ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES

U.S. EPA Brownfield
American Recovery and Reinvestment Act of 2009 (ARRA) Revolving Loan Fund (RLF) Assistance Amendment (AA)# 2B-00E96801-2
and RLF AA# BL-00E48101-4
Indiana Brownfields Program
And
U.S. EPA Brownfield Cleanup CA# BF-00E61501
City of Richmond
for the
Former Richmond Gas Plant (a.k.a. MGP)
16 East Main Street
Richmond, Indiana
Indiana Brownfields Program
October 2012

This Analysis of Brownfield Cleanup Alternatives (ABCA) was prepared in cooperation among the Indiana Brownfields Program (Program), the City of Richmond (City), and AECOM Technical Services, Inc. (AECOM) as a requirement for utilizing United States Environmental Protection Agency (U.S. EPA) Revolving Loan Fund (RLF) *and Cleanup* monies to remediate a brownfield. This ABCA presents five remedial alternatives considered to mitigate potential exposure to affected **ground water** at the Former Richmond Gas Plant Site in Richmond, Indiana (Site). This ABCA and associated funding pertain only to ground water remediation activities at the Site. Soil remediation activities were addressed in previous, separate documentation. Remedial measures to address impacted ground water are anticipated to be completed in 2013 and 2014. This ABCA focuses on the Site information pertinent to the property that was once the western portion of the Richmond former manufactured gas plant (MGP). This ABCA includes Site details, a summary of remedial alternatives, a summary of previous Site activities, remedial action objectives, the analysis of remedial alternatives and the selected site remedy. The vacant, vegetated Site is designated industrial with anticipated recreational re-use.

Site Details

Site Name:	Richmond Gas Plant (MGP) 16 East Main Street Richmond, Indiana
Property Owner:	City of Richmond Department of Metropolitan Development 50 North 5th Street Richmond, IN 47374
Site Representative:	Mr. Tony Foster Executive Director City of Richmond Department of Metropolitan Development

Summary of Remedial Alternatives for Soil

1. Alternative 1 – Monitored Natural Attenuation
2. Alternative 2 – Ground Water Pumping and Treatment
3. Alternative 3 – In-Situ Chemical Oxidation Injection
4. Alternative 4 - In-Situ Biodegradation Injection
5. Alternative 5 - Site Capping

Summary of Previous Site Activities

Site investigations have been performed to delineate soil and ground water impacts associated with the Site through means of records searches, subsurface structure identification, local hydrogeological investigations, surface and subsurface sampling, installation of ground water monitoring wells, and laboratory analysis of soil and ground water samples. Information and findings from previous Site investigative efforts is provided in the documents summarized below. It is the intent of this document to focus on the information pertinent to the ground water impacts to the west of the Site and the impacted surface and subsurface soil at the Site that remains following the source removal activities.

Multiple investigations were performed at the Site between 1994 and 2012 to determine the potential for environmental impacts related to past MGP operations, to identify the presence of MGP residuals, and to identify or confirm the presence of former MGP structures.

Subsurface structures at the Site identified during the previous investigation activities include a gas holder, a tar well, and multiple building foundations associated with historic gas plant activities. The former MPG building basement is located in the southern portion of the Site and contains a shallow well, approximately 8 feet below grade. An abandoned tunnel or cistern, presumably utilized for the City of Richmond's historical sewer system, was also identified during investigation activities. The removal of residual MGP material from the well in the basement, the removal of impacted water and MGP residual material from the abandoned tunnel/cistern, and the backfilling of the basement area and tunnel/cistern are included in the Removal Action Work Plan activities, which are currently scheduled for completion in 2012.

The Contaminants of Concern (COC) identified in the ground water and soil during previous investigations include: benzene, ethylbenzene, total xylenes, benzo(a)anthracene, benzo(a)pyrene, benzo(b)- fluoranthene, dibenzo(a,h)anthracene, and total and weak acid dissociable (WAD) cyanide. The source areas for these COC have been identified as the former tar well in the northwest corner of the Site, the soil in the immediate vicinity of the former MGP building foundation, and the soil in the vicinity of one soil boring (SB-14) located near the northeast corner of the Site. A potential fourth source area has been identified (the former 65,000 cubic feet gas holder in the southern portion of the Site) and will be addressed as necessary during the source removal activities. The removal of source material from these targeted areas is addressed in the approved Removal Action Work Plan (AECOM, 2011).

A ground water investigation was conducted in July and August 2012 to delineate the extent of COC concentrations greater than their applicable Indiana Department of Environmental

Management (IDEM) Risk Integrated System of Closure (RISC) Default Closure Levels in the ground water at the Site. The results of these investigation activities are included in the Remedial Action Work Plan for Groundwater Remediation and Site Capping Activities (AECOM, 2012) and have been utilized to develop the ground water remedial options detailed in this ABCA. The purpose of this ABCA is to identify alternatives to reduce Site COC impacts to below IDEM RISC levels.

Environmental Investigations Conducted at the Site Include the Following:

- Preliminary Assessment. The Preliminary Assessment (PA) was completed by RETEC in August 1993 and concluded that below-grade structures may contain MGP residuals.

- Site Inspection. A Site Inspection report was completed by RETEC in October of 1995 addressing evaluation of the vertical and horizontal extent of MGP residuals in subsurface soils. During the investigation, 22 soil borings were completed, four of which were converted to monitoring wells MW-1 through MW-4. A concrete structure was encountered during the advancement of soil boring SB-A, and several attempts were made within an area of approximately 20 square feet to install the boring; however, at a depth of approximately seven feet auger refusal occurred. Soil boring observations indicated that the uppermost water bearing unit is located at approximately 13 to 21 feet below ground surface (bgs). Soil borings generally indicate that a four to ten foot layer of fill material extends across the Site, underlain by four to ten feet of silty sand and clay, underlain by bedrock. Generally, two soil samples were collected from each soil boring and analyzed for benzene, tolulene, ethylbenzene, and total xylenes (BTEX), polynuclear aromatic hydrocarbons (PAHs), and total cyanide. One soil sample was collected from soil borings SB-5 and SB-13, and three soil samples were collected from SB-20. COCs including benzene, benzo(a)- anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene constituent concentrations were detected in soil samples SB-13, SB-14, and SB-20. Slug Testing. A Slug Testing Site Inspection was conducted by RETEC in February 1995 addressing additional hydrogeologic data from the upper-most-water-bearing unit at the Site.

- Additional Site Investigation. An Additional Site Investigation was completed by RETEC in October 1995 to evaluate the lateral extent of soil and ground water impacts toward the Whitewater River. During the investigation, two soil boring/monitoring wells were installed (MW-101 and MW-102). Constituents detected included PAHs in soil, and ethylbenzene, total xylenes, PAHs, and total cyanide in ground water.

- Surface Soil Sampling. In 1996, RETEC completed a surface soil investigation to assess the impact of MGP residuals at the Site. Samples were collected at twelve locations across the Site (SS-1 through SS-12).

- Ground Water Monitoring. In 1996, RETEC collected a ground water sample from monitoring well MW-102. The remaining wells were not sampled due to the presence of product observed during collection of static water levels.

- Remediation of Purifier Parcel. In 2005, RETEC completed a soil remediation on the Purifier parcel located adjacent to the eastern boundary of the Site. During the remediation, three test pits were completed within the northwest portion of the subject Site in the area of the tar well. The first two test pits (TP-01 and TP-02) were completed to a depth of approximately 15 feet. Both test pits found no indications of a tar well. The

soil from the test pits had no visual staining and the PID readings of screened soil were 0.0 ppm. The third test pit, TP-03, located approximately 20 feet west of TP-01 and TP-02, was completed to a depth of approximately 9 feet. At 9 feet a large piece of concrete, approximately 4 feet by 3 feet and a thickness of 6 inches, was exposed and lifted by the excavator. Under the exposed piece of concrete was a structure containing water and a tar-like material. The concrete appeared to be covering the structure; however, only a portion of the structure was exposed, and no estimate of structure size could be determined. The concrete was put back in place and the soil replaced into the test pit. Visual staining was observed on the soil from TP-03 at a depth of approximately 7 feet.

- Supplement Subsurface Investigation. In 2007 Burgess and Niple conducted a subsurface investigation was conducted to: investigate and define the former 65,000 and 10,000 cubic foot (cf) gas holders, delineate subsurface tar byproduct left from historical manufactured gas plant operations, and evaluate potential ground water impact on the Site due to historical manufactured gas plant operations. The investigation included completion of two test pits, installation of two monitoring wells (MW-05 and MW-06) and completion of seven soil borings. Soil samples were collected from test pits completed in each holder. No other samples were collected.

- Phase II Investigation. A Phase II Site Investigation (Phase II) was conducted by Keramida Inc. in May 2011. The investigation activities included soil borings, monitoring well installation, monitoring well gauging and sampling of soil and ground water. Surface soil and subsurface soil samples were collected for analysis of BTEX, PAHs, total cyanide, weak acid dissociable (WAD) cyanide, and select metals. Ground water samples were collected for analysis of BTEX, PAHs, WAD cyanide, and select metals.

- Remedial Efforts to Define A Plume - 2012. In July and August 2012, AECOM completed six soil borings, installed seven monitoring wells, collected three subsurface soil samples, and collected eight ground water samples. Soil samples were collected for analysis of BTEX, PAHs, and total organic carbon (TOC). Ground water samples were collected for analysis of BTEX, PAHs, Resource Conservation and Recovery Act (RCRA) metals, total and ferrous iron, and total cyanide. A second mobilization was completed in September 2012 in preparation for the activities to be conducted under the approved Removal Action Work Plan. Two test pits were completed to identify the source areas targeted for removal activities and a third test pit was completed adjacent to MW-001, which has historically contained measureable amounts of LNAPL. The on-site test pitting identified one additional source area located adjacent to the existing former MGP building foundation. The third test pit identified the presence of free product in a perched aquifer located at the fill-clay interface; however, significant accumulation of free product did not occur and free product was not observed on the ground water table below this interface.

Previous Reports

The following documents have been prepared to summarize investigation activities described above at the Site:

- Preliminary Assessment, Former Manufactured Gas Plant Site, Richmond, Indiana. August 15, 1994 [PA] (RETEC, 1994).

- Site Inspection Report, Former Manufactured Gas Plant Site, Richmond, Indiana. March 31, 1995 [SI] (RETEC, 1995a).

- Slug Testing Report, Site Inspection, Former Manufactured Gas Plant Site, Richmond, Indiana. March 31, 1995 (RETEC, 1995b).

- Additional Site Investigation Report, Former Manufactured Gas Plant Site, Richmond, Indiana. January 12, 1996 (RETEC, 1996a).

- Surface Soil Sampling Report, Former Manufactured Gas Plant Site, Richmond, Indiana. May 31, 1996 (RETEC, 1996b).

- Ground Water Monitoring Summary, April 1996, Former Manufactured Gas Plant, Richmond, Indiana. June 21, 1996 (RETEC, 1996c).

- Soil Boring and Analytical Summary – December 2004, Former MGP Site – Richmond, Indiana, RETEC Project Number # IGC20-18598. Letter Report. February 16, 2005.(RETEC, 2005a).

- Supplemental Site Investigation Work Plan, Former Manufactured Gas Plant Site, Western Parcel (Main Process Area), Richmond, Indiana. May 26, 2005. (The RETEC Group, Inc., 2005b).

- State of Indiana Department of Natural Resources Division of water, Early Coordination/Environmental Assessment. DNR# ER-11607. Letter Correspondence. July 13, 2005. (IDNR, 2005).

- Remediation Completion Report, Purifier Parcel – Richmond MGP, Richmond, Indiana. August 18, 2005. (RETEC, 2005c).

- Supplement Subsurface Investigation, Former Manufactured Gas Plant, Richmond, Indiana. Letter Report. April 20, 2007. (Burgess and Niple, 2007).

- Phase II Investigation Report, Former Manufactured Gas Plant, 77 Johnson Street, Richmond, Indiana. June 11, 2011. (Keramida Inc., 2011).

- Remedial Action Work Plan, Richmond Gas Plant, 16 East Main Street, Richmond, Indiana, Brownfield 4980004. November 2011 (AECOM, 2011).

- Remedial Action Work Plan – Groundwater Remediation and Site Capping Activities, Richmond Gas Plant, 16 East Main Street, Richmond, Indiana. September 2012 (AECOM, 2012).

Remedial Action Objectives

The Site currently is vacant and its cover is predominately fill material and dense vegetation. See Figures 1 and 2. Current Site use is designated industrial with anticipated future use designated as recreational. The remedial objective for the Site is to ensure that exposure to affected media is controlled sufficiently to protect future receptors: construction workers and recreational patrons.

Remedial action needed to protect potential receptors within the Site by reducing the source area contaminant levels to below IDEM RISC levels should include the following:

- Treat MGP-impacted ground water that could facilitate the migration of MGP impacts into off-site media, particularly the East Fork of the White River; and
- Eliminate or control potential exposure pathways for site workers and recreational patrons.

An analysis of alternatives to achieve these objectives is presented below followed by the selected remedial recommendation for the Site.

Analysis of Alternatives

Cleanup alternatives considered to mitigate exposure to impacted **ground water** included the following:

- Alternative 1 – Monitored Natural Attenuation
- Alternative 2 – Ground Water Pumping and Treatment
- Alternative 3 – In-Situ Chemical Oxidation Injection
- Alternative 4 – In-Situ Biodegradation Injection
- Alternative 5 – Site Capping

The remedial action alternatives considered were evaluated using the following criteria:

(1) Effectiveness

a. The degree to which the toxicity, mobility and volume of the contamination is expected to be reduced (i.e., the ability to reduce or destroy contaminant mass).
b. The degree to which a remedial action option, if implemented, will protect public health, safety and welfare and the environment over time.
c. The degree to which implementation of remedial activities will adversely impact public health, safety and welfare and the environment.

(2) Implementability

a. The technical feasibility of constructing and implementing the remedial action option at the site or facility.
b. The availability of materials, equipment, technologies and services needed to conduct the remedial action option.

(3) Cost

a. Capital costs, including both direct and indirect costs.
b. Initial costs, including design and testing costs.
c. Annual operation and maintenance costs.

Alternative 1 – Monitored Natural Attenuation

Monitored natural attenuation is a passive remedial option which relies on natural processes including biodegradation and volatilization to reduce COC levels. Active quarterly monitoring is required for this alternative.

(1) Effectiveness – Provided that the COC source is removed, monitored natural attenuation should be effective in documenting decreasing ground water impacts over time. The drawbacks to this approach include a significant period (several years) to reduce or eliminate COC and the continued potential for COC to reach the East Fork of the Whitewater River before adequate attenuation.

(2) Implementability - Implementation would be simplistic as it will only require quarterly ground water sampling and analysis.

(3) Total Cost – ($10,000+) includes quarterly ground water monitoring cost ($10,000 per quarter) for an indeterminate number of quarters.

Alternative 2 – Ground Water Pumping and Treatment

Design and installation of a remedial system which pumps impacted ground water to a treatment system capable of removing COC by carbon treatment, aeration or biological means.

(1) Effectiveness – Ground water pumping and treatment will effectively contain the contaminant plume and protect the East Fork of the Whitewater River from impact, however, reduction in plume size may not result. In addition, measured LNAPL at the site does not warrant the installation of a costly free product recovery system. This treatment alternative will require construction of a permanent treatment system and ongoing operation and maintenance, resulting in the most costly remedial alternative.

(2) Implementability – Significant initial design and construction effort and associated cost required to implement in the short term. Long term personnel and equipment requirements for operation, maintenance and monitoring. Discharge permitting for treated water may be required.

(3) Cost – Total Cost ($450,000+) includes system installation cost ($350,000) and operation and maintenance costs ($100,000 per year) for an indeterminate period.

Alternative 3 – In-Situ Chemical Oxidation Injection (ISCO)

Injecting a strong oxidant into the ground water plume to reduce mass and destroy COC.

(1) Effectiveness – ISCO can effectively reduce residual COC concentrations by destruction upon contact. This alternative can be implemented over a generally short time span and has been effective on residual COC at other locations. This alternative will not be effective over the long term if a persistent source remains at the Site. Health and safety consideration as remedial process may result in an exothermic reaction at the time and point of injection.

(2) Implementability – Although COC destruction and reduction may be achieved with a single injection event, a series of three injection events are typical to achieve destruction and reduction goals. Ground water sampling and analysis should be conducted prior to

the first event and following each of the three injection events to monitor remedial progress.

(3) Cost – Total Cost ($283,000) includes injection costs for three events ($243,000) and monitoring costs for four quarters ($40,000).

Alternative 4 – In-Situ Biodegradation Injection

Injection of a substrate into the ground water plume to stimulate growth of desirable indigenous bacteria that consume COC.

(1) Effectiveness – This option would effectively reduce the COC concentrations by degrading COC over time and enhancing natural attenuation. This alternative will not be effective over the long term if a persistent source remains at the Site.

(2) Implementability – It is likely that at least 3 injection events would be required to reduce COC. An additional incubation time beyond injection events would be required to allow biodegradation of COC to acceptable levels. In-situ biodegradation treatment should address lighter COC such as benzene, but may take longer to address PAHs. Depending upon the acceptability of the biodegradation rate, additional injection beyond 3 events could be required.

(3) Cost – Total Cost ($256,000+) includes injection costs for three events ($216,000+) and monitoring costs for four quarters ($40,000).

Alternative 5 – Site Capping

Covering the Site with low permeability soil (clay) to reduce infiltration of precipitation into the residual impacted soil (i.e., reduce potential for migration to ground water) and restricting contact with construction workers and recreational users.

(1) Effectiveness – This option would effectively reduce the potential for continued ground water impacts from Site soil and protect construction workers and recreational Site users from contact with impacted soil.

(2) Implementability – Cap design and placement is relatively simple and effective, although some additional effort is required to add topsoil and plant grass over the capped area. Additional engineering considerations will also be required to account for an asphalt road planned by the City of Richmond to cross the cap. The asphalt surface may be incorporated into cap design as alternative impermeable cover.

(3) Cost – Site Capping ($262,000) includes cap placement ($190,000) and topsoil placement and seeding ($72,000).

Recommendation for Site Remedy

Alternative 1 (Monitored Natural Attenuation) requires the least amount of engineering and design and is the least expensive option in the short term. This alternative does not meet the objective to reduce or destroy contaminant mass. Further, this alternative does not provide a

known timeline and does not promptly address potential migration of COC to the East Fork of the Whitewater River. Alternative 2 (Ground Water Pump and Treatment) is the most costly alternative and would require installation of a system within the flood plain and substantial O&M costs. Alternative 3 (In-situ Chemical Oxidation Injection) is an initially costly option that will reduce and destroy COC mass almost immediately. Residual COC above cleanup goals could be eliminated with additional injection events. Alternative 4 (In-Situ Biodegradation Injection) is a slightly less costly injection option, but adequate COC reduction and/or destruction will not take place immediately. It is likely that this option will require additional injection events and may not achieve PAH cleanup goals. Alternative 5 (Site Capping) eliminates the potential for direct contact with MGP-affected soils and reduces the potential for COC migration to ground water.

The recommended remedy for ground water complements the ABCA recommendation for soil and the source removal activities completed under the approved Removal Action Work Plan (AECOM, 2011). The recommended remedy is a combination of Alternative 3 (In-Situ Chemical Oxidation Injection) and Alternative 5 (Site Capping). This combination will reduce and destroy COC mass immediately through chemical oxidation and reduce the potential migration of residual COC in soil to ground water by eliminating the infiltration of precipitation. Further, as noted above, Site capping will eliminate the potential direct contact to residual COC in surface soils for future site workers and recreational patrons.

Decision Document

A decision document will be issued at the close of the public comment period with additional details on the selected alternative for site remedy. The decision document will serve as a notice to proceed with federally funded remediation activities and will be available in the local information repository for public view, along with this Site ABCA and other Site-related documents for public view.

FIGURE 1

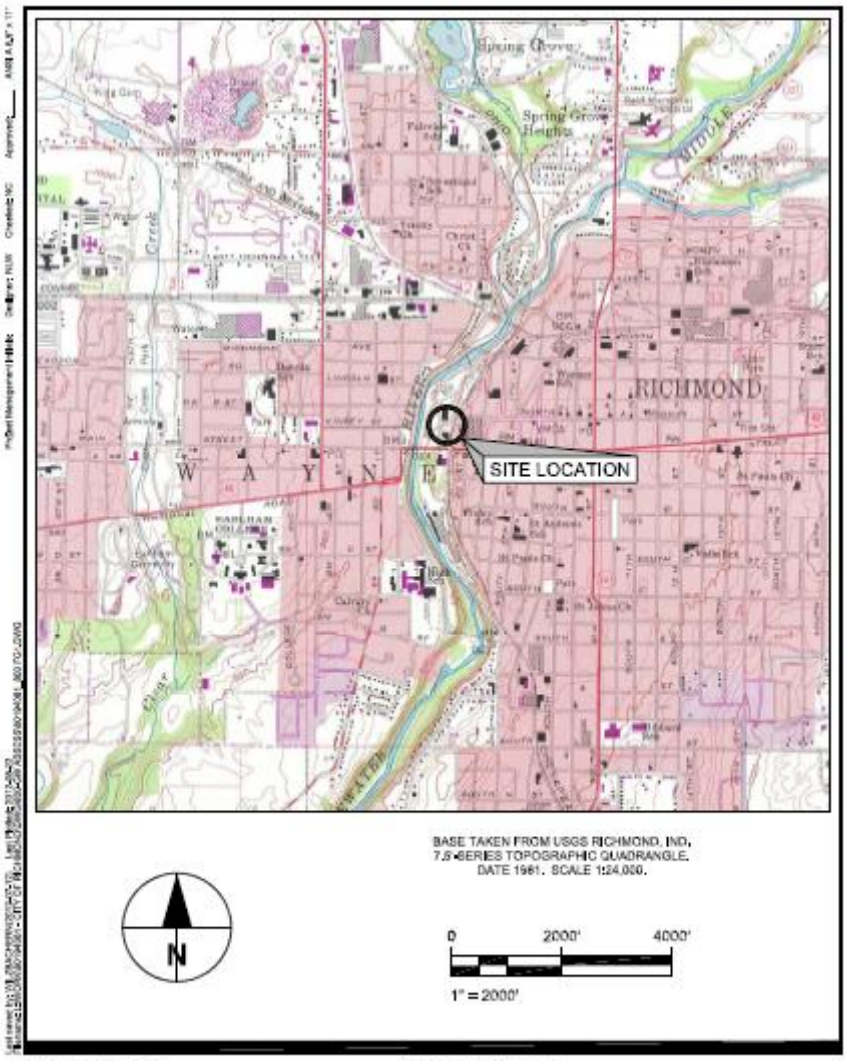
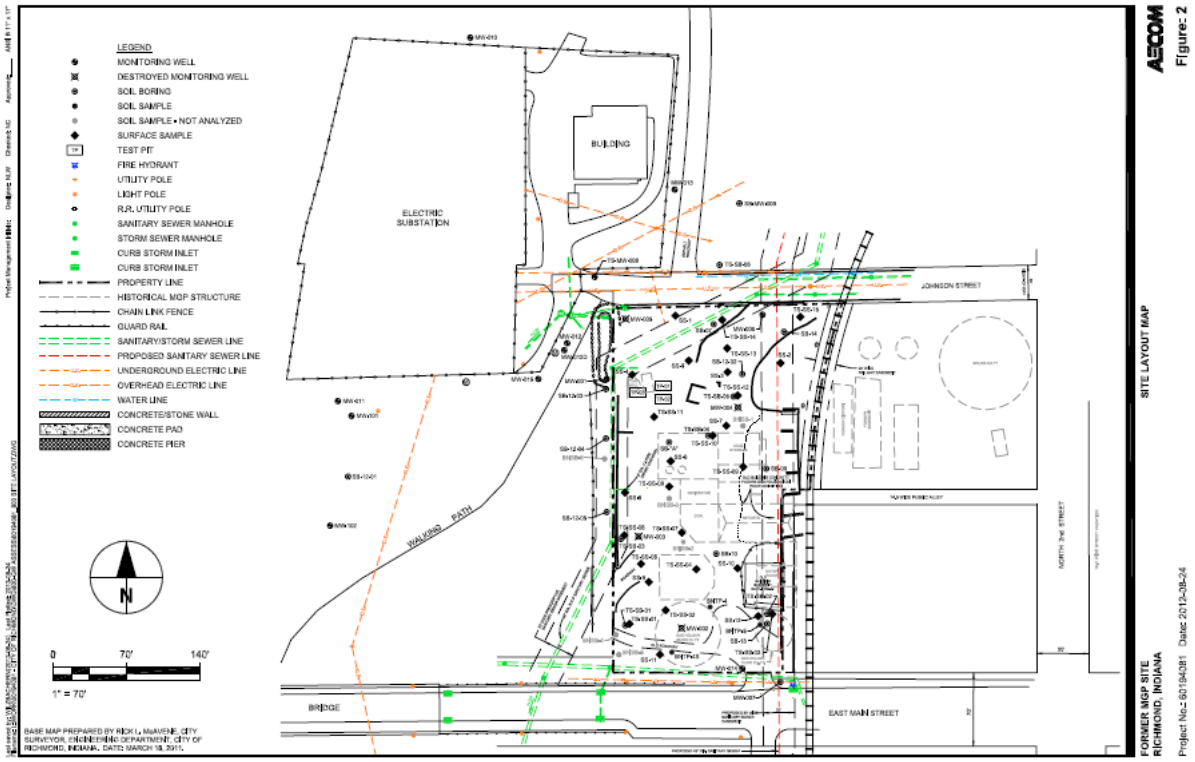

RICHMOND
SITE LOCATION
W A Y N E
BASE TAKEN FROM USGS RICHMOND, IND.
7.5' SERIES TOPOGRAPHIC QUADRANGLE.
DATE 1961. SCALE 1:24,000.
N
0
2000'
4000'
1" = 2000'
FORMER MGP SITE
RICHMOND, INDIANA
SITE LOCATION MAP
AECOM
Project No.: 60194081 Date: 2012-07-12
Figure: 1

FIGURE 2


LEGEND
MONITORING WELL
DESTROYED MONITORING WELL
SOIL BORING
SOIL SAMPLE
SOIL SAMPLE • NOT ANALYZED
SURFACE SAMPLE
TEST PIT
FIRE HYDRANT
UTILITY POLE
LIGHT POLE
R.R. UTILITY POLE
SANITARY SEWER MANHOLE
STORM SEWER MANHOLE
CURB STORM INLET
CURB STORM INLET
PROPERTY LINE
HISTORICAL MGP STRUCTURE
CHAIN LINK FENCE
GUARD RAIL
SANITARY/STORM SEWER LINE
PROPOSED SANITARY SEWER LINE
UNDERGROUND ELECTRIC LINE
OVERHEAD ELECTRIC LINE
WATER LINE
CONCRETE/STONE WALL
CONCRETE PAD
CONCRETE PIER
ELECTRIC SUBSTATION
BUILDING
JOHNSON STREET
WAYSIDE PATH
BRIDGE
EAST MAIN STREET
N
0
70'
140'
1" = 70'
AECOM
Figure: 2
SITE LAYOUT MAP
FORMER MGP SITE
RICHMOND, INDIANA