FINAL COMPLETION REPORT

For

The City of Sioux Falls – Brownfield Site Final Remediation Report

Issued: July 2006

Submitted by:
City of Sioux Falls, South Dakota

Prepared with Assistance from:
HDR Engineering, Inc.

CERTIFICATION

The City of Sioux Falls – Brownfield Site Final Remediation Report

Based upon our observations and testing, as documented in the enclosed Final Completion Report, it is our opinion that the City of Sioux Falls – Phillips Avenue Fifth Street to Falls Park Drive Site Remediation activities have been completed in material satisfaction of the technical requirements of the South Dakota Department of Environment and Natural Resources (DENR) approved Environmental Remediation Plan and the Final Construction Documents.

Prepared by:

HDR Engineering Inc. and the City of Sioux Falls

Bill Brinker, PE (South Dakota E-3109)
Quality Assurance Officer

Christopher Peterson
Resident Project Representative

_____

_____

Bruce Larsen
HDR Project Manager

Mark D. Cotter, PE
City of Sioux Falls

_____

_____

Submitted:

July 2006

TABLE OF CONTENTS

Page

LIST OF TABLES

APPENDICES

SECTION 1.0 – INTRODUCTION

1.1 Purpose and Background

The purpose of this report is to document the remediation activities at the City of Sioux Falls (City) – Phillips Avenue Fifth Street to Falls Park Drive Site Remediation (Site) and to present a brief background on historical Site decisions. The Site is an area bounded on the north by East Falls Park Drive and the Burlington Northern Santa Fe railroad; on the east by the Big Sioux River, Sioux Steel, and other commercial properties; on the south by West 6th Street; and on the west by commercial properties fronting North Main Avenue and North Phillips Avenue. The Site was contaminated by industrial activities and possibly by turn-of-the-century urban renewal activities associated with filling in low-lying areas along the Big Sioux River. The contamination in this area was characterized under a U.S. Environmental Protection Agency (USEPA) Brownfield Pilot Project in 2002.

The City has viewed the Site as a Brownfield-type property that is lightly contaminated and underutilized. The Site essentially cut off the downtown area from the City's major tourist attraction, Falls Park. In the mid- to late 1990s, the City began planning efforts to connect the downtown area to Falls Park by extending North Phillips Avenue, expanding Falls Park to the south, and expanding commercial development into the area.

Prior to characterization of the Site as a Brownfield property, property owners included Pitts, Inc., which used the property for scrap metal salvaging, lead-acid battery storage, and shipping; I-29 Brickyard, which sold home improvement materials; and the State of South Dakota Rail Transit Authority, which included mainline and side tracks. Prior to 1965, there was a railroad roundhouse, which was used for engine repair, refueling, and maintenance, near the center of the Site.

When North Phillips Avenue, which runs north and south, was extended, it divided the Site into two separate land uses to the east and west. The east side extends the City's Falls Park area (Park Area) to West 6th Street, while the west side will be available for commercial development (Redevelopment Area). Therefore, prior to sampling at the Site, conceptual site models were developed to identify exposure pathways to potential receptors from each type of land use. Risk-based site-specific soil screening levels (SSLs) were developed for recreational users in the Park Area; construction workers and occupational users in the Redevelopment Area, and a soil-to-groundwater migration pathway in both areas so that sample results could be evaluated and decisions made on whether remediation of the Site was necessary.

A number of inorganic and organic parameters exceeded the exceeded the SSLs for both the Park Area and the Redevelopment Area. In the Park Area, metals (arsenic and lead (a metalloid)), volatiles (methylene chloride), and semi-volatiles (anthracene, benzo(a)anthracene, benzo(a)pyrene, fluoranthene, fluorine, and pyrene) were discovered above the SSLs. The metals exceeded the recreational and construction worker scenarios,

while the volatiles and semi-volatiles primarily exceeded the groundwater migration scenario. In the Redevelopment Area, metals (arsenic, chromium, lead, mercury, and selenium (a metalloid)), volatiles (methylene chloride, tetrachloroethene, and trichloroethene), poly-chlorinated biphenols (aroclor-1248, aroclor-1254, and aroclor-1260), and semi-volatiles (benzo(a)anthracene and benzo(a)pyrene) were discovered above the SSLs. Arsenic, lead, and benzo(a)pyrene exceeded the occupational user scenario, while lead was the only compound that exceeded the construction worker scenario. All compounds in the Redevelopment Area exceeded the groundwater migration scenario.

A number of conclusions were drawn from the analytical data. First, lead was the predominant contaminant at the Site. Second, the Redevelopment Area and Phillips Avenue were slightly more contaminated that the Park Area. Third, most of the contaminants in the Redevelopment Area and Phillips Avenue were co-located with lead. In other words, when elevated levels of lead were encountered, other elevated compounds were found as well. Finally, most of the organic parameters were only slightly above screening levels.

Two different remediation approaches were incorporated at the Site. In the Redevelopment Area and Phillips Avenue, soils were removed to a risk-based site-specific SSL that was approved by USEPA Region 8. This screening level was calculated to be 1,000 mg/kg lead. Soils in the Redevelopment Area or in Phillips Avenue were removed that were equal to or greater than 1,000 mg/kg lead and did not have at least 2 feet of clean soil between the finished grade and the elevated lead concentration. In the Park Area, a soil cover system was designed that would prevent exposure and limit the downward migration of moisture. The cover system consisted of 12 inches of compacted clay and 18 inches of topsoil. In the Park Area, there were also two areas of excavation. One was along the bank of the Big Sioux River, where the cover system would be installed, and the second was in an area where surface storm water was to be routed from the downtown area to the Big Sioux River. Soils from these two excavation areas were handled similarly to soils from the Redevelopment Area.

Soils that were removed from the Site were either placed under the cover system in the Park Area or were disposed of in the City of Sioux Falls landfill. In order to determine whether soil removal was necessary and whether the removed soil could be disposed of in the City's landfill, a 50-foot grid was set up in areas of known contamination and areas of known soil excavation. Samples were analyzed for lead at 1-foot intervals to a depth of 2 feet below final grade or until the lead concentration was below 1,000 mg/kg. Soils that were disposed of in the City's landfill had to meet Subtitle D requirements; therefore, samples that were collected during the grid sampling were also analyzed for Toxic Characteristic Leaching Procedure (TCLP) for lead. Samples were grouped into various concentration intervals and analyzed to identify an upper bound lead concentration that might be associated with exceeding the TCLP threshold. The concentration intervals (i.e., all lead concentrations in a given interval were lower than the maximum interval concentration) were 250 mg/kg, 500 mg/kg, 750 mg/kg, 1,000 mg/kg, and 1,250 mg/kg.

Results for all TCLP analyses from all five levels were below the regulatory limit of 5.0 mg/l. TCLP analyses were discontinued at the 1,250 mg/kg interval because the estimated volume of soils on-Site would fit beneath the Park Area cover system. Soils that were excavated from the Site that were above 1,250 mg/kg lead were placed beneath the Park Area cover system. Soils less than 1,250 mg/kg that were not disposed of on-Site were disposed of in the City's landfill.

The activities described above were undertaken pursuant to the *Environmental Remediation Plan* (ERP), February 2004, and the final Contract Documents titled *Phillips Avenue 5th Street to Falls Park Drive – Site Remediation*. The ERP was developed as a guideline for the remediation design documents and is being included as part of the final Contract Documents. The ERP has been modified slightly to reflect the fact that Site remediation has been completed. The Future Activities Management Plan, Section 6.0 of the ERP, has been revised to describe the proposed Institutional Controls for the Site. Both documents have received the approval (with the exception of the Institutional Controls) of the South Dakota Department of Environment and Natural Resources (DENR). The Institutional Controls are being developed and implemented by the City of Sioux Falls. These documents were developed to comply with the substantive soil management requirements outlined by the DENR. These requirements were discussed in DENR correspondence dated October 14, 2003 and February 9, 2004 and HDR correspondence dated February 6, 2004.

This report presents the documentation, procedures and data used to verify that activities and practices complied with the project specifications, drawings, and design documents. This document is the "Final Completion Report" for the remedial activities performed on the Site. It is prepared in compliance with the ERP, Section 5.9.4.

1.2 Scope

The scope of this report is to document the material compliance of completed field activities with the technical requirements of the project. Documentation of project activities exists in several forms, including site observation records as documented by the Resident Project Representative (RPR), records of third party testing laboratory analyses and service providers, required Contractor submittals, shop drawings, photo logs, disposal records, and surveys. All of the previously listed documentation was used to verify compliance with the Contract Documents.

1.3 Quality Assurance/Quality Control

Construction Quality Management (CQM) is defined as proactive planning, development, and implementation of both Quality Control (QC) and Quality Assurance (QA) throughout the project. Activities required for QA and QC were defined in the ERP and the Contract Documents.

QC is a production tool that was employed by the manufacturer of materials and by the construction contractor installing materials at the Site. Quality Control was an ongoing process of measuring and controlling the characteristics of the product in order to meet the contractors' and manufacturers' requirements set forth in the Contract Documents.

QA, by contrast, is a verification tool employed by the City of Sioux Falls (the City) and HDR Engineering, Inc. (HDR) to confirm that the materials and installation meet project specifications. QA activities consisted of observations and tests used to provide quantitative criteria with which to accept the final product or verify QC documentation. QA is generally performed independently of the QC activities. The QA activities were implemented under the supervision of a South Dakota professional engineer.

1.4 Content

The intent of this report is to document the remedial activities that took place. The report is organized into sections summarizing a particular phase of the project. The following is a summary of the sections and contents:

Brownfield Pilot Project History

- Site Description
- Historical Site Use
- Proposed Future Site Use
- Sampling Activities
- Site Assessment
- Recreation Park Area
- Redevelopment/Phillips Avenue Corridor
- Remediation Level

Site Remediation

- Overview
- Remedial Activities
- Pre-Construction Activities
- Environmental Monitoring
- Materials Removal and Disposal
- Cover System Construction
- Unexpected Conditions
- Potential Manufactured Gas Plant (MGP) Waste
- Underground Storage Tank (UST)

Project QA/QC

- Overview
- On-site Observation
- Testing
- QA Testing
- Screening Tests
- Materials Handling
- Surveying
- Project Quantities

SECTION 2.0 – BROWNFIELD PILOT PROJECT HISTORY

2.1 Site Description

The City completed environmental remediation activities for the Sioux Falls Brownfield site in December 2004. The project was completed in cooperation with and approvals from Region 8 of the U.S. Environmental Protection Agency (EPA) and the South Dakota Department of Natural Resources. The Brownfield site is located at the north end of downtown Sioux Falls. The site is bordered by 6th Street to the south, the Sioux Steel manufacturing facility and the Big Sioux River to the east, Falls Park to the north, and former South Dakota State Rail Authority land to the west (see Appendix A, Figure 2-1). Site coordinates are approximately 43° 33' 03" N latitude and 96° 43' 23" W longitude. The overall Brownfield site was approximately 25 acres.

A portion of the site is located on land reclaimed during the early part of the 20th century by filling with municipal trash and debris. The reclaimed area had previously been a low wetland area adjacent to what had been Saney Island. Filling of the area was done to straighten the Big Sioux River and make the former wetland area suitable for commercial purposes. The fill areas may have also been used for disposal of MGP waste produced by a former coal gasification plant located south of the site.

2.2 Historical Site Use

The majority of the site was owned by Pitts Inc. (Pitts), a scrap metal processor. Pitts used the site for a variety of materials recovery operations: scrap metal salvage, lead-acid battery storage, auto salvage, and white goods storage and salvage. Pitts occupied approximately half of the Brownfield area.

Historical site photos show that a portion of the site was used for railroad operations. These include the South Dakota Department of Transportation trackage (occupying the entire west side of the site), a roundhouse in the east-central part of the site, and various maintenance buildings. The roundhouse was built in 1928 and remained on the site until it burned in 1992. The roundhouse had been used for refueling, maintenance, and storage until operations ceased in 1965. Just to the north of the Pitts property was the I-29 Brickyard property. This was a commercial property for resale of home building materials.

2.3 Proposed Future Site Use

Prior to any remedial work in the area, the City developed a detailed plan for use of the site. The complete details of the plan were described in the *Phillips to the Falls, a Brownfields Redevelopment Plan* (Big Muddy Workshop, 1998). Specifically dealing with the Brownfield site, the plan included three separate future land uses: an extension of Phillips Avenue from downtown to Falls Park, creation of a redevelopment corridor

west of the Phillips Avenue extension, and the creation of a recreational park area to the east. Each of these areas, having specific future uses, was evaluated individually for remedial action.

2.4 Sampling Activities

HDR prepared a document, *Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP)*, to provide direction for field sampling and characterization activities. During this initial phase of site investigation, surface soil, subsurface soil, groundwater, and QA/QC samples were obtained. Sample locations were selected based on historical site use and previous environmental investigations. Based on that information, samples were analyzed for heavy metals as well as polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), polyaromatic hydrocarbons (PAHs), and petroleum hydrocarbons. Following the initial sampling effort, additional samples were collected in several areas of concern to further delineate contaminated areas.

2.5 Site Assessment

The information compiled during the sampling and analysis was incorporated into the *Brownfield Site Assessment, Site Characterization Report* (BSA)*, March 2003*. The BSA characterized the presence, type, and magnitude of potential site contamination. The results of the various soil sampling activities were compared against the site-specific soil screening levels (SSLs) to determine whether additional characterization or response was warranted. The SSLs were set based on future land use, taking into consideration the potential for human exposure to contaminants. The development of the SSLs is described in the BSA. Groundwater sampling results were compared with either South Dakota Groundwater Quality Standards (SDGWQSs) or, for chemicals with no SDGWQSs, federal Maximum Contaminant Levels (MCLs).

2.5.1 Recreational Park Area

Sampling and assessment activities in the recreational park area were located based on the historical site uses. Surface soil samples were taken in this area to determine if the proposed capping features would be adequate to prevent exposure through surface soil. Analysis of soil samples in the recreational park area above potential user SSLs were PAHs, arsenic, and lead.

Subsurface samples were taken to determine exposure potentials for construction workers and potential for leaching into groundwater. Samples were tested for metals, total petroleum hydrocarbon (TPH), VOCs, and semivolatile organic compounds (SVOCs) at 10 locations and varying depths. One location exceeded the SSL for PAHs, although concentration was within one order of magnitude of the SSL. The required cover system consisted of 12 inches of compacted clay and 18 inches of topsoil and was determined to be protective of human health and the environment. A detailed discussion of the sampling results is included in the BSA.

2.5.2 Redevelopment/Phillips Avenue Corridor

Tests of surface soils in the corridor revealed that occupational user SSLs were exceeded for arsenic, lead, and benzo(a)pyrene at various locations across the site. Groundwater migration SSLs are exceeded for PCBs, two PAHs, arsenic, lead, chromium, mercury, selenium, methylene chloride, tetrachloroethene, and trichloroethene. Lead is the only constituent detected in subsurface soil samples above construction worker SSLs.

Because lead was the primary contaminant in subsurface soils and other contaminants were collocated with elevated lead concentrations in surface soils, the preferred remediation was to excavate and remove surface soils in the redevelopment corridor. This included spot removals of subsurface soils in selected areas. A detailed discussion of the sampling results is included in the BSA.

2.5.3 Remediation Level

With approvals from EPA and DENR, a risk-based SSL for lead was set at 1,000 mg/kg. It was determined that any soils left in place containing concentrations of lead greater than the SSL must have a minimum of 2 feet of clean cover. The ERP includes discussion of required remedial actions and the decision process used to develop them. In order to comply with these requirements, areas that were to be disturbed in the redevelopment corridor and the park area were marked with a 50-foot grid system. A vertical core was obtained from each grid point, and a sample was analyzed from the core at 1-foot intervals until the analysis was less than the SSL. Using the cross sections for Phillips Avenue, this identified locations where additional excavation would be required to satisfy these criteria.

As discussed in Section 3.0, Site Remediation, excavated soils were either to be placed on top of existing soil and below the cover system in the Recreational Park Area, reused as select backfill, or disposed of in the Sioux Falls Landfill. For any soils that were disposed of in the landfill, a determination was required that this material was not hazardous. Soil samples obtained from the grid points described in the previous paragraph were reviewed, and three samples from representative locations across the Site were composited from the following concentration intervals and analyzed by Toxicity Characteristic Leaching Procedure (TCLP) analysis. The intervals were 100-250 mg/kg, 251-500 mg/kg, 501-750 mg/kg, 751-1,000 mg/kg, and 1,001-1,250 mg/kg. None of the tested intervals met threshold levels for consideration as hazardous. Therefore, soils with concentrations less than 1,250 mg/kg of lead could be disposed of in the Sioux Falls Landfill. Results of the TCLP analysis are included in Appendix C.

SECTION 3.0 – SITE REMEDIATION

3.1 Overview

The remedial activities for the site were based on the proposed future land uses: redevelopment/Phillips Avenue Corridor and recreational park areas. The ERP was developed as the basis for development of the remediation drawings and specifications. A copy of the ERP, which has been updated to include the Institutional Controls for the Brownfield Site, is contained in Appendix G.

3.2 Remedial Activities

HDR prepared the Construction Contract Documents based on the conclusions and direction set forth in the ERP and previous documents. The Contract Documents were used as the basis for selecting a remediation contractor via low bid through a competitive bidding process. The contract was awarded to Remediation Services, Inc. (RSI) of Independence, Kansas. The scope of the work required is described in Section 3.2.1, below, and in Appendix A. Appendix A contains the detailed specifications and drawings that make up the Contract Documents as well as the Contract Change Orders issued to modify the Contract Documents and change the work as field conditions dictate.

The remediation involved three fundamental phases: 1) Pre-construction Activities; 2) Materials Removal and Disposal; and 3) Cover System Construction. The scope of the project is summarized in the following sections and in the ERP, which is included as part of the Contract Documents. The following sections summarize the work performed during each phase.

3.2.1 Pre-Construction Activities

Pre-construction activities preceded remediation activities. The Contractor was responsible for the following activities prior to beginning remedial activities:

- Development and submittal of the following work and safety plans:
  - Site Specific Health and Safety Plan (HASP)
  - Dust Control Plan
  - Stormwater Pollution Prevention Plan
  - Air Monitoring Plan
  - Spill Prevention and Response Plan
  - Materials Handling and Staging Plan
  - Decontamination Plan
  - Site Security Measures Plan
- Project schedule
- Establishment of site access and control, including temporary perimeter fence, sign-in/sign-out sheet, and site surveillance during remediation

- Contractor mobilization – movement of appropriate equipment, personnel, sub-contractors, and materials to the site
- Erosion and sedimentation control measures

3.2.2 Environmental Monitoring

During construction, three of the work and safety plans were of primary concern. Those were Dust Control, Air Monitoring, and Stormwater Pollution Prevention. Elements of all of the work and safety plans were exercised during work at the site; however, the previously mentioned plans were the most applicable to this site.
Dust control was of great concern because of the location of the site in the center of town, its proximity to nearby businesses, and adjacent projects occurring concurrently. The Contractor utilized a 3,000-gallon water truck to apply water to the site when dust was visible or airborne dust was anticipated. A 10,000-gallon storage tank was used to store water on-site.

The Contractor was required to monitor airborne dust levels as part of their health and safety plan. Monitoring was conducted at the perimeter of the site as well as on equipment operating in areas of high lead concentrations. Level C personal protective equipment was used in areas until air monitoring results demonstrated that air borne contaminants were below required levels for three consecutive days. Maximum levels were set at 1.47 mg soil per m^3 of air based on a maximum soil lead concentration of 34,000 mg/kg per the ERP.

Two rain events exceeding 3 inches in 24 hours occurred during the course of the project. Both times stormwater collected at the site and required dewatering. Whenever water was discharged from areas that had not been remediated, the stormwater was sampled for lead and total hardness. These parameters were within acceptable discharge limits (refer to Appendix C). The water was filtered with a sock filter to remove sediment prior to discharge from the site, via the City's storm sewer system. On-site spills of potentially hazardous materials (fuels, lubricants, fertilizers, etc) were also considered as part of the Stormwater Pollution Prevention Plan. No spills were observed onsite during the remediation.

3.2.3 Materials Removal and Disposal

The Contract defined how materials would be removed from the site and disposed of. As defined in subsequent sections, on site soil management was defined by the soil lead concentration determined during previous soil sampling activities. Soils were divided into three classifications or types. The soil types were as follows:

- Type 1 Soil – 0-100 mg/kg Lead
- Type 2 Soil – 101-1,000 mg/kg Lead
- Type 3 Soil – >1,001 mg/kg Lead

Soil samples were taken at 50-foot intervals across the site, establishing a grid for soil removal (See Appendix B, Figures B-1a to B-9a). Each grid or grouping of like soil type grids was marked in the field for removal and management. Prior to excavation, each segregated area was checked against the soil type grid verifying that soils were properly excavated. The soils were separated into stockpiles by soil type for management. Type 3 soils being removed first and staged for placement in the Phase V area (beneath the Recreational/Park Area cap). Type 2 was staged for transport to the landfill. The Contractor provided manifests that were recorded at the landfill for each material that was disposed (soil, rubble, concrete, asphalt, etc).

- Type 1 Soil – 1) reuse on-site for beneficial fill; 2) dispose off site at the City's Subtitle D landfill if unsuitable for use on-site
- Type 2 Soil – 1) dispose at a Subtitle D landfill
- Type 3 Soil – 1) place in Phase V cover area; 2) treat and retest for disposal at a Subtitle D landfill; 3) dispose at a Subtitle C landfill

There was an option of on-site treatment for Type 3 soils prior to off-site disposal. However, no soils were treated on-site. All Type 3 soils were disposed of in the Phase V cover area.

During placement of Type 3 soils in the Phase V cover area there was concern over adequate volume to contain all of the Type 3 soils. Ultimately a change in the final cover elevation created adequate volume for all Type 3 soils excavated on-site. Extent and depth of Type 3 materials place in the Phase V area are shown in Appendix B, Figure B-20.

For areas that were excavated but not previously sampled (i.e., pullback area), soil was placed in stockpiles of approximately 1,000 CY. Prior to disposal, each stockpile was sampled and handled according to the procedure above. Depth of excavation in the pull back area is included in Appendix B, Figure B-44. Results from stockpile sampling are included in Appendix C.

Based on screening tests taken along proposed utility corridors, several locations were identified for further investigation. Indicated as pothole locations 20 through 24 on the contract drawings, each location was excavated and sampled. Excavation limits for each location were 10 feet by 10 feet square, and depth varied at each location (See Appendix B. Soils from the excavation were placed in the Phase V area. Tests were taken at all four sides of each excavation. Tests performed at each location were based on previous screening tests and/or on field observations during excavation.

One location, pothole 24, exhibited contaminant levels high enough to require additional remediation. In that case, each of the utility corridors (water and sewer) were excavated in the direction of the contaminant until field observations indicated that no visual evidence or odor was present. At that time, an additional sample was taken for additional screening. Results of tests for pothole 24 as well as the additional pothole locations are included in Appendix C.

During installation of sewer and water lines as part of the construction of Phillips Avenue, some of the soil surrounding the pipes was removed and replaced with material from off site. This removal was not performed as a remedial action but because of soils unsuitable for backfill use. The result of this was the creation of a "clean corridor" surrounding those underground utilities. This will provide a buffer area from contaminated soils during future service to those utilities. The locations of underground utilities installed during construction of Phillips Avenue are included in Appendix B, Figures B-27 to B-40. Samples of typical pipe installation details are also included in Appendix B, Figures B-42 and 43.

3.2.4 Cover System Construction

Remedial measures in the recreational park area included the placement of soil capping features identified as the cover system. As defined in the ERP, the cover system was required to serve two purposes. The first is to provide a physical barrier from human exposure to contaminated materials. The second is to control the potential groundwater contamination by limiting the amount of surface water that can infiltrate into the subsurface, further limiting the potential for exposure. The location and extent of the cover system is included in the original construction contract documents, refer to Appendix A.

The capping system consisted of 12 inches of low permeability clay and 18 inches of topsoil. A portion of the capping system included a 40-mil geosynthetic liner in place of the 12 inches of clay (See Appendix B, Figure 11 for location). This was in an area used as an overland drainage feature needed for the Phillips Avenue extension project.

The cover system design was detailed in the Contract Documents. The clay material was sourced from the Sioux Falls Regional Landfill. The material consisted of low permeability glacial clay till. Required in-place hydraulic conductivity was specified to be less than $10E^{-7}$ cm/sec. Hydraulic conductivity was determined via Daniel's Method correlations using moisture/density tests as an indication of in-place permeability. Refer to Appendix D for test results.

3.3 Unexpected Conditions

Due to the history and nature of activities that occurred at the site, there was potential for the remedial or other on-site contractors to encounter uncharacterized waste. The ERP provided guidance for the management of such wastes. Ultimately, two discoveries were made that fell in the category of "uncharacterized." The first was a material that was eventually determined to have the characteristics of Manufactured Gas Plant (MGP) waste. The second was an Underground Storage Tank (UST) partially filled with diesel fuel.

3.3.1 Potential Manufactured Gas Plant (MGP) Waste

MGP has been discovered at various sites around the City in past years. It is a byproduct of a coal gasification plant that operated at a downtown site in the early 1900s. The presence of a weathered hydrocarbon-appearing material was discovered at various locations across the site (See Appendix B, Figure B-10 for locations). Representative samples of the waste were tested for the presence of various metals, VOCs, and hydrocarbons (See Appendix C for test results). The relatively low concentrations from these analyses, specifically arsenic and cyanide, led to the decision to treat the waste as a Type 1, 2, or 3 soil based on previous soil screening tests discussed in Section 3.2.3.

3.3.2 Underground Storage Tank (UST)

During storm sewer installation for the Phillips Avenue extension, the Contractor discovered a previously unknown UST. The tank had a capacity of approximately 1,000 gallons and contained roughly 200 gallons of diesel fuel. The fuel was removed and disposed of appropriately by TJ's Used Oil, and the tank excavated. The tank was disposed of at the landfill and the excavation was refilled with material obtained from the site. No release from the tank was observed. The UST was located in the Phase V Cap Area (See Appendix B, Figure B-10 for location), no additional soil remediation was performed.

SECTION 4.0 – PROJECT QUALITIY ASSURANCE/QUALITY CONTROL

4.1 Overview

HDR was responsible for the observation and documentation of the activities related to QA for the project. In this case, that included daily observation of construction activities, review of test reports, review of contractor submittals, and coordination of other QA operations.

4.2 On-Site Observations

While construction operations were underway, the On-Site Construction Observer recorded information relevant to construction. Weather conditions, work performed, equipment on-site, and other miscellaneous information about construction and remediation efforts were recorded in the daily field log. Any requests from the Contractor or directions from the Engineer were also added to the daily field log. Daily field logs are included in Appendix F.

4.3 Testing

Various types of testing were required by the ERP and the Contract Documents. Testing generally consisted of two types: 1) QA testing to determine the acceptability of constructed components and manufactured units; and 2) Testing to screen materials for presence of contamination. Appendix B, Figure B-10 presents locations and the parameters that were performed on these samples. Appendix C contains the laboratory analyses for these samples.

4.3.1 QA Testing

QA testing was required for two components of the project. The first was testing required to determine the permeability of the cover system. The second was testing and documentation required for the high-density polyethylene (HDPE) liner system. Cover system field testing was performed to determine if the in-place permeability of the low permeability clay layer was less than the specified $1x10^{-7}$ cm/sec. The method of testing to determine compliance with the hydraulic conductivity criteria (e.g., $1x10^{-7}$ cm/sec) was based on the Daniel Method "Acceptable Zone" established during Sioux Falls Regional Landfill Cell 1 construction and subsequently modified during the Phase I Capping project. Correlation testing had been previously performed on the borrow site to show that the material was similar to the material used to determine the Daniel Method acceptable zone (see Appendix D). Field testing was performed by Maxim Technogies under direction of HDR. Field testing was performed in accordance with ASTM 2933. Results of permeability testing are included in Appendix D.

The HDPE liner system required a series of tests, submittals, and documentation. The first requirement was a submittal documenting material properties, methods of installation, and personnel. A certified installer was present on-site at all times during the

installation. The second was testing of various portions of the liner and documentation to provide evidence of compliance with the contract documents. Records of tests and documentation are included in Appendix E.

4.3.2 Screening Tests

Testing of previously characterized and uncharacterized materials was required throughout the project. Materials for areas such as the pullback area, which had been tested, received additional testing prior to disposal. Uncharacterized wastes, or unexpected conditions, were recognized as a potential issue due to the historic use of the site. Testing required for any unexpected or unknown materials was defined in the ERP, Section 5.7. Such materials were managed on a case-by-case basis. The reader is referred to information and documentation included in Appendix C.

4.4 Materials Handling

Much of the project required excavation of contaminated materials. These excavated materials required management as defined in the Contract Documents and ERP. Materials excavation was performed in three separate areas, the Phase I Pullback area, the Phase II Phillips Avenue Remediation area, and the Phase V Cover System area.

Prior to remedial work, sampling results were used to produce a series of figures to record the sampling results. The sampling had been performed on a 50-foot grid pattern across the site. The figures were used as a graphical guide for site excavation and materials management. Each 50-foot grid was assigned a color corresponding to each of the three soil types based on concentration.

As materials were excavated, they were moved to stockpiles that averaged approximately 1000 CY each. Those excavated from areas of known concentration were handled as defined in Section 3.2.2. Materials from areas that had not been previously sampled were stockpiled and sampled to determine concentration and then managed accordingly.

4.5 Surveying

During the project, two types of surveys were performed. The first type was construction staking, and the second type was verification and records surveys. Construction staking was used by the Contractor as a guide for construction and remediation. Verification and records surveys were used to document and verify the Contractor's work. Survey information was used to record locations and elevations of contaminated materials placed on-site as well as to record final elevation and determine final project quantities.

Topographic surveys of the final elevations of the cover system area are included in Appendix B. Additional record drawings are also included in Appendix B.

4.6 Project Quantities

During the project, several excavation, placement, and hauling quantities were recorded. Final quantities were determined by a combination of survey and landfill records. Final project quantities are as shown in Table 1.

Table 1
Final Project Quantities

On Site Quantities	
Phase I Pullback Area Soil (approx)	11,000 CY
Phase I Pullback Area Impermeable (Rubble, concrete, asphalt, etc) (approx)	1,600 TONS
Phillips Avenue Remediation Area (approx)	30,000 CY
Type 3 material placed in Phase V Cap Area (approx)	15,000 CY
Landfill Disposal Quantities	
Type I and II Soils	66,780.92 TONS
Type I and II Petroleum-Contaminated Soils	1,708.96 TONS
Impermeable Material (Rubble)	5,015.92 TONS
Tires	14.20 TONS