UNC
ENVIRONMENT,
HEALTH & SAFETY

The University of North Carolina at Chapel Hill
Department of Environment, Health & Safety
1120 Estes Drive Ext., CB# 1650
Chapel Hill, North Carolina 27599-1650

July 15, 2014

Ms. Janet K. Macdonald
NC DENR Division of Waste Management
Inactive Hazardous Sites Branch
217 West Jones Street
Raleigh, North Carolina 27603

Subject: **Quarterly Update- Q2 2014**
UNC Cogeneration Facility
Chapel Hill, Orange County, NC
Site ID No. NCR000010272

Dear Ms. Macdonald:

Attached for your review is the Q2 2014 Quarterly Status Report for the subject site. Geosyntec Consultants of NC, PC, the Registered Environmental Consultant for the site, prepared the document.

Please contact Larry Daw at (919) 962-6666 or me at (919) 843-5913 if you have any questions. Thank you.

Sincerely,

Mary Beth Koza

Mary Beth Koza
Director, Environment, Health and Safety

Attachment

Cc: Larry Daw, UNC-CH
Daniel Elliott, Geosyntec
Eric Nesbit, Geosyntec

Geosyntec Consultants of NC, PC
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Quarterly Status Report – Q2 2014
July 15, 2014

Reporting Period: April 1, 2014 through June 30, 2014

Site:
The University of North Carolina at Chapel Hill
Cogeneration Facility
575 W. Cameron Avenue
Chapel Hill, Orange County, NC

Site ID No.: NCR000010272

Geosyntec Registered Site Manager: Eric Nesbit, P.E.

Work completed during reporting period:

Laboratory results for soil and groundwater were reviewed to assess data gaps in the ongoing Remedial Investigation (RI) pursuant to NCDENR requirements. Based on this review, an addendum to the RI Workplan is being prepared for submission. The scope of work for the RI Workplan Addendum includes sediment and surface water sampling and analysis, additional delineation of groundwater related to dissolved manganese, total dissolved solids, and sulfate, and a study of background metals concentrations in native soil.

Work expected to be completed during Q3 2014:

Submittal of the RI Workplan Addendum is expected in the third quarter. The initial phases of field work for the addendum are expected as well.

Schedule Compliance:

Work on this project is progressing in a manner to achieve the mandatory work phase completion deadlines set out in 15A NCAC 13C .0302(h).

REC PROGRAM DOCUMENT CERTIFICATION FORM - PAGE 1 OF 2
IHSB SITE NAME UNC Cogeneration Facility, Site ID No. NCR000010272
DATE & NAME OF DOCUMENT July 15, 2014 Q22014
TYPE OF SUBMITTAL (circle all that apply): [✓ Report,] [✓ Work plan,] Work Phase Comp. Statement, Schedule Change

REMEDIATING PARTY DOCUMENT 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."

Mary Beth Koza
Name of Remediating Party

Mary Beth Koza
Signature of Remediating Party

July 15, 2014
Date

NOTARIZATION

North Carolina (Enter State)

Wake **COUNTY**

I, Holly Van Norman, a Notary Public of said County and State, do hereby certify that Mary Beth Koza did personally appear and sign before me this day, produced proper identification in the form of NCDL 34841925, was duly sworn or affirmed, and declared that, to the best of his or her knowledge and belief, after thorough investigation, the information contained in the above certification is true and accurate, and he or she then signed this Certification in my presence.

WITNESS my hand and official seal this 15 day of July, 2014.

Notary Public (signature)

(OFFICIAL SEAL)

HOLLY VAN NORMAN

My commission expires: 11/15/17.

REC PROGRAM DOCUMENT CERTIFICATION FORM - PAGE 2 OF 2
IHSB SITE NAME UNC Cogeneration Facility, Site ID No. NCR000010272
DATE & NAME OF DOCUMENT July 15, 2014 Q22014
TYPE OF SUBMITTAL (circle all that apply) [✓ Report,] [✓ Work plan,] Work Phase Comp. Statement, Schedule Change

REGISTERED SITE MANAGER CERTIFICATION OF SIGNATURES

As the Registered Environmental Consultant for the Site for which this filing is made, I certify that the signatures included herewith are genuine and authentic original handwritten signatures and/or true, accurate, and complete copies of the genuine and authentic original handwritten signatures of the persons who purport to sign for this filing. I further certify that I have collected through reliable means the originals and/or copies of said signatures from the persons authorized to sign for this filing who, in fact, signed the originals thereof. Those persons and I understand and agree that any copies of signatures have the same legally binding effect as original handwritten signatures, and I certify that any person for whom I am submitting a copy of their signature has provided me with their express consent to submit said copy. Additionally, I certify that I am authorized to attest to the genuineness and authenticity of the signatures, both originals and any copies, being submitted herewith and that by signing below, I do in fact attest to the genuineness and authenticity of all the signatures, both originals and copies, being submitted for this filing.

Eric Nesbit
Name of Registered Site Manager

Signature of Registered Site Manager

July 15, 2014
Date

REGISTERED SITE MANAGER DOCUMENT 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-310, et seq, and the remedial action program Rules 15A NCAC 13C .0300. I am aware that there are significant penalties for willfully submitting false, inaccurate or incomplete information."

Eric Nesbit
Name of Registered Site Manager

Signature of Registered Site Manager

July 15, 2014
Date

NOTARIZATION

North Carolina (Enter State)

Wake COUNTY

I, Holly Van Norman, a Notary Public of said County and State, do hereby certify that Eric Nesbit did personally appear and sign before me this day, produced proper identification in the form of NCDL 23159960, was duly sworn or affirmed, and declared that, he or she is the duly authorized environmental consultant of the remediating party of the property referenced above and that, to the best of his or her knowledge and belief, after thorough investigation, the information contained in the above certifications is true and accurate, and he or she then signed these Certifications in my presence.

WITNESS my hand and official seal this 15 day of July 2014.

Notary Public (signature)

(OFFICIAL SEAL)

HOLLY VAN NORMAN

My commission expires: 11/15/17.

Document Certification Form No. DC - II
(Revised 8/11)

Prepared for

The University of North Carolina at Chapel Hill
Department of Environment, Health and Safety
1120 Estes Drive Extension, CB#1650
Chapel Hill, NC 27599-1650

WORK PLAN ADDENDUM FOR REMEDIAL INVESTIGATION

UNC-CHAPEL HILL COGENERATION FACILITY
CHAPEL HILL, NORTH CAROLINA

SITE ID # NCR000010272

Prepared by

Geosyntec Consultants of NC, PC #C-3500
2501 Blue Ridge Road, Suite 430
Raleigh, NC 27609

Project Number GN5219

July 2014

I, Eric Nesbit, a Professional Engineer for Geosyntec Consultants of NC, PC do certify that the information in this report is correct and accurate to the best of my knowledge.

SEAL
026217
ERIC C. NESBIT

18 July 2014

Geosyntec Consultants of NC, PC is licensed to practice engineering in North Carolina. The certification number (Firm's License Number) is C-3500.

Geosyntec Consultants of NC, PC is licensed to practice geology in North Carolina. The certification number (Firm's License Number) is C-295.

LIST OF FIGURES

LIST OF APPENDICES

1. Introduction

On behalf of The University of North Carolina at Chapel Hill (UNC-CH), Geosyntec Consultants of NC, PC (Geosyntec) has prepared this Remedial Investigation Work Plan Addendum for UNC-CH's Cogeneration Facility (Site) located at 575 West Cameron Avenue, Chapel Hill, North Carolina. This Work Plan Addendum advances the scope of work presented in the Remedial Investigation Work Plan submitted in October 2013 (Geosyntec Consultants, 2013).

2. Summary

On September 3, 2010, UNC-CH submitted a *Notification of an Inactive Hazardous Substance or Waste Disposal Site* to the North Carolina Department of the Environment and Natural Resources' (NCDENR) Inactive Hazardous Waste Sites Branch (IHSB). The notification was prompted when soils suspected of containing coal combustion by-products (CCBs) were encountered during excavation for the construction of a new warehouse building for the UNC-CH Cogeneration Facility.

CCBs include fly ash, bottom ash, boiler slag, and flue gas emission control waste from the combustion of coal and other fossil fuels. CCBs have been beneficially reused by industry and for construction for decades. Coal ash is added to concrete to provide higher strength and is used as structural fill for roadways. While considered solid wastes, CCBs are specifically exempt from being considered hazardous wastes under 40 CFR 261.4(b)(4). However, CCBs do have the potential to contain hazardous substances, such as select metals, polycyclic aromatic hydrocarbons (PAHs), and dioxins/furans [Contaminants of Concern (COC)].

UNC-CH has entered into an Administrative Agreement (AA) dated May 29, 2013 with NCDENR to enroll the Site into the Registered Environmental Consultant (REC) program, a voluntary cleanup program in the State of North Carolina. Within the REC program, the remediating party contracts with an IHSB-approved environmental consulting firm to direct, implement, regulate, and certify that all investigation and remediation work is performed in compliance with the program regulations found under Title 15A of the North Carolina Administrative Code, Subchapter 13C .0300 (15A NCAC 13C .0300).

UNC-CH contracted with Geosyntec, an approved REC consultant, to conduct a remedial investigation of the Site. Geosyntec is conducting the remedial investigation in compliance with North Carolina regulations to delineate the lateral and vertical extent of adverse impacts of CCBs in environmental media including soil, groundwater, surface water and sediment. The remedial investigation is being performed in phases. The initial phase of the remedial investigation (RI) included investigation of soil, the installation of monitoring wells, and groundwater sampling on University-owned property. This Work Plan Addendum includes additional soil and groundwater assessment along with an assessment of surface water and sediments in the drainage feature also on University-owned property. Additional assessment may be conducted if further on-site or off-site delineation is warranted.

Soil investigation on the Site evaluated soil down to groundwater. The locations of the subsurface samples are shown on **Figure A1** with tables embedded in the figure showing analyte results exceeding the residential screening levels for soil.

In the Piedmont region of North Carolina, naturally occurring metals are present in the native soil and are found throughout the region at levels that exceed residential screening levels. To determine if the concentrations of metal exceedances are naturally occurring or are attributable to former Site operations, Geosyntec will conduct a background sampling program. Further details of the proposed background study are included in Section 4.

Groundwater delineation included the installation of three monitoring wells and one piezometer on Site as shown in **Figure A2**. Monitoring well MW-1 is located up gradient of the historic CCB operations area. MW-1 provides data needed to determine groundwater flow direction and background geochemistry. Monitoring wells MW-2 and MW-3 are located in the areas where CCBs were found during the subsurface soil investigation to evaluate the direct impact of potential COCs on groundwater quality.

The applicable groundwater quality standards (as codified in Title 15A of the North Carolina Administrative Code, Subchapter 2L) for manganese, sulfate, and total dissolved solids were exceeded as shown in **Figure A2**. Manganese is a common constituent in groundwater in this area of North Carolina and was found in elevated concentrations in the up gradient monitoring well MW-1. Manganese was detected at concentrations that exceed groundwater quality standards in MW-2 and MW-3. Sulfate was detected at concentrations slightly exceeding groundwater quality standards in MW-3. Total dissolved solids in MW-3 exceed groundwater quality standards, as well. Additional groundwater investigation is needed to delineate dissolved manganese, sulfate and TDS south of MW-3 and the scope of work is described in Section 5.

Based on the findings of the initial Remedial Investigation activities, the following additional activities are proposed for the Site.

3. Background Soil Study

Many metals commonly found at industrial sites are also found in non-impacted areas. Background refers to constituents or locations that are not influenced by the releases from a site and is usually described as naturally occurring (US EPA, 2002). Understanding typical background concentrations of metals in soil is important to interpreting soil screening levels. Background levels in North Carolina vary according to the geology of the area and therefore site specific background analysis of unimpacted areas is a tool frequently utilized and supported by NCDENR to evaluate soil screening data. The purpose of the proposed background soil study is to establish site specific background soil levels for metals for the Site for use in assessing remedial goals.

Results from the initial soil investigation indicate exceedances at the Site above preliminary soil remediation goals (PSRGs) for aluminum, arsenic, cobalt, iron, manganese, and vanadium. An initial statistical evaluation indicates that many of these exceedances may be within natural background levels. Remediation of soil to below background levels for metals is not necessary within the REC program (NCDENR, 2014). To determine Site-specific background levels, ten background soil samples will be collected with a DPT rig from the locations shown on **Figure A4**. The samples will be collected in accordance with the QAPP and Region IV EPA Field SOPs. Background soil samples will be analyzed for total metals by EPA Method 6010C.

4. Soil Delineation

Additional soil sampling is proposed in order to complete onsite delineation of CCB impacts in soils. A total of three soil samples will be collected at the locations shown in **Figure A3**. The samples will be collected onsite using direct push technology (DPT). Soil samples will be collected from 3 to 4 feet BGS from soil borings SB-28 and SB-29 and from 4 to 5 ft BGS from soil boring SB-30. A section of soil boring approximately six inches in length will be collected into a stainless steel bowl, mixed manually using a stainless steel spoon, and then divided into laboratory-supplied sample containers. Sample locations may be adjusted by the Geosyntec field engineer or geologist based on field conditions.

Soil samples will be analyzed for the following parameters:

- Total Metals (Hazardous Substance List plus Aluminum, Barium, Cobalt, Iron and Vanadium) by US EPA Method 6010C for
- PAHs by US EPA Method 8270D SIM; and

- Dioxins/Furans by US EPA Method 8290.

Quality assurance samples (including duplicates, matrix spikes, and matrix spike duplicates (MS/MSDs) will be collected in accordance with the QAPP (Geosyntec Consultants, 2013).

5. Groundwater Investigation

Analytical results from the groundwater investigation completed during the implementation of the original Work Plan were compared with groundwater quality standards. As mentioned in Section 2 above, regulatory exceedances were found for manganese, sulfate, and total dissolved solids (TDS) in samples collected from monitoring wells on-Site in March 2014. An additional monitoring well is needed to delineate groundwater quality exceedances downgradient of the Site. The new monitoring well, MW-5, will be installed within the UNC-CH owned parcels south of McCauley Street (**Figure A5)**.

5.1. Monitoring Well Construction

A NC-certified driller will install the new monitoring well (proposed MW-5) with a DPT-6620 under direct supervision of Geosyntec. The new monitoring well will be constructed according to US EPA Region 4 SESD’s SOP and the QAPP (Geosyntec Consultants, 2013). Consistent with the previous monitoring wells, the new monitoring well will be constructed with 2-inch diameter, Schedule 40 PVC well casings and screens with 0.010-inch slot openings. A filter pack of Grade 1 silica sand will be placed around the screen to at least one foot above the top of the screen. A two foot thick bentonite seal will be placed directly above and in contact with the filter pack. The bentonite seal will be allowed to hydrate for at least 30 minutes prior to emplacing grout into the annular space between the casing and the borehole. The grout will terminate at ground surface. Lithology will be logged during monitoring well installation.

5.2 Monitoring Well Development

Well development will not be initiated until the well is allowed to settle overnight following installation of the surface completion.

Well development of the new monitoring well will be performed in accordance with the QAPP (Geosyntec Consultants, 2013). The well will be pumped with a submersible pump to remove turbid water and sediments. Turbidity, temperature, specific conductivity, pH, and dissolved oxygen measurements will be collected periodically and recorded during development. Well development will be judged completed when (i) turbidity measures less than or equal to 10 Nephelometric turbidity units (NTUs), (ii) turbidity has not improved over the previous hour of well development or (iii) well has been purged for three hours.

5.3. Groundwater Sampling

Following installation and development of the new groundwater monitoring well, all Site monitoring wells will be allowed to stabilize for at least one week prior to collecting groundwater samples. The sampling event will include groundwater gauging and low flow sampling of monitoring wells MW-1, MW-2, MW-3, and MW-5 and piezometer PZ-4.

Groundwater samples will be collected in accordance with the QAPP using low-flow sampling methods as described in EPA Region 4 Groundwater Sampling SOP to reduce the potential for sampling suspended sediments along with groundwater/porewater (Geosyntec Consultants, 2013; U.S. Environmental Protection Agency, 2011). Wells will be purged using a low-flow pump with the intake located in the mid-portion of the screened interval of the wells. To the extent practical, the purge rate will be set to minimize drawdown and avoid agitation of the sample. Unfiltered groundwater samples will be collected in accordance with NCDENR requirements.

During sampling, groundwater will be purged through a flow-through cell equipped with temperature, pH, conductivity, redox potential and dissolved oxygen (DO) sensors to monitor real-time variations in these parameters. Turbidity will be measured using a separate turbidity meter. Water quality parameters will be measured and recorded in a field logbook or on field forms. The monitoring well/piezometer will be considered sufficiently purged when water quality parameters have stabilized through three consecutive readings as follows:

- pH: ±0.1 SU;
- Specific Conductance: ±5%; and
- Turbidity: <10 NTUs or stable within 10%.

If the designated water-quality parameters do not become stabilized after five well volumes have been removed, then recording of values will cease at that time and a note of explanation will be recorded in the field log book. In some cases, it is possible to purge a monitoring well or piezometer dry, even with slow purge rates. When a monitoring well/piezometer is purged dry, this is generally accepted as an adequate purge volume, and the well can be sampled after sufficient recharge. Time should be minimized between purging a well dry and collecting a sample. The temperature, pH, conductivity, redox potential, DO and turbidity will be measured during the collection of the sample from the recharged volume and recorded as the measurements of record for the sampling event.

Precautions will be taken to minimize agitation and aeration of the groundwater samples during collection. Samples sent to the laboratory for analysis will be properly preserved, labeled, logged onto a chain-of-custody form, and placed into an iced cooler prior to shipment.

Groundwater samples will be analyzed for the following parameters:

- Total metals (Hazardous Substance List plus Aluminum, Barium, Cobalt, Iron and Vanadium) by EPA Method 6010C;
- Cations and anions (sulfate, chloride, calcium, magnesium, sodium, potassium) by EPA Method 9056A;
- Total Alkalinity by EPA by Standard Method 2320B;
- Sulfate by EPA Method 9034; and
- Total Dissolved Solids (TDS) by Standard Method 2540C.

Sample IDs will conform to the convention established in the Work Plan and QAPP indicating the monitoring well ID number for the location of the sample location.

6. Sediment and Surface Water

In accordance with the original work plan, Geosyntec will assess surface water and sedimentation in the drainage feature located on site and on UNC-CH owned property located south of the Site. Three co-located sediment and surface water samples will be collected: one from the most upstream portion of the drainage feature located on the Site; one from point located midway between the upstream and downstream samples located on Site, and one immediately downstream of the Site on the UNC-CH owned parcels south of McCauley Street. The proposed sampling locations are presented in **Figure A6.**

Surface water and sediment samples will be collected into laboratory-supplied sample containers and will be properly preserved, labeled, logged onto a chain-of-custody form, and placed into an iced cooler prior to shipment. Precautions will be taken to minimize agitation and aeration of the surface water samples during collection. Surface water samples will be analyzed for:

- Total metals (Hazardous Substance List plus Aluminum, Barium, Cobalt, Iron and Vanadium) by EPA Method 6010C;
- PAHs by US EPA Method 8270D SIM;
- Dioxins/Furans by US EPA Method 8290;
- Sulfate by EPA Method 9034; and
- TDS by Standard Method 2540C.

Sediment samples will be analyzed for:

- Total metals (Hazardous Substance List plus Aluminum, Barium, Cobalt, Iron and Vanadium) by EPA Method 6010C;
- PAHs by US EPA Method 8270D SIM; and
- Dioxins/Furans by US EPA Method 8290.

Sediment sample IDs will conform to the convention established in the Work Plan and QAPP only preceded by SED to indicate a sediment sample.

Surface water sample IDs will conform to the convention established in the Work Plan and QAPP only preceded by SW to indicate surface water.

All surface water and sediment sampling will be performed in general accordance with the US EPA SESD’s SOPs for surface water and sediment sampling (U.S. Environmental Protection Agency, 2007; U.S. Environmental Protection Agency, 2010). Surface water samples will be collected prior to sediment samples in order to avoid introducing suspended solids disturbed during sediment sample collection into the surface water samples. Surface water samples may be collected by directly dipping sample containers into the stream or may be sampled using a peristaltic pump with dedicated tubing.

Sediment samples may be collected with a stainless steel sleeve and spoon or with a hand auger from ground surface to six inches below ground surface. The samples will be homogenized in a stainless steel bowl with a stainless steel spoon prior to collection into sample containers. All sediment sampling equipment will be decontaminated prior to reuse.

7. Community Health and Safety Plan

Task hazard analyses (THAs) for the tasks associated with this Work Plan Addendum are included in **Appendix K-A** and will serve as appendices to the HASP. The THAs address aforementioned field activities that were not included in the original HASP.

Following completion of the RI activities, a report will be prepared summarizing the RI and its results. The report will be submitted electronically to the IHSB.

8. Quality Assurance

The QAPP has been updated to include changes in the sampling plan and is being resubmitted as **Appendix L-A**.

REFERENCES

Geosyntec Consultants, 2013. Work Plan for Remedial Investigation, UNC-CH Cogeneration Facility, Chapel Hill, North Carolina. Raleigh, NC.

Inactive Hazardous Sites Branch, 2012. *Registered Environmental Consultant Program: Implementation Guidance.* Division of Waste Management, Superfund Section. Raleigh, NC: North Carolina Department of Environment and Natural Resources. Retrieved 02 01, 2013, from http://portal.ncdenr.org/c/document_library/get_file?uuid=a80d62d7-b052-4a4c-b8b5-d37b52ae31ec&groupId=38361

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CERCLA Cleanup Program. U.S. EPA Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response, April 26, 2002. OSWER 9285.6-07P.

U.S. Environmental Protection Agency, 2007. US EPA Region 4 Operating Procedure for Surface Water Sampling. Athens, GA.

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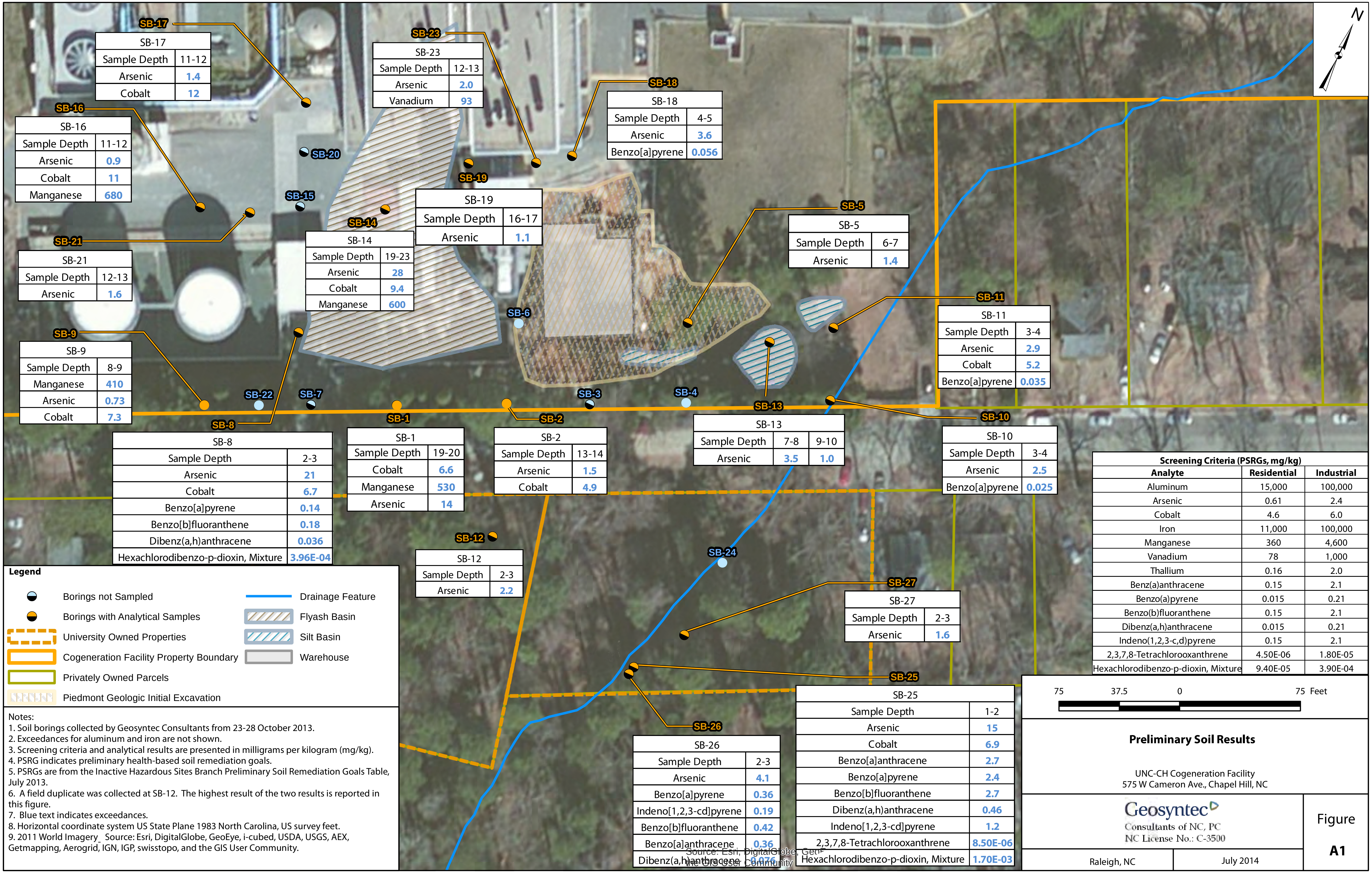
U.S. Environmental Protection Agency,2011a. US EPA Region 4 Operating Procedure for Groundwater Sampling. Athens, GA.

U.S. Environmental Protection Agency,2011b. US EPA Region 4 Operating Procedure for Soil Sampling. Athens, GA.

U.S. Environmental Protection Agency,2013. US EPA Region 4 Operating Procedure for Design and Installation of Monitoring Wells. Athens, GA .



SB-17	
Sample Depth	11-12
Arsenic	1.4
Cobalt	12

SB-23	
Sample Depth	12-13
Arsenic	2.0
Vanadium	93

SB-18	
Sample Depth	4-5
Arsenic	3.6
Benzo[a]pyrene	0.056

SB-16	
Sample Depth	11-12
Arsenic	0.9
Cobalt	11
Manganese	680

SB-19	
Sample Depth	16-17
Arsenic	1.1

SB-5	
Sample Depth	6-7
Arsenic	1.4

SB-14	
Sample Depth	19-23
Arsenic	28
Cobalt	9.4
Manganese	600

SB-21	
Sample Depth	12-13
Arsenic	1.6

SB-11	
Sample Depth	3-4
Arsenic	2.9
Cobalt	5.2
Benzo[a]pyrene	0.035

SB-9	
Sample Depth	8-9
Manganese	410
Arsenic	0.73
Cobalt	7.3

SB-8	
Sample Depth	2-3
Arsenic	21
Cobalt	6.7
Benzo[a]pyrene	0.14
Benzo[b]fluoranthene	0.18
Dibenz(a,h)anthracene	0.036
Hexachlorodibenzo-p-dioxin, Mixture	3.96E-04

SB-1	
Sample Depth	19-20
Cobalt	6.6
Manganese	530
Arsenic	14

SB-2	
Sample Depth	13-14
Arsenic	1.5
Cobalt	4.9

SB-13		
Sample Depth	7-8	9-10
Arsenic	3.5	1.0

SB-10	
Sample Depth	3-4
Arsenic	2.5
Benzo[a]pyrene	0.025

SB-12	
Sample Depth	2-3
Arsenic	2.2

SB-27	
Sample Depth	2-3
Arsenic	1.6

SB-25	
Sample Depth	1-2
Arsenic	15
Cobalt	6.9
Benzo[a]anthracene	2.7
Benzo[a]pyrene	2.4
Benzo[b]fluoranthene	2.7
Dibenz(a,h)anthracene	0.46
Indeno[1,2,3-cd]pyrene	1.2
2,3,7,8-Tetrachlorooxanthrene	8.50E-06
Hexachlorodibenzo-p-dioxin, Mixture	1.70E-03

SB-26	
Sample Depth	2-3
Arsenic	4.1
Benzo[a]pyrene	0.36
Indeno[1,2,3-cd]pyrene	0.19
Benzo[b]fluoranthene	0.42
Benzo[a]anthracene	0.36
Dibenz(a,h)anthracene	0.076

Legend

◓	Borings not Sampled	━	Drainage Feature
◓	Borings with Analytical Samples	▨	Flyash Basin
▭	University Owned Properties	▨	Silt Basin
▭	Cogeneration Facility Property Boundary	▭	Warehouse
▭	Privately Owned Parcels		
▨	Piedmont Geologic Initial Excavation		

Notes:
1. Soil borings collected by Geosyntec Consultants from 23-28 October 2013.
2. Exceedances for aluminum and iron are not shown.
3. Screening criteria and analytical results are presented in milligrams per kilogram (mg/kg).
4. PSRG indicates preliminary health-based soil remediation goals.
5. PSRGs are from the Inactive Hazardous Sites Branch Preliminary Soil Remediation Goals Table, July 2013.
6. A field duplicate was collected at SB-12. The highest result of the two results is reported in this figure.
7. Blue text indicates exceedances.
8. Horizontal coordinate system US State Plane 1983 North Carolina, US survey feet.
9. 2011 World Imagery_ Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Screening Criteria (PSRGs, mg/kg)		
Analyte	**Residential**	**Industrial**
Aluminum	15,000	100,000
Arsenic	0.61	2.4
Cobalt	4.6	6.0
Iron	11,000	100,000
Manganese	360	4,600
Vanadium	78	1,000
Thallium	0.16	2.0
Benz(a)anthracene	0.15	2.1
Benzo(a)pyrene	0.015	0.21
Benzo(b)fluoranthene	0.15	2.1
Dibenz(a,h)anthracene	0.015	0.21
Indeno(1,2,3-c,d)pyrene	0.15	2.1
2,3,7,8-Tetrachlorooxanthrene	4.50E-06	1.80E-05
Hexachlorodibenzo-p-dioxin, Mixture	9.40E-05	3.90E-04

Preliminary Soil Results

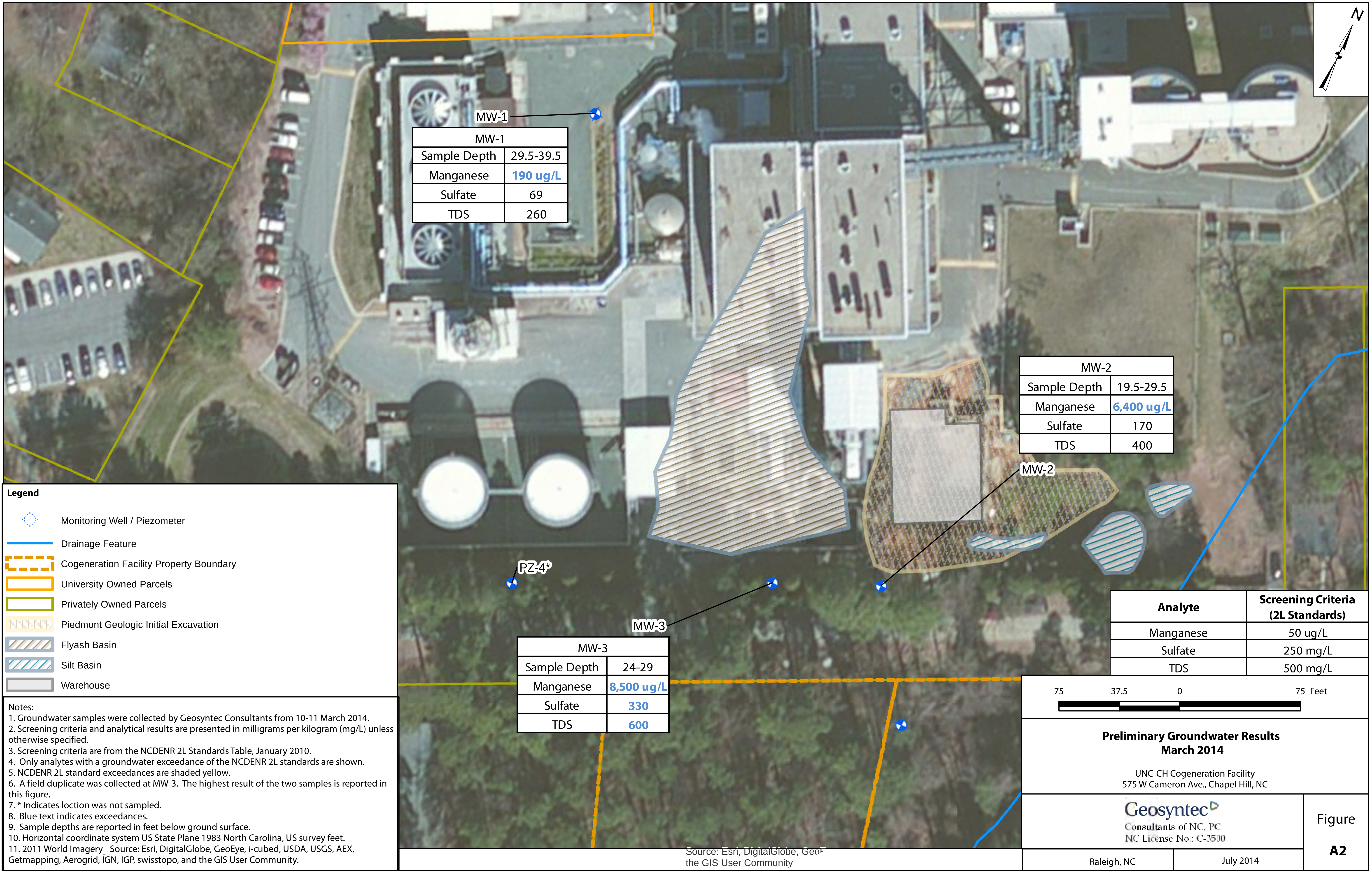
UNC-CH Cogeneration Facility
575 W Cameron Ave., Chapel Hill, NC

Geosyntec
Consultants of NC, PC
NC License No.: C-3500

Figure
A1

Raleigh, NC
July 2014

Path: (Raleigh-01\Data) M:\GIS\UNC-CH - GN5219 Cogeneration Facility RI\MXD\RI Work Plan Addendum\Figure A1-Subsurface Soil Delineation Exceedances.mxd 16 July 2014 CLC



MW-1	
Sample Depth	29.5-39.5
Manganese	190 ug/L
Sulfate	69
TDS	260

MW-2	
Sample Depth	19.5-29.5
Manganese	6,400 ug/L
Sulfate	170
TDS	400

MW-3	
Sample Depth	24-29
Manganese	8,500 ug/L
Sulfate	330
TDS	600

Analyte	Screening Criteria (2L Standards)
Manganese	50 ug/L
Sulfate	250 mg/L
TDS	500 mg/L

Legend

⌖	Monitoring Well / Piezometer
━	Drainage Feature
▭	Cogeneration Facility Property Boundary
▭	University Owned Parcels
▭	Privately Owned Parcels
▨	Piedmont Geologic Initial Excavation
▨	Flyash Basin
▨	Silt Basin
▭	Warehouse

Notes:
1. Groundwater samples were collected by Geosyntec Consultants from 10-11 March 2014.
2. Screening criteria and analytical results are presented in milligrams per kilogram (mg/L) unless otherwise specified.
3. Screening criteria are from the NCDENR 2L Standards Table, January 2010.
4. Only analytes with a groundwater exceedance of the NCDENR 2L standards are shown.
5. NCDENR 2L standard exceedances are shaded yellow.
6. A field duplicate was collected at MW-3. The highest result of the two samples is reported in this figure.
7. * Indicates loction was not sampled.
8. Blue text indicates exceedances.
9. Sample depths are reported in feet below ground surface.
10. Horizontal coordinate system US State Plane 1983 North Carolina, US survey feet.
11. 2011 World Imagery_ Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Source: Esri, DigitalGlobe, GeoE
the GIS User Community

Preliminary Groundwater Results
March 2014

UNC-CH Cogeneration Facility
575 W Cameron Ave., Chapel Hill, NC

Geosyntec
Consultants of NC, PC
NC License No.: C-3500

Raleigh, NC
July 2014

Figure
A2

Path: (Raleigh-01\Data) M:\GIS\UNC-CH - GN5219 Cogeneration Facility RI\MXD\RI Work Plan Addendum\Figure A2 -GW Exceedances.mxd 16 July 2014 CLC

Legend

◐ Previously Collected Soil Sample
◐ Proposed Soil Sample with SB-##
▭ Cogeneration Facility Property Boundary
▭ University Owned Parcels
▭ Privately Owned Parcels
▨ Piedmont Geologic Initial Excavation
▨ Flyash Basin
▨ Silt Basin
▭ Warehouse

Notes:
1. Previously collected soil borings were collected by Geosyntec Consultants from 23-28 October 2013.
2. Horizontal coordinate system US State Plane 1983 North Carolina, US survey feet.
3. 2011 World Imagery_ Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Proposed Soil Samples to Support Delineation

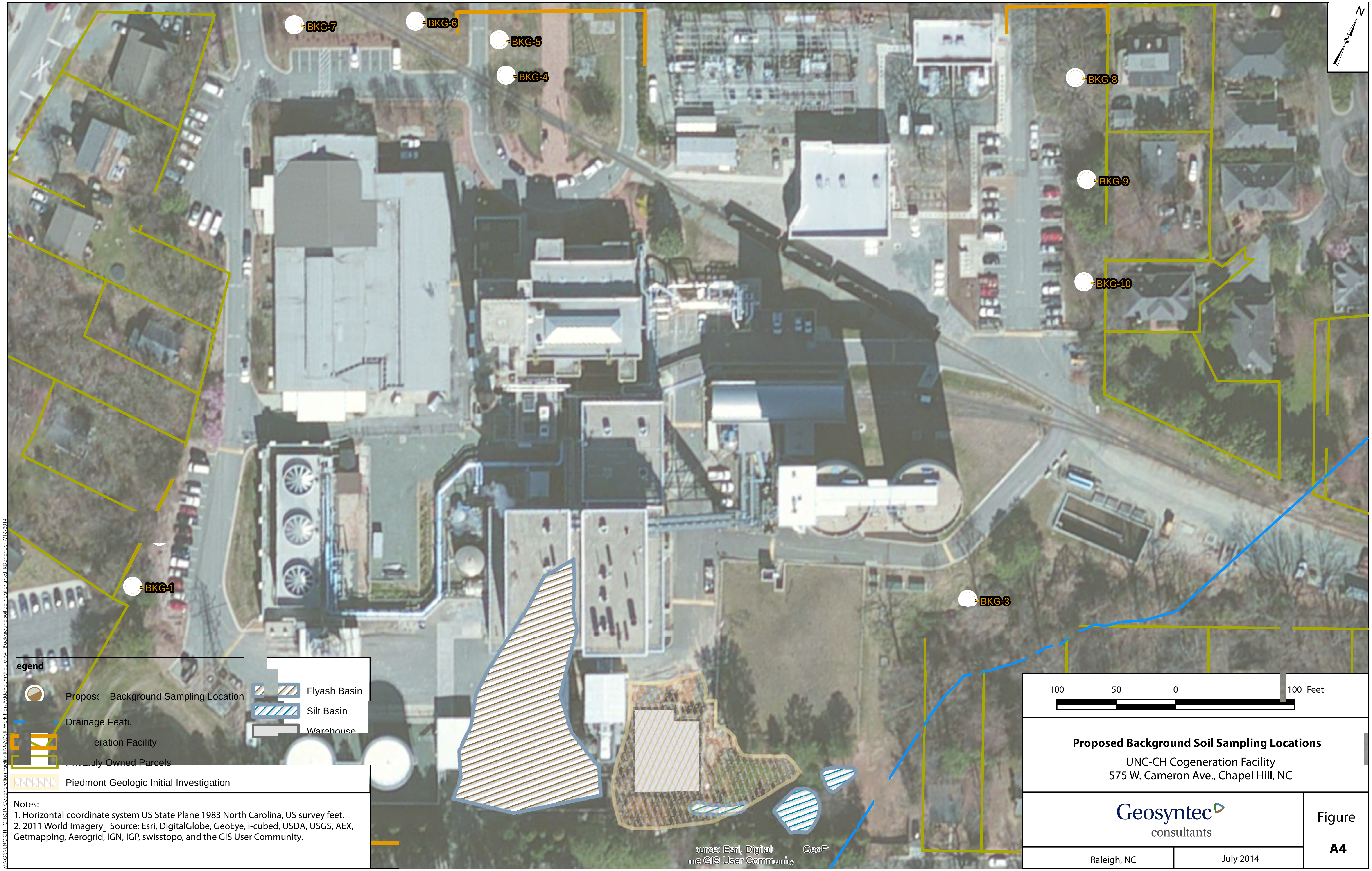
UNC-CH Cogeneration Facility
575 W Cameron Ave., Chapel Hill, NC

Geosyntec
Consultants of NC, PC
NC License No.: C-3500

Figure **A3**

Raleigh, NC
July 2014

Path: (Raleigh-01\Data) M:\GIS\UNC-CH - GN5219 Cogeneration Facility RI\MXD\RI Work Plan Addendum\Figure A3-Proposed Soil Borings.mxd 16 July 2014; RDonahue



egend

● Propose l Background Sampling Location

Drainage Featu

eration Facility

ely Owned Parcels

Piedmont Geologic Initial Investigation

▨ Flyash Basin

▨ Silt Basin

Warehouse

Notes:
1. Horizontal coordinate system US State Plane 1983 North Carolina, US survey feet.
2. 2011 World Imagery_ Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Proposed Background Soil Sampling Locations

UNC-CH Cogeneration Facility
575 W. Cameron Ave., Chapel Hill, NC

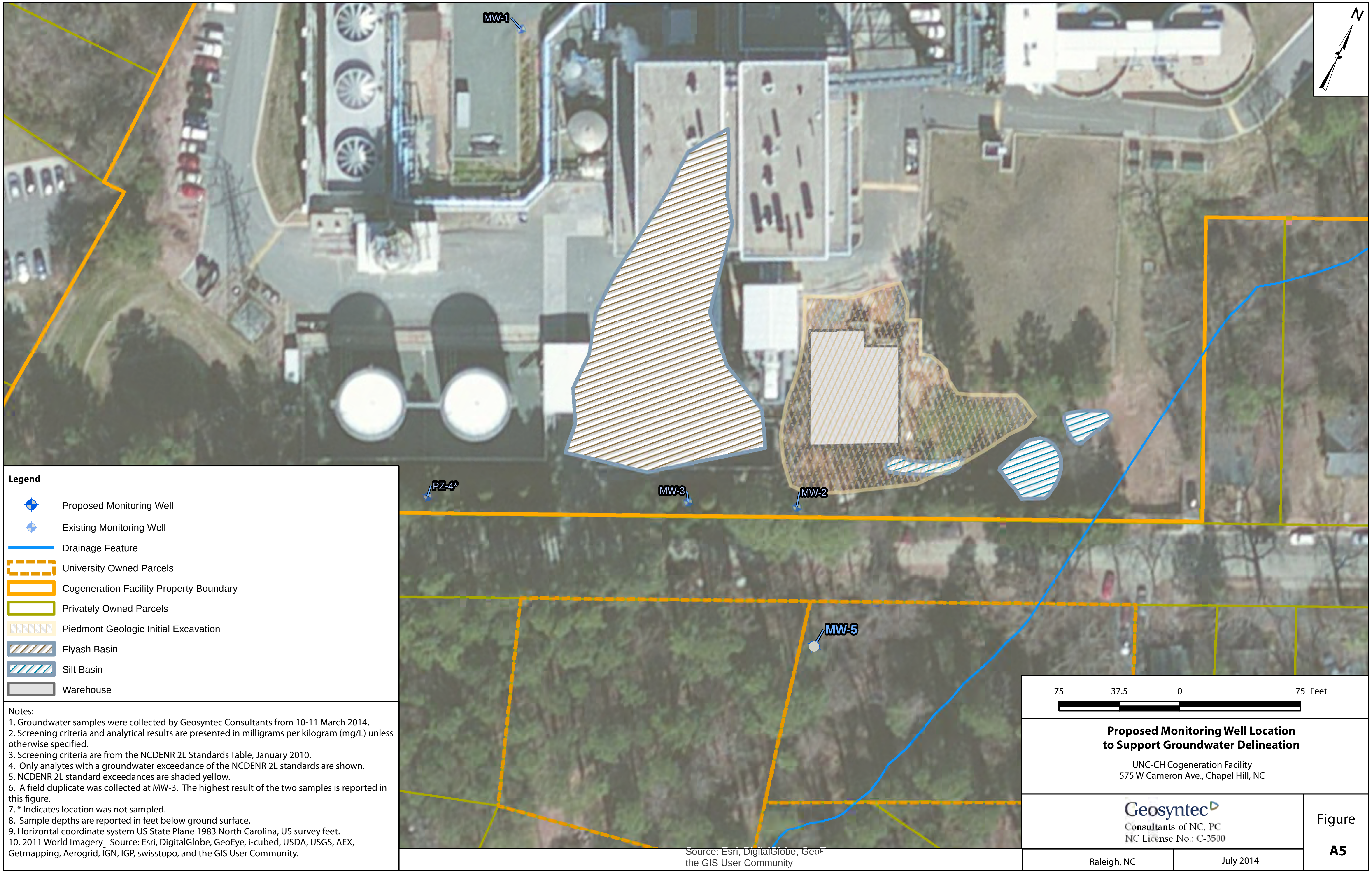
Geosyntec
consultants

Raleigh, NC

July 2014

Figure
A4

M:\GIS\UNC-CH - GN5219 Cogeneration Facility RI\MXD\RI Work Plan Addendum\Figure A4 - Background soil delineation.mxd; RDonahue; 7/16/2014



Source: Esri, DigitalGlobe, Geo
the GIS User Community

Legend

- ⌖ Proposed Monitoring Well
- ⌖ Existing Monitoring Well
- ━ Drainage Feature
- ▭ University Owned Parcels
- ▭ Cogeneration Facility Property Boundary
- ▭ Privately Owned Parcels
- ▨ Piedmont Geologic Initial Excavation
- ▨ Flyash Basin
- ▨ Silt Basin
- ▭ Warehouse

Notes:
1. Groundwater samples were collected by Geosyntec Consultants from 10-11 March 2014.
2. Screening criteria and analytical results are presented in milligrams per kilogram (mg/L) unless otherwise specified.
3. Screening criteria are from the NCDENR 2L Standards Table, January 2010.
4. Only analytes with a groundwater exceedance of the NCDENR 2L standards are shown.
5. NCDENR 2L standard exceedances are shaded yellow.
6. A field duplicate was collected at MW-3. The highest result of the two samples is reported in this figure.
7. * Indicates location was not sampled.
8. Sample depths are reported in feet below ground surface.
9. Horizontal coordinate system US State Plane 1983 North Carolina, US survey feet.
10. 2011 World Imagery_ Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Proposed Monitoring Well Location
to Support Groundwater Delineation

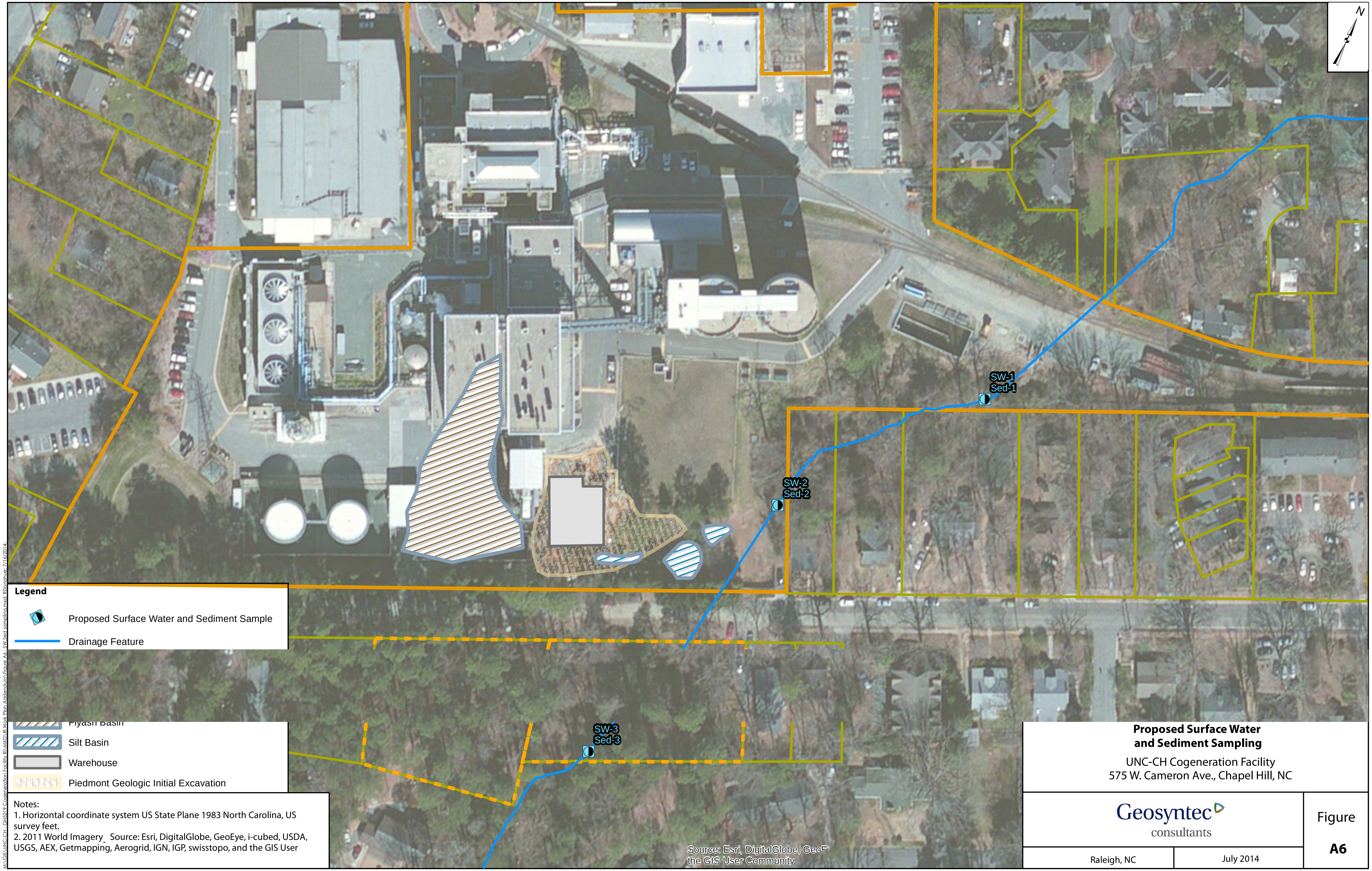
UNC-CH Cogeneration Facility
575 W Cameron Ave., Chapel Hill, NC

Geosyntec
Consultants of NC, PC
NC License No.: C-3500

Raleigh, NC
July 2014

Figure
A5

Path: (Raleigh-01\Data) M:\GIS\UNC-CH - GN5219 Cogeneration Facility RI\MXD\RI Work Plan Addendum\Figure A5 - Proposed MW.mxd 16 July 2014 ; RDonahue



Notes:
1. Horizontal coordinate system US State Plane 1983 North Carolina, US survey feet.
2. 2011 World Imagery_ Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User

Proposed Surface Water and Sediment Sampling

UNC-CH Cogeneration Facility
575 W. Cameron Ave., Chapel Hill, NC

Geosyntec
consultants

Raleigh, NC

July 2014

Figure

A6

M:\GIS\UNC-CH - GN5219 Cogeneration Facility RI\MXD\RI Work Plan Addendum\Figure A6 - SW,Sed sampling.mxd; RDonahue; 7/16/2014;

APPENDIX K-A

Geosyntec consultants

PRE-WORK THA

THA Title:	Surface Water and Sediment Sampling	**Date:**	6/9/2014
Project Name:	UNC Cogeneration Facility	**Client Name:**	UNC-CH
Project Number:	GC5219	**Client Project Manager:**	Mary Beth Coza
Project Location:	Chapel Hill, North Carolina	**Geosyntec Project Manager:**	Eric Nesbit
Scope of Work Summary:	The overall purpose and objective of the Remediation Investigation is to determine the nature and extent of coal combustion byproduct (CCB) impacts at the Site. Based on previous data, CCBs were identified in soils along the discharge pathway to the stream. Co-located surface water and sediment ampling will be conducted at three locations water to determine the nature and extent of CCB impacts, if any, to the stream. The focus of this THA is surface water and sediment sampling.		

Work Steps	**Process or Activity**	**Hazards**	**Hazard Control**
Task 1: Locate Sampling Locations Locate sampling locations initially using a GPS or tape measure and the referenced physical features. Place stakes or pin flags at all sampling locations for later surveying.		Slips/trips/falls Heat/cold stress Biohazards: snakes, bees, spider, ticks, poison ivy Contaminant exposure: metals, dioxins, PAHs	Pay close attention to foot placement; slow deliberate movement, especially around the boundary of water bodies. Wear disposable gloves and safety glasses. Avoid direct contact with contaminated matrixes. Dress for weather conditions. Apply sunscreen and insect spray if needed. Wear long sleeve shirt or Tyvek or use a barrier cream when near the poisoned plants.
Task 2: Surface Water Sampling Use the sample containers themselves or a peristaltic pump with dedicated tubing to collect the samples.		Biohazards: snakes, bees, spider, ticks, poison ivy Contaminant exposure: metals, dioxins, PAHs	Wear disposable gloves and safety glasses. Avoid direct contact with contaminated matrixes.
Task 3: Sediment Sampling Collect the sediment samples with stainless steel spoons and /or hand augers. Homogenize the samples in stainless steel bowls with stainless steel spoons .		Biohazards: snakes, bees, spider, ticks, poison ivy. Contaminant exposure: metals, dioxins, PAHs	Wear disposable gloves and safety glasses, avoid direct contact with contaminated matrixes.
Task 4: Sample Collection, Labeling and Packing Place the samples in the laboratory-supplied sample containers and label the bottles. Pack samples in cooler with ice and proper blanks.		Contaminant exposure: metals, dioxins, PAHs Back strain when transporting coolers full of collected samples packed with ice.	Wear disposable gloves and safety glasses. Avoid direct contact with contaminated matrixes. Use proper lifting techniques. Get assistance when possible, especially for containers heavier than 50 lbs.
Task 5: Equipment Decontamination Decontaminate the impacted equipment, such as steel hand auger et. al., before reuse.		Slips, Trips, and Falls Hand injuries during manual handling of materials. Contaminant exposure: metals, dioxins, PAHs	Pay close attention to foot placement; slow deliberate movement, especially around the boundary of water bodies. Pay close attention to the sharp edge of steel hand auger to avoid cutting or other injuries of hands. Wear disposable gloves and safety glasses. Avoid direct contact with contaminated matrixes.

Min. Personal Protective Equipment (PPE):	Long pants, safety glasses, safety (steel-toed) boots, nitrile gloves, hard hat and ear plugs where appropriate.

Individuals Must Sign the last page of this THA after review.

HAZARD		**HAZARD CONTROLS (check all that apply and comment as required)**
WALKING/WORKING SURFACES (EHS 210, 501)		
☒	☒ Uneven terrain ☒ Slippery surfaces	☒ Walkways are cleared of equipment, vegetation, excavated material, tools and debris ☐ Pits and floor openings are covered or otherwise guarded ☒ Work areas are illuminated adequately; field operations are not conducted before sunrise or after sunset unless adequate lighting is provided. ☐ Spills are cleaned up promptly ☐ Salt applied to icy areas, snow cleared from walkways
☐	LADDERS / STAIRS ☐ Extension Ladders ☐ Step Ladders	☐ Employees trained in safe ladder use at safety meeting ☐ Extension ladders are properly footed, secured at top, and setup at proper angle ☐ Stepladders are set on level ground or properly shimmed with spreaders locked.

HAZARD		HAZARD CONTROLS (check all that apply and comment as required)
	☐ Fixed Ladders ☐ Stairs	☐ Stairs have proper rise over run and stairs >4 steps or 4' have guardrails. ☐ Ladders/Stairs Comments: ☐ Never use a step ladder as a straight ladder. All straight ladders shall be extended three rungs past leading edge. Never use metal ladders while working with electricity.
☐	MANLIFT used to reach work ☐ Scissor Lift ☐ Extensible Boom ☐ Articulated Boom ☐ vertical Lift ("Genie")	☐ Operators are sufficiently trained, experienced and qualified. ☐ Equipment is inspected after mobilization and is in good condition. ☐ Harness & Lanyard worn whenever operating the lift (scissor lifts may be excepted) ☐ Overhead and surface obstructions are reviewed with operators prior to use. **Manlift Comments:**
WORKING ALONE (EHS 207)		
☐	☐ Getting injured or incapacitated with no one else around to help ☐ Falling victim to crime	☐ Someone else knows your whereabouts, what you're doing and when you should be expected back to their office or project site location. This will be accomplished by communicating three (3) times at a mimumum with the supervisor or the project manager 1 – Upon Arrival 2 – Midway through the day 3 – Upon Departure ☐ Ensure the area has wireless coverage, summon alternate communication method if wireless phones are not operable. ☐ Checked the weather forecast to avioid being caught up in bad weather conditions; ☐ Ensured that vehicle has sufficient fuel and is well maintained; ☐ Allowed self sufficient time for the trip so that you are not rushing; ☐ Drive with any bags, records and equipment hidden so that you are not seen hiding them as you park; **Working Alone Comments:**
EXCAVATIONS / TRENCHING/UNDERGROUND HAZARDS (EHS 402)		
☐	☐ Max Depth ≥ 20' ☐ Max Depth ≥ 5' ☐ Max Depth <5' with potential cave-in hazard ☐ Potential permit-required confined space at depth ≥ 4' ☐ Underground utilities ☐ Structures/foundations ☐ Falls into excavations	☐ Sloping & shoring for excavations ≥20' are approved by a professional engineer ☐ Sloping & shoring for excavations ≥5' when persons are exposed to cave-in. (specify below) ☐ Sloping & shoring for shallow (<5') excavations with cave-in hazard (specify below) ☐ Excavations ≥ 4' are classified as a non-permit confined space ☐ Excavations ≥ 4' are classified as Alternate Entry or Permit-Required (see confined space) ☐ Underground utilities have been identified and marked. ☐ Local "dig safe" organization has been notified for utility locations in public areas or rights of way. Number: ___811_________________________ Date: ____________________ ☐ Hand digging within 3' of utility locations. ☐ Excavations are protected by perimeter fencing (not barricade tape): (☐ rigid fence - chain link or wood, ☒safety fence 6' from edge.) **Excavation Comments:**
CONFINED SPACES (EHS 118)		
☐	☐ No <u>Serious</u> Hazards ☐ Toxic atmosphere ☐ carbon monoxide ☐ hydrogen sulfide ☐ ☐ Flammable atmosphere ☐ Low oxygen ☐ Combustible dust ☐ Other Serious Hazard:	☐ Confined space is altered so that it is no longer a confined space. (describe below) ☐ Confined space is downgraded to a non-permit confined space. (identify which spaces below) ☐ Alternate Entry is used. (Identify which space qualify for confined space entry below) ☐ Full permit-required confined space entry is used due to presence of serious hazards. ☐ Rescue team has been notified (☐ Paid FD ☐ Volunteer FD ☐ Plant Rescue) Rescue Team:___________________________ Phone Number: ____________________ ☐ All entrants and attendants for Alternate Entry and Permit-Required Entry have confined space entry training. **Confined Space Comments:**
BOAT OPERATIONS/WORKING ON or NEAR WATER and ICE (EHS 306)		
☐	☐ Drowning ☐ Hypothermia	☐ Only qualified employees are operating the boat ☐ Coast Guard-approved Personal Flotation Device (PFD), sized and adjusted to the wearer, is worn by all when involved in boat operations. ☐ A float plan is completed prior to leaving dock. ☐ Emergency equipment like ring buoy, flares and fire extinguishers are present **Boat, water operations Comments:**
DRILLING (EHS 403)		

PRE-WORK THA

HAZARD		**HAZARD CONTROLS (check all that apply and comment as required)**
☒	☐ Struck By, Run-Over, Caught In Between (pinch points), Roll Over, Fluid Leaks ☒ Underground utilities, aboveground ☐ Spills	☐Contractor inspected the drill rig ☐ High visibility vests, hard hats are being worn near the equipment ☐ Operators and helpers will maintain a safe distance to moving parts. All those working near moving or rotating parts will secure loose hair, clothing, and equipment. ☐ Drill rigs will only be moved with masts lowered. Masts will be erected with outriggers fully extended when equipped with outriggers. ☐ Max. safe slope for rig will be followed ☐ Spinning parts of the rig are guarded when possible, no loose clothing being worn near the rig ☒ Local "dig safe" organization has been notified for utility locations in public areas or rights of way. Number: _811___________________________ Date: ____________________ ☒ IDW is being managed as per regulations ☐ Area is surveyed for overhead utilities ☐ Hearing protection is used when working near the rig ☐ Spill equipment is available for fuel and hydraulic fluid leaks. Spill Kit Located: __________ **Drilling operations Comments:**
HEAVY EQUIPMENT [other than cranes] (EHS 504)		
☐	☐ Max. safe slope for each vehicle will be followed Struck By, Run-Over, Caught In Between (pinch points), Roll Over, Fluid Leaks ☐ Bulldozer ☐ Excavator ☐ Front Loader ☐ mini Skid Steer (bobcat) ☐ mini Excavator ☐ Dump Truck ☐ Drill/Boring Rig ☐ Lull / Material Handler ☐ Forklift ☐ Manlift - specify type(s) ☐ Land Clearing loader	☒ Qualified persons operate all heavy equipment. (certificate is required for forklift and lull operators) ☒ Equipment will be inspected upon mobilization ☒ All leaks or defective safety equipment will be repaired before use. ☒ Operators will be reminded of seatbelt use by: _Rachel Donahue_________________________ ☒ Eye contact with the operator is made prior to approaching near equipment or swing radius ☒ High visibility vests are required ☒ Max. safe slope for each vehicle will be followed ☒ Counterweight swing radius will be barricaded. ☒ Rigging directly to the forks of a lull, forklift, or front loader equipped forks is prohibited. Crane hook attachments will be used (specify):____________________________________ ☒ Spill equipment is available for fuel and hydraulic fluid leaks. Spill kit located:_ one each piece of heavy equipment__________
ENVIRONMENTAL HAZARDS (NON CHEMICAL) (EHS 124, 125, 127)		
☒	☒ Heat Stress ☐ Cold Stress ☒ Insects, spiders, ticks ☒ Wild animals ☐ Mold, fungi ☒ Poisonous plants ☐ Hazardous noise	☒ Heat/Cold stress are monitored in accordance with Geosyntec procedures EHS 124 & EHS 125 ☒ Fluids are provided to prevent worker dehydration ☒ Types and injury potential of snakes, insects, spiders are reviewed with workers ☒ Insect repellant is used, PPE is used to protect against sting/bite injuries. ☒ All potentially poisonous plants such as poison ivy, poison oak, poison sumac are identified, long sleeve shirt or Tyvek is worn or a barrier cream is used when near these plants ☐ Hearing protection is used when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) **Environmental Hazards Comments:**
POWER TOOLS, HAND TOOLS, and EXTENSION CORDS (EHS 121)		
☒	Eye injury, hand/arm cuts, electrical shock, strains, foot injuries, dust ☐ Grinders ☐ Needle Gun ☐ Chop saw ☐ Chain saw ☐ Trimmer ☐ Concrete/asphalt saw ☐ Trencher ☒ other tools	☐ All tools and electrical cords will be inspected upon mobilization by: _______________ ☐ All tools and electrical cords in-use will be inspected daily by: ________________ ☐ Grinder speeds will not exceed grinding wheel ratings. ☐ Water or wet cutting performed to control dust ☐ Respirators used to prevent exposure to dust (respirator type:______________________) ☐ Thorough utility survey conducted prior to any concrete cutting, coring ☐ Face shield and safety glasses used (required for all grinders, jackhammers, chain saws, etc) ☐ Kevlar chaps and jacket (required for all chainsaw work) ☐ Hearing protection required for which tools or areas: ______________________ ____ ☒ All extension cords are in good condition with no cuts through outer insulation, ground plugs are present, and no "vinyl tape" repairs. **Tool & Cord Comments:**
MANUAL MATERIAL HANDLING / MATERIAL STORAGE / HOUSEKEEPING (EHS 401)		
☒	Back or shoulder strain, struck by falling objects, trips and falls, incompatible materials (fire or explosion) ☒ hvy manual lifting (>30 lbs)	☐ Mechanical lifting equipment used to reduce manual material handling: (☐ Forklift/Lull ☐ Heavy Equipment ☐ chainfall ☐ ______________________) ☒ Manual lifting more than 50 lbs by a single person will be avoided.

PRE-WORK THA

	HAZARD	HAZARD CONTROLS (check all that apply and comment as required)
	☐ chemical storage ☐ compressed gas storage ☐ Tall storage greater than 2 pallets stacked. ☐ Material & equipment laydown areas ☐ Debris removal	☒ Good manual lifting techniques will be reviewed prior to site work. ☐ Incompatible chemicals will be separated by 20' ☐ Secondary containment will be provided for the following chemicals: ___________________ ☐ Safety equipment will be located near chemical storage. ☐ Spill Kit ☐ Emergency Shower ☐ Eyewash ☐ Drench Hose ☐ Splash PPE ☐ Flammable gases and oxygen will be separated by 20'. ☐ All compressed gas cylinders will be transported vertically and secured upright. ☐ Equipment and materials will not be stored on site ☐ Debris will be moved daily and placed in designated areas. **Material Handling & Housekeeping Comments:**
TRAFFIC & SIDEWALK OBSTRUCTION (EHS 517)		
☒	☒ Vehicle accidents ☒ Pedestrians struck by vehicles or heavy equipment ☐ Pedestrians falls ☐ Pedestrian struck-by falling objects	☐ DOT signal devices will be used to re-route vehicles around excavations or busy site entrances/exits that affect road traffic. ☐ Flaggers will be used and have DOT Flagger Training ☐ Pedestrian traffic will be safely routed around or over excavations. ☐ Pedestrian traffic will be safely routed around or under overhead work. **Traffic & Sidewalk Comments:** Be careful to watch any pedestrians walking to the work zone
HAZARDOUS WASTE SITE WORK (EHS 108, 112, 301)		
☒	☒ exposure to hazardous vapors or dust, contact with contaminated materials, fire, and explosion. Contaminants of Concern and hazardous chemicals include: ☐ volatile organic compounds (describe: ___________ _____________) ☒ semivolatile organic cmpds (describe:____PAHs_________ ______________________) ☒ metal dusts (describe:__ ___________ ______________________) ☐ PCBs ☐ caustic (NaOH) ☐ Acid (H_2SO_4, HCl) ☒ Other hazardous waste site hazards are covered elsewhere in the HASP)	☒ Site workers with a potential for contact with contaminated materials will have OSHA 40-hour training, current 8-hour refresher, and medical exam. ☒ Intrusive work activities include: __hand augering____ ____ The perimeter of intrusive work areas are identified by:_______________________________ Decontamination of personnel or equipment is not anticipated with the current scope of work. ☒ Decontamination of personnel and small tools will be conducted as follows: • Remove particulate matter and surface film with tap water; • Manual scrub with non-phosphate soap solution (Alconox); • Tap water rinse; • 10% nitric acid rinse (if sampling for metals/cyanide); Distilled/De-ionized water rinse; • Pesticide grade hexane rinse (if sampling for PCBs); and, • Air dry. ☒ Decontamination of heavy equipment will be conducted as follows: ____ ____ ☒ Heavy equipment leaving the site will be inspected by_Rachel Donahue_____________________ ☒ Work area monitoring is not anticipated with the current scope of work. ☐ Work Area Air Monitoring as follows for (dust, VOCs, etc) **OR** see attached. ________ ________ Level C Tyvek, boot covers, nitrile gloves, half or full face respirator with _____________ cartridges changed daily ________ ________ Level B Same as above except supplied air respirator ________ ________ STOP work, contact EHS Department ☒ Community Air Monitoring is not anticipated with the current scope of work. ☐ Community Air Monitoring is required per the attached document. **Comments/Other:**

EMERGENCY RESPONSE (911 Service is Available ☒ Yes ☐ No)

Emergency Medical Treatment - Hospital Name: Hospital Address:	UNC Hospital 101 Manning Dr. Chapel Hill, NC	**Number:**	(919) 966-4721
Non-Emergency Med. Treatment - Clinic Name: Occupational Clinic Address:	UNC Urgent Care 6103 Farrington Rd., Suite 101 Chapel Hill, NC 27517	**Number:**	(919) 957-6610
Fire Department Name	Chapel Hill Fire Department	**Number:**	911
Spill Response:		**Number:**	
Client Representative Name::	Larry Daw	**Office Number:**	(919) 962-6666
		Cell Number:	(919) 883-7019
Geosyntec **Project Manager** Name:	Eric Nesbit	**Office Number:**	(919) 424-1823
		Cell Number:	(919) 796-4137

PRE-WORK THA

HAZARD	**HAZARD CONTROLS (check all that apply and comment as required)**		
Geosyntec **Corporate H&S** Name:	Dale Prokopchak	**Office Number:**	(804) 332-6376
		Cell Number:	(804) 349-8067

Emergency Response Comments:

Date: 6/9/2014	
Project Name: UNC Cogeneration Facility	
THA Title: Surface Water and Sediment Sampling	
Subcontractor Name: CCI	
Geosyntec Representative (reviewed by):	
Subcontractor Foreman/Supervisor Signature (authorize):	
Crew Signatures (acknowledge):	
Print Name	**Signature**

PLEASE RETURN A COPY OF THIS SIGNED PAGE TO GEOSYNTEC PROJECT MGR., SUPERINTENDENT UPON REVIEW AND ACKOWLEDGMENT BY THE CREW MEMBERS. ALL NEW CREW MEMBERS SHALL BE ORIENTATED THE SAME AND A SUBMITTAL OF A NEW SIGN IN SHEET SHALL BE COMPLETED.

Geosyntec consultants

PRE-WORK THA

THA Title:	Soil Removal	**Date:**	6/9/2014
Project Name:	UNC Cogeneration Facility	**Client Name:**	UNC-CH
Project Number:	GC5219	**Client Project Manager:**	Mary Beth Coza
Project Location:	Chapel Hill, North Carolina	**Geosyntec Project Manager:**	Eric Nesbit
Scope of Work Summary:	The overall purpose and objective of the Remediation Investigation is to determine the nature and extent of coal combustion byproduct (CCB) impacts at the Site. Based on previous data, CCBs were identified in soils along the discharge pathways to the stream. While delineating these areas, contaminated soil will be removed with shovels when possible and with an a mini-excavator, if necessary, by a subcontractor. The focus of this THA is soil removal.		

Work Steps	**Process or Activity**	**Hazards**	**Hazard Control**
Task 1: Inspect site and equipment Locate extents of initial excavation areas. Have utilities located in these areas.		Slip/trip/fall Utility protection Heat/cold stress Biohazards: snakes, bees, spider, ticks, poison ivy Contaminant exposure: metals, dioxins, PAHs	Mark excavation areas and conduct utility locate. Inspect equipment (i.e. excavator) for proper utilization. Review equipment manual. Avoid direct contact with contaminated matrixes.
Task 2: Soil Removal Remove soils by hand to 3' below ground surface to protect utilities and then either proced with shovels or with excavation equipment if necessary. When side-walls and bottom of areas are deemed visually clean of CCB impacts, confirmation samples will be collected. If samples still indicate exceedances, continue excavation until side-wall and floor samples are clean.		Removal Hand/foot injury Loud noise (if use removal equipment) Slips, trips, and falls\ Heat/cold stress Biohazards: snakes, bees, spider, ticks, poison ivy Contaminant exposure: metals, dioxins, PAHs	Wear appropriate PPE, including ear plugs as required, safety glasses, and steel toed boots. Pay attention to excavation areas and proper equipment use. Pay close attention to hand and foot placement, watch for rubble/debris which could disrupt operations, slow deliberate movements – don't hurry. Avoid direct contact with contaminated matrixes.
Task 3: Back-fill		Slip/trip/fall Hand/foot injury Heat/cold stress Biohazards: snakes, bees, spider, ticks, poison ivy	Wear appropriate PPE. Pay close attention to hand and foot placement, slow deliberate movements – don't hurry.

Min. Personal Protective Equipment (PPE):	Long pants, safety glasses, safety (steel-toed) boots and nitrile gloves. Safety vest, hard hat and ear plugs where appropriate.

Individuals Must Sign the last page of this THA after review.

HAZARD		**HAZARD CONTROLS (check all that apply and comment as required)**
WALKING/WORKING SURFACES (EHS 210, 501)		
☒	☒ Uneven terrain ☐ Slippery surfaces	☒ Walkways are cleared of equipment, vegetation, excavated material, tools and debris ☐ Pits and floor openings are covered or otherwise guarded ☐ Work areas are illuminated adequately; field operations are not conducted before sunrise or after sunset unless adequate lighting is provided. ☒ Spills are cleaned up promptly ☐ Salt applied to icy areas, snow cleared from walkways
☐	LADDERS / STAIRS ☐ Extension Ladders ☐ Step Ladders ☐ Fixed Ladders ☐ Stairs	☐ Employees trained in safe ladder use at safety meeting ☐ Extension ladders are properly footed, secured at top, and setup at proper angle ☐ Stepladders are set on level ground or properly shimmed with spreaders locked. ☐ Stairs have proper rise over run and stairs >4 steps or 4' have guardrails. ☐ Ladders/Stairs Comments: ☐ Never use a step ladder as a straight ladder. All straight ladders shall be extended three rungs past leading edge. Never use metal ladders while working with electricity.
☐	MANLIFT used to reach work ☐ Scissor Lift ☐ Extensible Boom	☐ Operators are sufficiently trained, experienced and qualified. ☐ Equipment is inspected after mobilization and is in good condition. ☐ Harness & Lanyard worn whenever operating the lift (scissor lifts may be excepted)

PRE-WORK THA

	HAZARD	**HAZARD CONTROLS (check all that apply and comment as required)**
	☐ Articulated Boom ☐ vertical Lift ("Genie")	☐ Overhead and surface obstructions are reviewed with operators prior to use. **Manlift Comments:**
WORKING ALONE (EHS 207)		
☐	☐ Getting injured or incapacitated with no one else around to help ☐ Falling victim to crime	☐ Someone else knows your whereabouts, what you're doing and when you should be expected back to their office or project site location. This will be accomplished by communicating three (3) times at a mimumum with the supervisor or the project manager 1 – Upon Arrival 2 – Midway through the day 3 – Upon Departure ☐ Ensure the area has wireless coverage, summon alternate communication method if wireless phones are not operable. ☐ Checked the weather forecast to avioid being caught up in bad weather conditions; ☐ Ensured that vehicle has sufficient fuel and is well maintained; ☐ Allowed self sufficient time for the trip so that you are not rushing; ☐ Drive with any bags, records and equipment hidden so that you are not seen hiding them as you park; **Working Alone Comments:**
EXCAVATIONS / TRENCHING/UNDERGROUND HAZARDS (EHS 402)		
☒	☐ Max Depth ≥ 20' ☐ Max Depth ≥ 5' ☒ Max Depth <5' with potential cave-in hazard ☐ Potential permit-required confined space at depth ≥ 4' ☒ Underground utilities ☐ Structures/foundations ☒ Falls into excavations	☐ Sloping & shoring for excavations ≥20' are approved by a professional engineer ☐ Sloping & shoring for excavations ≥5' when persons are exposed to cave-in. (specify below) ☒ Sloping & shoring for shallow (<5') excavations with cave-in hazard (specify below) ☐ Excavations ≥ 4' are classified as a non-permit confined space ☐ Excavations ≥ 4' are classified as Alternate Entry or Permit-Required (see confined space) ☒ Underground utilities have been identified and marked. ☒ Local "dig safe" organization has been notified for utility locations in public areas or rights of way. Number: ___811_________________________ Date: ____________________ ☒ Hand digging within 3' of utility locations. ☒ Excavations are protected by perimeter fencing (not barricade tape): (☐ rigid fence - chain link or wood, ☒safety fence 6' from edge.) **Excavation Comments:**
CONFINED SPACES (EHS 118)		

☐	☐ No <u>Serious</u> Hazards
	☐ Toxic atmosphere
	    ☐ carbon monoxide
	    ☐ hydrogen sulfide
	    ☐
	☐ Flammable atmosphere
	☐ Low oxygen
	☐ Combustible dust
	☐ Other Serious Hazard:
		☐ Confined space is altered so that it is no longer a confined space. (describe below)
		☐ Confined space is downgraded to a non-permit confined space. (identify which spaces below)
		☐ Alternate Entry is used. (Identify which space qualify for confined space entry below)
		☐ Full permit-required confined space entry is used due to presence of serious hazards.
		☐ Rescue team has been notified (☐ Paid FD ☐ Volunteer FD ☐ Plant Rescue)
		Rescue Team:___________________________ Phone Number: ____________________
		☐ All entrants and attendants for Alternate Entry and Permit-Required Entry have confined space entry training.
		Confined Space Comments:

BOAT OPERATIONS/WORKING ON or NEAR WATER and ICE (EHS 306)		
☐	☐ Drowning ☐ Hypothermia	☐ Only qualified employees are operating the boat ☐ Coast Guard-approved Personal Flotation Device (PFD), sized and adjusted to the wearer, is worn by all when involved in boat operations. ☐ A float plan is completed prior to leaving dock. ☐ Emergency equipment like ring buoy, flares and fire extinguishers are present **Boat, water operations Comments:**
DRILLING (EHS 403)		

PRE-WORK THA

HAZARD		HAZARD CONTROLS (check all that apply and comment as required)
☐	☐ Struck By, Run-Over, Caught In Between (pinch points), Roll Over, Fluid Leaks ☐ Underground utilities, aboveground ☐ Spills	☐ Contractor inspected the drill rig ☐ High visibility vests, hard hats are being worn near the equipment ☐ Operators and helpers will maintain a safe distance to moving parts. All those working near moving or rotating parts will secure loose hair, clothing, and equipment. ☐ Drill rigs will only be moved with masts lowered. Masts will be erected with outriggers fully extended when equipped with outriggers. ☐ Max. safe slope for rig will be followed ☐ Spinning parts of the rig are guarded when possible, no loose clothing being worn near the rig ☐ Local "dig safe" organization has been notified for utility locations in public areas or rights of way. Number: ____________________________ Date: ____________________ ☐ IDW is being managed as per regulations ☐ Area is surveyed for overhead utilities ☐ Hearing protection is used when working near the rig ☐ Spill equipment is available for fuel and hydraulic fluid leaks. Spill Kit Located: __________ **Drilling operations Comments:**
HEAVY EQUIPMENT [other than cranes] (EHS 504)		
☒	☒ Max. safe slope for each vehicle will be followed Struck By, Run-Over, Caught In Between (pinch points), Roll Over, Fluid Leaks ☐ Bulldozer ☐ Excavator ☐ Front Loader ☐ mini Skid Steer (bobcat) ☒ mini Excavator ☐ Dump Truck ☐ Drill/Boring Rig ☐ Lull / Material Handler ☐ Forklift ☐ Manlift - specify type(s) ☐ Land Clearing loader	☒ Qualified persons operate all heavy equipment. (certificate is required for forklift and lull operators) ☒ Equipment will be inspected upon mobilization ☒ All leaks or defective safety equipment will be repaired before use. ☒ Operators will be reminded of seatbelt use by: _Rachel Donahue_________________________ ☒ Eye contact with the operator is made prior to approaching near equipment or swing radius ☒ High visibility vests are required ☒ Max. safe slope for each vehicle will be followed ☒ Counterweight swing radius will be barricaded. ☒ Rigging directly to the forks of a lull, forklift, or front loader equipped forks is prohibited. Crane hook attachments will be used (specify):____________________________________ ☒ Spill equipment is available for fuel and hydraulic fluid leaks. Spill kit located:_ one each piece of heavy equipment__________
ENVIRONMENTAL HAZARDS (NON CHEMICAL) (EHS 124, 125, 127)		
☒	☒ Heat Stress ☐ Cold Stress ☒ Insects, spiders, ticks ☒ Wild animals ☐ Mold, fungi ☒ Poisonous plants ☒ Hazardous noise	☒ Heat/Cold stress are monitored in accordance with Geosyntec procedures EHS 124 & EHS 125 ☒ Fluids are provided to prevent worker dehydration ☒ Types and injury potential of snakes, insects, spiders are reviewed with workers ☒ Insect repellant is used, PPE is used to protect against sting/bite injuries. ☒ All potentially poisonous plants such as poison ivy, poison oak, poison sumac are identified, long sleeve shirt or Tyvek is worn or a barrier cream is used when near these plants ☒ Hearing protection is used when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) **Environmental Hazards Comments:**
POWER TOOLS, HAND TOOLS, and EXTENSION CORDS (EHS 121)		
☐	Eye injury, hand/arm cuts, electrical shock, strains, foot injuries, dust ☐ Grinders ☐ Needle Gun ☐ Chop saw ☐ Chain saw ☐ Trimmer ☐ Concrete/asphalt saw ☐ Trencher	☐ All tools and electrical cords will be inspected upon mobilization by: _______________ ☐ All tools and electrical cords in-use will be inspected daily by: ________________ ☐ Grinder speeds will not exceed grinding wheel ratings. ☐ Water or wet cutting performed to control dust ☐ Respirators used to prevent exposure to dust (respirator type:______________________) ☐ Thorough utility survey conducted prior to any concrete cutting, coring ☐ Face shield <u>and</u> safety glasses used (required for all grinders, jackhammers, chain saws, etc) ☐ Kevlar chaps and jacket (required for all chainsaw work) ☐ Hearing protection required for which tools or areas: ______________________ ____ ☐ All extension cords are in good condition with no cuts through outer insulation, ground plugs are present, and no "vinyl tape" repairs. **Tool & Cord Comments:**
MANUAL MATERIAL HANDLING / MATERIAL STORAGE / HOUSEKEEPING (EHS 401)		
☒	Back or shoulder strain, struck by falling objects, trips and falls, incompatible materials (fire or explosion) ☒ hvy manual lifting (>30 lbs)	☒ Mechanical lifting equipment used to reduce manual material handling: (☐ Forklift/Lull ☒ Heavy Equipment ☐ chainfall ☐ ______________________) ☒ Manual lifting more than 50 lbs by a single person will be avoided.

	HAZARD	**HAZARD CONTROLS (check all that apply and comment as required)**
	☐ chemical storage ☐ compressed gas storage ☐ Tall storage greater than 2 pallets stacked. ☒ Material & equipment laydown areas ☒ Debris removal	☒ Good manual lifting techniques will be reviewed prior to site work. ☐ Incompatible chemicals will be separated by 20' ☐ Secondary containment will be provided for the following chemicals: ___________________ ☒ Safety equipment will be located near chemical storage. ☒ Spill Kit ☐ Emergency Shower ☐ Eyewash ☐ Drench Hose ☐ Splash PPE ☐ Flammable gases and oxygen will be separated by 20'. ☐ All compressed gas cylinders will be transported vertically and secured upright. ☐ Equipment and materials will not be stored on site ☒ Debris will be moved daily and placed in designated areas. **Material Handling & Housekeeping Comments:**
TRAFFIC & SIDEWALK OBSTRUCTION (EHS 517)		
☐	☐ Vehicle accidents ☐ Pedestrians struck by vehicles or heavy equipment ☐ Pedestrians falls ☐ Pedestrian struck-by falling objects	☐ DOT signal devices will be used to re-route vehicles around excavations or busy site entrances/exits that affect road traffic. ☐ Flaggers will be used and have DOT Flagger Training ☐ Pedestrian traffic will be safely routed around or over excavations. ☐ Pedestrian traffic will be safely routed around or under overhead work. **Traffic & Sidewalk Comments:**
HAZARDOUS WASTE SITE WORK (EHS 108, 112, 301)		
☒	☐ exposure to hazardous vapors or dust, contact with contaminated materials, fire, and explosion. Contaminants of Concern and hazardous chemicals include: ☐ volatile organic compounds (describe: __________ ____________) ☐ semivolatile organic cmpds (describe:_____________ ____________________) ☒ metal dusts (describe:__arsenic, cobalt in soil__________ ____________________) ☐ PCBs ☐ caustic (NaOH) ☐ Acid (H_2SO_4, HCl) ☐ Other hazardous waste site hazards are covered elsewhere in the HASP)	☒ Site workers with a potential for contact with contaminated materials will have OSHA 40-hour training, current 8-hour refresher, and medical exam. ☐ No intrusive work activities or areas are anticipated with current scope of work. Intrusive work activities include: ____ ____ The perimeter of intrusive work areas are identified by:____________________________ Decontamination of personnel or equipment is not anticipated with the current scope of work. ☒ Decontamination of personnel and small tools will be conducted as follows: • Remove particulate matter and surface film with tap water; • Manual scrub with non-phosphate soap solution (Alconox); • Tap water rinse; • 10% nitric acid rinse (if sampling for metals/cyanide); Distilled/De-ionized water rinse; • Pesticide grade hexane rinse (if sampling for PCBs); and, • Air dry. ☒ Decontamination of heavy equipment will be conducted as follows: ____steam cleaned____ ☒ Heavy equipment leaving the site will be inspected by_Rachel Donahue____________________ ☒ Work area monitoring is not anticipated with the current scope of work. ☐ Work Area Air Monitoring as follows for (dust, VOCs, etc) **OR** see attached. ________ ________ Level C Tyvek, boot covers, nitrile gloves, half or full face respirator with _____________ cartridges changed daily ________ ________ Level B Same as above except supplied air respirator ________ ________ STOP work, contact EHS Department ☒ Community Air Monitoring is not anticipated with the current scope of work. ☐ Community Air Monitoring is required per the attached document. **Comments/Other:**

EMERGENCY RESPONSE **(911 Service is Available ☒ Yes ☐ No)**

Emergency Medical Treatment - Hospital Name: Hospital Address:	UNC Hospital 101 Manning Dr. Chapel Hill, NC	**Number:**	(919) 966-4721
Non-Emergency Med. Treatment - Clinic Name: Occupational Clinic Address:	UNC Urgent Care 6103 Farrington Rd., Suite 101 Chapel Hill, NC 27517	**Number:**	(919) 957-6610
Fire Department Name	Chapel Hill Fire Department	**Number:**	911
Spill Response:		**Number:**	
Client Representative Name::	Larry Daw	**Office Number:**	(919) 962-6666
		Cell Number:	(919) 883-7019
Geosyntec **Project Manager** Name:	Eric Nesbit	**Office Number:**	(919) 424-1823
		Cell Number:	(919) 796-4137

PRE-WORK THA

HAZARD	**HAZARD CONTROLS (check all that apply and comment as required)**		
Geosyntec **Corporate H&S** Name:	Dale Prokopchak	**Office Number:**	(804) 332-6376
		Cell Number:	(804) 349-8067
Emergency Response Comments:			

Date: 6/9/2014	
Project Name: UNC Cogeneration Facility	
THA Title: Soil Removal	
Subcontractor Name:	
Geosyntec Representative (reviewed by):	
Subcontractor Foreman/Supervisor Signature (authorize):	
Crew Signatures (acknowledge):	
Print Name	**Signature**

PLEASE RETURN A COPY OF THIS SIGNED PAGE TO GEOSYNTEC PROJECT MGR., SUPERINTENDENT UPON REVIEW AND ACKOWLEDGMENT BY THE CREW MEMBERS. ALL NEW CREW MEMBERS SHALL BE ORIENTATED THE SAME AND A SUBMITTAL OF A NEW SIGN IN SHEET SHALL BE COMPLETED.

APPENDIX L-A

DRAFT

Prepared for

The University of North Carolina at Chapel Hill
Department of Environment, Health and Safety
1120 Estes Drive Extension
Chapel Hill, North Carolina 27599-1650

QUALITY ASSURANCE PROJECT PLAN

UNC-CH COGENERATION FACILITY
CHAPEL HILL, NORTH CAROLINA
SITE ID # NCR000010272

Prepared by

Geosyntec consultants

engineers | scientists | innovators

Geosyntec Consultants of NC, PC
49601 Six Forks Road, Suite 340
Raleigh, North Carolina 27609

Project Number GN5219

May 2013

For Discussion Only

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ACRONYMNS AND ABRIEVIATIONS

AOC	Area of concern
bgs	below ground surface
CCB	Coal combustion byproduct
COC	Chemicals of Concern
DQOs	Data Quality Objectives
DU	Decision unit
DPT	Direct push technology
EHS	Environment, Health and Safety
ft	feet
GC/MS	Gas Chromatograph/Mass Spectrometer
GPS	Global Positioning System
g	grams
HASP	Health and Safety Plan
IHSB	Inactive Hazardous Waste Sites Branch
in	inches
ISM	Incremental Sampling Methodology
IDW	Investigation Derived Waste
kg	kilogram
LCS	Laboratory Control Standard
L	liters
LCL	Lower Confidence Limit
µg	micrograms
NIST	National Institute for Standards and Testing
NCAC	North Carolina Administrative Code
MS/MSD	Matrix Spike/Matrix Spike Duplicate

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MDL	Method Detection Limit
mL	milliliters
mm	millimeters
ng	nanograms
NTU	Nephelometric Turbidity Units
NC DENR	North Carolina Department of the Environment and Natural Resources
oz	ounces
%R	Percent Recovery
pg	picograms
PLM	Polarized light microscopy
PAH	Polycyclic Aromatic Hydrocarbons
PQL	Practical Quantitation Limit
PARCC	Precision, accuracy, representativeness, completeness, and comparability parameters
PVC	Poly vinyl chloride
PSRG	Preliminary Soil Remediation Goals
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
REC	Registered Environmental Consultant
RPD	Relative Percent Difference
RG	Remediation Goals
RSM	Registered Site Manager
SESD	Science and Ecosystem Support Division
SOP	Standard operating procedure
UCL	Upper Confidence Limit
UNC-CH	The University of North Carolina at Chapel Hill

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US EPA	United States Environmental Protection Agency

1. PROJECT ORGANIZATION AND RESPONSIBILITIES

Management of the project is the responsibility of The University of North Carolina (NC) at Chapel Hill (UNC-CH). Personnel from the Raleigh office of Geosyntec Consultants of NC, PC (Geosyntec) will provide technical management, oversight, and conduct field work for the site assessment. TestAmerica, Inc. (TestAmerica) is the prime contract laboratory performing the required analyses. TestAmerica is an accredited environmental laboratory under the National Environmental Laboratory Accreditation Program and is a NC Certified Lab (#385-Denver, #64-Knoxville). Both the organizational structure and responsibilities are designed to ensure adequate project control and proper quality assurance (QA) for the site assessment program. The project organization and points of contact are provided in Section 1.3 of the Remedial Investigation Work Plan.

2. PROBLEM DEFINITION

This Quality Assurance Project Plan (QAPP) is an appendix to the Remedial Investigation Work Plan was prepared using United States Environmental Protection Agency (US EPA) Guidance for QAPPs (2002). This project is a remedial investigation to be conducted within the regulatory structure of the Inactive Hazardous Sites Branch Registered Environmental Consultant (IHSB REC) program. The REC program is a voluntary cleanup program whereby the remediating party, UNC-CH, contracts with a program-approved REC, Geosyntec, to implement and self-regulate an investigation and remediation (if any) within the rules and regulations found in Title 15A of North Carolina Administrative Code, Subchapter 13C, Part .0300 (15A NCAC 13C .0300) and NC Statute 130A-310. This remedial investigation concerns the parcel on which the UNC-CH Cogeneration Facility (the Plant) is located. The parcel containing the Plant (the Parcel) is approximately 14.6 acres and is located at 575 West Cameron Avenue, Chapel Hill, North Carolina.

The Plant and surrounding Parcel are owned and operated by UNC-CH primarily for the generation and distribution of steam. Coal combustion byproducts (CCBs) were encountered during the construction of a new warehouse at the Plant in June 2010. Environmental samples were collected by Piedmont Geologic, PC. Soil and groundwater laboratory results indicated elevated levels of select metals, polycyclic aromatic hydrocarbons (PAHs) and dioxins/furans (collectively referred to herein as chemicals of concern or COCs) in comparison with NC DENR screening levels for respective constituents.

Before the current state of the art cogeneration facility was built, a historical steam generation/power plant (referred to here as the “predecessor plant”) operated on the Parcel from 1940 to 1992. According to research of historical records and interviews with key UNC-CH personnel, CCBs found on the Parcel likely originate from the operation of the predecessor plant. Further information of the Plant’s history can be found in Section 3 of the Work Plan.

Elevated levels of COCs are suspected to be associated with buried CCBs. Thus, the investigation area encompasses the area of the former flyash basin and associated settling pond, as well as locations in the southern part of the Facility where CCBs (ash, specifically) may have been used as structural fill. Project specific data quality objects (DQOs) are presented in **Table 2.1**.

Table 2.1 - Project Specific DQOs

	Decision	**Inputs**	**Study Boundaries**	**Decision Rule**	**Limits on Decision Error**
Delineate CCBs in Soil	Where are CCBs present/absent in soil (vertically and horizontally)?	• Borings will be positioned using a modified EPA Triad method. • CCB impact at individual boring locations will be determined using Tiered Visual Assessment. • Confirmation analytical soil samples will be collected along the visually assessed periphery of CCB-impacted area. A representative subset of these samples will be analyzed for COCs (select metals, PAHs, dioxins and furans) based on professional judgment. • Full data validation will be performed on the first sample for each analysis, with level 2A validation for subsequent samples.	Samples collected during the Remedial Investigation within the Area of Concern (AOC) as shown in **Figure 6** of the work plan.	1. Visual Assessment Verification samples will be collected as soon as sufficient volume of a sample type is available and submitted to lab for rapid turnaround to verify accuracy of visual assessment. If visual assessment verification samples do not agree with their field classification, then field observations will be recalibrated based on lab results. 2. If metals detections in confirmation periphery samples are above the IHSB PSRGs then a background study for metals in soil will be initiated. 3. If analytical results indicate PAHs or dioxins/furans are detected in confirmation periphery samples above IHSB PSRGs then additional delineation and/or study may be required.	1. Visual assessment verification samples should agree with their field designation. 2. 100% of confirmation periphery samples should fall below IHSB PSRGs. If confirmation periphery sample results fall above IHSB PSRGs, a background study may be initiated per REC guidance.
	Decision	**Inputs**	**Study Boundaries**	**Decision Rule**	**Limits on Decision Error**
Assess Impacts to Soil from CCBs	What are the concentrations of COCs in the CCB-impacted soil?	• Borings will be positioned using a modified EPA Triad method. • Note that Decision Units (DUs) may be added based on field observations or analytical results. **For soil depth <2 feet (ft):** • Mean concentrations of COCs in shallow soil will be measured using the Incremental Sampling Method (ISM). **For soil depth >2ft:** • A representative subset of discrete samples collected from soil borings advanced during the delineation phase will be analyzed for COCs. • Full data validation will be performed on the first sample for each analysis, with level 2A validation for subsequent samples.	Impacted areas of AOC as determined by visual delineation during the Remedial Investigation.	1. If confirmation periphery sample results exceed IHSB Preliminary Soil Remediation Goals (PSRGs) then further delineation may be required.	Data is of sufficient quality for use if no major, repeated or systematic quality issues are encountered during data validation.

Table 2.1 - Project Specific DQOs

Assess Potential Groundwater Impacts from CCBs	**Decision**	**Inputs**	**Study Boundaries**	**Decision Rule**	**Limits on Decision Error**
	Is groundwater impacted by COCs? What are the concentrations of COCs in groundwater?	• Monitoring Wells or piezometers will be installed to collect water level readings in order to confirm groundwater flow direction. • Low-flow sampling for COCs (select metals, PAHs, dioxins and furans) will be performed after installing monitoring wells in the source area or immediately downgradient. The following water quality parameters will be collected: pH, specific conductance, temperature, and turbidity. • 100 % Data validation will be performed on for the initial sample data collected.	Groundwater analytical results and water levels from monitoring wells and piezometers collected during the Remedial Investigation (anticipated as shown in **Figure 10** of the work plan).	1. If water level data does not confirm that monitoring wells are positioned correctly to capture a potential plume based on groundwater flow direction, then additional monitoring wells must be installed. 2. Sample results will be screened against 15A NCAC 2L standards. If metals are detected above 2L standards, a background study for metals will be initiated. If PAHs or dioxins/furans are detected above 2L standards, additional delineation and/or analysis	Data is of sufficient quality for use if no major, repeated, or systematic quality issues are encountered during data validation.
Assess Potential Surface Water and Sediment Impacts from CCBs	**Decision**	**Inputs**	**Study Boundaries**	**Decision Rule**	**Limits on Decision Error**
	Are surface water and sediments impacted by COCs? What are the concentrations of COCs in surface water and sediments?	• Surface water and sediment samples will be collected from university owned parcels. . The following water quality parameters will be collected: pH, specific conductance, temperature, and turbidity.	UNC owned properties.	1. If contamination is found upstream of the site in concentrations greater than the downstream concentrations, downstream delineation may not be necessary. 2. If contamination is detected in any downstream sample at concentrations greater than upstream (background) samples, additional surface water/sediment assessment will be needed.	Data is of sufficient quality for use if no major, repeated, or systematic quality issues are encountered during data validation.
Establish Soil and Groundwater Remediation Goals (RG)	**Decision**	**Inputs**	**Study Boundaries**	**Decision Rule**	**Limits on Decision Error**
	RGs for each COC in each environmental medium must be established following soil and groundwater delineation	The following data will be used in establishing RGs for the Facility: • Analytical soil results • Analytical groundwater results • Data validation results • IHSB PSRGs • Risk assessment calculations	Soil impacts within the AOC and the groundwater plume (if any) based on sampling results from the Remedial Investigation.	Not Defined	Not Defined

Table 2.1 - Project Specific DQOs

		Useable data collected during the soil and groundwater delineation tasks will be used to establish RGs for each. Must follow REC program Implementation Guidance Appendix D and E for establishing RGs for soil. Must follow REC Program Implementation Guidance Appendix D for establishing RGs for groundwater.			

3. PROJECT DESCRIPTION

The objectives of this phase of the project are to:

1. Delineate the location of CCBs in soil;
2. Assess impacts to soil from CCBs;
3. Assess potential impacts to groundwater from CCBs;
4. Assess potential impacts to surface water and ediments from CCBs; and
5. Establish RGs for soil and groundwater.

These five objectives correspond directly to five tasks into which the work for this remedial investigation is split.

3.1 Fieldwork Overview

Soil borings will be advanced using direct push technology (DPT) or a hand auger throughout the AOC to address two objectives: (1) to visually delineate the location of CCBs in soil and (2) to assess impacts to deep soil from CCBs through analytical testing. Individual soil borings collected at each location will be used for both purposes. A breakdown of the tasks addressing each objective is provided in **Table 3.1**.

After visual delineation is complete (Objective 1), a subset of the subsurface analytical samples collected will be analyzed for COCs, and shallow soil from CCB-impacted area(s) will be sampled using ISM (Objective 2). Groundwater will be monitored using up to five monitoring wells and/or piezometers which will be installed on the Parcel (Objective 3). Analytical results will be compared against PSRGs and 2L Standards. If concentrations exceed the limits stated in the PSRGs or 2L, then additional delineation is required or alternative RGs will need to be developed.

A total of five types of soil samples will be collected during fieldwork activities. The types of soil samples that will be collected and their purpose are listed in **Table 3.1**.

Table 3.1 - Summary of Soil Sample Types

Objective Addressed	**Sample Type**	**Collection Method**	**Analyzed By**	**Method**	**Purpose of Sample**
1 Delineation	Tiered Visual Assessment Samples	Sample delineation phase soil borings	Field staff (on site)	Tiered Visual Assessment	Delineation of area of CCB impact
1 Delineation	Verification Samples	Sample delineation phase soil borings	MicroVision Laboratories, Inc. (Chelmsford, MA)	Coal Ash/Wood Ash Analysis	Confirm effectiveness of Tiered Visual Assessment
1 Delineation	Confirmation Samples	Sample delineation phase soil borings	TestAmerica, Inc. (Knoxville, TN, and Denver, CO)	Chemical analysis (see **Section 3.2**)	Delineate horizontal extent of CCB impacts
2 Soil Assessment	Discrete Deep Soil Samples	Sample delineation phase soil borings	TestAmerica, Inc. (Knoxville, TN, and Denver, CO)	Chemical analysis (see **Section 3.3**)	Delineate vertical extent of CCB impacts
2 Soil Assessment	ISM Shallow Soil Samples	Incremental sampling over the top 2 ft of soil in the delineated area of CCB impact	TestAmerica, Inc. (Knoxville, TN, and Denver, CO)	Chemical analysis with ISM sample processing	Assess potential exposure under residential and industrial exposures

3.2 Delineation of CCB Impacted Areas

The goal of CCB-impacted soil delineation is to determine if/where CCBs are present in the AOC. Continuous core soil samples will be collected using DPT or hand augering.

A complete soil boring will be retrieved from each location until native soil is observed or refusal is reached. This sampling approach will allow for each core to be observed as a complete boring prior to sampling. Cores will be visually assessed for CCB impacts along the full length of the core using Tiered Visual Assessment. The boring location will be considered “impacted” if CCBs are observed at any depth along the core.

Delineation will continue by stepping out from impacted locations until unimpacted borings are collected at a distance of approximately 30 feet from impacted locations; assessment activities during this phase of the investigation will be limited to UNC-CH owned properties only. Verification samples and confirmation analytical samples will be collected to assess the effectiveness of visual assessment and the delineation process. Delineation sampling is further described in **Section 5.2.1.**

3.3 Assessment of Potential CCB-Impacts to Soil

3.3.1 Characterization of CCB-impacted Deep Soil

The objective of sampling CCB-impacted deep soil is to assess impacts to soil below 2 ft bgs. As soil cores are being collected during the delineation phase of the project, an analytical sample will be collected from each impacted core at the depth corresponding to the apparent highest concentration of CCBs based on professional judgment. Additional samples may be collected if deemed necessary by field staff.

Soil sampling and preparation procedures specified in the US EPA Region 4 Soil Sampling standard operation procedure (SOP) will be used. Deep soil sampling is further described in **Section 5.2.2**.

3.3.2 Characterization of CCB-impacted Shallow Soil

ISM will be employed to characterize shallow soil in order to obtain unbiased representative estimates of mean concentrations of COCs. These mean concentrations will be used to assess risk to persons exposed to shallow soil under residential or industrial scenarios. CCB-impacted shallow soil will be characterized as two DUs. The horizontal limits of DU-1 will extend to the horizontal limits of CCB impacts determined during the delineation phase within the fence line of the Parcel; the vertical limits will be ground surface to 2 ft bgs. DU-1 is designed to include soils to which an industrial worker on the Parcel may be exposed. DU-2 will extend to the horizontal limits of CCB impacts determined during the delineation phase on the two off-site properties owned by UNC-CH; the vertical limits will be ground surface to 2 ft bgs. DU-2 is designed to include soils to which a resident may be exposed. Additional DUs may be defined as necessary during the remedial investigation. Shallow soil sampling is further described in **Section 5.2.3**.

3.4 Groundwater Sampling

The objective of the groundwater investigation is to understand hydrological conditions at the Parcel and to determine whether groundwater at the Parcel is impacted by COCs. To achieve this objective, several monitoring wells and/or a piezometer(s) will be installed.

3.4.1 Groundwater Monitoring Well and Piezometer Installation

Up to five groundwater monitoring wells, or up to four groundwater monitoring wells and one piezometer, will be installed in the upper portion of the surficial aquifer with the assumption that shallow groundwater flows mostly southerly towards a nearby intermittent drainage feature or, alternatively, towards Morgan Creek.

The area of interest for groundwater monitoring is the main area of CCB-impacted soil and the area immediately down-gradient of this location. One monitoring well will be installed upgradient to provide background concentration levels of COCs and to allow for triangulation to determine the direction of groundwater flow. The water table is expected to be encountered between 15 and 25 ft bgs based on information gathered from previously installed monitoring well MW-1, which was abandoned during construction of the warehouse. **Figure 10** in the Work Plan shows anticipated groundwater monitoring well locations.

A NC-certified driller will install the wells and piezometer under direct supervision of Geosyntec. Monitoring wells will be installed with a hollow stem auger and/or air rotary drill rig or a mini sonie rig and will be constructed according to US EPA Region 4 Science and Ecosystem Support Division’s (SESD’s) SOP with some notable exceptions. Type III, double-cased wells will be installed to seal off the potentially impacted overburden where necessary. Historical drawings imply the fly ash basin was approximately 24 ft deep and therefore, CCB impacts are not anticipated below 24 ft bgs. The outer poly vinyl chloride (PVC) casing depth will be set a minimum of two feet into native soil as determined in the field by Geosyntec’s onsite geologist/engineer. The outer casing will be grouted in place and allowed to cure for a minimum of 24 hours prior to continuing the borehole. Two inch (in), PVC well casings with 5 or 10-ft, 0.01-in slotted screen will be installed within the outer casing. Total depths of the wells are estimated to be less than 45 ft. The bentonite seal will be allowed to hydrate overnight prior to grouting.

Well development will not be initiated until the well is allowed to sit/settle overnight following installation of the surface completion. Well development will be performed by first surging with a surge block and then by pumping to remove turbid water and sediments. Well development will continue until the water clarity is acceptable as determined by Geosyntec's geologist or engineer onsite. Turbidity measurements will be collected periodically and recorded during development. Well development will be judged completed when (i) turbidity measures less than or equal to 10 Nephelometric turbidity units (NTUs), (ii) turbidity has not improved over the previous hour of well development or (iii) well has been purged for three hours. .

Following installation of new groundwater monitoring wells and completion of well development, the monitoring wells will be allowed to stabilize for at least one week prior to collecting groundwater samples. Well locations (ground surface and top of casing) will be surveyed by a NC-licensed surveyor for future reference.

3.4.2 Piezometer Installation

If installed, piezometers will be constructed with 2-in PVC well material to an estimated depth of 45 ft bgs or less. If necessary, well development will occur for the piezometers and analytical samples will be collected.

3.4.3 Groundwater Sample Collection

A low-flow, micro-purge technique will be used for groundwater sample collection in general accordance with the US EPA SESD's SOP for groundwater sampling. The pump intake or tubing, depending on pump selection, will be placed in the mid-portion of the screened interval of the well. To the extent practical, the purge rate will be set to minimize drawdown. Stability of field parameters will prompt sample collection. **Section 5.3** provides more detail regarding groundwater sampling.

3.5 <u>Laboratory Analysis</u>

3.5.1 Delineation Verification Samples

CCB-delineation verification samples will be sent to MicroVision Laboratories, Inc. in Chelmsford, Massachusetts for verification analysis using their "Coal Ash/Wood Ash Analysis" SOP which includes the following components:

- Preliminary inspection;

- Stereomicroscope examination;
- Polarized Light Microscopy (PLM) – Uses a 10X to 500X PLM and optical effects that aid in the identification of CCBs;
- Scanning Electron Microscopy – Uses a high magnification (up to 100,000X) to aid in the identification of CCBs; and
- Energy Dispersive X-Ray Spectroscopy (EDS) – Provides qualitative and quantitative results of the particles, which are compared to industry standards.

3.5.2 Analytical Samples

Analytical samples of sampled media types will be analyzed by the following methods to address COCs:

- US EPA Method 6010C for total metals (Hazardous Substance List plus Aluminum, Barium, Cobalt, Iron and Vanadium);
- US EPA Method 7470A (soil) /7471B (water) for Mercury;
- US EPA Method 8270D SIM for PAHs; and
- US EPA Method 8290 for Dioxins/Furans.

QC samples, including blind field duplicates, matrix spikes and matrix spike duplicates (MS/MSDs), and equipment blanks will be collected during sampling events. These QC samples are used to monitor changes that may occur to the samples during and after sample collection. Equipment blanks enable evaluation of bias (systematic errors) that could occur due to decontamination, handling, storage, and transport of the samples. Blind field duplicates are used to evaluate the accuracy of the laboratory. Analytical samples will be analyzed by TestAmerica, Inc. in Denver, CO and Knoxville, TN.

3.5.3 ISM Sample Processing

ISM sample-processing procedures are designed to increase the representativeness and reproducibility of laboratory results. An ISM-compliant laboratory sample-processing procedure will be designed and followed for ISM samples.

Upon receipt of each ISM sample, the laboratory will spread the sample out on an aluminum sheet lined with parchment paper and will disaggregate the sample manually using a wooden spatula. Immediately following disaggregation, a 30 gram (g) subsample will be collected using the 2-D slabcake method and analyzed for the following 5 PAHs by US EPA Method 8270D SIM:

- Naphthalene
- 1-methylnaphthalene
- 2-methylnaphthalene
- Acenaphthene
- Acenaphthylene

The remainder of the sample will be air dried and disaggregated again using a wooden spatula. A #10 sieve will be used to collect coarse particles (>2 millimeters, mm) from the sample, and these coarse particles will be run through a jaw crusher set to 1-2 mm. The coarse particles, reduced in size to <2 mm, will be recombined with the remainder of the sample. The entire sample will then be milled. Due to the possibility for sample contamination from chromium in stainless steel products, a non-stainless steel ball mill grinder with ceramic balls will be used for particle size reduction.

After milling, subsamples will be collected from the processed sample using the 2-D slabcake method and analyzed for the remaining COCs.

3.6 Decontamination Procedures

A decontamination station will be set up on the tanker truck unloading apron next to the Fuel Oil tanks at the Facility. Runoff from this area of the facility is piped to the on-site wastewater treatment facility, which will be used to treat the decontamination water. Plastic containers with the various rinses of water and soap will be laid out on 10-mil thick plastic sheeting. Prior to use and after each sampling event, reusable soil and groundwater sampling equipment will be properly decontaminated and cleaned to prevent cross-contamination.

Field equipment cleaning and decontamination procedures will be based on the US EPA Region 4 SESD SOP for field equipment cleaning and decontamination as described below.

3.6.1 Soil Sampling Equipment Decontamination

Equipment will be decontaminated after each sample is collected. Note that no decontamination is necessary between ISM increments, as long as they are part of the same sample. Decontamination is necessary between ISM samples or sample replicates.

For non-disposable equipment or tools in contact with samples, the following decontamination procedure will be used:

1. Clean with tap water and Liquinox® detergent using a brush to remove particulate matter and surface films.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with distilled water and place on a clean foil-wrapped surface to air-dry.
4. Decontamination and rinse water baths will be refreshed each morning and periodically during the day as needed based on the judgment of the Field Team Leader.
5. After decontamination, sampling equipment will be wrapped and stored in aluminum foil (shiny side out) until the next use.

Larger equipment, including DPT equipment, will be cleaned with hot, soapy water and rinsed with tap water as necessary to avoid cross-contamination.

3.6.2 Monitoring Well Installation

Tools and equipment involved in monitoring well construction, primarily auger flights, will be decontaminated with a high pressure, hot water steam cleaner prior to use and between monitoring well locations. Prior to washing, loose soil will be brushed off of the equipment. Decontamination may require the use of a wire brush to remove rust and soil. Sawhorses or racks will be used while decontaminating auger flights to prevent cleaned flights becoming re-contaminated.

3.6.3 Groundwater Sampling Equipment Decontamination

A pump with disposable tubing will be used for low-flow groundwater sampling. The following decontamination procedure will be used for groundwater sampling and monitoring equipment which cannot be replaced in between samples:

1. Disassemble equipment as much as possible to facilitate internal cleaning.
2. Using a brush, scrub components with detergent and tap water.
3. Rinse thoroughly with tap water.
4. Rinse thoroughly with distilled water and place on a clean foil-wrapped surface to air-dry.
5. After decontamination, sampling equipment will be wrapped and stored in aluminum foil (shiny side out) until the next use.

3.7 Abandonment of Soil Borings

Following sample collection, borings will be abandoned consistent with the NCAC Title15A Subchapter 2C Well Construction Standards.

3.8 Investigation Derived Waste

All soil cuttings will be treated as investigation derived waste (IDW) and will be stored in appropriate containers to be staged at the Facility. Samples of the media will be collected for characterization of the waste prior to disposal. Waste logs will be maintained in compliance with regulations, and IDW containers will be properly labeled and covered. UNC-CH will coordinate disposal of the waste.

Purge and decontamination water will be treated in the on-site wastewater treatment facility.

3.9 Personnel or Equipment Requirements

It is anticipated that the following field equipment will be utilized by Geosyntec field personnel during this project:

- YSI 556 MPS Multi-Meter (for measuring field parameters, temperature and conductivity);

- LaMotte turbidity meter or similar for measuring turbidity;

- A low-flow, micro-purge pump (peristaltic or bladder pump depending on depth to groundwater);

- A 1.5-in to 2-in hand auger;

- A stainless steel hand trowel; and

- Personal protective equipment as described in the Health and Safety Plan (HASP), which includes hearing protection, eye protection, work gloves, nitrile gloves, steel-toed boots, and protection from sun-exposure.

No special training, licenses, equipment, or certifications are required other than those used in the performance of the crew’s routine job duties. Geosyntec personnel are trained in Health and Safety for Hazardous Waste Sites as required by 29 CFR 1910.120 and receive specialized training in field sampling techniques. A site-specific HASP is included in Appendix J of the work plan.

3.10 Project Schedule

Field work will begin following receipt of administrative agreement and submittal of the work plan. Field work is likely to begin in the summer of 2013 and will continue until the investigation is complete.

4. SAMPLING DESIGN

The sample designs for subsurface soil, groundwater, surface water, and sediment were selected based on observations made during site visits, interviews with UNC-CH personnel, and information provided and gathered during work plan preparation activities.

4.1 Soil Sampling

Boring locations will be determined based on historical operations on UNC-CH property (see **Figure 7** of the Work Plan). Tentative boring location will be spaced 30 ft apart (to be verified in the field using a hand-held Global Positioning System (GPS) receiver). Boring collection will begin in the southern portion of the property in an area expected to have CCB impacted soils, and delineation will continue following a modified US EPA Triad Approach.

On the two State-owned lots south of McCauley Street, borings will be advanced in the approximate locations presented in **Figure 7** of the Work Plan and **Figure A1** of the Work Plan Addendum. Actual boring locations will depend heavily on the accessibility and safety of boring locations.

4.2 Groundwater

The objective of the groundwater investigation is to understand hydrological conditions on the Parcel and to determine whether groundwater has been impacted by CCB-impacted soil on the Parcel. The groundwater sampling design will include monitoring wells installed in or immediately up- or down-gradient of the areas determined to be most heavily impacted by CCBs during soil sampling activities. This layout is designed to allow for determination of groundwater flow direction, interception of possible contaminant plumes emanating from the source area, and determination of background levels of COCs.

The well placement and construction procedures described herein may be modified based on additional knowledge of soils at the Parcel gathered during the soil assessment phase. The monitoring well farthest to the southwest may be replaced by a piezometer to gauge the depth to the water table. Proposed locations for the new wells/piezometer are shown on **Figure 10** of the Work Plan and **Figure A2** of the Work Plan Addendum.

4.3 Surface Water and Sediment

The objective of the sediment investigation is to determine whether surface water and ediments within the drainage feature on Site have been impacted by CCBs. The surface water and sediment sampling design will included collecting three colocated sediment and surface water samples: one from immediately upstream of the site to establish natural or anthropogenic background conditions; one from the portion of the drainage feature on Site, and one immediately downstream of the site.

Proposed locations for the collocated surface water and sediment locations are shown on **Figure A3** of the Work Plan Addendum.

5. SAMPLING AND ANALYTICAL REQUIREMENTS

The procedures for sample collection, preservation, handling, custody, and decontamination will follow guidance described in US EPA Region 4 SOPs. **Table 5.1** provides a summary of the sampling and analytical requirements. Field sampling activities will be conducted under the supervision of the Technical Manager. Analytical sampling containers will be provided by TestAmerica and will come pre-preserved as applicable. Samples for MicroVision Laboratories will be collected into Geosyntec-supplied plastic Ziploc bags.

All sampling and field measurement equipment is owned or rented by Geosyntec and will be transported to the fieldwork location by Geosyntec personnel. An instrument that is determined to be malfunctioning will be replaced with a new piece of equipment.

Table 5.1 - Analytical Methods for Various Sample Types

Sample Type	**Sample Matrix**	**Analytical Methods**
Delineation Verification	Soil	Coal Ash/Wood Ash Analysis
Deep Soil Sample	Soil	EPA 6010C/7471B/8270D SIM/8290
Shallow Soil Sample	Soil	EPA 6010C/7471B/8270D SIM/8290
Groundwater Sample	Groundwater	EPA 6010C/7470A/8270D SIM/8290
Matrix Spike	Soil, Groundwater	EPA 6010C/7471B-7470A/8270D SIM/8290
Matrix Spike Duplicate	Soil, Groundwater	EPA 6010C/7471B-7470A/8270D SIM/8290

Sample Duplicate	Soil, Groundwater	EPA 6010C/7471B-7470A/8270D SIM/8290
Equipment Rinsate Blank	Water	EPA 6010C/7470A/8270D SIM/8290

5.1 Field Instrumentation

All field equipment needed for sampling as well as personal protective equipment will be properly maintained and calibrated prior to and during continued use to assure that measurements are as accurate as possible. Personnel will follow manufacturers' instructions to determine if instruments are functioning within their established operational ranges. Selected spare parts for sampling equipment and field instruments are located in the Geosyntec Raleigh office or at the company from which the equipment is rented. Calibration data will be recorded in the field logbook or on field data sheets.

Other requirements relating to calibration are as follows:

- To be acceptable, a field test must be bracketed between acceptable calibration results.
- The first check of the day may be an initial calibration, but the second check must be a continuing verification check.
- Each field instrument must be calibrated prior to use at no more than 24-hour intervals.
- Verify the calibration at no more than 24-hour intervals during use and at the end of use if the instrument will not be used the next day or within a time period greater than 24 hours.
- All initial calibration and verification checks must meet the acceptance criteria listed in **Table 5.2** below.
- If an initial calibration or verification check fails to meet the acceptance criteria, immediately recalibrate the instrument or remove it from service.
- If a calibration check fails to meet the acceptance criteria and it is not possible to reanalyze the samples, the following actions must be taken:

  - Report all results between the last acceptable calibration check and the failed calibration check as estimated (qualified with a "J");

  - Include a narrative of the problem; and

  - Shorten the time period between verification checks or repair/replace the instrument.

- If historically generated data demonstrate that a specific instrument remains stable for extended periods of time, the interval between initial calibration and calibration checks may be increased.

  - All acceptable field data must be bracketed by acceptable checks. Data that are not bracketed by acceptable checks must be qualified.

  - Base the selected time interval on the shortest interval that the instrument maintains stability.

  - If an extended time interval is used and the instrument consistently fails to meet the final calibration check, then the instrument may require maintenance to repair the problem or the time period is too long and must be shortened.

- For continuous monitoring equipment, field data must be bracketed by acceptable checks or the data must be qualified.

Table 5.2 - Calibration Acceptance Criteria

Field Parameter	**Acceptance Criteria**
Temperature	+/-0.2 °C against an NIST-traceable thermometer
Specific Conductance	+/-5% of each standard used
pH	+/-0.2 pH units of stated buffer value
Turbidity	Manufacturer specified

5.2 Soil Sampling

Table 5.1 presents the types of soil samples that will be collected during the soil sampling process. Each type of soil sampling is described in further detail within this section.

5.2.1 Delineation Samples

Delineation, delineation verification, and confirmation samples will be collected using a Geoprobe® direct push rig or split-spoon sampling sleeves where possible or a hand auger as necessary. Sampling will be conducted such that vertical cores are collected from locations where the ground surface is approximately flat.

Sampling will be conducted such that a complete soil boring is retrieved from each location in 4-ft increments using DPT, or in smaller increments if using a hand auger, until native soil is observed or refusal is reached. This sampling approach will allow for each core to be observed as a complete boring prior to sampling. Cores will be visually assessed for CCB impacts along the full length of the core using Tiered Visual Assessment as outlined in **Section 5.2.1.1**. Note that if refusal is reached and soil at the bottom of the borehole is impacted, a larger rig will be mobilized to resample these areas, if deemed necessary.

For purposes of delineation, detection of CCBs at a boring location will prompt a new boring offset approximately 60 ft from the impacted boring, moving away from areas of known impacts but staying on UNC-CH property (**Figures 7** and **8** of the Work Plan). When a boring is collected which contains no observed impacts from CCBs, another boring will be collected approximately midway between the boring with no impacts observed and the nearest boring with impacts observed. If the centrally located boring does not contain impacts, this central boring location will be used to delineate the boundary of CCB-impacted soil. If the centrally located boring does contain impacts, the previously collected neighboring boring without impacts will be used to delineate the boundary of CCB-impacted soil. The purpose of using this method is to determine the boundary of the area impacted by CCBs to within a distance of less than 30 ft.

Borings collected along the southern embankment of McCauley Street will be spaced so that they correspond with impacted samples from the borings located on the Parcel. Beyond the southern embankment of McCauley Street, samples will be collected along the western branch of the nearby intermittent drainage feature and along the eastern branch of the intermittent drainage feature. These borings will be collected from ground surface to refusal or to 12 ft below ground surface (bgs), whichever comes first.

The decision was made to remove impact soil during the delineation process for two areas. **Figure A5** of the Work Plan Addendum presents the areas where soil will be removed.

5.2.1.1 Tiered Visual Assessment

Field screening of each individual boring will be conducted as depicted in **Figure 9** of the Work Plan. Because the appearance of CCBs is significantly different than clay, silt, and sand, their presence in soils can generally be confirmed or denied using visual methods. The visual assessment to be performed is based on a method documented by the Licensed Site Professional Association of Massachusetts in *Methods for Evaluating Application of the Coal Ash and Wood Ash Exemption under the Massachusetts Contingency Plan* (1999). Tiered Visual Assessment will be conducted as follows:

<u>Tier 1: Initial Inspection</u>

The entire length of the soil core will be photographed and logged by a field geologist/engineer prior to inspection for obvious evidence of CCBs. If CCBs are obviously present, additional visual screening is not required. The core will then be processed for analytical sampling for COCs to address soil assessment objectives. If no CCBs are obviously present, representative sub-samples will be collected from every 2-ft interval along the length of the core and from areas of inconsistent staining for Tier 2 analysis.

<u>Tier 2: Hand Lens Inspection</u>

A source standard of both coal ash and native soil will be obtained from UNC-CH prior to initiating soil delineation. Each sub-sample collected during Tier 1 activities will be inspected using a 7x hand lens. Properties of the sub-samples will be recorded and sub-samples will be compared against the two source standards to determine whether CCBs are present. If a sub-sample is determined to contain CCBs visible through the hand lens, additional visual screening is not required and the core will be processed for analytical sampling. If a sub-sample does not contain CCBs visible through the hand lens, Tier 3 analysis will be conducted.

<u>Tier 3: Stereoscopic Inspection</u>

A sub-sample will be prepared for stereomicroscopic inspection by 1) drying the sample if necessary and 2) removing organic material (sticks, roots, etc.) and large fragments. Following sample preparation, approximately 5 g of the sample will be placed and spread uniformly onto a gridded 100-mm plate for stereoscopic inspection with a 50X stereomicroscope. The structure and shape of the material comprising the sub-sample will be examined for CCB indicator properties, such as spherical shape, luster, and fracturing pattern, and will be compared to reference photomicrographs (for coal and fly ash) and source standards. If the subsamples are found to contain CCBs, the core will be processed for analytical sampling. If no CCBs are identified using a stereomicroscope, the location of the core will be considered unimpacted by CCBs and analytical sampling will proceed.

5.2.1.2 Verification Sampling

Verification samples will be collected at key stages during delineation for laboratory analysis. This laboratory verification is meant to assess the reliability of the visual assessment method. A total of four verification samples will be collected which will be representative of the following conditions: (1) soil grossly impacted with CCBs visible during Tier 1; (2) soil with CCBs identifiable by hand lens in Tier 2; (3) soil determined to contain CCBs with a field microscope in Tier 3; and (4) soil determined to be free of CCBs with a field microscope in Tier 3.

Volume requirements for verification samples are 9-16 ounces (oz) of material, which will be collected from borings into Geosyntec-supplied bags and properly labeled. Soil sampling data will be recorded in the field logbook or on field data sheets in indelible ink as samples are collected. Chain-of-custody procedures will be maintained. There are no temperature requirements for verification sample collection. Verification samples will be collected at the first opportunity to verify the effectiveness of each tier of tiered visual assessment and will be sent to a MicroVision Laboratories for verification analysis using their “Coal Ash/Wood Ash Analysis” SOP. If the verification samples do not agree with field designations, field staff observations will be recalibrated based on the laboratory results.

5.2.1.3 Confirmation Sampling

In order to assess the effectiveness of the horizontal delineation process, analytical confirmation samples will be collected from “boundary” boring locations at a depth interval consistent with the deepest apparent impact of CCBs observed in the nearest impacted sample(s). A minimum of four confirmation borings will be collected for each separate, discernible impacted area, and one sample will be collected from each boring. A subset of collected confirmation samples will be analyzed for COCs, to be determined based on engineering judgment, rather than analyzing all collected samples. Note that for borings collected along the intermittent drainage feature south of McCauley Street, if no impacts are observed in these samples, confirmation samples will be collected as composite samples of the interval from ground surface to 2 ft bgs.

In order to assess the effectiveness of the vertical delineation process, at least three analytical confirmation samples will be collected from native soil below the deepest visually observed CCB impacts. These vertical confirmation samples will be collected from areas that exhibit a higher relative impact than the surrounding areas. Note that the depth to native soil is expected to be greatest in the vicinity of the former swale to the creek, up to 24 ft bgs. If vertical confirmation samples cannot be collected using a DPT rig, a larger rig will be mobilized for this effort, if deemed necessary.

Collected aliquots of the soil will be placed in laboratory-supplied, pre-cleaned sample containers, properly labeled, and packed in coolers for transfer to the laboratory. Chain-of-custody procedures will be maintained. Soil sampling data will be recorded in the field logbook or on field data sheets in indelible ink as samples are collected.

5.2.2 Deep Soil Samples

Soil samples at depths greater than 2 ft bgs will be collected using a Geoprobe® direct push rig or split spoon sampling sleeves where possible or a hand auger as necessary. With either coring method, the top several inches of material from each sampling interval will be discarded due to the tendency for the samplers to scrape material from the sides of the auger hole or to collect material that has sloughed off of the borehole wall after removal of the sampling device during the previous sampling interval.

Cores will be observed as a complete boring prior to sampling. Analytical samples will be collected from the area of the core determined to have the greatest concentration of CCBs. The interval of the core with the highest apparent concentrations of CCBs will be collected into a stainless steel bowl. Only the interval containing apparent impacts will be sampled; no soil from above or below the impacted segment will be included in the sample.

Soil sampling and preparation procedures specified in the US EPA Region 4 Soil Sampling SOP will be used.

Soil samples will be thoroughly mixed prior to filling sample containers to ensure that the sample is as representative as possible of the sample media. Round bowls will be used for mixing, and adequate mixing will be achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over. Collected aliquots of the soil will be placed in the laboratory-supplied, precleaned sample containers using the alternate shoveling method. The alternate shoveling method involves placing a spoonful of soil in each container in sequence and repeating until the containers are full or the sample volume has been exhausted. Threads on the container and lid will be cleaned to ensure a tight seal when closed.

Soil sampling data will be recorded in the field logbook or on field data sheets in indelible ink as samples are collected. Sample jars will be properly labeled, maintained at appropriate temperatures, and then held or laboratory-extracted and held for a period less than the allowable hold time of each analyte. Chain-of-custody procedures will be maintained. A subset of these samples corresponding to approximately 25% of the number of impacted samples collected will be selected based on engineering judgment to be analyzed by TestAmerica (Knoxville, TN and Denver, CO).

5.2.3 Shallow Soil Samples

ISM will be employed to characterize shallow soil. CCB-impacted shallow soil is anticipated to be characterized as two separate DUs, one on the Plant property and the second beyond the fence line at the southern property boundary. The horizontal limits of this DU will be the horizontal limits of CCB impacts determined during the delineation phase, and the vertical limits will be ground surface to 2 ft bgs. Three ISM replicates will be collected for each DU. Each ISM sample will be a structured composite of 30-50 increments. The number of increments will depend on the heterogeneity of the distribution of CCBs within the DU, with increasing heterogeneity prompting an increased number of increments.

Prior to sampling, the DU will be subdivided into as many areas (grids) of equal size as there are increments. One increment will be collected from each of the grids using a systematic grid sampling pattern and then the increments will be composited together into a single sample (replicate). In systematic grid sampling, increments of the same replicate are collected from the same relative position within each grid. The process will be repeated for each replicate, with a different starting position selected within the grid each for each replicate.

Increments will be as cylindrical as possible, and will be collected across the entire depth of the DU. A manual coring device, such as a hand auger, will be used for collecting increments in cohesive soils. For non-cohesive soils, increments will be taken using a hand trowel to ensure full recovery. When a trowel is used, care will be taken to produce a “core-like” sample over the entire depth of interest (The Interstate Technology & Regulatory Council, 2012, pp. 97-104). Both a trowel and a hand auger will be used if appropriate. The diameter of the core collected will be large enough that particles of all sizes are retained equally and will be greater than 16mm per the ITRC guidance. Consistency will be maintained in collecting cores to be composited within the same replicate sample.

The increments for each ISM replicate will be deposited with minimal handling into a sample container for shipment to the laboratory. To minimize error, sample processing will occur in a laboratory setting (see **Section 3.5**).

5.3 Groundwater Sampling

Prior to groundwater sampling, Geosyntec will measure the depth to water in each monitoring well/piezometer to assess groundwater flow direction.

Groundwater samples will be collected using low-flow sampling methods as described in US EPA Region 4 Groundwater Sampling SOP. Wells will be purged using a low-flow pump with the intake located in the mid-portion of the screened interval of the wells. To the extent practical, the purge rate will be set to minimize drawdown.

Purge water from the well will be piped to a flow-through cell equipped with temperature, pH, and conductivity meters to monitor real-time variations in these parameters. Turbidity will be measured using a separate turbidity meter. Water quality parameters will be measured and recorded in a field logbook or on field forms. The well has been sufficiently purged when water quality parameters have stabilized through 3 consecutive readings as follows:

- pH: ±0.2 SU;
- Specific Conductance: ±5%; and
- Turbidity: <10 NTUs or stable within 10%

In some cases, it is possible to purge a monitoring well dry, even with slow purge rates. When a well is purged dry, this is generally accepted as an adequate purge volume, and the well can be sampled after sufficient recharge. The temperature, pH, conductivity, redox potential, DO and turbidity will be measured during the collection of the sample from the recharged volume and recorded as the measurements of record for the sampling event.

Care will be taken to minimize agitation and aeration of the groundwater samples during collection. Samples sent to the laboratory for analysis will be properly preserved, labeled, logged onto a chain-of-custody form, and placed into an iced cooler for shipment to the laboratory. Laboratory-analyzed groundwater samples will be sent to the laboratory within 48 hours of sample collection.

5.4 Documentation and Records

Data management involves maintaining and controlling field data, laboratory analytical data, and other data relevant to the project. Bound field log books, loose leaf drilling logs, loose leaf field forms, or automated field data entry devices such as tablets, laptop computers, or cellular devices will be used for recording field data. This project will have dedicated field log books, forms, and databases that will not be used for other projects. Entries will be dated and the time of entry will be recorded. Sample collection data as well as visual observations will be documented. Sample collection equipment, field analytical equipment, and equipment used to make physical measurements will be identified in the field documentation. Calculations, results, equipment usage, maintenance, repair and calibration data for field sampling, field analytical, and field physical measurement equipment will also be recorded in field documentation. Once completed, the field forms, field databases, and field log book will become part of the project file. To the extent possible, files will be maintained electronically on a secure server which is regularly backed up.

Office data management will involve establishing and maintaining the electronic and paper project files. The project files will include the following:

- Notes/Minutes of meetings and important phone conversations
- Personnel organization and responsibilities
- Planning and scheduling
- QA audits and inspection reports
- Field sampling forms
- Project operations
- Calculations
- Laboratory analytical data

- Field analytical data
- Contract/purchase orders/change orders
- Bid evaluation
- Drawings

Project-related information will be routed to the project manager who will be responsible for distributing the information to appropriate personnel.

5.4.1 Sample Identification, Chain-of-Custody, and Transportation

As soon as each sample is collected, the location and relevant sampling information will be entered into the field notebook or onto the applicable field form. Each sample will have its own identification number (see **Table 5.3** for naming conventions), which will not change during the life of the project. Samples will be clearly labeled with indelible ink. To maintain and document sample possession, chain-of-custody procedures are required. These procedures are necessary to ensure the integrity of the samples from collection to data reporting. A sample is considered under custody if:

- It is in your possession; or
- It is in your view after being in your possession; or
- It was in your possession and you locked it up; or
- It is in a designated secure area.

Personnel who collect samples are responsible for the care and integrity of those samples until the samples are properly transferred or shipped. Therefore, the number of people handling the samples shall be kept to a minimum. Samples will be stored at appropriate temperatures as required by the analytical method to be performed. The sampler will complete a chain-of-custody form provided by the laboratory. The sampler will sign where indicated and record the Facility identification, sample number, date and time of sampling, sample location, and the analyses requested. When the custody of samples is transferred, the persons relinquishing and receiving custody will sign, date, and record the time of transfer on the chain-of-custody. If the samples are shipped using a commercial courier, a custody seal will be placed on the outside of the cooler, and a copy of the chain-of-custody will be included inside the cooler to be signed by the person receiving the samples. Upon receipt of the samples at the laboratory, a sample custodian will accept custody of the sample and verify that the chain-of-custody is still intact. The laboratory shall maintain the chain-of-custody throughout the analytical and reporting processes. Example chain-of-custody forms are shown in **Figure 5.2.**

Sample labeling, packing, transportation, and chain-of-custody procedures will be strictly followed, and samples will be delivered to the contract laboratory in watertight coolers using the following procedures:

- Never mix sample bottle lids.
- Place approximately 3” of inert packing material in the bottom of the plastic bag-lined cooler.
- Enclose water sample bottles in clear plastic bags through which the sample labels are visible, and seal the bag. Place bottles upright in the cooler.
- Place bags of ice around samples in the cooler.
- Place the chain-of-custody in a waterproof plastic bag and tape it to the inside of the cooler lid.
- Tape the cooler drain shut, if applicable.
- After closing the cooler, affix custody seal so that it is adhered to both the lid and the wall of the cooler.
- Secure lid by taping shut. Wrap the cooler completely with strapping tape at two locations without covering any labels. Be sure the custody seal is taped over.
- Attach the completed shipping label to the top of the cooler.

5.4.2 Field Documentation

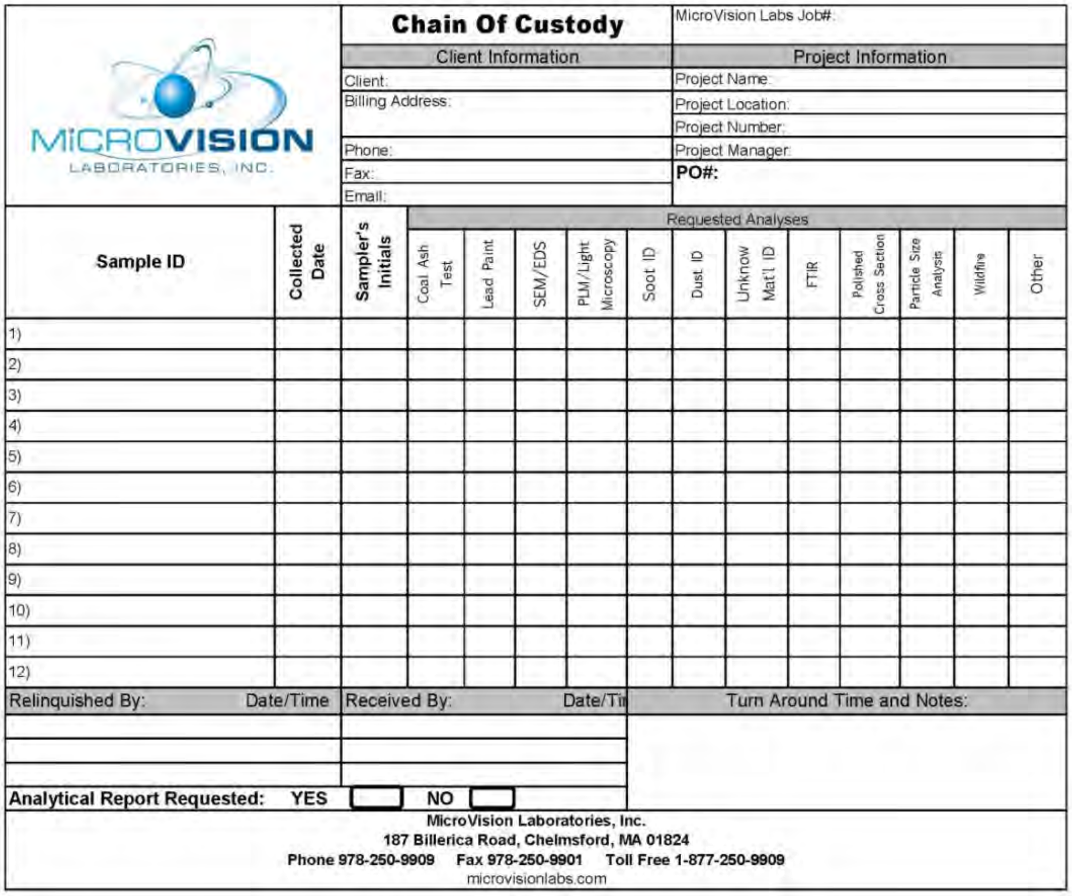
Bound, weatherproof field logbooks and/or media-specific sampling forms will be maintained by the field team. Project information will be entered into the project logbook or onto the field forms. The first page of the logbook or each individual field form will list the project name, logbook number (if applicable), and the dates of use.

The purpose of the logbook and field forms is to contain all project information. General guidelines for documentation are:

- Documentation will be completed in indelible ink.
- Written errors will be crossed out with a single line, initialed, and dated.
- Upon completion, documentation will be stored in project files and/or scanned and stored in the project directory on the Geosyntec server, which is regularly backed up.

Team members will record all information regarding sampling times and activities, chain-of-custody details, shipping information, and sample identification numbers. Weather conditions, unusual events, field measurements, visitors, and other fieldwork activities will be described on a daily basis.

Figure 5.2 - Chain-of-Custody



Chain Of Custody

MicroVision Labs Job#:

Client Information

Client:
Billing Address:
Phone:
Fax:
Email:

Project Information

Project Name:
Project Location:
Project Number:
Project Manager:
PO#:

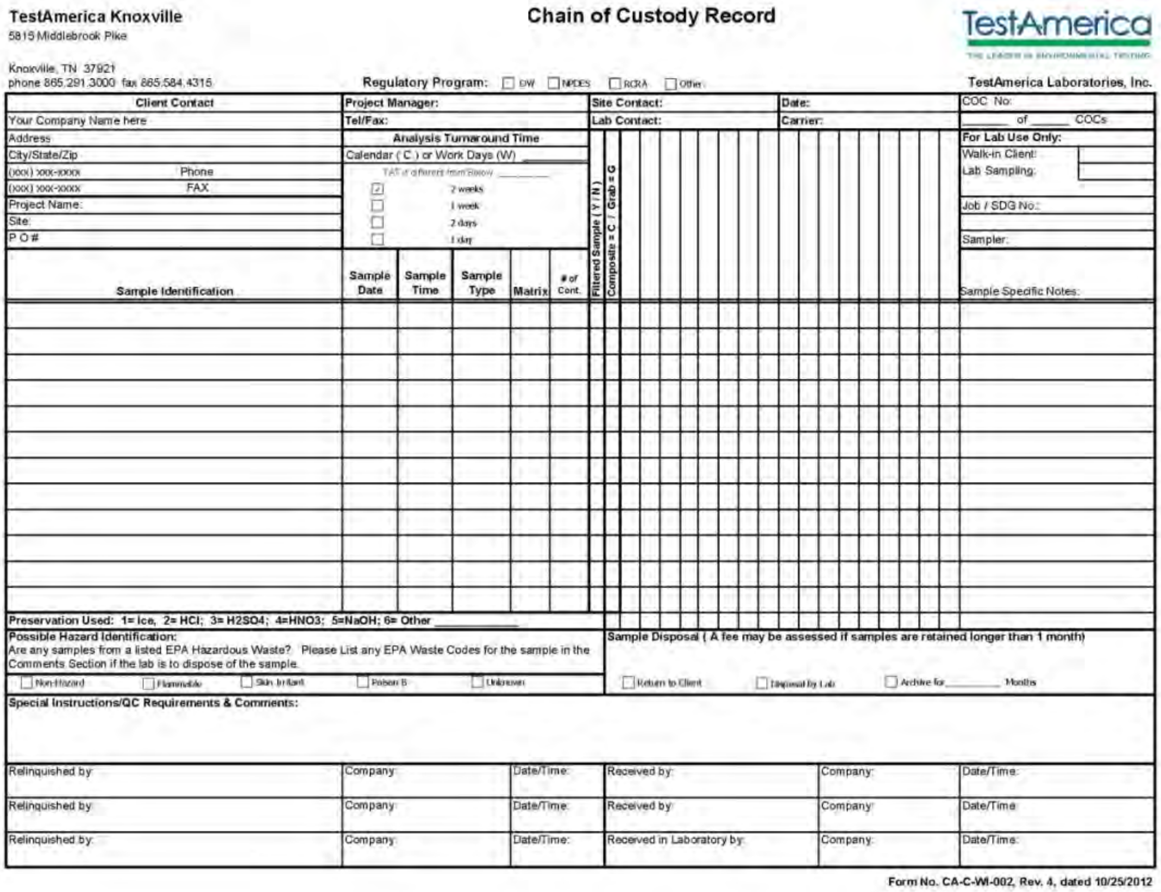
Sample ID	**Collected Date**	**Sampler's Initials**	Requested Analyses											
			Coal Ash Test	Lead Paint	SEM/EDS	PLM/Light Microscopy	Soot ID	Dust ID	Unknow Mat'l ID	FTIR	Polished Cross Section	Particle Size Analysis	Wildfire	Other
1)														
2)														
3)														
4)														
5)														
6)														
7)														
8)														
9)														
10)														
11)														
12)														

Relinquished By:	Date/Time	Received By:	Date/Ti	Turn Around Time and Notes:

Analytical Report Requested: YES ☐ **NO** ☐

MicroVision Laboratories, Inc.
187 Billerica Road, Chelmsford, MA 01824
Phone 978-250-9909 Fax 978-250-9901 Toll Free 1-877-250-9909
microvisionlabs.com

Figure 5.2 - Chain-of-Custody (continued)



TestAmerica Knoxville
5815 Middlebrook Pike

Knoxville, TN 37921
phone 865.291.3000 fax 865.584.4315

Chain of Custody Record

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Your Company Name here	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	______ of ______ COCs
Address	**Analysis Turnaround Time**			**For Lab Use Only:**
City/State/Zip	Calendar (C) or Work Days (W) ______			Walk-in Client:
(xxx) xxx-xxxx Phone	TAT if different from Below ______			Lab Sampling:
(xxx) xxx-xxxx FAX	☑ 2 weeks			
Project Name:	☐ 1 week			Job / SDG No.:
Site:	☐ 2 days			
P O #	☐ 1 day			Sampler:

Sample Identification	Sample Date	Sample Time	Sample Type	Matrix	# of Cont.	Filtered Sample (Y / N)	Composite = C / Grab = G																		Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4, dated 10/25/2012

5.4.3 Sample Numbering System

Each sample will have its own identification number, which will not change during the life of the project. The purpose of this numbering scheme is to provide a tracking system for the retrieval of analytical and field data for each sample. Samples will be clearly labeled with indelible ink. Sample identification numbers will be used on sample labels or tags, field data sheets and/or logbooks, chain-of-custody records, and all other applicable documentation used during the project. The naming conventions described below are tabulated in **Table 5.3**.

The identification for delineation soil samples will include a task identifier, the location ID, the starting sample depth (decimal feet below ground surface) and ending sample depth, and the sample date as YYMMDD, i.e. SDS-10015.0-16.0-130405.

The identification for deep analytical soil samples will include task identifier "DSS," the location ID, the starting sample depth (decimal feet below ground surface) and ending sample depth, and the sample date as YYMMDD, i.e. DSS-100-15.0-16.0-130405.

Note that if borings are collected at an angle, the start and end "depths" will correspond with the distance to ground surface, as with vertical borings. Projected depths will be considered when collecting analytical confirmation samples consistent with depths of the nearest impacted borings.

The identification for shallow analytical soil samples, which are collected using ISM in triplicate, will include task identifier "SSS," the location ID beginning with "DU," a letter designation A, B, or C to correspond with the replicate ID following the location ID, the starting sample depth (decimal feet below ground surface) and ending sample depth, and the sample date as YYMMDD, i.e. SSS-DU01A-0.0-0.5-130405.

The identification for groundwater samples will include a task identifier, the location ID, and the sampling date as YYMMDD i.e. GWA-MW03-130405.

The identification for sediment samples will include a task identifier, the location ID, the starting sample depth (decimal feet below ground surface) and ending sample depth, and the sampling date as YYMMDD i.e. SED-1-0.0-1.0-130405.

The identification for surface water samples will include a task identifier, the location ID, and the sampling date as YYMMDD i.e. SW-1-130405.

Sample types and their corresponding naming conventions are listed in **Table 5.3**.

Table 5.3 - Sample Naming Conventions

Task	**Sample Type**	**Prefix**	**Example Sample Name**
Delineation	Tiered Visual Assessment Samples	SDS (Soil Delineation Sample)	SDS-100-15.0-16.0-130405
Delineation	Verification Samples	SDV (Soil Delineation Verification)	SDV-100-15.0-16.0-130405
Delineation	Confirmation Samples	SDC (Soil Delineation Confirmation)	SDC-100-15.0-16.0-130405
Soil Assessment	Discrete Deep Soil Samples	DSS (Deep Soil Sample)	DSS-100-15.0-16.0-130405
Soil Assessment	ISM Shallow Soil Samples	SSS (Shallow Soil Sample)	SSS-DU01A-0.0-0.5-130405
Groundwater Assessment	Monitoring Well Sample	GWA (Groundwater Assessment)	GWA-MW03-130405
Sediment Assessment	Sediment Samples	SED	SED-1-0.0-1.0-130405
Surface Water Assessment	Surface Water Samples	SW	SW-1-130405

5.4.4 Laboratory Sample Custody and Documentation

Samples will be delivered to laboratory personnel authorized to receive samples. Upon receipt of samples, the lab will:

- Note the condition of the sample and reconcile the information on sample labels against that on the chain-of-custody record;
- Assign a laboratory sample ID number;
- Log the sample; and
- Store the sample in a secured sample storage area at appropriate temperatures. Pertinent information will be recorded on the chain-of-custody record, which will be signed and scanned in to be included with the electronic data deliverable.

The Geosyntec Project Manager will be informed immediately of inconsistencies between the chain-of-custody record and the sample containers received. Deviations from the accepted sample-handling procedures will be documented by the laboratory and reported to the Geosyntec Project Manager.

5.4.5 Document Corrections

Changes or corrections on project documentation will be made by crossing out the item with a single line. The person performing the correction must initial and date the correction. The original item, although erroneous, must remain legible. The new information will be written above the crossed-out item if possible. Corrections will be written clearly and legibly with indelible ink.

6. QUALITY CONTROL

6.1 Field Quality Control (QC) Samples

Field QC samples will be collected and analyzed to assess the consistency and performance of the soil and groundwater sampling activities. Field QC sample for this project will include blind field duplicates, MS/MSD, and equipment rinsates when necessary. Duplicate samples will be named such that they include the string "-9-" in between the sample prefix and the sample ID, i.e., the duplicate for MW-01 would be MW-9-01. Other types of field QC samples will be numbered so that they can be readily identified.

Note that for ISM samples, the QA process is maintained by collecting samples in triplicate in lieu of processing blanks, as advised by Mark Bruce, PhD, the technical advisor for ISM at TestAmerica.

Naming conventions for QC samples are explained in **Table 6.1**.

6.1.1 Field Duplicates

Field duplicates are two samples (an original and a duplicate) of the same matrix, to the extent practicable, collected at the same time and location and using the same sampling techniques. Field duplicate samples are used to evaluate the precision of the overall sample collection and analysis process. Field duplicates will be collected at a frequency of 1 per 20 regular samples and will be analyzed for the same set of analytes as for the regular sample collected. Exact locations of duplicate samples and sample identifications will be recorded in the field logbook or on field forms.

6.1.2 Matrix Spike and Matrix Spike Duplicates

The laboratory will analyze an MS/MSD for every 20 samples analyzed. Field personnel will collect triple the amount or the volume of the sample matrix for the original sample and MS/MSD sample. The MS/MSD sample will be used to determine the precision and accuracy of the sample preparation and analytical methods.

6.1.3 Equipment Rinsate Samples

Collection and analysis of field equipment blanks are provided as QC checks on the integrity of equipment decontamination procedures. Equipment rinsate samples will be prepared by using deionized water and sample bottles randomly selected from the bottles prepared for environmental samples. Equipment rinsate samples will be assigned unique sample numbers so as to not be identified by the laboratory as rinsate samples.

Equipment rinsate samples will be collected at a rate of one per every day of sampling when using non-dedicated equipment to sample soil or groundwater. These samples will be analyzed for the same sample compounds, elements, or parameters as those analyzed for the collected environmental samples.

Table 6.1 - QC Sample Naming Conventions

Sample Type	**Prefix**	**Example Sample Name**	**Frequency Collected**
Field Duplicate	Sample will maintain prefix of original sample. The string "-9-" will be placed between the prefix and the sample ID.	SDV-9100-15.0-16.0-040513	1 per 20 regular samples
Matrix Spike/Matrix Spike Duplicate	Sample will maintain prefix of original sample. –MS and –MSD will be appended to sample ID.	SDV-100-15.0-16.0-040513-MS SDV-100-15.0-16.0-040513-MSD	1 per 20 regular samples
Equipment Rinsate	EB (Equipment Blank)	ER01-040513	1 per 20 regular samples or a maximum of 1 per day

6.2 Laboratory Quality Control Samples

Method performance criteria for Methods EPA 6010C (metals), EPA 7470A/7471B (mercury), EPA 8270D SIM (PAHs), and EPA 8290 (dioxins and furans) are provided in **Table 6.2**. Surrogate recovery control limits are provided in **Table 6.3**.

Table 6.2 - Method Performance Criteria

	Matrix Soil									
Chemical of Concern	**Method**	**Reporting Limit**	**Method Detection Limit (MDL)**	**Units**	**QA/QC Acceptance Limits**					
					Laboratory Control Sample			**Matrix Spike**		
					LCL	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
Aluminum	6010C	10	1.55	mg/Kg	82	116	20	50	200	20
Antimony	6010C	1.5	0.38	mg/Kg	82	110	20	20	200	20
Arsenic	6010C	2	0.66	mg/Kg	85	110	20	76	111	20
Barium	6010C	1	0.076	mg/Kg	87	112	20	52	159	20
Beryllium	6010C	0.5	0.033	mg/Kg	84	114	20	72	105	20
Cadmium	6010C	0.5	0.041	mg/Kg	87	110	20	40	130	20
Chromium	6010C	1.5	0.058	mg/Kg	84	114	20	70	200	20
Cobalt	6010C	1	0.1	mg/Kg	87	110	20	72	106	20
Copper	6010C	2	0.217	mg/Kg	88	110	20	37	187	20
Iron	6010C	15	3.8	mg/Kg	87	120	20	70	200	20
Lead	6010C	0.8	0.27	mg/Kg	86	110	20	70	200	20
Manganese	6010C	1	0.1	mg/Kg	88	110	20	40	200	20
Nickel	6010C	4	0.123	mg/Kg	87	110	20	61	126	20
Selenium	6010C	1.3	0.86	mg/Kg	83	110	20	76	104	20
Silver	6010C	1	0.16	mg/Kg	87	114	20	75	141	20
Thallium	6010C	1.2	0.65	mg/Kg	84	110	20	78	101	20
Vanadium	6010C	2	0.094	mg/Kg	88	110	20	50	169	20

Table 6.2 - Method Performance Criteria

	Matrix Soil									
Chemical of Concern	**Method**	**Reporting Limit**	**Method Detection Limit (MDL)**	**Units**	**QA/QC Acceptance Limits**					
					Laboratory Control Sample			**Matrix Spike**		
					LCL	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
Zinc	6010C	3	0.398	mg/Kg	76	114	20	70	200	20
Mercury	7471B	17	5.53	ug/Kg	87	111	20	87	111	20
1-Methylphenanthrene	8270D SIM	5000	--	ng/Kg	50	150	50	50	150	50
2-Fluorobiphenyl	8270D SIM	--	--	ng/Kg	39	120	50	39	120	--
2-Methylnaphthalene	8270D SIM	5000	309	ng/Kg	30	120	30	30	120	30
Acenaphthene	8270D SIM	5000	160	ng/Kg	35	120	50	35	120	50
Acenaphthylene	8270D SIM	5000	170	ng/Kg	41	120	50	41	120	50
Anthracene	8270D SIM	5000	720	ng/Kg	43	120	50	43	120	50
Benzo[a]anthracene	8270D SIM	5000	900	ng/Kg	36	120	40	36	120	40
Benzo[a]pyrene	8270D SIM	5000	740	ng/Kg	20	120	30	20	120	30
Benzo[b]fluoranthene	8270D SIM	5000	1200	ng/Kg	37	120	28	37	120	28
Benzo[g,h,i]perylene	8270D SIM	5000	1100	ng/Kg	20	123	30	20	123	30
Benzo[k]fluoranthene	8270D SIM	5000	1000	ng/Kg	46	120	28	46	120	28
Chrysene	8270D SIM	5000	1000	ng/Kg	34	120	41	34	120	41
Dibenz(a,h)anthracene	8270D SIM	5000	1300	ng/Kg	20	120	25	20	120	25
Fluoranthene	8270D SIM	5000	1000	ng/Kg	45	120	30	45	120	30
Fluorene	8270D SIM	5000	470	ng/Kg	44	120	50	44	120	50

Table 6.2 - Method Performance Criteria

	Matrix Soil									
Chemical of Concern	**Method**	**Reporting Limit**	**Method Detection Limit (MDL)**	**Units**	**QA/QC Acceptance Limits**					
					Laboratory Control Sample			**Matrix Spike**		
					LCL	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
Indeno[1,2,3-cd]pyrene	8270D SIM	5000	1100	ng/Kg	20	127	50	20	127	50
Naphthalene	8270D SIM	5000	326	ng/Kg	44	120	50	44	120	50
Nitrobenzene-d5	8270D SIM	--	--	ng/Kg	42	120	50	42	120	--
Phenanthrene	8270D SIM	5000	1100	ng/Kg	44	120	42	44	120	42
Pyrene	8270D SIM	5000	1100	ng/Kg	43	120	30	43	120	30
Terphenyl-d14	8270D SIM	--	--	ng/Kg	35	120	50	35	120	--
2,3,7,8-TCDD	8290	1	0.97	pg/g	79	129	15	79	129	15
1,2,3,7,8-PeCDD	8290	5	0.41	pg/g	79	129	15	79	129	15
1,2,3,4,7,8-HxCDD	8290	5	0.57	pg/g	73	123	15	73	123	15
1,2,3,6,7,8-HxCDD	8290	5	0.36	pg/g	74	124	15	73	127	15
1,2,3,7,8,9-HxCDD	8290	5	0.41	pg/g	70	124	15	65	141	15
1,2,3,4,6,7,8-HpCDD	8290	5	0.38	pg/g	73	123	15	54	138	15
OCDD	8290	10	1.1	pg/g	75	125	15	31	154	15
2,3,7,8-TCDF	8290	1	0.71	pg/g	75	125	15	75	125	15
1,2,3,7,8-PeCDF	8290	5	0.74	pg/g	74	124	15	74	124	15
2,3,4,7,8-PeCDF	8290	5	0.45	pg/g	75	125	15	75	125	15
1,2,3,4,7,8-HxCDF	8290	5	0.48	pg/g	75	125	15	75	125	15
1,2,3,6,7,8-HxCDF	8290	5	0.59	pg/g	76	126	15	73	131	15

Table 6.2 - Method Performance Criteria

	Matrix Soil									
Chemical of Concern	**Method**	**Reporting Limit**	**Method Detection Limit (MDL)**	**Units**	**QA/QC Acceptance Limits**					
					Laboratory Control Sample			**Matrix Spike**		
					LCL	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
2,3,4,6,7,8-HxCDF	8290	5	0.2	pg/g	76	126	15	76	129	15
1,2,3,7,8,9-HxCDF	8290	5	0.38	pg/g	77	127	15	77	127	15
1,2,3,4,6,7,8-HpCDF	8290	5	0.4	pg/g	77	127	15	72	134	15
1,2,3,4,7,8,9-HpCDF	8290	5	0.63	pg/g	73	123	15	73	124	15
OCDF	8290	10	1.3	pg/g	49	128	15	45	135	15

Notes:
-- Not Available
PQL – Practical Quantitation Limit
LCL – Lower Confidence Limit
UCL – Upper Confidence Limit
RPD – Relative Percent Difference
Method 8290 utilizes a sample specific estimated detection limit in place of the traditional MDL.

Table 6.2 – Method Performance Criteria

	Matrix Water									
Chemical of Concern	**Method**	**Reporting Limit**	**MDL**	**Units**	**QA/QC Acceptance Limits**					
					Laboratory Control Sample			**Matrix Spike**		
					LCL	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
Aluminum	6010C	100	18	ug/L	87	111	20	83	119	20
Antimony	6010C	10	3.14	ug/L	88	110	20	81	124	20
Arsenic	6010C	15	4.41	ug/L	88	110	20	84	124	20
Barium	6010C	10	0.576	ug/L	90	112	20	85	120	20
Beryllium	6010C	1	0.474	ug/L	89	113	20	79	121	20
Cadmium	6010C	5	0.452	ug/L	88	111	20	82	119	20
Chromium	6010C	10	0.663	ug/L	90	113	20	73	135	20
Cobalt	6010C	15	1.36	ug/L	86	112	20	82	129	20
Copper	6010C	10	1.23	ug/L	89	111	20	82	119	20
Iron	6010C	100	22	ug/L	89	115	20	52	155	20
Lead	6010C	9	2.61	ug/L	89	110	20	89	121	20
Manganese	6010C	10	0.253	ug/L	90	110	20	79	121	20
Nickel	6010C	40	1.29	ug/L	89	111	20	84	120	20
Selenium	6010C	15	4.86	ug/L	85	112	20	71	140	20
Silver	6010C	10	0.933	ug/L	86	115	20	75	141	20
Thallium	6010C	15	4.91	ug/L	88	110	20	90	116	20

Table 6.2 – Method Performance Criteria

	Matrix Water									
Chemical of Concern	**Method**	**Reporting Limit**	**MDL**	**Units**	**QA/QC Acceptance Limits**					
					Laboratory Control Sample			**Matrix Spike**		
					LCL	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
Vanadium	6010C	20	4.53	ug/L	85	111	20	60	137	20
Zinc	6010C	10	1.11	ug/L	90	111	20	85	120	20
Mercury	7470A	0.2	0.027	ug/L	84	120	15	75	125	20
1-Methylphenanthrene	8270D SIM	100	--	ng/L	44	150	50	44	150	50
2-Fluorobiphenyl	8270D SIM	5	1	ng/L	42	120	--	42	120	--
2-Methylnaphthalene	8270D SIM	100	5.15	ng/L	36	121	30	36	121	31
Acenaphthene	8270D SIM	100	10.8	ng/L	47	120	50	47	120	50
Acenaphthylene	8270D SIM	100	9.96	ng/L	39	120	50	39	120	50
Anthracene	8270D SIM	100	14.2	ng/L	28	120	50	28	120	50
Benzo[a]anthracene	8270D SIM	100	3.21	ng/L	42	120	40	42	120	40
Benzo[a]pyrene	8270D SIM	100	5.14	ng/L	38	120	21	38	120	21
Benzo[b]fluoranthene	8270D SIM	100	3.44	ng/L	44	120	28	44	120	28
Benzo[g,h,i]perylene	8270D SIM	100	3.55	ng/L	39	120	23	39	120	23
Benzo[k]fluoranthene	8270D SIM	100	5.05	ng/L	43	120	28	43	120	28
Chrysene	8270D SIM	100	3.19	ng/L	35	120	41	35	120	41

Table 6.2 – Method Performance Criteria

	Matrix Water									
Chemical of Concern	**Method**	**Reporting Limit**	**MDL**	**Units**	**QA/QC Acceptance Limits**					
					Laboratory Control Sample			**Matrix Spike**		
					LCL	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
Dibenz(a,h)anthracene	8270D SIM	100	4.82	ng/L	27	126	25	27	126	25
Fluoranthene	8270D SIM	100	4.53	ng/L	46	120	24	46	120	24
Fluorene	8270D SIM	100	18.8	ng/L	49	120	50	49	120	50
Indeno[1,2,3-cd]pyrene	8270D SIM	100	14.7	ng/L	38	120	25	38	120	25
Naphthalene	8270D SIM	100	5.33	ng/L	37	120	50	37	120	50
Nitrobenzene-d5	8270D SIM	5	1	ng/L	43	120	--	43	120	--
Phenanthrene	8270D SIM	100	9.75	ng/L	46	120	42	46	120	42
Pyrene	8270D SIM	100	8.08	ng/L	49	120	22	49	120	22
Terphenyl-d14	8270D SIM	--	1	ng/L	47	120	--	47	120	--
2,3,7,8-TCDD	8290	10	2.1	pg/L	--	127	15	77	127	15
1,2,3,7,8-PeCDD	8290	50	2.6	pg/L	78	128	15	78	128	15
1,2,3,4,7,8-HxCDD	8290	50	1.3	pg/L	73	123	15	73	123	15
1,2,3,6,7,8-HxCDD	8290	50	1.8	pg/L	72	127	15	72	127	15
1,2,3,7,8,9-HxCDD	8290	50	1.6	pg/L	76	126	15	76	126	15
1,2,3,4,6,7,8-HpCDD	8290	50	1.5	pg/L	73	123	15	73	123	15
OCDD	8290	100	3.1	pg/L	75	125	15	75	125	15

Table 6.2 – Method Performance Criteria

	Matrix Water									
Chemical of Concern	**Method**	**Reporting Limit**	**MDL**	**Units**	**QA/QC Acceptance Limits**					
					Laboratory Control Sample			**Matrix Spike**		
					LCL	**UCL**	**RPD**	**LCL**	**UCL**	**RPD**
2,3,7,8-TCDF	8290	10	3.4	pg/L	74	124	15	74	124	15
1,2,3,7,8-PeCDF	8290	50	1.3	pg/L	74	124	15	74	124	15
2,3,4,7,8-PeCDF	8290	50	1.2	pg/L	74	124	15	74	124	15
1,2,3,4,7,8-HxCDF	8290	50	1.4	pg/L	75	125	15	75	125	15
1,2,3,6,7,8-HxCDF	8290	50	1.2	pg/L	75	125	15	75	125	15
2,3,4,6,7,8-HxCDF	8290	50	1.1	pg/L	76	126	15	76	126	15
1,2,3,7,8,9-HxCDF	8290	50	1.9	pg/L	76	126	15	76	126	15
1,2,3,4,6,7,8-HpCDF	8290	50	1.7	pg/L	71	121	15	71	121	15
1,2,3,4,7,8,9-HpCDF	8290	50	2.1	pg/L	73	123	15	73	123	15
OCDF	8290	100	1.3	pg/L	68	132	15	49	134	15

Notes:

-- Not Available
LCL – Lower Confidence Limit
UCL – Upper Confidence Limit
RPD – Relative Percent Difference
Method 8290 utilizes a sample specific estimated detection limit in place of the traditional MDL.

Table 6.3 Surrogate Recovery Control Limits

Analyte	**%R in Water Samples**	**%R in Soil Samples**
2-Fluorobiphenyl	42-120%	39-120%
Nitrobenzene-d5	43-120%	42-120%
Terphenyl-d14	47-120%	35-124%

6.2.1 Method Blanks

Method blanks for aqueous samples consist of organic-free or deionized water carried through the analytical scheme like a sample. For solid matrices, method blanks are prepared using Ottawa sand to simulate solid matrix effects. Method blanks serve to measure contamination associated with laboratory storage, preparation, or instrumentation. For most tests, one method blank is analyzed in every analytical batch of samples.

Note that for ISM samples, the QA process is maintained by collecting samples in triplicate in lieu of processing blanks, as advised by Mark Bruce, PhD, the technical advisor for ISM at TestAmerica.

6.2.2 Laboratory Control Standards (LCS)

A LCS is a sample containing known concentrations of specific target analytes. It can be purchased or prepared by spiking known amounts of target analytes into a well-characterized blank matrix. The matrix will be laboratory reagent water for water samples. The spiking solution used for the LCS/LCS duplicate preparation is of a source different from the stock that was used to prepare calibration standards. The LCS is prepared and analyzed with the associated samples, using the same reagents and under the same conditions. All analytes in the LCS must meet recovery criteria, as specified in SW-846. If the criteria are not met, the entire batch of samples must be re-prepared, together with a new LCS, and re-analyzed.

6.2.3 Surrogate Standards

Surrogates are measured amounts of certain compounds added before sample preparation or extraction. Analysts measure recovery of the surrogate to find systematic extraction problems. Surrogates are added to samples on a method specific basis.

6.2.4 Internal Standards

Internal standards are measured amounts of certain compounds added after sample preparation or extraction. They are used in an internal standard calibration method to correct sample results suffering from capillary column injection losses, purging losses, or the effects of viscosity. Internal standard calibration is currently used on a method specific basis.

6.2.5 Instrument Blanks

An instrument blank is used to monitor the cleanliness of the instrument portion of a sample analysis process. Instrument blanks must be analyzed following calibration runs, before sample analyses are initiated, and after analysis of samples that contain high concentrations of target analytes at concentrations greater than the required reporting limits. If the laboratory consistently observes contaminants in the instrument blanks, the source of the contamination must be investigated and eliminated, if possible. Instrument blanks are usually just the solvent or acid solution of the standard used to calibrate the instrument.

6.3 Additional Laboratory Quality Control Procedures

6.3.1 Control Charts

Control charts are used to monitor the precision and accuracy of the analytical methods, and to determine whether the QC data are within control limits. A control chart shows how a measured quantity compares with previous measurements of that quantity. Information is compiled and incorporated into the control charts by the QA Manager on a monthly basis.

If the data exceed the control limits, (i.e., if the measured value is more than three standard deviations away from the previously established average), then corrective action must be taken before the results are reported. If the data exceed the warning limits, (i.e., if the measured value is more than two but less than three standard deviations away from the previously established average), then the system will be monitored for possible corrective action. The control and warning limits are recalculated after every 20 measurements or once a year, whichever is more frequent.

7. EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

7.1 Maintenance of Field Equipment

The field engineer, geologist, or technician will inspect the drill rig and other equipment upon arrival and will document if the equipment provided by the driller is not in good condition, or if there is residual dirt, grease, or other possible sources of contamination. Field work will not proceed until the field staff has verified the good working condition of onsite equipment.

Prior to use and after each sampling event, soil and groundwater sampling equipment will be properly decontaminated and cleaned to prevent cross-contamination. Downhole equipment will be decontaminated prior to commencing operations and between locations. Within each ISM DU, equipment does not need to be decontaminated between increments. The equipment decontamination procedure is described in **Section 3.6** of this QAPP.

Nitrile phthalate-free gloves will be worn by sampling personnel during sample and equipment handling activities, including decontamination.

7.2 Maintenance of Laboratory Equipment

Instruments will be maintained according to the manufacturer's specifications. Major maintenance/repair is performed by or under the direction of the manufacturer's service personnel. Records of instrument checks and maintenance are kept in logbooks. The maintenance log contains the date, analyst, instrument fault (if any), and corrective or preventive maintenance performed.

7.3 Instrument Calibration and Frequency

This section describes calibration procedures for field and laboratory equipment.

7.3.1 Calibration of Field Equipment

Calibration of field equipment will be carried out at the beginning of each field day by field personnel following procedures outlined in the user manual for the applicable equipment. **Section 5.1** describes calibration activities in more detail.

7.3.2 Calibration of Laboratory Equipment

Laboratory instruments will be calibrated and the calibration acceptance criteria met before samples are analyzed. Calibration standards will be prepared with National Institute for Standards and Testing (NIST) traceable standards and analyzed according to method requirements. Initial calibration acceptance criteria documented in the laboratory SOPs will meet those of applicable guidance documents. The lowest concentration of the calibration standard will be less than or equal to the PQL based on the final volume of extract or sample, or PQLs will be reviewed against the regulatory limits after regulatory limits are established.

Initial calibration will be verified, before samples are analyzed, with a second source standard prepared at the mid-point of the calibration curve. Initial calibration verification will meet the acceptance criteria that are expressed in the laboratory SOPs.

Daily calibration verification will be conducted at the method-prescribed frequencies, and will meet the acceptance criteria of applicable guidance documents. Daily calibration verification will not be used for quantitation of target analytes.

Calibration data (calibration tables, chromatograms, instrument printouts, and laboratory logbooks) will be clearly labeled to identify the source and preparation of the calibration standard, and will, therefore, be traceable to the standard preparation records.

7.4 Inspection and Acceptance of Supplies and Consumables

Supplies and consumables will be inspected and approved by the Geosyntec Technical Manager to ensure products meet project requirements.

8. DATA QUALITY MANAGEMENT

8.1 Data-Tracking Procedures

Data received will be tracked by the Project Manager. The Technical Manager will be responsible for ensuring that field data is sent to the project manager.

8.2 Data Management Strategy

The project manager will (1) determine if the projects DQOs have been met based on data validation and review and (2) will calculate data completeness. The project manager will include a section in the final report that reconciles the collected data with project DQOs and establishes and documents data usability. The section will discuss the following topics:

- Implementation of sampling design and analysis according to the approved QAPP (or sample completeness and representativeness);
- Proper frequency of field QC samples and the adequacy of field decontamination procedures;
- Accuracy, bias, and precision of the data collected;
- Data comparability, if appropriate; and
- Data usability for project decisions.

9. ASSESSMENT AND OVERSIGHT

9.1 Assessment and Response Actions

The Geosyntec Project Manager and QA Manager have overall responsibility for supervising and ensuring that samples are collected and handled in accordance with this QAPP and that the documentation of field activities is adequate and complete. The Project QA Manager or designee will evaluate the implementation of the QAPP on a day-to-day basis. Field activities such as sample collection, preservation, and labeling will be checked for completeness. When procedures are found to be out of compliance with the QAPP, the deviation will be documented in the field logbook and corrective action will be taken.

9.1.1 Field Assessments

The Geosyntec QA Manager may schedule audits of field activities at any time to evaluate the execution of sample collection, identification, and control in the field. The audit may also include observations of chain-of-custody procedures, field documentation, instrument calibrations, and field measurements. Field assessments may be carried out by the Geosyntec QA Manager and/or the project manager.

Field documents and chain-of-custody forms will be reviewed to ensure that entries are printed or written in indelible ink, dated, and signed. Sampling operations will be reviewed and compared with the QAPP, Work Plan and applicable SOPs. The auditor will verify that the proper sample containers are used, that the preservatives are added or are already present in the container, and that the documentation of the sampling operation is adequate.

Field measurements will be reviewed by random spot-checking to determine that the instrument is within calibration, that the calibration is completed at the appropriate frequency, and that the sensitivity range of the instrument is appropriate for the project.

Audit findings will be documented in a report to the Geosyntec Consultants Program QA Manager and the Project Manager.

9.1.2 Laboratory Assessments

The Geosyntec QA Manager may schedule audits of the laboratory at any time. This systems audit includes evaluation of the analytical instruments, personnel, facilities, adherence to the method procedures, and QC.

9.2 Field Corrective Action Procedures

Field corrective action will be implemented as needed.

9.3 Laboratory Corrective Action Procedures

QC failures logically fall into two categories:

- Single QC outliers
- Systematic failure

QC outliers are identified by comparing the results from the analysis of the QA/QC samples to the control limits established for each method. Analytical control limits are maintained for LCSs, method blanks, spike recoveries, duplicates, and surrogate recoveries. In addition, many analytical methods have QC criteria for calibrations, sensitivity checks, and other method-specific quality checks that are performed routinely. The acceptance limits for most QA/QC criteria are based on historical data collected in the laboratory and are revised periodically.

If one of the above checks does not meet the acceptance criteria, the analyst at the bench, and sometimes the section supervisor, initiates corrective action. Such action is initiated by documenting the failure, identifying the source of the problem and deciding on a course of action to correct the problem. Once the source of the problem is identified, implementation of the corrective action is usually quick with little interruption in analysis. The nature of the problem, corrective action, and the result are documented in the laboratory corrective action form.

Systematic failures of a method, issues of method compliance, consistent contamination that the analyst cannot resolve, QC issues raised in audit reports, or QC issues that impact data already reported are examples of more serious problems that are dealt with directly by the laboratory QA Manager. The laboratory QA Manager along with the assistance of management and other technical staff in the laboratory identify the appropriate corrective action that will solve the problem. Details of this process are formally documented for future reference.

10. DATA MANAGEMENT

After the field data have been reviewed for accuracy, it will be reduced to tabular form for inclusion in the final report. During fieldwork, the field notebooks and field forms will be maintained by the Technical Manager, Project Manager, and Sampling Technician. The field notebooks and field forms will document the sampling locations, field sampling notes of the sampling crew, field instrument calibration data, and applicable observations made during the sampling event. The Technical Manager will review the records to ensure that proper documentation is being made. The Technical Manager will report to the QA Manager and Project Manager if there are problems encountered through direct observation or through review of the field notebooks or field forms. This report will include corrective actions taken and the potential effect on project objectives. Problems and corrective actions taken shall be recorded in the field notebook by the Technical Manager.

10.1 Data Reduction, Verification, and Reporting

Analytical data generated by the laboratory in support of the project will be reviewed before reporting to ensure the validity of the reported data. This internal laboratory data review process will consist of data reduction, three levels of documented review, and reporting. Review processes will be documented using appropriate checklist forms or logbooks, which will be signed and dated by the reviewer.

10.1.1 Data Reduction and reporting

Data reduction involves the mathematical or statistical calculations used by the laboratory to convert raw data to the reported data. The laboratory will perform reduction of analytical data as specified in each of the appropriate analytical methods and laboratory SOPs. Raw data results will be recorded for each method using method-specific forms or a standardized output from each of the various instruments.

Data calculations will be verified and initialed by personnel both generating and approving the calculations. Relevant raw and electronic data, including but not limited to logbooks, data sheets, electronic files, and final reports, notebook references, supporting documentation, and correspondence, will be assembled, packaged, and stored for a minimum of 6 years in accordance with NCDENR guidance. If the laboratory is unable to store project-related data for 6 years, then it is the responsibility of the laboratory to contact Geosyntec Consultants 30 days before disposal to make alternative arrangements.

Geosyntec will maintain copies of chain-of-custody records until receipt of the laboratory report. Laboratory reports will be logged in upon receipt and filed in chronological order.

10.1.2 Laboratory Data Verification and Review

After data reduction has occurred, draft reports of the analytical results are submitted to the project manager for review. The raw data and calculations are reviewed to ensure that the chemists correctly interpreted the data and did not make errors in the calculation of the reported analytical results. The project manager also reviews the data to ensure the QA/QC requirements are met. For each analytical method the analytical batch is checked to ensure that all QA/QC elements were performed. The QA/QC results are checked to identify potential deviations from the method QA/QC acceptance criteria. If deviations are found, appropriate corrective action must be taken before the results can be released.

Prior to release of the sample report, the sample data shall be reviewed by the laboratory for accuracy, precision, and holding times. This process includes a review of the data by the primary analyst and then a final review by the laboratory's QC Officer.

The soil data will be reported on a dry weight basis and take into account required dilutions. The analytical data packages will contain the following information: sample results, method blank results, laboratory control sample recovery, MS/MSD recoveries and RPDs, date and time of sample collection, date and time of sample receipt, date and time of sample extraction, date and time of sample analysis, dilution factors, pH of water samples, sample temperature at time of receipt, analytical methods used, method detection and quantitation limits, problems and corrective actions, and applicable certifications. The laboratory's review of the data will be based on the following criteria:

- Analysis samples within required holding times;
- Use of the appropriate analytical procedures;
- Use of properly calibrated and operating instruments; and

- Successful analysis of the appropriate QC samples.

The Project Chemist will be responsible for evaluating and validating the project data to determine if it meets the needs of the project. Data validation will be made using the criteria in the National Functional Guidelines for Organic Data Review (EPA 540/R-94/012) and the National Functional Guidelines for Inorganic Data Review (EPA 540/R-94/013). The project chemist will prepare a QC Summary Report of the project data to be included in the final report.

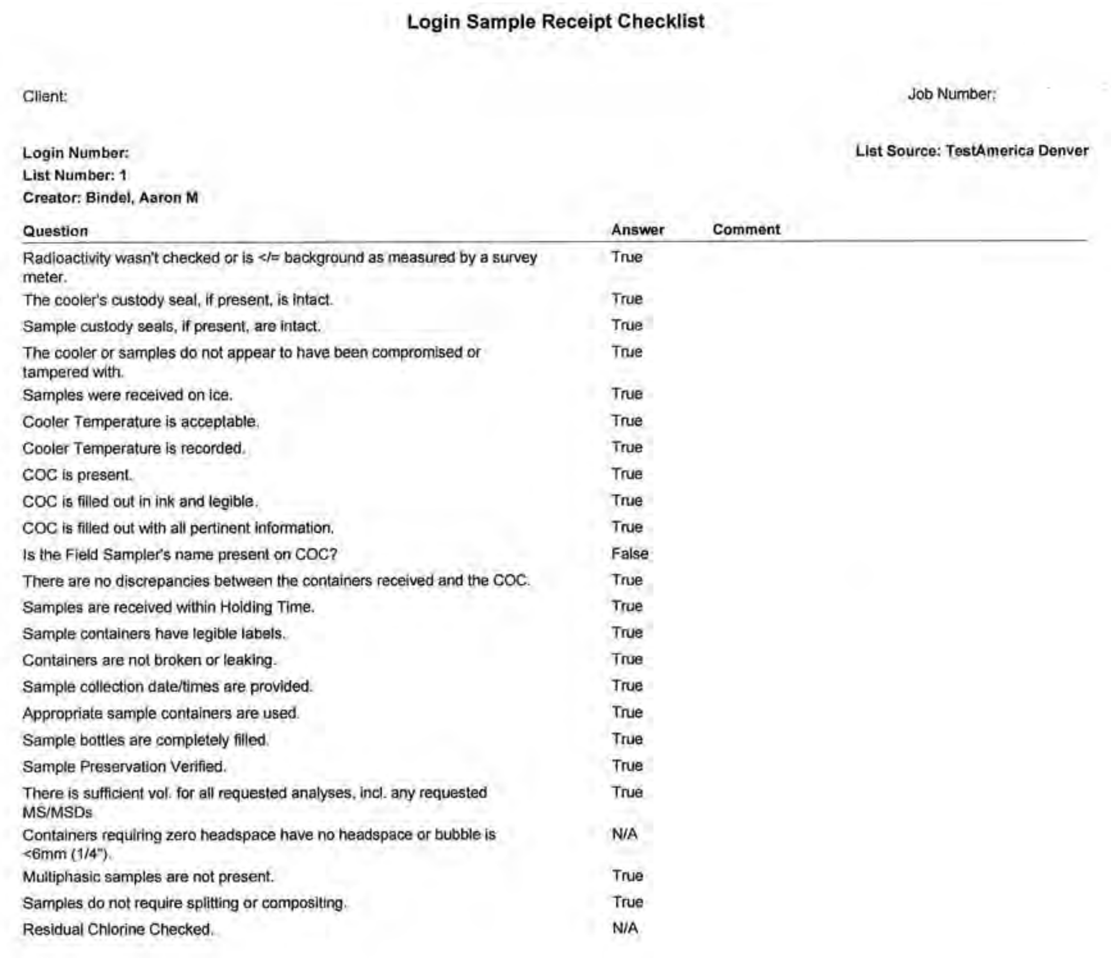
If a discrepancy occurs during the analytical process, corrective action will be taken to resolve the problems as quickly as possible and to bring the system into conformance with the project's QA requirements. This applies to both field and laboratory activities.

The laboratory has a corrective action system in place that operates under the direction of the laboratory's QA Manager. The lab's QA Manager or designee shall be responsible for initiating corrective actions as necessary. Corrective actions will be required if there are discrepancies noted upon receipt of the samples by the laboratory. Corrective actions will also be required if QC samples or laboratory conditions fail to meet method-specific criteria or criteria described in the laboratory's QA plan. A copy of the TestAmerica (Denver) "Sample Condition Upon Receipt Report" is shown in **Figure 10.1**. This form is used to document discrepancies and the corrective actions taken.

The following criteria will be used as part of the data verification process for all analytes: holding time, method blanks, laboratory control samples, MS/MSDs, surrogate recoveries, duplicate analysis, rinsate blanks, reported detection limits and compound quantitation, and overall assessment of the data.

Holding times and preservation requirements are listed in **Table 10.1**.

Figure 10.1 - Sample Condition Upon Receipt Report



Login Sample Receipt Checklist

Client:

Job Number:

Login Number:
List Number: 1
Creator: Bindel, Aaron M

List Source: TestAmerica Denver

Question	**Answer**	**Comment**
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	False	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Table 10.1 - Holding Times and Preservation Requirements

Matrix	**Analytical Group**	**Analytical and Preparation Method/SOP Reference**	**Sample Volume/Mass Required per Analysis**	**Containers and Volume Collected (number, size, type)**	**Preservation Requirements (chemical, temperature, light protected)**	**Maximum Holding Time (preparation/ analysis)**
Soil/Sediment	Metals	EPA Method SW846 6010C	1 g	1, 8-oz wide-mouth amber glass jar	Cool to 4°C ± 2°C	6 months
Soil/Sediment	Mercury	EPA Method SW846 7471B	0.5 g		Cool to 4°C ± 2°C	28 days
Soil/Sediment	PAHs	EPA Method SW846 8270D SIM	30 g		Cool to 4°C ± 2°C	14 days to extraction; 40 days to analysis
Soil/Sediment	PCDDs /PCDFs (Dioxins and Furans)	EPA Method SW846 8290	30 g	1, 4-oz amber glass jar	Cool to 4°C ± 2°C; store in the dark	30 to extraction; 45 days to analysis
Water	Metals	EPA Method SW846 6010C	50 mLs	500-mL HDPE	Preserve with HNO_3 pH<2	6 months
Water	Mercury	EPA Method SW846 7470A	30 mLs		Preserve with HNO_3 pH<2	28 days
Water	PCDDs /PCDFs (Dioxins and Furans)	EPA Method SW846 8290	1 L	2, 1-L amber glass bottles	Cool to 4°C ± 2°C, keep in the dark	30 days to extraction; 45 days to analysis
Water	PAHs	EPA Method SW846 8270D SIM	1 L	2,1-L amber glass bottles	Cool to 4°C ± 2°C	7 days to extraction; 40 days to analysis
Water	Field Parameters (pH, Conductivity, Turbidity)	N/A	N/A	N/A	N/A	Field analysis performed immediately upon collection.

Notes:

mL - milliliters
L – liters
All coolers must contain a temperature blank to verify that temperature preservation requirements are being met.

Analytical results will be delivered to the Geosyntec Project Manager within the laboratory standard turnaround time after the laboratory receives the samples. The laboratory shall provide the data in an EDD. Field and laboratory data will be maintained by the Geosyntec Project Manager. Electronic project files are stored on a secure Geosyntec server.

Upon delivery of data to Geosyntec, data will be reviewed by project staff for internal and external consistency. Each data package will be reviewed against a deliverables requirements checklist prepared based on project-specific DQOs. Discrepancies will be corrected and documented. Field and laboratory data will be managed using electronic systems.

10.2 Data Validation

Upon receipt of analytical reports from the laboratory, the Project QA Manager or designee will validate 20% of the data packages received for soil samples and the first data package received for groundwater samples in order to determine if it meets the needs of the project. The data validation will be performed using the criteria in the National Functional Guidelines for Organic Data Review (EPA 540/R-94/012) and the National Functional Guidelines for Inorganic Data Review (EPA 540/R-94/013). A report of the data validation will be prepared in the form of a QC Summary Report and will be included in the final report. Problems associated with the data will be noted in the final report and in tables containing data that has been qualified. **Tables 10.2** and **10.3** below list the definitions of the qualifying flags used.

The following criteria will be used as part of the Level 2A data validation process for all analytes: holding time, method blanks, laboratory control samples, MS/MSDs, surrogate recoveries, duplicate analysis, rinsate blanks, reported detection limits and compound quantitation, and overall assessment of the data. For full data validation, the above list of criteria will also include all raw and associated supporting data in data packages.

Table 10.2 - Organic Data Qualifier Flags

Data Qualifier	Definition of Data Qualifier
U	The analyte was analyzed for but was not detected above the reported sample quantitation.
J	The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified.

Table 10.3 - Inorganic Data Qualifier Flags

Data Qualifier	Definition of Data Qualifier
U	The material was analyzed for but was not detected above the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
J	The associated value is an estimated quantity.
UJ	The material was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise
R	The data are unusable.

11. DATA USABILITY

The objective of this investigation is to determine if/where CCBs on site are impacting media within the Parcel boundaries. This will be determined by assessing if the concentrations of possible contaminants in the groundwater and soil exceed the NCAC Title 15A 2L Standards (groundwater) or PSRGs (soil). Usability of the data for the project will be determined by reviewing the precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS parameters) of the data. The following describe the evaluation procedures for the PARCCS parameters.

Precision examines the distribution of the reported values about their mean. The distribution of reported values refers to how different the individual reported values are from the average reported value. Precision may be affected by the natural variation of the matrix or contamination within the matrix, as well as by errors made in the field and/or laboratory handling procedures. Field duplicate samples, laboratory duplicate samples, and MS/MSD samples will provide an indication of precision. Precision will be evaluated by the calculation of the RPD:

$$\text{RPD (\%)} = \text{Absolute value of } ((C_S – C_D)/(C_S + C_D)/2) \times 100$$

Where: C_S = Concentration of the sample

C_D = Concentration of the duplicate sample

The RPDs will be compared to the limits presented in **Table 6.2**.

Accuracy measures the bias of a measurement system. Sources of error introduced into the measurement system may be accounted for by using matrix spikes. Potential error sources include the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques. Accuracy will be evaluated by calculating the percent recoveries (%R) of the MS/MSD samples, surrogates and the laboratory control samples. The %R for the matrix spike samples will be calculated using the following equation:

$$\%R = ((C_M – C_S)/T) \times 100$$

Where: C_M = Concentration of matrix spike sample
C_S = Concentration of sample
T = amount spiked

The %R for the laboratory control samples and the surrogates will be calculated as:

$$\%R = (C/T) \times 100$$

Where: C = Observed concentration
T = Amount spiked

The %R values will be compared to the limits presented in **Tables 6.2** and **6.3**.

Representativeness expresses the degree to which sample data accurately and precisely represents a characteristic of a population, a parameter variation at a sampling point, or an environmental condition. This criterion will be met by assuring that sampling locations are properly selected, that a sufficient number of samples are collected, and that sampling and handling procedures are conducted in accordance with the protocols outlined in this Work Plan.

Completeness defines the percentage of measurements made which are judged to be valid measurements. Completeness will be compared to the goal of greater than 90%.

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal is achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units.

Sensitivity refers to the minimum magnitude at which analytical methods can resolve quantitative differences among sample concentrations. If the minimum magnitude for a particular analytical method is sufficiently below an action level or risk screening criterion, then the method sensitivity is deemed sufficient to fully evaluate the dataset with respect to the desired reference values.

The MDL is a theoretical limit determined through an MDL study, in which the concentration of a spiked solution is tested at least seven times. The standard deviation of the recovered concentrations (σ_{rec}) is computed and multiplied by the Student's t-distribution value to arrive at the MDL. In practice, to allow for matrix interferences variability in instrument control, a reporting limit of 2.5 to 5 times the MDL is typically selected.

Analytical sensitivity is readily evaluated by comparing method reporting limits to risk-based screening values, such as Region IX Preliminary Remediation Goals (PRGs).

12. REPORTS TO MANAGEMENT

12.1 Daily Field Logs

Daily field logs or a field notebook will be kept by the field team(s). The Technical Manager shall maintain a copy of each field log generated.

12.2 Project Reports

Quarterly reports will be prepared and submitted to UNC-CH and NC DENR throughout the life of this project to report on progress of the investigation.

The REC guidance requires a summary report that documents "the findings of the Facility investigation in sufficient detail to support the cleanup-level determination, conduct the feasibility study of remedial alternatives and support the proposed remedy" (Inactive Hazardous Sites Branch, 2012). Following completion of the RI activities, a report will be prepared that meets this requirement.

Problems that develop will be brought to the attention of the Project Technical Manager and/or the QA Officer. This notification will be documented in the field logs, and it shall be the responsibility of these persons to notify the REC Project Manager of documented problems. The impact of these problems will be discussed with the REC Project Manager, and results of these discussions will be summarized in the final report.

The Final Report will be prepared by the Technical Manager and reviewed by the Project Manager prior to being submitted to UNC-CH. The report will include: Facility history/project background, description of field sampling, description of fieldwork design, investigative findings, summary of QA/QC and impacts to the project, comparison to screening criteria, and conclusion of study findings.

The Project QA Officer shall prepare the QA/QC summary section of the report and provide this section to the Technical Manager as soon as data validation is complete. This will be done before the bulk of the final report is completed. It shall be the responsibility of the QA Officer to review the assessment report to ensure the data is being interpreted properly before it is released for general review.

13. REFERENCES

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