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Infrastructure, environment, facilities

CONSTRUCTION COMPLETION REPORT: GROUNDWATER REMEDIATION SYSTEM

UNC Chapel Hill
Airport Road Waste Disposal Area,
Chapel Hill, North Carolina

October 2006

Imagine the result

ARCADIS

For Don Malone

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Construction Completion Report: Groundwater Remediation System

UNC Chapel Hill
Airport Road Waste Disposal Area, Chapel Hill, North Carolina

Prepared for:
The University of North Carolina at Chapel Hill

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Our Ref.:
NC000239.0015

Date:
October 2006

Remediating Party Certification Statement (.0306(b)(2)):

"I certify under penalty of law that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this certification, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material and information contained herein is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

Peter A. Reinhardt – Director, Environment, Health & Safety
(Name of Remediating Party Official)

Pet A Reinhardt (signature) 10/23/06
(Signature of Remediating Party Official) Date

North Carolina

ALAMANCE COUNTY

I, Shelley L. Kutia, a Notary Public of said County and State, do hereby certify that Peter A. Reinhardt did personally appear and sign before me this the 23 day of Oct., 2006.

Shelley L. Kutia (signature)
Notary Public (signature) (OFFICIAL SEAL)

My commission expires: 5-29-2008

Registered Site Manager Certification Statement (.0306(b)(1)):

"I certify under penalty of law that I am personally familiar with the information contained in this submittal, including any and all supporting documents accompanying this certification, and that the material and information contained herein is, to the best of my knowledge and belief, true, accurate and complete and complies with the Inactive Hazardous Sites Response Act G.S. 130A-3 10, et seq, and the voluntary remedial action program Rules 1 5A NCAC 1 3C .0300. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

James E. Shilliday III, L.G.,RSM
(Name of Registered Site Manager)

(signature) 10/25/06
(Signature of Registered Site Manager) Date

North Carolina

WAKE COUNTY

I, Marcella R. Edmondson, a Notary Public of said County and State, do hereby certify that James E. Shilliday did personally appear and sign before me this the 25th day of Oct., 2006.

Marcella R. Edmondson (signature)
Notary Public (signature) (OFFICIAL SEAL)

My commission expires: 11/5/08

MARCELLA R. EDMONDSON
NOTARY
PUBLIC
WAKE COUNTY, N.C.

North Carolina Department of Environment
and Natural Resources
Division of Waste Management
Superfund Section
Inactive Hazardous Sites Branch

CONSTRUCTION COMPLETION CERTIFICATION
15A NCAC 13C.0306(b)(5)(D)

Media (check all that apply): All Media___ Soil ___ Ground water X Surface water___ Sediment___

Site Name UNC Airport Road Waste Disposal Area Street Address 235 Municipal Drive

County Orange Chapel Hill, North Carolina

Site ID No. NCD980557623

The construction of the final remedy, which is the subject of this certification has, to the best of my knowledge, been completed in compliance with the Inactive Hazardous Sites Response Act G.S. 130A-310, et seq. and the voluntary remedial action program Rules 15A NCAC 13C .0300, and ARCADIS G&M of North Carolina, Inc.
[REC Name]
is in compliance with Rules .0305(b)(2) and .0305(b)(3), of this section. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information.

[signature] 10/25/06
RSM Signature Date

James E. Shilliday, III
RSM Name

ARCADIS G&M of North Carolina, Inc. 801 Corporate Center Drive, Suite 300
REC Name Mailing Address

00021 Raleigh, North Carolina 27607
REC No. City, State, ZIP

North Carolina (Enter State)
Wake **COUNTY**

I, Marcella R. Edmondson, a Notary Public of said County and State, do hereby certify that James E. Shilliday III did personally appear and sign before me this the 25th day of October, 2006.

[signature]
Notary Public (signature)
My commission expires: 11/5/08

(OFFICIAL SEAL)

MARCELLA R. EDMONDSON
NOTARY
PUBLIC
WAKE COUNTY, N.C.

ARCADIS

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1. Introduction

The University of North Carolina at Chapel Hill (UNC) retained ARCADIS G&M of North Carolina, Inc. (ARCADIS) to implement a voluntary site cleanup using the Registered Environmental Consultant (REC) Program at the UNC Airport Road Waste Disposal Area (the site). In accordance with the Implementation Guidance of the REC Program (North Carolina Department of Environment & Natural Resources 2006), two major milestones in the program, the Remedial Investigation (RI) and the Remedial Action Plan (RAP), have already been completed.

The RI Report (ARCADIS 2004) described the scope of the RI and results of hydrogeological assessments. The RI Report also defined the nature and extent of the dissolved contaminant plume at the site. Following completion of the RI, a RAP was prepared (ARCADIS 2005) that recommended remedial action for source materials (excavation and off-site disposal) and groundwater contamination (extraction and treatment). The proposed groundwater remedy includes vacuum-enhanced recovery (VER) of shallow aquifer groundwater immediately downgradient of the source area, and conventional recovery (pumping) of impacted groundwater in the shallow and bedrock aquifers downgradient (north) of the source area. The extracted groundwater was proposed to be treated on-site using an air stripper and then discharged into a sanitary sewer or Crow Branch Creek via a National Pollutant Discharge Elimination System (NPDES) permit. The proposed source area remedy includes excavation and off-site disposal of the source materials and impacted soils. It is anticipated that the source area remedy will be implemented in 2007 or 2008.

As required by the REC Program (NCDENR 2006), the next step in the remedial process following completion of the RAP was to prepare Preconstruction Reports for the proposed remedial actions. The Preconstruction Report to address the groundwater remediation system was completed in March 2006 (ARCADIS 2006) and construction of the groundwater remediation system was initiated during the summer of 2006. A separate Preconstruction Report will be prepared for the source area remedy.

This Construction Completion Report for the groundwater remediation system documents the steps taken to construct and implement the groundwater remedial action. More specifically, it includes an introduction to the site history/setting, a brief synopsis of the RI and RAP, a summary of the major construction activities including recovery well installation, building construction and groundwater treatment system installation, variations in the design and as-built drawings of the system.

1.1 Site Description

1.1.1 Site Location and Surrounding Land Use

The Airport Road Waste Disposal Area is located near Martin Luther King, Jr. Boulevard (Historic Airport Road) in northern Chapel Hill, Orange County, North Carolina. The site latitude is 35^{o} 56’ 18.0” N, and the longitude is 79^{o} 03’ 22.0” W (NCDEHNR 1993). The site consists of a 0.489 acre wooded parcel of University property that is located adjacent to the entrance road for the Airport Road Inactive Sanitary Landfill.

An approximately 0.2 acre area of this tract was used from 1973 through 1978, with the approval of the State of North Carolina, to dispose of chemical waste from the University’s laboratory facilities in 16 separate burial trenches. An additional 0.289 acres adjacent to the 0.2-acre area was proposed for use when the original area was full. However, only two burials were conducted in this expanded area, both in 1979. All references to “site” or “waste disposal area” in this report include the original 0.2-acre area (16 burials) and that portion of the expanded area used for two burials in 1979. Access to the site is restricted by an 8-foot-high locked fence erected by the University in early 1994. Several warning signs surround the site.

Municipal facilities for the Town of Chapel Hill are to the east and south of the site on a parcel leased from the University since 1979. The municipal facilities include but are not limited to paved roadways, parking lots, a street and bus maintenance facility, and an animal shelter. The Horace Williams Airport is south of the site, and the Airport Road Inactive Sanitary Landfill, formerly used by the Town of Chapel Hill, is to the west. The area north of the site is heavily wooded. Crow Branch Creek is located north/northwest of the site in the wooded area. A small residential area accessible from Airport Road is located approximately 1,200 feet north of the site. Most of the property east of Airport Road is also developed for residential use (NCDEHNR 1993).

1.1.2 Site History

The University used the site from 1973 to 1979 to dispose of wastes from the University’s teaching, research, and hospital laboratories. A total of 18 burials in trenches were made at the site between 1973 and 1979 (NCDEHNR 1993). Each burial trench had a size of approximately 10 feet (ft) wide, 20 ft long and 10 ft deep.

The burial pits are located adjacent to one another with approximately 4 to 8 ft of native soil separating each pit. Buried wastes consisted of a variety of constituents, including halogenated and non-halogenated solvents and other organic compounds, pesticides, metals, acids, bases, and PCBs, based on a Notification of Hazardous Waste Site (EPA Form 8900-1) completed in 1981. A list of laboratory chemical wastes disposed of at the site (North Carolina Department of Human Resources ([NCDHR] 1984) is included in the 2005 RAP (ARCADIS 2005). There are no records or indications that pesticides or PCBs have been disposed of at the site.

1.1.3 Topography

The site and surrounding property are relatively flat, sloping gently to the north-northwest in the general direction of Crow Branch Creek. Surface elevations in the vicinity of the site are approximately 485 feet above mean sea level (ft msl) and slope to approximately 460 ft msl in the vicinity of Crow Branch Creek. The site location is depicted on a portion of the Chapel Hill 1967 (photorevised 1988) 7.5-minute United States Geologic Survey topographic map which is included as Figure 1-1. A more detailed site map that illustrates various site features, including topography, is presented in Figure 1-2.

1.1.4 Geology

Intrusive investigative activities (bedrock core holes and soil borings) conducted at the site have revealed a relatively thin layer of residual soils and weathered rock (saprolite) overlying competent bedrock. The saprolite layer, which contains the surficial aquifer, varies in lithology from sandy clay to clayey sand, and extends from land surface to approximately 5 to 25 feet below land surface (ft bls). Competent granodiorite bedrock underlies the saprolite. Lithologic information gathered at the site indicated that a competent granodiorite unit occurs at depths ranging from 5 to 25 ft bls and extends to a depth of at least 195 ft bls. The equigranular granodiorite contains abundant high-angle fractures commonly filled with pyrite, calcium carbonate, and chlorite. Occasional brecciated zones were noted at various depths during coring, and no evidence of diabase dikes was observed (Geraghty & Miller 1996).

1.1.5 Hydrogeology

The surficial (shallow) aquifer unit and shallow bedrock aquifer unit are the primary areas of concern for groundwater at the site. The surficial aquifer at the site is encountered in the saprolitic soils above bedrock, and extends to depths ranging from 5 to 25 ft bls. Vertical leakage from the surficial aquifer supplies the groundwater present in the fractures within the shallow bedrock layer. Bedrock at the site is generally encountered at depths ranging from 5 to 25 ft bls.

Potentiometric surface maps of the surficial and bedrock aquifer units indicate that groundwater flow in the shallow aquifer, south of Crow Branch Creek, is generally to the north, towards Crow Branch Creek. The groundwater flow direction for the shallow aquifer on the north side of Crow Branch Creek is generally toward the east/southeast convergent on Crow Branch Creek. The groundwater flow direction in the bedrock aquifer is similar to that of the shallow aquifer, and trends to the north/northeast.

Water level data collected from nested well pairs was utilized to calculate the vertical hydraulic gradient in various portions of the site. Upward vertical hydraulic gradients were measured at monitor well pairs MW-6/MW-7, MW-12/MW-15, MW-25/MW-26, MW-30/MW-31, and MW-32/MW-33, all of which are located downgradient of the source area. Wells located upgradient, in the vicinity of the source area, were found to have downward vertical gradients. This information is consistent with the hydrogeologic interpretation of the site in that the source area is located close to a groundwater flow divide along a topographic high, and thus tends to serve as a recharge area (Geraghty & Miller, 1996).

1.2 Remedial Investigation Summary

The RI Report (ARCADIS 2004) summarized the findings of numerous investigations conducted at the site between 1995 and 2004. The results of the investigation activities indicated that the surficial and bedrock aquifers downgradient of the site are impacted with volatile organic compounds at concentrations exceeding established groundwater standards. The following subsections provide a brief summary of the extent of contamination detected in the surficial and bedrock aquifers based on data collected in July 2004.

1.2.1 Surficial Aquifer

Analytical data from the July 2004 RI activities indicated that the horizontal extent of the volatile organic compound (VOC) plume within the shallow aquifer has been delineated. VOCs were detected at concentrations exceeding established groundwater standards at 5 of the 11 shallow monitor wells sampled during this event. Nine compounds (acetone, benzene, chloroform, 1,2-dichloroethane [DCA], diethyl ether, methylene chloride, 1,1,2,2-trichloroethane [TCA], trichloroethene [TCE], and total xylenes) were detected within the plume at levels in excess of their respective standards. The highest concentrations of site constituents typically and historically have been detected immediately downgradient of the source area (MW-1 and MW-2).

Based on the analytical data from the July 2004 sampling event, the portion of the VOC contaminant plume that exceeds groundwater standards in the shallow unconsolidated aquifer extends from the waste disposal area approximately 600 ft downgradient and terminates in the vicinity of Crow Branch Creek. At its widest point, the VOC contaminant plume is approximately 500 ft wide. The plume geometry in the shallow aquifer is consistent with previously described site hydrogeology and groundwater flow conditions.

1.2.2 Bedrock Aquifer

Bedrock zone monitor wells were utilized to delineate the horizontal and vertical extent of VOCs in the bedrock aquifer. The analytical results from the July 2004 RI activities indicated that VOCs were detected at concentrations above established groundwater standards in 8 of the 22 bedrock site monitor wells (MW-7, MW-9, MW-11, MW-13, MW-14, MW-15, MW-17, and MW-31). Seven compounds (acetone, benzene, chloroform, 1,2-DCA, diethyl ether, TCE, and vinyl chloride) were determined to be present in the bedrock zone wells above their respective standards. It should be noted that the VOC concentrations in the most impacted bedrock aquifer monitor well (MW-15) are orders of magnitude lower than the VOC concentrations detected in the most impacted shallow aquifer monitor wells (MW-1 and MW-2).

Based on the results of the July 2004 sampling event, the portion of the VOC contaminant plume that exceeds groundwater standards in the bedrock aquifer extends approximately 600 ft downgradient of the waste disposal area and is approximately 800 ft wide at its widest point. While the dissolved phase plume in the shallow aquifer is interpreted to terminate in the vicinity of Crow Branch Creek, the impacted groundwater in the bedrock aquifer extends slightly north of the creek. Diethyl ether was detected in bedrock monitor well MW-33 on the north side of Crow Branch Creek during several groundwater monitoring events; albeit at concentrations far below the standard of 1,200 micrograms per liter (µg/L). No VOC constituents other than diethyl ether were detected in monitor wells located north of the creek during the July 2004 sampling event.

1.3 Summary of the Remedial Action Plan

The RAP (ARCADIS 2005) evaluated the applicability of various remedial alternatives for source area and groundwater contamination at the site. The findings of the groundwater remediation alternative analysis indicated that groundwater extraction, treatment and disposal is the most effective and economical remediation plan that would also meet the remedial action objectives. The groundwater extraction system proposed to employ VER for the shallow aquifer immediately downgradient of the source area and conventional extraction (pumping) for shallow and bedrock aquifer contamination further downgradient. Groundwater recovery would be through a total of 10 wells (four shallow VER wells, three shallow pumping wells, and three deep bedrock pumping wells). An air stripper was recommended to treat the extracted water. The treated effluent was proposed to discharge either to a sanitary sewer or into Crow Branch Creek via an NPDES permit. In the event of the effluent being discharged to the sanitary sewer, ultimate final treatment and disposal was assumed to be provided at the wastewater treatment plant operated by Orange Water and Sewer Authority (OWASA).

1.4 Summary of the Groundwater Preconstruction Report

The Preconstruction Report associated with the proposed groundwater remediation system (ARCADIS 2006) provided the detailed design of the pump and treat remedy outlined in the RAP. The best disposal option for treated groundwater was determined to be discharge into the OWASA system.

The Preconstruction Report provided the detailed calculations used to properly size the remediation system components. Technical specifications and design drawings were included in the Preconstruction Report.

The groundwater remediation system was installed in the late summer of 2006. The remainder of this Construction Completion Report will provide a summary of the permitting requirements, construction activities, variation from the design presented in the Preconstruction Report, and as-built drawings of the main system components.

2. Permits

The following sections provide a summary of the permits associated with the construction of the groundwater remediation system. All permits were previously obtained and were included in the Groundwater Preconstruction Report (ARCADIS, 2006). Copies of the permits referenced below are included in Appendix A.

2.1 Recovery Wells

Recovery well permits are required for installation of recovery wells in North Carolina. A recovery well permit was obtained from the North Carolina Department of Environment and Natural Resources Division of Water Quality.

2.2 Town of Chapel Hill Zoning Compliance Review

The Town of Chapel Hill reviewed the project plan for compliance with the Town of Chapel Hill Land Use Management Ordinance. Based on their review, it was determined the project was in compliance with the ordinance and a Zoning Compliance Permit was issued.

2.3 Orange Water and Sewer Authority

OWASA agreed to accept the water from the groundwater treatment system following treatment. The permit allows for a maximum discharge of 43,200 gallons per day and requires periodic sampling of the discharge water to evaluate water quality and to demonstrate compliance with permit discharge limits.

2.4 Air Quality

As outlined in the Groundwater Preconstruction Report air emissions from the air stripper and liquid ring pumps were modeled to determine the expected concentrations. The model results indicated that the total VOC emission rate will be less than 5 tons per year; therefore, an air permit will not be required for the system. In addition, modeling indicated that no individual constituent would exceed its respective Acceptable Ambient Levels at the property line.

3. Recovery Well Installation

ARCADIS contracted Geologic Exploration (GEX), a North Carolina-licensed well driller, to install 3 shallow recovery wells (SRW-1, SRW-2 and SRW-3), 2 deep bedrock recovery wells (DRW-2 and DRW-3) and 3 vacuum enhanced recovery wells (VER-1, VER-3 and VER-4) wells. Recovery wells DRW-1 and VER-2 (Figure 1-2) were installed in 1998 as part of a pilot study program conducted at the site (ARCADIS 1998). Installation of these two previously installed wells will not be discussed further in this report. The shallow recovery wells were installed to provide capture of shallow groundwater in the saprolite/bedrock transition zone in the area near Crow Branch Creek northeast of the burial area. Deeper recovery wells were installed to provide capture of groundwater in deeper bedrock. The VER wells were installed to capture vapor and shallow groundwater downgradient of the source area.

The following sections describe details of the well installation. Recovery well installation records and lithologic logs are included in Appendix B and a summary of the recovery well construction details is included in Table 3-1.

3.1 Shallow Recovery Well Installation

Recovery wells SRW-1, SRW-2 and SRW-3 were installed on April 3 and 4, 2006. SRW-1 was installed as planned to a total depth of 25 ft bls. Bedrock was encountered at a depth of 3 ft bls, requiring the well to be installed using air rotary methods. A hollow stem auger was used to serve as a temporary casing to prevent caving between land surface and the top of bedrock.

SRW-2 and SRW-3 were installed to depths of 35 ft bls using a combination of hollow stem auger and air rotary methods, similar to that of SRW-1. These two recovery wells were installed into the upper bedrock to encounter fractured zones with sufficient water for pumping. An initial attempt to install SRW-2 was made 20 feet north of the final SRW-2 location; however this location lacked sufficient groundwater in either the overburden or shallow bedrock and such was abandoned with grout.

Following completion of the 6-inch diameter boreholes, each of the shallow recovery wells were completed with 4-inch diameter 15-foot long, stainless steel screens with a slot size of 0.010-inch and stainless steel riser to land surface. Medium grained (No. 2) sand was added in the annular space between each well screen and borehole wall, from the bottom of the borehole to approximately 3 feet above the top of screen. Bentonite pellets were then placed on top of each sand pack to form a 2-foot thick seal, which was then hydrated. A cement grout seal was then added to the well seal to approximately 2 ft bls to allow for installation of the recovery well vault.

3.2 Deep Bedrock Recovery Well Installation

Deep recovery wells DRW-2 and DRW-3 were installed between April 3 and April 7, 2006. The original location proposed for DRW-2 was near monitor well cluster MW-25 and MW-26, however the first attempt at this location did not connect with sufficient fractures for recovery purposes to a depth of 80 ft bls. As a result, this borehole was extended to 140 ft bls with still no significant fractures encountered. This location was abandoned with cement grout to land surface and a second location selected approximately 75 ft southwest of the original location. A 6-inch diameter polyvinyl chloride (PVC) casing was installed to a depth of 20 ft bls and grouted in place. PVC was substituted for black steel due to difficulty in locating of additional black steel from drilling suppliers for a second attempt. The 6-inch borehole was then extended to a depth of 80 ft bls, where it was determined that sufficient fractures were present for groundwater recovery. DRW-2 was completed as an open hole well to a total depth of 80 ft bls.

Recovery well DRW-3 was installed as originally outlined in the Preconstruction Report. A 6-inch diameter black steel surface casing was installed via air rotary methods and grouted in place to a depth of 20 ft bls. DRW-3 was completed as a 6-inch diameter open hole well to a depth of 150 ft bls.

3.3 Vacuum Enhanced Recovery Well Installation

VER wells VER-1, VER-3 and VER-4 were installed using hollow stem auger and air rotary drilling techniques as proposed in the Preconstruction Report. These wells were installed by initially advancing a pilot hole to bedrock (14 to 16.5 ft bls) for lithologic characterization. The augers were then removed and plugged with a wooden plug and again advanced to the bedrock interface to serve as a temporary casing. The 6-inch diameter borehole for each well was then extended to the final well depth of 25 ft bls using air rotary methods.

The VER wells were constructed of 4-inch diameter, 20-foot long, stainless steel screens with a slot size of 0.010-inch and stainless steel riser to land surface. Medium grained (No. 2) sand was added in the annular space between each well screen and borehole wall, from the bottom of the borehole to approximately 1 foot above the top of screen. Bentonite pellets were then placed on top of each sand pack to form a 1-foot thick seal, which was then hydrated. A cement grout seal was then added to the well seal to approximately 2 ft bls to allow for installation of the recovery well vault.

3.4 Recovery Well Development and Sampling

Following installation of the 8 new recovery wells, these wells and the 2 existing wells were developed to remove fines (silt and clay) from the sand pack. Each well was developed using a submersible pump until relatively clear.

On May 3 through May 6, 2006, groundwater samples were collected from each of the 10 recovery wells using low-flow sampling techniques. Samples were analyzed for volatile organics by USEPA Method 8260 and low level mercury by USEPA Method 1631E. These analyses were selected to assist in evaluation of constituent concentrations expected to be contributed to the treatment system from individual recovery wells and to serve as a baseline for future evaluation of remedial system effectiveness.

Laboratory analytical results from the May 2006 sampling activities are included in Appendix C and summarized on Table 3-2. Results of this sampling event were as expected; water quality in the individual recovery wells was similar to that of surrounding monitor wells.

4. Groundwater Remediation System Building Construction

The following sections discuss the construction of the building to house the groundwater treatment system.

4.1 Contractor Selection

On January 26, 2006 a pre-bid meeting was held at the UNC Facilities Management office for interested contractors. Mr. Ray Williams was assigned by UNC to serve as contract administrator for this portion of the project. The pre-bid meeting was followed by a site visit to view the location of the proposed building. Questions were field answered regarding the scope of the project and followed up with a formal bid addendum on February 6, 2006.

On March 3, 2006 the formal bid opening was held by Mr. Ray Williams. A single bid was received from Professional Building Systems of Hillsborough, North Carolina. UNC determined that this firm was qualified to perform the work and awarded the building construction to Professional Building Systems. The notice to proceed to construct was issued on March 21, 2006.

4.2 Contractor Mobilization

On April 11, 2006 a formal kick-off meeting was held at the building construction site. At that time, the formal scope was again reviewed with Professional Building Systems and the construction schedule discussed. During this meeting, the approximate location of the building corners, tree protection area and silt fencing were field located.

4.3 Site Clearing

Site clearing commenced on April 20, 2006. Prior to clearing, silt fencing was installed around the perimeter of the area to be disturbed to prevent runoff of silt laden storm water. Site clearing consisted of the removal of trees and underbrush. The surface of the construction area was scraped to remove topsoil and roots and expose the underlying soils.

Trees and underbrush removed from the site during clearing activities were taken to the UNC vegetation recycling facility to be converted into mulch.

Once the site clearing was complete and underlying soils were exposed, the locations of the building corners were staked again by ARCADIS.

4.4 Geotechnical Testing and Soil Removal

On April 28, 2006 S&ME was contracted to perform geotechnical testing of the future building pad area to determine the ability of the soils to support the building. A total of 4 soil borings were advanced within the footprint of the building to a depth of approximately 5 ft bls. Soils were field classified continuously for soil type and Dynamic Cone Penetrometer testing was performed at intervals of 1 foot.

The results of the testing indicated that the soils beneath the building were not suitable to hold the weight of the structure. The formal recommendation provided by S&ME was to remove the existing soils to a vertical depth of 3 feet below the topsoil layer and horizontally to a distance greater than 5 feet beyond the building footprint. The excavated area would then need to be backfilled with a suitable clay backfill material and properly compacted. A copy of the S&ME testing report is provided in Appendix D.

On May 4, 2006, S&ME returned to the site and examined the excavated area previously outlined in the April 28, 2006 report. The inspection confirmed that the unsuitable soils had been removed to a depth sufficient to begin backfill. The estimate on the volume removed for replacement was 138 cubic yards.

During the same visit, arrangements were made for S&ME to obtain a sample of the backfill clay for moisture-density testing from the backfill source (American Stone Quarry, Chapel Hill, North Carolina).

Following soil replacement and compaction, S&ME returned to the site on May 22, 2006 to perform density testing and moisture content analysis. Two locations were selected for testing. Both locations tested greater than 95% for compaction and the specified moisture criteria of +/- 3% of optimal moisture content. These results were deemed to be acceptable to allow for construction to proceed.

4.5 Footing Installation

Professional Building Systems excavated the corner footings on May 22 and 23, 2006. Each footing measured approximately 4 feet square by 2.5 feet deep. Two horizontal layers of rebar grid were installed and held in place by vertical rebar components.

The footings were poured on May 23, 2006 with concrete specified to have a compressive strength of 4,000 pounds per square inch (psi) after a 28-day curing period. S&ME was again on-site and collected representative cylinders for testing. The results of the compressive strength testing at 28 days indicated that the concrete was at 4,570 psi and as such, the concrete in the footings was determined to be acceptable. S&ME testing reports are included in Appendix D.

4.6 Slab Construction

Between May 24 and June 7, 2006 Professional Building Systems installed form boards and supports around the proposed exterior location of the building slab. The form boards divided the main building slab into two parts. The first area of approximately 400 square feet would house the remediation equipment and be completely surrounded by a 4-inch high secondary containment lip. A 12-inch deep sump was installed in the center of this area and the floor sloped to provide drainage into the sump. The second area of the building would be a small electrical control room of approximately 160 square feet on the north side of the building.

A layer of crushed stone approximately 6-inches thick was placed within the formed area directly over the underlying soils. The stone was then overlain by an under slab moisture barrier to prevent moisture migration from the soils through the slab into the building.

Mesh rebar was then installed within the main slab area and raised approximately 4-inches above the moisture barrier with specially designed risers. Additional steel rebar was placed in the collar around the edge of the slab in addition to the corner locations in the slab where the connection bolts to the structural steel was located. The connection bolts were installed in the forms and held in place to the rebar with metal ties.

On June 6, 2006, Mr. Shannon Dorsey, PE of ARCADIS, inspected the forms, reinforcement steel, moisture barrier and gave final approval to pour the pad.

The main slab was poured on June 8, 2006 using approximately 22.5 cubic yards of concrete in two pours. S&ME performed on-site testing of the concrete slump, temperature, and air content. S&ME also collected sample concrete cylinders for compressive strength testing. S&ME reported that the compressive strength of the concrete was 4,470 psi after 28 days of cuffing, which exceeded the 4,000 psi compressive strength requirement specified in the building design; thus the slab was determined to be acceptable. S&ME testing reports are included in Appendix D.

4.7 Structural Steel Installation

Professional Building Systems contracted the building fabrication to Chief Buildings Company (Chief) located in Grand Island, Nebraska. Chief provided a set of building plans through Professional Building Systems to ARCADIS for review of a standard steel frame building that fit the general specifications discussed in the Preconstruction Report.

One change to the original design suggested by Chief and Professional Building Systems was to raise the base of the support columns flush to the finished slab elevation. The original design called for the column base to be approximately 1.5-feet below the slab elevation. The reason for the design change was to reduce the number of concrete pours needed for construction. The change was reviewed by Shannon Dorsey of ARCADIS and UNC and approved. Otherwise there were no variations in building design from the original plan. The final color specified by UNC for the exterior was fieldstone.

The building components arrived on-site in early June and assembly of the structural steel began on June 19, 2006. The major components of the building were completed by July 5, 2006. Once assembled, the building was inspected by Mr. Shannon Dorsey of ARCADIS. Mr. Dorsey concluded that the building met the design criteria and had been correctly constructed. A copy of the certification letter from Mr. Dorsey is included in Appendix E. Photographs of the building construction are included in Appendix H.

4.8 Landscaping

Professional Building Systems was also responsible for construction of a bioretention basin. The basin serves to capture and filter storm water run-off from the building and gravel parking areas to prevent overland flow and erosion.

The basin was constructed on the northeast (downgradient) side of the building. Rain water is directed by soil berms into the basin where it will percolate through an approximately 6-inch thick layer of mulch into a 2-foot thick loamy topsoil mix. The topsoil is separated from an underlying 1-foot thick layer of washed stone (drainage layer) by a geotextile mat. A drainage system consisting of perforated pipe in the drainage layer allows water to exit the basin on the northeast side.

Professional Building Systems completed the bioretention basin as designed. UNC installed the final landscaping plantings on October 13, 2006.

5. Groundwater Remediation System Construction

The following sections detail the construction of the groundwater remediation system.

5.1 Contractor Selection

On April 27, 2006 a pre-bid meeting was held at the UNC Facilities Management office for interested contractors. Mr. Allen Andrews was assigned by UNC to serve as contract administrator for this portion of the project. The pre-bid meeting was followed by a site visit to the site and a question and answer session.

On May 15, 2006 the formal bid opening was held by Mr. Allen Andrews. A total of six firms were invited to bid on the project. The low bid on the project was submitted by Regional Design and Construction, Inc. (Regional) of Pineville, North Carolina. Regional teamed with South Atlantic Environmental Drilling and Construction Company (SAEDACCO) to perform the majority of the field activities. Following contract negotiations, notice to proceed was given to Regional on June 26, 2006.

5.2 Contractor Mobilization

A formal kick off meeting was held on July 24, 2006 to go over the scope of this phase of the project and commence construction of the groundwater remediation system.

5.3 Piping Installation

Installation of the below ground piping and conduit for the groundwater extraction system commenced on July 25, 2006. This work consisted of installing the recovery piping networks for the shallow, deep, and VER wells, the treated water discharge line that connects the treatment system to the OWASA discharge point, and the electrical and control wire conduits for the shallow and deep wells. The piping and conduit were buried in trenches in a manner similar to that discussed in the Preconstruction Report. The underground piping networks are depicted on Figure G-1 in Appendix G.

The OWASA discharge line consists of a 2-inch diameter, high density polyethylene (HDPE) line. This line was installed in a trench with a width of 24 inches and a minimum depth of 34-inches below land surface. The trench width specified in the Preconstruction Report was 8-inches; however, the contractor elected to increase the width to allow for ease of butt-welding (fusing) any joints in the HDPE pipe.

The recovery well piping networks, OWASA discharge line, and electrical and control wire conduits were all bedded in a 4-inch thick layer of quarry fines prior to backfilling and compacting the trenches with native soils. A minimum of 30-inches of backfill material was used as cover for the pipes to minimize the potential for freezing or crushing. The discharge line was terminated at the OWASA manhole designated as the discharge point. Connection into the manhole will be described in a later section.

The underground piping networks for the VER, shallow and deep bedrock recovery wells were installed in a similar fashion to the OWASA discharge line. Individual 1.5-inch diameter HDPE recovery lines were run from each of the shallow and deep recovery wells to the treatment system building. Individual 1.25-inch diameter HDPE lines were used to connect each VER well to the system building. In addition to the recovery piping, 2-inch diameter PVC conduits were installed in the trenches running to the shallow and deep recovery wells for the electrical and control wiring for the submersible pumps in these wells. The electrical and control wiring were placed in separate conduits as specified in the Preconstruction Report.

The trenching for the underground piping for the recovery wells generally followed the paths specified in the Preconstruction Report. However, the locations of the trench for DRW-2 and DRW-3 were adjusted slightly so that the recovery lines would tie directly to the building instead of joining the trench for DRW-1 near monitor well MW-13. The location of the VER lines and a portion of the OWASA discharge line were also adjusted slightly to shorten the length of piping required. Figure G-1 depicts the as-built locations of all underground piping networks for the system.

All underground piping was installed in trenches with a minimum depth of 30 inches below land surface as specified, with one minor exception. Piping near shallow recovery well SRW-1 could only be installed to a depth of 12 inches below land surface due to the presence of competent bedrock.

All of the underground recovery lines were pressure tested to ensure that no leaks were present. The groundwater recovery lines from the VER wells and shallow and deep bedrock wells were tested on August 10, 2006. The test consisted of sealing the open end of the individual lines at the wellhead. At the building end of the lines, pressure fittings were installed and the lines were pressurized to 80 psi with air. The pressure in the lines was observed for a period of 4 hours and following no pressure drop, these lines were determined to be tight.

The OWASA discharge line interval between the exterior of the building and the manhole connection point was pressure tested on August 18, 2006. The test consisted of applying 80 psi of air pressure and was conducted in a similar manner as the earlier test. The pressure was observed for a period of 4 hours at which time no pressure drop was observed and the line was determined to be tight.

5.4 OWASA System Connection

The connection to the OWASA sanitary sewer system was designated to be at manhole 47C4001 as per the OWASA discharge permit. The remediation system contractor installed the 2-inch diameter HDPE discharge line between the treatment system building and a location approximately 20 feet north of the manhole. The final connection to the OWASA manhole was performed by Sparrow and Sons, an approved OWASA contractor. The connection to the manhole was performed by coring a 6-inch diameter hole into the side of the pre-cast concrete manhole and installing a 4-inch diameter inlet pipe. The penetration was then sealed with a rubber-boot to prevent infiltration into the sewer. In addition to performing the manhole penetration, Sparrow and Sons installed a sewer cleanout line and an OWASA-provided, 1.5-inch diameter meter to record the total volume of water discharged to the sewer by the treatment system.

5.5 Wellhead Completion

The wellhead completions for the 10 recovery wells were generally installed as per the design in the Preconstruction Report. The existing 2-foot square concrete pads and bolt down covers on VER-2 and DRW-1 were removed and replaced with the larger covers.

The well covers utilized for the shallow and deep bedrock recovery wells were 2-foot square by 2-foot deep. The covers used for the VER wells were 3-foot square with split door hinges and gas assist lifts. All covers were manufactured by Cap Cop and are rated to carry H-20 traffic load.

5.6 Groundwater Treatment Equipment

The groundwater treatment equipment was generally installed as outlined in the Preconstruction Report with a few minor exceptions. A summary of the major components in the system are described in the following sections along with any changes to the original design. Manufacturer's literature for the major system components are included in Appendix I.

5.6.1 Electrical Controls

The original design on the electrical control panels called for all site equipment to be controlled via three separate panels to be mounted in the electrical room. The design was changed slightly to consolidate the three panels into a single control panel. Other than the consolidation into a single panel, no other changes were made to the original design.

Electrical power to the remediation equipment is three-phase 480-volt, 200-amp service connected to a 200-amp circuit breaker in the electrical panel located within the electrical control room. The electric service is supplied by Duke Energy and enters the site via overhead lines that connect into existing electric lines at the corner of Municipal Drive and Animal Shelter Drive. A timber pole is located approximately 75 ft east of the building, and the electric lines run underground the remainder of the distance to the building.

Following installation of the electrical wiring for the groundwater remediation system, the electrical components of the treatment system were third party inspected by MET Laboratories, Inc., to certify the components were properly installed. In addition, the North Carolina Department of Insurance inspected and approved the electrical components of the system. Copies of the inspection certifications are included in Appendix F.

5.6.2 Liquid Ring Pump Unit

A skid-mounted liquid-ring-pump (LRP) system was installed in the treatment system building to provide the vacuum required for the VER wells. The LRP unit consists of a 15-horsepower Atlantic Fluidics Model A-200 oil-sealed LRP, equipped with an oil reservoir, heavy duty oil filtration system, and high and low oil level alarms. Oil temperature is regulated via an AKG Model AC 16-3-R oil cooler controlled by a thermostatic valve.

A moisture knockout tank (Product Recovery Management Model 80) was installed on the suction side of the LRP system to separate the groundwater and vapor streams extracted from the VER wells. This knockout tank includes an internal secondary mist eliminator to further separate the groundwater and vapor phases and to protect against water being pulled into the LRP. Groundwater that collects in this tank is pumped to the settling tank via a progressive cavity pump. This pump is controlled by level controls installed within a 2-inch diameter, clear-PVC stilling well/site glass on the side of the knockout tank. The knockout tank is also equipped with vacuum gauges, dilution air valves, and a high-high water level switch that will deactivate the LRP system in the event that the transfer pump fails.

5.6.3 Air Stripper Unit

All groundwater extracted by the recovery system will be treated with an air stripper to remove VOCs to the discharge permit requirements prior to discharge to the OWASA sanitary sewer system. The air stripper installed for the treatment system was the QED Model 6.4 EZ-Tray, skid-mounted unit specified in the Preconstruction Report. The blower for this unit is a 5-horsepower, 230/460-volt, 3-phase explosion-proof motor manufactured by New York Blower. This blower will provide up to 320 standard cubic feet per minute (SCFM) air flow through the air stripper. The discharge pump that will pump the treated water from the air-stripper sump to the OWASA discharge point is a 2-horsepower Goulds NPE Series centrifugal pump. Air flow will be monitored though high and low pressure switches on the unit. Water levels in the unit will be monitored by float switches.

5.6.4 Settling Tank and Bag Filtration

A settling tank is incorporated into the system to serve as a collection point for solids (i.e., sand, silt, and iron and manganese precipitate) that might be generated by the shallow recovery wells and the VER wells. Historical data from the site has indicated that the shallow aquifer from which these wells will extract groundwater may have the potential to generate solids that could cause operation and maintenance (O&M) concerns for the air stripper and discharge piping if allowed to stay in solution. A bag filter system was also installed on the effluent from the settling tank to provide additional filtering of solids. Historical data from the deeper bedrock aquifer wells indicates that solids should not be an issue, therefore the groundwater extracted from DRW-1, DRW-2, and DRW-3 will bypass the settling tank and bag filter system.

The settling tank installed in the treatment system is a 500-gallon, closed-top, cone-bottom tank (ACE Roto-Mold Model No. CB0500-52). The tank is vented to the exterior of the building so that VOC off-gasses from the untreated water in the tank will not accumulate in the building. The inlet and outlet of the tank are configured to maximize the settling capabilities in the tank and to avoid disturbing the material that settles out in the lower cone of the tank. The settling tank is equipped with high and low-level switches that control a transfer pump that pumps the clarified water from the tank through the bag filter system (Krystil Klear Model 66) and to the air stripper. The bag filter system will initially utilize 25-micron filters; however, the filters can be changed to a smaller mesh size to provide additional filtration if deemed necessary during operation. The system is also plumbed so that an additional filter can be added if necessary.

5.6.5 System Indicators/Meters

The system is equipped with several indicators and/or meters designed to monitor various operating parameters of the remediation system as previously indicated. A general summary of the system meters are as follows:

- High and low level switches in the shallow and deep bedrock recovery wells;
- Totalizing flow meters for each of the shallow and deep bedrock recovery wells;
- High and low level switches on the settling tank and the LRP moisture separation tank;
- Pressure valves before and after the bag filter;
- High and low oil alarms on the LRP;
- Level switch in the treatment system pad sump;
- High and low air pressure switches and float switches on the air stripper unit; and
- Totalizing flow meters on the discharge line exiting the building and prior to entry into the OWASA system.

5.6.6 System Alarm Interlocks

The system is equipped with several alarm interlocks as discussed below. Each interlock will shut down portions of the system, unless specified otherwise. All alarms require manual reset, unless specified otherwise. All interlocks are equipped with an indicating pilot light.

- Recovery well pumps low level water (turns off individual pump but will reset automatically upon clearing condition);
- LRP seal-oil temperature high (turns off LRP);

- LRP seal-oil reservoir low level (turns off LRP);
- LRP seal-oil reservoir high level (turns off LRP);
- Moisture separation tank high-level alarm (turns off LRP);
- Settling tank high-level alarm (turns off SRW pumps, LRP and transfer pump);
- Air stripper blower failure (turns off DRW pumps, LRP and transfer pumps); and
- Air stripper high level water (turns off DRW pumps, LRP and transfer pumps).

5.6.7 Spare Parts/Miscellaneous

The following items/spare parts are stored on-site in the remediation equipment building:

- One (1) copy of the O&M manual;
- Field log of system measurements;
- Extra 5-gallon containers of manufacturer-specified oil for liquid ring pump; and
- Replacement 25-micron filter bags for bag filter system.

6. Groundwater Remediation Commencement

The groundwater remediation system commenced operation on October 5, 2006. The system will be modified and adjusted as needed over the first several months of operation to obtain the capture of groundwater outlined in the groundwater flow model.

During operation of the groundwater remediation system, performance of the system will be monitored as described in the following sections and as summarized in Table 6-1.

6.1 System Performance Monitoring Program

Combined influent to the treatment system (air stripper) will be sampled once weekly during the first month of system operation and monthly thereafter. The influent samples will be analyzed for VOCs using USEPA Method 8260. In addition, water samples will be collected after the air stripper to evaluate the effectiveness of the treatment system at removing the VOCs from the extracted groundwater. The pumping rates for the recovery wells and recovery system operation will be re-evaluated and adjusted as needed if analytical data indicate that the groundwater recovery system is producing groundwater with higher than anticipated VOC concentrations or if the analytical data indicate that the treatment system is not effectively removing the VOCs from the groundwater.

Additional effluent samples will also be collected from the treatment system and analyzed according to the requirements of the discharge permit with OWASA.

The monitoring program will also include close monitoring of the vapor discharge from both the VER wells and the air stripper. Air samples will be collected from the VER system and the air stripper discharge on a weekly basis during the first 3 months of operation, bi-weekly during the subsequent 3 months, and monthly thereafter during the first year of operation. From the second year onwards, off-gas samples will be collected on a semi-annual basis. USEPA Method 18 will be utilized to measure VOC concentrations in the air discharge samples. The VOC concentrations in the air discharge samples will be tabulated and monitored to ensure that the recommended maximum allowable air discharge limits are not exceeded on an annual basis. In addition, the VOC concentration data for the air discharge samples will be evaluated to ensure that acceptable ambient air concentrations are not exceeded at the property line.

6.2 Groundwater Monitoring Program

Water levels in the site monitor wells and recovery wells will be measured on a quarterly basis during the first year of operation and semi-annually thereafter. These data will be used to construct groundwater elevation maps and to evaluate the groundwater recovery system's effectiveness in containing and remediating the dissolved contaminant plume.

Groundwater samples were collected from the four VER wells, three shallow recovery wells, and three deep bedrock recovery wells prior to system startup and will be collected annually thereafter. The samples will be analyzed for VOCs using USEPA Method 8260 and total and dissolved iron and manganese using USEPA Method 6010. Based on the monitoring data, the groundwater recovery system can be optimized by making appropriate field alterations.

To properly monitor the progress of the groundwater remediation program, a subset of the site's groundwater monitor wells will be sampled on a regular basis. The groundwater monitor wells included in the sampling program will consist of MW-1, MW-2, MW-3, MW-4, MW-6, MW-7, MW-9, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-21, MW-22, MW-25, MW-26, MW-28, MW-30, MW-31, MW-32, and MW-33. Table 6-1 presents a list of parameters and monitoring frequencies under this program. As remediation progresses, the number of monitor wells to be sampled may change. In addition, the monitoring frequency may also change based on sampling results and reduction of contaminant concentrations. NCDENR will be notified prior to revising the groundwater monitoring program.

7. References

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ARCADIS, 2005. Remedial Action Plan, UNC Chapel Hill, Airport Road Waste Disposal Area, Chapel Hill, North Carolina. April.

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North Carolina Department of Environment and Natural Resources (NCDENR), 2006. Implementation Guidance, Registered Environmental Consultant Program. Division of Waste Management, Inactive Hazardous Site Branch. August.

Table 3-1. Summary of Recovery Well Construction Details, UNC Airport Road Waste Disposal Area, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

WELL ID	INSTALL DATE	TOTAL DEPTH (FT BLS)	SCREENED INTERVAL (FT BLS)	SCREEN SLOT SIZE (INCHES)	WELL DIAMETER (INCHES)	SCREEN MATERIAL	PUMP/DROP TUBE DEPTH (FEET)	DEPTH TO LEVEL SENSORS	
								LOW-OFF (FEET)	HIGH-ON (FEET)
DRW-1	4/2/1998	80	20 - 80	6-inch Open Borehole	6	Not Applicable	70	65	30
DRW-2	4/7/2006	80	20 - 80	6-inch Open Borehole	6	Not Applicable	70	65	40
DRW-3	4/7/2006	150	20 - 150	6-inch Open Borehole	6	Not Applicable	140	100	30
SRW-1	4/4/2006	25	10 - 25	0.010	4	Stainless Steel	20	27	10
SRW-2	4/13/2006	35	20 - 35	0.010	4	Stainless Steel	30	17	10
SRW-3	4/4/2006	35	20 - 35	0.010	4	Stainless Steel	30	27	13
VER-1	4/4/2006	25	5 - 25	0.010	4	Stainless Steel	20	Not Applicable	Not Applicable
VER-2	3/26/1998	25	5 - 25	0.010	4	Stainless Steel	20	Not Applicable	Not Applicable
VER-3	4/4/2006	25	5 - 25	0.010	4	Stainless Steel	20	Not Applicable	Not Applicable
VER-4	4/4/2006	25	5 - 25	0.010	4	Stainless Steel	20	Not Applicable	Not Applicable

FT BLS Feet below land surface.

Table 3-2. Summary of Analytical Results for Recovery Well Samples Collected May 3, 2006, UNC Airport Road Waste Disposal Area, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Constituent	Sample ID: Date Sampled:	VER-1 5/3/2006	VER-2 5/3/2006	VER-3 5/3/2006	VER-4 5/3/2006	SRW-1 5/3/2006	SRW-2 5/3/2006	SRW-3 5/3/2006	DRW-1 5/3/2006	DRW-2 5/3/2006	DRW-3 5/3/2006	NCAC 2L Standard
Volatile Organics (EPA Method 8260) ug/L												
Diethyl Ether		**29,000**	**110,000**	**68,000**	**15**	**1,900**	**8,200**	**6,200**	**11,000**	**200**	**98**	1200*
Chloroform		**30,000**	**95,000**	**4,800**	**6**	< 67	< 290	< 200	< 380	< 5.9	< 2.9	0.19
Methylene Chloride		**15,000**	**57,000**	**5,500**	< 1.0	< 67	< 290	< 200	< 380	< 5.9	< 2.9	5
Benzene		**7,600**	**19,000**	**8,600**	< 1.0	< 67	< 290	< 200	< 380	< 5.9	< 2.9	1
Xylenes		< 2,500	< 10,000	< 4,000	**2**	< 130	< 590	< 400	< 770	< 12	< 5.7	530
Low Level Mercury (Method 1631E) ng/L												
Mercury		**4.9**	**132**	**4.6**	**3.9**	**2.3**	**9.0**	**1.2**	**10.7**	**1.5**	**0.67**	1,100

ug/L Parts per billion (Micrograms per liter).
ng/L Parts per trillion (Nanograms per liter).
ND Constituent was not detected above the reporting limit.
* USEPA Region IX Preliminary Remedation Goal (PRG) for tap water (no NCAC 2L Groundwater Standard exists).

Table 6-1. Monitoring Program for the Groundwater Remediation System, UNC Airport Road Waste Disposal Area, The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina.

Parameter	Method	Groundwater Monitoring Wells[1]		Recovery Wells[2]		Transfer Tank		Treatment Influent[3]		Treatment Effluent		VER Off-gas[4]		Air Stripper Off-gas[4]	
		1st Year	2nd Year Onward	1st Year	2nd Year Onward	1st Year	2nd Year Onward	1st Year	2nd Year Onward	1st Year	2nd Year Onward	1st Year	2nd Year Onward	1st Year	2nd Year Onward
ORGANICS																	
Benzene	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
Chloroform	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
1,2-Dichloroethane	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
Diethyl ether	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
Methylene chloride	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
1,1,2,2-Tetrachloroethane	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
Trichloroethene	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
Trichlorofluoromethane	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
Vinyl chloride	USEPA Method 8260	Q	A	A	A	--	--	W-1/M	M	W-1/M	M	W-3/M	S	W-3/M	S
INORGANICS																	
Iron (Total/Dissolved)	USEPA Method SW 846 6010	--	--	--	--	W-1/M	S	W-1/M	M	W-1/M	M	--	--	--	--
Manganese (Total/Dissolved)	USEPA Method SW 846 6010	--	--	--	--	W-1/M	S	W-1/M	M	W-1/M	M	--	--	--	--
Arsenic	USEPA Method 6010B	--	--	--	--	W-1/M	S	W-1/M	M	W-1/M	M	--	--	--	--
Chromium	USEPA Method 6010B	--	--	--	--	W-1/M	S	W-1/M	M	W-1/M	M	--	--	--	--
Copper	USEPA Method 6010B	--	--	--	--	W-1/M	S	W-1/M	M	W-1/M	M	--	--	--	--
Lead	USEPA Method 6010B	--	--	--	--	W-1/M	S	W-1/M	M	W-1/M	M	--	--	--	--
Zinc	USEPA Method 6010B	--	--	--	--	W-1/M	S	W-1/M	M	W-1/M	M	--	--	--	--
Mercury	USEPA methold 1631E	--	--	--	--	--	--	W-1/M	M	W-1/M	M	--	--	--	--
PHYSICAL																	
Water Table Elevation	--	Q	S	Q	S	--	--	--	--	--	--	--	--	--	--
Flow	--	--	--	--	--	--	--	C	C	C	C	C	C	C	C

-- Not sampled/Not applicable.

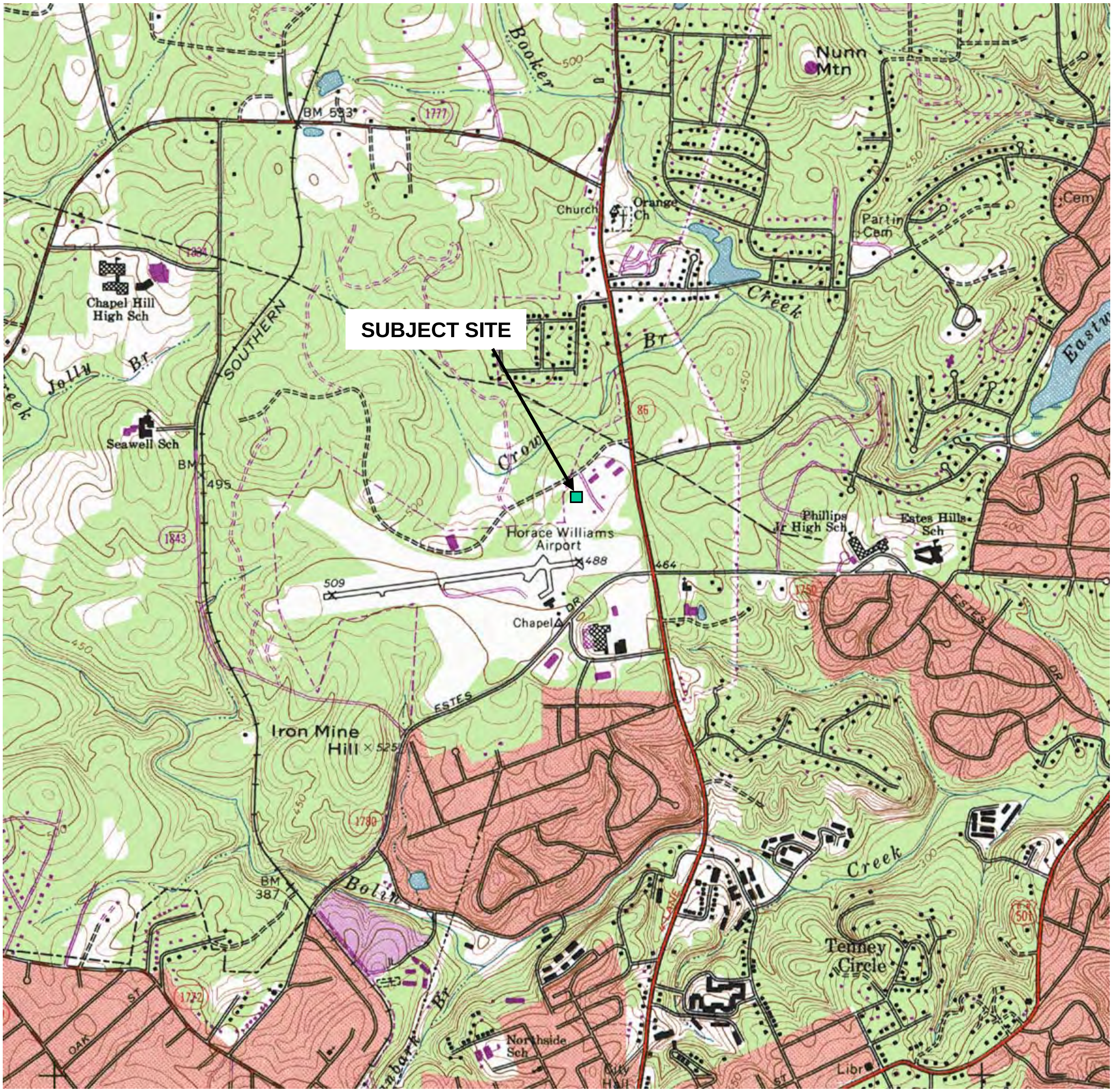
[1] For annual monitoring, wells MW-1, MW-2, MW-3, MW-4, MW-6, MW-7, MW-9, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-21, MW-22, MW-25, MW-26, MW-28, MW-30, MW-31, MW-32,and MW-33 will be sampled. During the first year of quarterly sampling, monitor wells MW-1, MW-2, MW-3, MW-6, MW-7, MW-11, MW-12, MW-13, MW-14, MW-15, MW-25, MW-26, MW-30, MW-31, MW-32, and MW-33 will be sampled.

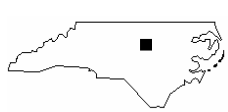
[2] Recovery wells, VER-1, VER-2, VER-3, VER-4, SRW-1, SRW-2, and SRW-3, DRW-1, DRW-2, and DRW-3, had samples collected prior to startup (May 2006) and will be annually thereafter.

[3] Once iron and manganese concentrations are significatly reduced, treatment influent sampling will be reduced to an annual basis.

[4] Off-gas sampling will be reduced to a quarterly basis once the constituent concentrations have dropped significantly.

A Annual sampling for parameters indicated.
C Continous flow monitoring per OWASA discharge permit requirements.
M Monthly sampling for parameters indicated.
Q Quarterly sampling for parameters indicated.
S Semi-annual sampling for parameters indicated.
W Weekly sampling for parameters indicated.
W-1/M Weekly sampling during first month and monthly thereafter for the parameters indicated.
W-3/M Weekly sampling during the first three months, bi-weekly sampling during the subsequent three months, and monthly thereafter for the parameters indicated.





QUADRANGLE LOCATION

SCALE 1:24,000

0 2000 4000

SCALE IN FEET

CONTOUR INTERVAL 10-FOOT DATUM IS MEAN SEA LEVEL

SOURCE: TOPOGRAPHY TAKEN FROM USGS 7.5 MINUTE QUADRANGLE

CHAPEL HILL 1967 (PHOTOREVISED 1988), NC MAP

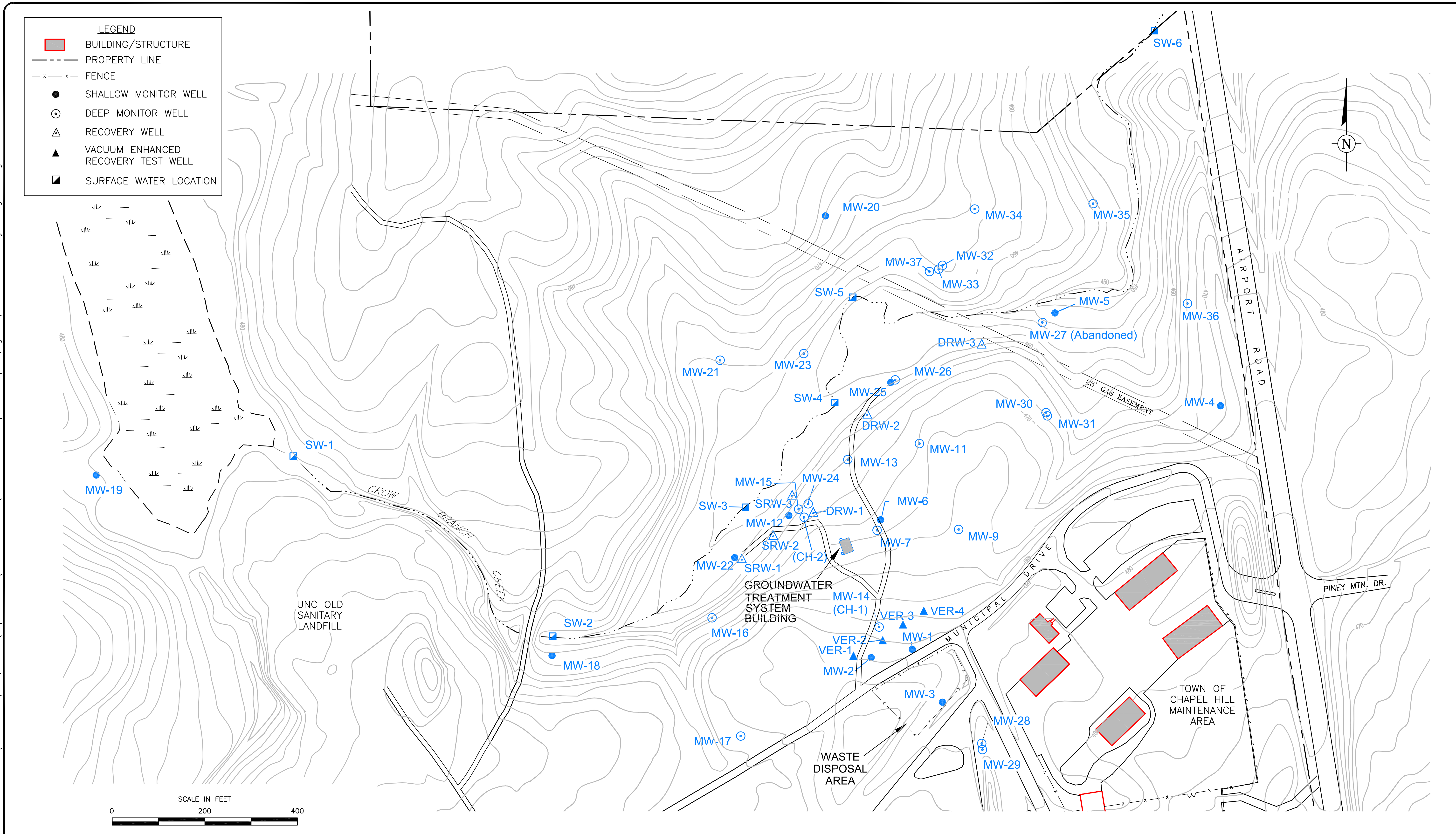
N

ARCADIS

Infrastructure, environment, facilities

801 Corporate Center Drive,
Suite 300
Raleigh, NC 27607
919-854-1282

REV.	DRAWING DATE: 9/15/2006	ACAD FILE:	
SITE LOCATION			
CLIENT: THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL			PM: JES
LOCATION: UNC AIRPORT ROAD WASTE DISPOSAL AREA CHAPEL HILL, NORTH CAROLINA			PE/RG:
DESIGNED:	DETAILED: JAP	PROJECT NO: NC000239.0015	FIGURE: 1-1



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User Name: Warren, Anne Path\Name : G:\ENV\UNIVNC\Airport Road\NC000239.0015\Construction Completion Report\Figures\UNC-APT-Site Layout fig1-2.dwg

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PRJT MANAGER:	CHECKED BY:	DRAFTER:	PROJECT NUMBER:
J. SHILLIDAY	A. PINNIX	A. WARREN	NC000239.0015

NOTES:

UNC AIRPORT ROAD WASTE DISPOSAL AREA
THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
CHAPEL HILL, NORTH CAROLINA

SITE LAYOUT

FIGURE:
1-2