Prepared for:
Duke Energy Corporation
Charlotte, North Carolina

Remedial Alternatives Focused Feasibility Study

Spartanburg Former Manufactured Gas Plant Site
Spartanburg, South Carolina

ENSR Corporation
May 22, 2008
Document No.: 02355180-400

ENSR | AECOM

Prepared for:
Duke Energy Corporation
Charlotte, North Carolina

Remedial Alternatives Focused Feasibility Study

Spartanburg Former Manufactured Gas Plant Site
Spartanburg, South Carolina

Prepared By
Darin R. Payne, Project Specialist

Reviewed By
Mark S. Westray, Senior Project Manager

Reviewed By
Stephanie R. Knight, P.E., Principal Engineer

South Carolina Registered Professional Engineer
No. 20175
5/22/08
Stephanie R. Knight

South Carolina
ENSR Corporation
No. C00671
Certificate of Authorization

ENSR Corporation
May 22, 2008
Document No.: 02355180-400

ENSR | AECOM

Contents

List of Appendices

List of Tables

List of Figures

List of Acronyms and Abbreviations

bgs	below ground surface
COC	constituents of concern
COI	constituents of interest
CSM	Conceptual Site Model
DO	dissolved oxygen
Duke	Duke Energy Corporation
ENSR	ENSR Corporation
FFS	Focused Feasibility Study
GAC	granular activated carbon
ISCO	*In Situ* Chemical Oxidation
iSOC®	*In Situ* Oxygen Curtain
ISS	*In Situ* Solidification
mg/L	milligrams per liter
MGP	manufactured gas plant
MNA	monitored natural attenuation
NAPL	nonaqueous phase liquid
PAH	polycyclic aromatic hydrocarbon
RAO	remedial action objective
RBSL	SCDHEC risk-based screening level
RG	remedial goal
SCDHEC	South Carolina Department of Health and Environmental Control
Site	Spartanburg former manufactured gas plant site in Spartanburg, South Carolina
SLERA	Screening Level Ecological Risk Assessment
SVOC	semivolatile organic compound
TFRER	Trespasser Focused Risk Evaluation Report

VOC	volatile organic compound

1.0 Introduction

ENSR Corporation (ENSR) has prepared this Focused Feasibility Study (FFS) for evaluation of remedial alternatives for the Spartanburg former manufactured gas plant (MGP) site, in Spartanburg, South Carolina (Site). Our understanding of site conditions and the history of remediation activities has been derived from our review of the reports listed in Section 7.0 References.

Extensive excavation was conducted at the Site during 2003 and 2004 to address impacted vadose zone soils, and excavated areas were backfilled with clean fill to the surface. A *Trespasser Focused Risk Evaluation Report* (CES, 2004) was performed previously which determined that the current site conditions do not pose a significant risk to human health that would necessitate remedial action, assuming the current commercial/industrial uses of the property are maintained in the future. However, since residual concentrations of MGP-related chemical constituents exceed the South Carolina Department of Health and Environmental Control (SCDHEC) Risk-Based Screening Levels (RBSL) in groundwater, it is necessary to identify and evaluate potentially applicable remedial measures. Consequently, this FFS has been prepared to present this evaluation.

2.0 Site description

The Site is located at 684 North Pine Street in Spartanburg, South Carolina with a total area of approximately 7.4 acres as indicated on Figures 2-1 and 2-2. The Site is bounded by North Pine Street and US Highway 176 to the west, Southern Railway mainline tracks to the north, additional commercial/ industrial property to the east, and Linder Road to the south. Piedmont Natural Gas Company (PNG) presently owns the majority of the former MGP property which is located in a predominately commercial and industrial section of Spartanburg. The remainder of the Site is owned by Duke Energy Corporation (Duke). Chinquapin Creek flows through the approximate center of the Site, entering the Site from the northwest through a culvert beneath the Southern Railway System railroad embankment. The creek flows southeasterly, then turns east and eventually flows beneath Fairview Avenue. A tributary of Chinquapin Creek enters the Site from the west through a culvert beneath North Pine Street and intersects with Chinquapin Creek.

3.0 Site history

MGP operations were conducted at the Site from the early 1900s to the mid-1950s. The plant was originally owned and operated by South Carolina Gas & Electric Company and was constructed south-southeast of the Southern Railway and along the west boundary of North Pine Street. The original plant had two gasholders and two tar wells. Duke Power Company purchased the property in 1928, and then sold it to PNG 1951. An additional gasholder and an aboveground tank were constructed on site around 1950. By 1960, all three gasholders and the two tar wells were demolished; and, by 1964, all equipment associated with the gas plant had been removed. Duke Energy performed remedial investigation and remedial design between the years of 2000 and 2003. The selected remedy of remedial excavation was performed between February 2003 and March 2004; a total of 67,596 tons of contaminated soil and debris was removed from the Site and properly disposed (Duke, 2006). The excavation was extensive; however, not all potentially impacted soils could be removed due to physical site restraints including, but not limited to, property boundaries, railroad right-of-way limits, and depth to groundwater.

On October 25, 2006 a Declaration of Covenants and Restrictions (Declaration) was executed by PNG, which states that contaminants in excess of allowable concentrations for unrestricted use remain at the property. Included among the covenants identified in the Declaration are restrictions prohibiting use of the property for residential, agricultural, recreational, child day care, schools, and elderly care facilities; and restrictions prohibiting the use of groundwater for drinking or irrigation purposes without the approval of SCDHEC. The Declaration was signed by SCDHEC on November 14, 2006 and was recorded with the property deed by the Spartanburg County Office of the Register of Deeds on November 30, 2006.

4.0 Geological setting

As described in the *Site Assessment Report* (S&ME 2005), the Site lies within the Piedmont Geologic Province of South Carolina. The shallow geology within the Spartanburg area is generally comprised of igneous and metamorphic crystalline rocks that are generally foliated and fractured. Groundwater elevations and direction of flow are shown on Figure 4-1. The percolation of water downward through the fractures has resulted in the formation of a layer of residual weathered material (saprolite) and soil at the land surface. The saprolite unit is considered a semi-permeable bed which may store and recharge water to the underlying bedrock aquifer. Groundwater occurs within the saprolite and residuum between the clay, silt, and sand grains. Groundwater also occurs and flows within the bedrock along secondary features, joints, and planes of weakness. Cross sections detailing groundwater elevations and well construction details are shown on Figures 4-2, 4-3, 4-4, and 4-5. Groundwater is encountered within the saprolite at depths ranging from 5.3 to 13 feet below ground surface (bgs). Partially weathered rock occurs at depths of about 15 to 24 feet bgs.

5.0 Summary of conceptual site model

A Conceptual Site Model (CSM) has been developed from the historic documents noted in Section 7. The CSM provides the technical basis for the identification, evaluation, and selection of remedial alternatives for the Site and consists of the following components:

- **Environmental Media Requiring Remedial Action.** The media which will be addressed through remedial actions include saturated zone subsurface soils and partially weathered rock containing residual nonaqueous phase liquid (NAPL) and elevated concentrations of sorbed constituents. These media constitute the primary source of contaminants that are continuing to leach to groundwater at concentrations that exceed RBSL values.
- **COI.** The COI for the Site consist of volatile organic compounds (VOCs) (primarily benzene) and semivolatile organic compounds (SVOCs) (primarily naphthalene). The primary risk drivers for groundwater are the constituents that exceed RBSL standards including benzene and naphthalene in some locations. Approximate limits of RBSL exceedances are shown on Figure 5-1.
- **Contaminant Source Areas.** The vadose zone remediation performed in 2003 and 2004 removed the source contamination in the unsaturated zone of the Site to an average depth of 8 feet bgs. The areas of the Site with persistent elevated concentrations of dissolved COI indicate that the residual contaminant sources are associated with the saturated alluvial and residual/saprolitic units (approximately 8-foot thickness) in the area of former MGP operations. This material constitutes the primary long-term source of impacts to groundwater quality at the Site. Limits of remediation are shown on Figure 5-2.
- **Migration Pathways.** The potential migration pathways for COI which will be addressed through remedial actions include:
  - Leaching/dissolution of COI from saturated zone soils
  - Migration of dissolved COI in groundwater to off-site locations
- **Potential Receptors and Exposure Pathways**. Current potential receptors and pathways for exposure to site COI include:
  - Construction/utility worker exposure to COI in saturated zone soils and groundwater through inhalation, incidental ingestion, and/or dermal contact, though currently there is no development planned for the property
  - The Screening Level Risk Ecological Assessment (SLERA) conducted by Blue Ridge Environmental Consulting in 2004 (Blue Ridge, 2004) concluded that human or ecological risks associated with the surface water of Chinquapin Creek are negligible.
  - The *Trespasser Focused Risk Evaluation Report* (CES 2004) states that residual carcinogenic and non-carcinogenic risk levels are both below SCDHEC recommended levels for relevant exposure pathways.

6.0 Remedial alternatives feasibility study

This section describes the specific remedial goals (RGs) and Remedial Action Objectives (RAO) for the Site, and then describes a set of potentially applicable remedial technologies to address the affected environmental media and ultimately achieve RGs. These technologies are initially screened then undergo detailed evaluation in order to identify the technologies that are most appropriate relative to site-specific factors.

6.1 Remedial goals

For the purposes of this FFS, RGs are defined as numerical criteria for environmental media that, when exceeded, result in a violation of statutory regulations. For the State of South Carolina, these are referred to as RBSLs for corresponding COI. Chemical impacts at the Site are limited to saturated zone soils and groundwater, for which there are no completed exposure pathways under the current uses of the property.

6.2 Remedial action objectives

Remedial Action Objectives are defined as follows:

- Maintain protection of human health and the environment
- Reduce subsurface contaminant mass associated with saturated soils containing residual contamination
- Reduce dissolved-phase COI concentrations
- Achieve SCDHEC RBSL Standards for all groundwater COI

6.3 Remedial options

To begin the remedial technology evaluation process, a list of applicable remedial technologies was developed. This feasibility study has been focused due to the fact that previous remedial actions have been performed at the Site; therefore, a focused field of six applicable remedial technologies was selected.

Candidate technologies are screened using three criteria:

- Applicability and appropriateness to the Site
- Relative cost
- Technical feasibility

Applicability and appropriateness of a potential technology must consider the specific constituents present; the media; the nature, extent, and status of sources of contamination; the physical condition of the Site and surroundings; and the ability of the technology to achieve the stated RAOs.

Relative cost of a technology examines the expected level of expense required to implement the technology at the Site relative to the other remedial technologies. This is not a detailed cost estimate but, rather, a general judgment based on experience implementing the technology at similar sites.

Technical feasibility of a potential technology must consider steps and procedures required to implement the remedy; site-specific conditions (size, topography, current and future land use, drainage routes, surface conditions, and other permanent conditions); practicality; and probability of success. In assessing practicality and probability of success, the remedial approach performance history and implementation impacts to public welfare and the environment have to be considered.

The remedial technologies that were included for detailed evaluation include:

- **No Action.** No Action is included as a benchmark for the comparison of costs and benefits associated with other technologies. Currently, impacts to soils and groundwater at the Site do not pose a risk to receptors; therefore, No Action is an appropriate option for consideration.

  It is noted that institutional controls, in the form of the land use restrictions imposed by the Declaration of Covenants and Restrictions, have already been implemented and are in force at the Site. As described previously, these land use restrictions prohibit residential and other specific land uses, and the use of groundwater for drinking or irrigation, unless approval is granted by SCDHEC. Therefore, these land use restrictions will be a component of each of the remedial alternatives that are evaluated in this document, including the No Action alternative.

- **Monitored Natural Attenuation.** MNA is a widely utilized technology at sites that pose a relatively low risk to human or ecological receptors. MNA involves tracking the natural degradation of contaminants at the Site without the introduction of foreign microorganisms, nutrients, oxygen, or mechanical enhancement. Natural attenuation is typically most effective for maintaining low and decreasing levels of COI in groundwater. Natural attenuation processes at MGP sites typically are highly effective in limiting the migration of dissolved contaminants.

- ***In Situ* Enhanced Biodegradation.** This technology involves the delivery of high concentrations of dissolved oxygen (DO) to the saturated zone via diffusion of pure oxygen gas. This technique allows greater oxygen mass transfer into the contaminated zone than can be achieved through the injection of ambient air. Increased DO concentrations stimulate aerobic biodegradation of COIs via natural metabolic pathways.

- ***In Situ* Chemical Oxidation (ISCO).** This technology involves the chemical destruction of organic contaminants in groundwater and soil by subsurface injection of strong oxidant solutions. Effective treatment requires the selection of oxidants that will react with the specific types of contaminants present at the Site. For MGP sites where simple aromatic VOCs (benzene, ethylbenzene, etc.) and polycylic aromatic hydrocarbons (PAHs) (naphthalene, phenanthrene, etc.) are the predominant COIs, modified Fenton's Reagent or, potentially sodium persulfate, are typically the most cost-effective oxidants for ISCO applications. ISCO is an aggressive technology used to address relatively high contaminant concentrations in saturated soils and groundwater.

- ***In Situ* Solidification (ISS).** This technology involves the mixing of soils with a solidification agent, such as a cement based grout mixture. The technique has proven successful at many former MGP sites in reducing the potential for chemical constituents associated with soils and/or residual NAPL to leach into groundwater.

  The implementation of this approach involves a batch plant to prepare the solidifying agent and a soil mixing rig or excavator to blend the stabilizing agent with the soils. This technology targets soils that could also be excavated but reduces the need for dewatering. Due to the fact that ISS rigs typically utilize tall masts, overhead power lines would have to be temporarily rerouted or protected during implementation (if possible). Utilization of ISS at the Site would require excavation and stockpiling of the existing clean fill above the saturated zone to allow ISS to be performed on soils in the saturated zone.

- **Saturated Zone Excavation.** Saturated zone excavation is a highly aggressive option that would remove soil containing residual NAPL from the source zone. The application of this approach to the Site would consist of the physical removal and stockpiling of existing clean fill above the saturated zone, followed by removal of saturated zone contaminated soil and source material using commonly available equipment to a maximum depth of approximately 18 to 20 feet bgs. Since excavation to this depth would extend below the water table, dewatering and water treatment would be required. Additionally, because of the proximity to Chinquapin Creek and the Duke Power substation, sloping or benching of the excavation would be impractical in those areas; therefore, engineered excavation shoring would be necessary.

6.4 Detailed evaluations of remedial technologies

Detailed evaluation of the remedial technologies is performed by comparison to eight criteria:

- Protection of human health and the environment, including attainment of remediation goals
- Compliance with applicable federal, state, and local regulations
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume
- Short-term effectiveness, defined as effectiveness in quickly mitigating Site-related adverse impacts to the environment and the local community
- Implementability, defined as technical and logistical feasibility, including an estimate of time required for completion
- Cost
- Community and state acceptance

Table 6-1 provides a comparison of each of the remedial technologies with respect to the evaluation criteria listed above. Table 6-2 summarizes the costs for each technology (detailed cost estimates and associated assumptions are provided in Appendix A for *in situ* enhanced biodegradation, ISCO, ISS, and saturated zone excavation.

6.4.1 No action

No Action means no remediation activities will be performed at the Site, including monitoring and sampling. MNA is not a part of this technology because, even though natural attenuation would be occurring, there would be no monitoring activities conducted to measure it. It is noted, however, that land use restrictions have already been implemented through the recordation of the Declaration of Covenants and Restrictions with the property deed.

No Action is a benchmark that is useful for comparison to the other remedial technologies. The benefit of any proposed remedial action must be greater than No Action to justify consideration of that remedial technology.

6.4.1.1 Protection of human health and the environment; attainment of remediation goals

As concluded in the Trespasser Focused Risk Evaluation Report (TFRER), the Site does not pose a risk to current receptors or trespassers since all impacts lie in the saturated zone soils. Therefore, direct contact by human receptors is unlikely and could be further limited with access controls (fencing). Further, the existence of the recorded land use restrictions provides long-term protection of human health by prohibiting uses of the property that are not compatible with the presence of contaminants in soils and groundwater at concentrations greater than unrestricted use levels.

The No Action option is likely to benefit from naturally occurring attenuation of COIs via such pathways as microbial degradation, volatilization, and dilution. However, without a monitoring plan, the rate of natural attenuation will be unknown, as will the progress of the Site toward meeting the remedial action objectives.

6.4.1.2 Compliance with applicable federal, state, and local regulations

This option does not comply with regulatory requirements because it does not address the exceedances of the RBSL Standards.

6.4.1.3 Long-term effectiveness and permanence

Over the long term, No Action may meet the criterion of effectiveness and permanence as any destruction of COIs through natural processes would be permanent. However, for areas with especially high concentrations of COIs, the time required to meet the RBSL Standards may be decades. Land use restrictions imposed by the Declaration have been recorded with the property deed and are considered to run with the land.

6.4.1.4 Reduction of toxicity, mobility, and volume

Over time the No Action option may reduce contaminant mass, mobility, and toxicity through natural attenuation processes; however, the time required to achieve RBSL Standards throughout the Site, especially in areas with residual NAPL, is difficult to estimate at this time.

6.4.1.5 Short-term effectiveness

The Site does not pose any imminent threat to the community or environment and, therefore, the No Action alternative provides adequate short-term effectiveness.

6.4.1.6 Implementability

This option does not require work plans, design, equipment, or construction. It is easily implemented.

6.4.1.7 Cost

This option does not require work plans, design, equipment, or construction. There are no costs associated with implementation or monitoring. The Declaration requires that PNG annually submit to SCDHEC a statement that the covenants and restrictions have been maintained; however, the cost for providing this statement is insignificant.

6.4.1.8 Community and state acceptance

Though current Site conditions pose no imminent risk to the community, this option does not provide ongoing evaluation of site conditions. Dissolved COI within groundwater currently exceed RBSL in the State of South Carolina. No Action would not document the progress of natural attenuation toward reaching the RGs at the Site and would not detect unexpected plume migration. Therefore, the acceptability of this alternative is doubtful.

6.4.2 Monitored natural attenuation

This technology is similar to the No Action alternative in that it does not apply engineered remedial measures or controls to mitigate site contaminants or their effects. Instead, MNA is based on a program of periodic groundwater monitoring to evaluate COI concentration trends, detect evidence of plume migration, and establish the predominant pathways of intrinsic biodegradation. Monitoring would also detect changes to the groundwater flow direction that could occur if site development occurs.

6.4.2.1 Protection of human health and the environment; attainment of remediation goals

MNA focuses on natural containment, degradation, and volatilization of COI in soil and groundwater by native microorganisms that use organic constituents associated with MGP residuals as a source of carbon for energy and synthesis of new biomass. Data collected during the annual groundwater monitoring have shown the presence of inorganic MNA parameters in groundwater (primarily nitrate, sulfate, and iron) which may support natural attenuation processes (S&ME, 2008). These processes have resulted in the stabilization of the contaminant plume within the Site boundary and varying degrees of contaminant reduction. Natural attenuation should continue to steadily decrease the mass of COI in soil and groundwater at the Site, but it is expected that MNA will require many years to reduce dissolved COI to below the RGs throughout the Site.

The existing land use restrictions are protective of human health and the environment and prohibit future land uses could create exposure pathways that could result in unacceptable human health risks.

6.4.2.2 Compliance with applicable federal, state, and local regulations

MNA complies with applicable regulations and is an appropriate remedial technology for some sites. However, the time required to reach the RGs via MNA is uncertain.

6.4.2.3 Long-term effectiveness and permanence

Natural attenuation processes have been shown to be highly effective in limiting the migration of dissolved COIs at numerous MGP sites across the country. MNA will result in permanent destruction of MGP-related constituents in soils and groundwater. Since rates of intrinsic biodegradation typically are relatively slow, very long time periods may be required for natural attenuation to significantly deplete contaminant mass in source areas and allow recovery of dissolved COI concentrations to below RG values. Since the existing land use restrictions associated with the Declaration are recored with the property deed and run with the land, the control of risks afforded by the land use restrictions is both effective and permanent.

6.4.2.4 Reduction of toxicity, mobility, and volume

The primary function of MNA is to allow natural processes (biodegradation, dilution, and volatilization) to destroy COIs *in situ*. Long-term monitoring is used to demonstrate that the COI plume is stable or shrinking. COI degraded by MNA are permanently destroyed, which will reduce the total volume, mass, and toxicity of COI at the Site.

6.4.2.5 Short-term effectiveness

The Site does not pose any imminent threat to the community or environment and, therefore, the MNA alternative provides adequate short-term effectiveness.

6.4.2.6 Implementability

MNA is easily implemented with site activities consisting of periodic groundwater monitoring using the existing wells at the Site which provide a sufficient cross section of the plume. It is expected that monitoring would be performed on a semiannual basis as is currently being performed. The current monitoring frequency provides sufficient data for seasonal changes in groundwater flows and elevations.

6.4.2.7 Cost

The costs associated with an MNA program at the Site are relatively low and consist of professional labor for groundwater sampling, data interpretation, and reporting, and costs for laboratory analyses of groundwater samples. For cost estimating purposes, a duration of 16 years has been assumed (available site data are not sufficient to allow a quantitative estimate of the expected time to achieve RG values) and costs of up to $25,000 per year for a semi-annual monitoring and reporting frequency for a present value of $314,028.

6.4.2.8 Community and state acceptance

MNA is expected to be generally acceptable to the community since there is no risk to human health or the environment and the existing land use restrictions ensure that future uses of the property do not create exposure pathways. The annual groundwater monitoring data indicates that the contaminant plume is being stabilized by the currently occurring MNA, however it is expected to require at least 16 years to reduce COI in groundwater below the RBSL Standards.

6.4.3 *In situ* enhanced biodegradation

This technology would involve the installation of oxygen diffusion contactors in a series of wells installed within the source area containing residual NAPL. Implementation of the technology at the Site is expected to achieve DO concentrations of greater than 40 milligrams per liter (mg/L) in the diffusion wells. Establishing enhanced concentrations of DO in impacted areas of the saturated zone would enable naturally occurring microbial populations in the soils and groundwater to biodegrade organic COI via aerobic metabolic pathways. In September 2006, an oxygen diffuser pilot study was initiated in MW-13D for treatment of the bedrock unit and a newly installed well, MW-13iSOC, was used to treat the saprolite unit. The groundwater monitoring results summarized in the Groundwater Report (S&ME, 2008) indicate an overall decrease in benzene and naphthalene in the wells that had oxygen diffusers in place for the pilot study, indicating that increases in DO concentrations have increased the level of microbial activity in the saturated zone soils leading to modest reductions of COI.

A conceptual layout of the oxygen diffusion contactors is shown on Figure 6-1. Under this approach, 37 oxygen diffusion wells would be installed to an average depth of about 20 ft bgs with 10 feet of well screen to address the saturated zone above the bedrock. The conceptual layout has the wells spaced at approximate 50 foot intervals in the downgradient (southwesterly) direction and 25 foot intervals in the crossgradient (northwest to southeast) direction, with slight adjustments in the spacing to place diffusion wells immediately upgradient of suspected hotspots. Recommendations for this conceptual layout were provided by inVentures Technologies, Inc., the manufacturer of the iSOC gas diffusion systems. inVentures Technologies has also provided Duke with technical support for the iSOC pilot study and, therefore, their technical personnel have a good understanding of site conditions. This conceptual approach represent a relatively aggressive implementation strategy designed to reduce residual contaminant mass as expeditiously as reasonably possible.

6.4.3.1 Protection of human health and the environment; attainment of remediation goals

In situ enhanced biodegradation is a proven technology for effectively addressing the dissolved organic COIs that are characteristic contaminants at MGP sites. The technology may be capable of reducing residual COI concentrations to below the RBSLs over time.

6.4.3.2 Compliance with applicable federal, state, and location regulations

In situ enhanced biodegradation would comply with applicable regulations and may be capable of achieving compliance with RBSL Standards under appropriate conditions.

6.4.3.3 Long-term effectiveness and permanence

In situ enhanced biodegradation offers permanent destruction and removal of organic COIs from the saturated zone. However, the treatment time required to achieve specific concentrations is dependent on starting concentrations and rates of biodegradation that would be established during implementation. As a result, the timeframe for achieving compliance with RBSL Standards cannot be readily predicted.

6.4.3.4 Reduction of toxicity, mobility, and volume

In situ enhanced biodegradation would enhance rates of COI biodegradation, resulting in the conversion of organic contaminants to cellular biomass, carbon dioxide, and water. Therefore, the technology would effectively reduce contaminant mass, mobility, and toxicity.

6.4.3.5 Short-term effectiveness

The implementation and operation of *in situ* enhanced biodegradation at the Site poses very little disruption to the community or the local environment. The rate at which dissolved COI concentrations would be reduced is related to the mass of contamination located within the area of influence of the oxygen diffusion wells and the associated oxygen demand resulting from contaminant biodegradation. Areas of the Site that do not respond favorably to *in situ* enhanced biodegradation may contain significant residual contaminant mass and, therefore, may require longer treatment times, closer spacing of oxygen diffusion wells, or application of more aggressive treatment technologies (ISCO, for example). In general, it is expected that reductions of dissolved COI concentrations would occur gradually, but steadily, following implementation of the technology.

6.4.3.6 Implementability

The technology is easily implemented using conventional well construction and materials. The oxygen diffusion systems do not require electrical power. Oxygen gas is supplied using standard compressed gas cylinders. Maintenance consists of cylinder replacement (approximately monthly) and periodic cleaning of the diffusion contactors. The technology offers great flexibility and the diffusion contactors can be moved from one well to another in response to monitoring data. Simple dissolved oxygen monitoring can be conducted by measuring DO consumption in the diffusion wells (or adjacent monitoring wells) after the flow of oxygen is shut off. Areas that exhibit rapid DO consumption may indicate the presence of significant residual contaminant mass, while low rates of DO consumption may indicate that most of the contaminant mass has been depleted.

6.4.3.7 Cost

The cost estimate for the *in situ* enhanced biodegradation technology for source treatment assumes that up to 37 wells would be used for oxygen diffusion. It is further assumed that gas cylinders would be replaced on a monthly basis, and the systems would be operated for a period of 8 years. A detailed breakdown of estimated costs is provided in Appendix A.

Implementation of the *in situ* enhanced biodegradation technology would be expected to cost approximately $421,189, with annual costs for operation and maintenance of about $45,000 per year including groundwater monitoring. Therefore, the estimated present value for implementation and 8 years of operation is approximately $737,075.

6.4.3.8 Community and state acceptance

The *in situ* enhanced biodegradation approach would not generate significant noise, truck traffic, dust, or odor. It is anticipated that the technology would be readily acceptable to the community and the state.

6.4.4 *In situ* chemical oxidation

ISCO is an aggressive, yet fairly unobtrusive, method of managing groundwater and soil contamination. For MGP sites, the most effective oxidants include Fenton's Reagent (catalyzed hydrogen peroxide), and sodium persulfate. In preparing for an ISCO remedy, a bench study would be performed to determine the optimum oxidant and concentrations for soils and contaminants at this site.

ISCO has been demonstrated to be effective at reducing concentrations of dissolved organic COI and residual NAPL within soils, typical of MGP sites.

Long-term risks associated with the technology are associated with the possibility that ISCO preferentially destroys organic matter which had acted as sorption sites for MGP residuals; and, with the resulting change in sorptive capacity, NAPL may coalesce as a free phase and migrate. Contaminant contact in proximity of the Duke Power Substation and Chinquapin Creek areas is not expected to be optimal because setbacks will be required to hydraulically control the oxidant and prevent potential upwelling in proximity to the substation and Chinquapin Creek. Additionally, oxidant contact with the targeted contamination is a fundamental problem with ISCO injection. The injected oxidant follows preferential pathways (also where most contamination is found) and may miss materials which have diffused into less transmissive geologic strata, such as the saprolitic zone. This is often demonstrated by short-term reduction of dissolved constituent concentrations, followed by a "rebound" in constituent concentrations.

ISCO is a rapidly developing treatment method, and implementation is fairly straightforward. Several contractors are available, most using a proprietary injection mechanism or tool in an attempt to obtain distinction in the marketplace. Given that remediation at the Spartanburg site will be focused on coal tar residuals in partially weathered rock and fractured bedrock, direct-push injection methods will not be feasible and, therefore, auger or coring drilling methods will be necessary to install the injection points.

A conceptual injection well layout is included on Figure 6-2. This conceptual approach assumes that each injection well would achieve an effective radius of influence of about 10 feet. Therefore, approximately 166 injection wells would be installed at a spacing of approximately 20 feet on center. The wells would be installed to an average depth of 20 ft bgs with 10 feet of well screen to focus treatment on the saturated zone above the bedrock.

In addition to normal remediation permits, an Underground Injection Control (UIC) permit would also be required, as well as notification (and potential permit requirements) to the local fire department that strong oxidants will be stored on site temporarily.

6.4.4.1 Protection of human health and the environment; attainment of remediation goals

The use of ISCO in the saturated zone soils will result in the rapid destruction of organic COI, removing the source of dissolved-phase contamination. As a result, successful implementation of ISCO will provide a high degree of protection of human health and the environment. Due to inherent variability in subsurface geologic/hydrogeologic conditions, some areas may be more completely treated than others; and, therefore, dissolved COI concentrations in the areas of the Site that are not effectively treated may exhibit a gradual rebound as COIs bound to soils or contained in residual NAPL partition back into the groundwater. Nevertheless, it is expected that this aggressive ISCO implementation approach will achieve sufficient COI mass reduction to allow natural attenuation mechanisms to achieve the RBSLs.

6.4.4.2 Compliance with applicable federal, state, and local regulations

This remedial alternative complies with all applicable regulations. Underground injection of chemical oxidants must be permitted by the SCDHEC, but the use of this remedial technology is well established.

6.4.4.3 Long-term effectiveness and permanence

ISCO results in the destruction of organic COIs via oxidation of the hydrocarbon to carbon dioxide and water. This reaction is rapid, energetic, and complete under optimum conditions. The approach to ISCO implementation for the Site is expected to eliminate most of the source area COI mass. Residual impacts in proximity of the Duke Power Substation and Chinquapin Creek are expected to be controlled by natural attenuation mechanisms and/or enhanced biodegradation processes.

6.4.4.4 Reduction of toxicity, mobility, and volume

In the short-term, ISCO using modified Fenton's Reagent may result in the production of heat due to exothermic decomposition of the reagent, which may decrease the viscosity of coal tar residuals and increase constituent solubility. Therefore, short-term mobilization of NAPL and increased concentrations of dissolved constituents have been observed at some sites. However, ISCO would effectively destroy contacted organic COI mass in the source zone rapidly, completely, and without unwanted byproducts. As the contaminant mass is reduced, its effect on groundwater quality will diminish, resulting in a decrease in the areal extent and volume of the dissolved COI plume, enabling natural attenuation processes to more effectively control constituent migration and ultimately achieve RBSLs.

6.4.4.5 Short-term effectiveness

Since current site conditions do not pose a risk to human health or the environment, there is no imminent threat that requires short-term mitigation. As described above, ISCO implementation may cause short-term or localized mobilization of NAPL and/or increased dissolved constituent concentrations. Such effects are transient and significant reduction in contaminant mass is expected. ISCO implementation would not have significant adverse impact on the community.

6.4.4.6 Implementability

The radius of influence of the ISCO injection wells is anticipated to be on the order of about 10 feet, requiring a relatively dense network of injection wells. Nevertheless, installation of the injection wells can be completed relatively easily by a drilling contractor using conventional drilling equipment and well materials. Depending on attainable flow rates, target volumes, and performance monitoring results, injection activities may require up to 60 days to complete.

6.4.4.7 Cost

The cost estimate for implementing ISCO at the Site is based on the following set of assumptions (a detailed breakdown of estimated costs is provided in Appendix A):

- ISCO would require the installation of up to 166 temporary injection wells spaced approximately 20 feet on center. A total of approximately 460,000 gallons of oxidant would be delivered to groups of wells on a rotating basis over a period of up to 7.5 months. Following ISCO treatment, groundwater monitoring would be performed on a semiannual basis until three events in a row displayed levels below RBSLs.
- Groundwater monitoring and reporting would be conducted semiannually for up to 5 years following the completion of ISCO.

Based on the use of Modified Fenton's Reagent, the estimated cost for implementation of ISCO would be about $2,780,000, with annual costs for monitoring and reporting of about $25,000 per year. The estimated present value for the ISCO approach is expected to total approximately $2,894,000, assuming operations and maintenance (O & M) for 5 years following injection.

6.4.4.8 Community and state acceptance

This technology carries limited risk to the environment and surrounding community. The risk comes from the need to store and handle a strong oxidizer as part of the ISCO remedial technology. Increased security and awareness by the local fire department would be required during this implementation. Because this is an aggressive *in situ* strategy, it is unlikely that the community would object; however, due to the dangerous nature of materials used, neighbors or city officials may prove wary of the approach, especially considering the low risk associated with existing conditions. During injection of some oxidants; the vigorous exothermic reaction causes upwelling and/or the discharge of steam which, though usually harmless, can prove alarming to the surrounding community. ISCO is a widely used technology on MGP sites and should reduce COI in groundwater below RBSLs following natural attenuation of any residual contamination that could not be contacted by the oxidant.

6.4.5 *In situ* solidification

The ISS approach would solidify the impacted saturated zone soils, thereby reducing the permeability of the soil matrix and potential for COIs to leach into groundwater. ISS would require the excavation and stockpiling of the clean fill placed during the previous vadose zone remedial excavation. Once the clean fill is excavated and stockpiled, solidification will extend to a maximum depth of about 18 feet bgs and will penetrate the saturated zone by up to 10 feet. At the Spartanburg site, ISS may be complicated by difficult augering conditions within the saprolite; however, it is assumed that penetration to 18 feet bgs will be achievable.

ISS eliminates the need for traditional dewatering methods because the process is implemented *in situ*. ISS typically generates between 20 to 35 percent spoils due to the addition of grout and the fluffing of the existing soils which will require off-site disposal. Figure 6-3 shows the anticipated limits of remediation for this approach. Based on the approximate limits of remediation, the ISS alternative would produce approximately 21,325 cubic yards of clean fill for stockpiling and reuse and 20,189 cubic yards of saturated zone soils would be solidified *in situ*. Once solidified, the unsaturated zone would be backfilled with the stockpiled clean fill previously removed. Groundwater monitoring would be performed on a periodic basis to document the reduction of dissolved COIs over time.

6.4.5.1 Protection of human health and the environment; attainment of remediation goals

Solidification of contaminated soils is an established method for managing source materials at MGP sites. ISS is a very effective technology for saturated zone soils that are physically accessible. ISS of the area shown in Figure 6-3 would address most of the soils that contain residual NAPL and, therefore, would remove most of the contaminant mass that constitutes a long-term impact to groundwater quality. Following the completion of this alternative, it is expected that natural attenuation processes would result in the reduction of dissolved COIs to RBSLs in a timeframe of 5 years.

6.4.5.2 Compliance with applicable federal, state, and local regulations

ISS is a proven technology that has been implemented in both the unsaturated and saturated zones of MGP sites across the country, and complies with applicable regulations. Local permits may be required for excavation activities. Incorporation of solidification additives (Portland cement, cement kiln dust, etc.) may require permitting by SCDHEC. ISS has the potential for VOC emissions and, therefore, an air discharge permit may be required. Air monitoring will be necessary to ensure that discharges are maintained below allowable limits.

6.4.5.3 Long-term effectiveness and permanence

ISS of saturated zone soils would provide an effective and permanent means of mitigating the potential risks posed by this material at the Site. The contamination would not be destroyed but, instead, would be solidified in place reducing the potential for COI contact with groundwater. It is expected that sequestering contaminant mass within the saturated zone soils through ISS would facilitate relatively rapid reduction in the concentrations of dissolved COIs to ultimately achieve the groundwater RBSLs.

6.4.5.4 Reduction of toxicity, mobility, and volume

ISS is a direct, immediate, physical solidification of the contaminant mass at the Site. Reducing permeability and leachability of the soils surrounding the source of the COI would limit the mobility of the COI and its recharge of the dissolved phase plume, thereby leading to a decrease in plume size and concentration.

6.4.5.5 Short-term effectiveness

The benefits resulting from the quick stabilization of contaminant mass from the subsurface would be somewhat balanced by possible short-term adverse conditions during remedy implementation. ISS may require protection and/or relocation of subsurface and overhead utilities due to the height of the rig mast. In addition ISS may create community disruption due to nuisance odors, dust, and truck traffic (the ISS spoils may require up to 160 dump truck loads for removal and approximately 50 truck loads of Portland cement).

6.4.5.6 Implementability

The undeveloped and open characteristics of the Site are amenable to ISS. The installation of solidified columns may be complicated by geologic conditions, subsurface debris, and the presence of overhead electric lines including the Duke Power Substation in the eastern portion of the Site. The overhead power lines may require relocation but it is not probable; and soils beneath the Substation will not be accessible to equipment as with the previous remediation (2003-2004) and will be left in place at this time. The ISS approach would be expected to require about 7 months to complete, from initial mobilization to the completion of site restoration.

6.4.5.7 Cost

The cost estimate for the ISS approach is based on the following set of assumptions (a detailed breakdown of estimated costs is provided in Appendix A):

- ISS will require the removal and stockpiling of approximately 21,325 cubic yards of clean fill placed in the unsaturated zone during the Site remediation performed between 2003 and 2004. ISS of the saturated zone will solidify approximately 20,189 cubic yards of soil for a total cost of $4,193,015.
- Groundwater monitoring and reporting would be conducted semiannually for up to 5 years following the completion of soil remediation at a cost of $25,000 per year.

The total present value estimated for the ISS approach is $4,307,508.

6.4.5.8 Community and state acceptance

Disruption to the community would include heavy truck traffic (at least 160 trips), potential for dust and odors, and a potential for loud noise associated with heavy equipment operation (batch plant and soil mix rig in particular). Some opposition to the project by the community is expected; and the project duration of 7 months would be the second longest of the remedial technologies and would require intense interaction and public relations with the community. In addition, the State may oppose this approach since it does not achieve permanent destruction or removal of the COI mass from the subsurface.

6.4.6 Saturated zone excavation

The saturated zone excavation approach would remove the impacted saturated zone soil and partially weathered rock in the area of the former MGP operations. This approach would require the excavation and stockpiling of the clean fill placed during the previous vadose zone remedial excavation. Once the clean fill is removed, the excavation would extend to a maximum depth of about 18 feet bgs and would penetrate the saturated zone by up to 8 feet. Due to the layout of the Site, the depth of excavation, and the need for dewatering, sloping would likely not be feasible and excavation shoring would be required in a majority of the Site. Figure 6-4 shows the anticipated limits of excavation for this approach. Based on the anticipated excavation limits, the saturated zone excavation alternative would produce approximately 21,325 cubic yards of clean fill for stockpiling and reuse and 20,189 cubic yards of saturated zone soils for transportation and disposal. Water produced by dewatering operations would be pumped to storage tanks, treated via granular activated carbon (GAC) filtration, and discharged to the City of Spartanburg sanitary sewer system. The excavation area would be backfilled with clean fill and the excavation shoring removed from the Site. Groundwater monitoring would be performed on a periodic basis to document the reduction of dissolved COIs over time.

6.4.6.1 Protection of human health and the environment; attainment of remediation goals

Excavation and disposal of contaminated soils is an established method for managing source materials at MGP sites. Excavation is a very effective technology for soils that are physically accessible. Excavation of the area shown in Figure 6-4 would address most of the soils that contain residual NAPL and, therefore, would remove most of the contaminant mass that constitutes a long-term impact to groundwater quality. Following the completion of this alternative, it is expected that natural attenuation processes would result in the reduction of dissolved COIs to groundwater RBSLs in a timeframe of 5 years.

6.4.6.2 Compliance with applicable federal, state, and local regulations

Excavation and disposal of impacted soil at an approved landfill is consistent with all applicable laws and is a common practice for former MGP sites and was previously performed at the Site for unsaturated zone soils. It is expected that the excavated material would be acceptable for disposal in a Subtitle D landfill as non-hazardous waste, following appropriate characterization as required by the disposal facility. The post-remediation phase of groundwater monitoring will demonstrate the extent to which source removal was sufficient to achieve the RBSLs for groundwater at the Site. Local permits may be required for excavation activities. Since excavation has the potential for VOC emissions and, therefore, an air discharge permit may be required. Air monitoring will be necessary to ensure that discharges are maintained below allowable limits.

6.4.6.3 Long-term effectiveness and permanence

Excavation and off-site disposal of the source area soils containing residual NAPL would provide an effective and permanent means of mitigating the potential risks posed by this material at the Site. The contamination would not be destroyed but instead would be transferred to a secure, lined landfill for isolation and permanent containment. It is expected that the substantial reduction in contaminant mass from the saturated and smear zone soils would facilitate relatively rapid reduction in the concentrations of dissolved COIs to ultimately achieve the RGs.

6.4.6.4 Reduction of toxicity, mobility, and volume

Excavation and disposal is a direct, immediate, physical reduction of contaminant mass and volume from the Site. Removing the source of the COI would limit its recharge of the dissolved phase plume, thereby leading to a decrease in plume size and concentration.

6.4.6.5 Short-term effectiveness

The benefits resulting from the quick elimination of contaminant mass from the subsurface would be somewhat balanced by possible short-term adverse conditions during remedy implementation. Saturated zone excavation may require protection and/or relocation of subsurface and overhead utilities. In addition, deep excavation may create community disruption due to nuisance odors, dust, and truck traffic (the excavated soil may require up to 700 dump truck loads for removal from the Site).

6.4.6.6 Implementability

The undeveloped and open characteristics of the Site are amenable to excavation. The installation of excavation shoring may be complicated by topography, and the presence of overhead electric lines including the Duke Power Substation in the eastern portion of the Site. The overhead lines may require relocation or de-energizing (if possible), and soils beneath the Substation will not be accessible to excavation equipment and, as with the previous remediation (2003-2004), will be left in place at this time. The saturated zone excavation approach would be expected to require about 7.5 months to complete, from initial mobilization to the completion of site restoration.

6.4.6.7 Cost

The cost estimate for the saturated zone excavation approach is based on the following set of assumptions (a detailed breakdown of estimated costs is provided in Appendix A):

- Excavation will require the removal and stockpiling of approximately 21,325 cubic yards of clean fill placed in the unsaturated zone during the Site remediation performed between 2003 and 2004.
- Excavation of the saturated zone will remove approximately 20,189 cubic yards of soil for off-site disposal in a certified landfill, and the removed soil will be replaced with clean fill. Dewatering and water treatment will be required for soil removal below the water table. Excavation shoring will be required for the excavation of all soils in a majority of the Site to complete excavation in proximity to Chinquapin Creek and the Duke Power Substation. The estimated cost associated with excavation, dewatering, and backfilling is $6,258,847.
- Groundwater monitoring and reporting would be conducted semiannually for up to 5 years following the completion of soil remediation at a cost of $25,000 per year.

The total estimated present value for the Saturated Zone Excavation approach is $6,373,340.

6.4.6.8 Community and state acceptance

Disruption to the community would include heavy truck traffic (at least 700 trips), potential for dust and odors, and a potential for loud noise associated with heavy equipment operation (shoring installation in particular). Some opposition to the project by the community is expected; and the project duration of 7.5 months would be the longest of the remedial technologies and would require intense interaction and public relations with the community.

6.4.7 Summary of remedial technology evaluations

The detailed evaluations presented in this section demonstrate that the individual technologies vary considerably with respect to the eight evaluation criteria, and no single remedial approach is capable of completely achieving the RAOs for the Site. Table 6-1 briefly summarizes the remedial technology evaluations. A comparison of the estimated costs associated with the implementation and operation/monitoring of the active remedial alternatives is provided in Table 6-2.

7.0 References

Blue Ridge, 2004. *Screening Level Ecological Risk Assessment for the Spartanburg Pine Street MGP Site.* Prepared by Blue Ridge Environmental Consulting, Inc. July 2004.

CES, 2004. *Trespasser Focused Risk Evaluation Report, Spartanburg Former Manufactured Gas Plant Site, Spartanburg, South Carolina.* Prepared by Corporate Environmental Solutions, LLC, Bridgeville, PA. February 2004.

Duke, 2006. *Spartanburg – Pine Street MGP Site, Final Soil Excavation Summary Report, Spartanburg, South Carolina*. Prepared by Duke Energy Corporation. June 6, 2006.

S&ME, 2005. *Site Assessment Report, Duke Power Pine Street MGP Site.* Prepared by S&ME South Carolina. April 2005.

S&ME, 2008. *Groundwater Summary Report, Pine Street MGP Site, Spartanburg, South Carolina.* Prepared by S&ME. January 30, 2008.

Tables

Table 6-1
Summary of Alternative Analysis
Former Manufactured Gas Plant
Spartanburg, South Carolina

	Remedial Alternatives					
Criterion	**No Action**	**Monitored Natural Attenuation**	***In Situ* Enhanced Biodegradation**	***In-Situ* Chemical Oxidation**	***In Situ* Solidification**	**Saturated Zone Excavation**
Overall protection of human health and the environment	Fair	Fair	Good	Good	Fair	Fair
Compliance with applicable federal, state, and local regulations	Unacceptable	Fair	Good	Good	Good	Good
Long-term effectiveness and permanence	Fair	Fair	Good	Good	Good	Good
Reduction of toxicity, mobility, and volumes	Fair	Fair	Good	Good	Good	Good
Short-term effectiveness	Fair	Fair	Fair	Fair	Good	Good
Implementability	Good	Good	Good	Fair	Difficult	Difficult
Cost	Low	Low	Moderate	High	High	High
State and community acceptance	Poor	Fair	Good	Good	Fair	Fair

Table 6-2
Cost Comparison for Remedial Alternatives
Former Manufactured Gas Plant
Spartanburg, South Carolina

Option	Description	Design[1]	Construction	O & M	O & M Duration (est)	O & M Present Value[2]	Total	-30%	+50%
1	No Action	$ -	$ -	$ -			$ -	$ -	$ -
2	Monitored Natural Attenuation	$ -	$ -	$ 25,000	16	$ 314,028	$ 314,028	$ 219,819	$ 471,041
3	*In Situ* Enhanced Biodegradation	$ 20,057	$ 401,132	$ 45,000	8	$ 315,886	$ 737,075	$ 515,952	$ 1,105,612
4	*In Situ* Chemical Oxidation	$ 132,376	$ 2,647,513	$ 25,000	5	$ 114,493	$ 2,894,381	$ 2,026,067	$ 4,341,572
5	*In Situ* Solidification	$ 199,667	$ 3,993,348	$ 25,000	5	$ 114,493	$ 4,307,508	$ 3,015,256	$ 6,461,262
6	Saturated Zone Excavation	$ 298,040	$ 5,960,807	$ 25,000	5	$ 114,493	$ 6,373,340	$ 4,461,338	$ 9,560,010

Notes:

[1] Design Costs estimated at 5% of construction costs

[2] Present Value calculations assume an estimated time period and a discount rate of 3%

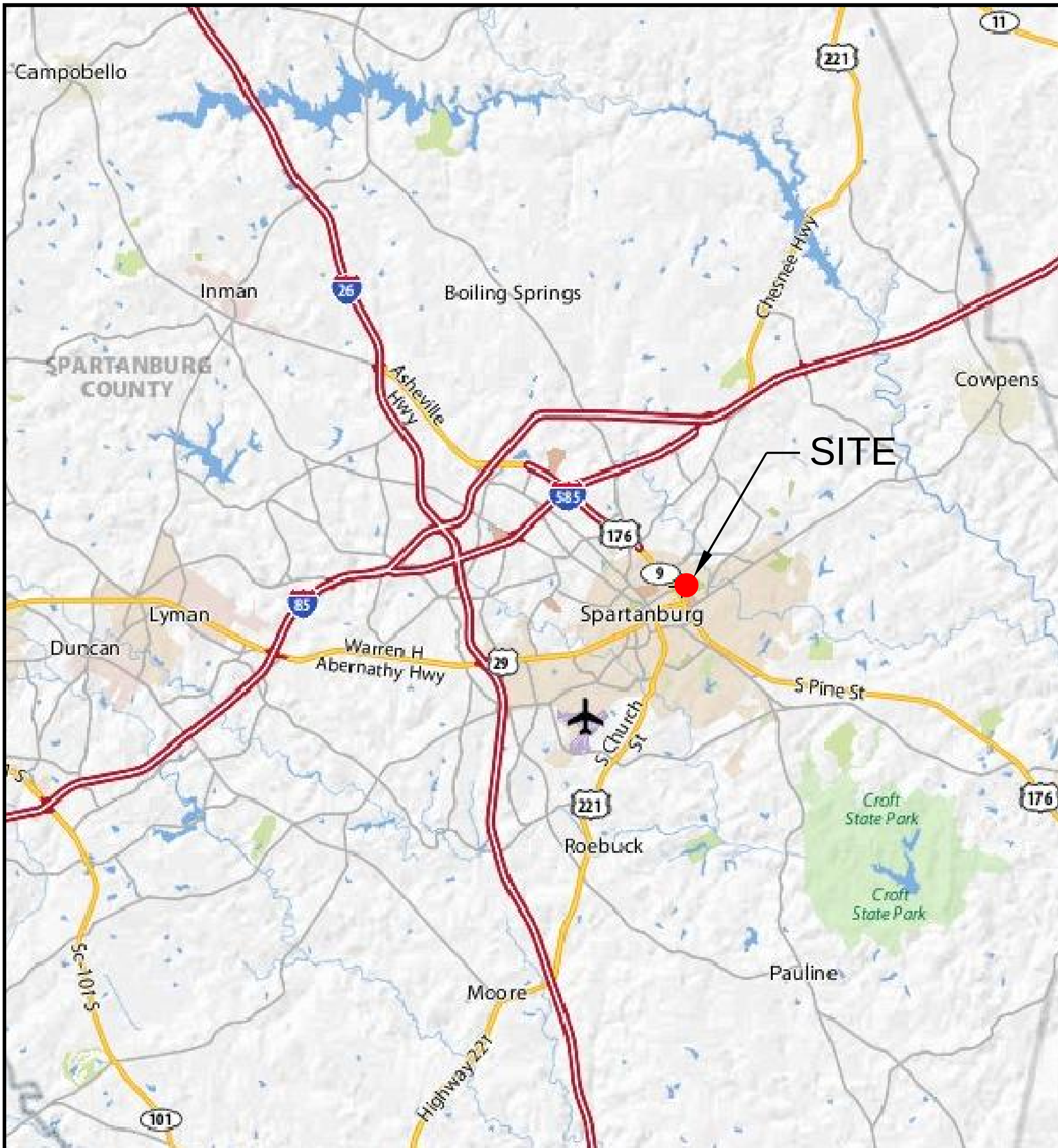
% = percent

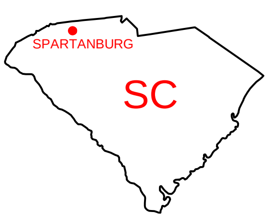
est = estimated

O & M = Operation and Maintenance

Figures

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations-Designs\(01) Task 300\(01) Figures\WS-02355-180-Fig02-1.dwg Layout: Layout1 User: ccampbell Plotted: May 12, 2008 - 3:35pm





SPARTANBURG, SOUTH CAROLINA

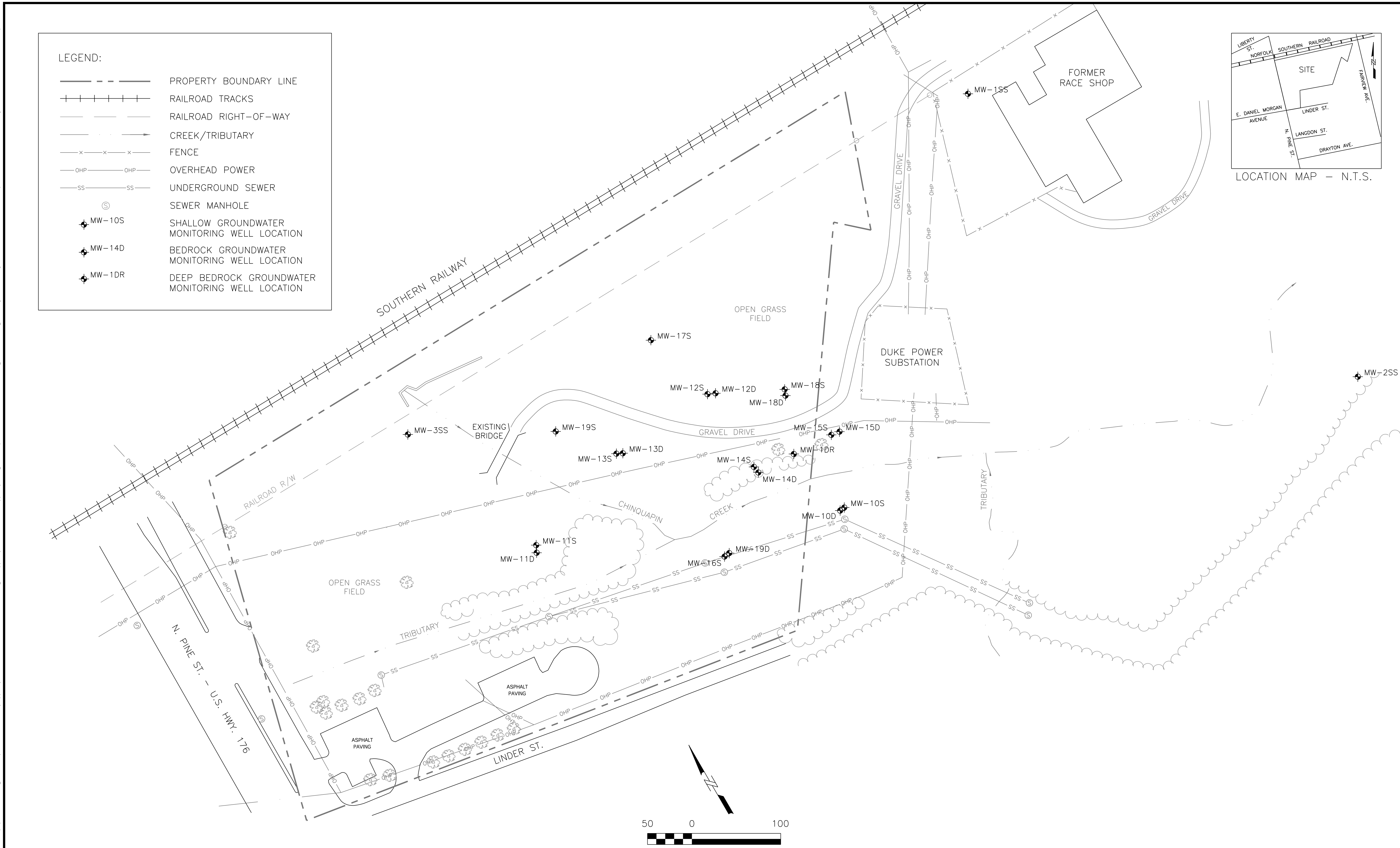
1.5 0 3 MI.

SCALE: 1"=3 MI.
(APPROXIMATE)

N

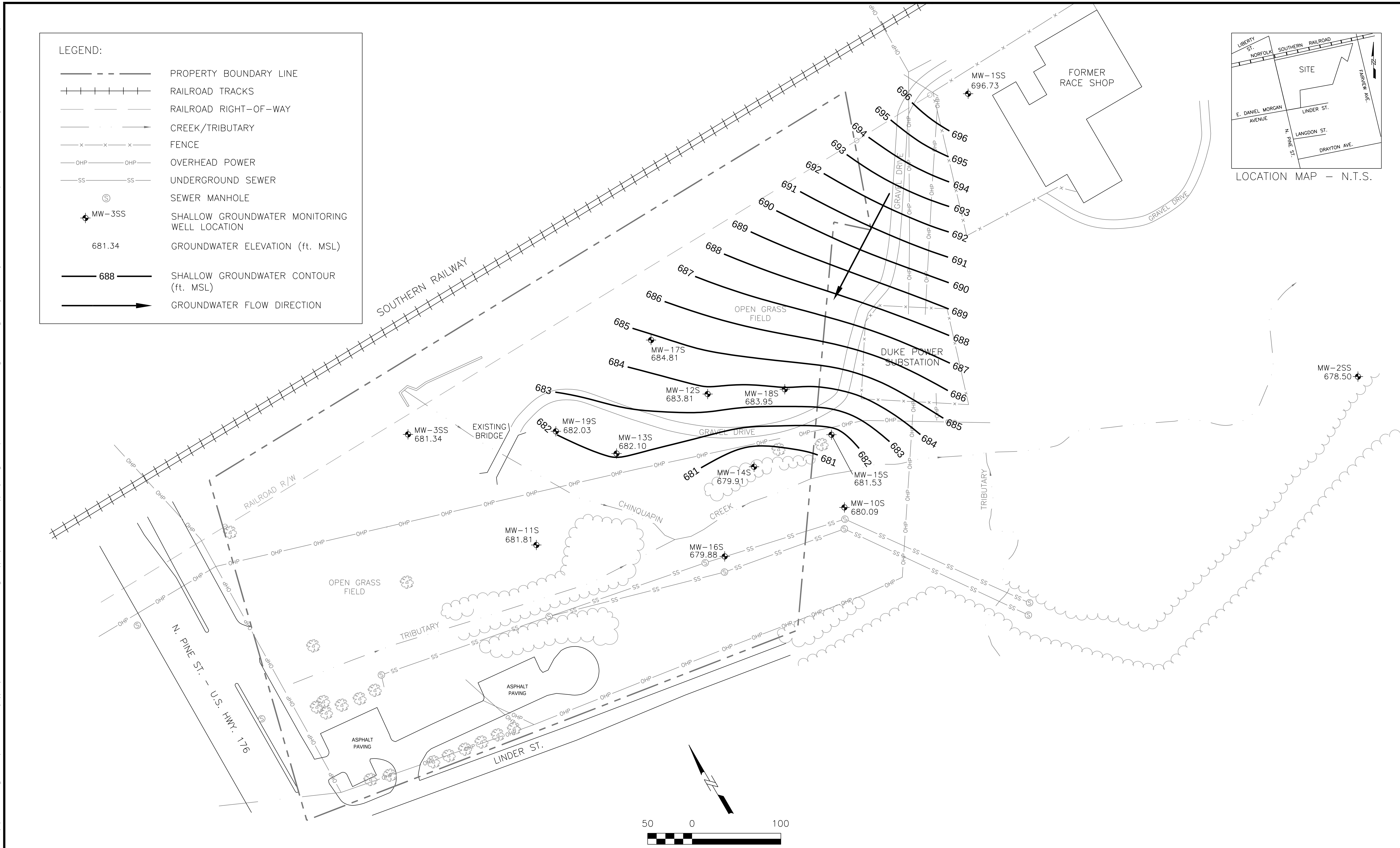
ENSR | AECOM

DUKE ENERGY CORPORATION FORMER MGP SITE SPARTANBURG, SC (02355-180-300))	SITE LOCATION MAP
DATE: 05/09/08 DRWN: C.C./UKN	FIGURE 2-1



ENSR | AECOM

DUKE ENERGY CORPORATION FORMER MGP SITE SPARTANBURG, SC (02355-180-300)	SITE MAP EXISTING CONDITIONS DECEMBER 2007
DATE: 05/20/08 DRWN: C.C./DM	FIGURE 2-2



ENSR | AECOM

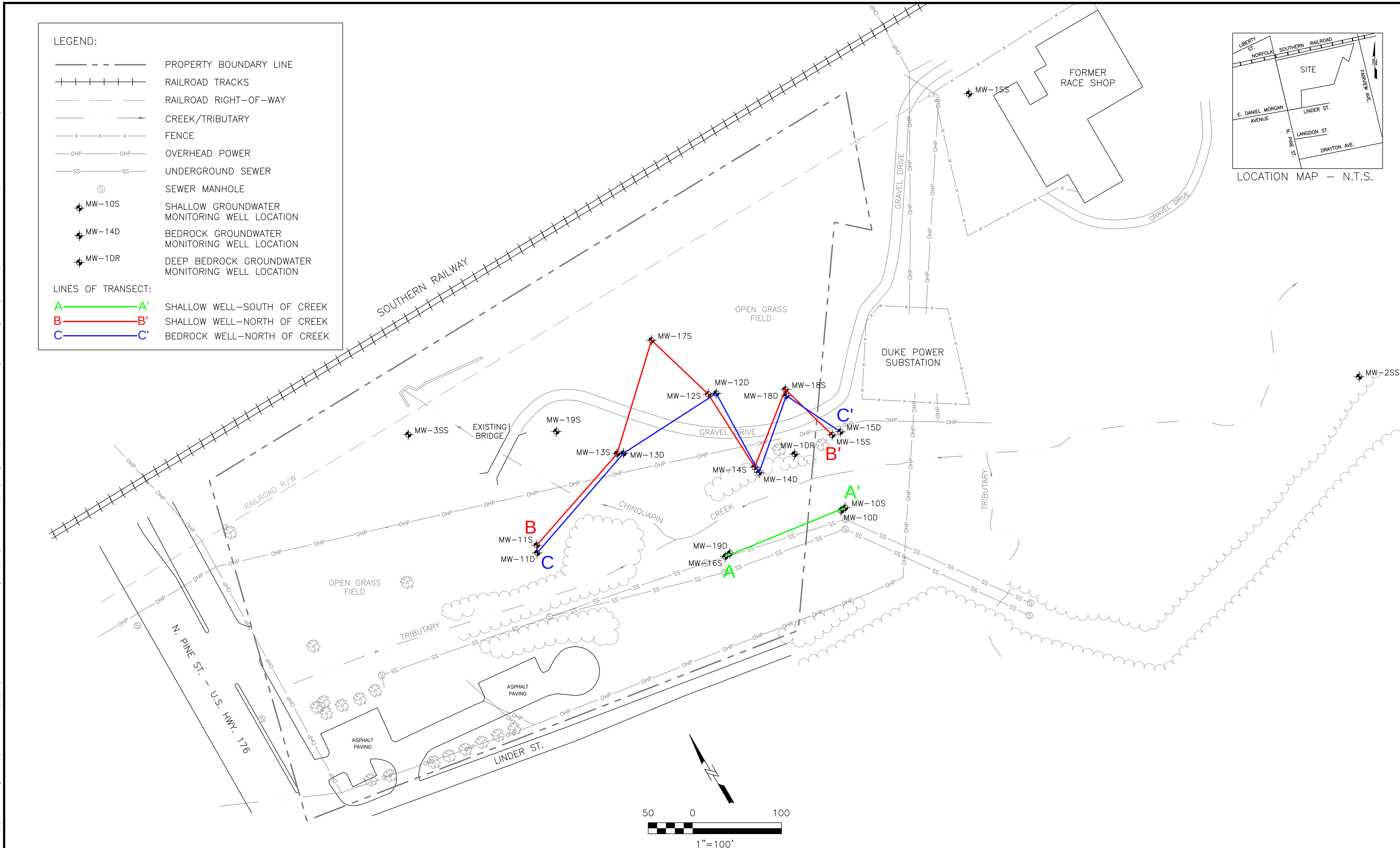
DUKE ENERGY CORPORATION
FORMER MGP SITE
SPARTANBURG, SC (02355-180-300)

GROUNDWATER ELEVATIONS
SHALLOW WELLS
DECEMBER 2007

DATE: 05/20/08 | DRWN: C.C./DM

FIGURE 4-1

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations-Designs\(01) Task 300\(01) Figures\DE-02355-180-Fig04-1.dwg Layout: Layout1 User: ccampbell Plotted: May 20, 2008 - 3:12pm Xref's



ENSR | AECOM

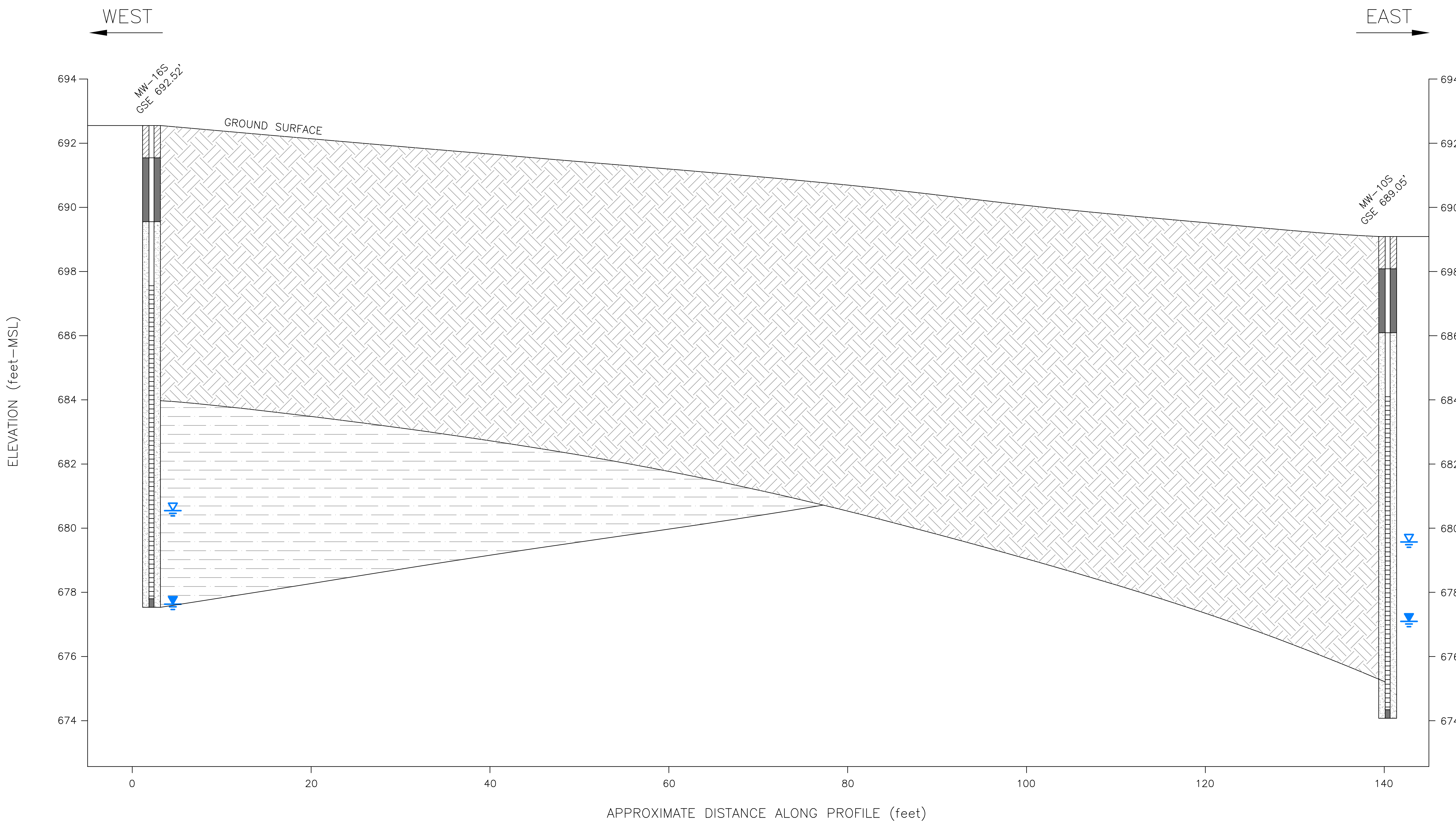
DUKE ENERGY CORPORATION
FORMER MGP SITE
SPARTANBURG, SC (02355-180-300)

LINES OF TRANSECT
A-A', B-B', AND C-C'

DATE: 05/21/08 DRWN: C.C./DM

FIGURE 4-2

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations-Designs\(01) Task 300\(01) Figures\DE-02355-180-Fig04-2.dwg Layout: Layout1 User: ccampbell Plotted: May 21, 2008 - 8:45am Xref's:



LEGEND:

GROUNDWATER, DECEMBER 2004

GROUNDWATER AT TIME OF BORING

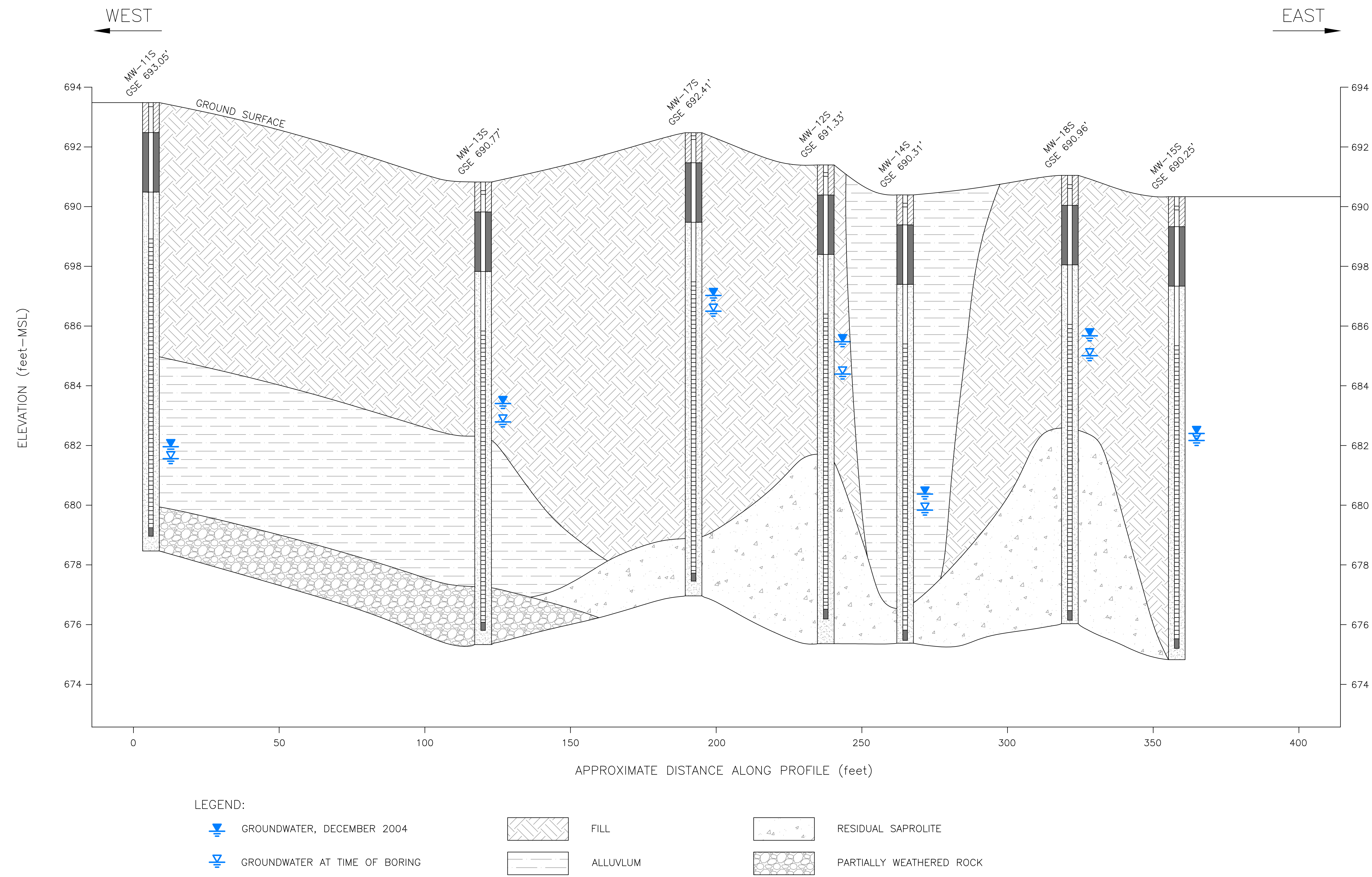
FILL

ALLUVLUM

ENSR | AECOM

DUKE ENERGY CORPORATION FORMER MGP SITE SPARTANBURG, SC (02355-180-300)	CROSS-SECTION A-A' SHALLOW WELLS SOUTH OF CREEK
DATE: 05/15/08 DRWN: C.C./DM	FIGURE 4-3

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations-Designs\(01) Task 300\(01) Figures\NS-02355-180-Fig04-3.dwg Layout: Layout1 User: ccampbell Plotted: May 15, 2008 - 10:47am



ENSR | AECOM

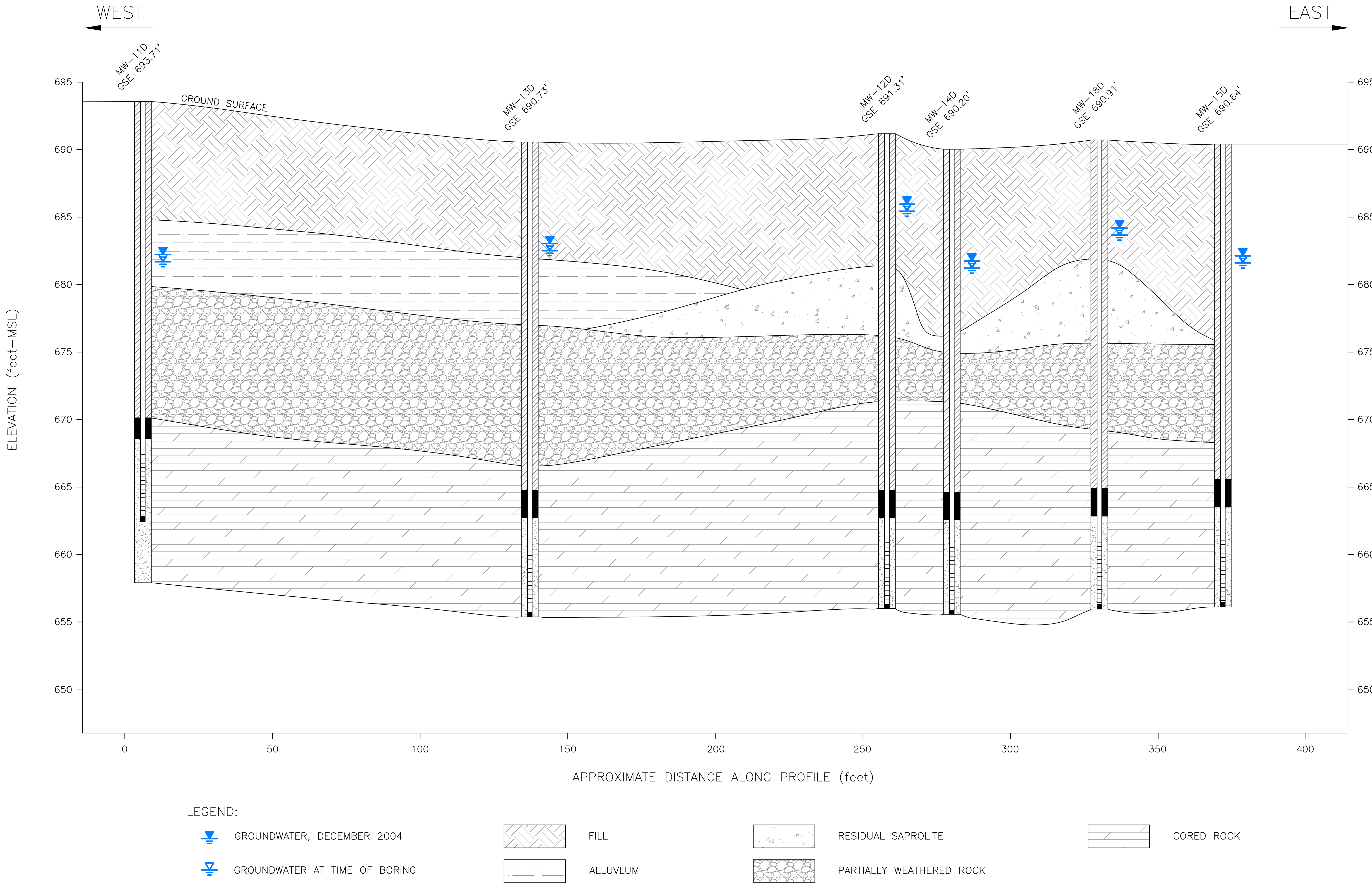
DUKE ENERGY CORPORATION
FORMER MGP SITE
SPARTANBURG, SC (02355-180-300)

DATE: 05/13/08 | DRWN: C.C./DM

CROSS-SECTION B-B'
SHALLOW WELLS NORTH OF CREEK

FIGURE 4-4

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations-Designs\(01) Task 300\(01) Figures\NS-02355-180-Fig04-4.dwg Layout: Layout1 User: ccampbell Plotted: May 15, 2008 - 12:34pm



ENSR | AECOM

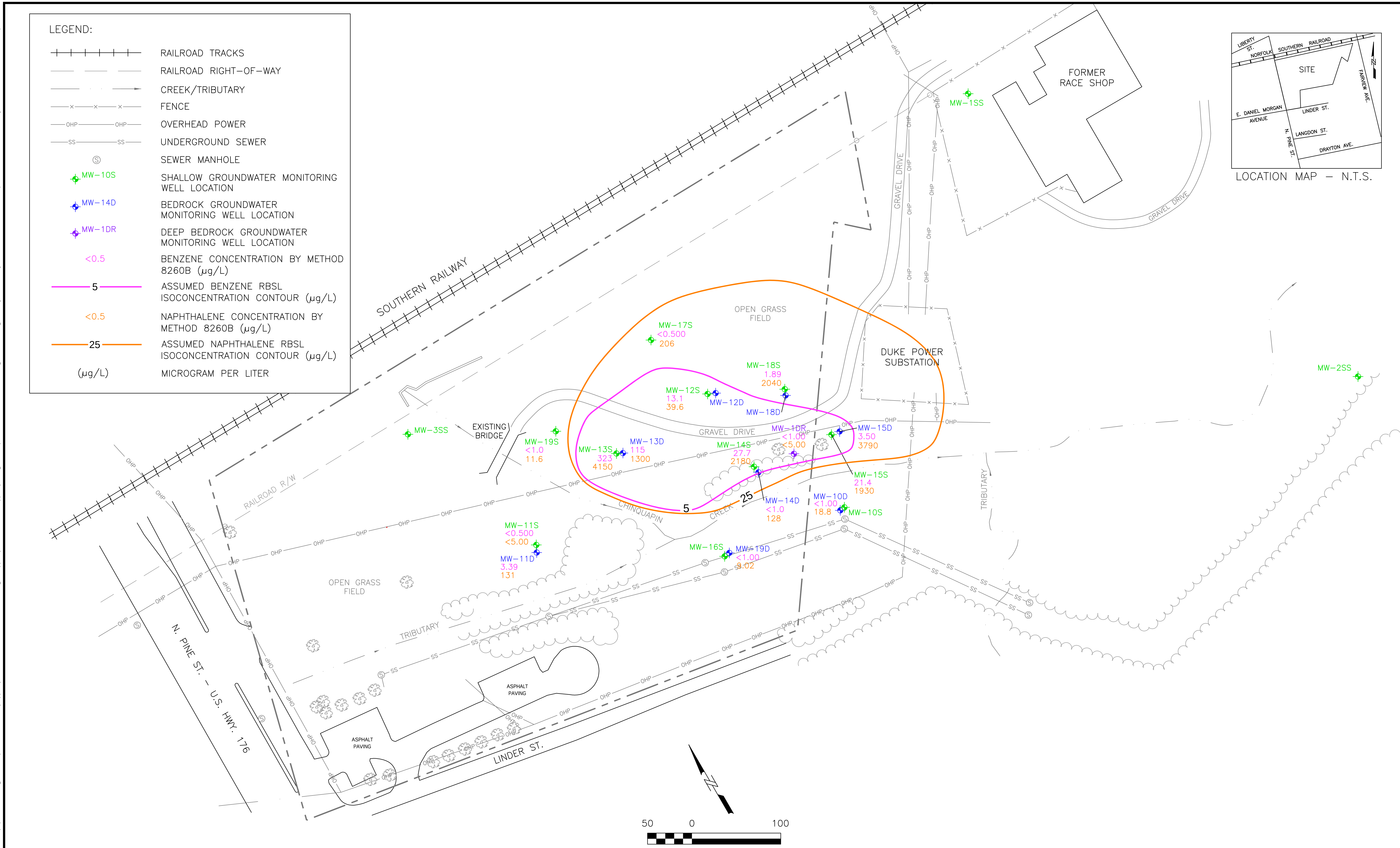
DUKE ENERGY CORPORATION
FORMER MGP SITE
SPARTANBURG, SC (02355-180-300)

CROSS-SECTION C-C'
BEDROCK WELLS NORTH OF CREEK

DATE: 05/15/08 | DRWN: C.C./DM

FIGURE 4-5

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations-Designs\(01) Task 300\(01) Figures\DE-02355-180-Fig05-1.dwg Layout: Layout1 User: ccampbell Plotted: May 20, 2008 - 3:11pm Xref's:



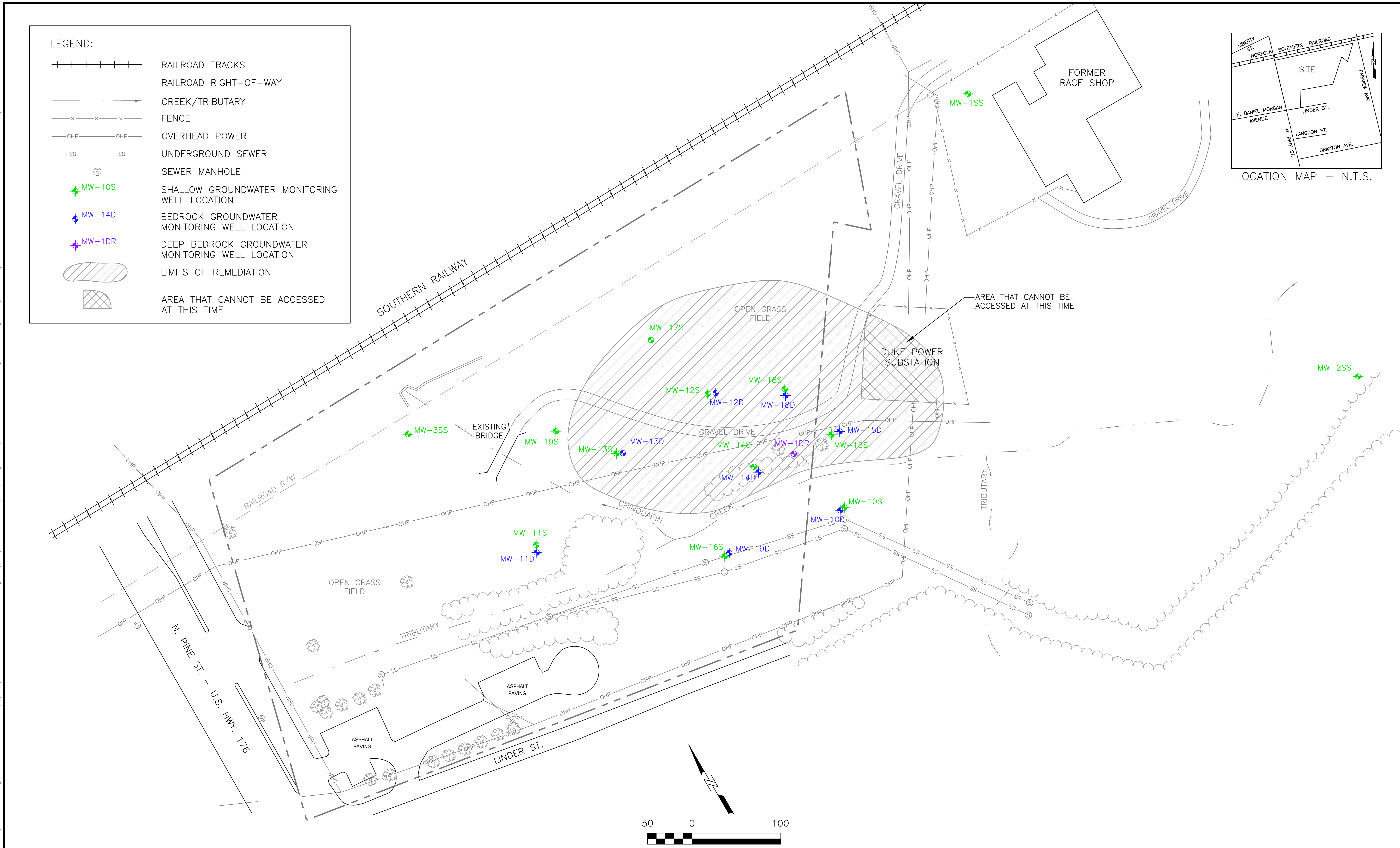
ENSR | AECOM

DUKE ENERGY CORPORATION
FORMER MGP SITE
SPARTANBURG, SC (02355-180-300)

BENZENE AND NAPHTHALENE GROUNDWATER CONCENTRATIONS DECEMBER 2007

DATE: 05/20/08 | DRWN: C.C./DM

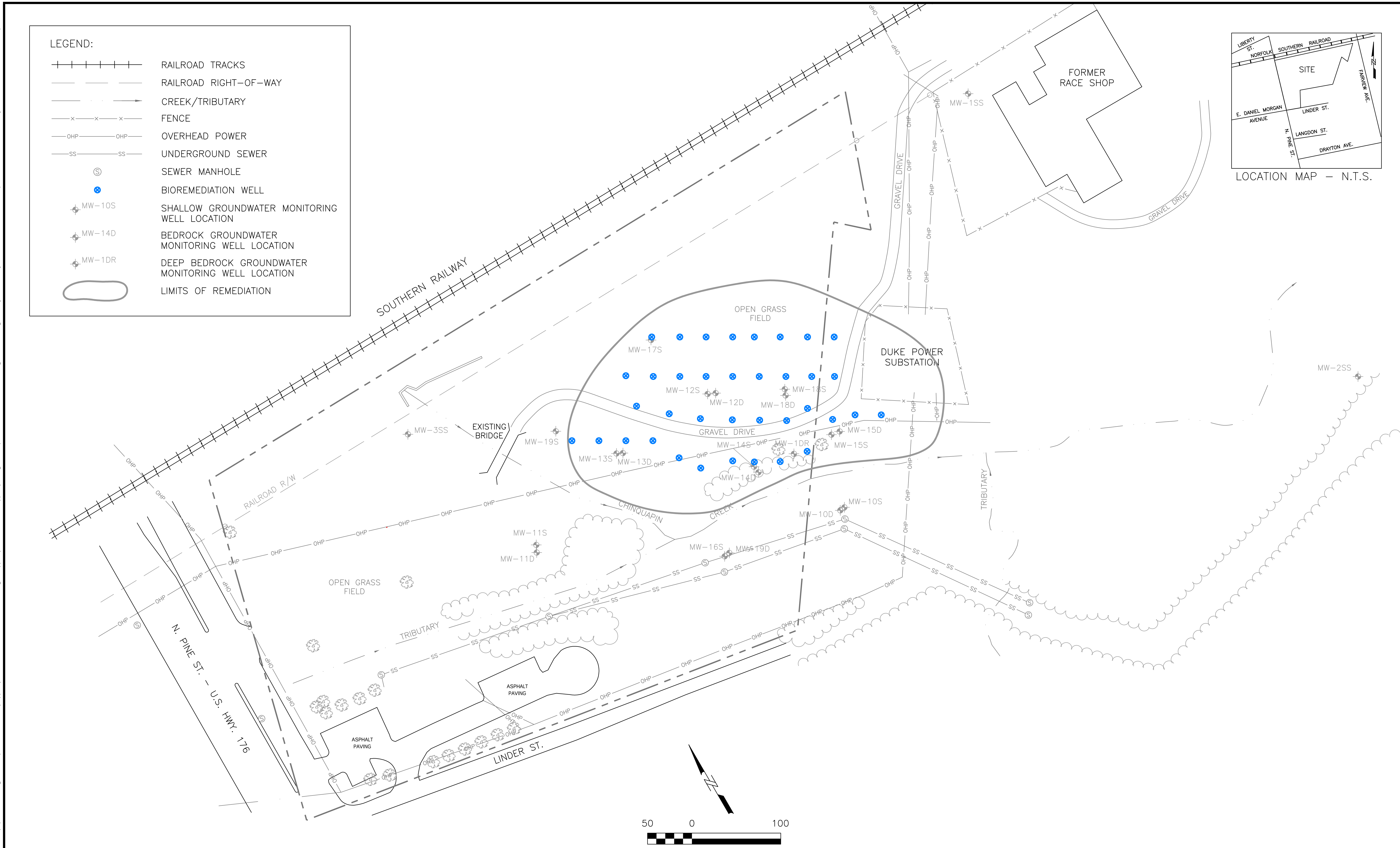
FIGURE 5-1



ENSR | AECOM

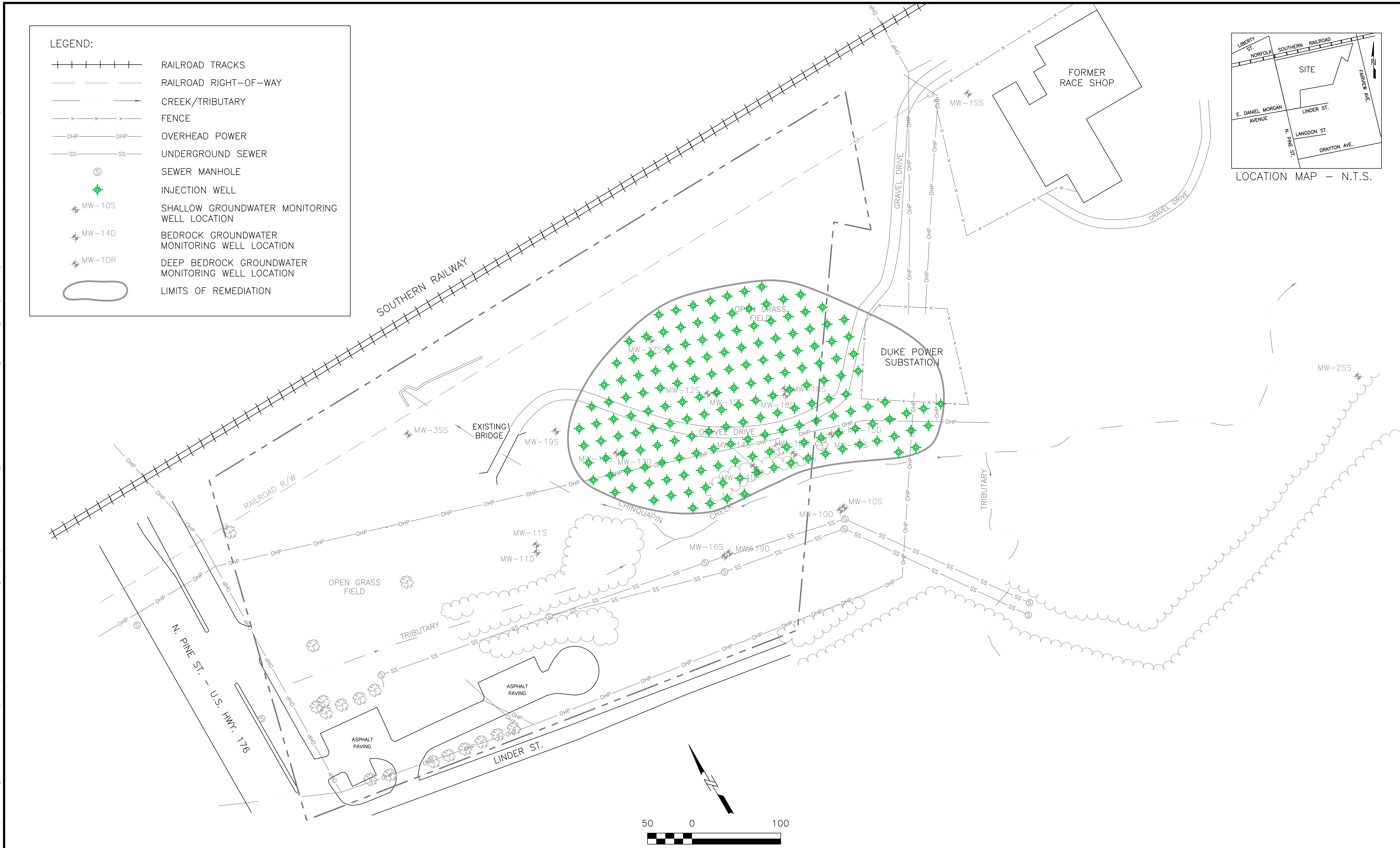
DUKE ENERGY CORPORATION FORMER MGP SITE SPARTANBURG, SC (02355-180-300)	LIMITS OF REMEDIATION
DATE: 05/09/08 DRWN: C.C./DM	FIGURE 5-2

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations-Designs\(01) Task 300\(01) Figures\DE-02355-180-Fig05-2.dwg Layout: Layout1 User: ccampbell Plotted: May 20, 2008 – 3:10pm Xref's:



ENSR | AECOM

DUKE ENERGY CORPORATION FORMER MGP SITE SPARTANBURG, SC (02355-180-300)	IN SITU ENHANCED BIOREMEDIATION CONCEPTUAL LAYOUT
DATE: 05/20/08 DRWN: C.C./DM	FIGURE 6-1



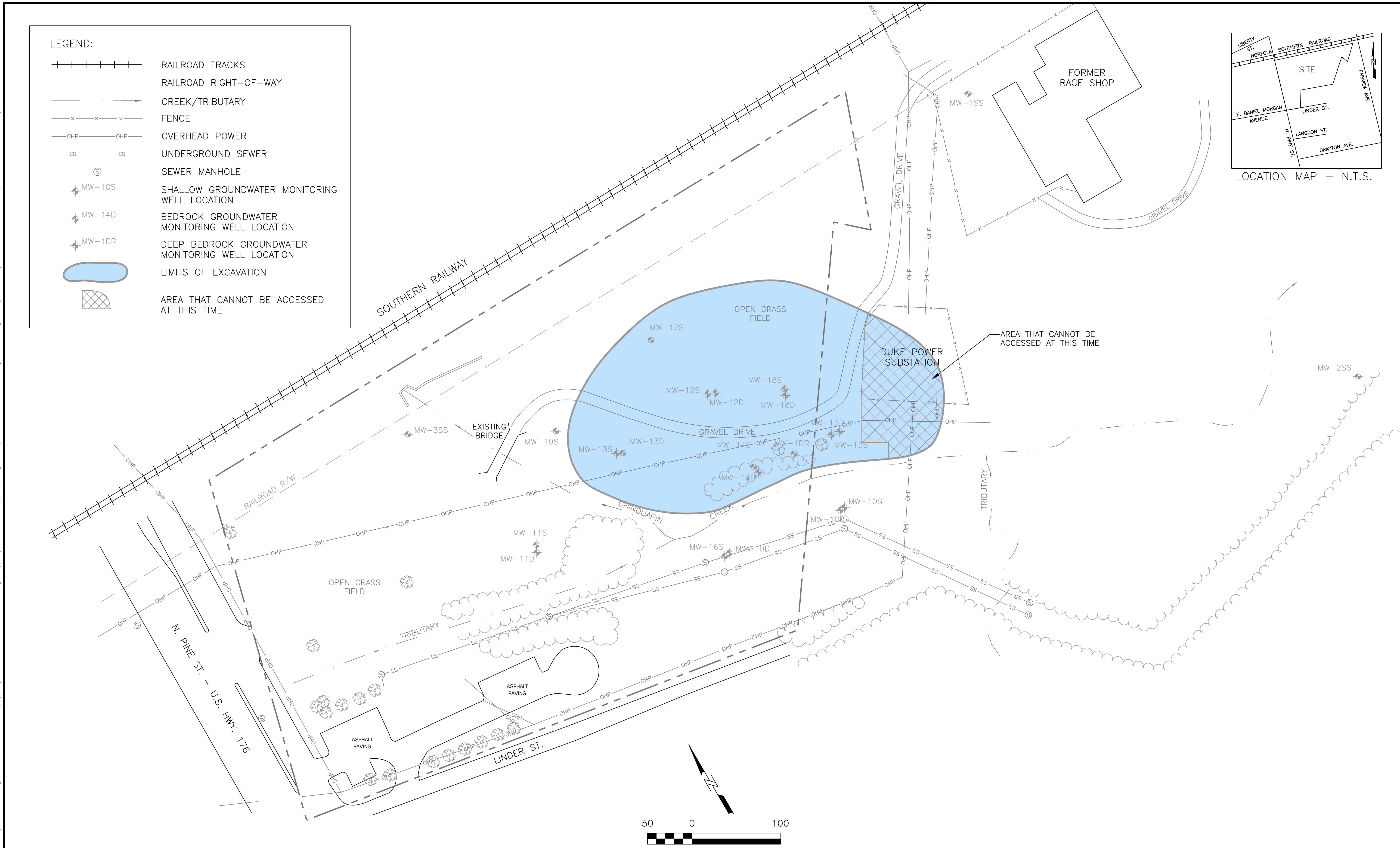
ENSR | AECOM

DUKE ENERGY CORPORATION
FORMER MGP SITE
SPARTANBURG, SC (02355-180-300)

IN SITU CHEMICAL OXIDATION
CONCEPTUAL LAYOUT

DATE: 05/20/08 | DRWN: C.C./DM | FIGURE 6-2

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations-Designs\(01) Task 300\(01) Figures\DE-02355-180-Fig06-2.dwg Layout: Layout1 User: ccampbell Plotted: May 20, 2008 – 3:16pm Xref's:



File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) Task 300\(01) Figures\DE-02355-180-Fig06-3.dwg Layout: Layout1 User: ccampbell Plotted: May 20, 2008 – 3:19pm Xref's:

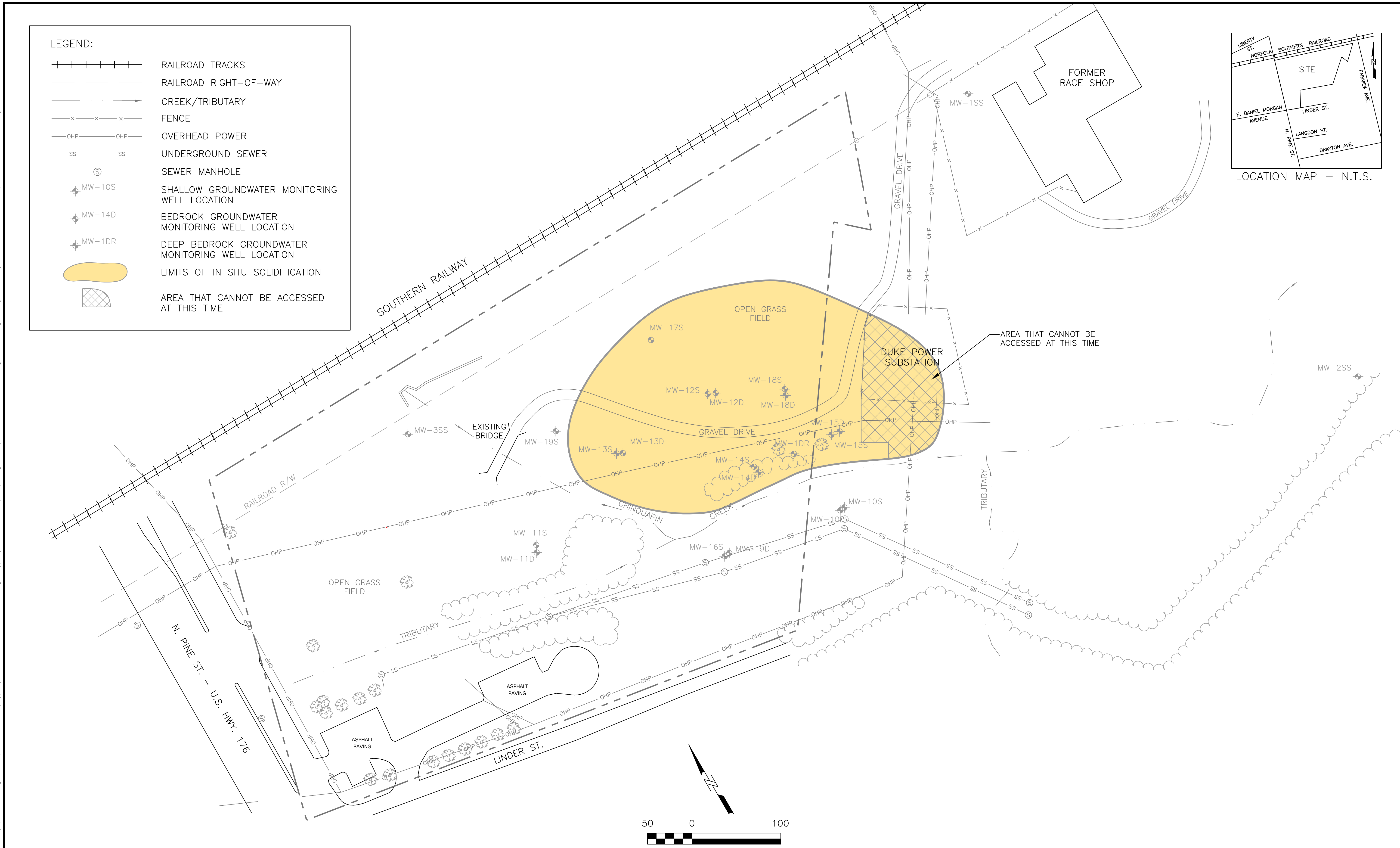
ENSR | AECOM

DUKE ENERGY CORPORATION
FORMER MGP SITE
SPARTANBURG, SC (02355-180-300)

SATURATED ZONE EXCAVATION

DATE: 05/20/08 | DRWN: C.C./DM

FIGURE 6-3



ENSR | AECOM

DUKE ENERGY CORPORATION FORMER MGP SITE SPARTANBURG, SC (02355-180-300)	IN SITU SOLIDIFICATION
DATE: 05/20/08 DRWN: C.C./DM	FIGURE 6-4

File: J:\DUKE ENERGY\Spartanburg, SC (02355-180)\(01) CAD Illustrations–Designs\(01) Task 300\(01) Figures\DE–02355–180–Fig06–4.dwg Layout: Layout1 User: ccampbell Plotted: May 20, 2008 – 3:22pm Xref's:

Appendix A

Detailed Cost Estimates

In Situ Enhanced Biodegradation

Project Name:	Spartanburg MGP	**Revision No.:**	1
Cost Estimate No.:	1	**Date:**	5/22/08
Client	Duke Energy	**Status:**	Draft
Location	Spartanburg, SC	**Author:**	Dpayne
		Office:	St Petersburg
Project Element:	*In Situ* Enhanced Biodegradation	**Reviewed By:**	
Type of Estimate:	Feasibility/Conceptual		

Project Details

Project Location:	Spartanburg, SC
Project Start Date:	
Project Duration:	1.5
Type of Contract:	With RETEC
Level of Accuracy:	*-30% to +50%*
Contingency:	20%

Scope Summary

Treatment Volume:	21570 CY
LF of Sheeting	
Type of Remediation:	*In Situ* Enhanced Biodegradation
Treatment System:	

Document Source:	FFS	**Rev. Date:**	5/9/2008	**Site Visit?**	No
Document Source:		**Rev. Date:**			
Document Source:		**Rev. Date:**			

Cost Summary

Prime Contractor Costs	$	89,830
Other Contracts & Purchases	$	208,125
Oversight Costs	$	103,178
Project Total Estimated Cost	$	401,133

Notes:
1. Note intended use and audience
2. List major project assumptions
3. Accuracy ranges are based on information provided in "Association for Advancement of Cost Engineering (AACE), International Cost Estimating Classifications, 18R-97"

Estimate Type		*Accuracy Range*
Preliminary		*-50% to +100%*
Feasibility/Conceptual		*-30% to +50%*
Engineering		
	30%	*-20% to +30%*
	60%	*-15% to +20%*
	90%	*-10% to +15%*

4. Contingency values are based on information provided in 'USEPA, Guide to Developing Cost Estimates, July 2000

Remediation Technology	*Scope Contingency*
Soil Excavation	*15% to 55%*
Groundwater Treatment (Multiple	*15% to 35%*
On-site Incineration	*15% to 35%*
Extraction Wells	*10% to 30%*
Vertical Barriers	*10% to 30%*
Synthetic Cap	*10% to 20%*
Off-site Disposal	*5% to 15%*
Off-site Incineration	*5% to 15%*
Bulk Liquid Processing	*5% to 15%*
Clay Cap	*5% to 10%*
Surface Grading/Diking	*5% to 10%*
Revegetation	*5% to 10%*

5. Values and costs are for informational purposes only. Values are not true costs because they represent a combination of fixed capital and quantity-proportional components

Spartanburg MGP

1

Duke Energy
Spartanburg, SC

In Situ Enhanced Biodegradation

By: Dpayne Rev Date: 5/22/2008

Prime Contractor Costs					10%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*Mark up*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Mobilization/ Demobilization*	*LS*	*1*	*$2,000*	*$200*	*$400*	*$2,600*	*$2,600*	*3%*
2	*Manifold Construction*	*LS*	*1*	*$19,100*	*$1,910*	*$3,820*	*$24,830*	*$24,830*	*28%*
3	*Well Installation*	*Ea*	*37*	*$40,700*	*$4,070*	*$8,140*	*$52,910*	*$1,430*	*59%*
4	*Site Restoration*	*LS*	*1*	*$7,300*	*$730*	*$1,460*	*$9,490*	*$9,490*	*11%*
				$69,100	*$6,910*	*$13,820*	*$89,830*		*100%*
Other Contracts & Purchases					5%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*RETEC MU*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*iSOC Operation*	*YR*	*1*	*$9,250*	*$463*	*$1,850*	*$11,563*	*$11,563*	*6%*
2	*iSOC Capital Purchase*	*Ea*	*37*	*$157,250*	*$7,863*	*$31,450*	*$196,563*	*$5,313*	*94%*
				$166,500	*$8,325*	*$33,300*	*$208,125*		*100%*
RETEC Costs					5%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*RETEC MU*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Temporary Facilities*	*MO*	*1*	*$12,750*	*$638*	*$2,550*	*$15,938*	*$15,938*	*15%*
2	*Personnel*	*Man Hours*	*761*	*$72,700*	*$0*	*$14,540*	*$87,240*	*$115*	*85%*
				$85,450	*$638*	*$17,090*	*$103,178*		*100%*
Grand Total							*$401,133*		

Spartanburg MGP

1

Duke Energy
Spartanburg, SC

In Situ Enhanced Biodegradation

Add Task | Delete Row | Add 10 Blank Rows

By: Dpayne   Rev Date: 5/22/08

Task/Sub Task	Description	Unit	Qty	Rate	Total Cost	
Prime Contractor Costs		NOTE- All costs include contractor Overhead and Profit				
1	**Mobilization/ Demobilization**	**LS**	**1**		**$2,000.00**	
	Equipment	LS	1	2000	$2,000.00	
					$0.00	
2	**Manifold Construction**	**LS**	**1**		**$19,100.00**	
	Trencher	Day	10	100	$1,000.00	
	Laborers(2)	Day	20	300	$6,000.00	
	Oxygen supply tubing	Ft	2000	0.4	$800.00	
	Conduit	Ft	2000	0.2	$400.00	
	Sand backfill	CY	20	15	$300.00	
	Regulator and fittings	Ea	6	400	$2,400.00	
	Oxygen Pigtail Hard-pipe	Ea	6	1000	$6,000.00	
	Housing	LS	2	1100	$2,200.00	
3	**Well Installation**	**Ea**	**37**		**$40,700.00**	
	Well Installation	Ea	37	1100	$40,700.00	
					$0.00	
					$0.00	
4	**Site Restoration**	**LS**	**1**		**$7,300.00**	
	Seeding	SF	34000	0.2	$6,800.00	
	Miscellaneous Restoration	LS	1	500	$500.00	
	SUB-TOTAL CONTRACTOR				**$69,100.00**	**$69,100.00**
	Mark-up	10%				**$6,910.00**
	Contingency	20%				**$13,820.00**
	Total Subcontractor					**$89,830.00**
Other Contracts & Purchases						
1	**iSOC Operation**	**YR**	**1**		**$9,250.00**	
					$0.00	
	Oxygen Bottle Supply	Ea	37	250	$9,250.00	
2	**iSOC Capital Purchase**	**Ea**	**37**		**$157,250.00**	
					$0.00	
					$0.00	
	iSOC Units	Ea	37	4250	$157,250.00	
					$0.00	
					$0.00	
					$0.00	
	SUB-TOTAL OTHER CONTRACTS				**$166,500.00**	**$166,500.00**
	Mark-up	5%				**$8,325.00**
	Contingency	20%				**$33,300.00**
	Total Subcontractor					**$208,125.00**
Oversight Costs						
1	**Temporary Facilities**	**MO**	**1**		**$12,750.00**	
	Mobilization/Demobilization/Office Trailer Etc.	LS	1	$3,000.00	$3,000.00	
	Utility Hook-Ups	LS	1	$3,000.00	$3,000.00	
	Temporary Facilities- Trailers/PortaJohn	MO	1.5	$500.00	$750.00	
	Office Equipment	MO	1.5	$500.00	$750.00	
	Office Supplies	MO	1.5	$500.00	$750.00	
	Telephone	MO	1.5	$750.00	$1,125.00	
	Electric	MO	1.5	$250.00	$375.00	
	Water	MO	1.5	$200.00	$300.00	
	Cleaning	MO	1.5	$350.00	$525.00	
	Pick Up	MO	1.5	$750.00	$1,125.00	
	Fuel/Maint	MO	1.5	$400.00	$600.00	
	Misc. Supplies	MO	1.5	300	$450.00	
2	**Personnel**	**Man Hours**	**761**		**$72,700.00**	
	Project Manager	Hr	60	$115.00	$6,900.00	
	Construction Manager	HR	300	$85.00	$25,500.00	
	Field Tech	HR	300	$60.00	$18,000.00	
	Home Office Support	Hr	60	$115.00	$6,900.00	
	HSO	Hr	0	$75.00	$0.00	
	Adiministration (Home Office)	HR	40	$35.00	$1,400.00	
	Travel Expenses	LS	1	$14,000.00	$14,000.00	
	SUB-TOTAL COSTS				**$85,450.00**	**$85,450.00**
	Mark-up (ODCs Only)	5%			(no m/u on labor)	**$637.50**
	Contingency	20%				**$17,090.00**
	Total Oversight					**$103,177.50**
	GRAND TOTAL					**$401,132.50**

Unit Rate Back-Up and Notes

Spartanburg MGP

General Notes: In Situ Enhanced Biodegradation

Work Statement:
Install oxygen diffuser wells, and install oxygen diffusers and manifold system
Material Classification:
Compacted clean fill to top of water table, followed by saprolitc zone which the wells will be installed.
General Approach:
(4) curtains will be installed for a total of 37 wells to approximately 20 feet-bgs. (2) distribution centers will be installed for the NE and SE areas of the site.
Health, Safety, and Environment: All work to be performed in modified level D, hard hat, steel toe boots, and gloves.
Production: Production values are based on approximately (2) wells per day and the oxygen diffusers will take approximately 10 days.
Volumes: GW remedy, number of iSOCs was recommended by inVentures, inc.
Unit Rates: Unit Rates were developed from vendors, subcontractors, and previous projects of similar scope.

In Situ Chemical Oxidation (ISCO)

Project Name:	Spartanburg MGP	**Revision No.:**	0
Cost Estimate No.:	1	**Date:**	5/22/08
Client	Duke Energy	**Status:**	Draft
Location	Spartanburg, SC	**Author:**	Dpayne
		Office:	Durham
Project Element:	*In Situ* Chemical Oxidation	**Reviewed By:**	
Type of Estimate:	Feasibility/Conceptual		

Project Details

Project Location:	Spartanburg, SC
Project Start Date:	
Project Duration:	7.5
Type of Contract:	
Level of Accuracy:	*-30% to +50%*
Contingency:	20%

Scope Summary

Treatment Volume: 21570 CY

Type of Remediation: In Situ Chemical Oxidation

Document Source:	FFS	**Rev. Date:**	5/9/2008	**Site Visit?**	No
Document Source:		**Rev. Date:**			
Document Source:		**Rev. Date:**			

Cost Summary

Prime Contractor Costs	$	2,093,325
Other Contracts & Purchases	$	12,500
Oversight Costs	$	541,688
Project Total Estimated Cost	$	2,647,513

Notes:

1. Note intended use and audience

2. List major project assumptions

3. Accuracy ranges are based on information provided in "Association for Advancement of Cost Engineering (AACE), International Cost Estimating Classifications, 18R-97"

Estimate Type	*Accuracy Range*
Preliminary	*-50% to +100%*
Feasibility/Conceptual	*-30% to +50%*
Engineering	
30%	*-20% to +30%*
60%	*-15% to +20%*
90%	*-10% to +15%*

4. Contingency values are based on information provided in 'USEPA, Guide to Developing Cost Estimates, July 2000

Remediation Technology	*Scope Contingency*
Soil Excavation	*15% to 55%*
Groundwater Treatment (Multiple	*15% to 35%*
On-site Incineration	*15% to 35%*
Extraction Wells	*10% to 30%*
Vertical Barriers	*10% to 30%*
Synthetic Cap	*10% to 20%*
Off-site Disposal	*5% to 15%*
Off-site Incineration	*5% to 15%*
Bulk Liquid Processing	*5% to 15%*
Clay Cap	*5% to 10%*
Surface Grading/Diking	*5% to 10%*
Revegetation	*5% to 10%*

5. Values and costs are for informational purposes only. Values are not true costs because they represent a combination of fixed capital and quantity-proportional components

Spartanburg MGP

1

Duke Energy
Spartanburg, SC

In Situ Chemical Oxidation

By: Dpayne Rev Date: 5/22/2008

Prime Contractor Costs					10%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*Mark up*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Mobilization/ Demobilization Excavation*	*LS*	*1*	*$20,000*	*$2,000*	*$4,000*	*$26,000*	*$26,000*	*1%*
2	*Temporary Facilities and controls*	*Mo*	*8*	*$62,650*	*$6,265*	*$12,530*	*$81,445*	*$10,859*	*4%*
3	*Well Installation*	*Ea*	*166*	*$166,000*	*$16,600*	*$33,200*	*$215,800*	*$1,300*	*10%*
4	*Fencing & E&S Control*	*LS*	*1*	*$2,800*	*$280*	*$560*	*$3,640*	*$3,640*	*0%*
5	*In Situ Chemical Injection - Labor*	*Day*	*142*	*$612,000*	*$61,200*	*$122,400*	*$795,600*	*$5,603*	*38%*
6	*Chemical Oxidant*	*Gal*	*460,000*	*$736,000*	*$73,600*	*$147,200*	*$956,800*	*$2*	*46%*
7	*Site Restoration*	*LS*	*1*	*$10,800*	*$1,080*	*$2,160*	*$14,040*	*$14,040*	*1%*
				$1,610,250	*$161,025*	*$322,050*	*$2,093,325*		*100%*
Other Contracts & Purchases					5%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*RETEC MU*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Treatability Study*	*LS*	*1*	*$10,000*	*$500*	*$2,000*	*$12,500*	*$12,500*	*100%*
				$10,000	*$500*	*$2,000*	*$12,500*		*100%*
RETEC Costs					5%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*RETEC MU*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Temporary Facilities*	*MO*	*8*	*$39,750*	*$1,988*	*$7,950*	*$49,688*	*$6,625*	*9%*
2	*Personnel*	*Man Hours*	*4,401*	*$410,000*	*$0*	*$82,000*	*$492,000*	*$112*	*91%*
				$449,750	*$1,988*	*$89,950*	*$541,688*		*100%*
Grand Total							*$2,647,513*		

Spartanburg MGP

Duke Energy
Spartanburg, SC

In Situ Chemical Oxidation

Add Task | Delete Row | Add 10 Blank Rows

By: Dpayne   Rev Date: 5/22/08

Task/Sub Task	Description	Unit	Qty	Rate	Total Cost	
Prime Contractor Costs		**NOTE- All costs include contractor Overhead and Profit**				
1	**Mobilization/ Demobilization Excavation**	**LS**	**1**		**$20,000.00**	
	Equipment and Chemicals	LS	1	20000	$20,000.00	
					$0.00	
2	**Temporary Facilities and controls**	**Mo**	**7.5**		**$62,650.00**	
	Trailers	MO	7.5	350	$2,625.00	
	Office Equipment	MO	7.5	750	$5,625.00	
	Office Supplies	MO	7.5	500	$3,750.00	
	Telephone	MO	7.5	550	$4,125.00	
	Cell Phones	MO	7.5	500	$3,750.00	
	Electric	MO	7.5	250	$1,875.00	
	Water	MO	7.5	300	$2,250.00	
	Pick Up Trucks (2)	MO	7.5	450	$3,375.00	
	Fuel/Maint	MO	7.5	400	$3,000.00	
	Misc Supplies	MO	7.5	300	$2,250.00	
	Decontamination Supplies	MO	7.5	500	$3,750.00	
	Water Truck	MO	7.5	3000	$22,500.00	
	Dumpster	Wk	35	50	$1,750.00	
	Port O John	MO	7.5	270	$2,025.00	
					$0.00	
3	**Well Installation**	**Ea**	**166**		**$166,000.00**	
					$0.00	
	Well Installation	Ea	166	1000	$166,000.00	
					$0.00	
4	**Fencing & E&S Control**	**LS**	**1**		**$2,800.00**	
	Privacy Fence	SF	5600	0.5	$2,800.00	
					$0.00	
					$0.00	
5	**In Situ Chemical Injection - Labor**	**Day**	**142**		**$612,000.00**	
	Injection Specialists(2)	Day	306	1000	$306,000.00	
	Injection Supervisor	Day	153	1000	$153,000.00	
	Injection Equipment	Day	153	1000	$153,000.00	
					$0.00	
					$0.00	
6	**Chemical Oxidant**	**Gal**	**460000**		**$736,000.00**	
					$0.00	
	Chemical Oxidant	Gal	460000	1.6	$736,000.00	
					$0.00	
					$0.00	
7	**Site Restoration**	**LS**	**1**		**$10,800.00**	
	Seeding	SF	36000	0.3	$10,800.00	
	Miscellaneous Restoration	LS	1	0	$0.00	
	SUB-TOTAL CONTRACTOR				**$1,610,250.00**	**$1,610,250.00**
	Mark-up	10%				**$161,025.00**
	Contingency	20%				**$322,050.00**
	Total Subcontractor					**$2,093,325.00**
Other Contracts & Purchases						
1	**Treatability Study**	**LS**	**1**		**$10,000.00**	
					$0.00	
	Laboratory Treatability Study	LS	1	10000	$10,000.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
	SUB-TOTAL OTHER CONTRACTS				**$10,000.00**	**$10,000.00**
	Mark-up	5%				**$500.00**
	Contingency	20%				**$2,000.00**
	Total Subcontractor					**$12,500.00**

Oversight Costs						
1	**Temporary Facilities**	**MO**	**7.5**		**$39,750.00**	
	Mobilization/Demobilization/Office Trailer Etc.	LS	1	$3,000.00	$3,000.00	
	Utility Hook-Ups	LS	1	$3,000.00	$3,000.00	
	Temporary Facilities- Trailers/PortaJohn	MO	7.5	$500.00	$3,750.00	
	Office Equipment	MO	7.5	$500.00	$3,750.00	
	Office Supplies	MO	7.5	$500.00	$3,750.00	
	Telephone	MO	7.5	$750.00	$5,625.00	
	Electric	MO	7.5	$250.00	$1,875.00	
	Water	MO	7.5	$200.00	$1,500.00	
	Cleaning	MO	7.5	$350.00	$2,625.00	
	Pick Up	MO	7.5	$750.00	$5,625.00	
	Fuel/Maint	MO	7.5	$400.00	$3,000.00	
	Misc. Supplies	MO	7.5	300	$2,250.00	
2	**Personnel**	**Man Hours**	**4401**		**$410,000.00**	
	Project Manager	Hr	600	$115.00	$69,000.00	
	Construction Manager	HR	1500	$85.00	$127,500.00	
	Field Tech	HR	0	$60.00	$0.00	
	Home Office Support	Hr	300	$115.00	$34,500.00	
	HSO	Hr	1500	$75.00	$112,500.00	
	Adiministration (Home Office)	HR	500	$35.00	$17,500.00	
	Travel Expenses	LS	1	$49,000.00	$49,000.00	
	SUB-TOTAL OVERSIGHT COSTS				**$449,750.00**	**$449,750.00**
	Mark-up (ODCs Only)	5%			**(no m/u on labor)**	**$1,987.50**
	Contingency	20%				**$89,950.00**
	Total Oversight Costs					**$541,687.50**
	GRAND TOTAL					**$2,647,512.50**

Unit Rate Back-Up and Notes

Spartanburg MGP

General Notes: In Situ Chemical Oxidation

Work Statement:
Prepare and inject chemical oxidant.
Material Classification:
Alluvial and residual zones are included for the saprolitic zone an assumed average porosity of 10% for sands and silts within the cracks and fissures of the saprolitic unit.
General Approach:
Chemicals will be batched on-site and injected into the subsurface using 1-inch diameter injection wells.
Health, Safety, and Environment: All work to be performed in modified level D, hard hat, steel toe boots, traffic vest , and gloves.   Special considerations and precautions will be required during handling of strong oxidants and additional security in the form of fencing may be required.
Production: Production values are based on projects of similar size and scope.
Volumes: Volumes are based on cross sectional data from the S&ME Annual Groundwater Report January 2009 (December 2007 data). Average thickness of saturatated zone as taken from top of water table to top of partially weathered rock. The total horizontal area is determined to be 72,800 Square Feet and the average thickness of the saturated zone is determined to be 8-feet.

In Situ Solidification (ISS)

Project Name:	Spartanburg, MGP	**Revision No.:**	2
Cost Estimate No.:	SB-1	**Date:**	5/22/08
Client	Duke Power	**Status:**	Draft
Location	Spartanburg, SC	**Author:**	DRP
		Office:	NYC
Project Element:	*In Situ* Solidification	**Reviewed By:**	
Type of Estimate:	Feasibility/Conceptual		

Project Details

Project Location:	Spartanburg, SC
Project Start Date:	1/1/2008
Project Duration:	6 Mo
Type of Contract:	Direct Owner
Level of Accuracy:	*-30% to +50%*
Contingency:	20%

Scope Summary

10' Excavation and ISS Barrier Wall Installation

Document Source:	FFS Draft	**Rev. Date:**	5/9/2008	**Site Visit?**	No
Document Source:		**Rev. Date:**			
Document Source:		**Rev. Date:**			

Cost Summary

Prime Contractor Costs	$	3,285,878
Other Contracts & Purchases	$	195,000
Oversight Costs	$	512,470
Project Total Estimated Cost	$	3,993,348

Notes:

1. Note intended use and audience

2. List major project assumptions

3. Accuracy ranges are based on information provided in "Association for Advancement of Cost Engineering (AACE), International Cost Estimating Classifications, 18R-97"

Estimate Type	*Accuracy Range*
Preliminary	*-50% to +100%*
Feasibility/Conceptual	*-30% to +50%*
Engineering	
30%	*-20% to +30%*
60%	*-15% to +20%*
90%	*-10% to +15%*

4. Contingency values are based on information provided in 'USEPA, Guide to Developing Cost Estimates, July 2000

Remediation Technology	*Scope Contingency*
Soil Excavation	*15% to 55%*
Groundwater Treatment (Multiple	*15% to 35%*
On-site Incineration	*15% to 35%*
Extraction Wells	*10% to 30%*
Vertical Barriers	*10% to 30%*
Synthetic Cap	*10% to 20%*
Off-site Disposal	*5% to 15%*
Off-site Incineration	*5% to 15%*
Bulk Liquid Processing	*5% to 15%*
Clay Cap	*5% to 10%*
Surface Grading/Diking	*5% to 10%*
Revegetation	*5% to 10%*

5. Values and costs are for informational purposes only. Values are not true costs because they represent a combination of fixed capital and quantity-proportional components

Spartanburg, MGP
SB-1
Duke Power
Spartanburg, SC

In Situ Solidification

By: DRP   Rev Date: 5/22/2008

Prime Contractor Costs					10%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*Markup*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Mobilization*	*LS*	*1*	*$256,115*	*$25,612*	*$51,223*	*$332,950*	*$332,950*	*10%*
2	*Temporary Facilities*	*MO*	*7*	*$355,780*	*$35,578*	*$71,156*	*$462,514*	*$66,073*	*14%*
3	*Clearing*	*LS*	*1*	*$6,503*	*$650*	*$1,301*	*$8,453*	*$8,453*	*0%*
4	*Fencing*	*LS*	*1*	*$11,288*	*$1,129*	*$2,258*	*$14,674*	*$14,674*	*0%*
5	*Excavation of Overburden*	*CY*	*21,325*	*$96,600*	*$9,660*	*$19,320*	*$125,580*	*$6*	*4%*
6	*In-Situ Solidification*	*CY*	*20,189*	*$1,268,740*	*$126,874*	*$253,748*	*$1,649,362*	*$82*	*50%*
7	*Transportation and Disposal*	*Ton*	*6,056*	*$242,240*	*$24,224*	*$48,448*	*$314,912*	*$52*	*10%*
8	*Odor Control Foam*	*LS*	*1*	*$62,500*	*$6,250*	*$12,500*	*$81,250*	*$81,250*	*2%*
9	*Backfill*	*CY*	*21,325*	*$186,675*	*$18,668*	*$37,335*	*$242,678*	*$11*	*7%*
10	*Site Restoration*	*SF*	*72,316*	*$41,158*	*$4,116*	*$8,232*	*$53,505*	*$1*	*2%*
				$2,527,599	*$252,760*	*$505,520*	*$3,285,878*		*100%*
Other Contracts & Purchases					*10%*	*20%*			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*RETEC MU*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Perimeter air monitoring*	*Day*	*6*	*$150,000*	*$15,000*	*$30,000*	*$195,000*	*$32,500*	*100%*
				$150,000	*$15,000*	*$30,000*	*$195,000*		*100%*
Construction Oversight Costs					*10%*	*20%*			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*RETEC MU*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Temporary Facilities*	*LS*	*1*	*$44,300*	*$4,430*	*$8,860*	*$57,590*	*$57,590*	*11%*
2	*ISS QA Sampling*	*Ea*	*20*	*$8,000*	*$800*	*$1,600*	*$10,400*	*$520*	*2%*
3	*Operations and Maintenance*	*Yr*	*1*	*$0*	*$0*	*$0*	*$0*	*$0*	*0%*
4	*Personnel*	*Man Hours*	*3,521*	*$370,400*	*$0*	*$74,080*	*$444,480*	*$126*	*87%*
				$422,700	*$5,230*	*$84,540*	*$512,470*		*100%*
Grand Total							*$3,993,348*		

Spartanburg, MGP
SB-1
Duke Power
Spartanburg, SC

In Situ Solidification

Add Task | Delete Row | Add 10 Blank Rows

By: DRP   Rev Date: 5/22/08

Task/Sub Task	Description	Unit	Qty	Rate	Total Cost
Prime Contractor Costs		**NOTE- All costs include contractor Overhead and Profit**			
1	**Mobilization**	**LS**	**1**		**$256,115.00**
	Equipment	PC	3	750	$2,250.00
	Misc Travel for Set-up	LS	1	2500	$2,500.00
	ISS Rig Mobilization	LS	1	250000	$250,000.00
	Project Manager	Day	1	640	$640.00
	Superintendant	Day	1	725	$725.00
					$0.00
					$0.00
2	**Temporary Facilities**	**MO**	**7**		**$355,780.00**
	Temorary Facilities-Porta/John	MO	7	750	$5,250.00
	Office Equipment	MO	7	500	$3,500.00
	Office Supplies	MO	7	500	$3,500.00
	Telephone	MO	7	500	$3,500.00
	Cell Phones	MO	7	500	$3,500.00
	Electric	MO	7	500	$3,500.00
	Water	MO	7	750	$5,250.00
	Pick Up	MO	7	600	$4,200.00
	Fuel/Maint	MO	7	6000	$42,000.00
	Misc. Supplies	MO	7	500	$3,500.00
	Decontamination Facilities	LS	7	7500	$52,500.00
	Dumpster	Wk	24	250	$6,000.00
	Site Superintendant	Day	140	500	$70,000.00
	Project Manager	Day	50	750	$37,500.00
	Site Engineer	Day	140	500	$70,000.00
	Adiministration	Day	50	340	$17,000.00
	E&S Controls	LF	1270	4	$5,080.00
	Surveying	LS	1	20000	$20,000.00
					$0.00
3	**Clearing**	**LS**	**1**		**$6,502.50**
	Cat 322 Excavator	Wk	0.5	2825	$1,412.50
	Chipper	Wk	0.5	900	$450.00
	Operator	Day	2	770	$1,540.00
	Laborer	Day	2	550	$1,100.00
	Transportation and Disposal	LS	1	2000	$2,000.00
4	**Fencing**	**LS**	**1**		**$11,288.00**
	Temporary Fencing	LF	1270	8	$10,160.00
	Fence Wind Screen	SY	1128	1	$1,128.00
					$0.00
5	**Excavation of Overburden**	**CY**	**21325**		**$96,600.00**
	Excavator	Day	21	600	$12,600.00
	Loader	Day	21	500	$10,500.00
	Articulated Dump	Day	21	650	$13,650.00
	Articulated Dump	Day	21	650	$13,650.00
	Operator (3)	Day	63	500	$31,500.00
	Laborer (2)	Day	42	350	$14,700.00
					$0.00
6	**In-Situ Solidification**	**CY**	**20189**		**$1,268,740.00**
	ISS Rig - Crane	MO	4	40000	$160,000.00
	Lull	MO	4	6000	$24,000.00
	Manlift	MO	4	11000	$44,000.00
	Excavator	Day	80	600	$48,000.00
	Batch Plant Rental	MO	4	9500	$38,000.00
	Silo Rental	MO	4	2500	$10,000.00
	Generator	MO	4	10000	$40,000.00
	Pig Mob	LS	1	2500	$2,500.00
	Pig 1st Month Rental	MO	4	2500	$10,000.00
	ISS Tool 1st Months Rental	MO	4	1000	$4,000.00
	Spare ISS tool	MO	4	500	$2,000.00
	Electrician	LS	1	5000	$5,000.00
	Welder	LS	1	10000	$10,000.00
	Misc Supplies & Equipmment	LS	1	10000	$10,000.00
	Fuel/Maint	MO	4	10000	$40,000.00
	Batch Plant Operator	Day	80	500	$40,000.00
	Crane Operator	Day	80	500	$40,000.00
	Misc Equip Operator	Day	80	500	$40,000.00
	Excavator Operator	Day	80	500	$40,000.00
	Grout Hose	Ea	20	600	$12,000.00
	Laborers(3)	Day	240	350	$84,000.00
	Travel: Per diem and lodging	Day	80	1200	$96,000.00
	Travel Rotation	MO	4	7000	$28,000.00
	Timber Crane Mats	Ea	12	1200	$14,400.00
	Bentonite @ 1%	Ton	323	240	$77,520.00
	Cement @ 9 %	Ton	2911	120	$349,320.00
					$0.00
7	**Transportation and Disposal**	**Ton**	**6056**		**$242,240.00**
					$0.00
	Disposal Spoils (20%)	Ton	6056	40	$242,240.00

8	**Odor Control Foam**	**LS**	**1**		**$62,500.00**	
	Foam Unit Rental	MO	5	2500	$12,500.00	
	Foam	Drum	16	500	$8,000.00	
	Foam Unit Labor	Day	100	395	$39,500.00	
	Foam Unit Mob	LS	1	2500	$2,500.00	
9	**Backfill**	**CY**	**21325**		**$186,675.00**	
	Excavator	Day	25	600	$15,000.00	
	Compactor	Day	25	300	7500	
	Loader	Day	25	500	12500	
	Articulated Dump	Day	25	600	15000	
	Operators(3)	Day	75	1000	75000	
	Dozer	Day	25	565	14125	
	Laborer	Day	25	350	8750	
	Gravel Road	CY	212	25	5300	
	Topsoil	CY	1340	25	33500	
10	**Site Restoration**	**SF**	**72316**		**$41,158.00**	
					$0.00	
	Plantings	LS	1	5000	$5,000.00	
	Seeding	SF	72316	0.5	$36,158.00	
	SUB-TOTAL CONTRACTOR				**$2,527,598.50**	**$2,527,598.50**
	Mark-up	10%				**$252,759.85**
	Contingency	20%				**$505,519.70**
	Total Subcontractor					**$3,285,878.05**
Other Contracts & Purchases						
1	**Perimeter air monitoring**	**Day**	**6**		**$150,000.00**	
	Perimeter air monitoring	Day	100	$1,500.00	$150,000.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
	SUB-TOTAL OTHER CONTRACTS				**$150,000.00**	**$150,000.00**
	Mark-up	10%				**$15,000.00**
	Contingency	20%				**$30,000.00**
	Total Subcontractor					**$195,000.00**
Construciton Oversight						
1	**Temporary Facilities**	**LS**	**1**		**$44,300.00**	
	Mobilization/Demobilization	LS	1	$5,000.00	$5,000.00	
	Utility Hook-Ups	LS	1	5000	$5,000.00	
	Temporary Facilities- Trailers/PortaJohn	MO	7	500	$3,500.00	
	Office Equipment	MO	7	500	$3,500.00	
	Office Supplies	MO	7	500	$3,500.00	
	Telephone	MO	7	750	$5,250.00	
	Electric	MO	7	250	$1,750.00	
	Water	MO	7	200	$1,400.00	
	Cleaning	MO	7	350	$2,450.00	
	Pick Up	MO	7	750	$5,250.00	
	Fuel/Maint	MO	7	600	$4,200.00	
	Misc. Supplies	MO	7	500	$3,500.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
2	**ISS QA Sampling**	**Ea**	**20**		**$8,000.00**	
	Sample Analysis	Ea	20	$400.00	$8,000.00	
					$0.00	
3	**Operations and Maintenance**	**Yr**	**1**		**$0.00**	
	Subtask	LS	1	$0.00	$0.00	
					$0.00	
4	**Personnel**	**Man Hours**	**3521**		**$370,400.00**	
	Project Manager	Hr	400	$125.00	$50,000.00	
	Construction Manager	HR	1440	$85.00	$122,400.00	
	Engineer	Hr	1440	$85.00	$122,400.00	
	Adiministration (Home Office)	HR	240	$65.00	$15,600.00	
	Travel Expenses	LS	1	$60,000.00	$60,000.00	
	SUB-TOTAL OVERSIGHT COSTS				**$422,700.00**	**$422,700.00**
	Mark-up (ODCs Only)	10%			**(no m/u on labor)**	**$5,230.00**
	Contingency	20%				**$84,540.00**
	Total Construction Oversight					**$512,470.00**
	GRAND TOTAL					**$3,993,348.05**

Unit Rate Back-up and Notes

Spartanburg MGP

Excavation General Notes - Excavator Crawler Mounted

Work Statement:
Excavate and stockpile overburden, ISS saturated zone soils. Backfill and compact with import and existing soils.
Material Classification:
Previously placed clean fill, saturated zone consists of alluvial sands and saprolite.
General Approach:
Remove the previously placed clean fill, solidify below the water table then continue backfill in the unsaturated zone.
Health, Safety, and Environment: All work to be performed in modified level D, hard hat, steel toe boots, traffic vest , and gloves.   .
Production: Production values are based on projects of similar size and scope.
Volumes: Volumes are based on cross sectional data from the SM&E Annual Groundwater Report January 2009 (December 2007 data). Average thickness of saturatated zone as taken from top of water table to top of partially weathered rock. The total horizontal area is determined to be 69140(due to power lines) Square Feet and the average thickness of the saturated zone is determined to be 8-feet for a cubic yardage of 20,189. The overburden to be removed and stockpiled is estimated based on a average depth to groundwater of 8-feet bgs for a total volume of 21,325 cubic yards.

Saturated Zone Excavation

Project Name:	Spartanburg MGP	**Revision No.:**	0
Cost Estimate No.:	1	**Date:**	5/22/08
Client	Duke Energy	**Status:**	Draft
Location	Spartanburg, SC	**Author:**	Dpayne
		Office:	St Petersburg
Project Element:	Excavation of Overburden and Saturated Zone Soils	**Reviewed By:**	
Type of Estimate:	Feasibility/Conceptual		

Project Details

Project Location:	Spartanburg, SC
Project Start Date:	
Project Duration:	7 Months
Type of Contract:	
Level of Accuracy:	*-30% to +50%*
Contingency:	20%

Scope Summary

Excavation of former structures and impacts below GW in the Northern Parcel area of the site.-ISOC Fence in Designated area

Excavation Volume:	21,570
LF of Sheeting	1141
Type of Remediation:	Excavation and Stockpile of Overburden
Treatment System:	200 GPM Treatment System

Document Source:	Feasibility Study	**Rev. Date:**	5/9/2008	**Site Visit?**	No
Document Source:		**Rev. Date:**			
Document Source:		**Rev. Date:**			

Cost Summary

Prime Contractor Costs	$	5,226,312
Other Contracts & Purchases	$	237,500
Oversight Costs	$	496,995
Project Total Estimated Cost	$	5,960,807

Notes:
1. Note intended use and audience
2. List major project assumptions
3. Accuracy ranges are based on information provided in "Association for Advancement of Cost Engineering (AACE), International Cost Estimating Classifications, 18R-97"

Estimate Type	*Accuracy Range*
Preliminary	*-50% to +100%*
Feasibility/Conceptual	*-30% to +50%*
Engineering	
30%	*-20% to +30%*
60%	*-15% to +20%*
90%	*-10% to +15%*

4. Contingency values are based on information provided in 'USEPA, Guide to Developing Cost Estimates, July 2000

Remediation Technology	*Scope Contingency*
Soil Excavation	*15% to 55%*
Groundwater Treatment (Multiple	*15% to 35%*
On-site Incineration	*15% to 35%*
Extraction Wells	*10% to 30%*
Vertical Barriers	*10% to 30%*
Synthetic Cap	*10% to 20%*
Off-site Disposal	*5% to 15%*
Off-site Incineration	*5% to 15%*
Bulk Liquid Processing	*5% to 15%*
Clay Cap	*5% to 10%*
Surface Grading/Diking	*5% to 10%*
Revegetation	*5% to 10%*

5. Values and costs are for informational purposes only. Values are not true costs because they represent a combination of fixed capital and quantity-proportional components

Spartanburg MGP

1

Duke Energy
Spartanburg, SC

Excavation of Overburden and Saturated Zone Soils

By: Dpayne   Rev Date: 5/22/2008

Prime Contractor Costs					10%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*Mark up*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Mobilization/ Demobilization Excavation*	*LS*	*1*	*$20,000*	*$2,000*	*$4,000*	*$26,000*	*$26,000*	*0%*
2	*Temporary Facilities and controls*	*Mo*	*7*	*$323,935*	*$32,394*	*$64,787*	*$421,116*	*$60,159*	*8%*
3	*Clearing*	*LS*	*1*	*$4,630*	*$463*	*$926*	*$6,019*	*$6,019*	*0%*
4	*Fencing & E&S Control*	*LS*	*1*	*$2,800*	*$280*	*$560*	*$3,640*	*$3,640*	*0%*
5	*Sheetpile Installation*	*LF*	*1,141*	*$1,369,200*	*$136,920*	*$273,840*	*$1,779,960*	*$1,560*	*34%*
6	*Construction Dewatering-200 gpm syster*	*LS*	*1*	*$133,000*	*$13,300*	*$26,600*	*$172,900*	*$172,900*	*3%*
7	*Excavate Overburden*	*CY*	*21,325*	*$96,600*	*$9,660*	*$19,320*	*$125,580*	*$6*	*2%*
8	*Saturated Soil Excavation*	*CY*	*20,189*	*$144,000*	*$14,400*	*$28,800*	*$187,200*	*$9*	*4%*
9	*Soil Amendment*	*Tons*	*15,000*	*$58,500*	*$5,850*	*$11,700*	*$76,050*	*$5*	*1%*
10	*Transportation and Disposal*	*Ton*	*30,283*	*$1,223,320*	*$122,332*	*$244,664*	*$1,590,316*	*$53*	*30%*
11	*Fill Placement*	*CY*	*44,343*	*$575,560*	*$57,556*	*$115,112*	*$748,228*	*$17*	*14%*
12	*Odor control Foam Consumables*	*Day*	*60*	*$47,000*	*$4,700*	*$9,400*	*$61,100*	*$1,018*	*1%*
13	*Site Restoration*	*LS*	*1*	*$21,695*	*$2,169*	*$4,339*	*$28,203*	*$28,203*	*1%*
				$4,020,240	*$402,024*	*$804,048*	*$5,226,312*		*100%*
Other Contracts & Purchases					5%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*RETEC MU*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Air Monitoring*	*Mo*	*6*	*$190,000*	*$9,500*	*$38,000*	*$237,500*	*$39,583*	*100%*
				$190,000	*$9,500*	*$38,000*	*$237,500*		*100%*
RETEC Costs					5%	20%			
Task ID	*Task Descr.*	*Unit*	*Quantity*	*Bare Cost*	*RETEC MU*	*Contingency*	*Total Cost*	*Unit Rate*	*%*
1	*Temporary Facilities*	*MO*	*7*	*$37,500*	*$1,875*	*$7,500*	*$46,875*	*$6,696*	*9%*
2	*Personnel*	*Man Hours*	*4,181*	*$375,100*	*$0*	*$75,020*	*$450,120*	*$108*	*91%*
				$412,600	*$1,875*	*$82,520*	*$496,995*		*100%*
Grand Total							*$5,960,807*		

Spartanburg MGP

Duke Energy
Spartanburg, SC

Excavation of Overburden and Saturated Zone Soils

Add Task | Delete Row | Add 10 Blank Rows

By: Dpayne   Rev Date: 5/22/08

Task/Sub Task	Description	Unit	Qty	Rate	Total Cost
Prime Contractor Costs		NOTE- All costs include contractor Overhead and Profit			
1	**Mobilization/ Demobilization Excavation**	**LS**	**1**		**$20,000.00**
	Excavation Equipment	LS	1	10000	$10,000.00
	Site Preparation	LS	1	5000	$5,000.00
	Temporary Facilities Mobilization	LS	1	5000	$5,000.00
					$0.00
2	**Temporary Facilities and controls**	**Mo**	**7**		**$323,935.00**
	Trailers	MO	7	500	$3,500.00
	Office Equipment	MO	7	750	$5,250.00
	Office Supplies	MO	7	500	$3,500.00
	Telephone	MO	7	550	$3,850.00
	Cell Phones	MO	7	500	$3,500.00
	Electric	MO	7	250	$1,750.00
	Water	MO	7	300	$2,100.00
	Pick Up Trucks (2)	MO	7	1200	$8,400.00
	Fuel/Maint	MO	7	6000	$42,000.00
	Misc Supplies	MO	7	300	$2,100.00
	Decontamination Supplies	MO	7	500	$3,500.00
	Water Truck	MO	7	3000	$21,000.00
	Dumpster	Wk	35	50	$1,750.00
	Port O John	MO	7	270	$1,890.00
	Site Superintendant	Day	140	500	$70,000.00
	Project Manager	Day	60	750	$45,000.00
	Site Engineer	Day	140	500	$70,000.00
	Adiministration	Day	60	340	$20,400.00
	E&S Controls	LF	1270	3.5	$4,445.00
	Surveying	LS	1	10000	$10,000.00
					$0.00
3	**Clearing**	**LS**	**1**		**$4,630.00**
	Excavator	Day	2	750	$1,500.00
	Chain Saw	Day	2	150	$300.00
	Chipper	Day	2	350	$700.00
	Equipment Operator	Day	2	615	$1,230.00
	Laborer	Day	2	450	$900.00
4	**Fencing & E&S Control**	**LS**	**1**		**$2,800.00**
	Privacy Fence	SF	5600	0.5	$2,800.00
					$0.00
					$0.00
5	**Sheetpile Installation**	**LF**	**1141**		**$1,369,200.00**
	Sheetpile Installation	SF	34230	40	$1,369,200.00
					$0.00
					$0.00
6	**Construction Dewatering-200 gpm system**	**LS**	**1**		**$133,000.00**
	Mob/demob system	LS	1	30000	$30,000.00
	Rental of System	MO	4	15000	$60,000.00
	T&D of spent Carbon	LS	1	8000	$8,000.00
	Well Point Installation	Day	15	2000	$30,000.00
	POTW Discharge	LS	1	5000	$5,000.00
					$0.00
					$0.00
7	**Excavate Overburden**	**CY**	**21325**		**$96,600.00**
	Excavator	Day	21	600	$12,600.00
	Loader	Day	21	500	$10,500.00
	Articulated Dump	Day	21	650	$13,650.00
	Articulated Dump	Day	21	650	$13,650.00
	Operator (3)	Day	63	500	$31,500.00
	Laborer (2)	Day	42	350	$14,700.00
					$0.00
					$0.00
8	**Saturated Soil Excavation**	**CY**	**20189**		**$144,000.00**
					$0.00
	Excavator	Day	40	600	$24,000.00
	Loader	Day	40	500	$20,000.00
	Articulated Dump	Day	40	650	$26,000.00
	Operator (3)	Day	120	500	$60,000.00
	Laborer (2)	Day	40	350	$14,000.00
					$0.00
9	**Soil Amendment**	**Tons**	**15000**		**$58,500.00**
					$0.00
	Excavator	Day	15	600	$9,000.00
	Loader	Day	15	500	$7,500.00
	Operator (2)	Day	30	500	$15,000.00
	Drying Agent	Ton	900	30	$27,000.00
					$0.00
					$0.00
					$0.00
					$0.00
10	**Transportation and Disposal**	**Ton**	**30283**		**$1,223,320.00**
					$0.00
	Disposal- Solid Waste	Ton	30283	40	$1,211,320.00
	Disposal- Debris	Ton	300	40	$12,000.00
					$0.00
					$0.00

11	**Fill Placement**	**CY**	**44343**		**$575,560.00**	
					$0.00	
	Compactor	Day	52	300	$15,600.00	
	Loader	Day	52	500	$26,000.00	
	Articulated Dump	Day	52	650	$33,800.00	
	Operators(3)	Day	156	1000	$156,000.00	
	Dozer	Day	52	565	$29,380.00	
	Laborer	Day	52	350	$18,200.00	
	Common Fill	CY	21570	12	$258,840.00	
	Gravel Road	CY	212	20	$4,240.00	
	Topsoil	CY	1340	25	$33,500.00	
					$0.00	
12	**Odor control Foam Consumables**	**Day**	**60**		**$47,000.00**	
	Foam Unit Mob/Demob	LS	1	5000	$5,000.00	
	Foam Unit Rental	MO	5	3000	$15,000.00	
	Foam Labor	Day	60	450	$27,000.00	
					$0.00	
13	**Site Restoration**	**LS**	**1**		**$21,694.80**	
					$0.00	
	Seeding	SF	72316	0.3	$21,694.80	
					$0.00	
					$0.00	
	SUB-TOTAL CONTRACTOR				**$4,020,239.80**	**$4,020,239.80**
	Mark-up	10%				**$402,023.98**
	Contingency	20%				**$804,047.96**
	Total Subcontractor					**$5,226,311.74**
Other Contracts & Purchases						
1	**Air Monitoring**	**Mo**	**6**		**$190,000.00**	
	Air Monitoring Stations and Operator	Mo	120	1500	$180,000.00	
	Air monitoring plan, Mobilization	LS	1	10000	$10,000.00	
					$0.00	
					$0.00	
					$0.00	
					$0.00	
	SUB-TOTAL OTHER CONTRACTS				**$190,000.00**	**$190,000.00**
	Mark-up	5%				**$9,500.00**
	Contingency	20%				**$38,000.00**
	Total Subcontractor					**$237,500.00**
Construction Oversight Costs						
1	**Temporary Facilities**	**MO**	**7**		**$37,500.00**	
	Mobilization/Demobilization/Office Trailer Etc.	LS	1	$3,000.00	$3,000.00	
	Utility Hook-Ups	LS	1	$3,000.00	$3,000.00	
	Temporary Facilities- Trailers/PortaJohn	MO	7	$500.00	$3,500.00	
	Office Equipment	MO	7	$500.00	$3,500.00	
	Office Supplies	MO	7	$500.00	$3,500.00	
	Telephone	MO	7	$750.00	$5,250.00	
	Electric	MO	7	$250.00	$1,750.00	
	Water	MO	7	$200.00	$1,400.00	
	Cleaning	MO	7	$350.00	$2,450.00	
	Pick Up (2)	MO	7	$750.00	$5,250.00	
	Fuel/Maint	MO	7	$400.00	$2,800.00	
	Misc. Supplies	MO	7	300	$2,100.00	
2	**Personnel**	**Man Hours**	**4181**		**$375,100.00**	
	Project Manager	Hr	560	$115.00	$64,400.00	
	Construction Manager	HR	1400	$85.00	$119,000.00	
	Field Tech	HR	400	$60.00	$24,000.00	
	Home Office Support	Hr	100	$115.00	$11,500.00	
	HSO	Hr	1400	$75.00	$105,000.00	
	Adiministration (Home Office)	HR	320	$35.00	$11,200.00	
	Travel Expenses	LS	1	$40,000.00	$40,000.00	
	SUB-TOTAL OVERSIGHT COSTS				**$412,600.00**	**$412,600.00**
	Mark-up (ODCs Only)	5%			**(no m/u on labor)**	**$1,875.00**
	Contingency	20%				**$82,520.00**
	Total Construction Oversight					**$496,995.00**
	GRAND TOTAL					**$5,960,806.74**

Unit Rate Back-up and Notes

Spartanburg MGP

General Notes - Saturated Zone Excavation

Work Statement:
Excavate and stockpile overburden, excavate and dispose of saturated zone soils. Backfill and compact with import and existing soils. Excavation will require sheetpile and dewatering.
Material Classification:
Previously placed clean fill, saturated zone consists of alluvial sands and saprolite.
General Approach:
Remove the previously placed clean fill, install shoring and dewatering controls, excavate and backfill below the water table then continue backfill in the unsaturated zone.
Health, Safety, and Environment: All work to be performed in modified level D, hard hat, steel toe boots, traffic vest , and gloves.   Special considerations and precautions will be required during handling of strong oxidants and additional security in the form of fencing may be required.
Production: Production values are based on projects of similar size and scope.
Volumes: Volumes are based on cross sectional data from the SM&E Annual Groundwater Report January 2009 (December 2007 data). Average thickness of saturatated zone as taken from top of water table to top of partially weathered rock. The total horizontal area is determined to be 69140(due to power lines) Square Feet and the average thickness of the saturated zone is determined to be 8-feet for a cubic yardage of 20,189. The overburden to be removed and stockpiled is estimated based on a average depth to groundwater of 8-feet bgs for a total volume of 21,325 cubic yards.