. Dove Harbor is directly to the east of the Site. The MGP facility was built on imported clay fill material of a thickness of 6 to 20 feet placed onto over-bank river sediments. Much of the clay fill has been replaced by clean granular fill during the soil remediation activities that have occurred at the Site. Two groundwater units have been investigated at the Site. A silty sand unit lies between two clay-confining units, referred to as the UCU and the LCU. The UCU directly underlies the clay fill and clean granular fill. The alluvial aquifer of the Mississippi River underlies the LCU. The alluvial aquifer is used as a source of drinking water in the Dubuque area.

While the LCU appears to exist in all of the contaminated areas of the Site, it appears to be absent in areas north of the Site, in areas near monitoring wells W-13 and W-113 south of the Site and in some portions of the Highway 61 corridor. In the areas where the LCU is absent, the alluvial aquifer occurs directly beneath the UCU. Figure 4 shows the elevation of the base of the LCU.

The silty sand aquifer ranges in thickness from 2.5 feet to over 13 feet. The silty sand aquifer is comprised of silty sand, poorly graded sand with silt and poorly graded sand. This aquifer is generally thicker and exhibits a deeper base in the eastern and northern portions of the Site.

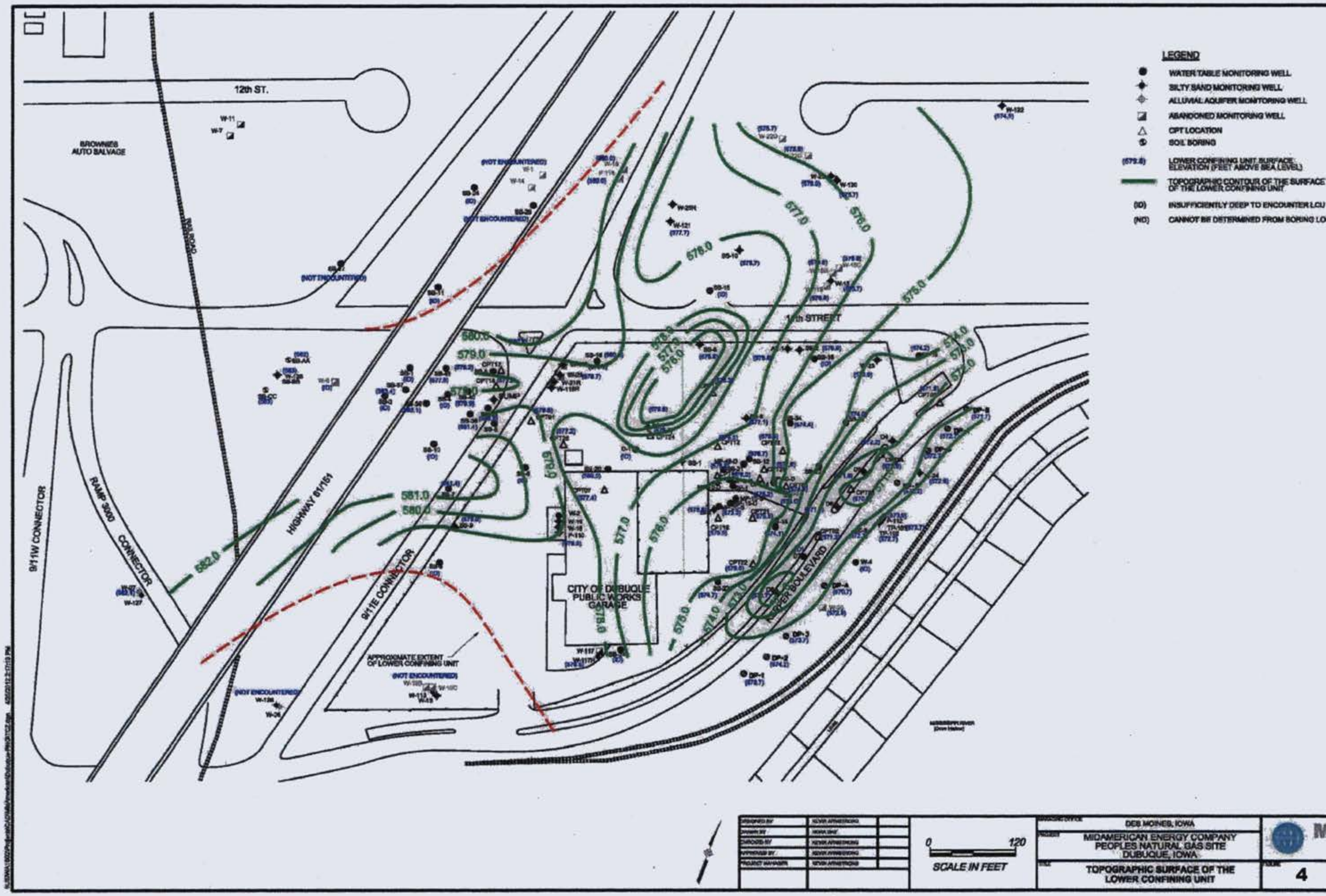


FIGURE 4 - Elevation of the Base of the LCU

The alluvial aquifer consists of poorly graded sand and is approximately 150 feet thick in the vicinity of the Site, with coarse gravels predominating the lower 50 feet. The alluvial aquifer occurs between 19 and 29 feet below ground surface (bgs) in the northern portion of the Site, an average of 33 feet bgs in the central portion of the Site, and approximately 41 feet bgs in the easternmost portion of the Site.

The groundwater flow direction in the silty sand aquifer and alluvial aquifer has varied significantly over the course of site work primarily due to pumping of groundwater in the vicinity of the Site and variations in surface water levels in the Mississippi River. Groundwater flow directions in both aquifers have ranged from north-northeast to south-southeast when the on-site extraction well and drain sump pump were not operating. Historical water-well surveys identified several wells in the area pumping large volumes of water from the alluvial aquifer that had a significant effect on the direction of groundwater flow at the Site. Currently there are no wells in proximity to the Site known to be influencing groundwater flow. At the present time, groundwater flow in the silty sand aquifer is generally to the east-southeast, with occasional westerly components. The flow is bifurcated at times, which is likely the effect of flow in the river being diverted westerly by higher hydraulic head in the Mississippi River.

The average horizontal gradient in the silty sand aquifer is 0.0014 foot per foot. Since shutdown of the extraction system and the off-site wells, the Mississippi River and Dove Harbor typically have a lower elevation than the groundwater in the silty sand wells nearest the levee, indicating it is a gaining stream in this area. During times of high river levels, groundwater flow is reversed over a portion of the Site. Groundwater flow in the alluvial aquifer is generally to the east-southeast. The average horizontal gradient in the alluvial aquifer is 0.0007 foot per foot. Slight downward gradients were observed between the silty sand and alluvial aquifers in the main portion of the Site, and slightly upward gradients were observed near Dove Harbor during low river stage.

Dove Harbor is the closest portion of the Mississippi River to the Site. The base of Dove Harbor is maintained at an elevation of 581 to 583 feet above sea level. A survey of channel depths by the U.S. Army Corps of Engineers from 1998 shows the maximum depth of the Mississippi River in the vicinity of the Site to be approximately 31 feet below the normal pool elevation of 592 feet above sea level, or 561 feet above sea level. Therefore, it appears that the silty sand aquifer lies below the bottom of Dove Harbor, separated vertically from the bottom sediments and water of the harbor by approximately 4.5 feet or more of UCU materials, based upon the elevation of the silty sand aquifer around monitoring well P-112 (refer to Figure 2). The top of the LCU slopes upward near the river. It appears that groundwater in the fill material at the water table may discharge into Dove Harbor during periods of low and normal river levels.

Groundwater Contamination: The groundwater contamination at the Site has been routinely monitored for BTEX and PAHs since implementation of the remedial action. The most recent sampling results reported are from September 2012 and are as follows:

- For wells screened at the water table, benzene ranged from 557 μg/L to below the detection limit; and naphthalene, the most mobile of the PAHs, from 7.29 μg/L to below the detection limit.

- For wells screened in the silty sand aquifer, benzene ranged from 2,080 μg/L to below the detection limit, and naphthalene from 2,540 μg/L to below the detection limit.

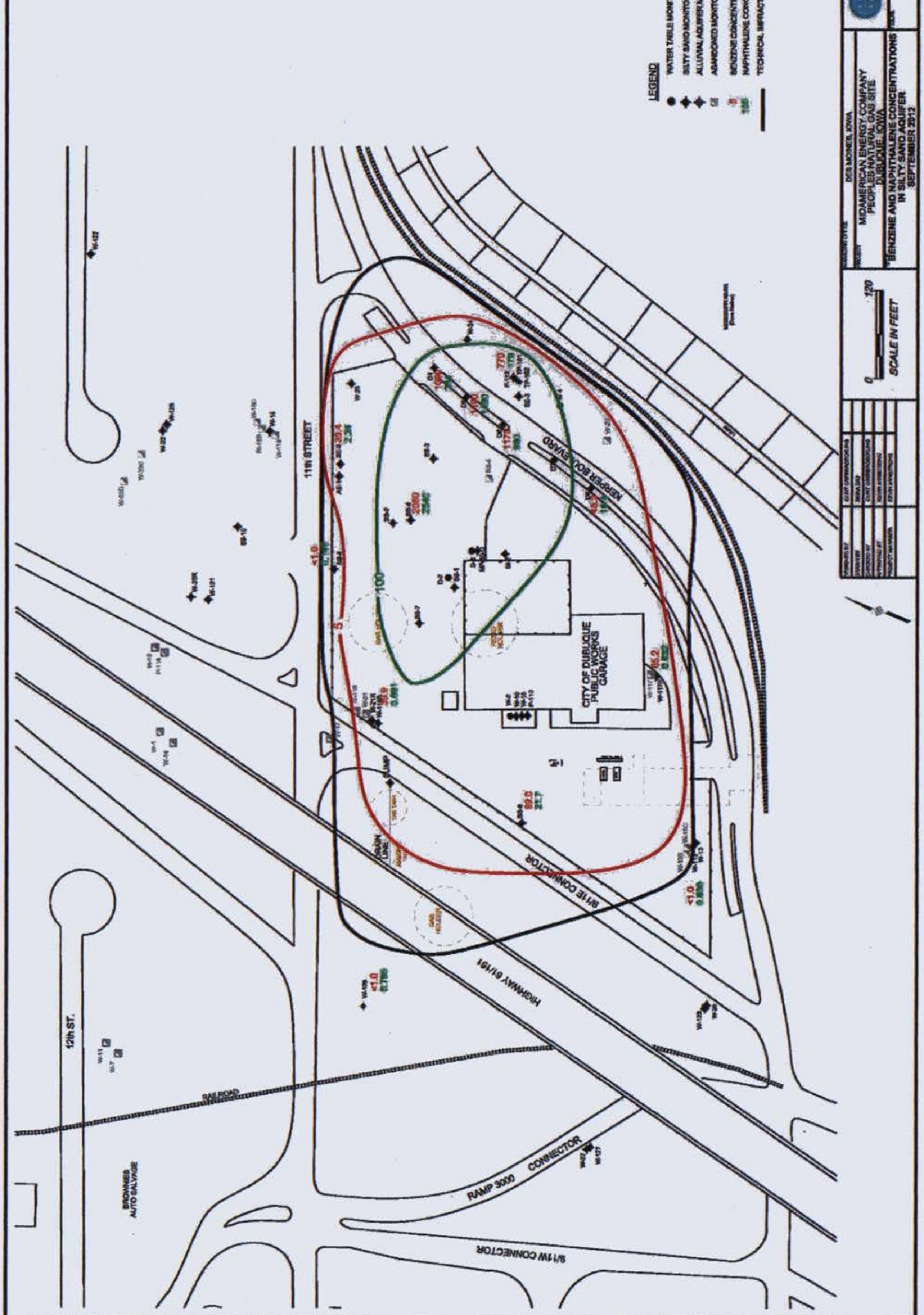
- In the alluvial aquifer, benzene was only detected in one well, MW-21R, most recently at 57.3 μg/L.

In 2005, MW-21 was replaced with MW-21R when it was determined that the original well casing was cracked, allowing groundwater from the more heavily contaminated silty sand aquifer to move into the alluvial aquifer. Low levels of naphthalene were found in three alluvial aquifer wells in September 2012. Figures 5 and 6 show the extent of benzene and naphthalene contamination in the silty sand and alluvial aquifers.

Conclusions Reached Since the 1991 RI/FS and ROD: Through implementation of the remedy and additional investigations that have been conducted at the Site, several new conclusions have been reached:

- The mass of DNAPL remaining at the Site is substantially larger than the amount estimated in the RI. The screening technology used to quantify the DNAPL mass did not exist in 1991.
- Iron and fouling significantly impact the ability to extract and treat the groundwater.
- The groundwater flow direction in the affected aquifers during the RI and design of the remedy was significantly affected by pumping of off-site wells that are no longer in operation.
- The extent of the LCU has been more completely defined and appears to limit the movement of DNAPL from the silty sand aquifer to the Mississippi River.
- The contaminated groundwater is not considered to be a principal threat for the Site. DNAPLs found in the groundwater may be considered source material and, therefore, a principal threat at this Site.

FIGURE 5 – Benzene & Naphthalene Concentrations in the Silty Sand Aquifer



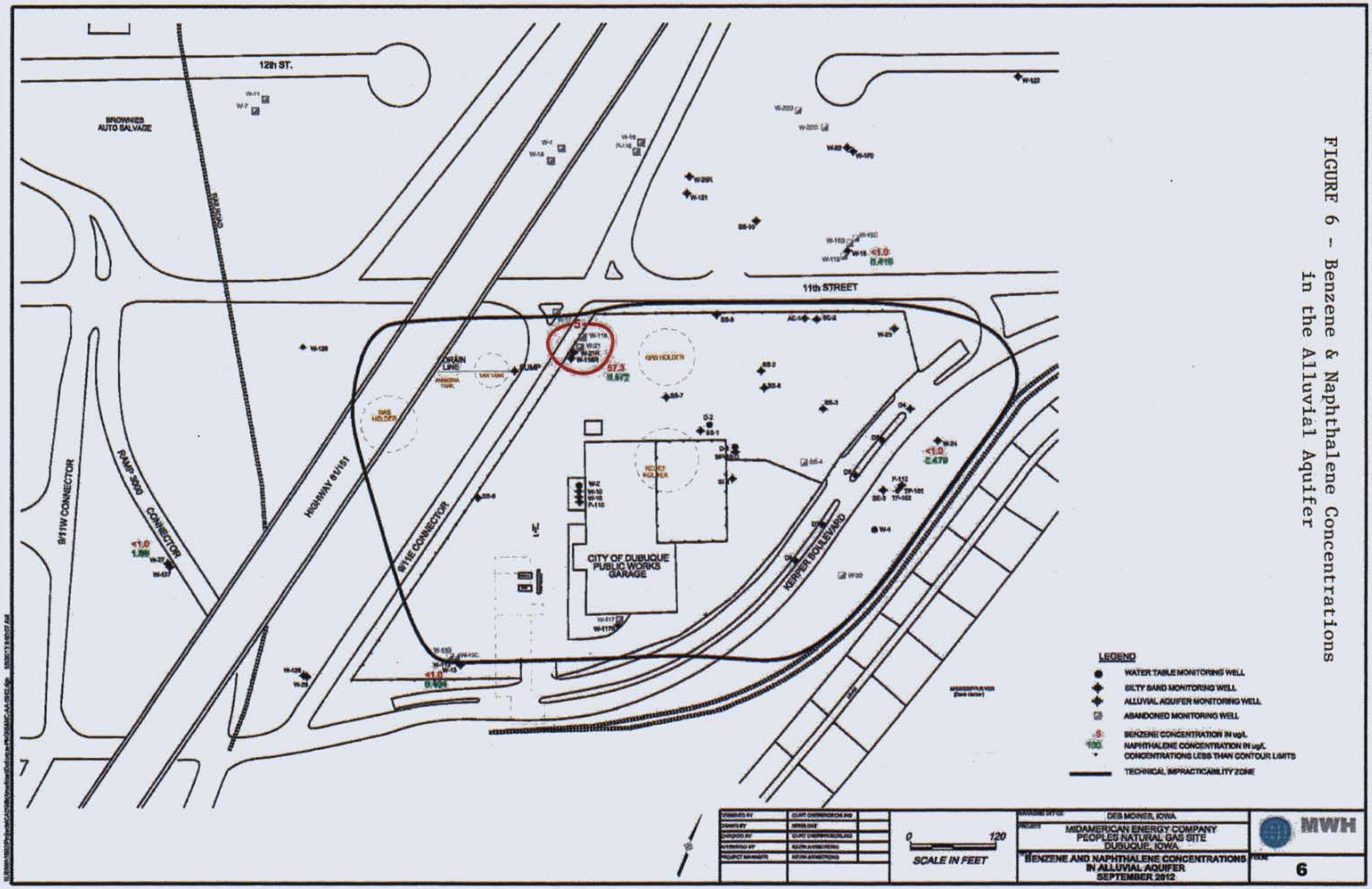


FIGURE 6 - Benzene & Naphthalene Concentrations in the Alluvial Aquifer

6.0 Current and Potential Future Land and Resource Use

Land Uses: As described previously, the eastern portion of the Site is owned by the city, where a public works garage was operated on the property until early 2006. The former public works garage remains on the property. The city continues to store equipment on part of the property and lease a portion of the property to a tenant for storage of building materials. Future use of the property is anticipated to be similar. Consideration is being given to using the property for storage and light maintenance of city buses. The western portion of the Site is where a section of U.S. Highway 61 lies. It is owned by IDOT. This is not anticipated to change in the foreseeable future. The area directly east of the former public works garage, between Kerper Boulevard and the levee, is owned by the city and is undeveloped. It is unlikely that this area will be developed as it is not very large, and there are heavily utilized rail lines at the toe of the levee. The area surrounding the Site is used for industrial purposes and that is not anticipated to change.

Groundwater and Surface Water Uses: In the vicinity of Dubuque, Iowa, water is obtained from the alluvial and bedrock aquifers for municipal, domestic and industrial use. The city has a well field consisting of four bedrock and five alluvial wells approximately 1.5 miles northeast of the Site. Water wells at a former meat processing facility north of the Site previously affected groundwater flow at the Site, but have now been properly abandoned. The Site is served by the municipal water supply and there are no water wells present on adjacent properties. The existing institutional controls prohibit the installation of water wells on the Site.

IDNR currently has authority to prohibit private and public water well installation in the vicinity of contamination. This authority is provided in Rule 567-38.12 (445B) and Subrule 567-43.3(7) of the Iowa Administrative Code, which address well permitting authority for private and public water supplies respectively. In both the Rule and Subrule, IDNR has the authority to prevent installation of new wells in known impacted groundwater sources or where a new well may alter migration of impacted groundwater.

Dove Harbor, on the Mississippi River, is located approximately 300 feet east of the Site. The city also maintains a stormwater retention basin approximately 1,000 feet northeast of the Site. Dove Harbor and the Mississippi River are maintained for boat traffic. Sport and commercial fishing occur on the Mississippi River. The city of Dubuque does not draw drinking water from the Mississippi River.

7.0 Summary of Site Risks

During the RI, a baseline risk assessment was conducted to determine the current and future effects of site contaminants on human health and the environment. The May 1991 baseline risk assessment was referred to as an endangerment assessment and included a human health baseline risk assessment and an ecological risk assessment. Since that time, changes in risk assessment methodology, assumptions and toxicity, and their effect on the protectiveness of the remedy have been evaluated during five-year reviews of the remedy, documented most recently in the Third Five-Year Review Report dated July 22, 2010.

7.1 Summary of Human Health Risk Assessment

The baseline risk assessment estimates what risks the site poses if no action was taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD Amendment summarizes the results of the baseline risk assessment for this site, identifies changes to risk assessment methodology and toxicity values that have changed since that time and presents current estimates of risks due to exposure to contaminated groundwater and vapor intrusion.

In general, the EPA requires or undertakes remedial actions for Superfund sites when the excess carcinogenic (cancer) risk exceeds 10^{-4}. A risk of 10^{-4} represents an increase of one in ten thousand, or 1/10,000, for a reasonable maximum exposure (RME). This risk represents the lifetime risk of developing cancer as a result of releases from the site being evaluated.

Remedial actions may also be conducted at Superfund sites when the hazard index (HI) equals or exceeds 1 for the RME scenario. The HI is a numeric expression of the noncarcinogenic risk to human health resulting from releases from the site being evaluated.

Identification of Contaminants of Concern

COCs are the Site contaminants that must be addressed by the response action because they present the greatest risk to human health. In the 1991 baseline risk assessment, the following contaminants were identified as the contaminants of potential concern (COPCs) in groundwater: benzene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; dibenz(a,h)anthracene; indeno(1,2,3-cd)pyrene; chrysene; fluorine; fluoranthene; pyrene; acenaphthene; anthracene; and cyanide. All of these COPCs, except benzene and cyanide, are among a group of compounds referred to as PAHs. Ultimately, fluorine, fluoranthene, pyrene, acenaphthene and anthracene were eliminated as COPCs due to the limited amount of risk that they posed. In the 1991 ROD, in addition to the COPCs identified during the baseline risk assessment, naphthalene, ethylbenzene, toluene and xylenes were added as COCs for groundwater because they were present at concentrations that exceeded state regulatory levels. Naphthalene is a PAH. Benzene, toluene, ethylbenzene and xylenes are VOCs and as a group are commonly referred to as BTEX.

PAHs: There are 16 PAH compounds that are routinely analyzed at MGP sites. Seven of these compounds – benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; dibenz(a,h)anthracene; and indeno(1,2,3-cd)pyrene – are classified by the EPA as probable human carcinogens. Naphthalene is classified by the EPA as a possible human carcinogen. Naphthalene was considered noncarcinogenic at the time of the 1991 ROD. Benzo(a)pyrene and dibenz(a,h)anthracene are considered to have the highest level of carcinogenicity of the PAHs. The only PAH to have an MCL is benzo(a)pyrene at 0.2 µg/L. In addition to being carcinogenic, naphthalene also poses a relatively high level of noncancer risk to humans through inhalation of the vapors. The noncancer risks posed by naphthalene are currently considered to be much higher than they were at the time of the 1991 ROD.

BTEX: These four compounds are VOCs commonly found at MGP and petroleum sites. Benzene and ethylbenzene are considered carcinogenic, while toluene and xylenes are not. The EPA considers benzene to be a known human carcinogen. The MCL for benzene is 5 µg/L. MCLs for the other three compounds are 1,000 µg/L for toluene; 700 µg/L for ethylbenzene; and 10,000 µg/L for xylenes.

As described in the most recent five-year review report, cyanide was identified as a COPC in the baseline risk assessment, but it was not a COC in the 1991 ROD. While not explained in the ROD, further evaluation of the noncancer risk associated with this compound in groundwater at the Site indicated the HI was 1.86×10^{-3} for an adult resident and 1.91×10^{-3} for a child resident. These levels are so low that cyanide was properly eliminated as a COC.

Exposure Assessment

Exposure refers to the potential contact of an individual (the receptor) with a contaminant. The exposure assessment evaluates the magnitude, frequency, duration and route of potential exposure. Exposure scenarios are developed using current exposure pathways with existing land uses and also exposures which might reasonably be predicted to occur based upon expected or logical future land use assumptions.

The potential human receptors that were evaluated for exposure to groundwater in the baseline risk assessment were future off-site adults and children using the groundwater as a primary drinking water source. Only ingestion of groundwater was considered, and the concentrations of the COCs that were used were those found in a well that is now abandoned and upgradient of the Site due to the change in groundwater flow direction that has occurred since pumping has ceased at several wells in the area. Current risk assessment methodology would also include evaluation of dermal contact with groundwater and inhalation of VOCs in groundwater due to household water uses (that is, showering and cooking).

At the time the original baseline risk assessment was conducted, there were no current exposures to the groundwater contaminants since no one was using water from the plume. That is still the case. Potential vapor intrusion from contamination in subsurface soil and groundwater into buildings was not assessed during the baseline risk assessment. The threat of vapor intrusion is not an exposure pathway that needs to be considered for the current use of the former public works garage, but must be considered should the use of that building change in the future, or if a new building were to be built over the plume.

Screening-Level Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

where: Risk = a unitless probability (e.g., $2x10^{-5}$) of an individual developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

SF = slope factor, expressed as $(mg/kg\text{-}day)^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., $1x10^{-6}$). An excess cancer risk of $1x10^{-6}$ indicates that an individual experiencing the RME estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an excess lifetime cancer risk because it would be in addition to the risks of cancer that individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. The EPA's generally acceptable risk range for site-related exposures is $1x10^{-4}$ to $1x10^{-6}$.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any harmful effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). A HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic noncarcinogenic effects from that chemical are unlikely. The HI is generated by adding the HQs for all COCs that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. A HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. A HI greater than 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD
where: CDI = chronic daily intake
RfD = reference dose.

A new baseline risk assessment was not prepared for purposes of this ROD Amendment since a baseline risk assessment has already been conducted for this site. However, it was recognized that the risks associated with exposure to groundwater contamination at the Site should be re-evaluated to reflect more current methodology, toxicity values and concentrations of contamination. In an effort to evaluate the current human health risks associated with exposure to groundwater at the Site, a screening-level risk evaluation was conducted using recent monitoring data from the Site and current risk methodologies. The results of the screening-level evaluation are summarized in Table 1. The estimated excess individual lifetime cancer risks for benzene, ethylbenzene, benzo(a)pyrene and naphthalene are significantly greater than $1x10^{-4}$, or 1 in 10,000, in the event of domestic use of a well in the contaminated groundwater plume at some time in the future. In addition, the noncancer HQ is greater than 1 for benzene, ethylbenzene and naphthalene in the event of domestic use of a well in the contaminated groundwater plume at some time in the future. Specifically, naphthalene presents the highest excess individual lifetime cancer risk of $2x10^{-2}$, or 2 in 100, and noncancer HQ of 497.

Table 1
Groundwater Exposure
Estimated Cancer Risks and Hazard Quotients

Contaminant	EPC (μg/L)[1]	Cancer Risk	Hazard Quotient
Benzene	1,426	$4x10^{-3}$	49
Ethylbenzene	984	$8x10^{-4}$	1.5
Benzo(a)pyrene	10.1	$4x10^{-3}$	---
Naphthalene	3,033	$2x10^{-2}$	497

[1]Exposure point concentrations (EPCs) are based on 95 percent upper confidence limits (UCLs) of the arithmetic mean. If insufficient data were available to calculate 95 percent UCLs, then arithmetic means were calculated. In general, the only data used in the calculation of EPCs was from wells in which concentrations exceeded MCLs.

These estimated risk values exceed the EPA's target cancer risk range of $1x10^{-6}$ to $1x10^{-4}$ and noncancer HQ of 1. Therefore, a significant human health threat exists if groundwater in the plume at the Site is used for domestic purposes. Since this was a screening-level risk evaluation, the excess individual cancer risks for each compound were not added together to evaluate overall cancer risk, but clearly that value would be greater than any of the individual cancer risk values. Likewise, the individual noncancer

HQs were not added together to determine the noncancer HI, but given the individual HQs that exceeded 1, it is certain that adding together multiple compounds would result in an HI greater than 1.

A screening-level evaluation of future human health risks associated with vapor-intrusion exposure was conducted using groundwater monitoring data from the Site and current risk methodologies. The concentrations of contaminants in groundwater were used to calculate indoor air concentration expressed in micrograms per cubic meter ($\mu g/m^3$) of air. The results of the screening-level evaluation are summarized in Table 2. The estimated excess individual lifetime cancer risks for benzene, ethylbenzene and naphthalene are greater than $1x10^{-4}$, or 1 in 10,000. In addition, the noncancer HQ is greater than 1 for benzene and naphthalene. Specifically, benzene presents the highest excess individual lifetime cancer risk of $5x10^{-4}$, or 5 in 10,000, and naphthalene presents the highest noncancer HQ of 5.5. These estimated risk values exceed the EPA's target cancer risk range of $1x10^{-6}$ to $1x10^{-4}$ and noncancer HQ of 1. Based on this evaluation, contaminants in groundwater at the Site are at concentrations that may pose a significant health risk through vapor intrusion. The total excess individual lifetime cancer risk and noncancer HQs may be higher than presented in this screening-level risk assessment because risk was only determined for individual contaminants.

Table 2
Indoor Air Exposure Due to Vapor Intrusion
Estimated Cancer Risks and Hazard Quotients[1]

Contaminant	Groundwater EPC[2] (µg/L)	Calculated Indoor Air Concentration ($\mu g/m^3$)	Carcinogenic Risk	Hazard Quotient
Benzene	1426	156	$5.0x10^{-4}$	5.0
Ethylbenzene	984	128	$1.3x10^{-4}$	0.1
Naphthalene	3033	17.2	$2.4x10^{-4}$	5.5

[1]Indoor air concentrations, carcinogenic risk, and noncarcinogenic hazards were calculated using the Vapor Intrusion Screening-Level Calculator (USEPA, 2012a).
[2]Exposure point concentrations are based on 95 percent UCLs of the arithmetic mean. If insufficient data were available to calculate 95 percent UCLs, then arithmetic means were calculated. In general, the only data used in the calculation of EPCs was from wells in which concentrations exceeded MCLs.

7.2 Summary of Ecological Risk Assessment

In the 1991 endangerment assessment, ecological risk was evaluated for freshwater aquatic life in the Mississippi River and Dove Harbor. Since the limited number of surface water and sediment samples collected did not contain detectable levels of site contaminants, contaminant transport modeling was used to estimate the concentrations of four contaminants (benzene, benzo[a]anthracene, benzo[a]pyrene and naphthalene) that could be expected in surface water in both the harbor and the river in the future if no action was taken. These concentrations were used to assess the ecological risk, and the conclusion reached was that there would not be any adverse impacts to aquatic life. However, the chronic and acute contaminant levels in freshwater used in the 1991 endangerment assessment for comparison are not consistent with the levels that would now be used to assess risk in freshwater. Of the four contaminants considered, the only contaminant in surface water that might pose an unacceptable level of risk using current methodology would be naphthalene in surface water in Dove Harbor, but it was determined that the risk would be minimal.

In the ecological risk assessment, there was no consideration given to sediment contamination that might be expected to occur from the contaminants entering the harbor or river from the Site. During the most recent five-year review, it was noted that it would be desirable to sample the harbor sediment since PAHs have a preference to adhere to sediment. Since Dove Harbor is dredged periodically to maintain the depth of the harbor for navigation, it might be possible to sample sediment in conjunction with dredging of the harbor. However, due to the barge traffic in the harbor and the proximity of the coal pile at a nearby power plant, both potential sources of PAH contamination, it may be very difficult to determine whether the source of PAH contamination is the Site or these other sources.

In conclusion, if groundwater from the Site is allowed to discharge to Dove Harbor, it may be possible for aquatic life to be exposed to an unacceptable level of naphthalene in surface water. The effect of this groundwater discharge to the sediment of Dove Harbor has not been quantified, but would be difficult to attribute to the Site since multiple sources of the same contaminants are present in and around the harbor.

7.3 Risk Assessment Summary and Conclusions

The COCs for groundwater at the Site are benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, chrysene, naphthalene, ethylbenzene, toluene and xylenes. No one is currently using the groundwater in the vicinity of the plume associated with the Site, but the alluvial aquifer serves as a source of water in the area. A significant human health threat exists if groundwater in the plume at the Site were to be used for domestic purposes at some time in the future. The screening-level risk evaluation determined that benzene, ethylbenzene, benzo(a)pyrene and nathphalene would each individually exceed the EPA's acceptable cancer risk range. Benzene, ethylbenzene and naphthalene would each individually exceed the noncancer HQ of 1.

The COCs evaluated for indoor air exposure due to vapor intrusion of volatile contaminants in groundwater were benzene, ethylbenzene and naphthalene. There are currently no buildings over the plume or near enough to the plume that are constructed or used in such a manner that vapor intrusion would pose a threat to occupants. However, if the use of the former public works garage were to change, or new buildings were to be constructed over the plume in the future, the screening-level risk evaluation concluded that benzene, ethylbenzene and naphthalene would each individually exceed the EPA's acceptable cancer risk range. Benzene and naphthalene would each individually exceed the noncancer HQ of 1.

The conclusion of the ecological risk assessment in the 1991 endangerment assessment was that the Site did not pose an ecological risk to Dove Harbor or the Mississippi River. However, reassessment with current toxicity values determined that if groundwater from the Site is allowed to discharge to Dove Harbor, it may be possible for aquatic life to be exposed to an unacceptable level of naphthalene in surface water. The effect of this groundwater discharge to the sediment of Dove Harbor has not been quantified, but would be difficult to attribute to the Site since multiple sources of the same contaminants are present in and around the harbor.

The response action selected in this ROD Amendment is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

8.0 Remedial Action Objectives

Remedial Action Objectives (RAOs) provide a general description of what the actions taken at a site are expected to accomplish. The RAOs for this site in the 1991 ROD were as follows:

- minimize direct contact with soil;
- minimize the potential exposure to users of the alluvial aquifer to groundwater with contaminants that exceed MCLs, have a total excess lifetime cancer risk of greater than $1x10^{-6}$ or have a HI that exceeds 1;
- provide remedies that allow eventual achievement of other groundwater standards that are applicable or relevant and appropriate in the alluvial aquifer; and
- minimize migration of contaminants from other media to the extent necessary to protect the alluvial aquifer.

In addition to the existing RAOs, two RAOs are being added:

- prevent and/or reduce future human exposure to indoor air containing COCs that exceed health-based levels, and
- prevent migration of contaminated groundwater from the Site to the Mississippi River.

Cleanup levels are the concentrations of the COCs in the affected media that must not be exceeded to ensure that the RAOs will be met. Soil cleanup levels were established in the 1991 ROD. Visibly contaminated soil from the surface to 6 feet below grade and more heavily contaminated soil from 6 feet to the UCU, or the maximum depth that could be reached by the excavator, was excavated, treated off-site and replaced with clean fill.

Groundwater cleanup levels were established in the 1991 ROD, and the levels for benzene and naphthalene were modified in the 2004 ESD. However, as has been noted in the most recent five-year review, there have been numerous changes to toxicity values and risk assessment methodology which affect the levels of some of the COCs that would be protective. The cleanup levels for groundwater at the Site are listed in Table 3. The revised cleanup levels for groundwater were determined based upon the following hierarchy:

- The MCL is the cleanup level for COCs that have MCLs.
- For COCs without an MCL, a risk-based cleanup level was determined based on an excess lifetime cancer risk of $1x10^{-6}$ and/or a target HQ of 1.
- When the risk-based level is below the laboratory practical quantitation limit (PQL), the PQL is the cleanup level, provided it falls within the acceptable risk range.

Table 3
Groundwater Cleanup Levels
in micrograms per liter (µg/L)

Contaminant of Concern	Current Cleanup Level (1991 ROD or ESDs)	Chemical-Specific ARAR (MCLs)	Risk-Based Level[1]	Practical Quantitation Limit[2]	Revised Cleanup Level (Changed values are **bold**)
Benzene	5	5	-	-	5
Ethylbenzene	700	700	-	-	700
Toluene	2000	1000	-	-	**1000**
Xylenes	10,000	10,000	-	-	10,000
Naphthalene	100	-	0.14	0.1	**0.14**
Benzo(a)pyrene	0.2	0.2	-	-	**0.2**
Benzo(a)anthracene	0.1	-	0.029	0.1	0.1
Benzo(b)fluoranthene	0.2	-	0.029	0.1	**0.1**
Benzo(k)fluoranthene	0.2	-	0.29	0.1	**0.29**
Chrysene	0.2	-	2.9	0.1	**2.9**
Dibenz(a,h)anthracene	0.2	-	0.0029	0.013	**0.013**
Indeno(1,2,3cd)pyrene	0.4	-	0.029	0.1	**0.1**

[1]Risk-based cleanup level was determined based on an excess lifetime cancer risk of $1x10^{-6}$ and/or a target HQ of 1.
[2]Practical Quantitation Limits listed are laboratory Reporting Limits except for dibenzo(a,h)anthracene where the Method Detect Limit is used.

9.0 Description of Alternatives

9.1 Alternative 1: No Action

Estimated Capital Cost: $0
Estimated Annual Operation and Maintenance (O&M) Cost: $0
Estimated Present Worth Cost: $0
Estimated Time to Achieve RAOs: Never

The NCP requires that the EPA consider a no-action alternative against which other remedial alternatives can be compared. Under this alternative, no further action would be taken to monitor, control or remediate the Site.

The expected outcome of Alternative 1 is that RAOs would be unlikely to be met in decades, or even centuries, since significant amounts of DNAPL are known to be present in the groundwater and subsurface soil. No measures would be in place to prevent the groundwater plume from moving into the Mississippi River. Without environmental covenants in place nothing would prevent future vapor intrusion into indoor air above the plume.

9.2 Alternative 2: Institutional Controls with Additional Excavation

Estimated Capital Cost: $1,826,040
Estimated Annual O&M Cost: $46,800
Estimated Present Worth Cost: $2,394,000
Estimated Time to Achieve RAOs: More than 1,000 years

Alternative 2 includes both institutional controls and additional excavation of contaminated soil to prevent exposure to contaminated groundwater. In 2005, the Iowa state legislature passed the Uniform Environmental Covenants Act (UECA), which has been certified under Iowa Code Title XI, Chapter 455I, providing a legally enforceable means to restrict land use or access under a real estate instrument called an environmental covenant. Implementation of environmental covenants to restrict access to residual contamination is proposed for the Site. In addition to environmental covenants, the IDNR Water Supply Section, the city Water Department and the Dubuque County Health Department would be notified in writing of the area of contamination for consideration when reviewing new water well permit applications. These notifications are informational institutional controls. The city of Dubuque has notified the EPA of plans to introduce a city ordinance placing limitations on installation of water wells in the vicinity of the Site as well as other areas within the city. Once implemented, this ordinance will prevent contaminated groundwater from the Site from being moved to previously uncontaminated areas through pumping of groundwater. An ordinance is a governmental institutional control.

The second component of this alternative is additional excavation. To achieve the cleanup levels specified in Table 3, the source areas for groundwater contamination must be addressed. As discussed in section 3.1 of the 2006 TI Evaluation Report, soil excavation was a component of the original remedy to address contamination at the Site. Approximately 45 percent of the original source contamination was removed from the Site through excavation. As discussed in Section 5.3 of the TI Report, the source material remaining at the Site includes DNAPL located in the area northeast of the former maintenance building and below the base of the excavations. The estimated 614,290 pounds of residual source material have the potential to be a source of further releases to groundwater or surface water, with the quantity of contaminants either staying the same or decreasing over time due to physical, chemical and biological natural attenuation processes. Natural attenuation reduces contaminant concentrations in groundwater and limits migration via natural processes such as biodegradation, chemical transformation, sorption, dispersion, diffusion and volatilization. Much of the remaining material is not readily accessible because it is beneath the building or sewer line on the Site, or its removal would risk compromising the LCU. Following further excavation proposed in this alternative, an estimated 206,230 pounds or 34 percent of source material would remain at the Site. Excavation of contaminated soil in the UCU and silty sand aquifer would also include removal of DNAPL. It would also require removal of clean soil in areas previously remediated, would require extensive dewatering and would risk compromise of the LCU unless pressure equal to or greater than the hydraulic head of the underlying alluvial aquifer is maintained on the LCU to prevent upheaval. Due to the large mass of source material that would remain untreated, it is estimated that it would take more than 1,000 years to achieve cleanup levels in the silty sand aquifer.

The expected outcome of Alternative 2 is that the institutional controls would prevent exposure to contaminated water, air and soil. The mass of subsurface contamination would be reduced but the 200,000 pounds of source material that would be expected to remain would serve as an ongoing source of groundwater contamination in the silty sand aquifer. Without continued monitoring, the location of the plume would be uncertain, but it would be expected to continue to move toward the river. The potential exists that the LCU could be damaged during excavation, allowing source contamination to move into the alluvial aquifer. The RAOs would not be met for centuries.

9.3 Alternative 3: Institutional Controls and In Situ Solidification

Estimated Capital Cost: $3,143,520
Estimated Annual O&M Cost: $46,800
Estimated Present Worth Cost: $3,711,000
Estimated Time to Achieve RAOs: More than 1,000 years

Alternative 3 combines institutional controls, as described previously, with in situ solidification. In situ solidification is accomplished by mixing a combination of Portland cement, cement kiln dust, lime, fly ash or other binding agents into the subsurface soil. A heavy-duty, large-diameter auger is used to mix the soil while injecting the binding agent, effectively distributing the binding agent throughout the soil. The binding agent subsequently solidifies upon reaction with water or hydration. Contaminated groundwater within the treatment zone participates in the hydration reaction and is, therefore, bound within the resulting structure. This technology reduces contaminant mobility by binding the contaminant into a solid mass with low permeability that resists leaching, and/or by chemically binding contaminants to the solidification reagents. Solidification neither reduces contaminant mass nor completely prevents leaching or volatilization, and may become less effective over time as the binding agents degrade. This technology is effective to 55 feet bgs. The auger can be positioned adjacent to the exterior wall of a building, and mixing of subsurface soil can extend up to approximately four feet beneath a building foundation. However, at this site, this will be limited by the way the former maintenance garage is constructed, which includes pilings for subsurface support. Similarly, this technology would be very limited with respect to the extent that contamination beneath Highway 61 could be addressed. The technology is limited by subsurface debris greater than 3 feet in diameter. To implement this technology at the Site, the uncontaminated areas would be excavated and stockpiled prior to the start of the project.

Approximately 30,500 square feet of the contaminated area would be accessible to the treatment auger. The source material extends to a depth of up to 35 feet bgs with an approximate treatment volume of 22,600 cubic yards. Approximately 65 percent of the total mass remaining at the Site is accessible for treatment. Of the total mass, 35 percent would remain untreated after solidification. After solidification, the zone that was treated would be much less permeable than the surrounding soils and would likely result in a change in the groundwater flow direction at the Site. The proximity of the stage changes of the Mississippi River, which is hydraulically connected to the silty and alluvial aquifers, may result in multiple flow directions at the Site, causing additional contaminant migration from untreated areas. Due to the large mass of source material that would remain untreated, it is estimated that it would take more than 1,000 years to achieve cleanup levels in the silty sand aquifer.

The expected outcome of Alternative 3 is that the institutional controls would prevent exposure to contaminated water, air and soil. The mass of subsurface contamination that would not be solidified would be reduced but the 200,000 pounds of source material that would be expected to remain would serve as an ongoing source of groundwater contamination in the silty sand aquifer. It is unknown how effectively, and for what period of time, the contaminants would remain bound up. The groundwater flow would be changed by the presence of the treated zone. Without continued monitoring, the location of the plume would be uncertain, but it would be expected to continue to move toward the river. The RAOs would not be met for centuries.

9.4 Alternative 4: Institutional Controls with In Situ Thermal Treatment

Estimated Capital Cost: $2,847,000
Estimated Annual O&M Cost: $46,800
Estimated Present Worth Cost: $3,416,000
Estimated Time to Achieve RAOs: More than 1,000 years

Alternative 4 combines institutional controls with in situ thermal treatment. In situ thermal treatment is possible east of the city maintenance garage and could extend beneath the building. However, the presence of U.S. Highway 61 would limit treatment in the Highway Corridor area. In situ thermal treatment uses heat to volatilize contaminants, decrease the viscosity of DNAPL, and desorb and then thermally destruct contaminants adsorbed to soil. The technology can use heater wells or electrodes to generate heat in the subsurface. Volatilized contaminants are extracted in the vapor phase, and recovery wells can be used to capture mobile product. In situ thermal treatment is most effective in unsaturated soils, where the higher temperatures required for desorption and destruction of contaminants can be achieved. In saturated soils, the operating temperature is limited to 212 degrees Fahrenheit (°F), the boiling point of water. In situ heating technologies have been used to successfully remediate chlorinated solvent sites, but the success of this technology to treat MGP contaminants or in restoring groundwater to drinking water standards is not certain.

TarGOST™ data indicates that DNAPL remains in both the unsaturated fill material above the UCU and in the silty sand aquifer. Dewatering the silty sand aquifer would be required to achieve temperatures greater than 212°F. Dewatering is not practical and risks damage to the LCU due to upward force from the underlying alluvial aquifer. Therefore, the highest temperature that could be achieved in the silty sand aquifer is 212°F. At this temperature, volatile contaminants would be removed, and free-phase DNAPL would be mobilized for collection. However, residual DNAPL and adsorbed contaminants would remain. It is estimated that thermal treatment would remove approximately 361,670 pounds or 59 percent of the total remaining mass. The contaminant mass beneath U.S. Highway 61 could not be treated. Due to the significant mass of source materials that would remain in the subsurface, it is estimated that it would take more than 1,000 years to achieve groundwater cleanup levels in the silty sand aquifer.

The expected outcome of Alternative 4 is that the institutional controls would prevent exposure to contaminated water, air and soil. Thermal treatment would be limited in the saturated zone, where the majority of the contaminant mass remains. The mass of subsurface contamination that would not be treated is estimated to be 250,000 pounds. This source material would serve as an ongoing source to groundwater contamination in the silty sand aquifer. Without continued monitoring, the location of the plume would be uncertain, but it would be expected to continue to move toward the river. The RAOs would not be met for centuries.

9.5 Alternative 5: Institutional Controls and MNA

Estimated Capital Cost: $64,300
Estimated Annual O&M Cost: $68,040
Estimated Present Worth Cost: $523,000
Estimated Time to Achieve RAOs: More than 100,000 years

Alternative 5 combines institutional controls with MNA. The plume would be monitored through groundwater sampling and analysis to detect changes in groundwater concentrations or plume migration. Of all the natural attenuation processes described in Alternative 2, biodegradation is the primary mechanism that reduces contaminant mass. Biodegradation is generally capable of addressing dissolved contaminants and does not appreciably remediate DNAPL. Low permeability and adsorptive clayey soil can be the primary physical attenuation mechanisms, which limit migration rates and greatly increase the time available for on-site biodegradation.

Current data indicates the dissolved plume is generally stable and supports the ability of natural attenuation processes to contain the contaminated groundwater plume to prevent further migration of the groundwater plume to potential receptors, except in the area of silty sand aquifer well P-112. Concentrations of contaminants in P-112 are increasing, apparently as a result of the change in flow direction due to shutdown of the off-site upgradient wells, which extracted large volumes of water, and the on-site extraction system. The current direction of groundwater flow is not expected to change now that none of these wells are operating.

As discussed in Section 5.6 of the 2006 TI Report, groundwater conditions at the Site appear conducive to microbial activity, and initial geochemical data suggest various microbial processes are occurring. Continued groundwater monitoring would be required to confirm contaminant migration is not occurring and that concentrations are stable and will eventually decrease. The majority of contamination remains in the upper fill layer and the silty sand aquifer, with the underlying low permeability UCU and LCU providing a mechanism to limit source migration at the Site. DNAPL retention as residual material will also limit the degree of both vertical and horizontal migration.

Approximately 99 percent of the remaining contaminant mass is comprised of PAHs. PAHs have a higher propensity to remain bound to the soil matrix than to dissolve into groundwater. Natural attenuation of PAHs is limited because microbial degradation predominantly occurs in the dissolved phase. As a result, it is estimated that it would take more than 100,000 years to achieve groundwater cleanup levels in the silty sand aquifer.

The expected outcome of Alternative 5 is that the institutional controls would prevent exposure to contaminated water, air and soil. Monitoring would provide a mechanism for observing the movement of contaminated groundwater, although it is not anticipated that the entire plume would ever achieve the groundwater cleanup levels. Monitoring for the MNA parameters would provide additional information pertaining to the mechanisms that maintain plume stability. The plume is expected to reach the river. The RAOs would not be met for centuries, if ever.

9.6 Alternative 6: Institutional Controls with Hydraulic Containment and MNA

Estimated Capital Cost: $149,000
Estimated Annual O&M Cost: $122,280
Estimated Present Worth Cost: $1,706,000
Estimated Time to Achieve RAOs: More than 100,000 years

Alternative 6 combines institutional controls with a hydraulic containment system consisting of extraction wells located between Kerper Boulevard and the levee to prevent migration of the downgradient plume. Pilot testing of this system occurred and confirmed the viability of this option to capture the downgradient plume in the silty sand aquifer while operating at a very low flow rate through several extraction wells in an effort to minimize the likelihood of the biological and iron fouling that plagued the original groundwater extraction system. Small amounts of compounds called sequestering agents may be added at the extraction wells to further prevent fouling of the wells. Pilot test sampling indicated that the extracted water could be discharged to the sanitary sewer system but a treatment system may be added if the contaminant levels in the extracted water exceed levels that may be discharged to the sanitary sewer system. The pumping rates that would be used for this alternative should not mobilize DNAPL. While contamination will be removed from the silty sand aquifer, the impact on the levels of contamination remaining at the Site will be very minimal since the objective is to control the downgradient plume, not to remove all of the contamination from the silty sand aquifer.

As described in Alternative 5, natural attenuation would continue to reduce contaminant concentrations in the dissolved plume supporting plume stability. Monitoring would verify that this was occurring. It is estimated that it would take more than 100,000 years to achieve groundwater cleanup levels in the silty sand aquifer.

The expected outcome of Alternative 6 is that the institutional controls would prevent exposure to contaminated water, air and soil. The hydraulic containment system would prevent groundwater in the silty sand aquifer from reaching the Mississippi River and result in a very minor reduction in contaminant mass. The lower rate of pumping planned with this system is not expected to mobilize DNAPL. Natural attenuation is expected to continue to reduce contaminant concentrations in the dissolved plume, supporting plume stability. Monitoring would verify that the hydraulic containment system is controlling plume movement and that natural attenuation is occurring and supporting plume stability. The RAOs would not be met for centuries, if ever.

10.0 Summary of Comparative Analysis of Alternatives

Nine criteria are used to evaluate the different alternatives individually and against each other in order to select the remedy. A summary of the comparative analysis of alternatives for the Site is presented in Attachment 1. The nine evaluation criteria are: (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility or volume of contaminants through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state/support agency acceptance and (9) community acceptance. This section summarizes the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are discussed below.

10.1 Overall Protection of Human Health and the Environment determines whether an alternative eliminates, reduces or controls threats to public health and the environment through institutional controls, engineering controls or treatment.

All of the alternatives except the no-action alternative, Alternative 1, would provide adequate protection of human health and the environment by using layered institutional controls to prohibit future well placement in the vicinity of the Site and controlling future vapor intrusion. While existing proprietary property restrictions, city and county ordinances and state rules provide some degree of protection, they do not address potential future exposures to contaminated soil, groundwater and air in all areas of the contaminated groundwater plume without implementation of environmental covenants and a city ordinance placing restrictions on installation of water wells in the vicinity of the Site.

During the design and implementation of Alternatives 2 through 4, steps might have to be taken to prevent mobilization of DNAPL. For each of the Alternatives 2 through 6, a large volume of contaminant mass would remain following implementation. Excavation (Alternative 2) is likely to disturb the steady-state DNAPL distribution and result in increased risk to human health and the environment by promoting migration and increasing the risk of contaminant dissolution if the LCU is compromised. In situ solidification (Alternative 3) is likely to create low permeability areas and change the groundwater flow paths at the Site. In situ thermal treatment (Alternative 4) is limited in effectiveness due to water in the surrounding aquifer. Dewatering the aquifer would compromise the LCU and promote migration and contaminant dissolution. While MNA (Alternatives 5 and 6) would reduce concentrations of the more mobile contaminants (BTEX and naphthalene), it would have a very limited impact on the other contaminants and have almost no impact on DNAPL. The presence of DNAPL in inaccessible areas suggests that none of the alternatives are likely to achieve the cleanup levels in groundwater at the Site in a reasonable amount of time. The hydraulic containment system (Alternative 6) would prevent expansion of the plume toward the Mississippi River and remove a limited amount of contamination from the silty sand aquifer.

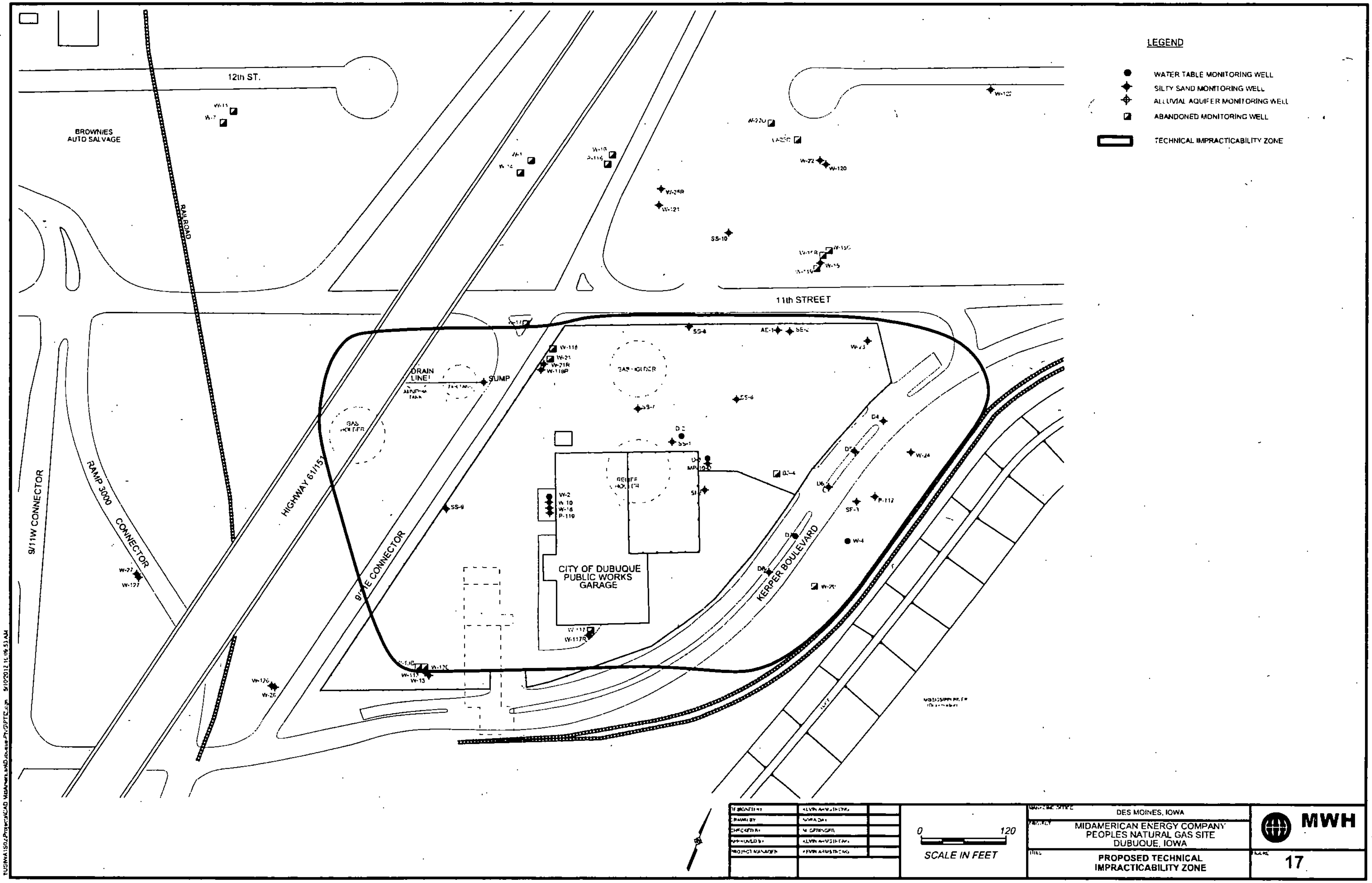
10.2 Compliance with ARARs evaluates whether the alternative meets federal and state environmental statutes, regulations and other requirements that pertain to the Site, or whether a waiver is justified.

The ARARs identified for all of the alternatives are listed in Attachment 2. None of the alternatives are likely to comply with chemical-specific ARARs for all compounds due to the nature and distribution of the contaminants at the Site. Due to the presence of a large volume of DNAPL, it is unlikely that the MCL would ever be met for benzo(a)pyrene. It has been demonstrated through past experience at similar sites that long-term treatment of high levels of dissolved concentrations of PAHs cannot be remediated in a reasonable time frame. At this time, there is no known reliable method for removing and remediating the DNAPL or treating it in place.

When there are site-specific conditions that may inhibit groundwater restoration as is the case at this Site, the EPA has established guidance and a mechanism to evaluate the technical impracticability of restoring groundwater to meet ARARs. Therefore, it has been determined that a TI ARAR waiver is appropriate for the groundwater contaminants at the Site. This TI ARAR waiver is necessary for all of the alternatives considered for remediation of this site. The EPA refers to the portion of the aquifer where groundwater cannot be restored to drinking water standards within a reasonable time frame as the "TI zone." The TI zone for this Site applies to the shallowest occurrence of groundwater to the bottom of the LCU. This includes all of the silty sand aquifer in the area as shown in Figure 7.

All ARARs listed for each of the alternatives would be achieved outside the TI zone.

FIGURE 7 - Proposed Technical Impracticability Zone



10.3 Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.

Each of the alternatives, except Alternative 1, provides some degree of long-term protection. The institutional controls portion of Alternatives 2 through 6 adequately protects human health because the proposed institutional controls would effectively prevent any future exposure to contaminated groundwater and vapor intrusion. The institutional controls include existing IDNR rules; new environmental covenants, which prohibit future well installation on-site and prevent potential vapor intrusion; and a new city ordinance to place limitations on well installation in the vicinity of the Site. The city water department, the Dubuque County Health Department and the IDNR Water Supply Section would be notified of the contamination present at the Site. The institutional controls are layered to increase their reliability. The existing IDNR rules are expected to provide long-term effectiveness and permanence. Because an environmental covenant is a legally binding document, a high level of long-term effectiveness and reliability is expected. The city ordinance would provide additional long-term effectiveness and reliability, ensuring that contaminants from the Site will not be moved to previously uncontaminated groundwater. All alternatives will require statutory five-year reviews of the remedy.

Alternatives 2, 3 and 4 may mobilize DNAPL, exacerbating current conditions and requiring long-term monitoring and management. Additional excavation and in situ thermal treatment activities may damage the LCU and allow DNAPL to migrate downward into the alluvial aquifer. Alternative 3 will create a low permeability zone that may encourage the development of new vertical and lateral groundwater pathways. Mobilization of DNAPL is likely to increase the total volume of contaminated groundwater. Disturbing the steady-state conditions will likely cause greater dissolution into groundwater, thus increasing contaminant concentrations. All alternatives leave a large volume of contaminated mass in the subsurface that will continue to exist as a long-term source of dissolved PAHs and BTEX that will affect a large aquifer volume.

Alternative 5 may not prevent contaminated groundwater from reaching the Mississippi River if the movement of the dissolved plume is faster than the natural attenuation processes are able to reduce the contaminants to nonhazardous compounds.

The hydraulic control component of Alternative 6 decreases the likelihood that the groundwater plume in the silty sand aquifer will expand toward the Mississippi River and will remain effective as long as the system is in operation.

10.4 Reduction of Toxicity, Mobility or Volume of Contaminants Through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment and the amount of contamination present.

Alternative 1 does not include treatment as a component of the remedy. Therefore, that alternative will not reduce the toxicity, mobility or volume of contamination at the Site, nor does it satisfy the statutory preference for treatment as a principal element of the remedy.

Alternatives 2, 3 and 4 will remove or immobilize over half of the total contaminant mass, but contaminant mass remaining as DNAPL or adsorbed to the soil matrix is inaccessible to these alternatives because of the presence of U.S. Highway 61, the city maintenance garage and the 30-inch sanitary sewer force main. Alternative 2 would not involve treatment of principal threat wastes if the excavated soil was disposed of in a landfill. If the excavated soil was thermally treated following excavation, then treatment of principal threat wastes would occur. Alternatives 3 and 4 involve treatment of principal-threat wastes. Alternatives 2, 3 and 4 may potentially increase contaminant mobility by mobilizing DNAPL into new lateral and vertical migration paths. Alternative 5 does not involve active treatment and provides only limited reductions in toxicity, mobility or volume. Alternative 6 would result in a small decrease in contaminant volume since dissolved contaminants in extracted groundwater would be treated at the waste water treatment plant. The groundwater to be treated would not be a principal threat waste. A significant quantity of contaminant mass containing PAHs and VOCs will remain at the Site with each alternative.

10.5 Short-Term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents and the environment during implementation.

Alternative 1 would pose no increase in the short-term risks to the community or the environment since no actions would be taking place. Alternative 5 poses minimal risk to the community or environment from monitoring; however, a slight risk of field and laboratory worker exposure to contaminants while sampling and analyzing the groundwater is present. The proper use of personal protective equipment and appropriate laboratory procedures should eliminate nearly all risk to workers. Alternatives 2, 3 and 4 potentially expose site workers to soil and groundwater contamination during implementation, but risk to the community is minimal and can be mediated through air monitoring, use of proper health and safety plans and standard operating procedures. The risk to workers from alternatives 2, 3 and 4 is increased during equipment installation, equipment repair, cleaning and material handling. Risks to workers would be minimized by adherence to a proper health and safety plan. The opportunity is present for contaminants to be transferred to the vapor phase during implementation of Alternatives 2 and 4. Therefore, some additional community exposure is likely with these alternatives. Plans for air monitoring during intrusive soil work and suppression of vapors, should they occur, would mitigate this risk. Alternative 4 includes DNAPL recovery resulting in potential exposure to site workers, the community and the environment in the event of an accidental release during recovery or storage. These risks can be minimized with proper personal protective equipment, standard operating procedures and secure storage prior to transport. Alternative 6 poses minor risks to the public while wells are being installed outside of the fenced area of the Site. This is manageable with proper construction site controls. There is also a potential that the LCU could be damaged during well installation, allowing DNAPL to move deeper. This is also avoidable with knowledge of the geology of that area and proper care taken while installing the wells.

10.6 Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

Alternative 1 does not involve implementation of any actions. Each of the other alternatives includes institutional controls, including those provided by the city code, county ordinance and IDNR rules which are already in place. Environmental covenants should not be difficult to place on the Site properties with the cooperation of the property owners. The city has expressed an interest in implementing an ordinance to place limitations on well installation in the vicinity of the Site as well as other areas in the city.

Alternative 4, in situ thermal treatment, is the most difficult to implement because of the complexity of the equipment, borehole installation and the limited amount of historical use of the technology on MGP contaminants. Alternative 2, excavation, is the next most difficult to implement due to the amount of clean soil that would need to be excavated and the volume of contaminated soil and groundwater that would either need to be treated or disposed of. Alternative 3 would not remove mass from the Site and would not require an extensive site preparation period. Alternative 6 would require the installation of wells and an extraction system but the technology is readily available and well developed. Particular care would need to be taken to monitor water quality during operation of the extraction system to avoid system fouling problems experienced in the past. Coordination with the city waste water treatment plant would have to be ongoing. Alternative 5 includes ongoing monitoring, which is already being done. Alternatives 2, 3 and 5 have been implemented at other MGP sites and a familiarity with the processes would increase their implementability.

10.7 Cost includes estimated capital and annual operations and maintenance costs as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. The present worth costs were calculated at a discount rate of 7 percent. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

Alternative 1 involves no cost. The second least costly option is Alternative 5 with a present worth cost estimated at $523,000. The most costly option is Alternative 3 with a present worth cost estimated at $3,711,000. The remaining alternatives are estimated at $3,416,000 for Alternative 4; $2,394,000 for Alternative 2; and $1,706,000 for Alternative 6. A detailed itemization of costs and assumptions for each alternative, except Alternative 1, is included in Attachment 3.

It is significant to note that the cost estimates for all of the alternatives are based upon 30 years of operation for purposes of comparison, though in all cases the remedies will need to operate well beyond 30 years to ensure protectiveness. Costs will be significantly higher if the periods of operation extend well beyond 30 years.

10.8 State/Support Agency Acceptance considers whether the state agrees with the EPA's analyses and recommendations as described in the RI/FS and Proposed Plan.

The state of Iowa supports the selected amended remedy.

10.9 Community Acceptance considers whether the local community agrees with the EPA's analyses and Preferred Alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

During the public comment period, including the public meeting held in Dubuque, Iowa, written and verbal comments and questions were received. The comments and questions and the EPA's responses may be found in the Responsiveness Summary section of this ROD Amendment. The full text transcript of the public meeting is included in the AR.

11.0 Principal Threat Wastes

The NCP establishes an expectation that the EPA will use treatment to address the principal threats posed by a site wherever practicable [NCP Section 300.430(a)(1)(iii)(A)]. The principal threat concept is applied to the characterization of source materials at a Superfund site. Source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material; however, nonaqueous phase liquids (NAPLs) in groundwater may be viewed as source material.

The contaminated groundwater at this site is not considered a principal threat waste, but the DNAPL, which is found primarily in the silty sand aquifer, is a principal threat waste. The additional excavation described in Alternative 2 would result in the removal of some of the DNAPL. However, a significant quantity of DNAPL would remain in the aquifer serving as a source for groundwater contamination for an extremely long period of time. Also, damaging the LCU during excavation could cause DNAPL to move deeper into the alluvial aquifer.

In situ solidification, a component of Alternative 3, may immobilize or even destroy some DNAPL, but a significant quantity would still remain to serve as an ongoing source of contamination in the silty sand aquifer. In situ thermal treatment, a component of Alternative 4, may destroy some of the DNAPL but, as with Alternative 3, a significant quantity would remain to serve as an ongoing source.

Alternatives 1, 5 and 6 do not significantly reduce the volume of DNAPL so there is no treatment of principal threat wastes.

12.0 Selected Amended Remedy

12.1 Summary of the Rationale for the Selected Amended Remedy

The selected amended remedy for the Site is Alternative 6, which addresses the groundwater contamination using institutional controls in conjunction with a hydraulic containment system consisting of extraction wells located between Kerper Boulevard and the levee to prevent migration of the downgradient plume. Natural attenuation would continue to reduce contaminant concentrations in the dissolved plume supporting plume stability. Monitoring would verify that this was occurring. An important element of the selected amended remedy is a TI ARAR waiver for groundwater in the area designated as the TI zone. The selected amended remedy will prevent groundwater in the silty sand aquifer from moving into Dove Harbor or the river while minimizing the risk of mobilizing DNAPL.

Several key limitations would prevent aquifer restoration in a reasonable time frame resulting in the determination that a TI ARAR waiver was necessary:

- Approximately 99 percent of the estimated 614,290 pounds of contaminant mass remaining at the Site is comprised of PAHs.

- PAHs have a higher propensity to remain bound to the soil matrix than dissolve into groundwater due to characteristic low aqueous solubilities, vapor pressures and Henry's Law Constants; and high molecular weights, soil-water partition coefficients, and octanol-water partition coefficients.

- A large spatial area and aquifer volume at the Site are impacted with residual and free-phase DNAPL. The presence of DNAPL will exist as a long-term source of dissolved PAH and BTEX compounds in site groundwater.

- The complex stratigraphy of the silty sand aquifer presents intrinsic difficulties to any remedial alternative. Dissolved contaminants will diffuse from the fine-grained lower permeability lenses into the higher permeability zones, preventing aquifer restoration within a reasonable time frame.

- Due of the topography and thickness of the LCU, remedial options that require contact with the LCU risk compromising the integrity of the layer.

- Further source removal by excavation is physically limited by the presence of Highway 61, the city garage, the 30-inch sanitary sewer force main and concerns over potential damage to the LCU.

- Extensive remedial efforts in the form of groundwater extraction and treatment and ozone sparge/SVE have been undertaken at the Site and have been demonstrated to be ineffective at restoring the silty sand aquifer.

The spatial area over which the TI zone extends is illustrated in Figure 7. The vertical extent of the TI zone is from the shallowest occurrence of groundwater to the bottom of the LCU. Due to the presence of dispersed source material (impacted soil, residual NAPL, and NAPL free product) remaining at depth below the water table after source removal actions, it is deemed technically impracticable to attain the chemical-specific ARARs and groundwater cleanup levels within a reasonable time frame.

The selected amended remedy was chosen over the other alternatives because it is expected to achieve substantial reduction of the risks posed by contamination and implements measures to control future exposure to contaminated groundwater, subsurface soil and air. None of the alternatives would comply with chemical-specific ARARs in a portion of the silty sand aquifer, hence the necessity of the TI ARAR waiver. The selected amended remedy is protective while posing minimal problems with short-term effectiveness or implementability when compared to the other alternatives. The long-term effectiveness and permanence of the selected amended remedy was also favorable when compared to the other alternatives. Although Alternatives 3, 4 and possibly 2 used treatment to reduce toxicity, mobility or volume of contaminants to a greater extent than the selected amended remedy, there is some reduction of contaminants mass through treatment of the extracted groundwater. The cost of the selected amended remedy is lower than all of the alternatives except Alternative 5 and the no-action alternative (Alternative 1).

12.2 Description of Selected Amended Remedy

The remedy selected in the 1991 ROD included the following actions:

- excavation and incineration of contaminated soil from the surface to six feet below grade that exceeded 100 mg/kg of carcinogenic PAHs and 500 mg/kg total PAHs;

- excavation and incineration of contaminated source soils that have visible coal tar contamination from six feet below grade to the surface of the UCU;

- enhanced in situ bioremediation to treat the contaminated groundwater and contaminated source soils in the silty sand aquifer;

- groundwater extraction of both the silty sand and alluvial aquifers to reduce contaminant concentrations to levels established by the state of Iowa Administrative Code Chapter 133; and

- groundwater monitoring of both the silty sand and alluvial aquifers to ensure successful implementation of the groundwater treatment systems.

ESDs later modified this remedy to limit groundwater extraction to only the silty sand aquifer and changed the cleanup levels for naphthalene and benzene in groundwater. The excavation and incineration of accessible source soils was completed. Contaminated source soils remain in areas beneath the former public works garage building and utilities that cross the Site. It is possible that these soils may become accessible at some time in the future if the building is removed or the utilities are no longer in service.

The enhanced in situ bioremediation consisted of ozone sparging/SVE. During the exploration of remedial options to address residual contamination, as described in the TI Evaluation Report and the Amendment to the 2006 TI Evaluation Report, there were no other enhanced in situ bioremediation technologies that were identified which were capable of addressing residual contamination.

The selected amended remedy includes groundwater extraction in the silty sand aquifer at the downgradient edge of the plume to contain contaminants exceeding the cleanup levels from moving outside of the TI zone. Monitoring in both the silty sand and alluvial aquifers will continue to ensure that cleanup levels are being met in areas outside of the TI zone.

One of the key elements of the selected amended remedy is institutional controls. Deed restrictions are already in place on the portion of the Site owned by the city and the Highway 61 corridor, which is owned by the state. These institutional controls are informational devices, intended to inform a property owner of a condition on the property, but have limited enforceability. The deed restrictions on these properties will be replaced with environmental covenants, pursuant to the Iowa Uniform Environmental Covenants Act. An environmental covenant will also be placed on city-owned property east of Kerper Boulevard in the area identified as the TI zone. On the properties to the west of Kerper Boulevard, the limitations in the environmental covenants will restrict water well installation, subsurface excavation and vapor intrusion into buildings. On the property to the east of Kerper Boulevard, the limitations in the environmental covenants will restrict water well installation and vapor intrusion into buildings. It is anticipated that the property owners will be the "Grantors" of the covenants, MidAmerican Energy Company will be the "Holder", and the EPA and IDNR will be the "Agencies".

The IDNR Water Supply Section, the city Water Department and the Dubuque County Health Department will be notified in writing of the area of contamination for consideration when reviewing new water well permit applications. These notifications are informational institutional controls. The city of Dubuque has notified the EPA of plans to introduce a city ordinance placing limitations on installation of water wells within the city. Once implemented, this ordinance will prevent contaminated groundwater from the Site from being moved to previously uncontaminated areas through pumping of groundwater. An ordinance is a governmental institutional control.

Implementation of the institutional controls will allow the following RAOs to be achieved:

- minimize direct contact with soil;
- minimize the potential exposure to users of the alluvial aquifer to groundwater with contaminants that exceed MCLs, have a total excess lifetime cancer risk of greater than $1x10^{-6}$ or have a HI that exceeds 1; and
- prevent and/or reduce future human exposure to indoor air containing COCs that exceed health-based levels.

A TI ARAR waiver was necessary since none of alternatives were capable of complying with chemical-specific ARARs in a portion of the contaminated groundwater plume within a reasonable time frame.

Preliminary plans are that the hydraulic containment system will consist of three extraction wells located between Kerper Boulevard and the levee, near monitoring well P-112, to prevent migration of the downgradient plume. The system would consist of the extraction wells and conveyance pipings as well as a small building to house the control equipment to operate the system and an oil-water separator. Pilot testing confirmed the viability of this option to capture the downgradient plume in the silty sand aquifer while operating at a very low flow rate, estimated to be one gallon per minute for each well, in an effort to minimize the likelihood of the biological and iron fouling that plagued the original groundwater extraction system and the potential to move DNAPL.

The addition of small amounts of sequestering agents into the aquifer should minimize the possibility that the extractions wells or the areas surrounding the wells will become fouled. It is estimated that 0.2 pounds of sequestering agent will be added to each extraction well per day through an automated injection system. A request for the permit to inject the sequestering agent has been submitted to the EPA.

Pilot test sampling indicated that the extracted water would contain low levels of contamination that would be permissible to discharge to the sanitary sewer system for treatment at the municipal waste water treatment plant if they were willing to issue a permit to do so. That permit has been obtained. In the future a treatment system may be added if the contaminant levels in the extracted water exceed levels that may be discharged to the sanitary sewer system.

While contamination will be removed from the silty sand aquifer, the impact on the levels of contamination remaining at the Site will be very minimal since the objective is to control the downgradient plume, not to remove all of the contamination from the silty sand aquifer.

Natural attenuation has been demonstrated to be occurring within the contaminated plume. Sampling will continue to assure that is occurring, and monitoring will ensure that groundwater cleanup levels are being met outside the TI zone in the silty sand aquifer and in the alluvial aquifer. A program was already underway prior to this ROD Amendment to abandon older monitoring wells that might allow contamination from the silty sand aquifer to move into the alluvial aquifer. In some cases, the wells will be replaced, if needed to provide adequate monitoring.

Implementation of the hydraulic control system and MNA will allow the following RAOs to be achieved:

- minimize the potential exposure to users of the alluvial aquifer to groundwater with contaminants that exceed MCLs, have a total excess lifetime cancer risk of greater than $1x10^{-6}$ or have a HI that exceeds 1;

- provide remedies that allow eventual achievement of other groundwater standards that are applicable or relevant and appropriate in the alluvial aquifer;

- minimize migration of contaminants from other media to the extent necessary to protect the alluvial aquifer, and

- prevent migration of contaminated groundwater from the Site to the Mississippi River.

12.3 Summary of the Estimated Remedy Costs

Attachment 3 includes the detailed cost estimate for the selected amended remedy on the page labeled Table I-6. The capital expenditures planned for this remedy include installation of additional monitoring and extraction wells, installation of conveyance piping subsurface electrical connections, construction of a control system building, oil-water separator and control system. The capital expenditures also include the expenses involved with implementation of the environmental covenants, obtaining permits, preparation of design documents and oversight of the construction. O&M costs will include the cost of utilities to operate the hydraulic control system, chemical to prevent fouling, parts for routine system maintenance, well maintenance and semiannual groundwater sampling.

The discount rate used to calculate the present net worth costs was 7 percent. The information in this cost estimate was based on the best available information regarding the anticipated scope of the selected amended remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedy. Major changes may be documented in the form of a memorandum to the AR, an ESD or a ROD Amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.4 Expected Outcomes of the Selected Remedy

The expected outcome of the selected amended remedy is that the institutional controls will prevent exposure to contaminated water, air and soil. The hydraulic containment system will prevent groundwater in the silty sand aquifer from reaching the Mississippi River and result in a very minor reduction in contaminant mass. The lower rate of pumping planned with this system is not expected to mobilize DNAPL and will minimize fouling of the extraction wells. Natural attenuation is expected to continue to reduce contaminant concentrations in the dissolved plume, supporting plume stability. Monitoring would verify that the hydraulic containment system is controlling plume movement and that natural attenuation is occurring and supporting plume stability. Groundwater in the TI zone will never achieve the groundwater cleanup levels. Groundwater outside the TI zone, including the alluvial aquifer, should not exceed the groundwater cleanup levels.

13.0 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The selected amended remedy is designed and expected to be the final cleanup action at this Site and represents the best balance of trade-offs among alternatives with respect to pertinent criteria given the scope of the action. In addition, CERCLA includes: i) a preference for remedies that employ treatment that permanently and significantly reduces the toxicity, mobility or volume of hazardous wastes as a principal element, and ii) a bias against off-site disposal of untreated wastes. The following sections discuss how the selected amended remedy addresses these statutory requirements.

13.1 Protection of Human Health and the Environment

The select amended remedy is protective of human health and the environment from the risks posed by contaminated groundwater through implementation of institutional controls in conjunction with implementation of the TI zone while preventing the downgradient plume from moving to the Mississippi River with the hydraulic control system. The institutional controls will prevent human exposure to contaminated groundwater, indoor air exposure to volatile contaminants via vapor intrusion and exposure to residual subsurface soil contamination. Natural attenuation processes may reduce groundwater concentrations over time for some contaminants. The hydraulic containment and treatment system will prevent contaminated groundwater from moving to the Mississippi River and will remove small amounts of contaminant mass.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected amended remedy is expected to comply with ARARs. As described previously, pursuant to CERCLA 121(d)(4), compliance with ARARs may be waived when determined that it is technically impracticable to do so. The MCLs pursuant to the Safe Drinking Water Act are chemical-specific ARARs for the selected amended remedy. It has been documented in the TI Evaluation Report that it is technically impracticable to achieve the MCLs and other health-based action levels within a specific portion of the contaminated groundwater plume. Therefore it has been determined that a TI ARAR waiver is appropriate for the groundwater contaminants at the Site. The EPA refers to the portion of the aquifer where groundwater cannot be restored to drinking water standards within a reasonable timeframe as the "TI zone." The TI zone for this Site is shown in Figure 7.

The selected amended remedy includes groundwater extraction with discharge to the sanitary sewer system with treatment at the city waste water treatment facility. This requires compliance with the Clean Water Act, 33 USC Section 1251-2762, National Pretreatment Standards 40 CFR Part 403, which pertains to pollutants going to publicly owned pretreatment works; and Iowa Water Pollution Control Regulations IAC 567-Chapter 62, pertaining to effluent and pretreatment standards. Sequestering agents may be injected at the extraction wells to prevent fouling. This requires compliance with the Clean Water Act Underground Injection Control Program, 40 CFR Parts 144 and 146, which establishes criteria, standards and the permitting process for underground injection of liquids.

13.3 Cost Effectiveness

The selected amended remedy is cost effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" [NCP § 300.430(f)(1)(ii)(D)]. This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs; hence, this alternative represents a reasonable value for the money to be spent. The estimated present worth cost of the selected amended remedy is $1,706,000. Attachment 3 includes the present worth cost estimate for the selected amended remedy, Alternative 6. The information in the cost estimate is based on the best available information for this remedy. Changes in the cost elements are likely to occur as a result of any new information and data collected during the implementation of the remedy. Major changes may be documented in the form of a memorandum in the AR, an ESD or a ROD Amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project costs.

13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The EPA has determined that the selected amended remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner at this Site. The selected amended remedy is the final remedy decision currently planned at the Site. The EPA has determined that the selected amended remedy is the best balance of trade-offs in terms of the balancing criteria given the scope of this action while also considering the statutory preference for treatment as a principal element, the bias against off-site treatment and disposal, and considering state and community acceptance.

13.5 Preference for Treatment as a Principal Element

The selected amended remedy does not satisfy the preference for treatment as a principal element of the remedy. DNAPL is a principal threat waste associated with this site. None of the alternatives were capable of addressing DNAPL and several alternatives posed a significant threat of damaging the LCU, allowing DNAPL to move into the alluvial aquifer. While small amounts of dissolved contamination will be removed and treated by the hydraulic control system, the system will not address DNAPL and the waste will remain in place.

13.6 Five-Year Review Requirements

This remedy will result in hazardous substances, pollutants or contaminants remaining on site above health-based levels, therefore a statutory review will be conducted to ensure that the remedy continues to provide adequate protection of human health and the environment within five years after the initiation of the remedial actions. Five-year reviews have been conducted for this Site since 2000. The fourth five-year review will be conducted in 2015.

14.0 Documentation of Significant Changes

The Proposed Plan for the Peoples Natural Gas Site was released for public comment in June 2013.The Proposed Plan identified Alternative 6, institutional controls with hydraulic containment and MNA, as the preferred alternative. The EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

PART III: RESPONSIVENESS SUMMARY

1.0 Introduction

This Responsiveness Summary has been prepared in accordance with CERCLA, as amended, and the NCP, 40 CFR §300.430(f). This document provides the response from the EPA to all significant comments received on the Proposed Plan from the public during the 30-day public comment period.

On June 26, 2013, the EPA released the Proposed Plan and AR file which contains the pertinent documents for the Site. The Proposed Plan discussed the EPA's proposed actions to address contamination at the Site. The public comment period began on June 26, 2013, and ended on July 25, 2013. The EPA held a public meeting on July 8, 2013, at the Carnegie-Stout Public Library in Dubuque, Iowa, to present the Proposed Plan and provide the public an opportunity to comment. A copy of the transcript from the public meeting is included in the AR.

2.0 Comments Received and Responses

The following comments were received verbally during the public meeting or in writing during the public comment period.

2.1 Comment: The Iowa Department of Transportation had no objection to the preferred alternative.

2.2 Comment: A commenter asked whether the costs associated with the preferred alternative included costs the city would incur if extracted groundwater was put into the sanitary sewer system.

Response: MidAmerican Energy has been working with the city to obtain a permit for disposal of extracted groundwater into the sanitary sewer system. The permit did not include any cost for disposal of the water. The quantities of water to be disposed would be very small, so if there were any charge for this disposal, it would have a minimal impact on the cost of the remedy.

2.3 Comment: A commenter asked whether the property would be viable for future uses once limitations are placed on its uses.

Response: Both the Highway 61 corridor and the property surrounding the former public works garage already have use limitations spelled out in notices on the deeds. When environmental covenants are implemented on these properties, the activity and use limitations will be much the same with the addition of measures to prevent future vapor intrusion. This should not have an impact on the Highway 61 corridor. The current uses of the former public works garage property would be unaffected. The city has indicated that the property might be used as an operations center for the city bus system in the future. That use would also be acceptable. There are numerous future uses for the property that would be acceptable and consistent with the activity and use limitations that will be placed in the environmental covenant.

GLOSSARY OF TERMS

This glossary defines many of the technical terms used in relation to the Site in this ROD Amendment. The terms contained in this glossary are often defined in the context of hazardous waste management and apply specifically to work performed under the Superfund program. Therefore, these terms may have other meanings when used in a different context.

Administrative Record: The body of documents the EPA uses to form the basis for selection of a response action.

Applicable or Relevant and Appropriate Requirements: Section 121(d)(2)(A) of CERCLA incorporates into law the CERCLA Compliance Policy, which specifies that Superfund remedial actions meet any federal standards, requirements, criteria or limitations that are determined to be legally applicable or relevant and appropriate requirements. The provision also requires that state ARARs must be met if they are more stringent than federal requirements.

Aquifer: An underground layer of rock, sand or gravel capable of storing water within cracks and pore spaces, or between grains. When water contained within an aquifer is of sufficient quantity and quality, it can be tapped and used for drinking or other purposes. The water contained within the aquifer is called groundwater.

Capital Costs: Expenses related to the labor, equipment and material costs of construction.

Carcinogenic Risk: Carcinogenic risks are probabilities usually expressed in scientific notation (e.g., $1x10^{-6}$). An excess carcinogenic risk of $1x10^{-6}$ indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of a site-related exposure.

Cleanup Levels: Medium- and contaminant-specific goals established to achieve RAOs (for example, treatment of contaminated groundwater to MCLs).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): A federal law passed in 1980 and thereafter amended in 1986, 1992, 1996 and 2002. The Act created a special tax that goes into a Trust Fund, commonly known as Superfund, to investigate and cleanup abandoned or uncontrolled hazardous waste sites. Under the program, the EPA can either: (1) pay for and perform site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work, or (2) take legal action to force parties responsible for site contamination to clean up the site or pay back to the federal government the cost of the cleanup.

Contaminant of Concern: The chemical substances found at the site at concentrations that may pose an unacceptable risk to human health or the environment.

Dense Nonaqueous Phase Liquid (DNAPL): Liquid that is denser than water and only slightly soluble in water.

Downgradient: Downstream from the flow of groundwater. The term refers to groundwater flow in the same way that "downstream" refers to a river's flow.

Explanation of Significant Difference: Documents a significant change to a remedy selected in a ROD that does not fundamentally alter the overall cleanup approach.

Feasibility Study: The report that presents the identification and evaluation of the most appropriate technical approaches to address contamination at a Superfund site.

Groundwater Extraction and Treatment: A groundwater remediation technology that uses extraction wells and systems that treat the discharge from the extraction wells.

Groundwater: Water filling spaces between soil, sand, rock and gravel particles beneath the earth's surface that often serves as a source of drinking water.

Hydrogeology: The geology of groundwater, with particular emphasis on the chemistry and movement of water.

Hazard Index: A hazard index (HI) is calculated for noncarcinogenic effects. A HI less than one predicts that there will not be any noncancerous effects.

Institutional Controls: Nonengineered instruments such as administrative and legal controls that help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy.

Maximum Contaminant Level: The maximum permissible level of a contaminant in water which is delivered to any user of a public water supply pursuant to the Safe Drinking Water Act.

Manufactured Gas Plant (MGP): A facility that used heat to convert coal or oil into methane for purposes of heating and lighting. They operated from the mid-1800s until the arrival of natural gas pipelines in the mid-1900s.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The federal regulation that guides the Superfund Program.

National Priorities List: The EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial response.

Operation and Maintenance Costs: The cost and time frame of operating labor, maintenance, materials, energy, disposal and administrative components of the remedy.

Plume: A body of contaminated groundwater flowing from a specific source. The movement of the groundwater is influenced by such factors as local groundwater flow patterns, the character of the aquifer in which groundwater is contained and the density of the contaminants.

Present Worth Cost: The present worth of a future investment or payment that is calculated using a predetermined discount or interest rate. Present worth cost is the amount of money which, invested in the current year, would be sufficient to cover all the costs over time associated with a remedial action.

Proposed Plan: A document requesting public input on a proposed remedial alternative.

Record of Decision: A document which is a consolidated source of information about the site, the remedy selection process and the selected remedy for a cleanup under CERCLA.

Remedial Action: Action taken to clean up contamination at a site to acceptable standards.

Remedial Action Objectives: General descriptions of what the cleanup will accomplish (for example, restoration of groundwater to drinking water levels).

Remedial Investigation: A detailed study of a site. The RI may include an investigation of air, soil, sediment, surface water and groundwater to determine the source(s), types of contaminants and extent of contamination at a site.

Removal Action: A response action, typically short-term, that may be taken to address releases or threatened releases requiring prompt response.

Soil Vapor Extraction: Typically used to remove VOCs from soil. A vacuum is applied to subsurface soil inducing an air stream through the soil, thereby transferring the VOC contaminants from the soil to the air. The contaminant-laden air or soil vapor is extracted from the subsurface with a vacuum blower, treated and discharged to the atmosphere.

Superfund: The nickname for CERCLA.

Vadose Zone: The earth that extends from the top of the ground surface to the water table.

Volatile Organic Compounds (VOCs): Carbon-based compounds (such as solvents) which readily volatilize at room temperature and atmospheric pressure. Most are not readily dissolved in water, but their solubility is above health-based standards for potable use. Some VOCs are carcinogenic.

ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
AR	administrative record
BTEX	benzene, toluene, ethylbenzene and xylenes
bgs	below ground surface
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
COC	contaminant of concern
COPC	contaminant of potential concern
DNAPL	dense nonaqueous phase liquid
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESD	Explanation of Significant Differences
HAL	health advisory level
HI	hazard index
HQ	hazard quotient
IDNR	Iowa Department of Natural Resources
IDOT	Iowa Department of Transportation
LCU	lower confining unit
MCL	maximum contaminant level
mg/kg	milligram per kilogram
MGP	manufactured gas plant
MNA	monitored natural attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OU	operable unit
O&M	operation and maintenance
PAH	polynuclear aromatic hydrocarbon
PNG	Peoples Natural Gas
PQL	practical quantitation limit
ROD	Record of Decision
RAO	remedial action objective
RfD	reference dose
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
SF	slope factor
SVE	soil vapor extraction
TarGOST™	Tar-Specific Green Optical Screening Tool
TI	technical impracticability
UCL	upper confidence limit
UCU	upper confining unit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per meter cubed
VOC	volatile organic compounds
WRRC	water and resource recovery center

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ATTACHMENT 1

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER
PREPARED BY MIDAMERICAN ENERGY COMPANY
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

Criteria	Alternative 2 Institutional Controls and Additional Excavation	Alternative 3 Institutional Controls and In Situ Solidification	Alternative 4 Institutional Controls and In Situ Thermal Treatment	Alternative 5 Institutional Controls and Monitored Natural Attenuation	Alternative 6 Institutional Controls, Hydraulic Containment System and Monitored Natural Attenuation
OVERALL PROTECTIVENESS					
Groundwater Ingestion for Existing Users	High because no existing users to protect.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Groundwater Ingestion for Future Users	High because institutional controls prohibit use of groundwater.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Environmental Protection	Moderate. DNAPL and groundwater plume contained by site geology. Low to moderate if the LCU is damaged.	Moderate. DNAPL and groundwater plume contained by site geology. Low to moderate if the LCU is damaged and/or created area of low permeability changes flow paths.	Same as Alternative 2.	Moderate. DNAPL and groundwater plume contained by site geology.	Moderate. DNAPL contained by site geology. Downgradient plume migration controlled by hydraulic containment system.
COMPLIANCE WITH ARARs					
Chemical-Specific	ARARs for accessible soil could be achieved. ARARs for groundwater would take in excess of a thousand years.	Same as Alternative 2.	Same as Alternative 2.	ARARs not likely achieved in a reasonable timeframe. Natural attenuation processes will reduce the overall contaminant mass over time.	Same as Alternative 5.
Action-Specific	None identified.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Location-Specific	None identified.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Other	None identified.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
LONG-TERM EFFECTIVENESS					
Magnitude of Residual Risk	The low potential for future use of groundwater near the site remains. Restrictions on accessing contaminated groundwater will remove exposure risk.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Adequacy and Reliability of Control	Multiple layers of protection: existing IDNR rules and Environmental Covenants. Contaminant mass removed through excavation.	Multiple layers of protection: existing IDNR rules and Environmental Covenants. Contaminant mass immobilized by in situ solidification.	Multiple layers of protection: existing IDNR rules and Environmental Covenants. Contaminant mass volatilized and/or mobilized for extraction by in situ thermal treatment.	Multiple layers of protection: existing IDNR rules and Environmental Covenants. MNA increases reliability of predicting future plume concentrations, assessment of plume size and applicability of institutional controls.	Multiple layers of protection: existing IDNR rules and Environmental Covenants. MNA increases reliability of predicting future plume concentrations, assessment of plume size and applicability of institutional controls. Hydraulic containment system reduces potential for off-site migration of groundwater plume.
Need for 5-Year Review	Review required to ensure adequate protection of human health and environment.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
REDUCTION IN TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Treatment Process and Materials Treated	Excavation of accessible soil contaminant mass.	Solidification of accessible soil and groundwater contaminant mass.	Extraction and volatilization of accessible contaminant mass.	None.	Extracted groundwater would be treated at the WRRC by screening, grit removal, primary treatment, secondary treatment by the oxygen activated sludge process, final clarification and ultraviolet disinfection.
Amount of Hazardous Materials Destroyed or Treated	65% of the total remaining contaminant mass will be removed. 206,230 pounds of contaminant mass remains. DNAPL will remain and mobilization is possible.	65% of the total remaining contaminant mass will be immobilized but not destroyed. 206,230 pounds of contaminant mass remains mobile. DNAPL will remain and mobilization is possible.	59% of the total remaining contaminant mass will be removed. 252,620 pounds of contaminant mass remains. DNAPL will remain and mobilization is possible.	None.	A relatively small mass of dissolved compounds would be extracted by the hydraulic containment system, with subsequent treatment at the WRRC. In addition, natural attenuation processes would gradually reduce contaminant concentrations.

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DUBUQUE, IOWA

Criteria	Alternative 2 Institutional Controls and Additional Excavation	Alternative 3 Institutional Controls and In Situ Solidification	Alternative 4 Institutional Controls and In Situ Thermal Treatment	Alternative 5 Institutional Controls and Monitored Natural Attenuation	Alternative 6 Institutional Controls, Hydraulic Containment System and Monitored Natural Attenuation
REDUCTION IN TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT (CONTINUED)					
Degrees of Expected Reduction	Untreated source material would remain in the inaccessible area beneath the city maintenance garage, along the 30-inch sanitary sewer force main, and within the Highway Corridor area, leaving an on-going source for groundwater contamination.	None.	Temperatures are limited to 212°F. Approximately 41% of the estimated 614,290 pounds of contaminant mass remaining at the site is present under Highway 61 or remains east of the City maintenance garage as residual DNAPL or adsorbed material.	None.	Although some contaminant mass will be removed by the hydraulic containment system, the overall reduction is expected to be small.
Degree to which Treatment is Reversible	Mass removal is irreversible but may mobilize DNAPL. DNAPL will remain as an on-going source for groundwater contamination.	Immobilization is irreversible. Low permeability may encourage mobilization of DNAPL. DNAPL will remain as an on-going source for groundwater contamination.	Thermal treatment of contaminant mass is irreversible. The DNAPL may be mobilized. DNAPL will remain as an on-going source for groundwater contamination.	None.	The small amount of contaminant mass removed by the hydraulic containment system is irreversible. However, continued downgradient migration would be expected if the system were to be shut off.
Type/Quantity of Residuals	206,230 pounds of untreated source material would remain in the inaccessible area beneath the city maintenance garage, along the 30-inch sanitary sewer force main, and within the highway corridor area.	Same as Alternative 2.	225,620 pounds of untreated source material would remain present under Highway 61 and east of the city maintenance garage as residual DNAPL or adsorbed material. This untreated source material is either inaccessible to in situ thermal treatment and/or not susceptible to treatment due to the temperature limitation of 212°F.	Current conditions persist with natural degradation.	Current conditions persist with natural degradation.
Statutory Preference for Treatment	Does not satisfy for inaccessible areas of the site. Alternative 3 would satisfy the preference by reducing the contaminant mass in the accessible soil by 66% of the total site contaminant mass.	Does not satisfy for inaccessible areas of the site. Alternative 4 would satisfy the preference by irreversibly reducing contaminant mobility in accessible soil and groundwater by 66% of the total site contaminant mass.	Does not satisfy for inaccessible areas of the site. Alternative 5 would satisfy the preference by destroying and reducing the contaminant mass in accessible soil by 59% of the total site contaminant mass.	Does not satisfy.	Satisfies preference for treatment for the small amount of contaminant mass removed by the hydraulic containment system. Does not satisfy for remainder of site contaminants.
SHORT-TERM EFFECTIVENESS					
Protection of Community During Remedial Actions	Minor, controllable exposure risks from excavated soil and vapor migration.	Minor, controllable exposure risks from soil cuttings and vapor migration.	Minor, controllable exposure risks from soil cuttings, extracted groundwater and vapor migration.	Risk to community by remedy is not increased.	Minor, controllable risks during construction outside of the fenced portion of the site. Minor, controllable exposure risks from extracted groundwater.
Protection of Workers During Remedial Actions	Risks controlled through use of PPE and Standard Operating Procedures.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Environmental Impacts	LCU may be damaged allowing DNAPL to migrate into the alluvial aquifer. Excavation may facilitate DNAPL migration.	LCU may be damaged allowing DNAPL to migrate into the alluvial aquifer. Low permeability area may alter groundwater flow direction locally.	LCU may be damaged allowing DNAPL to migrate into the alluvial aquifer. Heated soil may facilitate DNAPL migration.	No short-term environmental impact.	LCU may be damaged during well installation allowing DNAPL to migrate into the alluvial aquifer. Groundwater extraction may induce DNAPL migration by increasing hydraulic gradient.
Time until RAOs Achieved	As soon as restrictions are in place.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
IMPLEMENTABILITY					
Ability to Construct and Operate the Technology	Difficult. Equipment and process is common but there is a large volume of overburden to remove and excavators must protect LCU.	Difficult. Equipment and process is specialized. The treatment process is relatively complex.	Difficult. Equipment and process is uncommon for FMGP sites. The treatment process is relatively complex.	Easy. Monitoring wells already installed and groundwater sampling previously conducted at the site.	Moderate. Monitoring wells already installed and groundwater sampling previously conducted at the site. Hydraulic containment system equipment and process is common.
Ability to Construct and Operate the Technology	Difficult. Equipment and process is common but there is a large volume of overburden to remove and excavators must protect LCU.	Difficult. Equipment and process is specialized. The treatment process is relatively complex.	Difficult. Equipment and process is uncommon for FMGP sites. The treatment process is relatively complex.	Easy. Monitoring wells already installed and groundwater sampling previously conducted at the site.	Moderate. Monitoring wells already installed and groundwater sampling previously conducted at the site. Hydraulic containment system equipment and process is common.

ATTACHMENT 1 (CONTINUED)

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER
PREPARED BY MIDAMERICAN ENERGY COMPANY
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

Criteria	Alternative 2 Institutional Controls and Additional Excavation	Alternative 3 Institutional Controls and In Situ Solidification	Alternative 4 Institutional Controls and In Situ Thermal Treatment	Alternative 5 Institutional Controls and Monitored Natural Attenuation	Alternative 5 Institutional Controls, Hydraulic Containment System and Monitored Natural Attenuation
IMPLEMENTABILITY (CONTINUED)					
Reliability	High. Multiple layers of protection and appropriate authorities notified. Excavation equipment is reliable.	Moderate. Multiple layers of protection and appropriate authorities notified. Equipment reliable.	Moderate. Multiple layers of protection and appropriate authorities notified. Equipment is reliable, but untested at an FMGP site.	High. Multiple layers of protection and appropriate authorities notified. Monitoring ensures current plume conditions are known.	High. Multiple layers of protection and appropriate authorities notified. Operation of hydraulic containment system is mature technology. Poor water quality will require on-going maintenance to control scaling and biofouling of system. Monitoring provides current data on plume conditions.
Ease of Undertaking Additional Remedial Action if Necessary	Difficult. Access to the remaining contamination limited by the LCU, maintenance garage and highway corridor.	Difficult. Solidified areas of the site not easily penetrated. Access to the remaining contamination limited by the LCU, maintenance garage and highway corridor.	Possible, but restricted by conveyance piping and well layout during implementation. Access to the remaining contamination limited by the LCU, maintenance garage and highway corridor.	High.	High.
Ability to Monitor Effectiveness	New well permits could easily be verified to be outside of known area of contamination. Groundwater monitoring used to ensure impacted areas are addressed.	New well permits could easily be verified to be outside of known area of contamination. Groundwater monitoring used to ensure impacted areas are addressed.	New well permits could easily be verified to be outside of known area of contamination. Groundwater monitoring used to ensure impacted areas are addressed.	New well permits could easily be verified to be outside of known area of contamination. MNA increases predictability of future concentrations.	New well permits could easily be verified to be outside of known area of contamination. MNA increases predictability of future concentrations. Effectiveness of the hydraulic containment system monitored by groundwater extraction rates.
Ability to Obtain Approvals from other Agencies	High.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Coordination with Other Agencies	Required coordination with city, county and IDNR for implementation of institutional controls plus excavation permits.	Same as Alternative 2 plus groundwater discharge permits and building permits.	Same as Alternative 3 plus air discharge permits.	Required coordination with city, county and IDNR for implementation of institutional controls.	Required coordination with city, county and IDNR for implementation of institutional controls; and the WRRC for POTW Industrial Wastewater Discharge Permit.
Availability of Off-Site Treatment/Disposal	Required coordination for off-site treatment/disposal of impacted soil.	Not applicable.	Same as Alternative 2.	Not applicable.	Treatment available at WRRC.
Availability of Necessary Equipment/Specialists	Readily available.	Potential for low availability as it is not a common technology.	Potential for low availability as there is only one licensed contractor.	Same as Alternative 2.	Same as Alternative 2.
Availability of Prospective Technologies	Commonly utilized.	Available technology, but will require bench-scale testing.	Same as Alternative 2, but not specifically for FMGP contaminants. Pilot-scale testing may be required.	Same as Alternative 2.	Same as Alternative 2.
COST					
Capital, Operation & Maintenance, Present Worth Cost (7% discount rate)	$2,394,000	$3,711,000	$3,416,000	$523,000	$1,706,000

Notes:

% = Percent
°F = Degrees Fahrenheit
ARAR = Applicable or Relevant and Appropriate Requirements
City = City of Dubuque
DNAPL = Dense nonaqueous phase liquid
FMGP = Former Manufactured Gas Plant
IDNR = Iowa Department of Natural Resources
LCU = Lower Confining Unit
MNA = Monitored natural attenuation
POTW = Publically Owned Treatment Works
PPE = Personal protective equipment
RAOs = Remedial action objectives
WRRC = Water and Resource Recovery Center

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ATTACHMENT 2

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Federal			
Safe Drinking Water Act	40 USC Section 300		
National Primary Drinking Water Regulations	40 CFR Part 141	Establishes MCLs which are health-based standards for public water systems.	MCLs are relevant and appropriate to groundwater contaminants.
National Secondary Drinking Water Regulations	40 CFR Part 143	Establishes SMCLs which are non-enforceable guidelines for public water systems to ensure the aesthetic quality of the water.	SMCLs may be "TBC" values if treated groundwater is used as a source of water.
Maximum Contaminant Level Goals	PL No. 99-339 100 Statute 642 (1986)	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects with an adequate margin of safety.	MCLGs for organic and inorganic contaminants may be relevant and appropriate if a more stringent standard is required to protect human health or the environment.
Clean Water Act	33 USC Section 1251-2762		
National Pretreatment Standards	40 CFR Part 403	Sets standards to control pollutants which pass through or interfere with treatment processes in POTWs or which may contaminate sewage sludge.	Applicable to discharge of water from the hydraulic containment system, as referenced by 567 IAC 62.4(3).
Clean Air Act	42 USC Section 7401-7671		
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes standards for ambient air quality to protect public health and welfare.	Applicable to portland cement concrete batching plant equipment, as referenced by 567 IAC 28.1, for the ISS remedial option.

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
State			
Iowa Environmental Quality Act	Iowa Code Chapter 455B	Defines the jurisdiction of the IDNR, powers and duties of the commission and the director, and civil or criminal proceedings to be undertaken by the State Attorney General.	None.
Iowa Water Pollution Control Regulations			
Scope Of Title--Definitions--Forms--Rules Of Practice	IAC 567—Chapter 40	Water supply definitions. Defines MCLs to which IAC Chapter 133 refers.	None.
Water Supplies	IAC 567—Chapter 41	Contains the drinking water standards and specific monitoring requirements for the public water supply program.	May be relevant and appropriate to groundwater contaminants.
Water Quality Standards	IAC 567—Chapter 61	Contains the water quality standards of the State, including classification of surface waters.	Applicable to discharge of water generated during dewatering activities or from the hydraulic containment system.
Effluent And Pretreatment Standards: Other Effluent Limitations Or Prohibitions	IAC 567—Chapter 62	Contains the standards or methods for establishing standards relevant to the discharge of pollutants to waters of the state.	Applicable to discharge of water generated during dewatering activities or from the hydraulic containment system.
Rules for Determining Cleanup Actions and Responsible Parties	IAC 567—Chapter 133	These rules establish the procedures and criteria the IDNR will use to determine the parties responsible and cleanup actions necessary to meet the goals of the State pertaining to the protection of groundwater. These rules pertain to the cleanup of groundwater, soil, and surface water where groundwater may be impacted.	Applicable to soil or groundwater contaminated above State of Iowa Action Levels.

ATTACHMENT 2 (continued)

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
State (continued)			
Iowa Land Recycling Program and Response Action Standards	IAC 567—Chapter 137	These rules establish the policies and procedures for the voluntary enrollment of contaminated property in the "land recycling program" established under IAC Chapter 137. These rules also establish the response action standards that participants must meet in order to qualify for an NFA certificate; the statutory protections and immunities that follow are associated with the NFA.	Not an ARAR, but a TBC guidance standard for the State of Iowa.
Iowa Air Pollution Control Regulations			
Ambient Air Quality Standards	IAC 567—Chapter 28	Identifies the state ambient air quality standards (adopts the National Primary and Secondary Ambient Air Quality Standards as published in 40 CFR Part 50)	Applicable to portland cement concrete batching plant equipment.

Notes:
ARAR = Applicable or relevent and appropriate requirements.
CFR = Code of Federal Regulations.
IAC = Iowa Administrative Code.
IDNR = Iowa Department of Natural Resources.
ISS = In-situ solidification.
MCLGs = Maximum Contaminant Level Goals.
MCLs = Maximum Contaminant Levels.
NFA - No further action.
POTW = Publically-Owned Treatment Works.
SMCLs = Secondary Maximum Contaminant Levels
TBC = To Be Considered.
USC = United States Code..

LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Federal			
Solid Waste Disposal Act	42 USC Section 6901-6987		
Contents Of Part B: General Requirements	40 CFR 270.14(b)(11) (iii) and (iv)	Provides requirements for owners and operators of hazardous waste management facilities located in the 100-year floodplain.	Applicable if remedial activities result in the site becoming a TSD facility.
Clean Water Act	33 USC Section 1251-2762		
Section 404(b)(1) Guidelines For Specification Of Disposal Sites For Dredged Or Fill Material	40 CFR Part 230	Establishes a permit program administered by the U.S. Army Corps of Engineers to regulate discharge of dredged or fill material into waters of the U.S.	Applicable if excavated material is discharged into waters of the U.S.
State			
Iowa Environmental Quality Act	Iowa Code Chapter 455B	Defines the jurisdiction of the IDNR, powers and duties of the commission and the director, and civil or criminal proceedings to be undertaken by the State Attorney General.	None.
Floodplain Development	IAC 567—Chapters 70-72 and 75	Regulates construction on floodplains and floodways in the state.	Applicable to excavation or construction activities.

Notes:
CFR = Code of Federal Regulations.
IAC = Iowa Administrative Code.
IDNR = Iowa Department of Natural Resources.
TSD = Treatment, storage, and disposal.
U.S. = United States.
USC = United States Code.

ATTACHMENT 2 (continued)

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Federal			
Solid Waste Disposal Act	42 USC Section 6901-6987		
Hazardous Waste Management Systems: General	40 CFR Part 260	Establishes procedures and criteria for modification or revocation of any provision in 40 CFR Parts 260-265, and 268.	May be applicable if a substance at the site were to be excluded from the list of hazardous wastes.
Identification and Listing of Hazardous Waste	40 CFR Part 261	Defines those solid wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 263-265 and Parts 124, 270 and 271.	Applicable.
Standards Applicable To Generators Of Hazardous Waste	40 CFR Part 262	Establishes standards for generators of hazardous waste.	Applicable.
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards that apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	Applicable if off-site transportation of hazardous waste is required.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards that define the acceptable management of hazardous waste for owners and operators of facilities that treat, store or dispose hazardous waste.	Subparts B through X would be applicable if any off-site facility accepted hazardous waste for treatment, storage, or disposal.
Land Disposal Restrictions	40 CFR Part 268	Identifies hazardous wastes that are restricted or prohibited from land disposal.	Applicable to land disposal of hazardous waste generated during the remedial action. Not applicable to environmental media left or treated in situ.
Hazardous Waste Permit Program	40 CFR Part 270	Establishes provisions covering basic EPA hazardous waste permitting requirements.	A permit is not required for on-site CERCLA response actions, per 40 CFR 300.400(e)(1). However, compliance with substantive permit requirements is required.

ATTACHMENT 2 (continued)

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Federal (continued)			
Off-Site Rule	40 CFR 300.440	Establishes criteria and procedures for determining whether facilities are acceptable for receipt of CERCLA wastes from response actions authorized or funded under CERCLA.	Applicable.
Clear Air Act	42 USC Section 7401-7642		
National Ambient Air Quality Standards	40 CFR Part 50	Treatment technology standards for emissions to air.	If an alternative developed would involve emissions governed by these standards, then the requirements are applicable.
Clean Water Act	33 USC Section 1251-2762		
Oil Pollution Prevention	40 CFR Part 112	Establishes procedures, methods, equipment, and other requirements to prevent discharge of oil from non-transportation-related on-shore and off-shore facilities into or upon navigable waters of the U.S.	Applicable if more that 1,320 gallons of oil is stored at the site.
Designation Of Hazardous Substances/Determination Of Reportable Quantities For Hazardous Substances	40 CFR Parts 116 and 117	This regulation designates hazardous substances and associated reportable quantities.	Applicable if hazardous substances are used and released on site.
EPA Administered Permit Programs: The National Pollutant Discharge Elimination System	40 CFR 122.26	Provides requirements for stormwater discharges.	Applicable if one or more acres are disturbed during remedial activities, as referenced by 567 IAC 64.13(1).

ATTACHMENT 2 (continued)

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Federal (continued)			
Criteria And Standards For The National Pollutant Discharge Elimination System	40 CFR Part 125	Establishes criteria and standards for the imposition of technology-based treatment requirements in permits under section 301(b) of the Clean Water Act.	Applicable if dewatered groundwater is discharge to navigable waters.
Underground Injection Control Program	40 CFR Parts 144 and 146	Establishes criteria and standards and the permiting process for the underground injection of liquids.	Applicable to the underground injection of remediation agents or chemical sequestrants into wells.
Emergency Planning and Community Right to Know	42 USC Section 11001-11050		
Emergency Planning And Notification	40 CFR Part 355	Establishes requirements for a facility to provide information necessary for developing and implementing State and local chemical emergency response plans, and requirements for emergency notification of chemical releases.	Applicable if extremely hazardous substances are present at the site in quantities exceeding threshold levels.
Hazardous Chemical Reporting: Community Right-To-Know	40 CFR Part 370	Establishes reporting requirements for providing the public with important information on the hazardous chemicals in their communities.	Applicable if hazardous chemicals are present at the site in quantities exceeding threshold levels.
Transportation			
Hazardous Materials Regulations	49 CFR Parts 171-173, and 177	Establishes requirements for transportation of hazardous materials.	Applicable to off-site transportation of hazardous materials.
Occupational Safety and Health Act	29 USC Section 651-678	Regulates worker health and safety.	Applicable to personnel involved in implementation of remedial action.
State			
Iowa Environmental Quality Act	Iowa Code Chapter 455B	Defines the jurisdiction of the IDNR, powers and duties of the commission and the director, and civil or criminal proceedings to be undertaken by the State Attorney General.	None.
Solid Waste Management And Disposal			

ATTACHMENT 2 (continued)

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
State (continued)			
Scope Of Title--Definitions--Forms--Rules Of Practice	IAC 567—Chapter 100	Provides general requirements relating to solid waste management and disposal.	Applicable.
Special Waste Authorizations	IAC 567—Chapter 109	Provides rules for disposal of special waste.	Applicable to disposal of excavated material.
Iowa Air Pollution Control Regulation			
Controlling Pollution	IAC 567—Chapter 22	Provides standards and procedures for permitting of emission sources and the special requirements for nonattainment areas.	Applicable to batch plant required to process soil binding agent used for ISS.
Emission Standards For Contaminants	IAC 567—Chapter 23	Provides air emission standards for contaminants.	Applicable to fugitive dust from remediation activities. Requires reasonable precautions to be taken to prevent nuisance levels of particulate matter. Applicable to particulate emissions from portland cement concrete batching plants used for ISS.
Excess Emission	IAC 567—Chapter 24	Details excess emissions reporting requirements, and equipment maintenance and repair requirements.	Applicable to portland cement concrete batching plant equipment used for ISS.
Measurement Of Emissions	IAC 567—Chapter 25	Provides testing and sampling requirements for new and existing sources.	Applicable to portland cement concrete batching plant equipment used for ISS.
Iowa Water Pollution Control Regulations			
Private Water Well Construction Permits	IAC 567—Chapter 38	Defines requirements for private water well construction permits.	Applicable if additional wells are installed.
Requirements For Properly Plugging Abandoned Wells	IAC 567—Chapter 39	Provides requirements for well abandonment.	Applicable if wells are abandoned.

ATTACHMENT 2 (continued)

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
State (continued)			
Scope Of Title--Definitions--Forms--Rules Of Practice	IAC 567—Chapter 40	Water supply definitions. DefinesMCLs to which Chapter 133 refers.	None.
Nonpublic Water Wells	IAC 567—Chapter 49	Establishes uniform minimum standards and methods for well construction and reconstruction for nonpublic water supply wells.	Applicable to extraction wells.
Water Withdrawals	IAC 567—Chapters 50-54	Provides requirements for water withdrawal permits. Permits are required for withdrawals greater than 25,000 gallons per day.	Applicable if the withdrawal rate is greater than 25,000 gallons per day.
Scope Of Title IV (Wastewater Treatment And Disposal)--Definitions--Forms--Rules Of Practice	IAC 567—Chapter 60	Provides general definitions and rules of practice, including forms, applicable to the public in the department's administration of this title.	Applicable if groundwater is discharged to navigable waters, or if one or more acres are disturbed during remedial activities. Provides instructions and form requirement for NPDES permit applications.
Wastewater Construction And Operation Permits	IAC 567—Chapter 64	Contains the standards and procedures for obtaining construction, operation, and NPDES permits for wastewater disposal systems.	Applicable if groundwater is discharged to navigable waters, or if one or more acres are disturbed during remedial activities.
Well Contractor Certification	IAC 567—Chapter 82	Establishes certification and requirements for well contractors.	Applicable to well installation activities.
Laboratory Certification	IAC 567—Chapter 83	Provides procedures for laboratory certification.	Applicable to all laboratories conducting analyses of contaminated site parameters pursuant to IAC 567 - Chapter 133.
Solid Waste Management And Disposal			
Scope Of Title--Definitions--Forms--Rules Of Practice	IAC 567—Chapter 100	Provides general requirements relating to solid waste management and disposal.	Applicable.

ATTACHMENT 2 (continued)

ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
PEOPLES NATURAL GAS SITE - DUBUQUE, IOWA

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
State (continued)			
Spills And Hazardous Conditions			
Notification Of Hazardous Conditions	IAC 567—Chapter 131	Provides requirements for reporting a hazardous condition.	Applicable if hazardous substances are used and released during remedial activities.
Rules For Determining Cleanup Actions And Responsible Parties	IAC 567—Chapter 133	Establish procedures and criteria to determine the parties responsible and cleanup actions necessary to meet the goals of the state pertaining to the protection of groundwater. These rules pertain to the cleanup of groundwater itself and soils and surface water where groundwater may be impacted.	Applicable.

Notes:

CERCLA = Comprehensive, Environmental Response, Compensation, and Liability Act.
CFR = Code of Federal Regulations.
EPA = Environmental Protection Agency.
IAC = Iowa Administrative Code.
IDNR = Iowa Department of Natural Resources.
ISS = In-situ solidification.
MCL = Maximum Contaminant Levels.
NPDES = National Pollutant Discharge Elimination System.
U.S. = United States.
USC = United States Code.

ATTACHMENT 3

Detailed Itemization of Costs & Assumptions for Each Alternative

TABLE I-1

CONTINUED OPERATION OF THE GROUNDWATER EXTRACTION AND TREATMENT SYSTEM
PNG FORMER MANUFACTURED GAS PLANT SITE - DUBUQUE, IOWA

Item/Description	Estimated Quantity	Unit	Unit Cost	Total Cost	Comments
DIRECT COSTS					
Direct Capital Costs					
Well Installation & Development					(Note "M" references are from Means Environmental)
Mobilization	1	lump	$5,000	$ 5,000	
Install 6" Groundwater Extraction Well	1	well	$2,200	$ 2,200	
			Subtotal	**$ 7,200**	
Trenching & Lateral Hookups					
Vaults, Valves, Fitting, Gauges, and Installation	1	wells	$2,000	$ 2,000	
Trenching & Backfilling	222	yd^3	$7	$ 1,700	6' deep x 2' wide, for laying laterals. M 17-03-0255.
Laterals (electrical and water)	500	LF	$14	$ 6,900	M 33-26-0302 & M 20-02-0506
			Subtotal	**$ 10,600**	
Remedial System Building & Components					
Reestablish control system	1	lump	$3,500	$ 3,500	
			Subtotal	**$ 3,500**	
Direct Annual Costs					
System OM&M					
Electricity	3,267	kwh	$0.06	$200	M 33-42-0101
Water treatment chemical for scale control	1	lump	$1,000	$ 1,000	
Parts replacement	1	lump	$2,000	$ 2,000	
			Subtotal	**$ 3,200**	
GW Monitoring					
Semi-annual groundwater monitoring	2	events	$4,195	$ 8,400	16 samples w/ QA for PAHs, BTEX per event
Purge Water Analytical and Disposal	2	events	$500	$ 1,000	
Well Maintenance & Repairs	2	events	$500	$ 1,000	
			Subtotal	**$ 10,400**	
Contingency	20%			**$ 7,000**	
TOTAL-DIRECT COSTS			**TOTAL**	**$ 41,900**	
INDIRECT COSTS					
Indirect Capital Costs					
Implementation of Environmental Covenants	1	lump	$3,000	$ 3,000	
Design and Health and Safety Plan	1	lump	$45,000	$ 45,000	
Bid Preparation, Selection	1	lump	$20,000	$ 20,000	
Renew City of Dubuque wastewater discharge permit	1	lump	$3,000	$ 3,000	
Construction oversight	1	lump	$10,000	$ 10,000	10 days for installation and startup
Overall system cleaning/rehabilitation/startup	40	hr/person	$80	$ 6,400	Crew of 2 for 5 days
Wastewater discharge permit application	1	lump	$4,000	$ 4,000	
Construction completion report	1	lump	$25,000	$ 25,000	
			Subtotal	**$ 116,400**	
Indirect Annual Costs					
Weekly maintenance for scale/biofouling control	624	hours	$80	$ 50,000	Crew of 1 for 12 hours/week
Field Time and Supplies (GW monitoring)	48	hr/person	$100	$ 9,600	Crew of 2 for 3 days per event, 2 events.
Project Management	1	lump	$5,000	$ 5,000	
System and Monitoring Report Preparation	2	events	$9,000	$ 18,000	
			Subtotal	**$ 82,600**	
	ROR	**# Events**	**Each**	**NPV**	
Five-Year Review Costs	7%	6	$12,000	$26,100	Every 5 years for 30 years.
			Subtotal	**$ 26,100**	
Project Close-out Costs	**ROR**	**Year**	**Cost**	**NPV**	
Project Management	7%	30	$6,000	$800	
Bid Preparation & Selection	7%	30	$30,000	$4,000	
Removal of wells, laterals & remedial building.	7%	30	$37,500	$5,000	includes 51 wells @ $500 per well
Close-out Report	7%	30	$40,000	$5,300	
			Subtotal	**$ 15,100**	
Contingency	20%			**$ 48,100**	
TOTAL-INDIRECT COSTS			**TOTAL**	**$ 288,300**	
NET PRESENT VALUE OF ANNUAL COSTS	**ROR**	**Years**	**Annual**	**PV**	
(Annual Costs includes all direct and indirect)	7%	29	$ 96,200	**$ 1,181,200**	System O&M + GW Monitoring + Indirect Annual (1st yr costs listed previously. This line for remaining 29)
TOTAL COST (30 years)				**$ 1,511,000**	Total costs rounded to nearest $1000.

Notes:

Unit costs based on previous projects, subcontractor bids or Means Heavy Construction (1999) or Environmental Remediation (2002) Cost Data. Assume 3% annual inflation.

ROR = Rate of Return

TABLE I-2

ADDITIONAL EXCAVATION
PNG FORMER MANUFACTURED GAS PLANT SITE - DUBUQUE, IOWA

Item/Description	Estimated Quantity	Unit	Unit Cost	Total Cost	Comments
DIRECT COSTS					
Direct Capital Costs					
Soil Excavation					(Note "M" references are from Means Environmental)
Mobilization	1	lump	$5,000	$ 5,000	
Shoring	3,000	SF	$9	$ 27,400	M 17-03-0904
Kerper Boulevard demolition	290	CY	$42	$ 12,100	M 17-02-0209
Excavation and backfill	48,000	CY	$14	$ 695,100	M 17-03-0266, M 17-03-0423, & M 17-03-0428
Confirmatory soil sampling	50	samples	$150	$ 7,500	
Contaminated soil thermal desorption	5,000	CY	$120	$ 600,000	
Reconstruction of Kerper Boulevard	1,800	SY	$23	$ 41,600	M 18-01-0301
Miscellaneous site work	1	lump	$10,000	$ 10,000	
			Subtotal	**$ 1,398,700**	
Direct Annual Costs					
GW Monitoring					
Semi-annual groundwater monitoring	2	events	$4,195	$ 8,400	16 samples w/ QA for PAHs, BTEX per event
Purge Water Analytical and Disposal	2	events	$500	$ 1,000	
Well Maintenance & Repairs	2	events	$500	$ 1,000	
			Subtotal	**$ 10,400**	
Contingency	20%			**$ 281,900**	
TOTAL-DIRECT COSTS			**TOTAL**	**$ 1,691,000**	
INDIRECT COSTS					
Indirect Capital Costs					
Implementation of Environmental Covenants	1	lump	$3,000	$ 3,000	
Design and Health and Safety Plan	1	lump	$45,000	$ 45,000	
Bid Preparation, Selection	1	lump	$20,000	$ 20,000	
Construction oversight and confirmatory sampling	1	lump	$30,000	$ 30,000	30 days for excavation and backfill
Construction completion report	1	lump	$25,000	$ 25,000	
			Subtotal	**$ 123,000**	
Indirect Annual Costs					
Field Time and Supplies (GW monitoring)	48	hr/person	$100	$ 9,600	Crew of 2 for 3 days per event; 2 events.
Project Management	1	lump	$5,000	$ 5,000	
Monitoring Report Preparation	2	events	$7,000	$ 14,000	
			Subtotal	**$ 28,600**	
	ROR	**# Events**	**Each**	**NPV**	
Five-Year Review Costs	7%	6	$12,000	$26,100	Every 5 years for 30 years.
			Subtotal	**$ 26,100**	
Project Close-out Costs	**ROR**	**Year**	**Cost**	**NPV**	
Project Management	7%	30	$6,000	$800	
Removal of wells	7%	30	$21,000	$2,800	42 wells @ $500 per well
Close-Out Report	7%	30	$40,000	$5,300	
			Subtotal	**$ 8,900**	
Contingency	20%			**37,400**	
TOTAL-INDIRECT COSTS			**TOTAL**	**$ 224,000**	
NET PRESENT VALUE OF ANNUAL COSTS	**ROR**	**Years**	**Annual**	**PV**	
(Annual Costs includes all direct and indirect)	7%	29	$ 39,000	**478,900**	Groundwater Monitoring + Indirect Annual (1st yr costs listed previously. This line for remaining 29)
TOTAL COST (30 years)				**$ 2,394,000**	Total costs rounded to nearest $1000.

Notes:

Unit costs based on previous projects, subcontractor bids or Means Heavy Construction (1999) or Environmental Remediation (2002) Cost Data. Assume 3% annual inflation. ROR = Rate of Return

TABLE I-3

IN-SITU SOLIDIFICATION
PNG FORMER MANUFACTURED GAS PLANT SITE - DUBUQUE, IOWA

Item/Description	Estimated Quantity	Unit	Unit Cost	Total Cost	Comments
DIRECT COSTS					
Direct Capital Costs					
Insitu stabilization	1	lump	$2,400,000	$ 2,400,000	Quote from vendor
Reconstruction of Kerper Boulevard	1,800	SY	$23	$ 41,600	M 18-01-0301
			Subtotal	**$ 2,441,600**	
Direct Annual Costs					
GW Monitoring					
Semi-annual groundwater monitoring	2	events	$4,195	$ 8,400	16 samples w/ QA for PAHs, BTEX per event
Purge Water Analytical and Disposal	2	events	$500	$ 1,000	
Well Maintenance & Repairs	2	events	$500	$ 1,000	
			Subtotal	**$ 10,400**	
Contingency	20%			**$ 490,400**	
TOTAL-DIRECT COSTS			**TOTAL**	**$ 2,942,400**	
INDIRECT COSTS					
Indirect Capital Costs					
Implementation of Environmental Covenants	1	lump	$3,000	$ 3,000	
Design and Health and Safety Plan	1	lump	$45,000	$ 45,000	
Bid Preparation, Selection	1	lump	$20,000	$ 20,000	
Construction Oversight	1	lump	$85,000	$ 85,000	17 weeks
Construction Completion Report	1	lump	$25,000	$ 25,000	
			Subtotal	**$ 178,000**	
Indirect Annual Costs					
Field Time and Supplies (GW monitoring)	48	hr/person	$100	$ 9,600	Crew of 2 for 3 days per event; 2 events.
Project Management	1	lump	$5,000	$ 5,000	
Monitoring Report Preparation	2	events	$7,000	$ 14,000	
			Subtotal	**$ 28,600**	
	ROR	**# Events**	**Each**	**NPV**	
Five-Year Review Costs	7%	6	$12,000	$26,000	Every 5 years for 30 years.
			Subtotal	**$ 26,000**	
Project Close-out Costs	**ROR**	**Year**	**Cost**	**NPV**	
Project Management	7%	30	$6,000	$800	
Removal of wells	7%	30	$21,000	$2,800	42 wells @ $500 per well
Close-Out Report	7%	30	$40,000	$5,300	
			Subtotal	**$ 8,900**	
Contingency	20%			**48,300**	
TOTAL-INDIRECT COSTS			**TOTAL**	**$ 289,800**	
NET PRESENT VALUE OF ANNUAL COSTS	**ROR**	**Years**	**Annual**	**PV**	
(Annual Costs includes all direct and indirect)	7%	29	$ 39,000	**478,900**	Groundwater Monitoring + Indirect Annual (1st yr costs listed previously. This line for remaining 29)
TOTAL COST (30 years)				**$ 3,711,000**	Total costs rounded to nearest $1000.

Notes:
Unit costs based on previous projects, subcontractor bids or Means Heavy Construction (1999) or Environmental Remediation (2002) Cost Data.
ROR = Rate of Return.

TABLE I-4

IN-SITU THERMAL TREATMENT
PNG FORMER MANUFACTURED GAS PLANT SITE - DUBUQUE, IOWA

Item/Description	Estimated Quantity	Unit	Unit Cost	Total Cost	Comments
DIRECT COSTS					
Direct Capital Costs					
Insitu themal treatment	1	lump	$2,250,000	$ 2,250,000	Quote from vendor
			Subtotal	**$ 2,250,000**	
Direct Annual Costs					
GW Monitoring					
Semi-annual groundwater monitoring	2	events	$4,195	$ 8,400	16 samples w/ QA for PAHs, BTEX per event
Purge Water Analytical and Disposal	2	events	$500	$ 1,000	
Well Maintenance & Repairs	2	events	$500	$ 1,000	
			Subtotal	**$ 10,400**	
Contingency	20%			**$ 452,100**	
TOTAL-DIRECT COSTS			**TOTAL**	**$ 2,712,500**	
INDIRECT COSTS					
Indirect Capital Costs					
Implementation of Environmental Covenants	1	lump	$3,000	$ 3,000	
Design and Health and Safety Plan	1	lump	$45,000	$ 45,000	
Bid Preparation, Selection	1	lump	$20,000	$ 20,000	
Construction Oversight	1	lump	$30,000	$ 30,000	assume 30 days for installation & startup
Construction Completion Report	1	lump	$25,000	$ 25,000	
			Subtotal	**$ 123,000**	
Indirect Annual Costs					
Field Time and Supplies (GW monitoring)	48	hr/person	$100	$ 9,600	Crew of 2 for 3 days per event: 2 events.
Project Management	1	lump	$5,000	$ 5,000	
Monitoring Report Preparation	2	events	$7,000	$ 14,000	
			Subtotal	**$ 28,600**	
	ROR	**# Events**	**Each**	**NPV**	
Five-Year Review Costs	7%	6	$12,000	$26,000	Every 5 years for 30 years.
			Subtotal	**$ 26,000**	
Project Close-out Costs	**ROR**	**Year**	**Cost**	**NPV**	
Project Management	7%	30	$6,000	$800	
Removal of wells	7%	30	$25,000	$3,300	50 wells @ $500 per well
Close-Out Report	7%	30	$40,000	$5,300	
			Subtotal	**$ 9,400**	
Contingency	20%			**37,400**	
TOTAL-INDIRECT COSTS			**TOTAL**	**$ 224,400**	
Net Present Value of Annual & Close-out Costs	**ROR**	**Years**	**Annual**	**PV**	
(Annual Costs includes all direct and indirect)	7%	29	$ 39,000	**478,800**	Groundwater Monitoring + Indirect Annual (1st yr costs listed previously. This line for remaining 29)
TOTAL COST (30 years)				**$ 3,416,000**	Total costs rounded to nearest $.1000.

Notes:

Unit costs based on previous projects, subcontractor bids or Means Heavy Construction (1999) or Environmental Remediation (2002) Cost Data.

ROR = Rate of Return.

TABLE I-5

MONITORED NATURAL ATTENUATION
PNG FORMER MANUFACTURED GAS PLANT SITE - DUBUQUE, IOWA

Item/Description	Estimated Quantity	Unit	Unit Cost	Total Cost	Comments
DIRECT COSTS					
Direct Capital Costs					
Well Installation & Development					(Note "M" references are from Means Environmental)
Mobilization	1	lump	$5,000	$ 5,000	
Install Monitoring Well	2	well	$1,800	$ 3,600	
			Subtotal	**$ 8,600**	
Direct Annual Costs					
GW Monitoring					
Semi-annual groundwater monitoring	2	events	$9,417	$ 18,900	19 smpls w/ QA for PAHs/BTEX/MNA param Per Event
Purge Water Analytical and Disposal	2	events	$500	$ 1,000	
Well Maintenance & Repairs	2	events	$500	$ 1,000	
			Subtotal	**$ 20,900**	
Contingency	20%			**$ 5,900**	
TOTAL-DIRECT COSTS			**TOTAL**	**$ 35,400**	
INDIRECT COSTS					
Indirect Capital Costs					
Implementation of Environmental Covenants	1	lump	$3,000	$ 3,000	
Design	1	lump	$40,000	$ 40,000	
Oversight, monitoring well installation	1	lump	$2,000	$ 2,000	2 days for installation
			Subtotal	**$ 45,000**	
Indirect Annual Costs					
Field Time and Supplies (GW monitoring)	64	hr/person	$100	$ 12,800	Crew of 2 for 4 days per event; 2 events
Project Management	1	lump	$5,000	$ 5,000	
Monitoring Report Preparation	2	events	$9,000	$ 18,000	
			Subtotal	**$ 35,800**	
	ROR	**# Events**	**Each**	**NPV**	
Five-Year Review Costs	7%	6	$12,000	$26,100	Every 5 years for 30 years.
			Subtotal	**$ 26,100**	
Project Close-out Costs	**ROR**	**Year**	**Cost**	**NPV**	
Project Management	7%	30	$6,000	$800	
Removal of wells	7%	30	$26,000	$3,500	52 wells @ $500 per well
Close-Out Report	7%	30	$40,000	$5,300	
			Subtotal	**$ 9,600**	
Contingency	20%			**$ 23,300**	
TOTAL-INDIRECT COSTS			**TOTAL**	**$ 139,800**	
NET PRESENT VALUE OF ANNUAL COSTS	**ROR**	**Years**	**Per Year**	**NPV**	
Projected for 30 years total (29 additional)					
(Annual Costs includes all direct and indirect)	7%	29	$ 28,350	**348,100**	Annual Groundwater Monitoring + Indirect Ann.
TOTAL COST (30 years)				**$ 523,000**	Total costs rounded to nearest $1000.

Notes:
Unit costs based on previous projects, subcontractor bids or Means Heavy Construction (1999) or Environmental Remediation (2002) Cost Data. Assume 3% annual inflation. ROR = Rate of Return

TABLE I-6

GROUNDWATER EXTRACTION / HYDRAULIC CONTROL
PNG FORMER MANUFACTURED GAS PLANT SITE - DUBUQUE, IOWA

Item/Description	Estimated Quantity	Unit	Unit Cost	Total Cost	Comments
DIRECT COSTS					
Direct Capital Costs					
Well Installation & Development					(Note "M" references are from Means Environmental)
Mobilization	1	lump	$8,500	$ 8,500	
Install 2" Monitoring Well	2	well	$1,800	$ 3,600	
Install 6" Groundwater Extraction Well	2	well	$3,500	$ 7,000	One extraction well already in place
			Subtotal	**$ 19,100**	
Trenching & Lateral Hookups					
Vaults, Valves, Fitting, Gauges, and Installation	3	wells	$2,000	$ 6,000	
Directional Bore under Kerper Blvd	1	lump	$7,000	$ 7,000	
Trenching & Backfilling	150	yd^3	$7	$ 1,200	4' deep x 2' wide x 450' long, for laying laterals. M 17-03-0255
Laterals (electrical and water)	450	LF	$14	$ 6,200	M 33-26-0302 & M 20-02-0506
			Subtotal	**$ 20,400**	
Remedial System Building & Components					
Control Panel	1	lump	$8,650	$ 8,650	Vendor Quote
Oil Water Separator	1	lump	$12,100	$ 14,100	Vendor Quote
Monitoring and Valving Equipment	1	lump	$14,500	$ 14,500	
Masonry Building/Equipment	1	lump	$25,000	$ 25,000	
			Subtotal	**$ 62,250**	
Direct Annual Costs					
System OM&M					
Electricity	16,337	kwh	$0.06	$1,000	M 33-42-0101
Water treatment chemical for scale control	1	lump	$5,000	$ 5,000	
Parts replacement/non-routine maintenance	1	lump	$5,000	$ 5,000	
			Subtotal	**$ 11,000**	
GW Monitoring					
Semi-annual groundwater monitoring	2	events	$9,417	$ 18,900	19 smpls w/ QA for PAHs/BTEX/MNA param Per Event
Well Maintenance & Repairs	2	events	$500	$ 1,000	
			Subtotal	**$ 19,900**	
Contingency	20%			**$ 26,600**	
TOTAL-DIRECT COSTS			**TOTAL**	**$ 159,250**	
INDIRECT COSTS					
Indirect Capital Costs					
Implementation of Environmental Covenants	1	lump	$3,000	$ 3,000	
Design and Health and Safety Plan	1	lump	$45,000	$ 45,000	
Bid Preparation, Selection	1	lump	$20,000	$ 20,000	
Renew City of Dubuque wastewater discharge permit	1	lump	$3,000	$ 3,000	
Construction oversight	1	lump	$25,000	$ 25,000	25 days for installation and startup
System Startup	50	hr/person	$95	$ 9,500	Crew of 2 for 5 days
Wastewater discharge permit application	1	lump	$4,000	$ 4,000	
Construction completion report	1	lump	$25,000	$ 25,000	
			Subtotal	**$ 134,500**	
Indirect Annual Costs					
Monthly maintenance for scale/biofouling control	144	hours	$100	$ 14,400	Crew of 1 for 12 hours/month
Monthly water effluent monitoring	12	events	$228	$ 2,800	1 sample for PAHs, BTEX per event
Field Time and Supplies (GW monitoring)	64	hr/person	$100	$ 12,800	Crew of 2 for 4 days per event; 2 events
Project Management	1	lump	$5,000	$ 5,000	
System and Monitoring Report Preparation	4	events	$9,000	$ 36,000	
			Subtotal	**$ 71,000**	
	ROR	**# Events**	**Each**	**NPV**	
Five-Year Review Costs	7%	6	$12,000	$26,100	Every 5 years for 30 years.
			Subtotal	**$ 26,100**	
Project Close-out Costs	**ROR**	**Year**	**Cost**	**NPV**	
Project Management	7%	30	$6,000	$800	
Bid Preparation & Selection	7%	30	$30,000	$4,000	
Removal of wells, laterals & remedial building.	7%	30	$33,000	$4,400	includes 42 wells @ $500 per well
Close-out Report	7%	30	$40,000	$5,300	
			Subtotal	**$ 14,500**	
Contingency	20%			**$ 49,300**	
TOTAL-INDIRECT COSTS			**TOTAL**	**$ 295,400**	
NET PRESENT VALUE OF ANNUAL COSTS	**ROR**	**Years**	**Annual**	**PV**	
(Annual Costs includes all direct and indirect)	7%	29	$ 101,900	**$ 1,251,100**	System O&M + GW Monitoring + Indirect Annual (1st yr costs listed previously. This line for remaining 29)
TOTAL COST (30 years)				**$ 1,706,000**	Total costs rounded to nearest $,1000.

Notes:
Unit costs based on previous projects, subcontractor bids or Means Heavy Construction (1999) or Environmental Remediation (2002) Cost Data. Assume 3% annual inflation.
ROR = Rate of Return