Environmental Programs

Brownfields SRF

Indiana Brownfields Program
an Indiana Finance Authority Environmental Program

100 North Senate Avenue, Room 1275
Indianapolis, Indiana 46204
www.brownfields.in.gov

Cindy Shively Klem
Brownfields Program Counsel
(317) 234-6018
cklem@ifa.in.gov

October 19, 2012

Chad Sidler
Environmental Review
Department of Natural Resources
Division of Historic Preservation and Archeology
402 West Washington Street, Room W-274
Indianapolis, Indiana 46204-2739

Re: City of Richmond, Wayne County
Former Manufactured Gas Plant
16 East Main Street, Richmond, Indiana
(a/k/a 77 Johnson Street, Richmond, Indiana)
Indiana Brownfields Program Project
(Note: Project is currently under DHPA review: DHPA No. 13537; INDOT Designation No. 0810267)

Dear Mr. Sidler:

This letter is to serve as the Indiana Brownfields Program's ("Program") formal request for a Section 106 National Historic Preservation Act review by the Indiana Department of Natural Resources' Division of Historic Preservation and Archaeology for the property at 16 East Main Street, Richmond, Wayne County, Indiana ("Site"). The Program is the recipient of a federal Brownfields revolving loan fund grant for environmental remediation awarded by the U.S. Environmental Protection Agency. As a condition of use of the federal funds, the Program must ensure a review is conducted to determine the potential applicability of the National Historic Preservation Act to the Site. In mid-December 2012, the City of Richmond plans to enter into a loan agreement with the Program and will use federal funds (Brownfields and State Revolving Funds) to remediate environmental impacts in the soil and groundwater at the Site.

Information about the Program's and City of Richmond's Plans:

Federal Funding Source: The City of Richmond plans to enter into a low-interest loan agreement with the Program and will use federal funds to remediate environmental contamination identified on the Site. Cindy Shively Klem with the Indiana Brownfields Program will work with the Division of Historic Preservation and Archeology ("DHPA") for review of the Brownfields project. However, because this Site may receive funds through the State Revolving Fund, Division of Water Program, Sarah Hudson will coordinate the review for those funds, and will provide information to Christie Stanifer at DNR's Environmental Review Section to review. In addition, this site is located in a larger area entitled the *Cardinal Greenway and Starr-Gennett Area Redevelopment Project,* which is currently being reviewed by the DHPA section. Reports related to the historic property records review and the archeological literature review for this project have already been completed, and the DHPA provided its response to these reports in letters dated June 28, 2012 and October 4, 2012. (The DHPA letters are attached to this letter as **"Exhibit A."**) In addition, the Remedial Action Work Plan for Ground Water Remediation and Site Capping Activities ("RAWP") for the Brownfields project has been approved by the Program's technical staff. (An abbreviate version of the RAWP is attached as **"Exhibit B"**).

Site Funding Background: This Site has a long history of environmental investigations beginning in 1994. It has received local, state and federal funding to address the environmental contamination at the former MPG plant. In 2008, the Site received a U.S. EPA Cleanup grant under a U.S. Cooperative Agreement to remediate the Site, and that Cooperative Agreement has been extended to January 2013. In 2011, the Site received additional funding under the Program's 128(a) U.S. EPA Assistance Agreement to conduct further site assessment activities. In August 2012, the City of Richmond applied to the Program for U.S. EPA Brownfield RLF and SRF loan funds to fully fund the completion of remediation activities.

Site Location/Remediation Information: This Site is essentially comprised of two parcels of property. The parcel number for the Former Richmond MPG Site is #891632340509000030 ("MPG parcel"). In addition, it is possible that groundwater cleanup and soil removal will occur on the southern portion of the parcel directly west of the MPG parcel. The parcel number for this off-site property is #891632340510000030. (A map showing both parcels is attached as **"Exhibit C-1."** Both parcels are owned by the City of Richmond. In addition, as discussed above, the Site is located in a larger area that is the *Cardinal Greenway and Star-Gennett Redevelopment Project*. The purpose of the redevelopment project is to create a pedestrian walk and bike trail in the City. The Richmond MGP site and the off-site property are identified in the archeology report as site 12Wy502. (An arial photograph from the archeology report showing site 12Wy502 is attached as **"Exhibit C-2."**)

The RAP identifies some of the remediation work to be performed using loan funds. The chemicals of concern ("COC") at the Site are: benzene, tolulene, ethylbenzene, total xylenes (BTEX), polynuclear aromatic hydrocarbons (PAHs), Resource Conservation and Recovery (RCRA) heavy metals and total cyanide. The source areas and COCs are located in soil in the tar well areas, the former building basement areas, and on another area designated as SB-14 associated with former MGP operations. It is anticipated that the RLF funds would be used for activities related to remediation of the groundwater by elimination/destruction of COC mass (free product) in the groundwater plume, and the installation of a permanent impermeable clay cap after the source removal activities have occurred.

Historical Site Background: The Richmond MGP began production of gas using the coal carbonization process in 1855. In 1882, the plant was rebuilt and converted to the carbureted water gas process. In approximately 1909, a 320,000 cubic foot capacity gas holder was added to the eastern portion of the Site. The plant operated intermittently until approximately 1941. Other gas holders having capacity of 65,000 and 10,000 cubic feet were located in the southwestern portion of the former MGP, but they have all been removed. In addition, underneath the former building easement, two brick underground tunnels containing tar at the bottom still exist on the property, and the foundations of the original building are still in place. The City plans to remove these underground structures with the previously awarded U.S. EPA Cleanup Grant funds prior to starting the work to be funded by the RLF loan funds. The Site is currently vacant and is heavily vegetated in most portions. All above-ground structures at the Site were demolished in 2009. (The City of Richmond had planned to reuse the buildings; however, a child fell off a building and was severely injured. Due to the buildings creating a public nuisance, the City demolished the buildings using SEP funds from a settlement with a private company.)

Historical Status of Site: The Richmond MGP site is not listed nor recommended to be listed on any State or National Registries.

Sources of Historical Information:

- Wayne County Interim Report (Indiana Historic Sites and Structures Inventory - August 2001)
- DNR – Indiana Properties listed on the State and National Registries
- Historic Properties Report, prepared by EFI Global, dated August 2, 2012
- DHPA letters dated October 4, 2012 and June28, 2012

Thank you for your assistance with the Section 106 review process. In order to facilitate the appropriate review process by the U.S. Environmental Protection Agency, the Program requests that all correspondence from your office to the Program also be copied to Patricia Polston, Project Manager, U.S. Environmental Protection Agency, Region 5, 77 W. Jackson Blvd., SB-7J, Chicago, IL 60604. Please feel free to contact me at (317)234-0618 if you should have any questions.

Sincerely,

Cindy Shively Klem
Program Counsel

Enclosures
cc: *(via electronic transmission)*
Patricia Polston, U.S. EPA
Tony Foster, City of Richmond
Michele Oertel, Indiana Brownfields Program
John Morris, Indiana Brownfields Program
Sarah Hudson, Indiana State Revolving Fund
Patrick Carpenter, Indiana Department of Transportation
Susan Ferestad, Shewsberry & Associates

Exhibit A

NHPA letters dated October 4, 2012 and June 28, 2012

October 4, 2012

Susan Ferestad
Project Manager
Shrewsberry & Associates, LLC
7321 Shadeland Station, Suite 160
Indianapolis, Indiana 46256

Federal Agency: Federal Highway Administration

Re: Archaeological literature review (Stillwell, 1/17/11) and archaeological field reconnaissance report (Stillwell, 9/4/12) regarding Cardinal Greenway and Starr-Gennett Area Redevelopment Project, Phase I (Designation No. 0810267; DHPA No. 13537)

Dear Ms. Ferestad:

Pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. § 470f), 36 C.F.R. Part 800, and the "Programmatic Agreement among the Federal Highway Administration, the Indiana Department of Transportation, the Advisory Council on Historic Preservation, the Indiana State Historic Preservation Officer regarding the implementation of the Federal Aid Highway Program in the State of Indiana," the staff of the Indiana State Historic Preservation Officer has conducted an analysis of the materials dated and received on September 11, 2012, for the aforementioned project in City of Richmond, Wayne County, Indiana.

Thank you for providing the archaeological literature and Phase Ia archaeological reconnaissance reports for the above project. Based upon the documentation available to the staff of the Indiana SHPO, archaeological site 12Wy502 does not appear to be eligible for inclusion in the National Register of Historic Places, and no further archaeological investigations at this site appear necessary.

Archaeological sites 12Wy295, 12Wy357 and 12Wy503 appear potentially eligible for inclusion in the National Register of Historic Places. These sites must either be avoided by all project activities, or subjected to further archaeological investigations. If avoidance is not feasible, an archaeological plan for further archaeological investigations must be submitted to the DHPA for review and comment. Any further archaeological investigations must be done in accordance with the "Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation" (48 F.R. 44716).

In regard to the archaeological reports, we note that the project areas and sizes differ in the literature review (200 acres) and the Phase Ia field reconnaissance report (150 acres). Our archaeological comments refer to the project area as depicted in the field reconnaissance report. In Figure 8 (page 35) of the field reconnaissance report, a number of archaeological sites not in the project area are depicted. For their protection, these should not be shown and should be available only to qualified professional archaeologists. On page 44, Figure 17 is very dark with little detail. Could a clearer figure be provided, and with citation if relevant? On page 45, is there a citation for Figure 18? On page 50, Figure 24 is labeled "12-Wy-357" while the label in the figure is "12-Wy-395." Please clarify.

If any archaeological artifacts or human remains are uncovered during construction, demolition, or earthmoving activities, state law (Indiana Code 14-21-1-27 and 29) requires that the discovery must be reported to the Department of Natural Resources within two (2) business days. In that event, please call (317) 232-1646. Be advised that adherence to Indiana Code 14-21-1-27 and 29 does not obviate the need to adhere to applicable federal statutes and regulations.

At this time, it would be appropriate for the Indiana Department of Transportation ("INDOT"), on behalf of the FHWA, to analyze the information that has been gathered from the Indiana SHPO, the general public, and any other consulting parties and make the necessary determinations and findings. Please refer to the following comments for guidance:

1) If the INDOT believes that a determination of "no historic properties affected" accurately reflects its assessment, then it shall provide documentation of its finding as set forth in 36 C.F.R. § 800.11 to the Indiana SHPO, notify all consulting parties, and make the documentation available for public inspection (36 C.F.R. §§ 800.4[d][1] and 800.2[d][2]).

2) If, on the other hand, the INDOT finds that an historic property may be affected, then it shall notify the Indiana SHPO, the public and all consulting parties of its finding and seek views on effects in accordance with 36 C.F.R. §§ 800.4(d)(2) and 800.2(d)(2). Thereafter, the INDOT may proceed to apply the criteria of adverse effect and determine whether the project will result in a "no adverse effect" or an "adverse effect" in accordance with 36 C.F.R. § 800.5.

Please be advised that prior to INDOT approving and issuing a finding, the 36 C.F.R. § 800.11 documentation must be submitted to INDOT for review and comment.

A copy of the revised 36 C.F.R. Part 800 that went into effect on August 5, 2004, may be found on the Internet at www.achp.gov for your reference. If you have questions about archaeological issues please contact Dr. Rick Jones at (317) 233-0953 or rjones@dnr.IN.gov. If you have questions about buildings or structures please contact John Carr at (317) 233-1949 or jcarr@dnr.IN.gov. Additionally, in all future correspondence regarding the above indicated project, please refer to DHPA No. 13537.

Very truly yours,

James A. Glass, Ph.D.
Deputy State Historic Preservation Officer

JAG:JRJ:jj

emc: Lawrence Heil, P.E., Indiana Division, Federal Highway Administration
Patrick Carpenter, Cultural Resources Office, Environmental Services, Indiana Department of Transportation
Mary Kennedy, Cultural Resources Office, Environmental Services, Indiana Department of Transportation
Shaun Miller, Cultural Resources Office, Environmental Services, Indiana Department of Transportation
Melany Prather, Environmental Services, Indiana Department of Transportation
Susan K. Ferestad, Shrewsberry & Associates, LLC,
Cindy Shively Klem, Indiana Brownfields Program, Indiana Finance Authority
Patricia Polston, Region 5, Environmental Protection Agency
Joe Mayes, Rundell Ernstberger Associates, LLC
Larry N. Stillwell, Archaeological Consultants of Ossian

DNR Indiana Department of Natural Resources

Mitchell E. Daniels, Jr., Governor
Robert E. Carter, Jr., Director

Division of Historic Preservation & Archaeology•402 W. Washington Street, W274 · Indianapolis, IN 46204-2739
Phone 317-232-1646•Fax 317-232-0693 · dhpa@dnr.IN.gov

June 28, 2012

Susan K. Ferestad
Project Manager
Vince L. Epps, CHMM, LEED AP
Senior Project Manager
Shrewsberry & Associates
7321 Shadeland Station, Suite 160
Indianapolis, Indiana 46256

Federal Agency: Federal Highway Administration

Re: Early coordination information and historic property records review (Daleiden-Fischer and Gilliam, 2/14/11) regarding Cardinal Greenway and Starr-Gennett Area Redevelopment, Richmond Avenue to South G Street (Des. No. 0810267; DHPA No. 13537)

Dear Ms. Ferestad and Mr. Epps:

Pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. § 470f), 36 C.F.R. Part 800, and the "Programmatic Agreement Among the Federal Highway Administration, the Indiana Department of Transportation, the Advisory Council on Historic Preservation and the Indiana State Historic Preservation Officer Regarding the Implementation of the Federal Aid Highway Program In the State of Indiana," the staff of the Indiana State Historic Preservation Officer has reviewed the materials submitted with your cover letter dated May 31, 2012 and received on June 5, 2012, for the above-indicated project within the City of Richmond, Wayne County, Indiana.

Thank you for notifying our office of the proposed project and of the Section 106 consulting parties who have been invited to participate. Other parties of whom we are aware who perhaps should be invited to participate are the Richmond Historic Preservation Commission (their contact information is available at http://www.in.gov/dnr/historic/4314.htm), the Eastern Regional Office of Indiana Landmarks (http://www.indianalandmarks.org/regionallandmarks/regionaloffices/Pages/default.aspx), and the Board of Commissioners of Wayne County (http://www.co.wayne.in.us/commissioners/) (see 36 C.F.R. §800.2[c][3]). For future reference, there is no harm in your having invited the Wayne County Genealogy Society or the local historical or preservation societies from outlying communities (e.g., Abington, Clay Township, Hagerstown, Centerville, and Western Wayne), but we would anticipate that such organizations probably have fairly specialized interests that would not include the City of Richmond as a geographic area (see 36 C.F.R. §800.2[c][5]), and it does not appear likely to us that they would accept your invitation.

As you are aware, a complete analysis of the project is not possible at this time. We note that you have provided a historic properties records review and are in the process of completing a historic properties report. Please provide the following information to facilitate the identification and analysis of historic properties in the project area:

- Literature Review
- Historic Context
- Research Methodology
- Property Descriptions
- National Register of Historic Places eligibility evaluations and recommendations

For further guidance on the indicated information, please refer to Appendix AA of the Indiana Department of Transportation's ("INDOT's") Indiana Cultural Resources Manual (http://www.in.gov/indot/files/January_2008_Manual.pdf). Please keep in mind that additional information may be requested in the future.

If you have questions regarding INDOT's Indiana Cultural Resources Manual, please contact Patrick Carpenter at (317) 233-2061 or pacarpenter@indot.IN.gov.

In regard to archaeology, it is our understanding that a Phase Ia archaeological field reconnaissance will be conducted for the proposed project. Once the archaeological report is received, the Indiana SHPO will resume identification and evaluation procedures for this project.

If any archaeological artifacts or human remains are uncovered during construction, demolition, or earthmoving activities, state law (Indiana Code 14-21-1-27 and -29) requires that the discovery be reported to the Department of Natural Resources within two (2) business days. In that event, please call (317) 232-1646. Be advised that adherence to Indiana Code 14-21-1-27 and -29 does not obviate the need to adhere to applicable federal statutes and regulations.

A copy of the revised 36 C.F.R. Part 800 regulations that took effect on August 5, 2004 may be found on the Internet at www.achp.gov. If you have questions about archaeological issues, please contact Dr. Rick Jones at (317) 233-0953 or rjones@dnr.IN.gov. If you have questions about buildings or structures, please contact Whitney Airgood-Obrycki at (317) 233-9636 or wairgoodobrycki@dnr.IN.gov or John Carr at (317) 233-1949 or jcarr@dnr.IN.gov. In all future correspondence regarding the Cardinal Greenway and Starr-Gennett Area Redevelopment (Des. No. 0810267), please refer to DHPA No. 13537.

Very truly yours,

Ron McAhron

for James A. Glass, Ph.D.
Deputy State Historic Preservation Officer

JAG:WAO:JRJ:JLC:jlc

emc: Patrick Carpenter, Indiana Department of Transportation
Mary Kennedy, Indiana Department of Transportation
Shaun Miller, Indiana Department of Transportation
Melany Prather, Indiana Department of Transportation
Susan K. Ferestad, Shrewsberry & Associates, LLC

Exhibit B

Remediation Work Plan for Ground Water and Site Capping Activities

(Redacted)

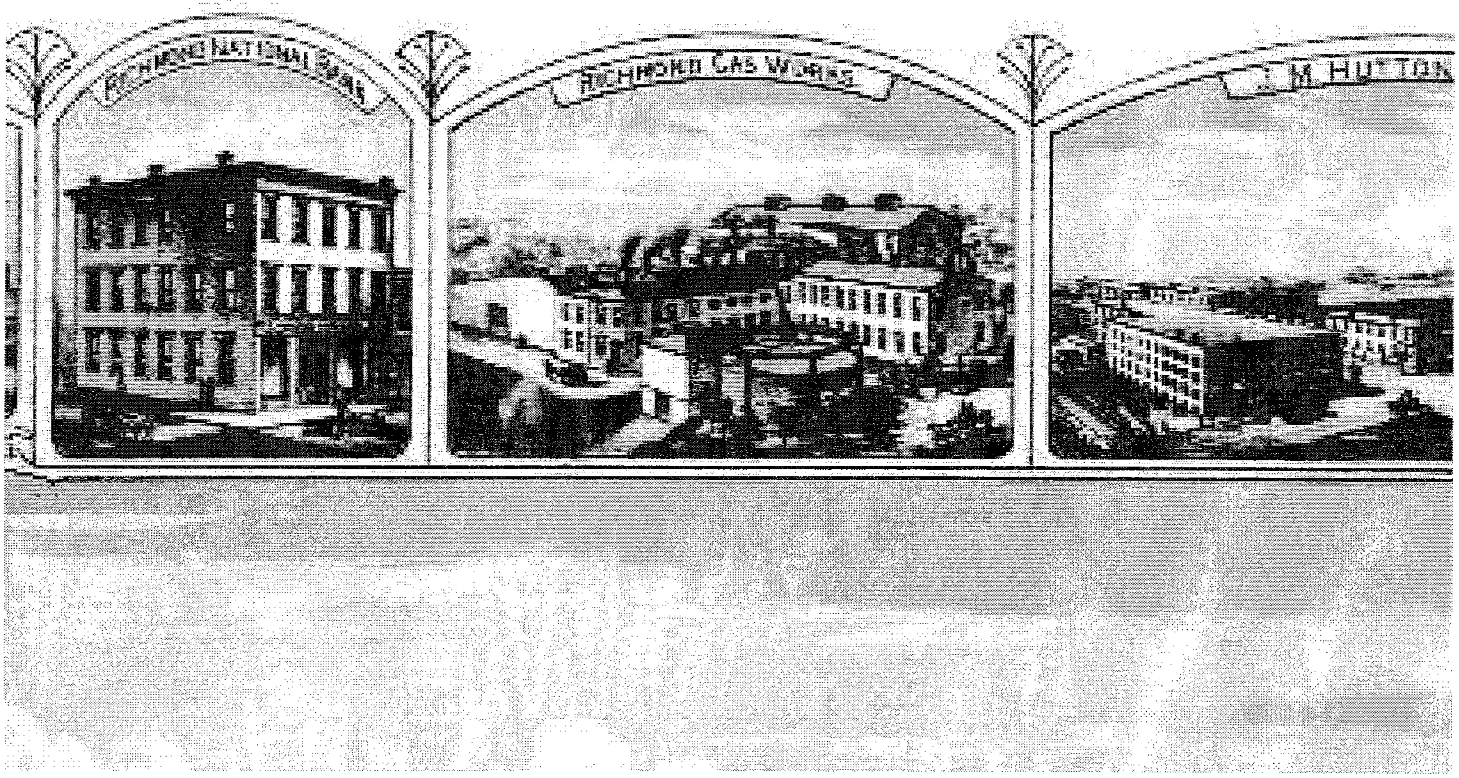
AECOM Environment

Prepared for:
City of Richmond

Prepared by:
AECOM
Bloomington, Indiana
September 2012

Remedial Action Work Plan Ground Water Remediation and Site Capping Activities

Richmond Gas Plant
16 East Main Street
Richmond, Indiana
Brownfields Number 4980004



AECOM Environment

Prepared for:
City of Richmond

Prepared by:
AECOM
Bloomington, Indiana
September 2012

Remedial Action Work Plan Ground Water Remediation and Site Capping Activities

Richmond Gas Plant
16 East Main Street
Richmond, Indiana
Brownfields Number 4980004

Prepared By: Nathan Conniff, CHMM, Environmental Scientist

Reviewed By: Brooks Bertl, P.E., L.P.G., Senior Project Manager

Reviewed By: Jeffrey Nelson, Department Manager - Indiana

Table of Contents

1.0 Introduction 1-1

1.1 Project Background 1-1

1.1.1 Site Description 1-1

1.1.2 Site Name and Address 1-2

1.1.3 Historical Summary 1-2

1.1.4 Past and Current Operations 1-3

1.1.5 Previous Investigations Conducted at the Site 1-3

1.2 Supporting Documentation 1-6

1.2.1 Previous Reports 1-6

1.3 Remedial Action Objectives 1-7

2.0 Background Information 2-1

2.1 Summary of Information Used to Select Remedy 2-1

2.1.1 Regional Geology 2-1

2.1.2 Regional Hydrogeology 2-1

2.1.3 Physical and Political Geographic Information 2-2

2.1.4 Identification of Susceptible Areas 2-2

3.0 Remedial Efforts To Define A Plume 3-1

3.1 Ground Water Assessment 3-1

3.1.1 Materials and Methods 3-1

3.2 Results 3-3

3.2.1 Field Observations 3-3

3.2.2 Laboratory Analytical Results 3-4

4.0 Sources of Contamination 4-1

4.1 Extent of Contamination 4-1

4.1.1 Surface Soil 4-1

4.1.2 Subsurface Soil 4-2

4.1.3 Ground Water 4-2

4.2 Risk Assessment 4-3

5.0 Analysis of Remedial Alternatives 5-1

5.1 Analysis of Alternatives 5-1

5.2 Ground Water Alternative Analysis 5-2

5.2.1 Alternative 1 – Monitored Natural Attenuation 5-2

5.2.2 Alternative 2 – Ground Water Pumping and Treatment 5-2
5.2.3 Alternative 3 – In-Situ Chemical Oxidation Injection (ISCO) 5-3
5.2.4 Alternative 4 – In-Situ Biodegradation Injection 5-3
5.2.5 Alternative 5 – Site Capping 5-3
5.2.6 Ground Water Recommendation 5-4

6.0 Remedial Action Plan 6-1
6.1 Description of Removal Action 6-1
6.2 Site Capping 6-1
6.2.1 Site Preparation 6-1
6.2.2 Cap Installation 6-1
6.3 Site Restoration 6-2
6.4 Ground Water Remediation 6-2
6.4.1 Injection Procedure 6-3
6.4.2 Progress Monitoring 6-3

7.0 Monitoring and Sampling Plan 7-1
7.1 Quarterly Ground Water Sampling 7-1
7.1.1 Sampling Procedures 7-1
7.1.2 Decontamination 7-1
7.1.3 Sample Shipment and Analysis 7-1
7.1.4 Data Management 7-2

8.0 Operation and Maintenance 8-1

9.0 Reporting 9-1
9.1 Completion Report 9-1
9.2 Progress Reports / Monitoring Reports 9-1

10.0 Projected Work Schedule 10-1

11.0 Cost Estimate 11-1

12.0 References 12-1

List of Appendices

Appendix A Boring Logs and Well Completion Diagrams

Appendix B Laboratory Analytical Reports and Chain-of-Custody Forms

Appendix C Hydraulic Conductivity Test Results

Appendix D Analysis of Brownfield Cleanup Alternatives

Appendix E Site-Specific Health and Safety Plan

Appendix F Quality Assurance Project Plan

List of Tables

Table 1	Sample Collection and Analyses Summary – Pre-2012 Investigation Data
Table 2	Soil Analytical Results– August 2012
Table 3	Monitoring Well Identification and Ground Water Elevations – August 2012
Table 4	Water Quality Parameters – August 2012
Table 5	Summary of Sample Analyses – August 2012
Table 6	Ground Water Analytical Results – August 2012
Table 7	Historical Surface Soil Analytical Results
Table 8	Historical Subsurface Soil Analytical Results
Table 9	Historical Ground Water Analytical Results

List of Figures

Figure 1	Site Location Map
Figure 2	Current Site Layout
Figure 3	Site Layout with Former MGP Structures
Figure 4	All Sampling Locations
Figure 5	Exceedances of RISC DCLs in Soil – August 2012
Figure 6	Potentiometric Surface Map – August 2012
Figure 7	Exceedances of RISC DCLs in Ground Water – August 2012
Figure 8	Geologic Cross Section A-A'
Figure 9	Geologic Cross Section B-B'
Figure 10	Surface Soil Exceedance Map – Pre-2012 Investigation Data
Figure 11	Subsurface Soil Exceedance Map – Pre-2012 Investigation Data
Figure 12	Ground Water Exceedance Map – Pre-2012 Investigation Data
Figure 13	Approximate Extent of Ground Water Plume – August 2012
Figure 14	Cap Design Location
Figure 15	Ground Water Injection Design

1.0 Introduction

AECOM Technical Services (AECOM) has prepared this Remedial Action Work Plan (RAWP) on behalf of the City of Richmond to summarize the ground water remediation and soil capping activities planned for the former manufactured gas plant (MGP) site located in Richmond, Indiana (the Site). The City of Richmond is planning to redevelop the Site and include it as part of a recreational pedestrian walk and bike trail for the citizens of Richmond. A contaminant source removal action is currently underway and is scheduled for completion in 2012. The details of the source removal action are included in the Indiana Department of Environmental Management (IDEM)-approved Removal Action Work Plan prepared by AECOM dated November 2011 (AECOM, 2011). The Site is currently enrolled in the Indiana Brownfields Program and is assigned Number 4980004.

This RAWP has been developed to address chemicals of concern (COC) identified to the west of the former MGP property in ground water and to prevent human contact with COC-impacted surface and subsurface soil at the Site. Investigation and characterization of the nature and extent of MGP-related residuals and evaluation of potential exposure to COC has been conducted in accordance with the IDEM Risk Integrated System of Closure (RISC) Technical Guide and User Guide (IDEM, 2001) and has been submitted to the Indiana Finance Authority (IFA) for review and approval.

This RAWP is organized into twelve sections and five appendices. Section 1 provides introductory information and Section 2 provides background information. Section 3 provides a summary of the investigation activities. Section 4 discusses the source of contamination. Section 5 discusses the analysis of remedial alternatives and Section 6 discusses the remedial action plan. Section 7 provides the quarterly ground water monitoring and sampling plan. Section 8 discusses operation and maintenance. Section 9 discusses reporting and Section 10 includes the proposed remedial action plan schedule. Section 11 provides an estimate of the cost and Section 12 provides a list of references used in preparation of this report. Appendices include the following:

Appendix A Boring Logs and Well Completion Diagrams

Appendix B Laboratory Analytical Reports and Chain-of-Custody Forms

Appendix C Hydraulic Conductivity Test Results

Appendix D Analysis of Brownfield Cleanup Alternatives

Appendix E Site-Specific Health and Safety Plan

Appendix F Quality Assurance Project Plan

1.1 Project Background

The following sections provide background information for the Site.

1.1.1 Site Description

The former MGP facility originally covered an area of 2.26 acres and has been divided into three separate parcels since cessation of MGP operations. The eastern and central parcels, covering

0.44 and 0.38 acres respectively, are owned by Indiana Gas Company (IGC) and are located east of the C & O Railroad. The western parcel (the Site), covering 1.429 acres, is owned by the City of Richmond. The Site is located on the on the north side of East Main Street approximately 250 feet west of the intersection of East Main Street and North 2nd Street in Richmond, Wayne County, Indiana. The location of the Site is shown in **Figure 1**.

The Site is bounded to the north by Johnson Street; to the east by railroad tracks, beyond which are the two parcels owned by IGC; to the south by East Main Street, beyond which is additional commercial property; and to the west by a vacant lot covered with grass and tree vegetation owned by the City of Richmond.

All buildings on the Site were demolished in 2009. The Site currently is vacant and is covered by a mixture of gravel, former MGP facility rubble, and vegetation. The current Site layout is shown in **Figure 2**. Land use on adjacent properties is characterized as nonresidential. The nearest surface water body is the East Fork of the Whitewater River, located approximately 300 feet west of the Site. General surface topography of the Site slopes steeply to the north and west into Johnson Street and the Whitewater River floodplain. The slope then gently grades towards the riverbank and then steeply into the River.

1.1.2 Site Name and Address

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

1.1.3 Historical Summary

The Richmond MGP began production of gas using the coal carbonization process in approximately 1855. During 1882 and 1883, the plant was rebuilt and equipped with new machinery, and converted to the carbureted water gas process sometime thereafter. Between 1896 and 1901 the CR&M Railroad was granted a right-of-way, and the track separated the western and eastern portions of the former MGP. By 1909, the 320,000 cubic feet capacity gas holder was added to the eastern portion of the former MGP (the eastern parcels of the former MGP is not the subject of this RAWP). Gas manufacturing was put on standby for a period, and natural gas was distributed through its mains until November 1924, at which time the company again began to manufacture gas. The plant operated intermittently until approximately 1941. The remaining two gas holders, located in the southwestern portion of the former MGP (located on the Site), had capacities of 65,000 and 10,000 cubic feet. Other former MGP structures located on the Site included: a tar well, coal shed, retorts, generator room and meter room.

1.1.4 Past and Current Operations

The locations of former MGP structures, including two gas holders (65,000 cubic feet and 10,000 cubic feet), a tar well, coal sheds, retorts, a generator room and a meter room are depicted on **Figure 3**. Two brick tunnels containing MGP residual material are located beneath the former MGP building easement.

All remaining above-ground structures on the Site were demolished in 2009. The Site is currently vacant and ground cover is a mixture of gravel, former MGP facility rubble, and vegetation. The City of Richmond is planning to redevelop and incorporate a portion of the Site into the existing recreational pedestrian and bicycle trail. The remaining portion of the Site will likely be used as a parking area and/or roadway connecting East Main Street to the Veterans Memorial Park located north of Johnson Street.

1.1.5 Previous Investigations Conducted at the Site

Site investigations have been performed to delineate soil and ground water impacts associated with the former Richmond MGP 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 in Section 1.2.1 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 former Richmond MGP facility 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 associated with the former MGP building 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 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 RISC Default Closure Levels in the ground water to the west of the Site. The results of these investigation activities are included in this RAWP and have been utilized to develop the ground water remedial program detailed in Section 6.4 of this RAWP.

A summary of environmental investigations conducted at the Site include the following:

- Preliminary Assessment. A 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 the 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. The auger continually encountered refusal at a depth of approximately seven feet below ground surface (bgs). Soil boring observations indicated that the uppermost water bearing unit is located at approximately 13 to 21 feet bgs. Soil borings generally indicate that a four to ten foot layer of fill material extends across the Site, which is underlain by four to ten feet of silty sand and clay, which is underlain by bedrock.

  Generally, two soil samples were collected from each soil boring and analyzed for benzene, toluene, ethylbenzene, 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. Benzene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene concentrations were detected in soil samples SB-13, SB-14, and SB-20 above their respective Tier II Nonresidential Cleanup Goals. Benzene and naphthalene concentrations were detected in the ground water samples above the Tier II Nonresidential Cleanup Goals.

- Hydraulic Conductivity Testing. A Slug Testing Site Inspection was conducted by RETEC in February 1995 to address hydrogeologic data from the upper-most water-bearing unit at the Site. A detailed discussion of the hydrogeology is provided in a subsequent section of this report.

- 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 borings/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. Concentrations of all constituents were less than the Tier II Nonresidential Cleanup Goals.

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

- Ground Water Monitoring. In 1996, RETEC collected ground water samples from monitoring well MW-102. The remaining wells were not sampled due to the observed presence of heavy sheen or light non-aqueous phase liquid (LNAPL) during the collection of static water levels.

- Purifier Parcel Remediation. In 2005, RETEC completed a soil remediation on a parcel of the former MGP property identified as the Purifier Parcel, located adjacent to the eastern boundary of the Site. During the remediation, three test pits were completed in the northwest portion of the Site in the area of the former 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 and the soil contained no visual staining. The photoionization detector (PID) headspace readings of the 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 nine feet. At nine feet, a large piece of concrete, approximately four feet by three feet with a thickness of approximately six inches, was exposed and lifted by the excavator. Beneath the exposed piece of concrete was a structure containing water and a tar-like material. The concrete piece appeared to be covering the structure; however, only a portion of the structure was exposed, and no estimate of size could be determined. The concrete piece was put back in place and the soil placed back in the test pit. Visual staining of the soil was observed beginning at a depth of approximately seven feet.

- Supplement Subsurface Investigation. In 2007, Burgess and Niple conducted a subsurface investigation to investigate and define the former 65,000 and 10,000 cubic-foot (cf) gas holders, delineate subsurface tar by-product left from historical manufactured gas plant operations, and evaluate potential ground water impacts on the Site due to historical MGP operations. The investigation included the completion of two test pits, the installation of two monitoring wells (MW-05 and MW-06), and the 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 soil and ground water sample collection. Surface soil and subsurface soil samples were collected for analysis of BTEX, PAHs, total cyanide, 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 groundwater table below this interface.

1.2 Supporting Documentation

1.2.1 Previous Reports

The following documents have been prepared to summarize investigation activities completed 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).
- Removal Action Work Plan, Richmond Gas Plant, 16 East Main Street, Richmond, Indiana, Brownfields No. 4980004. November 2011. (AECOM, 2011).

A figure depicting the locations of all soil boring and monitoring well locations associated with the historical investigations is included as **Figure 4**. A table summarizing laboratory analytical results from activities conducted during the historical investigations is included in **Table 1**.

1.3 Remedial Action Objectives

The Site is currently a vacant lot with a cover of predominately graded fill material and dense vegetation. Current Site use is designated industrial with anticipated future use designated as recreational. The remedial objective for the Site under this RAWP is to ensure that exposure to affected media is sufficiently controlled 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 off-site 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. This will include the implementation of an on-site cap.

The remedial action proposed in this RAWP addresses impacted ground water treatment and cap installation.

2.0 Background Information

The following information has been utilized to provide a framework for the site characteristics and assist with selection of an appropriate Site specific remedial program. Additional information regarding the exposure evaluation for COC at this Site may be found in Section 2.4 of the approved Removal Action Work Plan for source removal prepared by AECOM, dated November 2011.

2.1 Summary of Information Used to Select Remedy

2.1.1 Regional Geology

According to RETEC (RETEC 2005b), the Richmond area is underlain by Ordovician-aged skeletal limestone and calcareous shale from the Whitewater Formation included in the Maquoketa Group. Regionally, the Maquoketa Group is a westward-thinning wedge of rocks, approximately 700 to 1,000 feet thick in the basin, and consists primarily of shale in the lower part and limestone with smaller amounts of shale in its upper part. The major geologic structure in the Whitewater River basin is the Cincinnati Arch. Well records obtained from the Indiana Department of Natural Resources (IDNR) Water Division indicate that shale is likely to be the first bedrock material encountered at 19 feet below ground surface (bgs) at the Site. Wayne County lies in the Tipton Till Plain Physiographic section of Indiana.

Surficial materials in the Richmond area are underlain by mixed drift consisting of till and stratified drift in lineated form. The tills are primarily of the Trafalgar Formation and are a result of glacial advances. The lineated forms indicate collapse associated with sub-ice tunnels and ice-walled channels. The till consists of loam to sandy loam that contains abundant pebbles and cobbles, and scattered beds and lenses of silt, sand and gravel. The surface of the till has been only slightly modified by erosion since the till was deposited. A layer of weathered till (yellow/gray clay) ranging in thickness from three feet to 37 feet is indicated for the majority of the borings for which logs were available (IDNR). The USDA soil survey of Wayne County indicates that the Site soil is from the Eden association, which is steep to very steep, moderately deep, well-drained soil on upland side slopes.

2.1.2 Regional Hydrogeology

According to RETEC (RETEC 2005b), till deposited in the area of the Site contains beds and lenses of coarse-grained materials which are important locally because they serve as aquifers primarily for domestic and agricultural purposes. In some areas along the Whitewater River, thick and permeable deposits of sand and gravel exist, which constitute the major source of ground water in the region. Other regions in the Richmond area, including the area of the Site, contain only scattered deposits of sand and gravel. Water availability in the area of the Site is limited to these scattered sand and gravel deposits. Various logs from wells indicated that the sand and gravel aquifer, encountered at depths ranging from 28 to 70 feet, is utilized in the Richmond area. Wells located along the Whitewater River have been developed and yield over 1,000 gallons per minute (gpm) in the underlying sand and gravel. Wells located outside an approximate one-half mile radius from the river have a potential yield of only ten gpm from properly constructed wells.

The bedrock aquifer which occurs in the area of the Site is the Ordovician Bedrock Aquifer. Ordovician age bedrocks form a thick sequence of shales, limestones, dolomite, and sandstones. Ground water potential in the Maquoketa Group rocks is poor because they are essentially impermeable. Shale is the most commonly occurring bedrock material near the Site. In some areas the shale is covered by sandstone. Records from IDNR indicate that the limestone unit can be used as a source of ground water in the Richmond area.

2.1.3 Physical and Political Geographic Information

The Site slopes to the northwest, with elevations ranging from 942 to 905 feet above mean sea level (MSL). Some of the Site topography can be attributed to filling/grading associated with former facility operations and deposition of construction debris generated during a downtown Richmond gas explosion in 1968. The largest surface water body near the Site is the East Fork Of the Whitewater River, located approximately 475 feet west of the former MGP property.

The Site is located in a commercial/industrial area within the City of Richmond. The geographic location of the Site is 84°53'57.93" west longitude and 39°49'47.75" north latitude.

2.1.4 Identification of Susceptible Areas

The IDEM RISC Policy identifies three types of areas that are thought to be especially vulnerable to potential harm from contamination: geologically susceptible areas, wellhead protection areas, and ecologically susceptible areas. The following discussion provides a review of the Site setting with respect to these areas.

- **Geologically Susceptible Area Evaluation:** The presence of Karst terrain has not been observed in boring logs or reported in the vicinity of the Site.

- **Wellhead Protection Areas:** IDEM identified the Site as being located within a Wellhead Protection Area. According to RETEC, the City of Richmond well field lies approximately 0.6 mile south of the former MGP. It consists of a cluster of three wells that are all screened in the outwash deposits at an approximate depth of 59, 60 and 62 feet below ground surface.

- **Baseline Ecological Evaluation:** As stated previously, the majority of the Site is covered by fill or vegetation. The Site is not located within a designated forest, wildlife refuge, or other protected area. No surface water is present, and no rare or endangered species have been observed at the site. A letter from the Indiana Department of Natural Resources (IDNR) regarding the adjacent property states, "To date, no plant or animal species listed as a state of federally threatened, endangered, or rare have been reported to occur in the project vicinity" (IDNR, 2005).

3.0 Remedial Efforts To Define A Plume

3.1 Ground Water Assessment

The results of the historical investigations at the Site indicated that additional dissolve-phase COC delineation to the west of the Site and characterization of the LNAPL encountered at MW-001 was required in order to complete the development of the remedial action program.

To further delineate the COC in the ground water located to the west of the Site, six monitoring wells were installed, developed, and sampled between July 31 and August 17, 2012. Six soil borings were also completed during this investigation to evaluate subsurface soil conditions. LNAPL transmissivity tests were performed at MW-001 to determine the recovery rate of LNAPL into the well. Hydraulic conductivity tests were conducted to determine Site-specific ground water flow conditions in the weathered bedrock/gravel aquifer identified during this investigation.

3.1.1 Materials and Methods

3.1.1.1 Soil Boring Activities

The activities completed under the Ground Water Investigation commenced on July 31, 2012. Soil borings SB-12-01 through SB-12-05 and SB-MW-009 and monitoring wells MW-010 through MW-014 were completed using a track-mounted Geoprobe® 6620DT direct push rig outfitted with Hollow Stem Auger (HSA) equipment. Monitoring wells MW-012D and MW-015 were completed using a truck-mounted HSA rig.

A total of six soil borings (SB-12-01, SB-12-02, SB-12-03, SB-12-04, SB-12-05, and SB-MW-009) were completed using direct push methods, which allowed for continual collection and logging of soil cores. The locations of the soils borings are provided in **Figure 5** and soil boring logs are provided in **Appendix A**.

Soil boring SB-12-01 was completed to characterize soil conditions at the presumed limit of the ground water plume in the vicinity of monitoring wells MW-101 and MW-102. SB-12-02 was completed to characterize real-time subsurface soil conditions at the Site. Soil borings SB-12-03, SB-12-04, and SB-12-05 were advanced adjacent to the sanitary sewer line along the western property boundary to investigate the sewer line backfill as potential preferential pathway. An IDEM representative was on-site to observe the advancement of these three soil borings. The soil borings were advanced to depths ranging from 16 feet to 20 feet below ground surface (bgs), as directed by the IDEM representative. SB-MW-009 was intended to be completed as a monitoring well; however, competent bedrock was encountered prior to the ground water table and a monitoring well was not installed at this location.

Undisturbed soil samples were collected from SB-12-02 and MW-015 for laboratory analysis of porosity, grain size, and permeability to evaluate if soil conditions are conducive to ground water remediation by chemical injection. The two undisturbed soil samples were delivered via overnight courier to TestAmerica Laboratories, Inc. located in South Burlington, Vermont.

Subsurface soil samples were collected from SB-12-02 and MW-015 to evaluate current on-site and off-site conditions. One subsurface soil sample was collected from SB-12-02 and one subsurface soil sample and one saturated soil sample were collected from MW-015 and submitted for laboratory analysis of BTEX, PAHs, and total organic carbon (TOC). The soil samples were collected using laboratory-supplied sample media and place on ice in a laboratory-provided sample cooler and delivered to Pace Analytical Services, Inc. in Indianapolis, Indiana. The laboratory analytical results of the subsurface soil and saturated soil samples are summarized in **Table 2** and the laboratory analytical reports and chain-of-custody forms are provided in **Appendix B**.

3.1.1.2 Monitoring Well Installation and Development

A total of seven monitoring wells (MW-010, MW-011, MW-012S, MW-012D, MW-013, MW-014, and MW-015) were installed as part of this investigation. All monitoring wells were completed using Schedule 40 PVC riser pipe and 0.010-inch slot PVC well screens. The wells screens at MW-010, MW-011, MW-012S, and MW-013 were completed as ten feet in length. The well screen at monitoring well MW-013 was completed at five feet in length. The well screens at monitoring wells MW-012D and MW-015 were completed at 20 feet and 15 feet in length, respectively. Longer screen lengths were used to ensure that zones of representative water from the aquifer, as well as any potential LNAPL, would be captured. A filter pack comprised of clean quartz sand of uniform grain size was placed around the well screens to a depth of no less than one foot above the screen.

Each monitoring well was developed following installation using an electric submersible pump with new low-density polyethylene tubing. The flow rate of the pump was set at a sufficient speed to remove fine-grained sediment from the well while minimizing drawdown of the water level within the well. Development continued until either turbidity stabilized at the lowest value attainable value or a maximum of ten well volumes had been removed. All development water generated was stored in Department of Transportation (DOT)-approved 55-gallon open-top steel drums staged at the Site pending off-site transportation and disposal.

Monitoring well construction logs are provided in **Appendix A**. Monitoring well and soil boring locations are provided in **Figure 5**.

3.1.1.3 Ground Water Sample Collection

Ground water samples were collected from eight of eleven new installed and existing monitoring wells (MW-006, MW-008, MW-010, MW-011, MW-12D, MW-15, MW-101, and MW-102) using low-flow sampling methods. Monitoring well MW-001 was not sampled due to the measurable presence of LNAPL. Monitoring wells MW-012S, MW-013, and MW-014 were not sampled due to the absence of ground water, which could be attributed to recent drought conditions. Monitoring well MW-12D was installed at a deeper depth, adjacent to monitoring well MW-12S as groundwater analytical information at this location was deemed critical to complete Site evaluation. The water quality meter was bypassed during purging at MW-006 to protect this instrumentation as a result of NAPL globules observed in the water column.

Water level, total depth, and LNAPL thickness were collected using an oil-water interface meter with an accuracy of 0.01 foot. The measurements were used to evaluate the direction of ground water flow and determine the presence or absence of NAPL in the monitoring wells. A list of monitoring wells, ground water measurements, and their associated elevations are summarized in **Table 3**. A figure summarizing the ground water flow within the confined weathered bedrock/gravel layer is provided as **Figure 6**.

In order to facilitate groundwater sampling, each monitoring well was purged using a QED SamplePro Portable bladder pump. All ground water samples were collected using new low-density polyethylene tubing and bladders. During the purging process, ground water elevations and water quality parameters including pH, conductivity, oxidation-reduction potential, temperature, dissolved oxygen, and turbidity were measured and recorded at three to five minute intervals. Prior to sampling, each monitoring well was purged until stabilization of field parameters was achieved. All purge water generated was stored in DOT-approved 55-gallon open-top steel drums staged at the

Site pending off-site transportation and disposal. Water quality parameters at the time of sample collection are provided in **Table 4**.

Ground water samples were collected using laboratory-provided sample media and placed on ice in laboratory-provided sample coolers immediately following collection. Samples were delivered to Pace Analytical Services, Inc. in Indianapolis, Indiana and analyzed for BTEX, PAHs, RCRA metals, total and ferrous iron, and total cyanide. Ferrous iron measurements were collected in the field, with the exception of MW-006, which was submitted for laboratory analysis of ferrous iron. A summary of sample analyses are provided in **Table 5**. A table summarizing the ground water analytical results is provided in **Table 6** and the laboratory analytical report and chain-of-custody forms are provided in **Appendix B**. A figure depicting ground water concentrations of COC greater than their applicable RISC Default Closure Levels is provided as **Figure 7**.

3.1.1.4 Hydraulic Conductivity Test

Hydraulic conductivity tests were completed at MW-010. A pressure transducer was lowered to the base of the well screen and was used to continually measure water pressure and the corresponding water level in the well. A solid cylinder plastic slug was used to displace the water within the well during each of the tests. A falling head test was conducted by inserting the slug in the water column and measuring the water level as it falls to a static level. A rising head test was conducted by removing the slug from the water column and measuring the water level as it rises to a static level. The results of the falling head and rising head hydraulic conductivity tests are provided in **Appendix C**.

3.1.1.5 Transmissivity Testing and LNAPL Characterization

LNAPL transmissivity tests were conducted at MW-001 during this investigation. Initial LNAPL thicknesses were measured using an oil-water interface meter. Following measurement, LNAPL was removed from the well using a peristaltic pump until all LNAPL was removed from the water column and filter pack and the recovering LNAPL thickness was measured and recorded at specified intervals to determine the recovery rate.

Following removal, a sample of the purged LNAPL was collected and submitted to Torkelson Geochemistry, Inc. in Tulsa, OK for density, viscosity, and fingerprinting analysis in an effort to characterize and verify the LNAPL source.

3.2 Results

3.2.1 Field Observations

Visual and olfactory observations and PID headspace readings of the cores retrieved from the soil borings and monitoring wells indicated the presence of residual MGP material at the base of the fill and within the clay/silt layer to the west of the Site. Visual and olfactory observations and PID headspace readings of saturated soil impacts were evident in the monitoring wells completed adjacent to the northwest corner of the Site (MW-012S, MW-012D, and MW-015). One subsurface soil and one saturated soil sample was collected from MW-015 to delineate the extent of their respective impacts, the results of which were used in the calculations for remedial options.

The monitoring wells and soil borings completed to the north and northwest of the Site (SB-MW-009, MW-010, and MW-013) did not display evidence of subsurface soil or saturated soil impacts. In addition, the laboratory analytical results of the ground water samples collected during this investigation indicate that dissolved-phase impacts in the weathered bedrock/gravel confined aquifer are limited to the west of the Site. During the August 2012 ground water sampling, it was discovered that three of the monitoring wells (MW-012S, MW-013, and MW-014) did not contain water, which could be attributed to the recent drought conditions.

A summary of subsurface matrix conditions is presented below:

- **Surface soil:** The upper six inches of soil, light olive green to dark brown or black, moist organic rich loam. Non-fill surface soil was encountered only in the northern portion of the Site.

- **Surficial fill and debris:** Loam, with varying amounts of sand, gravel, and debris that includes brick, coal, cinders, and concrete. The fill unit ranges in thickness from one foot to eighteen feet and reaches its maximum thickness in the southeastern corner of the site (near the former building basement).

- **Clay:** Relatively thick, moist green-gray clay unit with up to 20% limestone fragments. The unit ranges in thickness from 4.5 feet to greater than 22.8 feet and overlies a bedrock and/or gravel layer at a depth between approximately 13 and 26.5 feet bgs.

- **Weathered bedrock & gravel:** Weathered limestone containing up to 50% gravel ranging from 13 to 26.5 feet bgs. This unit is saturated and believed to represent the true groundwater table beneath the site.

Geologic cross-sections of the Site and their respective locations are provided in **Figure 8** and **Figure 9**. The water table has been observed at depths ranging from approximately 13.5 to 21 feet bgs. Static ground water measurements from the August 2012 ground water sampling are summarized in **Table 3**. A potentiometric surface map of these data is provided as **Figure 6**.

The intent of the Remedial Efforts to Define a Plume was to delineate the extent of the dissolved-phase plume; however, during the course of activities, it was determined that additional data was required in the area immediately downgradient of MW-001. Monitoring wells MW-012D and MW-015 were installed and sampled subsequent to the initial ground water sampling activities to determine the concentration of COC downgradient from MW-001 and to determine if the LNAPL that is present in MW-001 is mobile beyond that point.

3.2.2 Laboratory Analytical Results

The laboratory analytical results for the subsurface soil and saturated soil samples collected during this investigation are summarized in tabular form in **Table 2**. The laboratory analytical results for the ground water samples collected during this investigation are summarized in tabular form in **Table 6**. The laboratory analytical reports and chain-of-custody forms are provided in **Appendix B**.

3.2.2.1 Subsurface Soil

A brief summary of the laboratory analytical results of the subsurface soil samples are provided below:

- Benzene was detected at a concentration greater than the RISC Residential Default Closure Level (RDCL) at MW-015.

- Benzene was detected at a concentration greater than the RISC Industrial Default Closure Level (IDCL) at SB-12-02. Additionally, ethylbenzene was detected at a concentration greater than the RISC RDCL but less than the IDCL.

- Benzo(a)pyrene was detected at a concentration greater than the RISC IDCL at MW-015. Naphthalene was also detected at a concentration greater than the RISC RDCL but less than the IDCL.

- Benzo(a)pyrene and dibenzo(a,h)anthracene were detected at concentrations greater than their respective RISC IDCL at SB-12-02. Four additional PAH constituents, including naphthalene, were detected at concentrations greater than their respective RISC RDCL but less than their respective IDCL.

3.2.2.2 Saturated Soil

A brief summary of the laboratory analytical results of the single saturated soil sample collected from boring MW-015 during this investigation is provided below:

- Benzene was detected at a concentration greater than the RISC IDCL.

- Benzo(a)pyrene and naphthalene were detected at concentrations greater than their respective RISC RDCL but less than their respective IDCL.

3.2.2.3 Ground Water

A brief summary of the laboratory analytical results of the ground water samples are provided below:

- Benzene was detected at a concentration greater than the RISC IDCL at MW-006 and MW-012D. Benzene was detected at a concentration greater than the RISC RDCL but less than the IDCL at MW-015. Ethylbenzene was also detected at a concentration greater than the RISC RDCL but less than the IDCL at MW-006.

- Benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene were detected at concentrations greater than the RISC IDCL at monitoring wells MW-006, MW-012D, and MW-015. One or more PAH constituent, including naphthalene, were detected at concentrations greater than their respective RISC RDCL but less than their respective IDCL at monitoring wells MW-006, MW-011 (and the duplicate), MW-012D, and MW-015.

- Total cyanide was detected at a concentration greater than the RISC IDCL at MW-006. Total cyanide was detected at a concentration greater than the RISC RDCL but less than the IDCL at MW-015.

3.2.2.4 LNAPL Transmissivity Testing and Fingerprinting Results

The transmissivity test was conducted on August 16, 2012. The test was conducted for six hours and measurable product was not detected until two hours into the test. The results of this test demonstrated that the LNAPL is not of the typical "floating lens" model, based upon the very slow recharge time. It appears that the LNAPL is being forced down the hillside through the weathered bedrock/gravel aquifer by hydraulic pressure and is slowly gravitating towards the well screen and bubbling up to the top of the water column, a model similar in nature to that of an oil-water separator. The source of the LNAPL appears to be the previously-identified on-site MGP source areas. It is anticipated that the flow and accumulation of LNAPL in monitoring well MW-001 will cease as a result of the source removal activities completed under the approved Removal Action Work Plan (AECOM, 2011).

As noted above, a sample of the purged LNAPL was collected and submitted to Torkelson Geochemistry, Inc. in Tulsa, OK for density, viscosity, and fingerprinting analysis. The laboratory fingerprinting analysis indicated that the likely source of this material is weathered coal tar liquids. The density of the LNAPL was reported to be 0.9914 gram per milliliter (g/mL) and the viscosity was reported to be 28.5 centipoise. The complete Torkelson Geochemistry Report is included in **Appendix B**.

4.0 Sources of Contamination

The conceptual model for the Site (AECOM, 2011) indicates that contamination is present in affected media as a result of the following:

- Past releases of MGP residuals to subsurface media from former MGP process structures including tar wells, gas holders and associated piping; and,
- Use and placement of fill, presumably for Site grading purposes and from residual construction debris resulting from the downtown explosion in 1968.

The previous CSM has been updated with the following information in order to develop the Site remedial program included in this RAWP.

4.1 Extent of Contamination

Investigations completed to date include screening and collection and analysis of surface soil, subsurface soil, and ground to delineate the nature and extent of MGP impacts. Given that the Site will be developed as part of a recreational area by the City of Richmond, the results of soil and ground water samples collected from on-site locations have been compared to Closure Levels established in the RISC Policy as follows:

- Surface soil data have been compared to Recreational Nondefault Closure Levels (RNCLs) and Construction Worker Direct Contact Closure Levels (CWDCs);
- Subsurface soil data have been compared to Residential and Industrial Migration to Ground Water (R-MTGW and I-MTGW, respectively) and CWDC Closure Levels; and,
- Ground water data have been compared to the Ground Water Residential and Industrial Default Closure Levels (GW-RDCLs and GW-IDCLs, respectively)

As noted above, it is anticipated that the 2012 MGP source removal activities will significantly reduce the LNAPL accumulation in monitoring well MW-001, therefore, direct LNAPL remediation, other than periodic monitoring and removal (if necessary) is not included in this RAWP.

4.1.1 Surface Soil

As noted above, the appropriate RISC closure levels for on-site and off-site surface soil are RNCLs and CWDCs. A summary of the historical surface soil analytical data at the Site is summarized in **Table 7**. This information is also included in the approved 2011 Removal Action Work Plan.

Concentrations of COC reported in surface soil samples collected were all below CWDCs. Concentrations of BTEX and cyanide were below RNCLs. The results of the surface soil samples indicate that concentrations of one or more PAH compound(s) and one or more metal compound(s) were reported above RNCLs in 33 samples (and 3 duplicates). **Figure 10** shows the locations of samples with detected concentrations of one or more COC reported above RNCLs. A summary of the PAH and metal compounds detected during previous investigations and a range of reported concentrations is provided below.

- Benzo(a)anthracene: Concentrations ranged from below detection limits to 60 mg/kg in the sample collected from TS-SS-09.

- Benzo(a)pyrene: Concentrations ranged from below detection limits to 43 mg/kg in the sample collected from TS-SS-09.

- Benzo(b)fluoranthene: Concentrations ranged from below detection limits to 30 mg/kg in the sample collected from TS-SS-09.

- Dibenzo(a,h)anthracene: Concentrations ranged from below detection limits to 13 mg/kg in the sample collected from TS-SS-09.

- Indeno(1,2,3-cd)pyrene: Concentrations ranged from below detection limits to 25 mg/kg in the sample collected from TS-SS-15.

- Arsenic: Concentrations ranged from 2.9 mg/kg in the sample collected from TS-SS-9 (0.5-1') to 28 mg/kg in the sample collected from TS-SS-15 (0-0.5')

- Lead: Concentrations ranged from 8.2 mg/kg in the sample collected from TS-SS-10 to 600 mg/kg in the sample collected from TS-SS-15.

The results from the surface soil samples demonstrate that the Site is delineated to CWDCs for all COC. The Site is delineated to RNCLs for volatile organic constituents (VOCs) associated with MGP residuals and cyanide. PAH exceedances of RNCLs in surface soil were observed to be widespread throughout the Site. Arsenic exceedances of RNCLs in surface soil were observed in the northwest and southern sections of the site. Surface soil is evaluated further in Section 2.4 of the Removal Action Work Plan (AECOM, 2011).

4.1.2 Subsurface Soil

As noted above, the appropriate RISC closure levels for on-site soils are R-MTGW, I-MTGW and CWDC. A summary of subsurface soil analytical data is summarized in **Table 8**.

The results from the subsurface soil samples from on-site locations indicate that detected concentrations of BTEX, one or more PAH compounds, arsenic, lead and total cyanide were reported above closure levels in 23 samples (and 3 duplicates). **Figure 11** shows the locations of samples with detected concentrations of one or more COC reported above R-MTGW, I-MTGW and CWDC closure levels.

The results from the subsurface soil samples demonstrate that conditions are generally delineated to CWDCs. PAH exceedances of CWDC closure levels were observed in the northeast portion of the Site. Lead exceedances of CWDC closure levels were observed in the southeast portion of the site (near the old building basement). BTEX and multiple PAH exceedances of R-MTGW and I-MTGW closure levels were observed to be widespread throughout the Site in subsurface soil and have not been fully delineated. Similar to surface soils, subsurface soil is evaluated further in Section 2.4 of the Removal Action Work Plan (AECOM, 2011).

4.1.3 Ground Water

A summary of historic ground water analytical data is provided in **Table 9** including the results from this investigation. Ground water sampling locations containing COC in excess of RISC Closure Levels during past investigation activities are shown on **Figure 12**. Analytical results from the multiple ground water sampling events demonstrate that BTEX, several PAHs, arsenic and cyanide both on-site and downgradient off-site exceed GW-RDCLs and GW-IDCLs. The extent of off-site COC-impacted ground water is presented in **Figure 13**.

4.2 Risk Assessment

Investigation and characterization of the nature and extent of COC associated with former MGP operations at the Site has been conducted in accordance with the RISC Technical Resource Guidance Document (Technical Guide). It is apparent from this assessment that the risks associated with residual COC include recreational and worker exposure to impacted surface and subsurface soils at the Site as well as exposure of the East Fork of the White River to impacted ground water identified to the west of the Site. Section 5.0 includes an analysis of remedial alternatives to address these COC.

5.0 Analysis of Remedial Alternatives

This Analysis of Remedial Alternatives (ARA) presents five remedial alternatives considered to address affected ground water migrating to the west of the Site. An Analysis of Brownfields Cleanup Alternatives (ABCA) to address impacted Site soil was recently completed for IDEM and the United States Environmental Protection Agency (U.S. EPA) to support the source removal activities under the approved Removal Action Work Plan (AECOM, 2011). The ABCA includes institutional controls to protect recreational users of the Site in addition to source removal activities. A copy of the ABCA is included in **Appendix D**. The recommended remedial alternative will be implemented to address affected ground water and will complement the source removal activities summarized in the ABCA and the approved Removal Action Work Plan (AECOM, 2011).

5.1 Analysis of Alternatives

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

- Alternative One – Monitored Natural Attenuation
- Alternative Two – Ground Water Pumping and Treatment
- Alternative Three – In-Situ Chemical Oxidation Injection
- Alternative Four – In-Situ Biodegradation Injection
- Alternative Five – 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.

5.2 Ground Water Alternative Analysis

5.2.1 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.

5.2.2 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 highest cost 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. Capital and O&M costs included .

5.2.3 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). All capital costs, no O&M costs.

5.2.4 Alternative 4 – In-Situ Biodegradation Injection

Injecting 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). All capital costs, no O&M costs.

5.2.5 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 ($72000). All capital costs, no O&M costs.

5.2.6 Ground Water Recommendation

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), Alternative 4 (In-Situ Biodegradation Injection) and Alternative 5 (Site Capping). This combination will reduce and destroy COC mass immediately through chemical oxidation, allow for continued long-term reduction of COC through biodegradation, 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.

6.0 Remedial Action Plan

6.1 Description of Removal Action

The selected remedial action program for this Site involves two activities, Site capping and in-situ ground water remediation, in addition to the source removal and institutional controls being implemented under the source removal program (AECOM, 2011). The purpose of the site capping will be to prevent contact of COC-impacted soil with construction workers and recreational users and to prevent infiltration and contact of precipitation with COC impacted soil. The purpose of the in-situ ground water remediation will be to reduce COC concentrations and destroy COC mass in impacted ground water to the west of the Site and protect the East Fork of the Whitewater River from COC impacts.

This remedial program is predicated on successful completion of the COC source removal program currently under way at the Site. Successful source removal is anticipated to eliminate the on-site source of LNAPL as well as significantly reduce the on-site mobile COC which could impact ground water to the west of the Site in the downgradient flow direction toward the East Fork of the Whitewater River. In addition, institutional controls will be implemented to limit future land use and provide proscriptive measures for future construction workers should they encounter residuals while conduction improvements to the property.

6.2 Site Capping

6.2.1 Site Preparation

It is anticipated that much of the Site preparation will be completed as part of the ongoing source removal activities at the Site. These activities include clearing and grubbing of vegetation over the COC-impacted areas of the site. It is possible that a limited amount of vegetation may require removal from the slope along the western edge of the property. If required, these clearing and grubbing activities will be completed with excavation equipment mobilized to the Site for cap placement activities. Cleared and grubbed vegetation will be chipped and mulched on-site using a trailer-mounted chipping machine. All mulched material will be stockpiled on-site to await use as cap cover in areas that do not require seeding.

Site preparation activities will also include any remaining Site grading that was not completed during source removal activities. Generally, the anticipated slope is a 3:1 grade downslope to the western edge of the site. Any Site grade that does not meet this slope requirement will be made to do so prior to capping activities utilizing the hydraulic equipment mobilized to the Site for cap installation.

One exception to the 3:1 grade requirement will be the base of the access road to be installed by the City of Richmond across the Site. The grade of this roadway will be provided by the City prior to mobilization and this roadway requirement will be incorporated into the Site grading plan.

6.2.2 Cap Installation

Once the Site has been graded, cap installation activities will be initiated. The general outline of the anticipated cap is included on **Figure 14**. Prior to approval for use, a sample of the proposed clay cap material will be collected from a local source of choice, delivered to an environmental/ geotechnical laboratory and analyzed for concentrations of COC (BTEX and PAHs) as well as proctor testing to ensure adequate compaction qualities of the clay. Assuming that the selected clay material does not contain detectable concentrations of COC and possesses adequate compaction characteristics, this material will be approved for use as the cap for the Site.

Following approval, clay fill will be transported to the Site from the selected local source by dump trucks. This material will be unloaded and spread across the Site with a track-mounted hydraulic excavator and front-end loader. Depending upon the compaction characteristics of the proctor analysis, approximately 4,600 tons of clay will be spread across the Site to a thickness of approximately 24 inches, with the exception of the area of the proposed City roadway. This clay cap material will then be compacted to 95% of the proctor value determined from geotechnical laboratory testing to a compacted thickness of 18 inches.

The uncapped area designated for the roadway will be backfilled using base material to be specified by the City of Richmond.

6.3 Site Restoration

Site restoration will commence following the completion of capping activities. Approximately 1,500 tons of topsoil will be placed over the compacted clay. The newly placed topsoil will be hydro-seeded to facilitate growth of grass. Any areas of the Site not capped and/or seeded will be covered with the stockpiled mulch material. The proposed City roadway across the Site will be completed with asphalt surface tied into the clay cap. The completion of the roadway will mark the completion of the Site capping activities.

6.4 Ground Water Remediation

As noted above, the selected remedial approach to address COC-impacted ground water to the west of the Site is a combination of in-situ chemical oxidation and biodegradation injections. Due to cost and reactivity considerations, chemical oxidation agents provided by Regenesis of San Clemente, California have been selected for this project in lieu of other conventional agents such as Fenton's reagent and high-concentration hydrogen peroxide. A brief summary of the selected Regenesis agents is presented below followed by injection and progress monitoring procedures.

The Regenesis agent RegenOx© is proposed to rapidly and effectively destroy COC within the saturated zone west of the Site. RegenOx© produces a cascade of oxidation reactions via a number of mechanisms including: surface mediated oxidation, direct oxidation, and free radical oxidation. COC reduction will be the result of the powerful desorption-surfactant like effect of RegenOx© (principally the catalyst) that draws the contaminant off of the soil surface and into the solution. The contaminant then reaches the catalytic surface where localized free-radical generation occurs leading to focused and efficient contaminant destruction. These reactions can be propagated in the presence of RegenOx© for periods of up to 30 days following a single injection.

RegenOx© produces minimal heat and is highly compatible with supplemental enhanced biodegradation application. Additionally RegenOx© is a powerful and relatively safe chemical oxidant that is safe for use in direct contact with underground utilities/infrastructure as it is non-corrosive and produces very low amounts of heat and pressure.

RegenOx© application will produce oxygen as a result of its reactions providing an advantageous and seamless transition from in-situ chemical oxidation to enhanced aerobic biodegradation by Oxygen Release Compound (ORC®) application. ORC is a formulation of intercalated magnesium peroxide that, when hydrated, will produce a controlled release of oxygen. ORC® supplies controlled-release molecular oxygen to the subsurface environment where it will accelerate the rate of naturally occurring aerobic contaminant biodegradation in ground water and saturated soils for periods of up to 12 months beyond a single application.

6.4.1 Injection Procedure

RegenOx© and ORC® application will destroy and reduce significant quantities of COC from the subsurface (both soil and ground water) and will be applied using direct-injection techniques. Three (3) injection events are planned for this remedial program, spaced at 120 day intervals. The initial two injection events will include the application of RegenOx© only. For the third injection event, ORC® will be mixed with Regenox©. In each case, these materials will be mixed with water to form an injectable slurry which will then be pressure injected into the zone of contamination. Once in the aquifer, ORC© particles can sorb to and/or reside in the soil matrix and produce a controlled-release of oxygen for periods of up to 12 months beyond a single application.

The area of concern for the injections is located to the west of the northwest corner of the Site, as shown in **Figure 15**. Approximately 180 injection points will be advanced on 10 foot centers within the treatment area from 18 feet bgs to 23 feet bgs, as determined by previous Site investigations.

During each of the first two injection events, 11,300 pounds (lbs.) of RegenOx© will be injected at the 180 points in the impacted area. The Regenox© will be delivered to the Site in powder form in 28 drums, each containing 400 lbs of RegenOx©. Approximately 670 lbs of Regenox will be mixed with water in 1,000 gallon batches in an appropriately-sized mixing tank. At the required injection volume of 94 gallons per point, this will provide sufficient slurry for injection into 10 points. The injection will be completed using a high pressure pump and direct push drilling equipment. It is anticipated that this mixing process will be completed twice per day and that 20 injections will be completed each work day. As a result, it is anticipated that each of the first two RegenOx© events will be completed in 10 work days, which includes one day for equipment mobilization and setup.

During the third injection event, 11,300 lbs of RegenOx© and 6,750 lbs of ORC© will be injected amongst the 180 points within the impacted area. The ORC© will be delivered to the Site in powder form in 27 fiber drums, each containing 250 lbs of ORC©. Approximately 350 lbs of ORC © will be mixed with 670 lbs of RegenOx© and water in batches of 1,000 gallons in an appropriately-sized mixing tank. At the same required injection volume of 94 gallons per point, this will provide sufficient slurry for 20 injections per work day and an anticipated completion of this third event in 10 work days, including one day for mobilization.

The direct push equipment and high pressure pump will be decontaminated prior to initiating field activities, at the completion of each work day, and immediately following the completion of each injection event using a high-pressure spray to remove contaminants and residual injection slurry. Decontamination rinsate water will be collected in DOT-approved 55-gallon open-top steel drums staged at the Site to await characterization and disposal. All field activities are anticipated to be completed using Level D personal protective equipment as specified in the attached Site-specific Health and Safety Plan (HASP) (see **Appendix E**).

6.4.2 Progress Monitoring

In order to monitor the remedial progress and reduction in COC mass, a ground water monitoring program will be part of the Site remedial activities. As noted above, the injection events will be spaced at 120 day intervals to allow for RegenOx© and ORC© curing time and to accomodate quarterly ground water monitoring during the injection program. A detailed description of Site ground water monitoring procedures and analytical requirements is included in Section 7.0.

The first ground water monitoring event will take place immediately prior to the initial injection event. Laboratory analytical data generated during this monitoring event will be used as a baseline for comparison of remedial effectiveness and progress. The second ground water monitoring event will take place approximately 90 days following the completion of the initial injection event. Laboratory analytical data from this monitoring event will be compared to the baseline levels to determine the reduction in COC from the initial injection event. A third and fourth groundwater monitoring event will take place approximately 90 days after the completion of the second and third injection events, respectively.

Assuming that progressive COC reduction is documented during these 4 ground water monitoring events, these events will be considered the initial 4 of the required eight (8) ground water monitoring events required to secure Site closure.

7.0 Monitoring and Sampling Plan

As noted above, ground water samples will be collected quarterly for eight quarters to document reduced concentrations of COC and to demonstrate mass contaminant reduction at the Site. Assuming that the in-situ chemical oxidation and biodegradation injection program is successful in progressively reducing COC concentrations in the ground water, the 4 monitoring events associated with the injection program will constitute the initial 4 of the required 8 ground water monitoring events required to secure Site closure. The following sections describe the ground water sampling activities and procedures to be completed during the quarterly sampling events.

7.1 Quarterly Ground Water Sampling

During each quarterly ground water sampling event, all monitoring wells within the Site network will be purged and sampled using low flow methods. Water level measurements will also be recorded to calculate the volume of water present, assess accumulation of fine-grained sediments, and evaluate the direction of ground water flow.

7.1.1 Sampling Procedures

Water level measurements will be measured with an oil-water interface meter with an accuracy of 0.01 foot. The ground water will be purged using a submersible pump capable of low flow methods. Additionally, new low-density polyethylene tubing and conducted at a flow rate sufficient to remove fine-grained sediment from the well while minimizing drawdown of the water level within the well. During the purging process, ground water elevations and physical parameters including pH, conductivity, oxidation-reduction potential, temperature, dissolved oxygen, and turbidity will be measured and recorded until stabilization of all parameters has been achieved. Stabilization will be considered achieved when consecutive readings of all physical parameters are within 10%.

Once stabilization has occurred, ground water samples will be collected using laboratory-supplied sample media and submitted to an off-site laboratory for analysis. Purge water generated during each sampling event will be stored in DOT-approved 55-gallon open top steel drums staged at the Site pending disposal. If free product is detected in any monitoring well, it will be removed using a peristaltic pump or disposable polyethylene bailer and placed in a DOT-approved 55-gallon open-top steel drum staged at the Site pending disposal.

7.1.2 Decontamination

Decontamination of all non-disposable ground water sampling equipment will occur following sample collection at each monitoring well using a phosphate-free detergent wash and a distilled water rinse. Decontamination water generated during each sampling event will be stored in DOT-approved 55-gallon open top steel drums staged at the Site pending disposal.

7.1.3 Sample Shipment and Analysis

Samples will be placed in laboratory-supplied sample coolers containing ice and delivered under standard chain-of-custody procedures to Pace Analytical Services, Inc. located in Indianapolis, Indiana for analysis of BTEX, PAHs, RCRA metals, total iron, and total and WAD cyanide. Ferrous iron concentrations will be measured immediately following sample collection using a Hach® ferrous iron test kit.

7.1.4 Data Management

Field personnel will adhere to the safety protocols outlined in the Site-specific HASP (**Appendix E**). Field observations and data will be collected in accordance with the procedures established in the Site-specific Quality Assurance Project Plan (**Appendix F**).

Brief letter reports summarizing the activities, findings, problems or potential problems, actions taken or actions needed to be taken, and laboratory analytical results will be prepared and submitted following each ground water sampling event.

8.0 Operation and Maintenance

No remediation systems are proposed in this RAWP. Therefore, no operation and/or maintenance procedures are required; however, it is recommended that monitoring well MW-001 be gauged on a monthly basis for a minimum of 3 months to ensure the absence of LNAPL accumulation following the completion of the source removal program outlined in the approved Removal Action Work Plan (AECOM, 2011).

9.0 Reporting

9.1 Completion Report

An interim completion report will be prepared following the completion of the 3 injection events and the initial 4 ground water sampling events to document the effectiveness of the injection program. The completion report will summarize the performance of the injections, the extent to which COC reduction has occurred, and the results of the associated ground water monitoring.

9.2 Progress Reports / Monitoring Reports

As noted above in Section 7.1.4, brief letter reports summarizing the activities, findings, problems or potential problems, actions taken or actions needed to be taken, and laboratory analytical results will be prepared and submitted following each ground water sampling event.

10.0 Projected Work Schedule

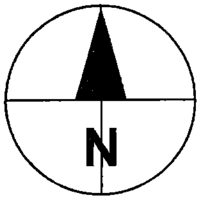
Project fieldwork is anticipated to begin in the winter of 2012/2013. Assuming that the initial monitoring and injection events occur in February 2013, the second injection event will occur in June 2013 and the third injection event will occur in October 2013. The fourth ground water sampling event will occur in September 2013. Assuming that adequate Site remediation is demonstrated by the results of the first 4 ground water sampling events and the final 4 ground water sampling events are completed approximately 90 days apart, the final ground water sampling event will be completed in September 2014. A Site Closure Report will be prepared and issued within 60 days of final receipt of analytical data (November 2014).

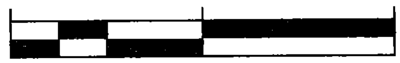
11.0 Cost Estimate

The total estimated cost to implement the activities in this RAWP is $719,000. This cost includes $262,000 for Site capping, $243,000 for three RegenOx© injection events, $72,000 for one ORC© injection event, $80,000 for 8 ground water sampling events, and $62,000 for project management and reporting.

Figures

BASE TAKEN FROM USGS RICHMOND, IND.
7.5'-SERIES TOPOGRAPHIC QUADRANGLE.
DATE 1981. SCALE 1:24,000.





1" = 2000'

FORMER MGP SITE
RICHMOND, INDIANA

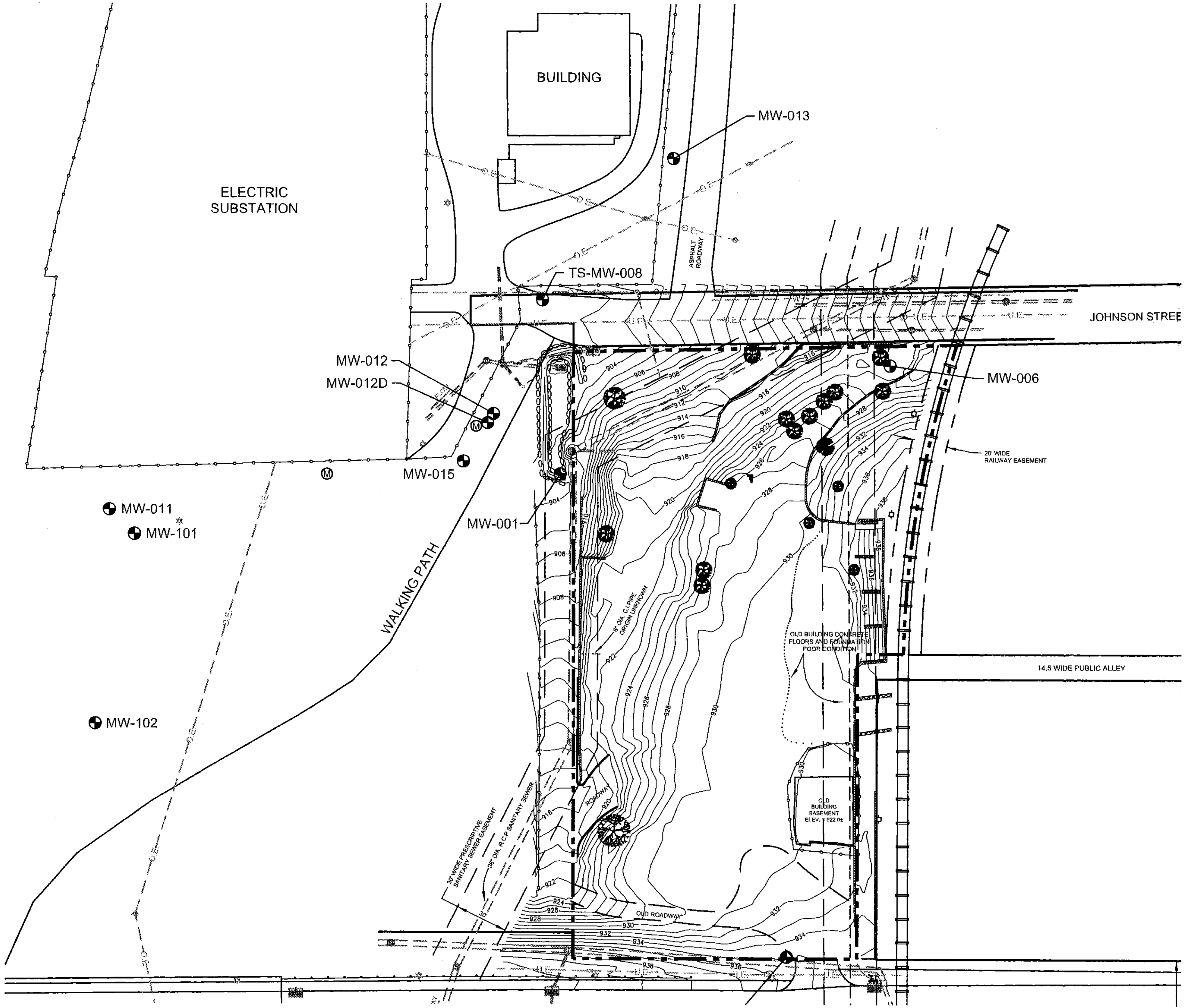
SITE LOCATION MAP

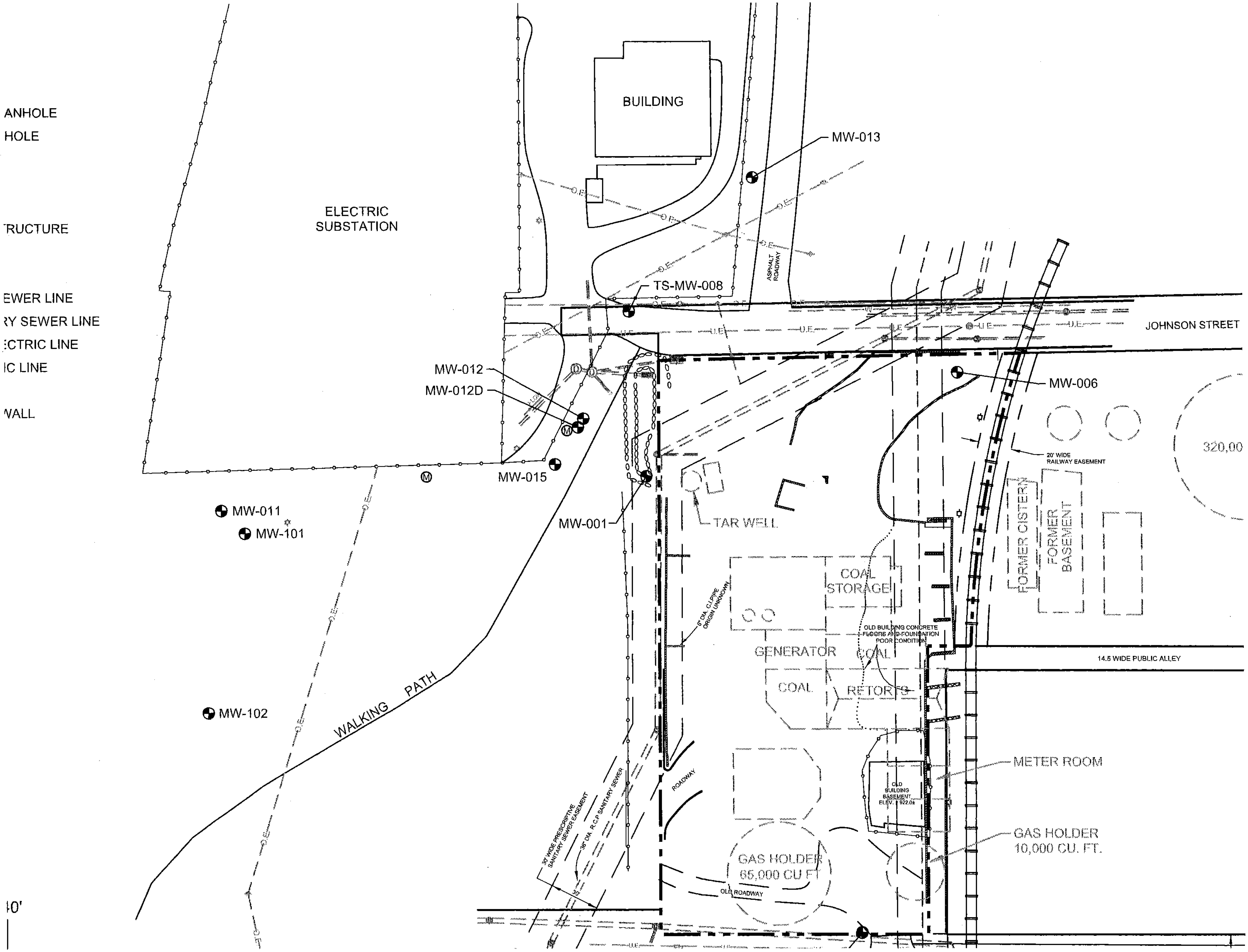
AECOM

Project No.: 60194081 Date: 2012-09-20

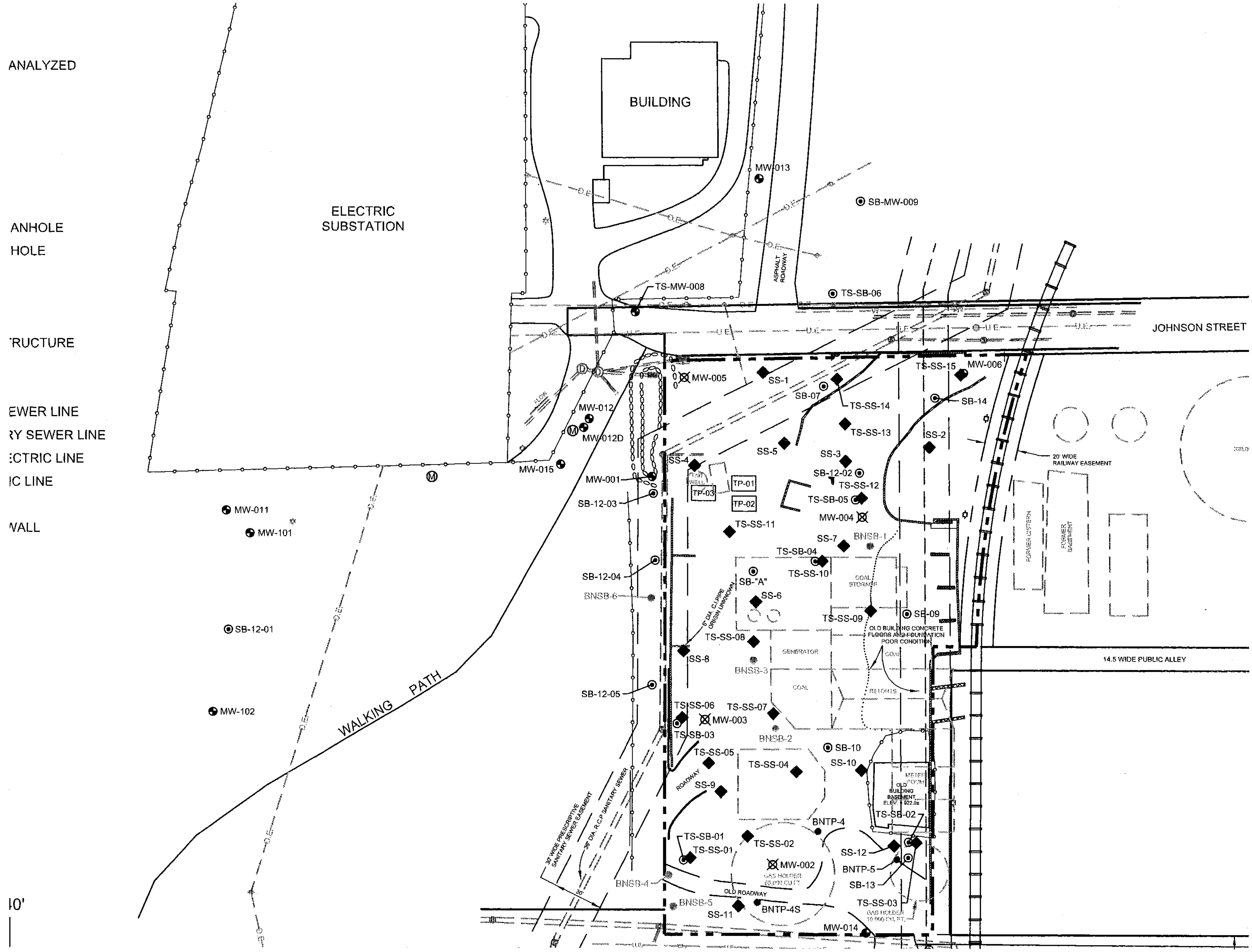
Figure: 1

ANHOLE
HOLE
DRANGLE
EWER LINE
RY SEWER LINE
ECTRIC LINE
IC LINE
WALL
10'





ANHOLE
HOLE
TRUCTURE
EWER LINE
RY SEWER LINE
ECTRIC LINE
IC LINE
WALL
40'
BUILDING
ELECTRIC
SUBSTATION
MW-013
TS-MW-008
ASPHALT ROADWAY
JOHNSON STREET
MW-012
MW-012D
MW-015
MW-001
MW-006
MW-011
MW-101
MW-102
WALKING PATH
TAR WELL
20' WIDE RAILWAY EASEMENT
320.00
FORMER CISTERN
FORMER BASEMENT
COAL STORAGE
6" DIA. C.I.PIPE ORIGIN UNKNOWN
OLD BUILDING CONCRETE FLOORS AND FOUNDATION POOR CONDITION
GENERATOR
COAL
COAL
RETORTS
14.5 WIDE PUBLIC ALLEY
ROADWAY
OLD BUILDING BASEMENT ELEV. 922.0±
METER ROOM
GAS HOLDER
10,000 CU. FT.
GAS HOLDER
65,000 CU FT
OLD ROADWAY
30' WIDE PRESCRIPTIVE SANITARY SEWER EASEMENT
36" DIA. R.C.P SANITARY SEWER
30'



ANALYZED
ANHOLE
HOLE
'RUCTURE
EWER LINE
'Y SEWER LINE
:CTRIC LINE
IC LINE
WALL
10'
BUILDING
ELECTRIC SUBSTATION
JOHNSON STREET
14.5 WIDE PUBLIC ALLEY
20' WIDE RAILWAY EASEMENT
FORMER CISTERN
FORMER EASEMENT
ASPHALT ROADWAY
WALKING PATH
30' WIDE PRESCRIPTIVE SANITARY SEWER EASEMENT
36" DIA. R.C.P SANITARY SEWER
6" DIA. C.I.PIPE ORIGIN UNKNOWN
OLD BUILDING CONCRETE FLOORS AND FOUNDATION POOR CONDITION
OLD BUILDING BASEMENT ELEV. 922.0±
METER ROOM
COAL STORAGE
GENERATOR
COAL
RETORTS
GAS HOLDER
GAS HOLDER 10,000 CU. FT.
OLD ROADWAY
ROADWAY
FLOW
MW-013
SB-MW-009
TS-MW-008
TS-SB-06
MW-005
SS-1
SB-07
TS-SS-14
TS-SS-15
MW-006
SB-14
TS-SS-13
SS-2
SS-5
SS-3
SB-12-02
TS-SS-12
TS-SB-05
MW-004
MW-012
MW-012D
MW-015
MW-001
SS-4
TP-01
TP-02
TP-03
SB-12-03
TS-SS-11
SS-7
BNSB-1
TS-SB-04
TS-SS-10
SB-"A"
SS-6
TS-SS-09
SB-09
TS-SS-08
SS-8
BNSB-3
SB-12-04
BNSB-6
SB-12-05
TS-SS-06
MW-003
TS-SB-03
TS-SS-07
BNSB-2
SB-10
SS-10
TS-SS-05
TS-SS-04
SS-9
BNTP-4
TS-SB-02
TS-SB-01
TS-SS-01
TS-SS-02
MW-002
SS-12
BNTP-5
SB-13
TS-SS-03
BNSB-4
BNSB-5
SS-11
BNTP-4S
MW-014
MW-011
MW-101
SB-12-01
MW-102

ORING WELL

EDANCES

DANCES

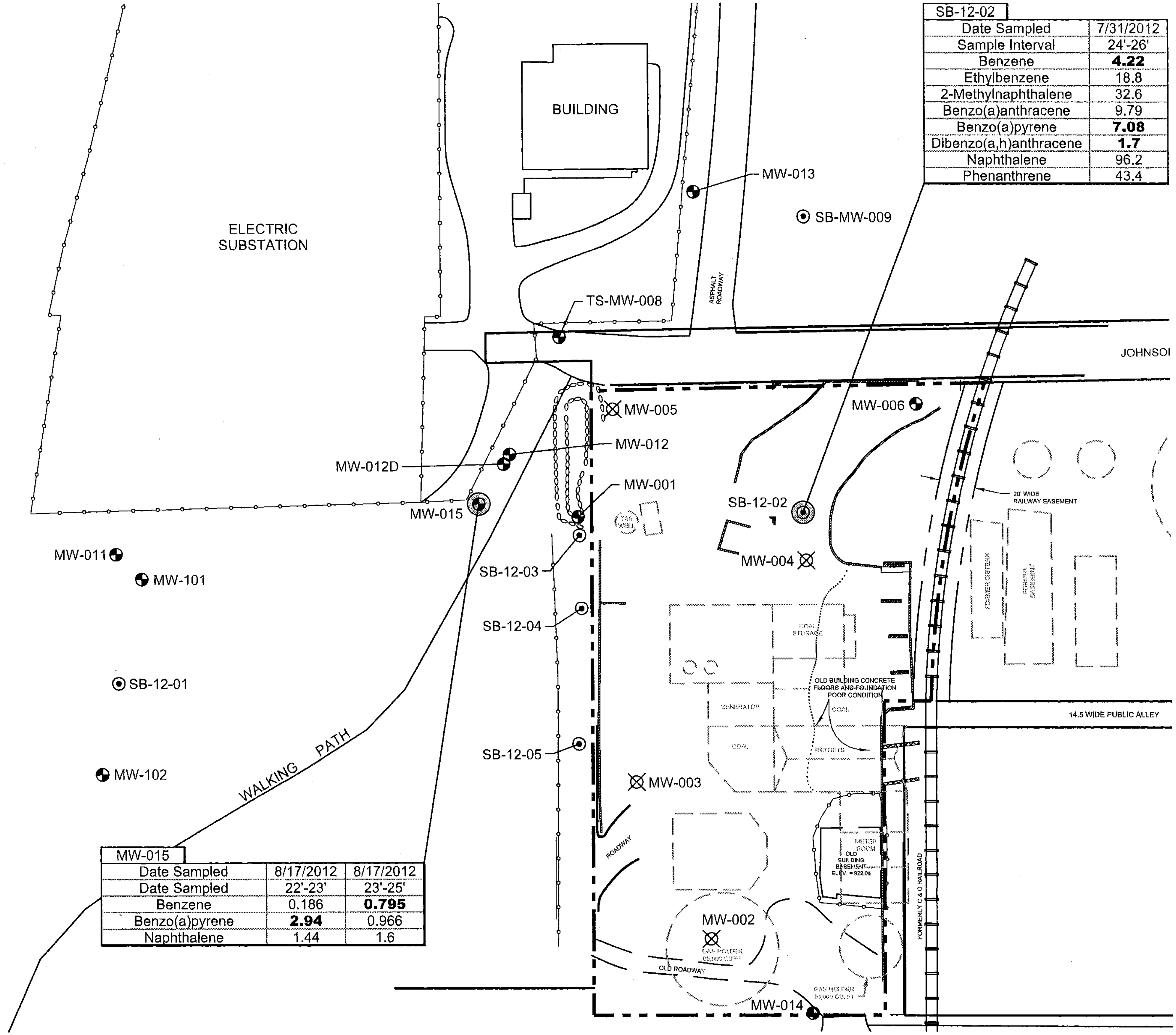
RUCTURE

WALL

al	RISC Industrial Default Closure Level
	0.35
	160
	210
	15
	1.5
	1.5
	170
	170

RED IN mg/kg.

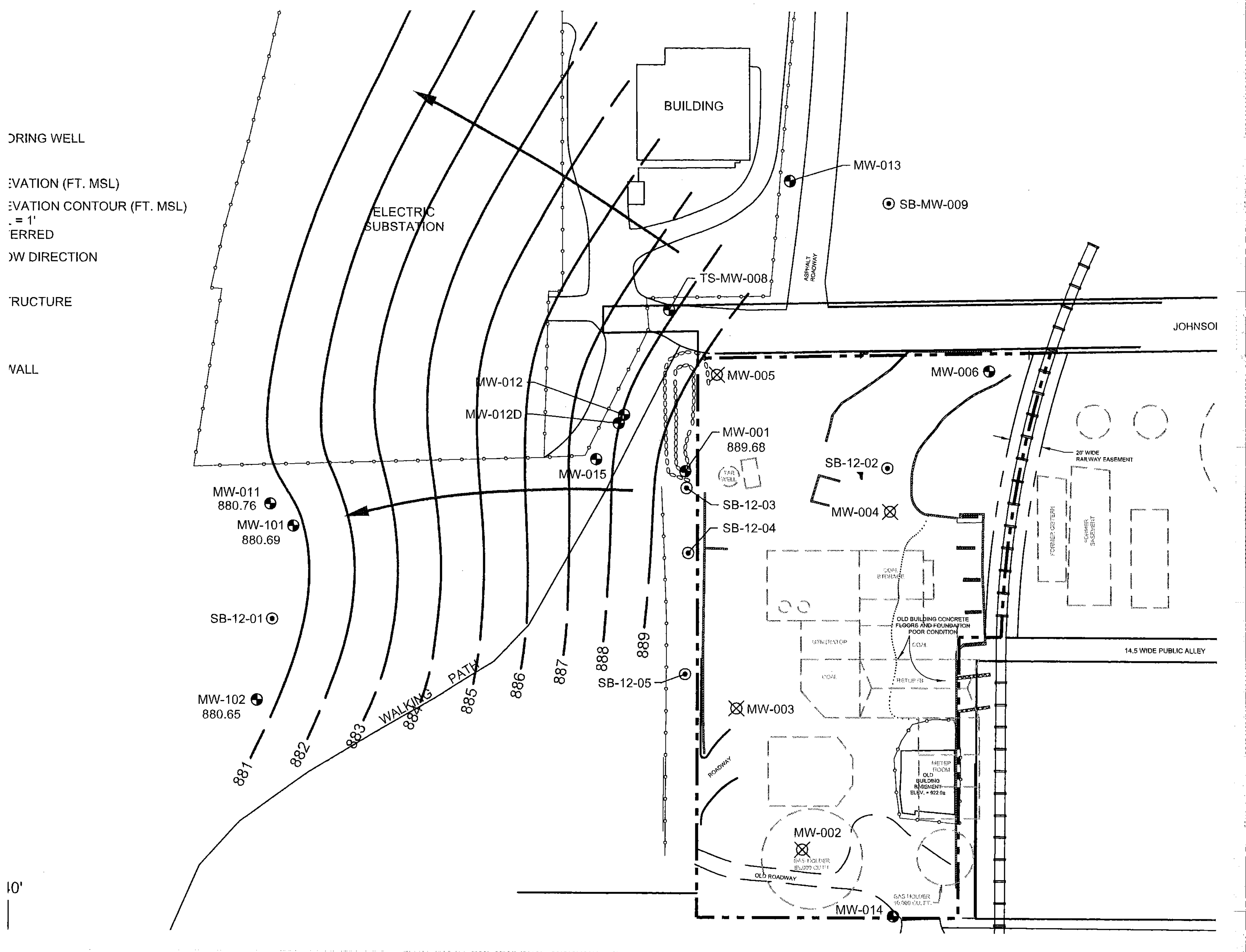
RISC INDUSTRIAL
CE.



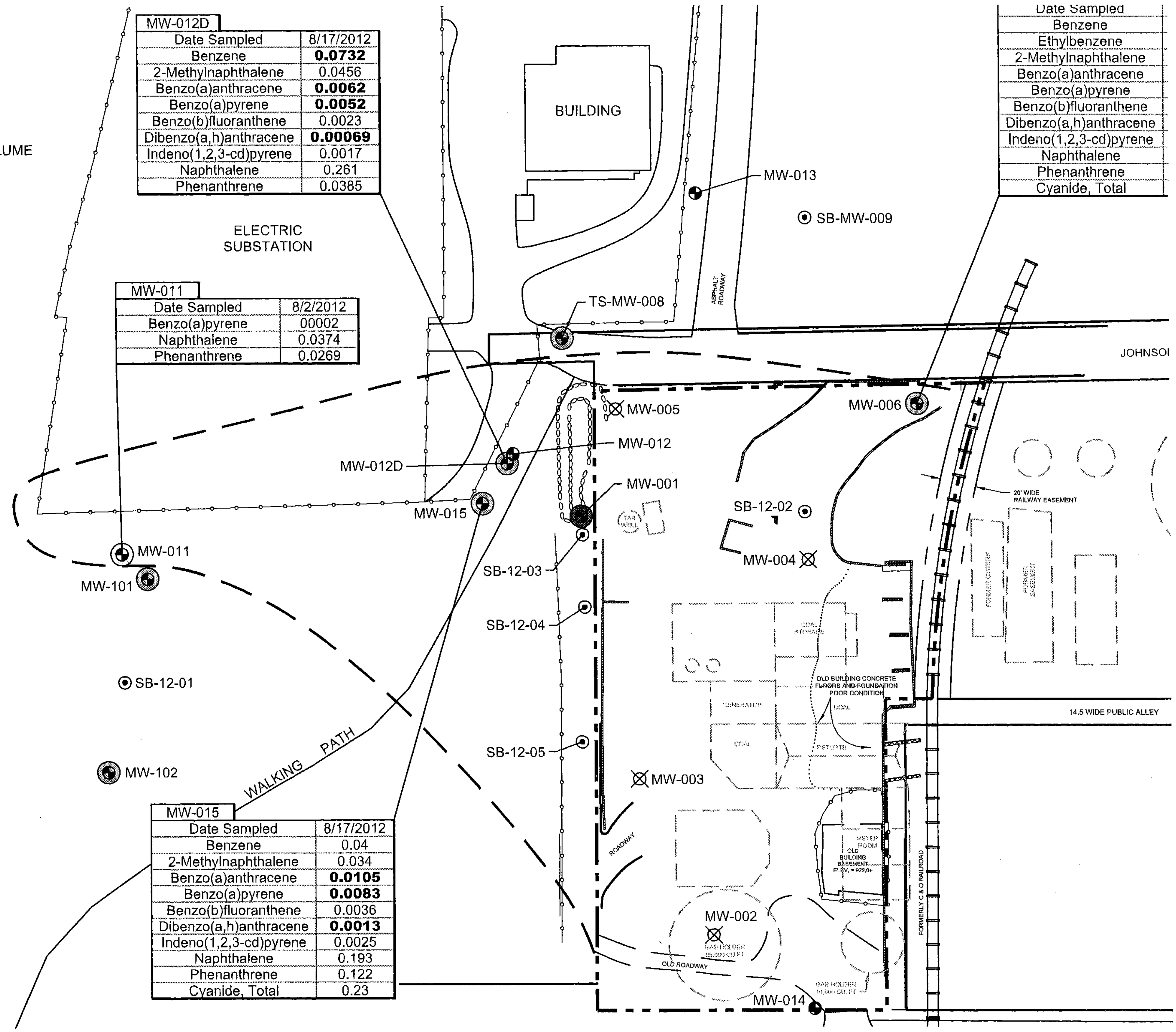
SB-12-02	
Date Sampled	7/31/2012
Sample Interval	24'-26'
Benzene	**4.22**
Ethylbenzene	18.8
2-Methylnaphthalene	32.6
Benzo(a)anthracene	9.79
Benzo(a)pyrene	**7.08**
Dibenzo(a,h)anthracene	**1.7**
Naphthalene	96.2
Phenanthrene	43.4

MW-015		
Date Sampled	8/17/2012	8/17/2012
Date Sampled	22'-23'	23'-25'
Benzene	0.186	**0.795**
Benzo(a)pyrene	**2.94**	0.966
Naphthalene	1.44	1.6

40'



ORING WELL
EVATION (FT. MSL)
EVATION CONTOUR (FT. MSL)
. = 1'
ERRED
OW DIRECTION
RUCTURE
WALL
40'
BUILDING
ELECTRIC SUBSTATION
MW-013
SB-MW-009
TS-MW-008
ASPHALT ROADWAY
JOHNSOI
MW-005
MW-006
MW-012
MW-012D
MW-015
MW-001
889.68
SB-12-02
MW-004
SB-12-03
SB-12-04
20' WIDE RAILWAY EASEMENT
OLD BUILDING CONCRETE FLOORS AND FOUNDATION POOR CONDITION
14.5 WIDE PUBLIC ALLEY
MW-011
880.76
MW-101
880.69
SB-12-01
MW-102
880.65
881
882
883
884
885
886
887
888
889
WALKING PATH
SB-12-05
MW-003
ROADWAY
MW-002
OLD ROADWAY
MW-014



MW-012D	
Date Sampled	8/17/2012
Benzene	**0.0732**
2-Methylnaphthalene	0.0456
Benzo(a)anthracene	**0.0062**
Benzo(a)pyrene	**0.0052**
Benzo(b)fluoranthene	0.0023
Dibenzo(a,h)anthracene	**0.00069**
Indeno(1,2,3-cd)pyrene	0.0017
Naphthalene	0.261
Phenanthrene	0.0385

MW-011	
Date Sampled	8/2/2012
Benzo(a)pyrene	00002
Naphthalene	0.0374
Phenanthrene	0.0269

MW-015	
Date Sampled	8/17/2012
Benzene	0.04
2-Methylnaphthalene	0.034
Benzo(a)anthracene	**0.0105**
Benzo(a)pyrene	**0.0083**
Benzo(b)fluoranthene	0.0036
Dibenzo(a,h)anthracene	**0.0013**
Indeno(1,2,3-cd)pyrene	0.0025
Naphthalene	0.193
Phenanthrene	0.122
Cyanide, Total	0.23

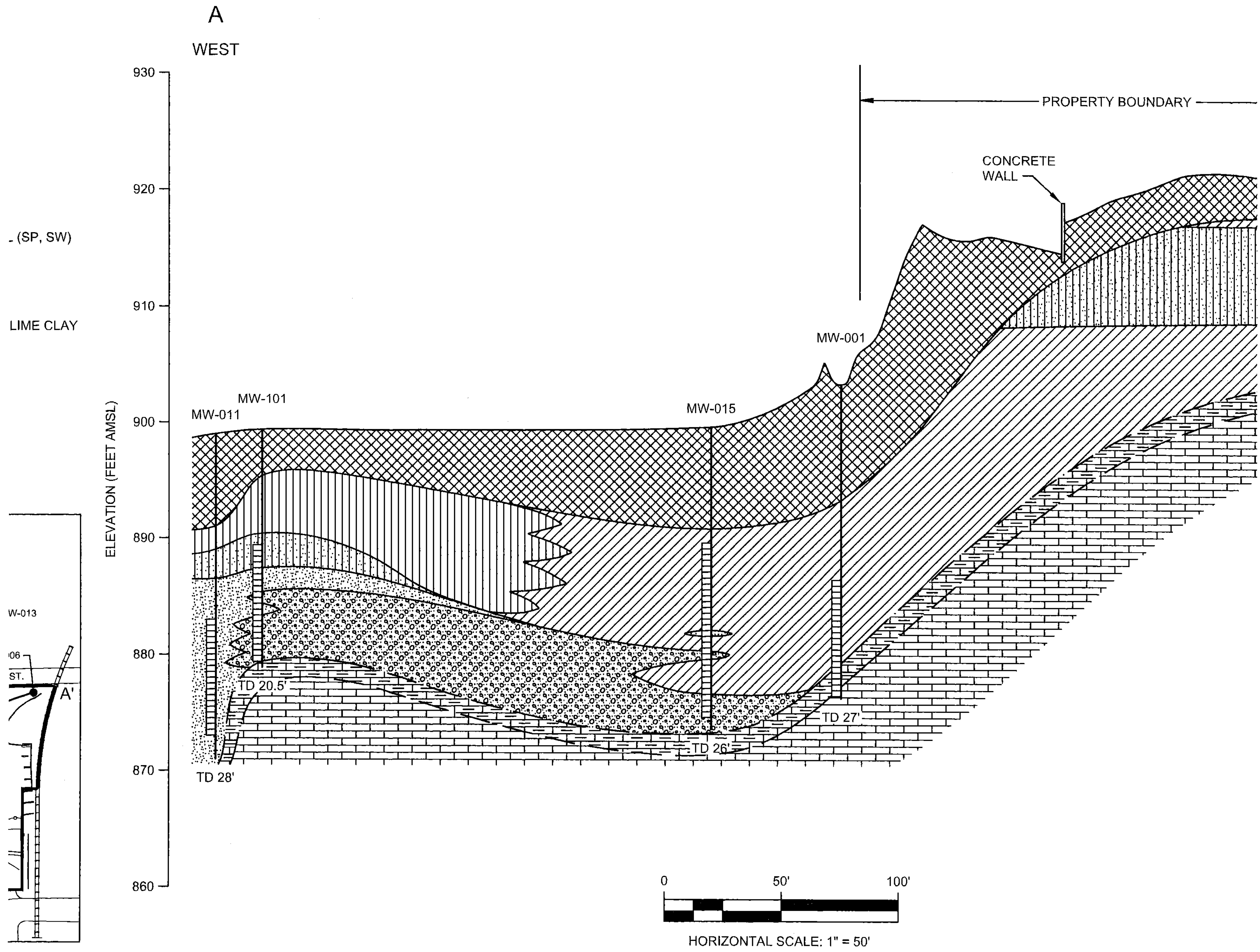
Date Sampled
Benzene
Ethylbenzene
2-Methylnaphthalene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd)pyrene
Naphthalene
Phenanthrene
Cyanide, Total

...al ...vel	RISC Industrial Default Groundwater Level
	0.052
	10
	0.41
	0.0039
	0.00039
	0.0039
	0.00039
	0.0039
	2
	0.31
	2

...EDANCES
...DANCES
...WELL
...NT OF CONTAMINANT PLUME
...RUCTURE
...WALL

...RED IN mg/L.
...RISC INDUSTRIAL
...CE.

...40'



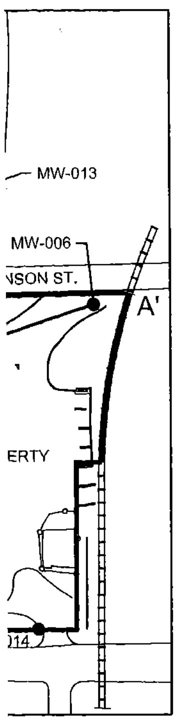
- (SP, SW)
LIME CLAY
W-013
06
ST.
A'
A
WEST
930
920
910
900
890
880
870
860
ELEVATION (FEET AMSL)
PROPERTY BOUNDARY
CONCRETE
WALL
MW-001
MW-011
MW-101
MW-015
TD 20.5'
TD 28'
TD 26'
TD 27'
0
50'
100'
HORIZONTAL SCALE: 1" = 50'

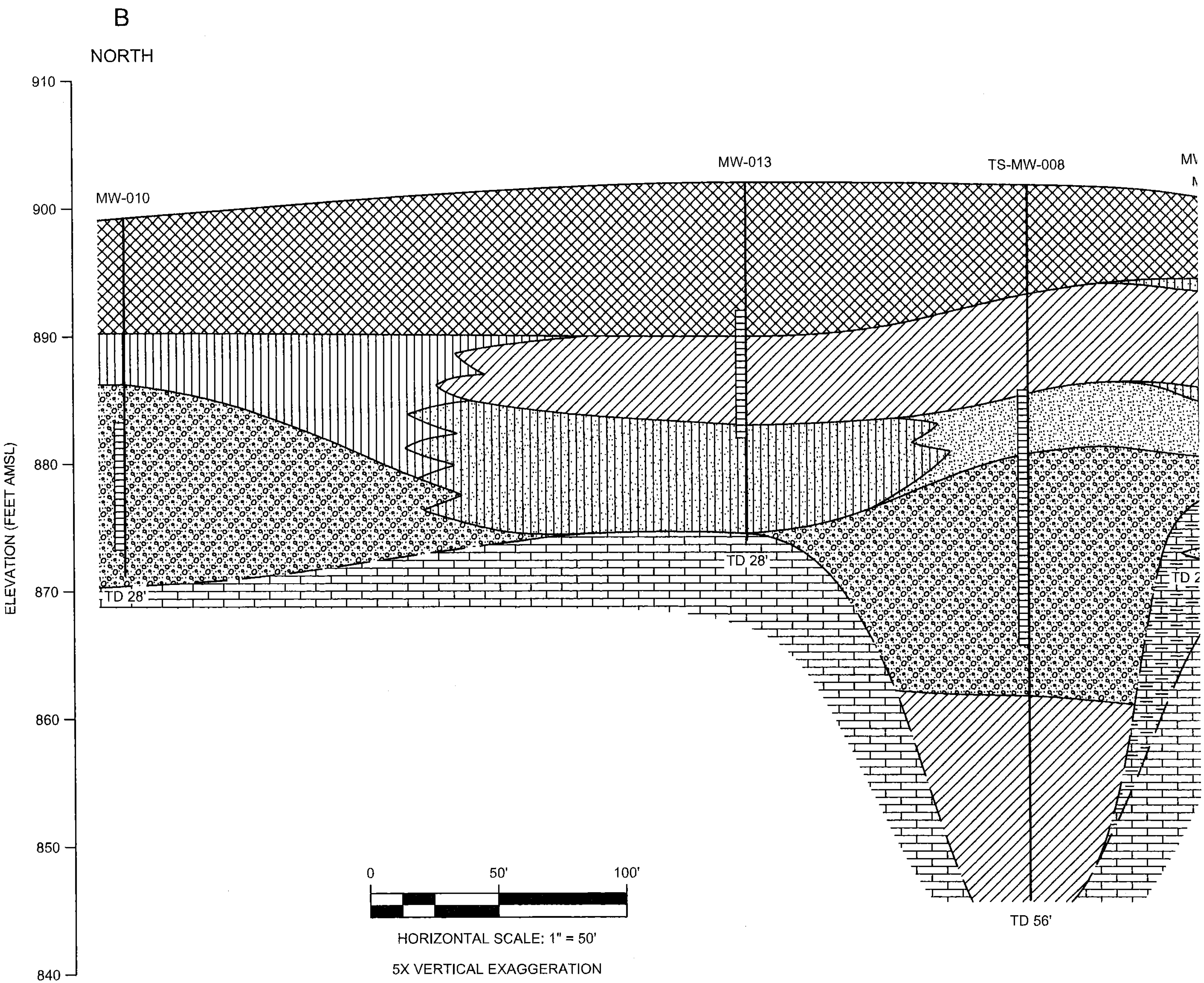
)

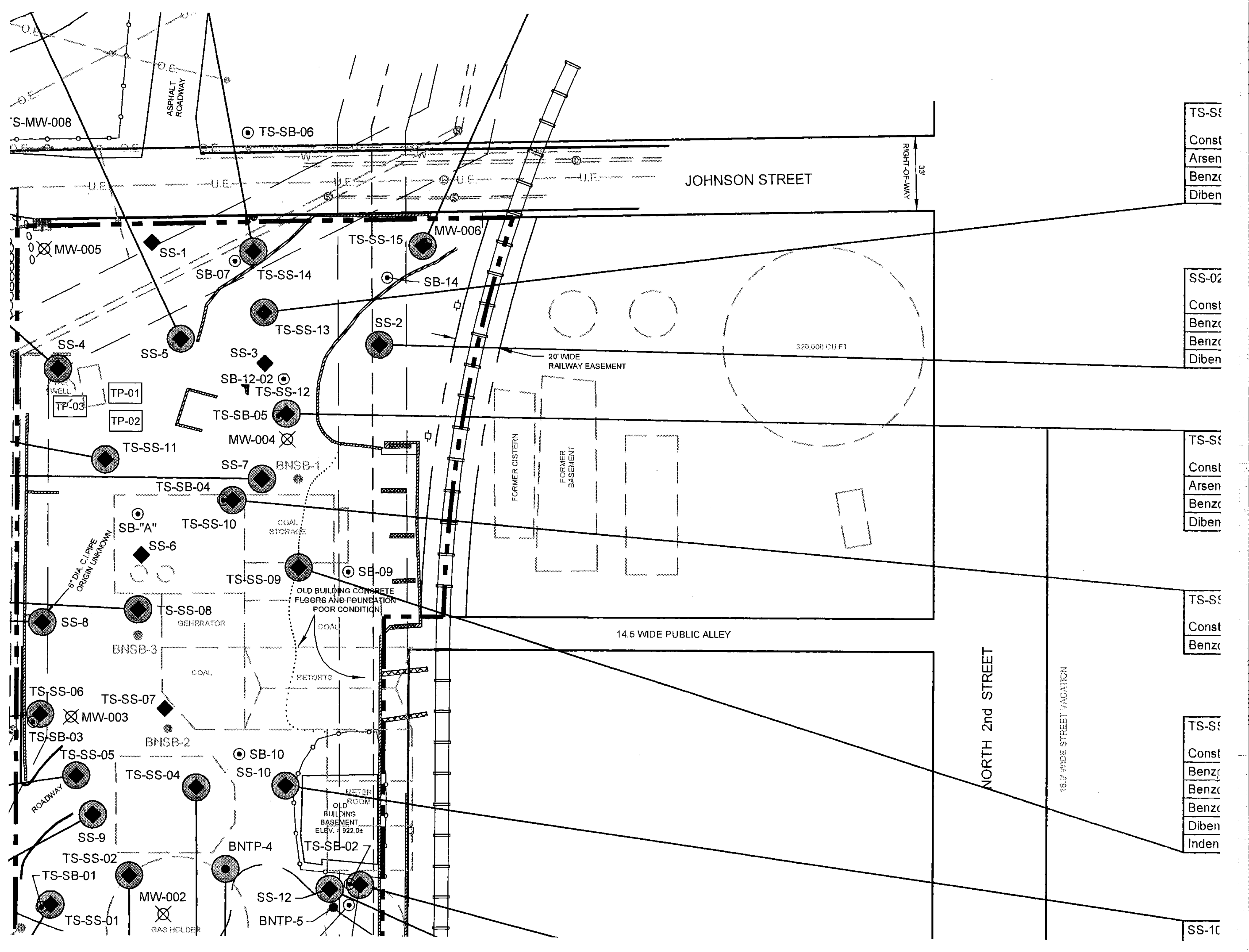
AVEL (SP, SW)

AND
M)

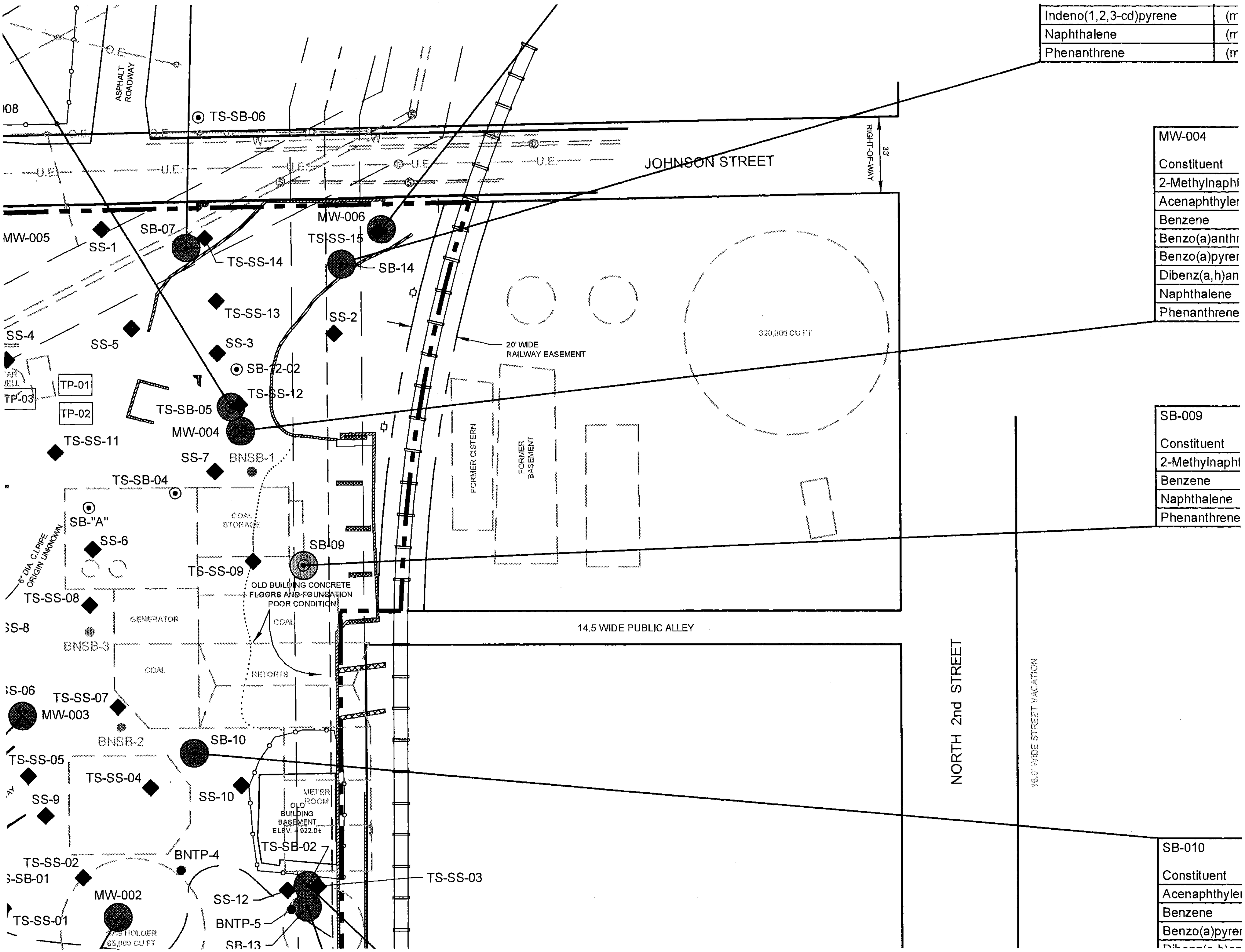
AND LIME CLAY



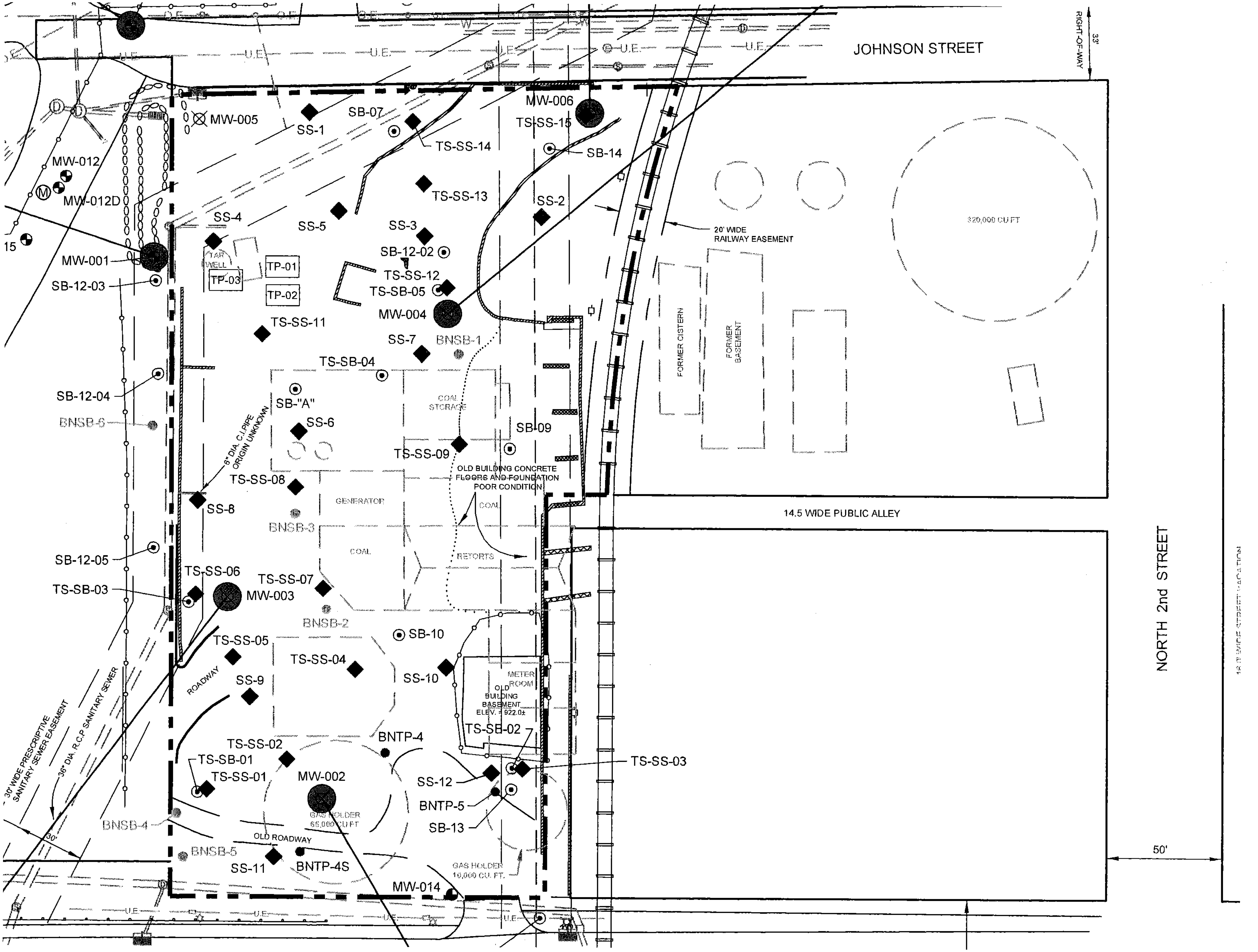




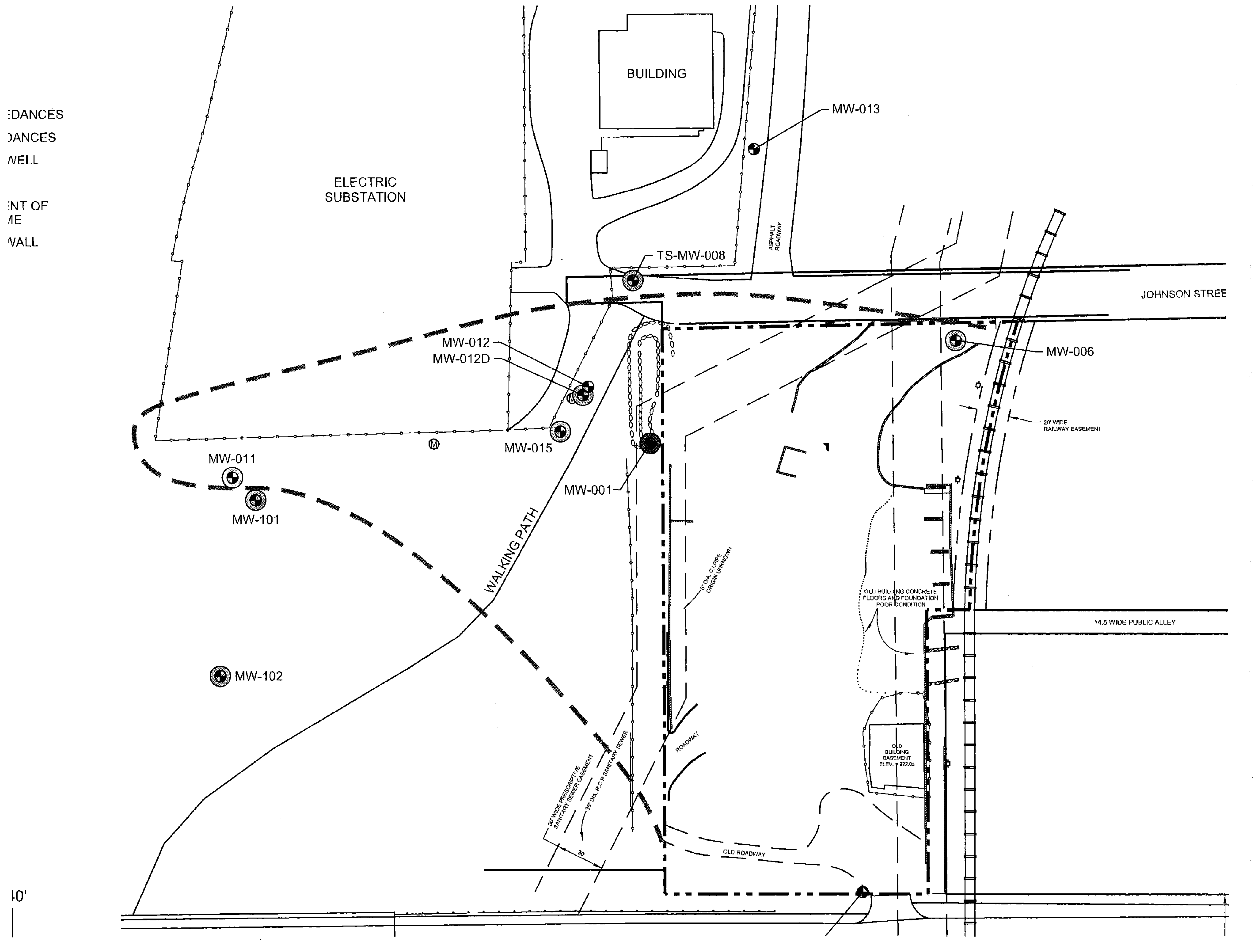
JOHNSON STREET
33'
RIGHT-OF-WAY
NORTH 2nd STREET
16.0' WIDE STREET VACATION
14.5 WIDE PUBLIC ALLEY
20' WIDE RAILWAY EASEMENT
320,000 CU FT
FORMER CISTERN
FORMER BASEMENT
ASPHALT ROADWAY
TS-MW-008
TS-SB-06
MW-005
SS-1
SB-07
TS-SS-14
TS-SS-15
MW-006
SB-14
TS-SS-13
SS-2
SS-4
SS-5
SS-3
SB-12-02
TS-SS-12
TP-01
TP-02
TP-03
WELL
TS-SB-05
MW-004
TS-SS-11
SS-7
BNSB-1
TS-SB-04
SB-"A"
TS-SS-10
COAL STORAGE
SS-6
TS-SS-09
SB-09
OLD BUILDING CONCRETE FLOORS AND FOUNDATION POOR CONDITION
6" DIA. C.I.PIPE ORIGIN UNKNOWN
SS-8
TS-SS-08
GENERATOR
BNSB-3
COAL
RETORTS
TS-SS-06
MW-003
TS-SS-07
TS-SB-03
BNSB-2
TS-SS-05
SB-10
TS-SS-04
SS-10
METER ROOM
OLD BUILDING BASEMENT ELEV. = 922.0±
ROADWAY
SS-9
BNTP-4
TS-SB-02
TS-SS-02
TS-SB-01
MW-002
SS-12
TS-SS-01
GAS HOLDER
BNTP-5
TS-SS
Const
Arsen
Benz
Diben
SS-02
Const
Benz
Benz
Diben
TS-SS
Const
Arsen
Benz
Diben
TS-SS
Const
Benz
TS-SS
Const
Benz
Benz
Benz
Diben
Inden
SS-10

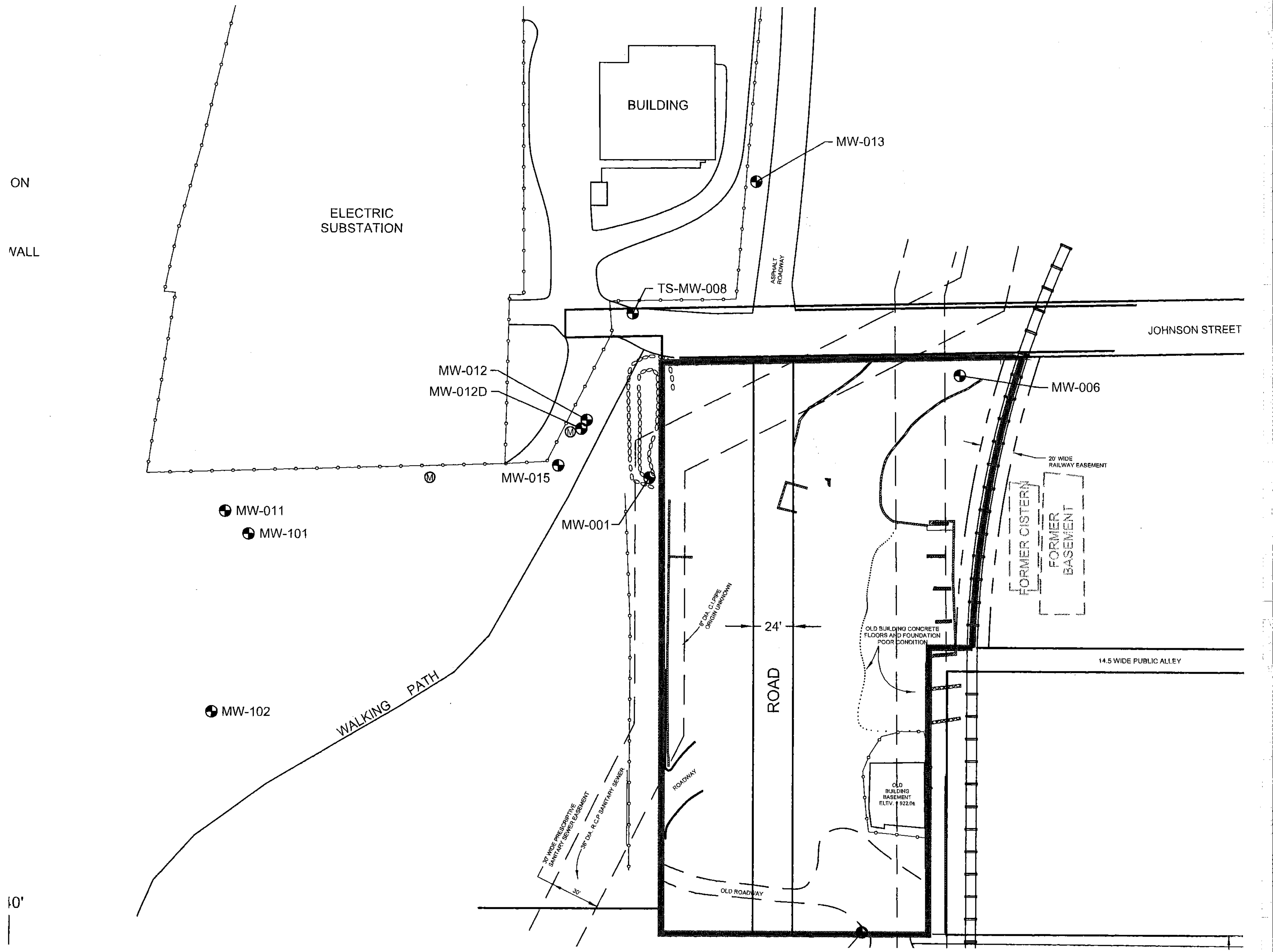


Indeno(1,2,3-cd)pyrene
Naphthalene
Phenanthrene
MW-004
Constituent
2-Methylnaphtl
Acenaphthylen
Benzene
Benzo(a)anthr
Benzo(a)pyren
Dibenz(a,h)an
Naphthalene
Phenanthrene
SB-009
Constituent
2-Methylnaphtl
Benzene
Naphthalene
Phenanthrene
SB-010
Constituent
Acenaphthylen
Benzene
Benzo(a)pyren
JOHNSON STREET
33'
RIGHT-OF-WAY
ASPHALT ROADWAY
TS-SB-06
MW-006
TS-SS-15
SB-14
SB-07
TS-SS-14
MW-005
SS-1
TS-SS-13
SS-2
SS-4
SS-5
SS-3
SB-72-02
TS-SS-12
TS-SB-05
MW-004
TP-01
TP-02
TP-03
TS-SS-11
SS-7
BNSB-1
TS-SB-04
SB-"A"
SS-6
COAL STORAGE
TS-SS-09
SB-09
OLD BUILDING CONCRETE FLOORS AND FOUNDATION POOR CONDITION
6" DIA. C.I.PIPE ORIGIN UNKNOWN
TS-SS-08
GENERATOR
COAL
RETORTS
BNSB-3
TS-SS-07
MW-003
BNSB-2
SB-10
TS-SS-05
TS-SS-04
SS-10
SS-9
METER ROOM
OLD BUILDING BASEMENT ELEV. = 922.0±
TS-SB-02
TS-SS-03
BNTP-4
TS-SS-02
MW-002
SS-12
BNTP-5
SB-13
TS-SS-01
GAS HOLDER 65,000 CU FT
20' WIDE RAILWAY EASEMENT
320,000 CU FT
FORMER CISTERN
FORMER BASEMENT
14.5 WIDE PUBLIC ALLEY
NORTH 2nd STREET
18.0' WIDE STREET VACATION

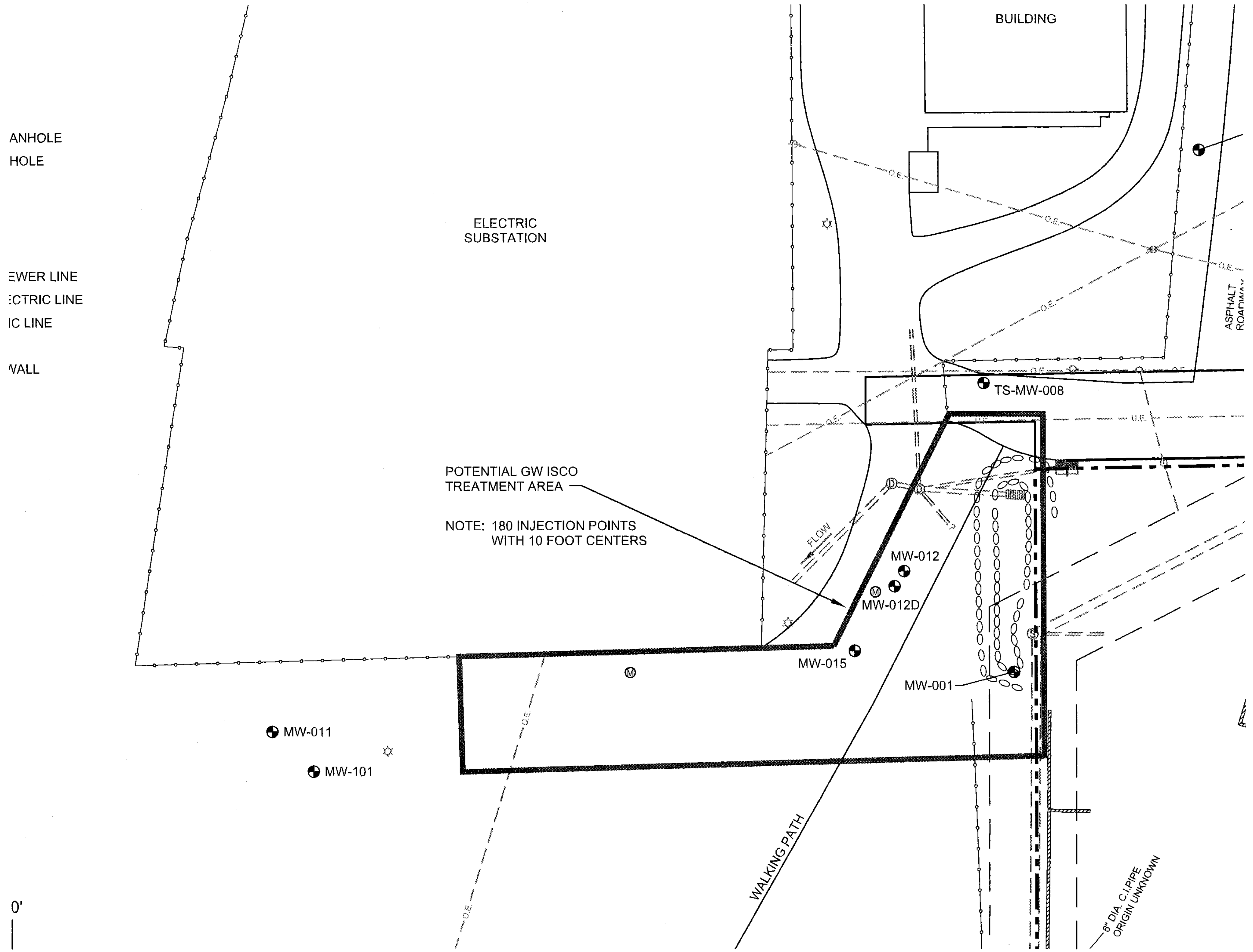


JOHNSON STREET
33'
RIGHT-OF-WAY
NORTH 2nd STREET
50'
14.5 WIDE PUBLIC ALLEY
20' WIDE
RAILWAY EASEMENT
320,000 CU FT
FORMER CISTERN
FORMER BASEMENT
MW-006
TS-SS-15
SB-14
SB-07
TS-SS-14
TS-SS-13
MW-005
SS-1
SS-2
SS-3
SS-4
SS-5
MW-012
MW-012D
15
MW-001
SB-12-03
TAR WELL
TP-01
TP-02
TP-03
SB-12-02
TS-SS-12
TS-SB-05
MW-004
TS-SS-11
SS-7
BNSB-1
TS-SB-04
COAL STORAGE
SB-12-04
BNSB-6
SB-"A"
SS-6
TS-SS-09
SB-09
6" DIA. C.I.PIPE ORIGIN UNKNOWN
OLD BUILDING CONCRETE FLOORS AND FOUNDATION POOR CONDITION
TS-SS-08
SS-8
GENERATOR
COAL
BNSB-3
COAL
RETORTS
SB-12-05
TS-SS-06
TS-SB-03
TS-SS-07
MW-003
BNSB-2
SB-10
TS-SS-05
TS-SS-04
SS-10
METER ROOM
OLD BUILDING BASEMENT ELEV. = 922.0±
ROADWAY
SS-9
TS-SB-02
BNTP-4
TS-SS-02
TS-SB-01
TS-SS-01
MW-002
TS-SS-03
SS-12
BNTP-5
SB-13
30' WIDE PRESCRIPTIVE SANITARY SEWER EASEMENT
36" DIA. R.C.P SANITARY SEWER
30'
BNSB-4
GAS HOLDER 65,000 CU FT
OLD ROADWAY
BNSB-5
SS-11
BNTP-4S
GAS HOLDER 10,000 CU. FT.
MW-014
U.E.
O.E.
W


EDANCES
DANCES
WELL
ENT OF
ME
WALL
BUILDING
ELECTRIC
SUBSTATION
MW-013
ASPHALT
ROADWAY
TS-MW-008
JOHNSON STREE
MW-006
MW-012
MW-012D
MW-015
MW-011
MW-101
MW-001
MW-102
WALKING PATH
20' WIDE
RAILWAY EASEMENT
6" DIA. C.I.PIPE
ORIGIN UNKNOWN
OLD BUILDING CONCRETE
FLOORS AND FOUNDATION
POOR CONDITION
14.5 WIDE PUBLIC ALLEY
ROADWAY
OLD
BUILDING
BASEMENT
ELEV. = 922.0±
30' WIDE PRESCRIPTIVE
SANITARY SEWER EASEMENT
36" DIA. R.C.P SANITARY SEWER
30'
OLD ROADWAY
40'



ON
WALL
ELECTRIC SUBSTATION
BUILDING
MW-013
ASPHALT ROADWAY
TS-MW-008
JOHNSON STREET
MW-012
MW-012D
MW-015
MW-006
20' WIDE RAILWAY EASEMENT
FORMER CISTERN
FORMER BASEMENT
MW-011
MW-101
MW-001
6" DIA. C.I.PIPE ORIGIN UNKNOWN
24'
ROAD
OLD BUILDING CONCRETE FLOORS AND FOUNDATION POOR CONDITION
14.5 WIDE PUBLIC ALLEY
WALKING PATH
MW-102
ROADWAY
OLD BUILDING BASEMENT ELEV. 922.0±
30' WIDE PRESCRIPTIVE SANITARY SEWER EASEMENT
36" DIA. R.C.P SANITARY SEWER
30'
OLD ROADWAY
40'


ANHOLE
HOLE
EWER LINE
:CTRIC LINE
IC LINE
WALL
0'
BUILDING
ELECTRIC
SUBSTATION
ASPHALT
ROADWAY
TS-MW-008
POTENTIAL GW ISCO
TREATMENT AREA
NOTE: 180 INJECTION POINTS
WITH 10 FOOT CENTERS
FLOW
MW-012
MW-012D
MW-015
MW-001
MW-011
MW-101
WALKING PATH
6" DIA. C.I.PIPE
ORIGIN UNKNOWN
O.E.
U.E.

<u>Exhibit C-1</u>

Parcel identification map

Parcel 891632340509000030: (Former Richmond MPG site) is highlighted in _green_ above.

Parcel 891632340510000030: (Off-site parcel) is highlighted in _red_ above.

Approximate groundwater remediation area on off-site parcel is highlighted in _orange_ above.

Exhibit C-2

Arial site map from Archaeology Report

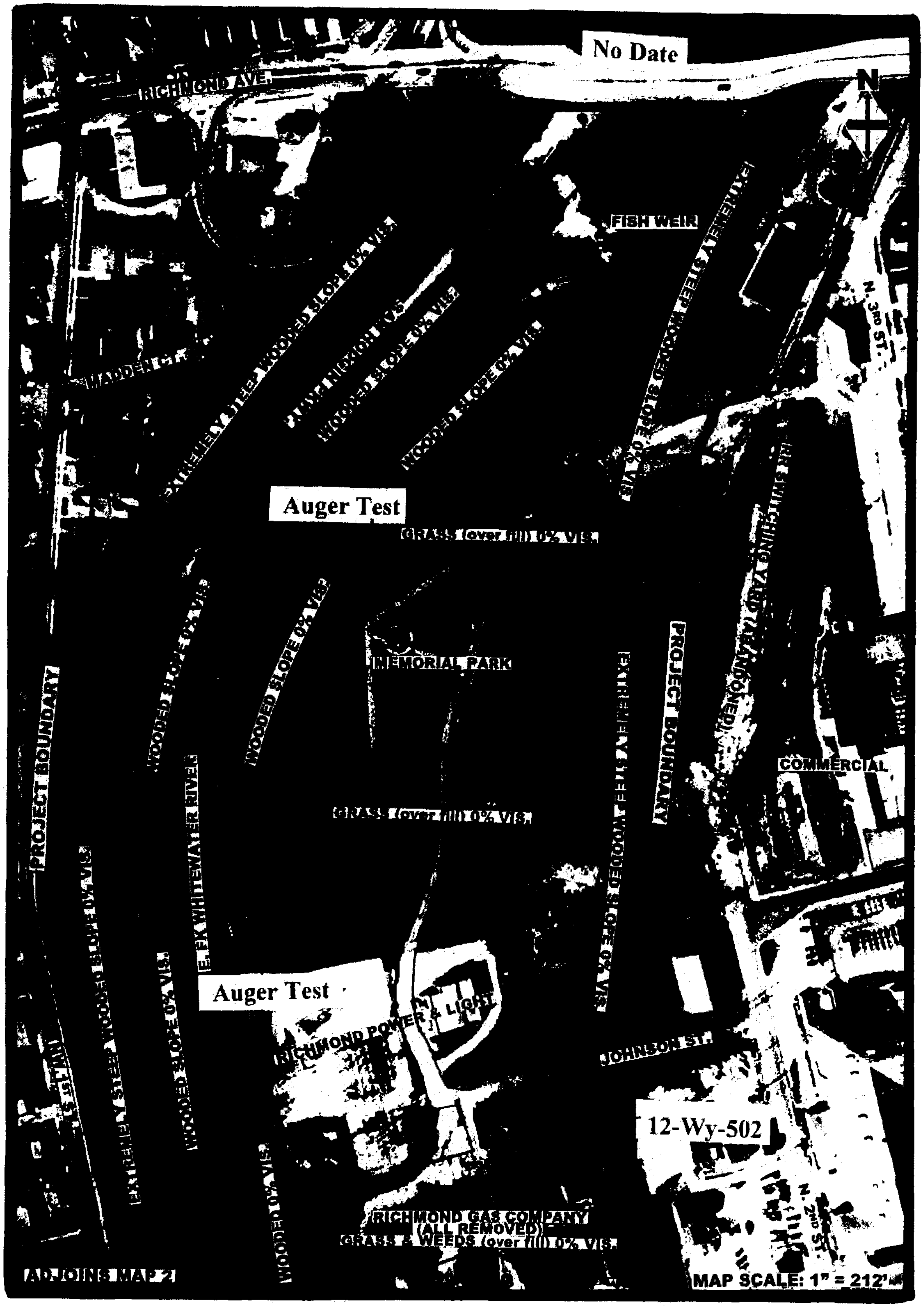


Figure 3. Aerial Map of the Northern Portion of the Project Area.

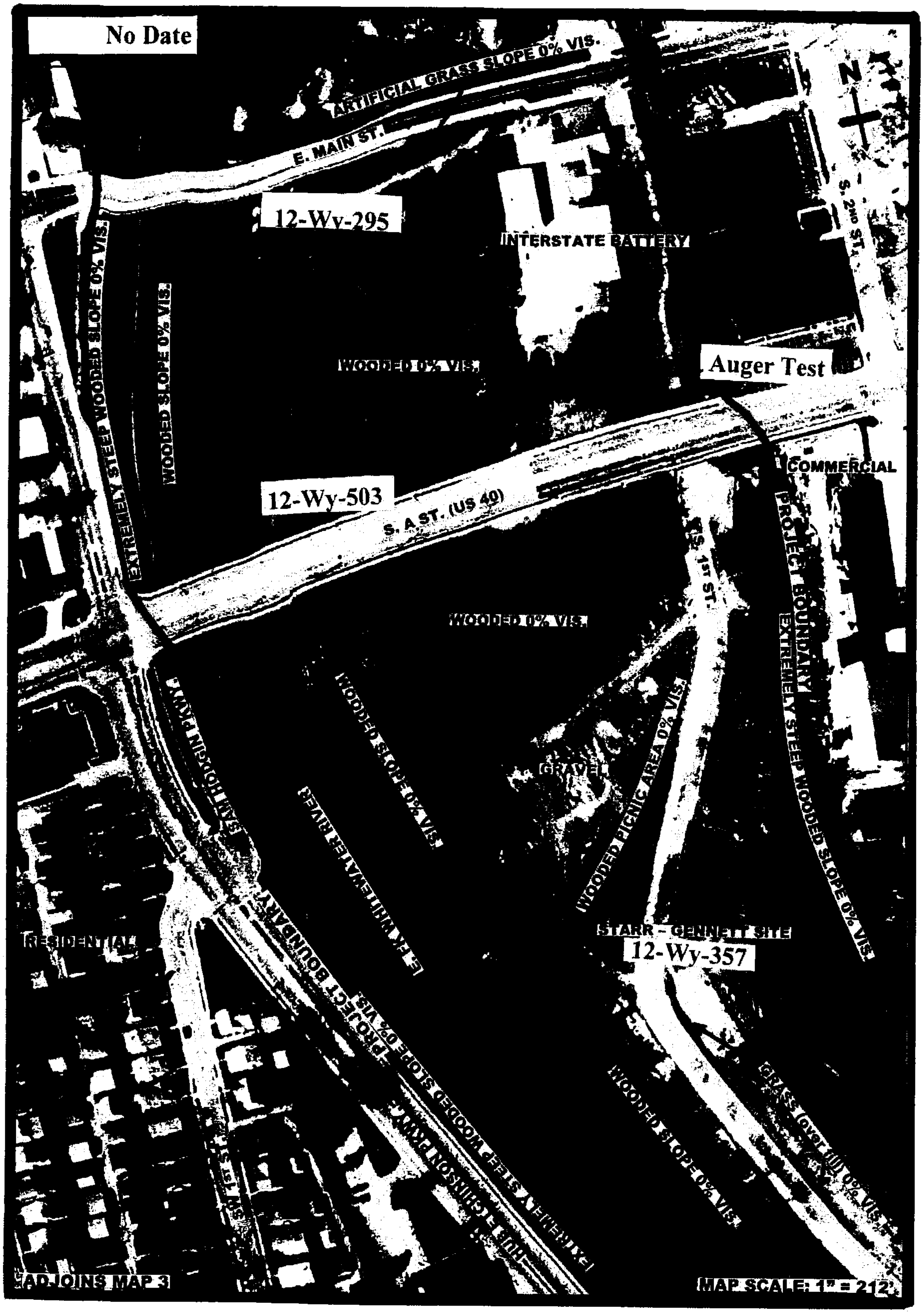


Figure 4. Aerial Map of the Central Portion of the Project Area.