ELECTRICAL RESISTANCE HEATING
FINAL REMEDIAL DESIGN

CTS OF ASHEVILLE, INC. SUPERFUND SITE

235 Mills Gap Road
Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
Consent Decree – Civil Action No. 1:16-cv-380

Prepared for:

CTS Corporation
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Prepared by:

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Amec Foster Wheeler Project 6252-16-2012

November 27, 2017

November 27, 2017

amec foster wheeler

Mr. Craig Zeller, P.E.
Superfund Remedial and Site Evaluation Branch
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Subject: **Electrical Resistance Heating Final Remedial Design**
CTS of Asheville, Inc. Superfund Site
235 Mills Gap Road, Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
Consent Decree – Civil Action No. 1:16-cv-380
Amec Foster Wheeler Project 6252-16-2012

Dear Mr. Zeller:

Please find attached the Electrical Resistance Heating Final Remedial Design for the above-referenced Site. Amec Foster Wheeler Environment & Infrastructure, Inc. prepared this Final Remedial Design on behalf of CTS Corporation to comply with the Consent Decree for Interim Remedial Design/Remedial Action at the CTS of Asheville, Inc. Superfund Site between the United States of America and CTS Corporation, Mills Gap Road Associates, and Northrop Grumman Systems Corporation (entered on March 7, 2017).

If you have questions regarding this Final Remedial Design, please contact us at (828) 252-8130.

Sincerely,

Amec Foster Wheeler Environment & Infrastructure, Inc.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

bgs	below ground surface
BMP	best management practice
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
ERH	electrical resistance heating
FSAP	Field Sampling and Analysis Plan
kWhr	kilowatt hours
LGAC	liquid-phase granular activated carbon
LNAPL	light non-aqueous phase liquid
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
NAPL	non-aqueous phase liquid
NCDEQ	North Carolina Department of Environmental Quality
OSHA	Occupational Safety and Health Administration
PID	photoionization detector
RAO	remedial action objective
RAWP	Remedial Action Work Plan
RD	Remedial Design
RTO	regenerative thermal oxidizer
SOW	Statement of Work
SWMP	Site Wide Monitoring Plan
TCE	trichloroethene (also, trichloroethylene)
TMP	temporary monitoring point
USEPA	United States Environmental Protection Agency
VGAC	vapor-phase granular activated carbon
VOC	volatile organic compound
WNCRAQA	Western North Carolina Regional Air Quality Agency

1.0 INTRODUCTION

This document presents the Final Remedial Design (RD) for implementation of the electrical resistance heating (ERH) interim remedial action at the CTS of Asheville, Inc. Superfund Site (Site) located at 235 Mills Gap Road in Asheville, Buncombe County, North Carolina (Figure 1). This ERH Final RD has been prepared to comply with Paragraph 3.5 of the Statement of Work (SOW) of the Consent Decree for Interim Remedial Design/Remedial Action (CD) at the Site between the United States of America and CTS Corporation, Mills Gap Road Associates, and Northrop Grumman Systems Corporation.

1.1 SITE DESCRIPTION

The approximate center of the Site is located at north latitude 35°29’36” and west longitude 82°30’25”. The Site formerly contained an approximate 95,000-square foot, single-story brick and metal structure on the southern portion of the Site. The building was demolished in December 2011 and the concrete building pad remains intact. The northeastern portion of the Site contains an asphalt-paved parking area, and asphalt-paved driveways are located parallel to the north (front) of the building pad and southeast (rear) of the building pad. A six-foot high chain-link fence surrounds the Site and a locked gate at the north end of the Site controls access to the Site from Mills Gap Road. The Site is unoccupied. The Site and surrounding area is illustrated on Figure 2. A Site map with existing features and property boundaries is included as Figure 3.

1.2 BACKGROUND

A non-aqueous phase liquid (NAPL) investigation was conducted at the Site in 2013 and 2014. An approximate one-acre area containing light NAPL (LNAPL) with comingled trichloroethene (TCE) was identified (Amec, 2014). A Focused Feasibility Study was conducted to evaluate potential remedial alternatives for the one-acre NAPL area. ERH was chosen as the recommended alternative (Amec Foster Wheeler, 2015a). An additional approximate 0.2-acre area located adjacent and upgradient of the NAPL area where elevated TCE concentrations had been detected was added to the proposed treatment area (Amec Foster Wheeler, 2015b). This 1.2-acre area is considered the TCE source area.

The United States Environmental Protection Agency (USEPA) approved ERH as the recommended interim remedial alternative for the source area and memorialized the decision in the Interim Record of Decision in February 2016. The CD was entered by the United States District Court for the Western District of North Carolina on March 7, 2017. A Remedial Design Work Plan was submitted to USEPA on April 19, 2017, and approved by USEPA on May 1, 2017.

This ERH Final RD presents the following:

- The remedial design criteria;
- The remedial approach;
- ERH system layout and specifications, including operation and maintenance information;
- An evaluation of ‘green’ processes that can potentially be implemented throughout the project;
- A description of monitoring and control measures to protect human health and the environment;
- A revised remedial action (RA) schedule;
- Site wide monitoring information;
- Construction quality assurance/quality control information;
- Performance monitoring objectives and procedures; and,
- A description for photographic documentation of the RA.

1.3 REMEDIAL ACTION OBJECTIVE

ERH will be implemented in the approximate 1.2-acre source area. In addition to TCE, the source area contains LNAPL from weathered fuel oil. In this area, TCE exists in three states: dissolved in groundwater, sorbed to saturated soil, and partitioned in the petroleum LNAPL. A remedial action objective (RAO) of a 95 percent reduction of TCE concentrations will be applied to soil, groundwater and LNAPL samples collected in the ERH treatment area.

A Technical Memorandum concerning the RAO (RAO Tech Memo) was submitted to USEPA on September 13, 2017. The RAO Tech Memo presented the methodology for determining successful achievement of the RAO. Using a ‘population of data approach’, the arithmetic average TCE concentration for each media in each treatment area will be determined from multiple baseline samples collected, and 5 percent of the arithmetic average TCE concentration will be calculated for each media (i.e., 95 percent TCE removal). These concentrations will become the target concentration for each media in the treatment area. Based on ERH remediation system performance indicators, at a time mutually-agreed upon with the ERH contractor, “confirmation” or post-remediation soil, groundwater, and LNAPL samples will be collected. The RAO will be met when the arithmetic average TCE concentration of each media type is at or less than 5 percent of the pre-remediation arithmetic average TCE concentration. If confirmation sampling indicates a portion(s) of the ERH treatment area has met the RAO, consideration will be given to terminating operation of the remediation system in that portion. USEPA will be notified of such potential partial system operation termination.

Additional information on the ERH performance monitoring is described in Section 5.0.

1.4 REMEDIAL DESIGN/REMEDIAL ACTION SCHEDULE

An updated interim RD/RA schedule is included in Appendix A.

1.5 SITE WIDE MONITORING PLAN

A Site Wide Monitoring Plan (SWMP) has been prepared for monitoring of various media throughout implementation of the interim remedial actions. The objectives of site-wide monitoring include:

- Collection of baseline data regarding the extent of contamination in affected media in the interim remedial action area;
- Collection of data through short- and long-term monitoring about the movement and changes in contamination throughout the Site before and after implementation of the interim remedial actions; and
- Collection of data to determine if additional or modified data/monitoring is required.

The SWMP will be updated periodically as necessary to meet the above objectives. The SWMP is included in Appendix B.

2.0 ERH TREATMENT AREA

The remedial design is based on subsurface data collected from within the ERH treatment area and general Site geologic and hydrogeologic information, as described in the following sections.

2.1 DESCRIPTION OF THE ERH TREATMENT AREA

The ERH treatment area is approximately 1.2 acres in size and is located in the south-central portion of the property located at 235 Mills Gap Road. A portion of the ERH treatment area extends onto the adjacent property to the east.

2.1.1 Geology and Hydrogeology

Soil in the ERH treatment area is generally residual soil (overburden) overlying bedrock. Minor amounts of fill material have been identified in the area. In general, the soil grades from a silty sand to sand with depth. Quartz veins/zones consisting of sand to gravel-sized fragments, have been observed in the overburden. The depth to bedrock is variable, but generally deepens from the southwest (approximately 25 to 30 feet) to the north, northeast, and east (approximately 50 to 60 feet).

Groundwater in the ERH treatment area generally flows radially from the south to the north and east. Based on depth to groundwater measurements during a period of high precipitation/recharge, the depth to groundwater generally ranged from approximately 7 feet below ground surface (bgs) to 20 bgs in the treatment area. Water table fluctuations of up to approximately 14 feet in the ERH treatment have been measured.

The horizontal hydraulic gradient in the shallow overburden in the treatment area is typically approximately 0.03. Based on an average Site hydraulic conductivity of 2.3×10^{-4} centimeters per second and an assumed effective porosity of 0.25, the groundwater seepage velocity is approximately 30 feet per year. The pH of groundwater in the treatment area is generally between 5 and 6.

2.1.2 Nature and Extent of Contamination

The source area is located below the south-central portion of the former building and extends to the immediate south and east. The nature of the chlorinated volatile organic compound (VOC) contamination, whether from pure product or from a mixed material/liquid containing a portion of chlorinated VOCs, is unknown. The primary release mechanism(s) associated with the chlorinated VOC contamination observed at the Site is also unknown.

The petroleum contamination identified at the Site consists primarily of fuel oil constituents. The primary release mechanism(s) associated with the petroleum contamination observed at the Site is unknown; however, the petroleum is suspected of originating from an aboveground fuel oil storage tank formerly used to store and supply fuel oil to the facility's boiler.

2.1.3 Soil

A soil vapor extraction system operated in the ERH treatment area from 2006 to 2010. An estimated 6,500 pounds of VOCs were removed from the unsaturated soil. Based on confirmation soil sampling and analysis conducted in 2014, there are minor concentrations of VOC or petroleum constituents remaining in the unsaturated soil.

Soil samples were collected below the water table (i.e., saturated soil) in 2015 to determine contaminant concentrations where contaminants are potentially sorbed to the soil matrix. TCE concentrations in soil samples collected below the water table ranged from 0.076 to 1,120 milligrams per kilogram (mg/kg), with an average concentration of 141 mg/kg.

2.1.4 LNAPL

An approximate one-acre area of the subsurface in the ERH treatment area has been delineated as containing some amount of LNAPL. The LNAPL is a weathered fuel oil or diesel fuel, which have similar formulations. Most of the petroleum-related compounds that have been detected are long-chain hydrocarbons, indicating that the petroleum has weathered, and the 'lighter' hydrocarbons have been removed via weathering processes that include evaporation, dissolution into groundwater, and biodegradation. The LNAPL also contains chlorinated VOCs, primarily TCE.

The LNAPL is primarily present in an immobile residual phase, as indicated by mobility testing and the baildown testing. However, some portion of the LNAPL is mobile, as evidenced by the accumulation of "free-product" LNAPL in monitoring wells MW-3, MW-12, MW-13 and piezometer PZ-2. The LNAPL thickness measured in monitoring wells MW-3 and MW-12 is approximately one foot and the LNAPL thickness in PZ-2 is approximately four feet. The apparent thickness of LNAPL in monitoring wells is typically greater than the actual thickness of LNAPL in the formation by a factor estimated to between two and ten (USEPA, 1995).

In the source area, TCE has largely partitioned into the LNAPL, as evidenced by the concentration of TCE detected in samples of the LNAPL. TCE has an octanol-water distribution coefficient (Kow) of 251 (calculated from log Kow of 2.4; USEPA, 2014) indicating that TCE will more readily partition into (i.e., dissolve into) the octanol phase than into groundwater. The analytical results of soil and groundwater samples collected within and below the LNAPL zone indicate that chlorinated VOC concentrations decrease below the LNAPL zone. Laboratory analysis of the LNAPL indicates TCE concentrations of 4,619 and 6,393 parts per million in the LNAPL.

The amount of petroleum that was released into the subsurface is not known. However, the extent of the LNAPL has been delineated and the LNAPL does not appear to be mobile or migrating (i.e., LNAPL has not been detected in downgradient monitoring wells).

2.1.5 Groundwater

The LNAPL acts as the primary source to the dissolved-phase groundwater plume. Over time, constituents in the LNAPL dissolve into the groundwater migrating through the LNAPL area, creating the dissolved-phase plume. In the source area, the VOC concentrations generally decrease with depth below the LNAPL zone.

Constituents in the dissolved-phase plume include petroleum constituents, TCE, tetrachloroethene, 1,1,1-trichloroethane, and degradation products of these compounds.

TCE is the primary chlorinated VOC present in soil and groundwater and cis-1,2-dichloroethene (cis-1,2-DCE), which is a degradation product of TCE, is the primary degradation product at the Site. The cis-1,2-DCE concentrations are generally less than one percent of the TCE concentrations indicating that little biodegradation is occurring. Additionally, vinyl chloride, which is a breakdown product of cis-1,2-DCE, has not been regularly detected in soil and groundwater samples. The pH of groundwater at the Site is typically around 5, which could be one of the factors limiting the ability of microbes to anaerobically degrade TCE to cis-1,2-DCE.

Groundwater samples were collected in the ERH treatment area in 2015. TCE concentrations in the groundwater samples ranged from 2,200 to 86,100 micrograms per liter (µg/L), with an average concentration of 21,500 µg/L.

2.1.6 Existing Features

The Site is unoccupied and there are no available utilities. However, former utility lines remain. A terra cotta sewer line is located below the southwestern and eastern portions of the former building slab and adjacent to the south-central exterior of the former building. A steel natural gas line is located near the eastern property boundary and then along the southern exterior wall of the former building. The natural gas line was removed from service by PSNC Energy, the natural gas utility, in May 2017. Overhead electrical service to the Site remains in place. Stormwater catchments and conveyance piping are located in the southwestern portion of the ERH treatment area.

A fire water loop is located around the northern, eastern and southeastern portion of the former building. The water service connection has been disconnected at an off-Site location. A municipal/public hydrant is located north of the Site east of the entrance adjacent to Mills Gap Road. This hydrant has been used to obtain water during drilling operations.

A former underground wastewater equalization open-topped vault is located in the western portion of the ERH treatment area. The vault was the former location of a wastewater pretreatment system. The vault is approximately six feet deep and has concrete walls. The vault is approximately 13.5 feet by 41.5 feet.

The majority of the ERH treatment area is at a similar elevation. A cut bank is located along the driveway south of the former building and extends up to approximately 15 feet vertically above the driveway. The area south of the driveway is somewhat wooded. The ERH treatment area extending to the east off the former Site plant property is generally wooded and slopes down to the east.

2.2 ERH BENCH TEST RESULTS

Two saturated soil samples were submitted to TRS Group, Inc. (TRS) for thermal bench testing. The objective of the bench test was to determine the amount of heat required to remove TCE from the Site soil. TRS tested the soil to determine the wet density, dry density, percent moisture, total organic carbon, and electrical resistivity of the soil.

The bench test results indicated that a steaming energy of approximately 125 kilowatt-hours per cubic yard (kWh/cy) will reduce the TCE concentration by 95 percent. The total energy required for remediation also includes the energy to increase the temperature of the subsurface to the target temperature (typically 50 kWh/cy) and the heat losses from the system, which is generally estimated to be 24 percent. Therefore, a design energy density of 175 kWh/cy is estimated to achieve a 95 percent TCE reduction.

3.0 REMEDIAL DESIGN

3.1 ERH DESCRIPTION

ERH is a process whereby soil and groundwater are heated by passing an electrical current through the subsurface between electrodes. Resistance of the flow of electrical current by the subsurface materials (primarily groundwater) induces the heating. A power control unit (PCU), which is a variable transformer system capable of providing multiple simultaneous power outputs at automatically adjustable levels, delivers energy to the electrodes.

The electrodes consist of the electrode element(s) and backfill consisting of graphite and steel shot. The backfill materials are conductive and essentially increase the surface area of the electrode. The heat created by resistance to the current creates steam and also evaporates the volatile contaminants. Vacuum blowers at ground surface connected to vapor recovery wells create a negative pressure in the treatment area. The steam generated by ERH acts as a carrier gas to transport VOCs to the VR wells. Steam and contaminant vapors are then transported to the ERH treatment compound. The heat generated in the subsurface is monitored by temperature monitoring points (TMPs), which contain multi-level temperature probes at each TMP.

3.2 ERH REMEDIAL DESIGN

Based on the information presented in Section 2.0, a remedy employing ERH with vapor/liquid treatment was developed. A liquid waste management and treatment system was designed to effectively treat liquid recovered from the subsurface and separate potential extracted LNAPL for storage, transport, and offsite disposal. The ERH design was developed by TRS, the selected ERH contractor, to remediate soil, groundwater, and LNAPL to achieve the RAO. The following Table 1 provides a summary of the general ERH design parameters and ERH system components.

Table 1: ERH Design Parameters and System Components

Treatment area	56,100 sf
Treatment volume	47,250 cy
Anticipated depth to groundwater	14 to 26 feet bgs
Anticipated depth to auger refusal	28 to 47 feet bgs
Estimated VOC mass	20,000 pounds
Estimated soil moisture	17 percent
Estimated soil resistivity	110 Ω-m
Electrode spacing	17 feet
Electrodes	229
Vapor recovery wells	229 (co-located with electrodes); 2 vapor-only recovery wells
Temperature monitoring points	18 locations
Total energy, incl. treatment equipment	8,510,000 kWhr
Average energy density	175 kWhr/cy
Vapor treatment	Regenerative thermal oxidizer (or potentially, granular activated carbon near the end of the expected treatment period)
Condensate treatment	Liquid granular activated carbon
Days of operation	90 to 120
sf – square feet; cy – cubic yards; bgs – below ground surface Ω-m – ohm-meters; kWhr – kilowatt-hours	

A Final Design, Execution, and Operation & Maintenance Plan (Final Execution Plan) has been prepared by TRS (Appendix C). The Final Execution Plan describes the components of the ERH heating and vapor/water treatment systems. The Final Execution Plan also contains drawings, descriptions of operation and maintenance (O&M) activities, and safety procedures.

A Construction Quality Assurance/Quality Control Plan was also developed to evaluate and confirm that overall project management is maintained, production and quality are in compliance with project requirements, and construction deficiencies are identified and corrected in a timely manner. The ERH Construction Quality Assurance/Quality Control Plan is included in Appendix D.

3.3 INFRASTRUCTURE REQUIREMENTS

The following utilities will be required for operation of the ERH system:

- Electricity
- Water
- Sewer
- Natural gas

Duke Energy maintains overhead electrical power along Mills Gap Road and along the eastern property border and fence. Electrical connections from Duke Energy's system will be made to the ERH system for powering the equipment (PCUs, treatment units, controllers, etc.). The electrical connection will include a 'drop' from Duke Energy's distribution network to new supply poles equipped with appropriate transformers, as well as connections from the supply poles to the power control units (PCUs) and treatment system. The PCUs provide electricity to the electrodes.

The existing Site overhead power line is located where drilling activities will be conducted; therefore a temporary power line will be installed by Duke Energy. Drilling will be conducted first along the path of the temporary power line, and then the temporary power line will be installed by Duke Energy (see Drawing Y-2 in the Final Execution Plan). Once the temporary power line has been installed, and the existing line removed, drilling will be conducted where the former line was located. Upon completion of the ERH remediation, the power line will be relocated to the original position by Duke Energy.

The City of Asheville maintains a water supply main along Mills Gap Road. Water is necessary for the scrubber that neutralizes the acid gas stream from the regenerative thermal oxidizer (RTO) and makeup water is necessary for the cooling tower recirculation loop that runs through the heat exchanger in the condenser. A new connection to the water supply main will be used to supply water to the treatment system. The City of Asheville will provide the water main connection and meter for the property. Water will also be needed for the installation of electrodes, temperature monitoring points, and monitoring wells. It is anticipated that a temporary connection to the water supply hydrant will be used for drilling activities until the connection to the water supply main is completed.

The Metropolitan Sewerage District (MSD) of Buncombe County maintains a sewer line adjacent to Mills Gap Road. The former Site facility was connected to the sewer line during operation, but it is unclear if the connection remains or is in adequate condition to transfer treated water from the vapor/liquid treatment system to the MSD system. An evaluation of the sewer connection will be performed during the MSD industrial pretreatment permitting phase prior to initiating transfer of wastewater from the system. If repairs/modifications to the existing piping, or a new connection, is necessary, the connection will be constructed and tested prior to wastewater transfer. MSD industrial pretreatment permit requirements will be met during operation of the ERH system, including monitoring, sampling, and reporting.

PSNC Energy maintains a natural gas line along Mills Gap Road. Natural gas will be used to operate the RTO. PSNC Energy will provide the natural gas connection and meter to the property.

3.4 PERMIT REQUIREMENTS

Under CERCLA Section 121(e)(1), federal, state, or local permits are not required for the portion of any removal or remedial action conducted entirely on site as defined in 40 CFR 300.5 (see also 40 CFR 300.400(e)(1) and (2)). In addition, CERCLA actions must only comply with the “substantive requirements,” not the administrative requirements of regulations. Administrative requirements include permit applications, reporting, record keeping, and consultation with administrative bodies.

The following agency regulations requiring a permit/adherence have been identified for implementation of ERH at the Site:

- Western North Carolina Regional Air Quality Agency (WNCRAQA) limits on total VOC discharge and constituent concentrations in ambient air at the property boundary
- North Carolina Department of Environmental Quality (NCDEQ) well construction and abandonment standards
- NCDEQ Underground Injection Control Program rules for subsurface injection, if applicable (described in Section 3.5)
- State and federal hazardous and non-hazardous waste characterization, storage, and disposal requirements

- NCDEQ erosion and sedimentation control requirements

Permits for the following are anticipated to be obtained:

- Metropolitan Sewerage District of Buncombe County industrial wastewater pretreatment discharge
- Buncombe County electrical construction

Actions to comply with the substantive requirements of the aforementioned regulations are described in Sections 4.0 and 7.0.

3.5 ERH SYSTEM INSTALLATION

Prior to installation of subsurface system component installation activities, it is anticipated that the following Site preparation activities will be conducted:

- Clearing of vegetation around the Site entrance to provide improved ingress/egress visibility from/to Mills Gap Road.
- Installation of signage along Mills Gap Road notifying traffic of the Site entrance.
- Installation of new fencing and gate at the entrance to the Site with a holding area to reduce traffic congestion at the entrance. A Site trailer will be located along the new fencing in such a way that Site visitors can only enter the restricted-access area through the Site trailer.
- Removal of a portion of the fence where the treatment area extends off-Site to the east, and installation of a temporary fence approximately 10 feet to the east. The temporary fence will have screens to prevent the public from being able to access the interior of the fence, where electrode components will be located.
- Installation of a gravel drive to the northwestern area of the former building pad to allow for heavy equipment and supply unloading on the former building pad.
- Clearing/grubbing in the treatment area to remove vegetation and other surface obstructions.
- Clearing and tree removal in the southern and southeastern portion of the treatment area, as necessary for drill rig access and piping installation.

Existing monitoring wells/piezometers that are constructed of polyvinyl chloride (PVC) will be abandoned prior to beginning installation of the ERH system components. The wells will be abandoned using a neat cement grout (i.e., bentonite will not be used, as heating via ERH can create desiccation and cracking of bentonite grout) placed via tremie pipe. The following wells are proposed for abandonment:

- Monitoring well MW-3A
- Piezometers PZ-1, PZ-2 and PZ-3
- SVE extraction wells VE-1 through VE-15
- SVE pilot test observation wells OW-1 through OW-4

Subsurface component installation activities will be conducted using four auger drill rigs operating at the same time. Vertical borings will be advanced at most locations. Angled borings will advanced where there are surface obstructions or steep topography (the slopes will not be regraded for the drill rigs). Also, angled borings will be advanced at the eastern property boundary/fence to access the subsurface treatment area on the off-site property to the east. Grading or clearing of the off-site property to the east is not anticipated.

The electrodes with vapor recovery points will be installed using nominal 8.25-inch diameter hollow-stem augers (creating a 12-inch diameter borehole). The TMPs and two individual vapor recovery points will be installed using nominal 4.25-inch hollow-stem augers (creating a nominal 8-inch diameter borehole). Cross section details depicting the electrode and TMP designs are included in Final Execution Plan in Appendix C.

The subsurface equipment (e.g., augers, cables, drill rods) used in drilling activities will not be decontaminated between electrode/TMP borings, as the area where the borings are advanced will subsequently be treated by ERH. Drilling equipment will be decontaminated between borings for installation of monitoring wells.

TRS will be responsible for procuring, mobilizing, setting up, and testing system components prior to use. These activities are described in the Final Execution Plan.

Based on evaluation of hydrogeologic conditions in the treatment area, an electrode wetting, or drip, system is not currently proposed. However, piping will be installed in the electrode borings so that if a drip system is determined to be necessary based on operational parameters, the system can be installed and readily connected to the electrodes. Also, if a drip system is required, NCDEQ will be notified and the appropriate injection permit/notification form will be submitted.

3.6 ERH SYSTEM OPERATION AND MAINTENANCE

TRS will be responsible for O&M of the ERH system with oversight by Amec Foster Wheeler. O&M information is included in the Final Execution Plan.

3.7 PHOTOGRAPHIC DOCUMENTATION OF REMEDIAL ACTIONS

Photographs of the ERH system installation and operational activities will be taken periodically throughout the interim remedial action. Photographs will focus on material and equipment documentation and specific operational activities (e.g., sample collection). Photographs will also be taken when there are work stoppages for material reasons (i.e., not administrative) and when material or equipment defects are identified. Photograph files will indicate briefly what the photograph is documenting, initials of the photographer, and the date of the photograph.

4.0 WASTE MANAGEMENT

Multiple waste streams will be generated during implementation of ERH. This section describes how waste will be characterized, stored, and disposed.

4.1 WASTE STREAMS

The following waste streams are expected to be generated:

- General solid waste
- Soil from drill cuttings
- Water from monitoring well development and groundwater purging
- Water from decontamination activities
- Treated condensate and waste from the RTO acid gas scrubber
- LNAPL
- Vapor as air effluent
- Liquid-phase granular activated carbon (LGAC)
- Vapor-phase granular activated carbon (VGAC), if used/generated.

Wastes will be managed in accordance with Section 4.4 of the SOW and applicable regulations, as described below.

4.2 SOLID WASTE

Non-regulated solid waste will include used disposable items, such as personal protective equipment (PPE), disposable sampling equipment, and general refuse. The items will be placed in plastic bags and deposited in a bulk solid water collection container for transport and disposal at the permitted Buncombe County municipal solid waste landfill.

4.3 SOIL

Soil will be generated during the installation of monitoring wells, electrodes, and temperature monitoring points. Based on the analytical results of soil samples collected from the vadose zone in the ERH treatment area (Amec, 2014), unsaturated soil can be managed as non-hazardous waste. Similarly, it is anticipated that saturated soil will be managed as hazardous waste due to TCE concentrations in soil (characteristic waste by toxicity). During drilling operations, soil cuttings will be transported to roll-off containers or transport trailer staged at the Site. The roll-off containers or trailers will be lined with plastic sheeting and will have covers that can be placed over the soil when not being filled. The containers will be visually inspected daily to identify potential leaks. If leaks are identified, temporary containment facilities will be constructed.

Unsaturated and saturated soil samples will be collected during installation of the subsurface components for characterization of the contaminant concentrations. The quantity of soil samples to be collected will ultimately be determined by the disposal contractor and/or disposal facility. The samples will either be analyzed for total VOCs according to USEPA Method 8260 and/or VOCs according to the toxicity characteristic leaching potential test, as directed by the disposal contractor and/or disposal facility.

Based on the analytical results of the soil samples, the soil will be manifested as either a non-hazardous waste and disposed of at a Subtitle D landfill, or as a hazardous waste and disposed of at a Subtitle C landfill or other appropriate disposal facility.

In accordance with Section 4.4 of the SOW, for out-of-state shipments, the USEPA Project Coordinator and the receiving facility state's environmental official will be notified prior to shipment of the waste.

4.4 NON-TREATED WATER

Non-treated water includes groundwater generated during monitoring well installation/ development, groundwater generated during purging/sampling monitoring wells, and water generated during decontamination activities. Non-treated water will be accumulated in labeled 55-gallon drums and staged on the former building concrete pad for disposal as an anticipated hazardous waste.

4.5 WASTEWATER

Condensate water will be treated by LGAC and discharged under an industrial pretreatment permit to MSD. Wastewater from the RTO acid scrubber will also be discharged to MSD. Periodic sampling/monitoring will be conducted as required by the MSD permit.

4.6 LNAPL

LNAPL recovered by the ERH system will be accumulated in an on-Site aboveground storage tank with sufficient containment in the event of a spill. The LNAPL will be sampled and analyzed for characteristic properties. It is anticipated that the LNAPL will be disposed as a hazardous waste.

4.7 LIQUID-PHASE GRANULAR ACTIVATED CARBON

Two LGAC vessels in series will be used to treat the condensate water. The LGAC will be sampled and analyzed for characteristic properties and disposed of as either a non-hazardous or hazardous waste depending on the analytical results.

4.8 VAPOR-PHASE GRANULAR ACTIVATED CARBON

As contaminant concentrations begin to decrease in recovered vapors near the expected end of the treatment period, the use of the RTO might be terminated and VGAC implemented to treat the recovered vapors. Two VGAC vessels (sized according to contaminant concentrations) would be operated in series. If utilized, the VGAC would be sampled and analyzed for characteristic properties and disposed of as either a non-hazardous or hazardous waste depending on the analytical results.

5.0 PERFORMANCE MONITORING

Performance monitoring will be conducted to determine when the RAOs have been achieved and to monitor compliance with regulatory requirements during system operation.

5.1 GROUNDWATER

Groundwater will be monitored in the ERH treatment area to determine if/when the groundwater RAO has been met. Existing monitoring wells MW-2 and MW-3, which are located in the ERH treatment area, will be used for groundwater monitoring during the ERH remedial actions. Ten additional monitoring well pairs (10 shallow and 10 deep overburden at each location) will be installed and used for additional groundwater monitoring. The locations of the new monitoring wells will be based on the final ERH electrode spacing. The new and existing monitoring wells will be fitted with a sealed wellhead that allows for groundwater samples to be collected via dedicated tubing and a pump. Monitoring well installation procedures will be described in the forthcoming Remedial Action Work Plan (RAWP) Field Sampling and Analysis Plan (FSAP).

The following table contains screened intervals of the proposed and existing monitoring wells. The monitoring wells are depicted in Figure 4.

Shallow Monitoring Well	Screened Interval (feet bgs)	Deep Monitoring Well	Screened Interval (feet bgs)
MW-2[1]	18 – 28	N/A	N/A
MW-3[1]	26 – 36	N/A	N/A
MW-23	30 – 35	MW-23A	45 – 50
MW-24[2]	25 – 30	MW-24A[3]	50 – 55
MW-25	30 – 35	MW-25A	45 – 50
MW-26	25 – 30	MW-26A	40 – 45
MW-27[2]	20 – 25	MW-27A[3]	40 – 45
MW-28	25 – 30	MW-28A	40 – 45
MW-29[2]	20 – 25	MW-29A	30 – 35
MW-30	20 – 25	MW-30A[3]	35 – 40
MW-31	30 – 35	MW-31A[3]	45 – 50

Shallow Monitoring Well	Screened Interval (feet bgs)	Deep Monitoring Well	Screened Interval (feet bgs)
MW-32[2]	20 – 25	MW-32A	40 – 45
Notes: 1 – existing monitoring well 2 – anticipated well screened at water table 3 – anticipated well screened at bottom of treatment zone			

The proposed monitoring well screened intervals are intended to be distributed throughout the treatment volume without bias toward areas that are potentially more or less contaminated than other areas. Some of the monitoring wells are intended to be screened across the water table (top of treatment zone), some wells screened in the middle of the treatment zone, and some wells screened near the bottom of the treatment zone. The actual depths/screened intervals of the water table monitoring wells will be determined in the field based on the depth of the water table during drilling. The actual depths/screened intervals of the monitoring wells to be installed near the bottom of the treatment zone will be dependent upon the shallowest depth of the nearest three electrodes which are installed to drilling refusal (i.e., the treatment zone generally will not extend below the shallowest electrode).

Baseline groundwater samples will be collected prior to initiating heating of the subsurface. Groundwater samples will be collected using low-flow purging/sampling. Water quality parameters (pH, temperature, conductivity, dissolved oxygen and oxidation reduction potential) will be monitored during purging. The groundwater samples will be submitted for analysis of TCE according to USEPA Method 8260. Groundwater sampling procedures will be described in the RAWP FSAP and QA/QC procedures and documentation will be described in the RAWP Quality Assurance Project Plan (QAPP).

Confirmation groundwater samples will be collected from the 22 monitoring wells. The determination of when the confirmation groundwater samples should be collected will be based on ERH system operational parameters (e.g., declining or asymptotic contaminant concentrations in influent vapor and/or achieving a target subsurface temperature). Because the groundwater will be hot from heating, hot groundwater sampling procedures will be implemented to prevent the volatilization of TCE from the groundwater prior to sample collection. Hot groundwater sampling procedures will be described in the RAWP FSAP.

5.2 SATURATED SOIL

Saturated soil will be monitored in the ERH treatment area to determine if/when the soil RAO has been met. Baseline soil samples will be collected from 15 boring locations in the ERH treatment area (Figure 4), and samples will be collected at approximate 10-foot intervals from below the top of the treatment zone to the bottom of the treatment zone. The treatment zone at a particular boring will be from the water table to the depth of the shallowest electrode or drilling refusal, whichever occurs first. Once the apparent water table is encountered, a soil sample will be collected at a depth of five feet below the water table, and at 10-foot intervals thereafter. A soil sample will not be collected in the bottom interval if the interval is five feet in length or less. The soil samples will be collected prior to initiating heating of the subsurface using direct-push technology equipment (DPT) sampling equipment. Based on the anticipated treatment zone thickness, a total of approximately 45 saturated soil samples are anticipated to be collected.

Confirmation soil samples will be collected at approximately the same locations/depths of the baseline soil samples. The determination of when the confirmation soil samples should be collected will be based on operational parameters (e.g., declining or asymptotic contaminant concentrations in influent vapor and/or achieving a target subsurface temperature). Because the soil will be hot from heating, hot soil sampling procedures will be implemented to prevent the volatilization of TCE from the soil prior to sample collection. Hot soil sampling procedures will be described in the RAWP FSAP.

The soil samples will be submitted for analysis of TCE according to USEPA Method 8260. Soil sampling procedures will be described in the RAWP and QA/QC procedures and documentation will be described in the RAWP QAPP.

5.3 LNAPL

LNAPL will be monitored in the ERH treatment area to determine if/when the LNAPL RAO has been met. Up to five baseline LNAPL samples will be collected from monitoring wells where sufficient LNAPL has accumulated for collection of an LNAPL sample. The LNAPL samples will be collected prior to initiating heating of the subsurface procedures that will be described in the RAWP FSAP.

Up to five confirmation LNAPL samples will be collected from the monitoring wells where LNAPL was collected prior to heating. If sufficient LNAPL is not present in a monitoring well for collection of a post-remediation sample, the TCE concentration will be considered to be zero at that location for averaging purposes. The determination of when the confirmation samples should be collected will be based on operational parameters (e.g., declining or asymptotic contaminant concentrations in influent vapor and/or achieving a target subsurface temperature). Because the LNAPL will be hot from heating, hot sampling procedures will be implemented to prevent the volatilization of TCE from the LNAPL prior to sample collection. Baseline and confirmation LNAPL samples will be collected using procedures that will be described in the RAWP FSAP.

The LNAPL samples will be submitted for analysis of TCE according to USEPA Method 8260. QA/QC procedures and documentation will be described in the RAWP QAPP.

5.4 PERIMETER AMBIENT AIR

Continuous ambient air monitoring will be conducted at the Site during ERH operations at the Site (i.e., heating/treatment operations). Ambient air monitoring will be conducted at four locations adjacent to the Site fence. The locations will generally be north, east, south, and west of the treatment system discharge stack, as shown on Figure 5. The air monitors will be photoionization detectors (PIDs) capable of measuring total VOCs in the parts per billion concentration range. The WNCRAQA regulations do not have a short-term/acute limit for total VOCs in ambient air. However, the limit for TCE in ambient air at a fenceline is 59 micrograms per cubic meter ($\mu g/m^3$) on an annual averaged basis. The ambient air monitor will be set to alarm if the concentration exceeds a 24-hour time weighted average of 11 parts per billion VOCs (59 $\mu g/m^3$ TCE equals 11 ppbv TCE). If the alarm concentration is exceeded during ERH operations, an evaluation of the ERH system will be conducted to determine how to reduce the VOC concentrations in the effluent air that are affecting the ambient air concentrations.

Baseline ambient air samples will be collected/analyzed prior to initiation of heating. The baseline ambient air samples will be collected at the proposed locations of the continuous ambient air monitors, and will provide baseline/background VOC concentrations. Ambient air samples will also be collected during ERH operations to provide a comparison to the measurements recorded by the ambient air monitors. Ambient air samples will be collected after two weeks of initial ERH operation/heating, weekly during the period of greatest VOC mass removal (anticipated to be approximately 5 weeks), and monthly thereafter. Ambient air samples will be collected in accordance with the procedures and QA/QC documentation included in the Supplement to Vapor Intrusion Assessment Work Plan (Revision 4) dated, June 11, 2014, but will be submitted for the full VOC list according to Method TO-15.

5.5 VAPOR DISCHARGE

The WNCRAQA regulations have discharge limits for various compounds, including TCE (4,000 pounds per year) when a permit is required. System effluent samples will be collected during system operation to estimate the total TCE effluent. Effluent air samples will be collected bi-weekly during initial operation, weekly during the period of greatest VOC mass removal, and every two weeks or monthly thereafter. Effluent samples will be collected using Tedlar bags and analyzed for VOCs according to TO-15. Sampling procedures will be described in the RAWP FSAP and QA/QC procedures and documentation will be described in the RAWP QAPP.

6.0 GREEN ELEMENTS OF REMEDIATION

USEPA's *Principles for Greener Cleanups* (USEPA, 2009) establishes a policy goal for evaluating ways to reduce the environmental footprint of cleanup/remediation actions to the extent possible, while still protecting human health and the environment. Environmental remediation is intrinsically a green process, as the environment is improved and risk to the community and human health is reduced or diminished. However, the various processes that are required to implement remediation each have environmental 'footprints' associated with them. USEPA advocates a green cleanup assessment using the following five elements:

- Total energy use and renewable energy use
- Air pollutants and greenhouse gas emissions
- Water use and impacts to water resources
- Materials management and waste reduction
- Land management and ecosystems protection

USEPA encourages the use of ASTM International's *Standard Guide for Greener Cleanups* E2893 (ASTM, 2016) which describes a process for evaluating, implementing, documenting, and reporting activities that reduce the environmental footprint of a cleanup project (USEPA, 2013). The *Standard Guide* identifies best management practices (BMPs) that can be evaluated for use during implementation of remedial activities. The BMPs are grouped into categories (e.g., materials and power/fuel), with 72 BMPs identified as being applicable to in-situ thermal treatment remediation. Based on an evaluation of the BMPs, 47 BMPs have the potential to be implemented during the proposed ERH remedial activities at the Site. BMPs identified in the *Standard Guide,* or identified independently, which have been incorporated into the design include the following:

- Using existing monitoring wells for performance monitoring.
- Co-locating electrodes and vapor recovery points to reduce energy, waste, and land disturbance.
- Utilizing reusable cabling.
- Cleaning sampling equipment using a biodegradable cleaning solution.
- Installing angled electrodes to minimize ground disturbance activities, such as clearing and grading.

- Providing reports/drawings electronically to reduce paper usage.
- Recycling consumables at the Site (e.g., drink bottles, cardboard).
- Carpooling to the Site, as is possible, to minimize travel impacts.
- Utilizing local staff and subcontractors to minimize travel impacts.
- Using regenerated (i.e., not virgin) LGAC and VGAC.
- Using an RTO, which is more efficient than a non-regenerative thermal oxidizer, and more effective than other vapor treatment techniques.
- Using solar-powered equipment for ambient air monitors.
- Using treated water for drip water, if necessary.

7.0 PROTECTING HUMAN HEALTH AND THE ENVIRONMENT

The ERH remedial activities will be implemented in a manner that is protective of human health and the environment. Protection of human health includes Site workers, persons on neighboring properties, and the community at large. A Health and Safety Plan (HASP) has been developed for workers conducting Site activities. The HASP conforms to applicable Occupational Safety and Health Administration (OSHA) regulations. The Site HASP will be updated to include health and safety information related to the ERH remedial activities and submitted with the ERH Remedial Action Work Plan.

Environmental projection is the prevention and control of environmental pollution and the reduction of habitat disruption that may occur to soil, groundwater, biological systems, surface water and air. To the extent possible, Site personnel will manage or reduce the impact to visual aesthetics, noise, and generation of waste streams (solid, liquid, and gas). Environmental resources within and adjacent to the project boundaries that may potentially be affected by the remedial activities will be identified and protected to the extent possible.

7.1 TRAINING

Site personnel that will be involved with below-grade construction, treatment system operation or sampling will be trained in 40-hour Hazardous Waste Operations and Emergency Response in accordance with OSHA 29 Code of Federal Regulations, with current annual refresher training.

Site personnel will also be trained in environmental protection and pollution control. An awareness briefing discussing environmental protection and pollution control as they relate to the construction and operation of the ERH system will be conducted prior to initiating work at the Site. Additional meetings will be conducted for new personnel and when Site conditions change.

7.2 SITE ACCESS

The project will require various personnel to enter the Site and project area. Only those persons who are properly trained or otherwise require access will be allowed to enter. A six-foot high chain-link fence surrounds the Site and a locked gate at the north end of the Site controls access to the Site from Mills Gap Road. The gate to the Site will remain locked at all times to restrict entry to the Site by non-authorized persons. Security systems will be installed to interrupt the electrical flow to the electrodes in the case of a trespasser in the area of the electrical field. The security systems will be remotely monitored and continuously record for documentation purposes in the case of a trespasser.

Work will not be conducted on the off-Site property where the ERH treatment area extends. Angled borings will be extended from the Site to the target locations/depths. During drilling and construction of the electrodes on the off-Site property, caution tape will be extended around the ERH treatment area as a “safety zone.” A temporary fence and gate will be installed approximately 10 feet east of the Site fence on the off-Site property to prevent non-Site personnel to contact the electrode wellheads that will be located near the Site fence.

7.3 WORK HOURS

Installation of the ERH system (e.g., drilling and system installation) will be conducted during daylight hours (generally 7:00 a.m. to 7:00 p.m.). The treatment system will operate automatically 24-hours per day, seven days per week, except during confirmation sampling or system down-time. Personnel will be on-Site during operation of the system generally during daylight hours. The system will be monitored remotely by TRS personnel and emergency contact phone numbers will be distributed to the project team at the beginning of the project. During operation, it is not anticipated to have personnel on Site over the weekends or holidays, but personnel will be available if a response at the Site is required.

7.4 LAND RESOURCES

Activities will primarily be limited to the fenced Site property boundaries. Significant grading is not anticipated. A steep slope is located in the southern portion of the ERH treatment area. If an electrode or TMP is to be located in a location on/adjacent to the slope which would limit drill rig access, an angled boring will be advanced to allow construction of the electrode or TMP at the specified location.

Clearing of trees and shrubs in the southeastern portion of the ERH treatment area is anticipated to provide clearances for drill rigs and piping construction.

7.5 EROSION AND SEDIMENTATION CONTROL

An erosion and sedimentation control plan will be prepared prior to conducting intrusive activities that will require the removal or grading of soil, which may have the potential to create or promote soil erosion at/off the Site. BMPs will be implemented to reduce or eliminate erosion and promote sediment control. BMPs may include vegetation cover, soil stabilization, or silt fencing. Structural systems will be installed, if necessary, to divert water flows from exposed soils, temporarily store flows, or otherwise limit runoff and the potential discharges of pollutants from exposed areas of the Site.

Site runoff with visible and significant amounts of sediment will be diverted from entering surface waters. The majority of Site runoff is expected to originate from the concrete pad and asphalt driveway/parking area located in the ERH treatment area. Other Site runoff is expected from the asphalt parking area in the northern portion of the Site. Runoff will be dispersed to the extent possible to reduce erosion.

7.6 WATER RESOURCES

Best work practices will be implemented to prevent additional contamination from impacting groundwater. There is no surface water at the Site; however, groundwater discharges areas are located east and west of the Site and develop into tributaries. Application of pesticides, insecticides or other hazardous chemicals to the soil or vegetation is not anticipated.

7.6.1 Spill Response and Control

Aside from caustic soda (1,000-gallon storage tank) that will be used in the RTO scrubber, Amec Foster Wheeler and the primary contractors do not anticipate using chemicals that would require an immediate response if a spill or release occurred. Spill response measures for the caustic soda will be described in the TRS Health and Safety Plan that will be submitted with the Remedial Action Work Plan. A Spill Prevention, Control, and Countermeasures Plan is not applicable as oil products will not be stored or handled on

Site above a quantity of 1,320 U.S. gallons (40 C.F.R. Part 112). Surface waters are not located proximal to the areas of proposed Interim RD/RA activities, such that releases of oil or other chemical products would be expected to impact the closest surface waters.

When spills or releases of hazardous materials or material that is suspected to be hazardous occurs, the following procedures will be implemented immediately:

- Work will be suspended in the area.
- The spill or leak source will be identified and controlled with the appropriate protective gear.
- Containment actions such as earthen beams, use of sorbet booms and/or pads, or excavating a shallow ditch to capture the release.
- Additional measures will be taken to minimize further movement and effect of the spill or leak on the surrounding area.

Actions or procedures addressing spills and leaks will be conducted in accordance with the Site Emergency Management Plan.

7.6.2 Liquid Treatment System

Containers and vessels that are part of the liquid treatment system will be equipped with secondary containment to contain liquids in the event of a release. The secondary containment equipment will be visually monitored periodically by TRS.

7.7 AIR RESOURCES

Remediation activities will be performed in a manner that minimizes the quantity of dust and gaseous vapors that may be released. Dust emissions and particulate will be controlled to the extent possible by implementing dust control measures, spraying water to minimize dust, and limiting the movement of vehicles and other dust suppression techniques, as necessary. Loads on trucks that could emit dust or falling debris will be covered. Containerized drill cuttings will be covered at the end of each day during drilling activities.

7.7.1 Particulates

Driving areas at the Site will be maintained so they are free from particulates which would cause applicable standards to be exceeded or which would cause a hazard or a nuisance. Spraying driving areas with water can be used control particulates from becoming airborne. Minimizing vehicle speeds, wetting dry soils, covering loads, and similar measures will control particulates along Site driving areas. Particulate control will be performed as the work proceeds and whenever a particulate nuisance or hazard is identified. The majority of the surface in the area of the Site which will receive vehicle use is either paved with asphalt or concrete which will minimize particulate generation.

7.7.2 Odor and Vapors

Subsurface vapors will be controlled by vacuum blowers at all times during system operation. Vapors will be captured and removed through the extraction wells and treated. Air monitoring equipment will be used at the exhaust of the air/vapor treatment system. Appropriate actions will be taken if excess vapor or odor concentrations are identified. Vapors or odors are not expected to travel off-Site during construction or operation of the ERH system. If vapors or odors are identified off-Site, action similar to the spill notification will apply.

7.7.3 Noise

The ERH system is inherently a quiet technology. The electrical infrastructure generates a slight hum, like that found at standard electrical substations. To mitigate the noise generated by the three vapor recovery blowers, each blower will be enclosed within a sound reducing enclosure. Further, each blower will have an effluent silencer to keep sound out of the piping. The enclosures are rated at 85 decibels at seven feet at full vacuum. The blowers are typically run at a reduced load, which produces significantly less noise than full power.

The drilling operations will produce noise typical of a construction site. Such drilling has occurred previously at the Site. Drilling will be performed during daylight hours when ambient noise is typically present in the Site area.

7.7.4 Water Vapor

An RTO emits water vapor via a discharge stack. The water vapor is warmer than the ambient air, so on colder days, the water vapor might appear as ‘smoke’. An RTO is more efficient at cooling the water vapor than a standard thermal oxidizer, so the amount of visual vapor will be less, but it should be noted that white water vapor might appear from time to time. The RTO will be equipped with an acid scrubber to neutralize the acid gas stream.

8.0 REFERENCES

Amec Environment & Infrastructure, Inc., 2014. NAPL Investigation Report, CTS of Asheville, Inc. Superfund Site (May 5, 2014).

Amec Environment & Infrastructure, Inc., 2014. Report of Soil Vapor Extraction Confirmation Sampling and Analysis, CTS of Asheville, Inc. Superfund Site (May 5, 2014)

Amec Foster Wheeler, 2015a. Final NAPL Area Focused Feasibility Study Report, CTS of Asheville, Inc. Superfund Site, September 10, 2015.

Amec Foster Wheeler, 2015b. NAPL Area Focused Feasibility Study Report Addendum, CTS of Asheville, Inc. Superfund Site, November 25, 2015.

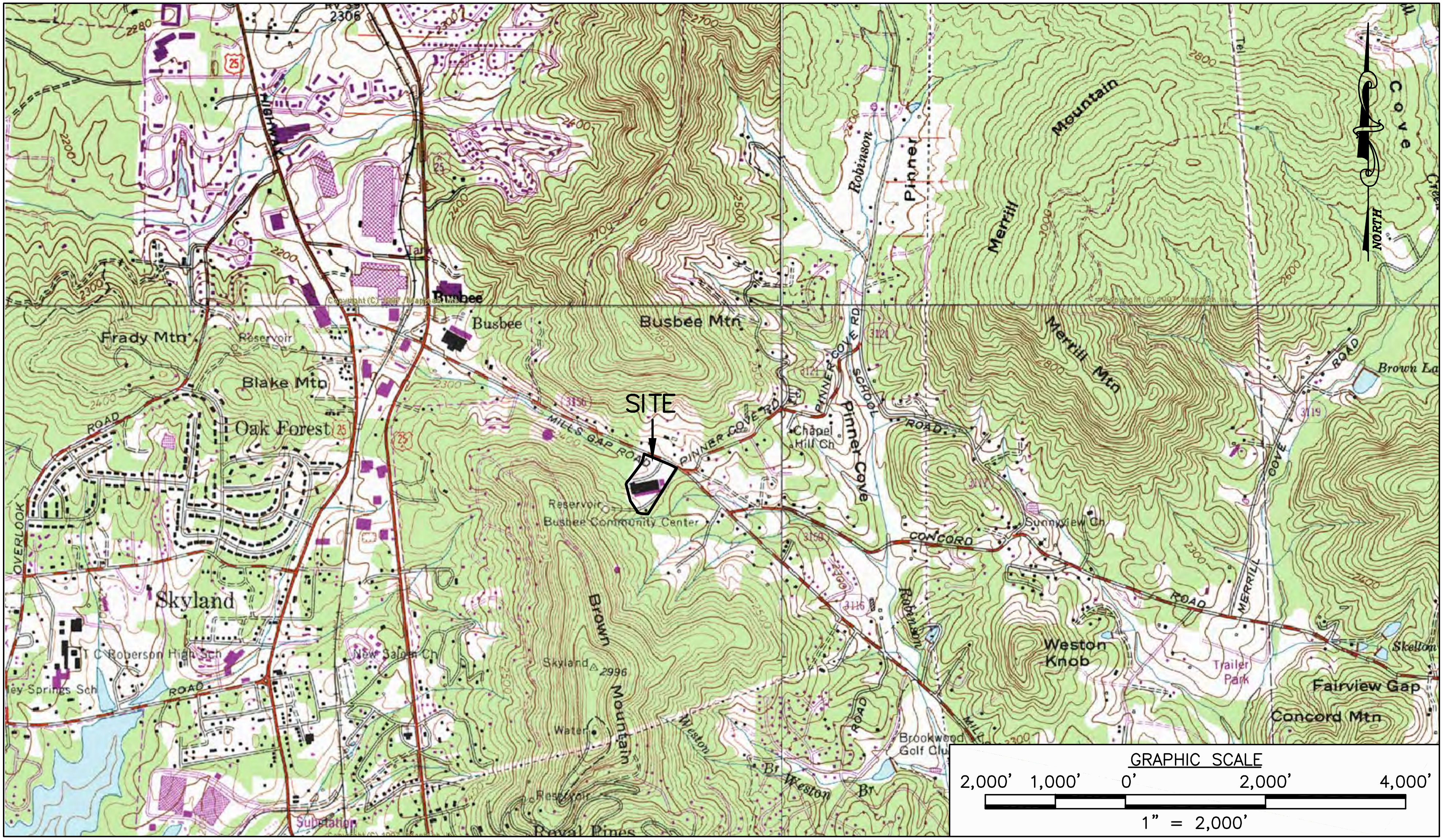
ASTM International, 2016. Standard Guide for Greener Cleanups, E2893-16.

USEPA, 1995. Light Non-Aqueous Phase Liquids. EPA/540/S-95/500, July 1995.

USEPA, 2009. EPA's Principles for Greener Cleanups website (August 27, 2009) https://www.epa.gov/greenercleanups/epa-principles-greener-cleanups accessed on August 24, 2017.

USEPA, 2013. Memorandum: Encouraging Greener Cleanup Practices through Use of ASTM Internationals Standard Guide for Greener Cleanups. December 23, 2013.

FIGURES



TOPOGRAPHIC SITE MAP
CTS OF ASHEVILLE, INC. SUPERFUND SITE
ASHEVILLE, NORTH CAROLINA

amec foster wheeler

DRAWN: SEK	ENG CHECK: --	DATE: APRIL 2017	PROJECT: 6252162012
DFT CHECK: MEW	APPROVAL: MEW	SCALE: 1" = 2,000'	FIGURE: 1

REFERENCE: USGS QUADRANGLES: ASHEVILLE (1961), OTEEN (1962), FRUITLAND (1978) AND SKYLAND (1978)

N

0 50 100 Feet

Legend

Spring
Fence
Property Line

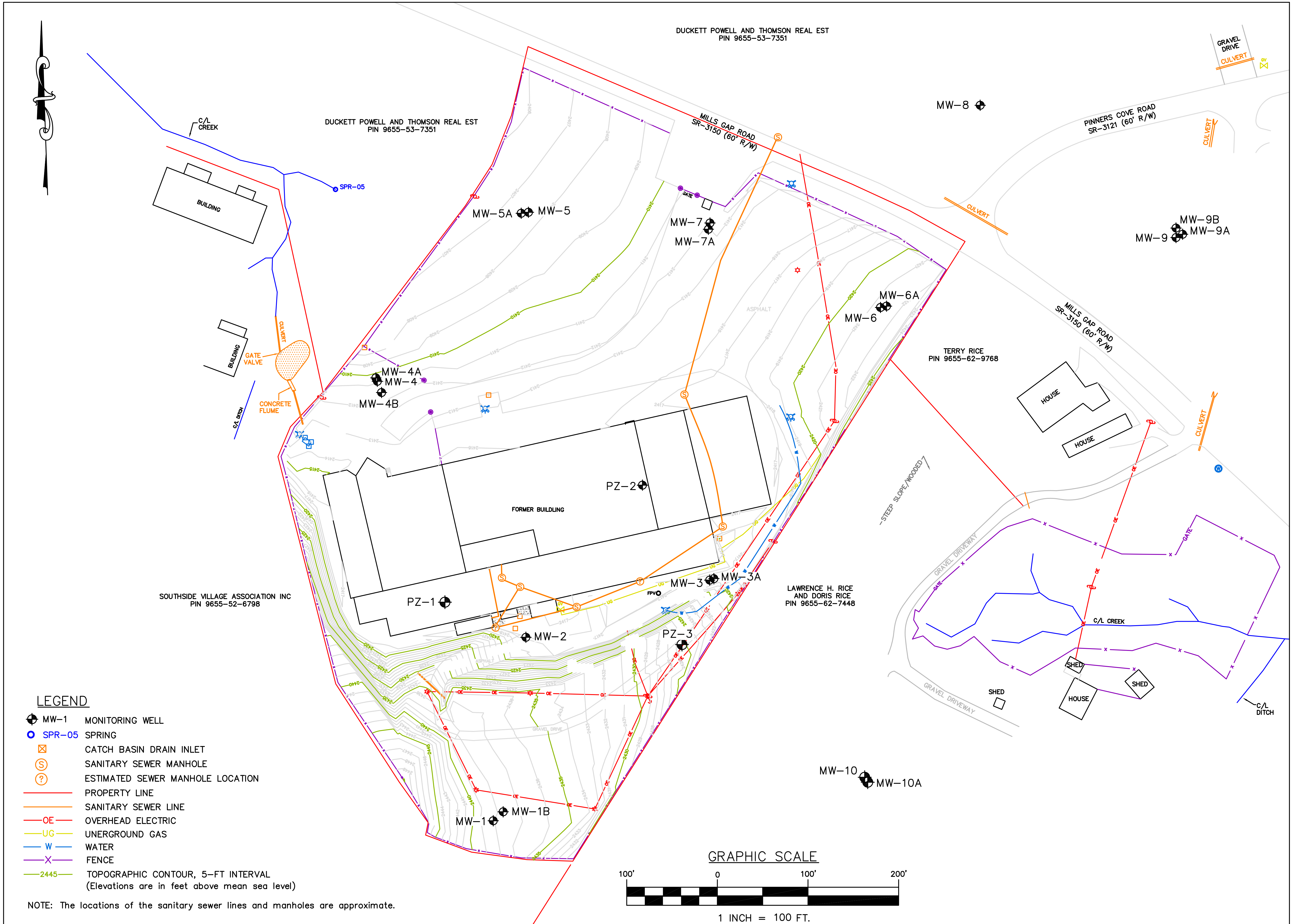
amec foster wheeler

CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

Site Map

Project 6252162012

Figure 2

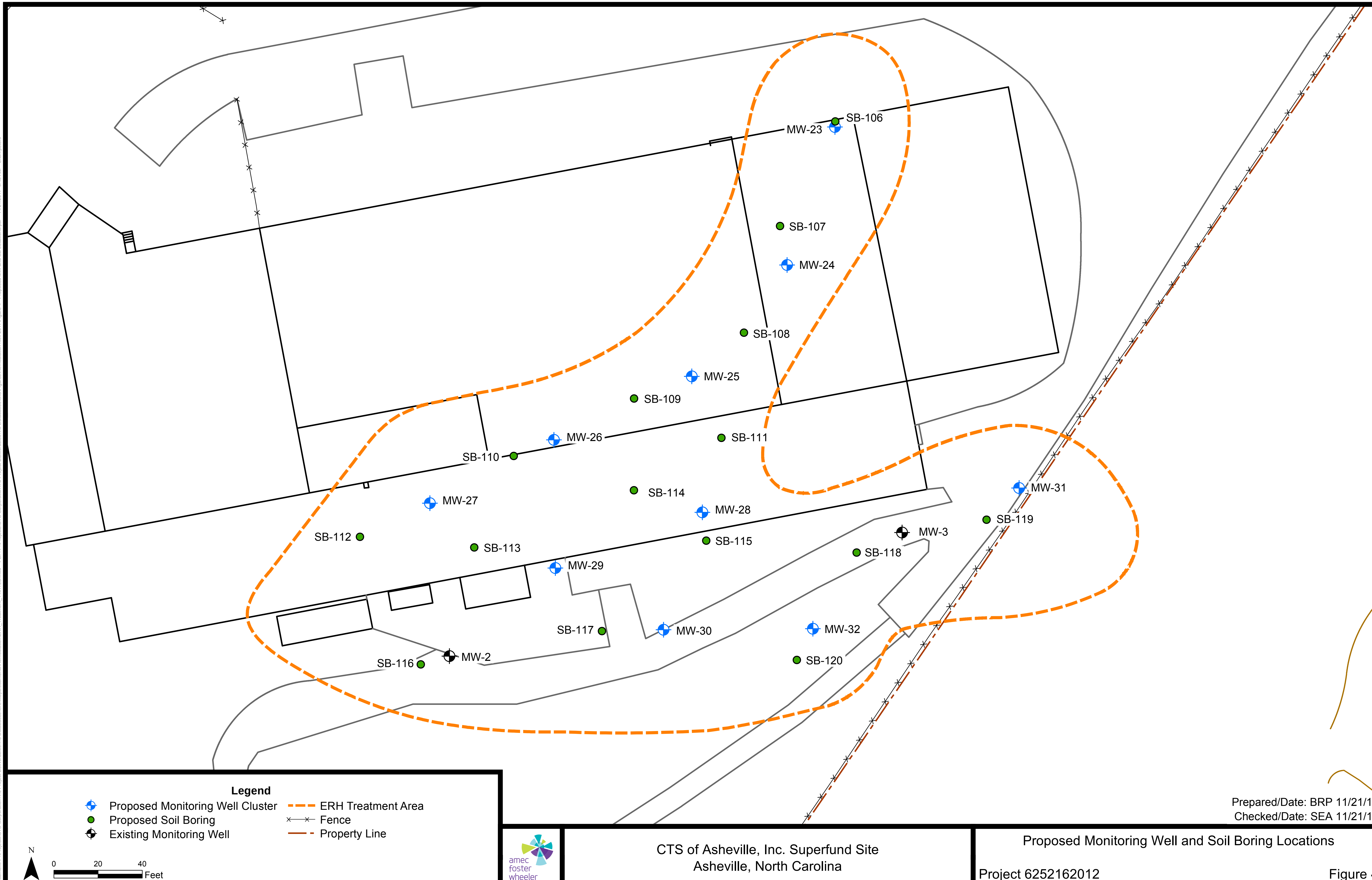


amec foster wheeler

SITE MAP WITH FEATURES
CTS OF ASHEVILLE, INC. SUPERFUND SITE
ASHEVILLE, NORTH CAROLINA

JOB: 6252-16-2012	FIG: 3
DATE: SEPTEMBER 2017	SCALE: 1"=100'
ENG CHECK: --	APPROVAL: MEW
DRAWN: SEA	DFT CHECK: MEW

REFERENCE: SURVEY PREPARED BY FREELAND & ASSOCIATES.



Prepared/Date: BRP 11/21/17
Checked/Date: SEA 11/21/17

CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

Proposed Monitoring Well and Soil Boring Locations

Project 6252162012

Figure 4

CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

Proposed Ambient Air Monitoring Locations

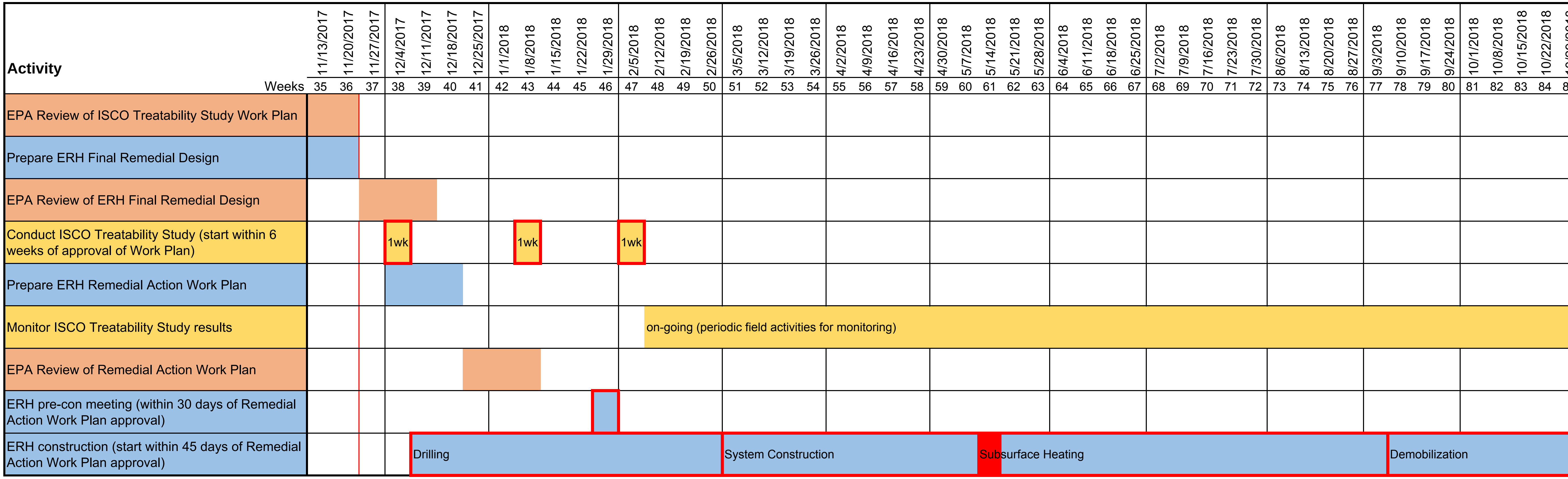
Project 6252162012

Figure 5

APPENDIX A

INTERIM REMEDIAL DESIGN/REMEDIAL ACTION SCHEDULE

CTS OF ASHEVILLE, INC. SUPERFUND SITE
SCHEDULE FOR INTERIM REMEDIAL DESIGN/REMEDIAL ACTION



Notes:

The schedule is based on indicated period for EPA approval or conditional approval of submittals without significant revisions, and is dependant on weather conditions and equipment availability, as applicable.

The project deliverable submittal dates shown above meet the stipulated schedules listed in the Consent Decree.

Schedule based on notice to proceed from EPA (approval of Coordinator and Contractor) received on March 20, 2017, and approval of Remedial Design and Pre-Design Investigation Work Plans on May 1, 2017.

Date indicates the beginning of the week (period of work).

ERH - Electrical Resistance Heating

ISCO - In Situ Chemical Oxidation

EPA document review and finalization period

Field activities/site visits are in red outline

APPENDIX B

SITE WIDE MONITORING PLAN

SITE WIDE MONITORING PLAN

CTS OF ASHEVILLE, INC. SUPERFUND SITE

235 Mills Gap Road
Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
Consent Decree – Civil Action No. 1:16-cv-380

Prepared for:

CTS Corporation
2375 Cabot Drive
Lisle, Illinois 60532

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
1308 Patton Avenue
Asheville, North Carolina 28806

Amec Foster Wheeler Project 6252-16-2012

November 27, 2017

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ACRONYMS

CD	Consent Decree
ERH	electrical resistance heating
FFS	Focused Feasibility Study
FSAP	Field Sampling and Analysis Plan
ISCO	in-situ chemical oxidation
LNAPL	light non-aqueous phase liquid
LRL	laboratory reporting limit
NAPL	non-aqueous phase liquid
QAPP	Quality Assurance Project Plan
RAO	remedial action objective
RAWP	Remedial Action Work Plan
RDWP	Remedial Design Work Plan
SWMP	Site Wide Monitoring Plan
TCE	trichloroethene (also, trichloroethylene)
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

DOCUMENT REVISION LOG

Revision	Date	Description
0	9/29/2017	Initial Issuance (with ERH Preliminary Remedial Design)
1	11/27/2017	Revised and submitted with ERH Final Remedial Design

1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) prepared this Site Wide Monitoring Plan (SWMP) for the CTS of Asheville, Inc. Superfund Site (Site) located at 235 Mills Gap Road in Asheville, Buncombe County, North Carolina (Figure 1). The activities described in this SWMP will be performed to comply with the Consent Decree for Interim Remedial Design/Remedial Action (CD) at the Site between the United States of America and CTS Corporation, Mills Gap Road Associates, and Northrop Grumman Systems Corporation.

1.1 SITE DESCRIPTION

The approximate center of the Site is located at north latitude 35°29'36" and west longitude 82°30'25". The Site formerly contained an approximate 95,000-square foot, single-story brick and metal structure on the southern portion of the Site. The building was demolished in December 2011 and the concrete building pad remains intact. The northeastern portion of the Site contains an asphalt-paved parking area, and asphalt-paved driveways are located parallel to the north (front) of the building pad and southeast (rear) of the building pad. A six-foot high chain-link fence surrounds the Site and a locked gate at the north end of the Site controls access to the Site from Mills Gap Road. The Site is unoccupied. The Site and adjacent property boundaries are illustrated on Figure 2.

1.2 BACKGROUND

A non-aqueous phase liquid (NAPL) investigation was conducted at the Site in 2013 and 2014. An approximate one-acre area containing light NAPL (LNAPL) with comingled trichloroethene (TCE) was identified (Amec, 2014). A Focused Feasibility Study (FFS) was conducted to evaluate potential remedial alternatives for the one-acre NAPL area. Electrical resistance heating ERH was chosen as the recommended alternative (Amec Foster Wheeler, 2015a). An additional approximate 0.2-acre area located adjacent and upgradient of the NAPL area where elevated TCE concentrations had been detected was added to the proposed treatment area.

An FFS Addendum was prepared to evaluate remedial options for an approximate 1.9-acre area located downgradient of the ERH treatment area where elevated TCE concentrations were identified (Amec Foster Wheeler, 2015b). The FFS Addendum proposed using in-situ chemical oxidation (ISCO) via emplaced potassium permanganate.

The United States Environmental Protection Agency (USEPA) approved ERH and ISCO as the recommended interim remedial alternatives in the two areas and memorialized the decision in the Interim Record of Decision in February 2016. The CD was entered into the United States District Court for the Western District of North Carolina on March 7, 2017. A Remedial Design Work Plan was submitted to USEPA on April 19, 2017, and approved by USEPA on May 1, 2017.

1.3 REMEDIAL ACTION OBJECTIVE

The remedial action objective (RAO) of the interim remedial action is a 95 percent reduction of TCE concentrations in subsurface media in the two identified remediation areas of the Site.

ERH will be implemented in the approximate 1.2-acre NAPL area of the Site. This area is generally considered the source area and, in addition to TCE, contains light non-aqueous phase liquid (LNAPL) from weathered fuel oil. In this area, TCE exists in three states: dissolved in groundwater, sorbed to soil, and partitioned in the petroleum LNAPL. The RAO of a 95 percent reduction of TCE will be applied to soil, groundwater and LNAPL samples in this 1.2-acre source area.

ISCO will be implemented in an approximate 1.9-acre area in the Northern Area of the Site where a dissolved-phase TCE plume is present. The majority of TCE is present dissolved in groundwater; therefore, the RAO of a 95 percent reduction of TCE will be applied to only groundwater samples in this Northern Area.

1.4 SITE WIDE MONITORING OBJECTIVES

The objectives of site-wide monitoring include:

- Collect baseline data regarding the extent of contamination in affected media in the interim remedial action area;

- Collect data through short- and long-term monitoring about the movement and changes in contamination throughout the Site before and after implementation of the interim remedial actions; and
- Collect data to determine if additional or modified data/monitoring is required.

This SWMP is focused on overall Site-wide monitoring activities. Performance monitoring that will be conducted for each of the interim remedial actions will be described in the respective remedial design documents. The objective of the interim remedial action performance monitoring is to determine when the RAOs for the respective treatment areas have been achieved.

2.0 MONITORING ACTIVITIES

Site-wide monitoring is intended to provide data to evaluate overall contaminant concentration trends in various impacted media over time; to evaluate the movement of contamination; and to determine if modified actions are required, such as increased/decreased monitoring locations or frequency of monitoring. Performance monitoring activities to determine if/when the RAO has been achieved is described in the ERH Final Remedial Design, dated September 29, 2017, and will be included in the ISCO Final Remedial Design.

The following media will be monitored as part of the Site Wide Monitoring Program:

- Groundwater
- Surface water
- Ambient air

2.1 GROUNDWATER

Site-wide groundwater monitoring will be conducted using monitoring wells located within and outside of the remediation areas. The Site Wide Monitoring Program will consist of baseline groundwater sampling and periodic sampling of select monitoring wells from the baseline sampling event.

Baseline groundwater samples will be collected from the following existing monitoring wells: MW-2, MW-3, MW-4, MW-4A, MW-5, MW-5A, MW-6, MW-6A, MW-7, MW-7A, MW-11, MW-11A, MW-16, MW-16A, MW-17, and MW-17A. A Bedrock Groundwater Monitoring Work Plan, dated September 27, 2017, also indicates that baseline groundwater sampling will be conducted twice before implementation of ERH remedial activities. The bedrock groundwater monitoring includes bedrock wells MW-1B, MW-4B, MW-9B, and MW-11B. One of the baseline bedrock groundwater monitoring events will be conducted with the site-wide baseline monitoring event.

It is anticipated that ten monitoring well pairs (one shallow and one deep at each location) will be installed in the ERH treatment area and at least three monitoring well pairs will be installed in the ISCO treatment area for performance of an ISCO treatability study prior to initiating ERH remediation. Baseline groundwater sampling for the Site Wide Monitoring

Program will also include three of the ERH treatment area monitoring well pairs and two of the ISCO treatability study monitoring well pairs.

Groundwater samples will be collected using low-flow purging/sampling and water quality parameters (pH, temperature, conductivity, dissolved oxygen, oxidation reduction potential, and turbidity) will be monitored during purging. Groundwater samples will be submitted for analysis of the following VOCs according to USEPA Method 8260:

- trichloroethene
- cis-1,2-dichloroethene
- trans-1,2-dichloroethene
- vinyl chloride

The Site Wide Monitoring Program will consist of the following monitoring wells and sampling frequencies beginning six months after the baseline sampling event is conducted, except for those wells in the ERH treatment area which are included in the performance monitoring plan conducted during treatment system operation:

Monitoring Well	General Location	Sampling Frequency
MW-1B	upgradient bedrock	semi-annual
MW-3	ERH treatment area overburden	semi-annual
MW-4B	downgradient bedrock	semi-annual
MW-5	downgradient overburden	semi-annual
MW-5A	downgradient overburden	semi-annual
MW-6	ISCO treatment area overburden	semi-annual
MW-6A	ISCO treatment area overburden	semi-annual
MW-7	ISCO treatment area overburden	semi-annual
MW-7A	ISCO treatment area overburden	semi-annual
MW-9B	cross-gradient bedrock	semi-annual
MW-11	downgradient overburden	annual
MW-11A	downgradient overburden	annual
MW-11B	downgradient bedrock	semi-annual
MW-17	downgradient overburden	annual
MW-17A	downgradient overburden	annual
3 well pairs to be installed in the ERH treatment area	ERH treatment area overburden	semi-annual
2 well pairs to be installed in the ISCO treatment area	ISCO treatment area overburden	semi-annual

The groundwater sample analyses results will be reported in a Level 4 data package, and full data validation will be conducted. Quality assurance/quality control (QA/QC) documentation and procedures are described in the Remedial Design Work Plan (RDWP) Quality Assurance Project Plan (QAPP).

2.2 SURFACE WATER

Surface water features are located east and west of the Site. Samples collected from both surface waters have indicated concentrations of VOCs associated with the Site. Surface water samples have been collected at various times in the past, and semi-annual surface water sampling began in October 2016 as requested by USEPA. Semi-annual surface water sampling will continue during the interim remedial actions as part of the Site Wide Monitoring Program.

Surface water samples will be submitted for analysis of the following VOCs according to USEPA Method 8260:

- trichloroethene
- cis-1,2-dichloroethene
- trans-1,2-dichloroethene
- vinyl chloride

Surface water sampling procedures will be included in the Remedial Action Work Plan (RAWP) Field Sampling and Analysis Plan (FSAP) and QA/QC procedures and documentation will be described in the RAWP QAPP.

2.3 AMBIENT AIR

Ambient air sampling/monitoring has been conducted in the vicinity of the Site since 2007. Quarterly ambient air samples are currently collected east and west of the Site in accordance with the Supplement to Vapor Intrusion Assessment Work Plan (Revision 4) Addendum #1, dated September 27, 2016 (VI Work Plan). Quarterly ambient air sampling will continue during the interim remedial actions as part of the Site Wide Monitoring Program in accordance with USEPA-approved procedures.

Ambient air sampling procedures are described in the VI Work Plan FSAP and Analysis Plan and QA/QC procedures and documentation will be described in the VI Work Plan QAPP.

2.4 DECONTAMINATION PROCEDURES

Decontamination of sampling equipment for groundwater sampling will be conducted in accordance with the RDWP FSAP.

2.5 MANAGEMENT OF INVESTIGATION DERIVED WASTE

Investigation derived waste will be managed in accordance with the RDWP FSAP. Purge water from will be accumulated and staged on the property from which it was generated. Purge water from MW-11B will be 'pumped' from the well to a 55-gallon drum staged within the fenced area on the adjacent property (the Remediation Easement Area).

If contaminants are not detected above the laboratory reporting limit (LRL), the purge water will be discharged to the ground surface at the Site property (235 Mills Gap Road). If contaminants are detected above the LRL, the purge water will remain containerized and characterized as non-hazardous or hazardous based on the reported concentrations and disposed of accordingly.

3.0 REPORTING AND SCHEDULE

Reporting for the ambient air and surface water sampling activities will continue to be included in the quarterly vapor intrusion monitoring reports in accordance with the VI Work Plan.

A Site Wide Groundwater Monitoring Report will be submitted to USEPA within 45 days of receipt of the groundwater analytical results for each site-wide monitoring event. The Report will include a description of field activities, a tabulation of analytical results, data validation results, and an evaluation of contaminant concentration trends.

4.0 REFERENCES

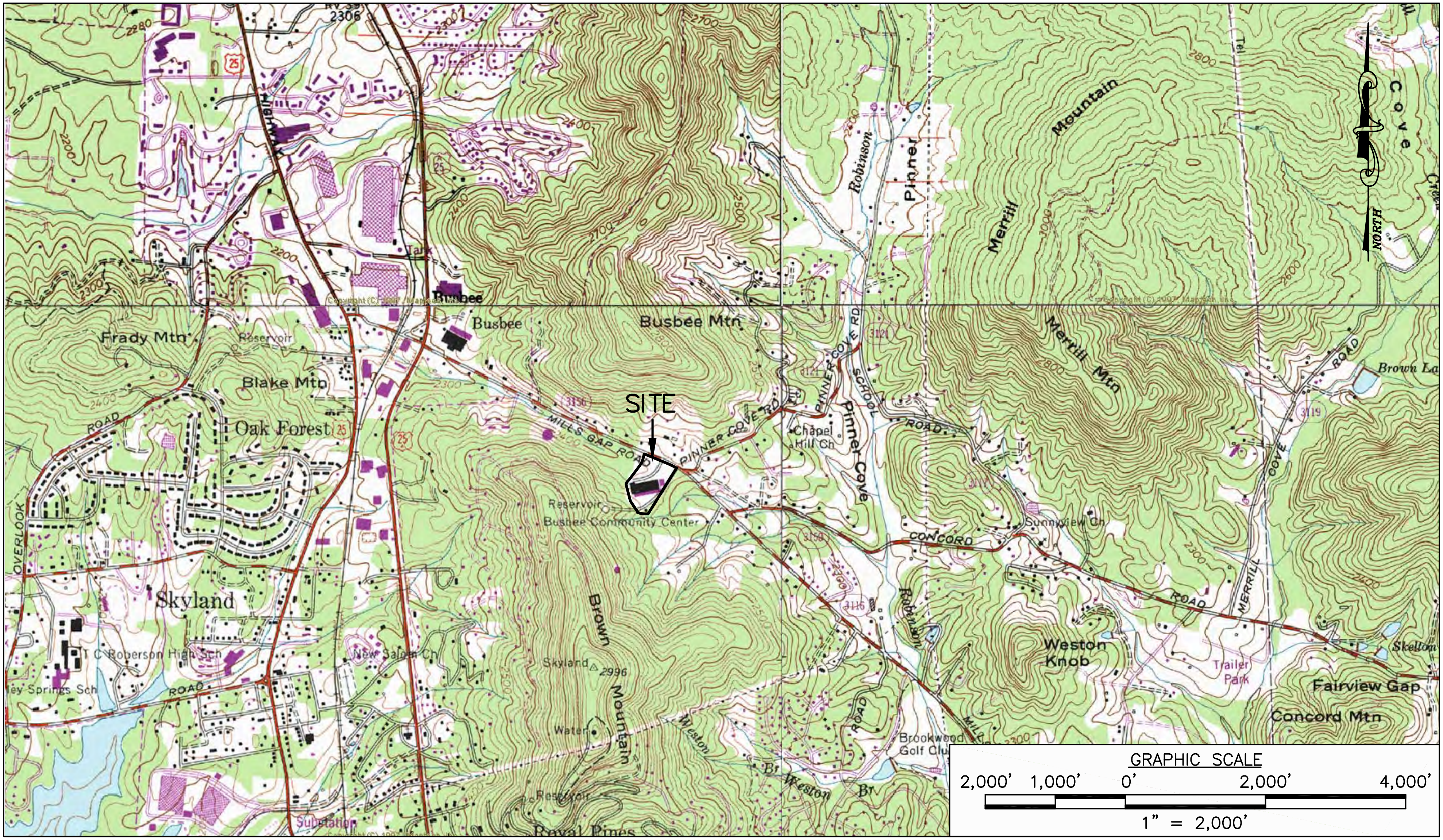
Amec Environment & Infrastructure, Inc., 2014. NAPL Investigation Report, CTS of Asheville, Inc. Superfund Site (May 5, 2014).

Amec Foster Wheeler, 2015a. Final NAPL Area Focused Feasibility Study Report, CTS of Asheville, Inc. Superfund Site, September 10, 2015.

Amec Foster Wheeler, 2015b. NAPL Area Focused Feasibility Study Report Addendum, CTS of Asheville, Inc. Superfund Site, November 25, 2015.

Amec Foster Wheeler, 2016. Supplement to Vapor Intrusion Assessment Work Plan (Revision 4) Addendum #1, CTS of Asheville, Inc. Superfund Site, September 27, 2016.

FIGURES



TOPOGRAPHIC SITE MAP
CTS OF ASHEVILLE, INC. SUPERFUND SITE
ASHEVILLE, NORTH CAROLINA

amec foster wheeler

DRAWN: SEK	ENG CHECK: --	DATE: APRIL 2017	PROJECT: 6252162012
DFT CHECK: MEW	APPROVAL: MEW	SCALE: 1" = 2,000'	FIGURE: 1

REFERENCE: USGS QUADRANGLES: ASHEVILLE (1961), OTEEN (1962), FRUITLAND (1978) AND SKYLAND (1978)

N

0 50 100 Feet

Legend

Spring — Fence — Property Line

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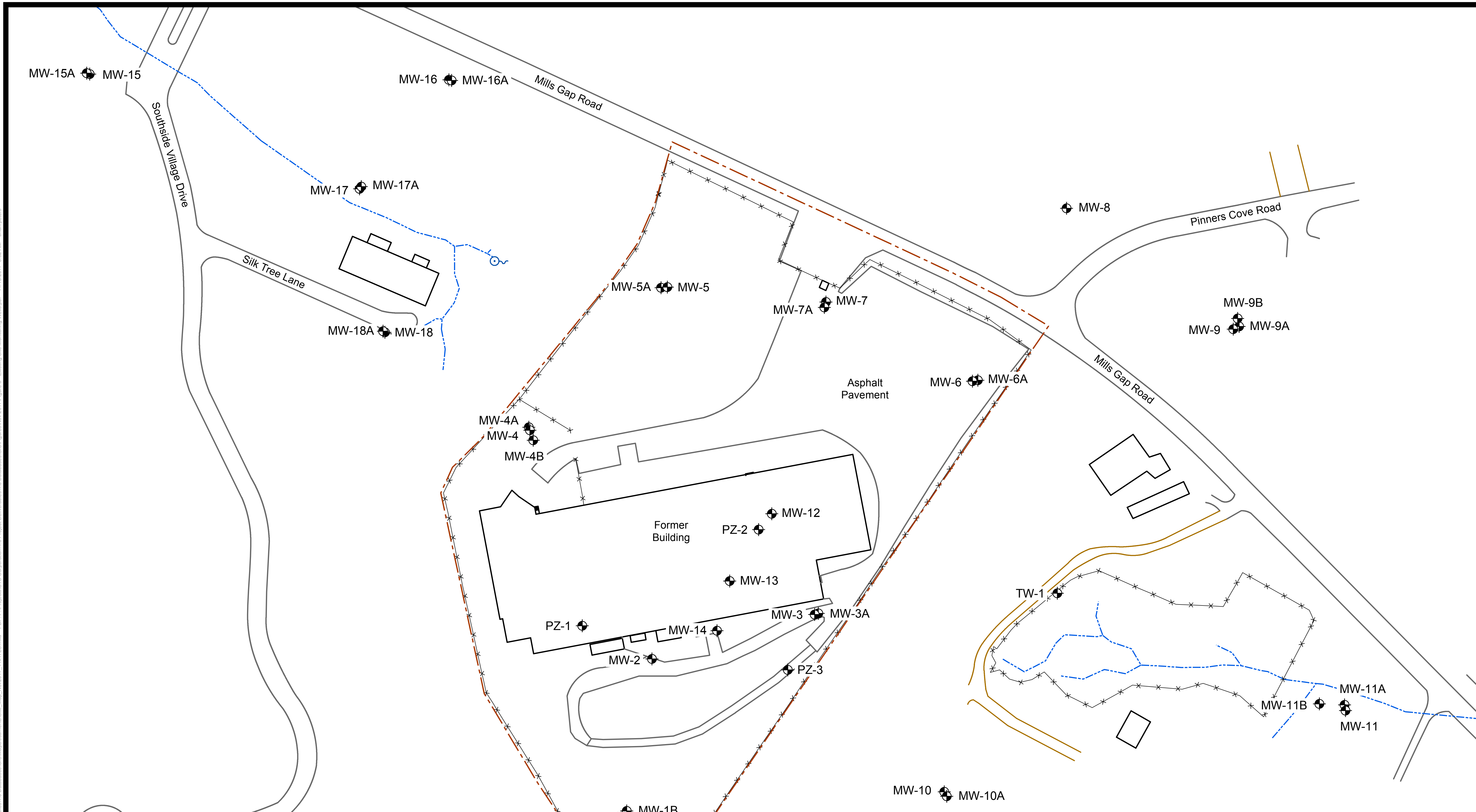
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

Site Map

Project 6252162012

Figure 2



Legend

Monitoring Well/Piezometer

Spring

Fence

Property Line

Notes:
1. MW-12, -13, and -14 are screened over the entire saturated zone.
2. Monitoring well MW-3A and piezometers PZ-1, PZ-2, and PZ-3 will be abandoned prior to initiating ERH remediation activities.

Prepared/Date: BRP 11/10/17
Checked/Date: SEA 11/10/17

amec foster wheeler

CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

Existing Site Monitoring Wells

Project 6252162012

Figure 3

APPENDIX C

FINAL DESIGN, EXECUTION, AND OPERATION & MAINTENANCE PLAN

TRS
Accelerating Value

Final Design, Execution, and Operation & Maintenance Plan Electrical Resistance Heating

CTS of Asheville, Inc. Superfund Site

Asheville, North Carolina

Issued: November 2017

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TABLE OF CONTENTS

List of Tables

List of Figures

Abbreviations and Acronyms

˚C	degree Celsius
CTS	CTS Corporation
ERH	electrical resistance heating
ft^2	square feet
ft bgs	feet below grade surface
ft/day	foot per day
ft/min	foot per minute
gpm	gallons per minute
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSA	hollow stem auger
kW	kilowatt
kWh	kilowatt hour
LGAC	liquid-phase granular activated carbon
NAPL	non-aqueous phase liquid
O&M	Operation and Maintenance
OMP	Operation and Maintenance Plan
OWS	oil water separator
PCU	Power Control Unit
PID	photoionization detector
PLC	Programmable Logic Controller
PM	Project Manager
RTD	resistance temperature detector
RTO	regenerative thermal oxidizer
Scfm	standard cubic feet per minute
Site	CTS of Asheville Superfund Site
TCE	trichloroethylene
TMP	temperature monitoring point
TRS	TRS Group, Inc.
µg/l	micrograms per liter
yd^3	cubic yard
VAC	volts alternating current
VGAC	vapor-phase granular activated carbon
VOCs	volatile organic compounds
VR	vapor recovery

1.0 INTRODUCTION

TRS Group, Inc. (TRS) has been contracted by CTS Corporation (CTS) to perform electrical resistance heating (ERH) at the Former CTS of Asheville, Inc. facility in Asheville, North Carolina. ERH is an *in situ* thermal remediation process for the treatment of volatile organic compounds (VOCs) in soil and groundwater.

This Final Design, Execution, and Operation & Maintenance Plan (Execution Plan) outlines the technical processes and monitoring planned for the operation and maintenance (O&M) of the ERH treatment system at the Site. The ERH treatment system is intended to operate at the site for 120 days. During this period, this Execution Plan may be revised, as necessary, to meet changes in design, permit, or Site conditions. Any revisions to the Execution Plan will be documented and tracked by TRS at the Site.

This Execution Plan will be used in conjunction with the Remedial Action Work Plan to be submitted under separate cover by Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), and numerous confidential internal TRS checklists and equipment O&M manuals.

2.0 SITE DESCRIPTION

The CTS of Asheville Site is located at 235 Mills Gap Road in Asheville, North Carolina. The Site formerly contained an approximate 95,000-square foot building on the southern portion of the Site. The building was demolished in December 2011 and the concrete building slab remains intact. The northeastern portion of the Site contains an asphalt-paved parking area and asphalt-paved driveways are located parallel to the north (front) of the former building and southeast (rear) of the former building. A six-foot high chain-link fence surrounds the Site and a locked gate controls access to the Site from Mills Gap Road. The Site is unoccupied, and is shown in **Figure Y-1**.

The Site was generally used for manufacturing operations from the 1950s to 1980s. Soil and groundwater contamination was identified at the Site in the early 2000s. Investigations identified the presence of chlorinated volatile organic compounds (VOCs), the large majority of which is trichloroethene (TCE) and petroleum constituents, which are believed to be primarily from weathered fuel oil. A soil vapor extraction system operated at the Site from 2006 to 2010, and approximately 6,500 pounds of VOCs were removed. Confirmation soil sampling has determined that the vadose zone has been successfully remediated to an acceptable degree at this time.

The area surrounding the Site is considered rural and contains residential and light commercial properties. The Site is situated on a topographic “saddle” between two prominent mountains. Properties northwest and southeast are topographically downgradient of the Site. The majority of the Site is relatively flat and natural surface drainage at the Site is to the northwest.
The Site is located in the Blue Ridge Physiographic Province, which is characterized by mountainous terrain, relatively high precipitation and a dense network of perennial streams. The Site is underlain by metasedimentary and metavolcanic rocks of the Ashe Metamorphic Suite,

including schistose metagraywacke, mica schist, and metagraywacke. The overburden (i.e., above bedrock) in the ERH treatment area consists of saprolite formed by the in-place weathering of the bedrock. The soil profile is generally silty sand to sand with little silt with depth. Quartz-rich veins/zones have been identified at the Site at various locations and depths. The depth to bedrock in the ERH treatment area ranges from 28 feet at MW-2 (elevation of 2,388 feet) to 60 feet at LIF boring 68 (elevation of 2,357 feet).

Groundwater generally flows radially to the north and east in the ERH treatment area. Based on depth to groundwater measurements during a period of high precipitation/recharge, the depth to groundwater generally ranged from approximately 7 feet below ground surface (bgs) to 20 bgs in the treatment area. In January 2015, the horizontal hydraulic gradient in the shallow overburden in the ERH
treatment area was approximately 0.03 and the horizontal hydraulic gradient in the deep saprolite (partially weathered rock zone) was approximately 0.02. The pH of groundwater in the treatment area is generally between 5 and 6.

3.0 SITE SPECIFIC DESIGN

The goal of the ERH remediation is to reduce trichloroethylene (TCE) in groundwater, saturated soil and NAPL by 95% compared to baseline concentrations. Based on the data provided by Amec Foster Wheeler and CTS, TRS has modeled the ERH remediation at the Site and the requirements to reach the designated remedial goals. The key design parameters are included below. TRS estimates that 8,250,000 kilowatt hours (kWh) of electrical energy will be applied to the subsurface to achieve the established remedial goals. The time required to apply this amount of energy to the subsurface is estimated to be 120 days.

The primary contaminant of concern is TCE, the important physical data for TCE are provided in **Table 1**.

Table 1. Boiling Point and Vapor Pressure of TCE

Chemical Name	Boiling Point (°C)	Vapor Pressure (atm at 100°C)
Trichloroethylene	87	1.45

A significant portion of the design is establishing the subsurface physical conditions. The key Site physical conditions used to establish design and operational parameters are summarized in **Table 2**.

Table 2. Key ERH System Parameters

ERH System Parameter	Value
Treatment Area	56,062 ft^2
Treatment Volume	47,200 yd^3
Depth of Treatment (average)	Top of water table to auger refusal during drilling(1)
Estimated Energy	8,250,000 kWh
Auxiliary Equipment Energy	260,000 kWh
Air and Vapor Recovery Flow Rate	1,464 cu ft/min
Condensate Recovery Rate	9 gpm

Notes:

(1) Treatment will occur to the variable depths as shown on Figure 1.

Key components of the design are described in the following subsections.

3.1. ERH Remediation Region

The ERH remediation region is 56,062 square feet (ft^2). The depths of treatment will extend from the top of the water table to auger refusal during drilling. The treatment volume is approximately 47,200 cubic yards (yd^3). The locations of all below grade components of the ERH system are illustrated in **Figure Y-1,** including; electrodes, vapor recovery wells, temperature monitoring points, groundwater monitoring wells and soil sample locations.

3.2. ERH System Components

The ERH system consists of the primary components listed in **Table 3** (also presented in **Figure Y-1**) and are further described in the sections below.

Table 3. ERH System Primary Components

System Component	Quantity
Vertical Electrodes	186
Angled Electrodes	43
Vapor Recovery Wells	229
Independent Vapor Recovery Wells	2
Temperature Monitoring Points (TMPs) within Treatment Region	18
Power Control Units (PCUs)	2
Steam Condensers	2
Vapor Recovery Blowers	2
Liquid Treatment System	1
Vapor Treatment System	1

3.3. Electrodes

The ERH system will have 229 electrodes at the Site set at varying depths installed by hollow stem auger (HSA) drilling equipment. Each electrode will be installed to refusal and constructed up to the top of the water table at that location. Depending on the length of the electrode, some will be split into two elements based on data collected during installation. Some electrodes will be installed at a range of angles from vertical to facilitate installation across topographic variations. A cross-section of the vertical and angled electrode designs are illustrated on **Figures M-1 through M-2**.

There is an overhead power line along the eastern property line that limits access of the drill rig for these locations. To manage this, drilling in the path of the temporary overhead power lines must be completed first to allow the temporary lines to be installed. The anticipated subsurface drilling order is provided in **Figure Y-2**.

3.4. Vapor Recovery Wells

Vapors consisting of air, VOCs, and steam will be collected from vapor recovery (VR) wells co-located with each electrode. The depth of the VR wells will vary depending on the depth to water at each location. Each screen will be three feet long, one inch diameter and have a 0.020-inch slotting. Each VR wells will have a control valve and be connected to the common collection header system prior to treatment. A cross-section of the co-located electrodes and VR well designs are illustrated on **Figures M-1 through M-2**.

There will be two independent VR wells installed above the heated zone on the adjacent eastern property. The wells will be the same construction as the co-located VR wells with a three-foot-long, one inch screen and 0.020-inch slotting set in a ten-foot sand pack. These VR wells will be positioned above the eastern edge of the heated zone to capture the furthest extent of heating due to the angled electrode and VR installation approach. The final installation approach for these two wells will be determined by the project team in consultation with the drilling subcontractor.

Due to the change in topography and angle of installation, these will either need to be installed vertically and trenched back to the CTS property or installed at a high angle to achieve the desired locations.

All VR wells will be connected to a header system that is routed to the two steam condensers. The layout will facilitate drill rig access for interim and final soil sampling activities.

The VR headers will have vacuum switches on each leg that will continuously monitor vacuum at the furthest extent of each system. If vacuum drops below the setpoint the electrodes will be de-energized to prevent heating without vapor recovery. These switches aid in the detection of piping failure or water traps that can form throughout the system.

3.5. Temperature Monitoring Points

As a means of monitoring the ERH process, TRS equipment will be able to provide continuous temperature data monitoring within the subsurface. Temperature data will be automatically recorded at least once per day from the 18 temperature monitoring points (TMP) locations within the ERH treatment region. Each TMP casing will consist of a sealed copper pipe between 1 and 1 1/2 inches in diameter and set in neat Portland cement. Each TMP will include a string of resistance temperature detectors (RTD) that will monitor subsurface temperatures at five-foot intervals. The deepest RTD depth will be one foot shallower than the shallowest of the surrounding three electrodes. A cross-section of the TMP designs are illustrated in **Figure M-3** and the above grade routing provided in **Figure Y-5**.

3.6. Power Control Units

TRS will mobilize two power control units (PCU) to the Site, one 4,500 kVA and the other 1,475 kVA, place on level ground, and connect to a temporary utility electrical service. A PCU is a variable voltage transformer system capable of providing three simultaneous power outputs at automatically adjustable levels of 130 to 860 volts. The PCUs are housed in weather-tight steel enclosures that provide security and electrical isolation. The PCUs are designed for 100 percent cycle duty. During ERH operation, the primary voltage is adjusted to the appropriate level for optimum subsurface heating. As the subsurface is heated, the PCUs will be adjusted to meet the changing Site subsurface conditions and maintain optimum voltage input throughout remediation.

PCU control and data acquisition are performed on a dedicated computer using professional industrial automation software. Remote data acquisition software is used to collect and store subsurface temperatures, power, voltage, amperage, and operational status data for the ERH system. Off-site project personnel are able to view and download this information in real-time using a high-speed internet connection. The locations of the PCUs and all other surface equipment are illustrated on **Figure Y-1**. The electrical one line for the system is provided in **Figure E-1**.

3.7. Steam Condensers

As the subsurface treatment volume is heated, VOCs will be volatilized and swept from the treatment volume soil and groundwater by steam generation. Air, VOC vapors, and steam will be collected from the electrodes and VR wells, which are located throughout the ERH treatment region. The electrodes and VR wells are designed to facilitate the recovery of air, VOC vapors, and steam from the subsurface. Two 40 horsepower rotary lobe vacuum blowers will provide the vacuum and airflow necessary to recover these media from the subsurface and to move them through the vapor treatment system. Each blower is rated for 900 standard cubic feet per minute (scfm) at 4 inches of Mercury and are sized to maximize the efficiency of the vapor treatment system.

Once the air, VOC vapors, and steam are collected, they are transported through the VR piping conveyance system to an ERH steam condenser. At the ERH steam condenser, steam is condensed to condensate water, while VOC vapors remain in the air stream and are routed through the condenser.

TRS will use two steam condenser units at the Site. Each steam condenser is equipped with two cooling towers. The components of the ERH steam condensers are housed in weather-tight, steel enclosures that provide security and soundproofing.

The condenser system consists of an inlet air/water separation vessel, a plate and frame heat exchanger, a condensate tank, a cooling tower, outlet air/water separation system, and ancillary pumps and controls. The vapor inlets and outlets of the condensers contain a mist eliminator that is 99 percent efficient in removing droplets to a size of 10 microns. The process flow and instrumentation diagrams for the ERH system is illustrated in **Figures P-1 through P-6**.

3.8. Liquid Treatment System

Condensate and any potential entrained groundwater will be collected and metered in the condenser. Liquid will be pumped to a weir tank that acts as an oil/water separator (OWS) to separate out any recovered NAPL from the liquid stream. The water will be pumped to treatment system consisting of an air stripper and dual liquid granular activated carbon (LGAC) vessels prior to discharge to the municipal sewer on demand. The final liquid treatment system will be designed as needed to meet the requirements of the local municipal sewer provider for discharge. The NAPL stream will be pumped to a tank for characterization and disposal by Amec Foster Wheeler.

There will be five secondary containment basins for the primary liquid treatment components to containerize any waste in the unlikely event of an uncontrolled release. There will be a basin under each condenser, the weir tank, the caustic soda tank and the RTO scrubber which will also hold the LGAC vessels. Each basin will be fitted with a level switch that will remotely alert project personnel of an exceedance of a high level inside each basin.

3.9. Vapor Treatment System

Prior to discharge to the atmosphere through a stack, VOC vapors are treated using a local vapor treatment system. The vapor treatment system includes a regenerative thermal oxidizer (RTO) with gas scrubber that will be fueled by natural gas. The RTO reduces VOC concentrations by 99% and the gas scrubber removes residual compounds remaining after incineration. The RTO can handle a large range of concentrations and contaminants at a flow rate sufficient to control vapors being produced by the ERH system. In the event of an alarm condition, the RTO will shut down and immediately remove power from the electrodes stopping the boiling of the subsurface and volatilization of the VOCs.

After the period of peak VOC removal has passed, the system may change over to a vapor phase granular activated carbon (VGAC) treatment system if the criteria of the vapor stream allows. The treatment train would be two 3,000 lbs VGAC vessels placed in series with a flow capacity of over 3,000 scfm. The change over to VGAC would only occur in the event the mass removal decreased well below the assumed peak extraction very early during the remediation. The decision to change over would be a project team decision based on data collected from the field.

The process and instrumentation diagrams for the blowers, RTO and liquid treatment systems are provide in **Figures P-7A through P-7C**.

3.10. System Interlocks

The ERH system will have interlocks that shut off each piece of equipment in the event of a malfunction. Under all fault conditions the electrodes are de-energized to prevent the production of VOCs without vapor recovery. In addition to the function interlocks within each unit, there will be vacuum switches installed in the vapor recovery piping that will de-energize the electrodes in the event of vacuum loss. All doors on electrical components will have door switches, locks or preventative mechanics to prevent un-authorized entry. The connection between the equipment is illustrated on the process and instrumentation diagrams in **Figures P-1 through P-8**.

The two condensers will have a cross over valve that will open in the event either unit needs maintenance or has an alarm condition. The electrodes will de-energize in this scenario to prevent overloading the single remaining condenser. This approach will minimize vapor recovery system downtime.

4.0 ERH SYSTEM START-UP AND OPERATIONS

ERH system start-up will involve the inspection, testing, and adjustment of all ERH system components, process equipment and controls.

4.1. Pre-Start-Up Activities

Prior to ERH system start-up, a final quality assurance inspection of all piping and electrical connections will be made. Quality assurance inspections and testing will be completed on the electrode cable connections, TMP field box connections, PCU, condenser components, liquid and vapor treatment systems, and interlock connections. All tanks will be visibly inspected for weld cracks or breaks, scrapes of protective coating, corrosion, and structural damage. The ERH condenser and VR system will be inspected and made operational in accordance with TRS internal operations and maintenance manuals.

4.2. Start-Up

The ERH system start-up period will span approximately two weeks. Actual time required for the entire start-up phase may be longer or shorter dependent upon actual field conditions encountered. The first phase of remediation will consist of vapor recovery and treatment system operations without subsurface power application. Before a voltage is first applied to the subsurface, the ERH condenser and vapor recovery system will be verified operational and optimized. All pressure, temperature, flow, and remote monitoring equipment will be verified for correct operation. Alarm and interlock functionality will also be confirmed. The data recording and management systems and communication protocols will be tested and refined. In the field, system capacity will be established and system controls will be verified. The start-up period will also include the training of Site workers.

ERH start-up will be initiated by energizing the electrodes at the lowest applied voltage possible. With the electrode field energized, operating parameters in the PCU will be compared against known standards, and step-and-touch, touch-and-touch, and step-and-step voltage surveys will be completed throughout the area overlying and surrounding the treatment zone (see Section 4.3). Initial power application and voltage survey protocols will be performed consistent with TRS' internal Standard Operating Procedures (SOPs) 1.2 (Application of Electrical Power to ERH sites) and 1.3 (Voltage Surveys), respectively. These SOPs are included in a separate binder and maintained at the Site in the PCU.

If all operating conditions are within accepted standards as outlined in design documents and TRS SOPs, the voltage to the electrode field will be slowly increased. With each significant increase in applied voltage, operating parameters will be reviewed and step-and-touch and step-and-step voltage surveys (**Section 4.3**) will be performed again. If operating conditions are not within accepted limits, changes will be made to the system configuration until they are once again acceptable. This iterative process can take several days before the full design voltage is applied to the field.

Once power application levels have reached optimum design conditions, final safety inspections and data quality checks will be completed. The internal TRS Start-up Safety Checklist will be completed by TRS Site personnel and reviewed and approved by TRS senior management to establish that the system is ready for unattended operations. System interlocks will be re-verified at this time for correct operation. During this process, operation of the PCUs will be observed while optimum voltage is applied to the electrode field. Remote capabilities of the PCU and data acquisition system will also be verified.

4.3. Voltage Surveys

To ensure the safe application of electrical energy to treat subsurface soils, TRS will perform voltage safety surveys initially, and as applied voltage is increased. These surveys are referred to as "step-and-touch", "step-and-step" and "touch-and-touch" voltage surveys. The purpose of these voltage safety surveys is to identify the location(s) of possible voltage effects on or directly adjacent to an operating ERH site. In recording step-and-touch potentials, additional readings will be measured at locations and on objects that could possibly conduct electrical current.

The electrical safety policy limit for exposed voltage on this ERH site is:

- Restricted/No Public Access: 10-volt step-and-touch, extension cords not permitted, no extension cord survey;

- Equipment Compound/Restricted Access: 10-volt step-and-touch, 10-volt extension cord survey within the compound; and

- Public Access Area 5-volt step-and-touch, 10-volt extension cord survey.

No voltage potentials greater than these limits will be permitted outside of any ERH exclusion zone during operations. If voltage potentials are detected above these limits, actions will be taken to remove or isolate the problem location(s).

TRS will perform the initial voltage survey with the treatment area on the CTS Site and the adjacent (within 50 feet of electrodes) property to the east. Once an initial baseline is established at the lowest applied voltage, impacts on induced voltage can be estimated with increases in applied voltage. If a contact voltage is detected during the baseline monitoring event in excess of the TRS electrical safety policy limits, mitigation efforts will be performed in that area. Once mitigation efforts are confirmed effective, baseline monitoring will continue. If all measurements are within the TRS electrical safety policy limits, subsequent tests will be performed during normal working hours while the space is occupied.

4.4. ERH System Operations

Once the internal TRS Safety Start-up Checklist has been completed and approved by TRS senior management, the Site is cleared for unattended operations and the system can be monitored and controlled remotely by operations staff. Routine Site visits will be conducted daily (Monday through Friday) to perform Site checks, equipment maintenance, system optimization tasks, scheduled measurements, and sampling activities. Typical site visits are conducted between the hours of 7:00 am and 5:00 pm. As necessary, unscheduled site visits will be made as a response to variances in operating parameters and system alarms. The anticipated response time for an operator during an unscheduled site visit is approximately 1 hour.

During the heat up period, operational parameters such as power input, subsurface temperatures, condensate production, and VOC concentrations in the process vapors will be measured. These data will be used to assess the efficiency of the ERH system and allow TRS personnel to target specific areas of the Site and optimize the efficiency of the system. Periodically, electrodes, electrode zones, or system operations will be reconfigured to focus the amount and location of energy input to the subsurface. These changes will be determined by TRS personnel based on review of operational data collected and analyzed throughout operations.

It should be noted that parameter monitoring described in this Execution Plan is variable. TRS will determine actual operating parameters based on real-time data collected during operations. Operational decisions will be determined to optimize the efficiency of the ERH system while maintaining the highest regard for safety. The electrodes, piping, and system equipment have been designed to allow flexibility of system operations. Summaries of typical system adjustments that will be performed are provided below:

- Vapor Capture: Vapor recovery wells and treatment zone header pipes are fitted with valves that will allow flow adjustments. Total flow at each condenser and subsurface temperature data will be evaluated to make valve adjustments that will optimize vapor capture and minimize potential migration.

- Electrode Performance: Subsurface heat-up rates, electrical measurements, temperature monitoring data, and general lithology data will be used to evaluate electrode performance. Adjustments to applied voltage at the respective step-down transformer and the possible addition of drip water will be used, as necessary to enhance performance.

The operational period of the ERH treatment system will continue until cleanup goals have been met.

4.5. ERH System Operation Safety Controls

There are certain hazards associated with ERH during the *in situ* heating of soil and groundwater. These hazards include possible contact with hazardous voltage, steam, hot water, or hazardous Site chemicals. Exposure to these hazards can be mitigated through engineering controls and strict adherence to documented procedures and safety protocols. All operation and maintenance activities will be conducted in accordance with the Site Health and Safety Plan (HASP) (**Appendix A**). Examples of safety restrictions include:

- Only trained, authorized personnel shall enter an ERH restricted area to complete project tasking. If an ERH exclusion zone is created due to high voltage potential readings, no personnel shall be permitted in this area during operations without authorization from the TRS Project Manager (PM). Refer to the HASP for more information (**Appendix A**).

- At no time will a 110/120 volt extension cord from a line source be used in an energized electrode field. An alternative power source such as a 12-volt automotive battery or portable generator must be used.

- Outdoor work will cease in the event of an electrical storm. Personnel will seek shelter in a metal building or enclosure if the potential for lightning strikes exist.

- No drilling or digging shall occur within 50 feet of any operating electrodes without written approval by TRS. Signs will be posted around the perimeter of the Site.

4.5.1. Power Control Units

Each PCU is equipped with an E-Stop button on the outside of the PCU next to the main office entrance of the PCU. Two additional E-stop buttons will be installed at the Site. These E-stops will be located near the main fence gate entrance to the property and in the southern area of the electrode field. Note: E-stop buttons only turn power off to the electrode field and does not affect the vapor recovery equipment. If needed, TRS personnel can remotely power down vapor recovery equipment or use local disconnects at equipment control boxes.

4.5.2. Electrodes

Each electrode will be connected to single phase alternating current power. This makes them both electrically and thermally conductive. Each location will have an above grade electrode head that is the central connection to the power supply, vapor recovery point and drip point (if needed).

4.5.3. VR Blowers

Blower operations, inspections and operational monitoring will be in accordance with TRS' internal Operations and Maintenance manual for blowers (maintained onsite in the PCU).

Automated VR blower functions are monitored, controlled, and recorded by the PCU computer. The VR blower is safety interlocked to the PCU to stop the application of electrical energy to the subsurface should it cease to operate for any reason.

The blowers are housed in a weather-tight steel enclosure that provides security and noise insulation. When working on or around the blowers, personnel will be made aware of specific hazards which may include:

- Electrical hazards: There are two separate power supplies connected to each blower; one for the main blower control power which is 3-phase, 480 volts alternating current (VAC) and a separate 120VAC power supply for controls and interlocks. Always remove power and lock out power to the blower when working on electrical devices. All TRS field personnel working within equipment panels shall be trained to a level of competent person and have completed Arc Flash safety training in accordance with National Fire Protection Association (NFPA) 70E. Be aware that interlock electrical energy is likely provided from a different piece of equipment, such as the PCU.

- Moving Parts: The motor and associated belts used to move air through the blower are covered by a protective shroud, however, lock out and tag out procedures should be followed when performing maintenance on the fan or its motor. Maintenance is the most reliable method of minimizing repairs to a blower. Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

4.5.4. Steam Condensers

Steam condenser operations, inspections and operational monitoring will be in accordance with TRS' internal Condenser O&M manual. The components of the condensers are housed in weather-tight, galvanized steel enclosures that provide security and soundproofing. The condensers are interlocked to the PCU to stop energy application to the subsurface should they cease to operate for any reason. When working around the condensers, personnel will be made aware of additional condenser specific hazards which may include:

- Electrical hazards: The main condenser control power is 480VAC (3-Phase). Always remove power and lock out power to the condenser when working on electrical devices. All TRS field personnel working within equipment panels shall be trained to a level of competent person and have completed Arc Flash safety training in accordance with NFPA 70E.

- Steam & Heat hazards: During operation of the condenser, steam and vapor at elevated temperatures are continually being processed by the condensers and will elevate the temperature of condenser process components. Be especially aware of the knock-out pots, the heat exchanger, and any vapor stream piping.

- Pressurized Water/Piping hazards: The circulation piping used to cool the vapor stream and the drip system piping used for electrode wetting is often under pressure and may become a hazard if ruptured. Watch for leaks and any sign of piping fatigue when working in the condenser and repair promptly when discovered.

- Slips and Trips: The complex network of piping contained in each condenser creates potential slip and trip hazards. Always move cautiously in and around the condenser and be aware of slick and unstable surfaces. When inside the condenser building use the internal walkways to access internal components.

4.5.5. Regenerative Thermal Oxidizer with Gas Scrubber

RTO operations, inspections and operational monitoring will be in accordance with TRS' internal O&M manual. The RTO is interlocked to the PCU to stop energy application to the subsurface should it cease to operate for any reason. When working around the condensers, personnel will be made aware of additional RTO specific hazards which may include:

- Electrical hazards: The main RTO control power is 480VAC (3-Phase). Always remove power and lock out power to the RTO when working on electrical devices. All TRS field personnel working within equipment panels shall be trained to a level of competent person and have completed Arc Flash safety training in accordance with NFPA 70E.

- Steam & Heat hazards: During operation of the RTO, vapor at elevated temperatures are continually being processed by the unit. Be especially aware of the hot vapor piping and exterior surface of the unit.

- Pressurized Water/Piping hazards: The natural gas and caustic soda piping is under pressure and may become a hazard if ruptured. Watch for leaks and any sign of piping fatigue when working at the RTO and repair promptly when discovered.

- Chemical Hazards: Elevated concentrations of VOCs are anticipated in the vapor stream and the caustic soda storage tank and transfer piping. All workers shall be aware of personal protective equipment and air monitoring requirements whenever working in these areas.

5.0INSPECTIONS AND MAINTENANCE

TRS will perform regularly scheduled inspections and maintenance on all equipment items for the duration of ERH treatment, consistent with the TRS process equipment O&M manuals and manufacturer's recommendations. Data gathered during system monitoring, including visual inspections, may also indicate that additional maintenance will be required. Each maintenance event will be recorded in daily activity report and noted in the specific equipment's lifetime maintenance log (kept on file on TRS' private server). The log will include: the date the maintenance was performed, the task, parts replaced, future recommendations, and who performed the task.

5.1. Inspections

Routine inspections by qualified personnel are an important component of TRS ERH treatment system operations. Any concerns identified during inspections will be brought to the attention of the TRS PM and an appropriate course of action, including repairs, shall be completed as soon as possible.

5.1.1. Daily Inspections

On a daily basis, personnel will confirm electronic data collection is occurring according to design. Based on available data, personnel will also make any necessary changes to power application, vapor recovery, and liquid pumping functions. Daily inspections include completing visual inspection of the ERH treatment system equipment.

5.1.2. Weekly Inspections

Personnel will complete a weekly work site inspection. During the weekly visual inspections, personnel will also check the warning placards located around the site perimeter. The "Danger High Voltage Do Not Dig or Drill" signs will be posted every 50 feet along the perimeter fence. Any missing signage shall be replaced.

5.1.3. Monthly Inspections

Monthly inspections will include testing safety interlocks of the security alarm system and routine inspections of the ERH treatment system equipment.

5.2. Condensers and Cooling Towers

Condenser and cooling tower operations, inspections and operational monitoring, trouble shooting, and maintenance will be in accordance with TRS internal O&M manuals. **Table 4** contains a maintenance schedule for the condenser and the cooling tower. Close adherence to the schedule will increase the life of the units and promote trouble-free operation.

Table 4. Steam Condenser Maintenance Schedule

Procedure	Monthly	3 Months	6 Months
Condenser Maintenance Checklist			
Inspect general condition of steam condenser.	●		
Check for surface corrosion of metal parts; interior and exterior	●		
Inspect Insulation for excessive wear, rips, or tears.	●		
Inspect heat exchanger for leaks.	●		
Inspect internal piping for leaks.	●		
Inspect recycle, blow down, condensate pumps for security, leaks, excessive noise or vibration, and excessive heat.	●		
Inspect knock-out tank sight gage for damage and transparency.	●		
Inspect/clean metal filter in "Y" strainer coming from second knock-out tank (**CAUTION: water may be hot!**)	●		
If applicable, inspect drip system filters for clogging and filter housing for damage leaks.	●		

Procedure	Monthly	3 Months	6 Months
Inspect electrical connections for security.		●	
With power off, inspect electrical cables and wiring for damage. Inspect condenser control, box for security/damage.		●	
Cooling Tower Maintenance Checklist			
Inspect general condition of cooling tower.	●		
Check water level in cold water basin. Adjust as necessary.	●		
Check float ball and make-up valve for proper operation.	●		
Check belt tension and general condition of V-belts.	●		
Check the line voltage, motor amperage and fan wheel rpm.	●		
Clean outside of blower motor to help assure proper cooling.		●	
Lubricate blower bearings and fan motor using a low pressure grease gun		●	
Check blower wheel for dirt buildup which can cause unbalance and vibration.		●	
Inspect and clean (rinse off) the low, high and high-high level switches.		●	
Clean and flush cold water basin.			●
Lubricate motor base and adjusting screw.			●

5.3. Vapor Recovery Blowers

Blower safety considerations, operations, inspections and operational monitoring, trouble shooting, and maintenance will be in accordance with the TRS internal O&M manual. Basic maintenance service needs are:

- Lubrication (careful not to over grease);
- Checking for hot spots;
- Checking for increases or changes in vibration and noise; and
- Recording of operating pressures and temperatures.

Lubrication is normally the most important consideration. Weekly checks of lubricant levels in the gearbox and bearing reservoirs will be performed. Driver lubrication practices will be in accordance with the manufacturer's instructions. Grease should be added to the drive end on the blower until new grease comes out of the seals. The grease should be added using a hand-powered grease gun in order to prevent damage to the seals by adding grease too quickly. In addition, the blower motor should be lubricated with grease. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts. VR blower maintenance schedule is provided in **Table 5**.

Table 5. Blowers Maintenance Schedule

Procedure	Weekly	Monthly	Every 2 Months	Quarterly
Change oil after initial 100 hours of operation.				
For blower with Grease Lubrication drive ends, grease bearings	•			
Check hour meter. Change oil every 2000 hours.	•			
Check lubricant levels in the gearbox and bearing reservoirs	•			
Inspect inline filter housing. Replace quarterly or more frequently if necessary.		•		
Inspect for surface corrosion.		•		
Inspect overall condition of blower (new, worn, safety hazard, etc.).		•		
Inspect bolt/fittings for tightness.		•		
Check for Hot Spots.		•		
Check for increases or changes in vibration and noise.		•		
Inspect V-belts for damage/wear. Replace if necessary.		•		
Inspect Air Filter for serviceability. Replace if necessary.		•		
Lubricate electric motor with ALVANIA R3 grease or equivalent lithium-based grease.			•	
Add grease with hand-powered gun to drive end until new grease comes out of the seals				•

5.4. Regenerative Thermal Oxidizer with Gas Scrubber

RTO operations, inspections and operational monitoring, trouble shooting, and maintenance will be in accordance with TRS' internal O&M manual. **Table 6** contains a maintenance schedule for the RTO and support equipment.

Table 6. RTO Maintenance Schedule

Procedure	Weekly	Monthly	Every 2 Months	Quarterly
Inspect condenser gasket for tightness.	•			
Inspect pumps for abnormal noise or leakage.	•			
Visual opacity inspection of stack (i.e. confirm the stack is not dark or opaque).	•			
Inspect scrubber access ports for tightness.		•		
Check for increases or changes in vibration and noise.		•		
Open and close all valves.		•		
Watch actuation of poppet valves for proper functionality.		•		
Inspect and replace, when necessary, the bleed air filter.		•		
Inspect drain lines and blow down and/or clean lines.			•	
Inspect caustic soda tank.	•			
Verify eye wash station functioning properly.	•			

6.0 PERFORMANCE MONITORING

System performance monitoring is critical to the operation of the project. This activity provides the information necessary for the project team to make informed decisions concerning the safe, efficient, and effective operation of the ERH system. The types of performance monitoring to be completed include:

- ERH treatment system operation data (electronic and manual), including pressures throughout the treatment system and flow rates and total flows of both liquid and vapor phases;
- Temperature Monitoring;
- Amperage Surveys;
- Voltage Surveys;
- Vapor recovery performance monitoring, including flow and vacuum measurements;

- Water treatment monitoring;

- Soil sampling performance monitoring (performed by Amec Foster Wheeler); and
- Groundwater and LNAPL performance monitoring (performed by Amec Foster Wheeler).

PCU control and data acquisition are performed on a dedicated computer and associated programmable logic controllers (PLCs). Remote data acquisition software is used to collect and store subsurface temperatures, power, voltage, amperage, and operational status data for the entire ERH system. Offsite project personnel are able to view and download this information in real time using a high-speed, wireless modem. The software also allows for control and/or monitoring of power application, vapor condensation, and liquid pumping functions.

6.1. Temperature Monitoring

Temperature data will be automatically collected on a daily basis from the TMPs. These data will be used to evaluate electrode performance.

6.2. Amperage Surveys

Electrode amperage surveys will be conducted frequently during start-up operations and at least weekly throughout system operations in order to prevent electrode cable over-current conditions. Because changes in current to individual electrodes generally occurs slowly, trends developed from the amperage surveys will be used to identify potential issues and implement resolutions.

TRS will monitor and evaluate the performance of each electrode at least weekly during operations. The electrical current to each electrode will be measured using a standard, hand-held, clamp-on ammeter. TRS will determine each electrode's performance based on voltage, current, power density, power flux, and energy values.

6.3. Voltage Surveys

The baseline and weekly voltage survey shall include locations along the perimeter fence, ERH equipment, Site features, and the area surrounding the ERH treatment region. Should voltage potentials exceed the TRS electrical safety policy limit outside of the restricted area, energy input into the subsurface will be decreased to the electrodes in close proximity of property boundary.

If any voltage safety measurement indicates more than the maximum allowed voltage, TRS will use engineering controls to achieve the TRS Electrical Safety Standard. Some typical engineering controls to may include:

- Isolation of locations exceeding the TRS Safety Limit by insulating or directly enclosing.
- Isolation of locations exceeding the TRS Safety Limit by restricting access to all personnel when power is applied by establishing an ERH exclusion zone. No personnel shall enter an ERH exclusion zone during ERH power application.

- Isolation of locations exceeding the TRS Safety Limit by restricting access to only qualified personnel when power is applied by establishing an ERH restricted zone.

6.4. Vapor Recovery Performance Monitoring

VR performance monitoring will include vapor samples collected from the VR treatment system. All vapor samples will be screened at the Site using a field instrument for total VOCs (photoionization detector [PID]). In addition, vapor samples collected at the VR treatment system will be sent offsite for laboratory analysis. The frequency and types of samples collected from the VR treatment system will be presented in the Remedial Action Work Plan that will be submitted by Amec Foster Wheeler.

Vapor samples collected from the VR treatment system, influent and effluent, will be used for mass removal estimates, RTO performance, and compliance monitoring, respectively (**Section 7.0**).

6.5. Subsurface Performance Monitoring

Performance monitoring of the treatment area will include the sampling and analysis of groundwater, soil and NAPL samples at various times during the remediation. The procedures and types of analyses will be presented in the Remedial Action Work Plan that will be submitted by Amec Foster Wheeler. The project team may alter the timing of each sampling event based upon data from the system. LNAPL will be sampled from monitoring wells, if present.

The performance monitoring data will be used to support ERH termination decisions. TRS will operate the ERH system until the concentration of TCE at each monitoring location in the treatment area meets the termination criteria by achieved a 95% reduction from the baseline concentration. Once the concentration of TCE has reached 95% reduction, energy application in this region can cease and be redirected to other portions of the ERH treatment area, as necessary.

7.0 COMPLIANCE MONITORING

The vapor and liquid treatment systems will be operated and monitored in a manner to achieve compliance with the process air and water discharge limits established by federal, state and local regulations. The limits will be evaluated and finalized during the design process as well as the technologies used to safely maintain those limits.

The performance of the ERH system, vapor treatment, and water treatment systems will be executed and evaluated by Amec Foster Wheeler and TRS staff and will include daily, weekly, and monthly samples collected and analyzed using field instruments (e.g. PID) and offsite laboratory analysis. Details of the types of samples, frequency, and laboratory analyses will be presented in the Remedial Action Work Plan that will be submitted by Amec Foster Wheeler.

7.1. Vapor Treatment

As described in previous sections, sampling ports, flow, and pressure measurement instrumentation will be used to determine, monitor, and report the vacuum and flow rate in the ERH vapor recovery system. TRS will perform weekly screening for total VOCs using a PID. In addition, vapor samples will be collected for offsite laboratory analysis; the sample results will be used to determine VOC recovery, RTO performance, and emissions compliance.

7.2. Liquid Treatment

Liquid samples will be collected for off-site laboratory analysis, as will be presented in the Remedial Action Work Plan that will be submitted by Amec Foster Wheeler, to assess VOC recovery (influent) and the efficiency of the carbon (effluent). When breakthrough of a LGAC vessel has been observed through laboratory analytical data, TRS will change out the LGAC.

In addition, a LGAC sample will be collected for waste characterization and regeneration purposes.

8.0 REPORTING

Weekly electronic letter reports will be submitted to CTS and Amec Foster Wheeler. These reports will describe the general operation of the ERH system, work performed during the previous weeks, and anticipated upcoming work. The reports will also contain data on the subsurface temperature profile, power applied by the entire remediation system and energy input to the subsurface.

9.0 SECURITY AND SITE ACCESS CONTROL

Site security and control will include the use of physical barriers and electronic security systems. The existing perimeter fence will be maintained and repaired in areas where continuity is compromised.

TRS will modify the existing entry gate to incorporate a larger holding area with a perimeter fence that funnels all personnel into the office trailer. The trailer will be used to manage access to the site for authorized and prevent unauthorized personnel predominantly during construction but the office will be maintained onsite during the entire project. The holding area will also be used for personnel parking and egress of trucks from Mills Gap Road on to the property. The existing gate will remain in place and be locked during non-business hours. There will be an equipment and personnel access gate from the holding area into the restricted zone for adequate access.

TRS will maintain two independent, wireless, cellular-based security systems. The first system is a perimeter infrared motion sensor security system. Motion sensors will be placed around the interior perimeter of the ERH exclusion zone and the ERH equipment compound. The motion-sensed security system will also be safety interlocked with the PCUs. In the event that the motion sensors are activated during the operational phase of the remediation, the safety interlock would interrupt power application to the subsurface.

The second security system is comprised of wireless, motion-activated cameras. When activated, the camera transmits a 10-second video clip to the security system provider dispatch to be evaluated for unauthorized entry. TRS personnel also receive the video clip via e-mail. If unauthorized entry is detected, the dispatch would contact TRS for specific direction. The camera-system is not safety interlocked with the PCUs or any other remediation equipment. A physical interior perimeter will be placed around the equipment compound. A site plan illustrating the locations of the holding area, interior perimeter, video cameras and motion sensors is provided in **Figure Y-3 and Y-4**.

10.0 HEALTH AND SAFETY MANAGEMENT

The Site-specific HASP identifies the policies and procedures to be implemented to protect site workers and visitors. The HASP establishes, in detail, the protocols necessary for protecting workers, Site personnel, visitors, and potential offsite receptors from potential physical and chemical hazards encountered during site activities.

All TRS personnel, and subcontractor staff, that may have contact with Site soil, groundwater, soil vapors or treatment residuals, will be qualified OSHA certified 40-hour hazardous waste operations and Emergency Response (HAZWOPER) Standard workers. This requirement includes maintaining annual 8-hour refresher training, 24-hour on the job training, participation in a medical monitoring program, and 8-hour specialized training for supervisors per 29 Code of Federal Regulations 1919.120. In addition, TRS personnel working within equipment panels will have completed Arc Flash safety training in accordance with NFPA 70E and will be trained to a level of competent person for their assigned task.

Prior to energizing the ERH system, an internal TRS Start-up Safety Inspection will be performed in two phases to ensure personnel safety at the time of initial power application. The first phase of this inspection demonstrates that all design safety features have been completed and are operating properly prior to applying power to the subsurface. Examples of these safety features include access guards, interlocks between system components, over level gauges, over temperature gauges, and power kill switches.

With the first phase of the inspection satisfactorily completed, the ERH system will be energized, and the second inspection phase initiated. All non-TRS personnel will be excluded from the ERH treatment region during this phase of the inspection. During this phase of the inspection, compliance with allowable surface voltages under operating conditions is verified at increasing energy application voltages. Surface voltage readings are recorded until the design input energy is reached.

The PCUs are equipped with an E-Stop button on the outside of the unit. Pressing the E-Stop button will immediately open the PCU disconnect and power application to the electrodes will cease.

11.0 SYSTEM DECOMMISSIONING

Upon completion of the work, TRS will remove all above grade temporary structures, piping, and equipment that it placed on the Site. Because the electrodes are constructed of a material that will continue to provide treatment of the groundwater that has a permeability no higher than the soils, the electrode materials may be left in place at project completion for continued beneficial treatment of residuals in groundwater. All locations where the electrodes were installed will be abandoned in place by Amec Foster Wheeler and finished at surface with a similar material to the surroundings, flush to grade. All equipment will be loaded onto trucks and demobilized from the Site. System piping and fittings will be disposed at the end of the project. Cables, solenoid valves and specific drip-system components (if implemented) will be reused or recycled at the end of the project.

FIGURES

ELECTRICAL RESISTANCE HEATING DESIGN PACKAGE

CTS OF ASHEVILLE SUPERFUND SITE
235 MILLS GAP ROAD
ASHEVILLE, NORTH CAROLINA

Prepared by:

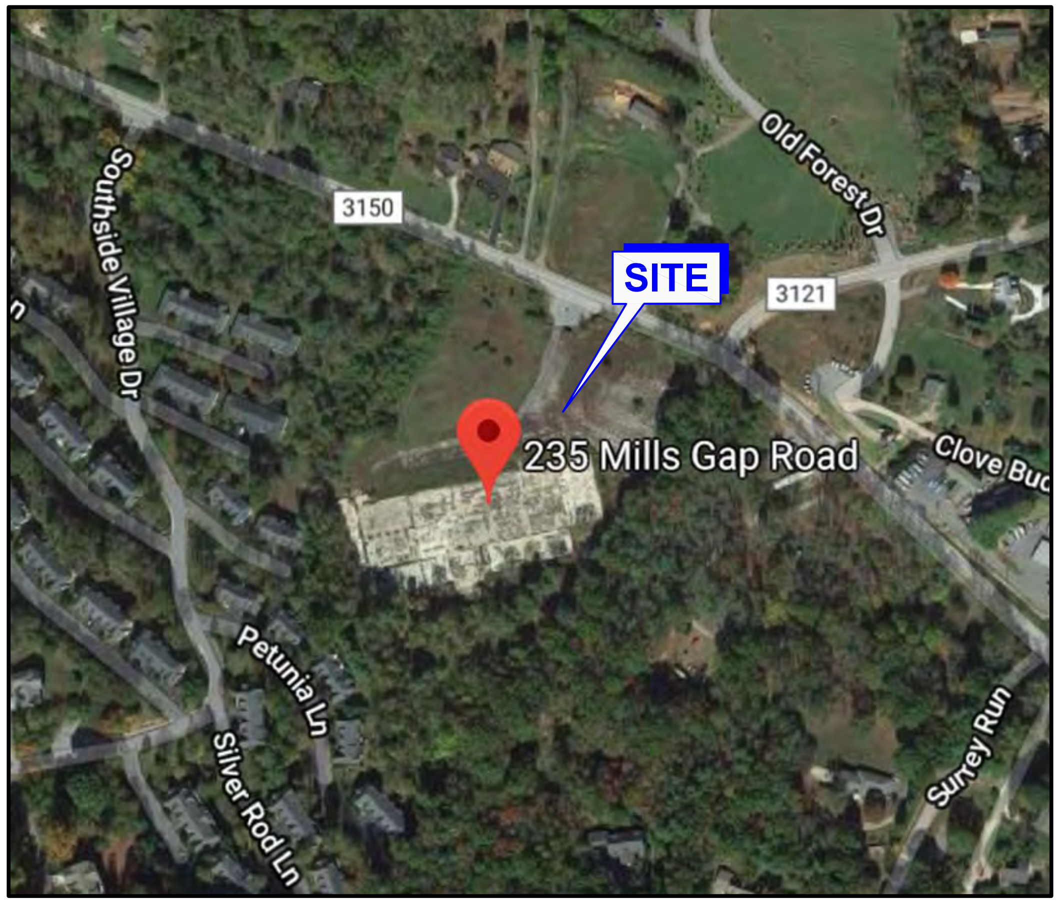
TRS Accelerating Value

NOVEMBER 2017

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17
ENGINEER SIGNATURE / DATE

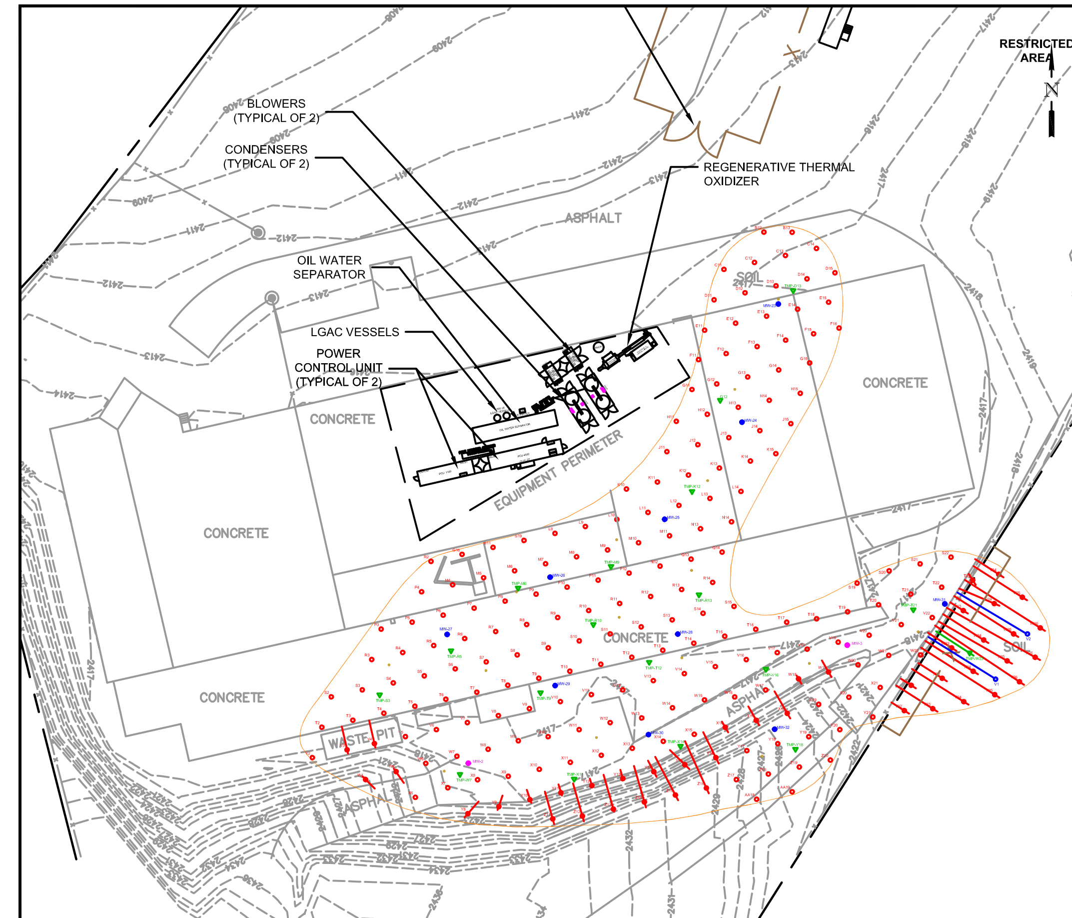
APPROVED
For Construction



SITE LOCATION MAP

SHEET INDEX

DRAWING NUMBER	TITLE AND DESCRIPTION
Y-1	SITE PLAN WITH ELECTRODE LAYOUT
Y-2	SUBSURFACE INSTALLATION PLAN
Y-3	SECURITY MOTION SENSOR PLAN
Y-4	SECURITY CAMERA PLAN
Y-5	TEMPERATURE MONITORING POINT WIRING PLAN
M-1	SINGLE ELEMENT VERTICAL ELECTRODE DETAIL
M-2	ANGLED ELECTRODE DETAIL
M-3	DUAL ELEMENT VERTICAL ELECTRODE DETAIL
M-4	TEMPERATURE MONITORING POINT DETAIL
P-1	LEGEND PROCESS AND INSTRUMENTATION DIAGRAM
P-2	PROCESS FLOW DIAGRAM
P-3	PROCESS FLOW DIAGRAM STREAM LEGEND
P-4	FIELD PROCESS AND INSTRUMENTATION DIAGRAM
P-5	CONDENSER PROCESS AND INSTRUMENTATION DIAGRAM
P-6	COOLING TOWER PROCESS AND INSTRUMENTATION DIAGRAM
P-7A	BLOWER AND THERMOX PROCESS AND INSTRUMENTATION DIAGRAM
P-7B	BLOWER AND THERMOX PROCESS AND INSTRUMENTATION DIAGRAM
P-7C	BLOWER AND THERMOX PROCESS AND INSTRUMENTATION DIAGRAM
P-8	WATER TREATMENT PROCESS AND INSTRUMENTATION DIAGRAM
E-1	ELECTRICAL ONE-LINE DIAGRAM



SITE PLAN

0 100
APPROXIMATE SCALE IN FEET

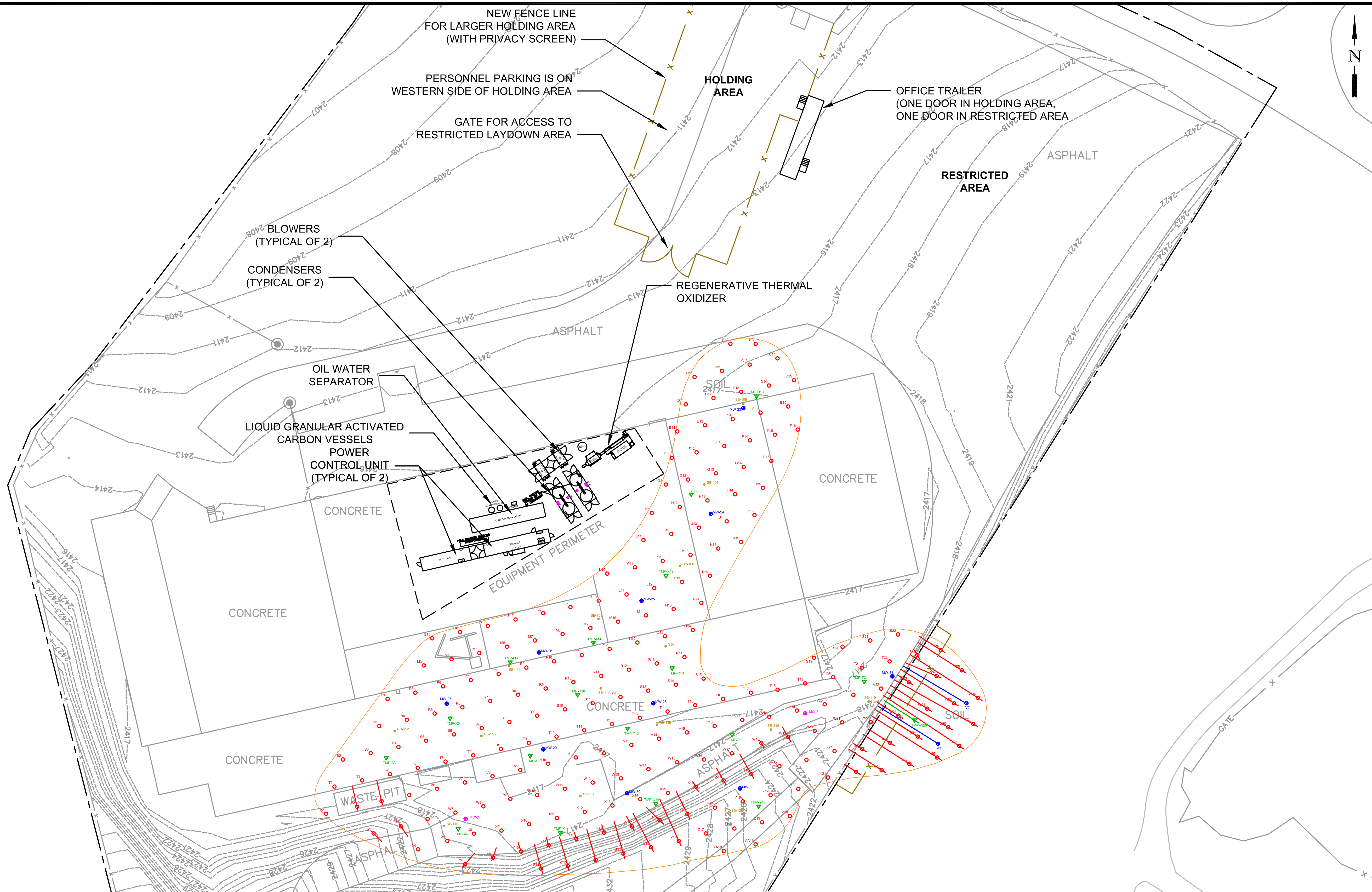
APPROVED

For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17

ENGINEER SIGNATURE / DATE



LEGEND

- VERTICAL ELECTRODE (QTY. 186)
- ANGLED ELECTRODE (QTY. 43)
- TEMPERATURE MONITORING POINT (18)
- SB-1 SOIL BORING (15)
- MW-1 MONITORING WELL CLUSTER (10)
- MW-2 EXISTING MONITORING WELLS (2)
- V1 ANGLED VAPOR RECOVERY WELL (2)

0 30 60 120

SCALE IN FEET

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27
SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

SITE PLAN WITH ELECTRODE LAYOUT

APPROVED FOR CONSTRUCTION

BY ____________

DATE ____________

DATE	2017.NOV.20
PROJECT	NC.ASH.1821
SHEET	Y-1

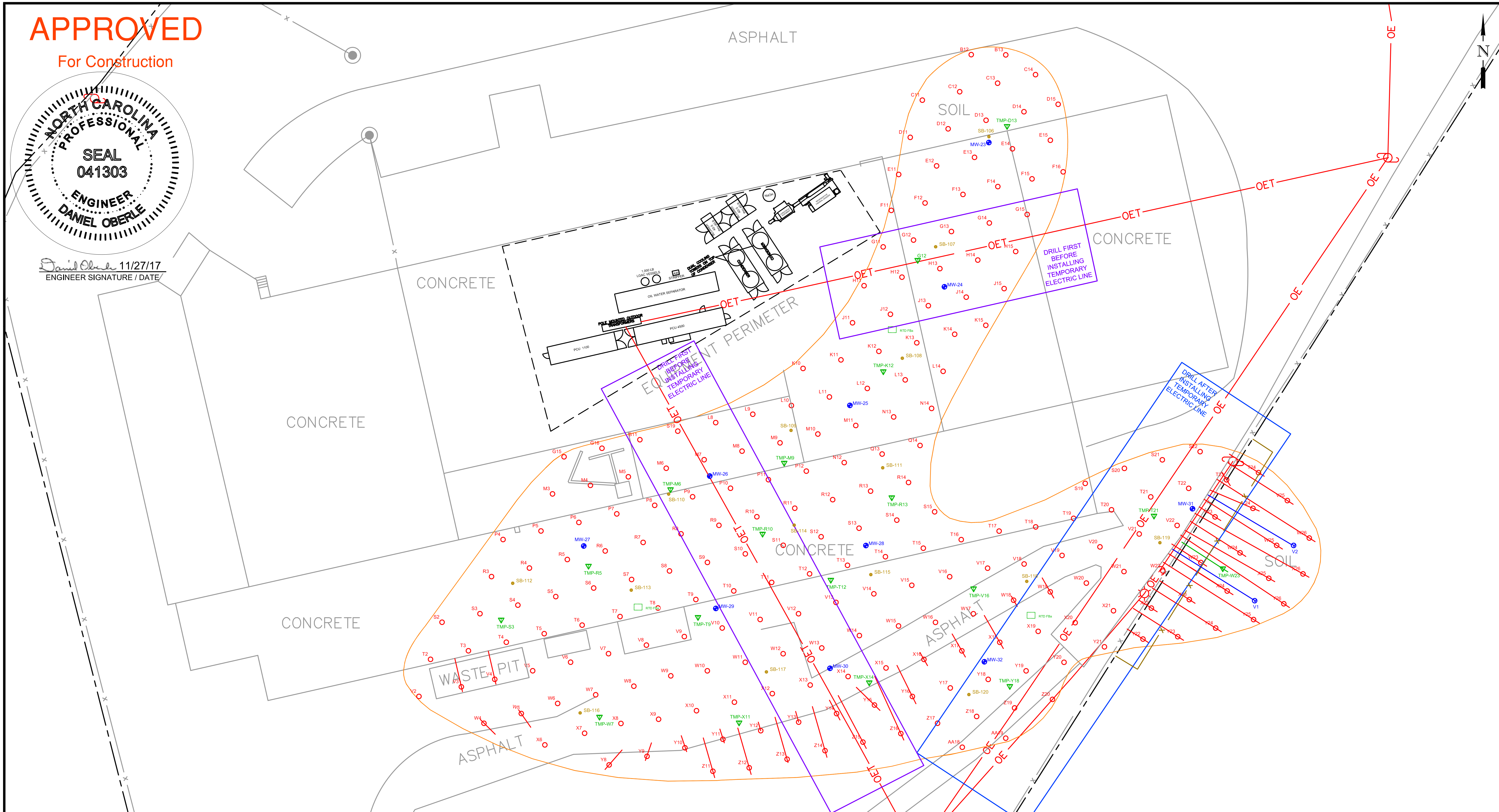
APPROVED

For Construction

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 041303 DANIEL OBERLE

11/27/17

ENGINEER SIGNATURE / DATE



LEGEND

- VERTICAL ELECTRODE (QTY. 186)
- ANGLED ELECTRODE (QTY. 43)
- TEMPERATURE MONITORING POINT (18)
- SB-1 SOIL BORING (15)
- MW-1 MONITORING WELL CLUSTER (10)
- V1 ANGLED VAPOR RECOVERY WELL (2)
- —OET— TEMPORARY OVERHEAD ELECTRIC LINE
- — OE — EXISTING OVERHEAD ELECTRIC LINE

0 20 40 80

SCALE IN FEET

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27

SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

SUBSURFACE INSTALLATION PLAN

APPROVED FOR CONSTRUCTION

BY ____________________

DATE ____________________

DATE 2017.NOV.20

PROJECT NC.ASH.1821

SHEET Y-2

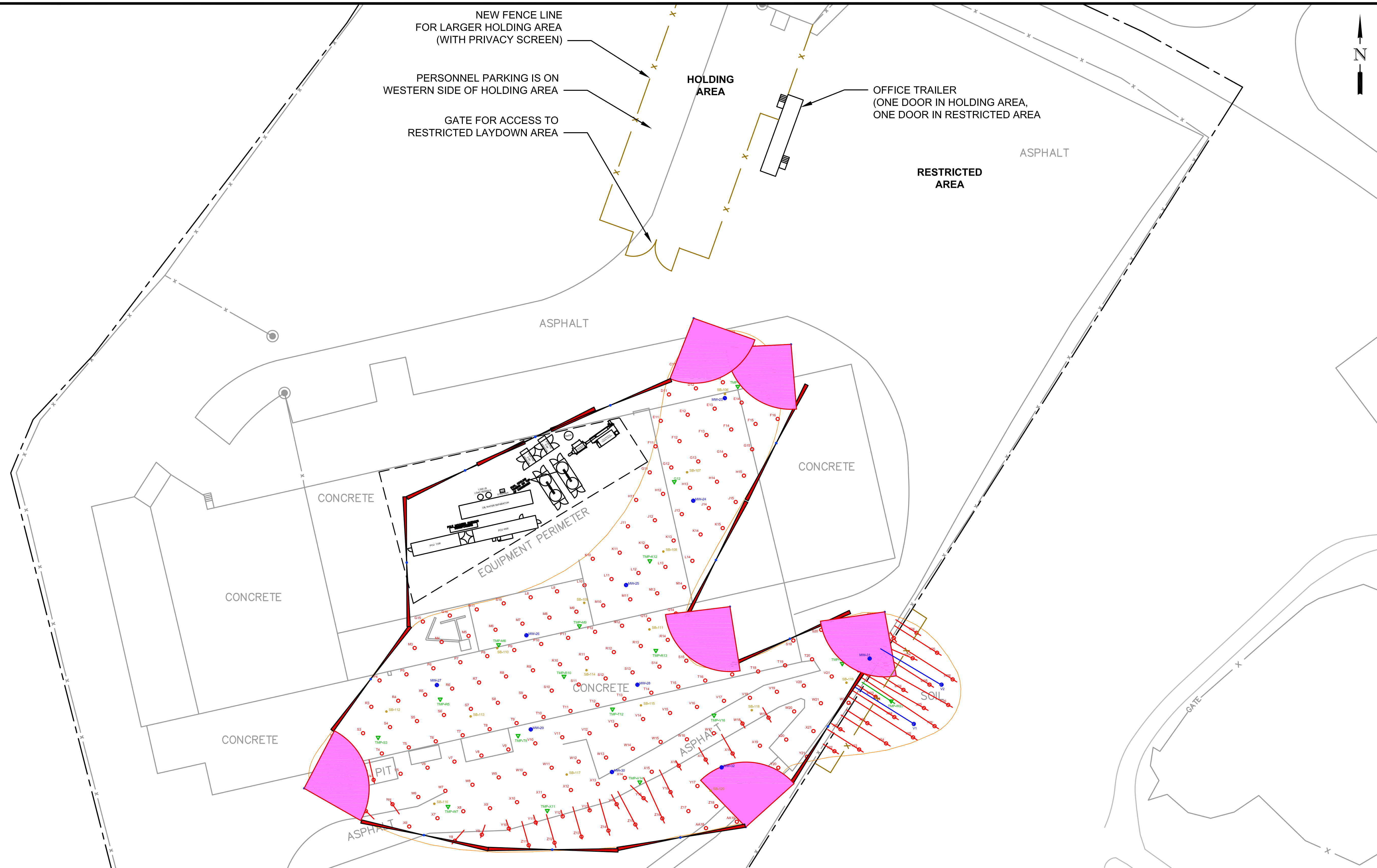
APPROVED

For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17

ENGINEER SIGNATURE / DATE



LEGEND

- VERTICAL ELECTRODE (QTY. 186)
- ANGLED ELECTRODE (QTY. 43)
- TEMPERATURE MONITORING POINT (18)
- SB-1 SOIL BORING (15)
- MW-1 MONITORING WELL CLUSTER (10)
- V1 ANGLED VAPOR RECOVERY WELL (2)
- SECURITY SENSOR COVERAGE

0 30 60 120

SCALE IN FEET

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

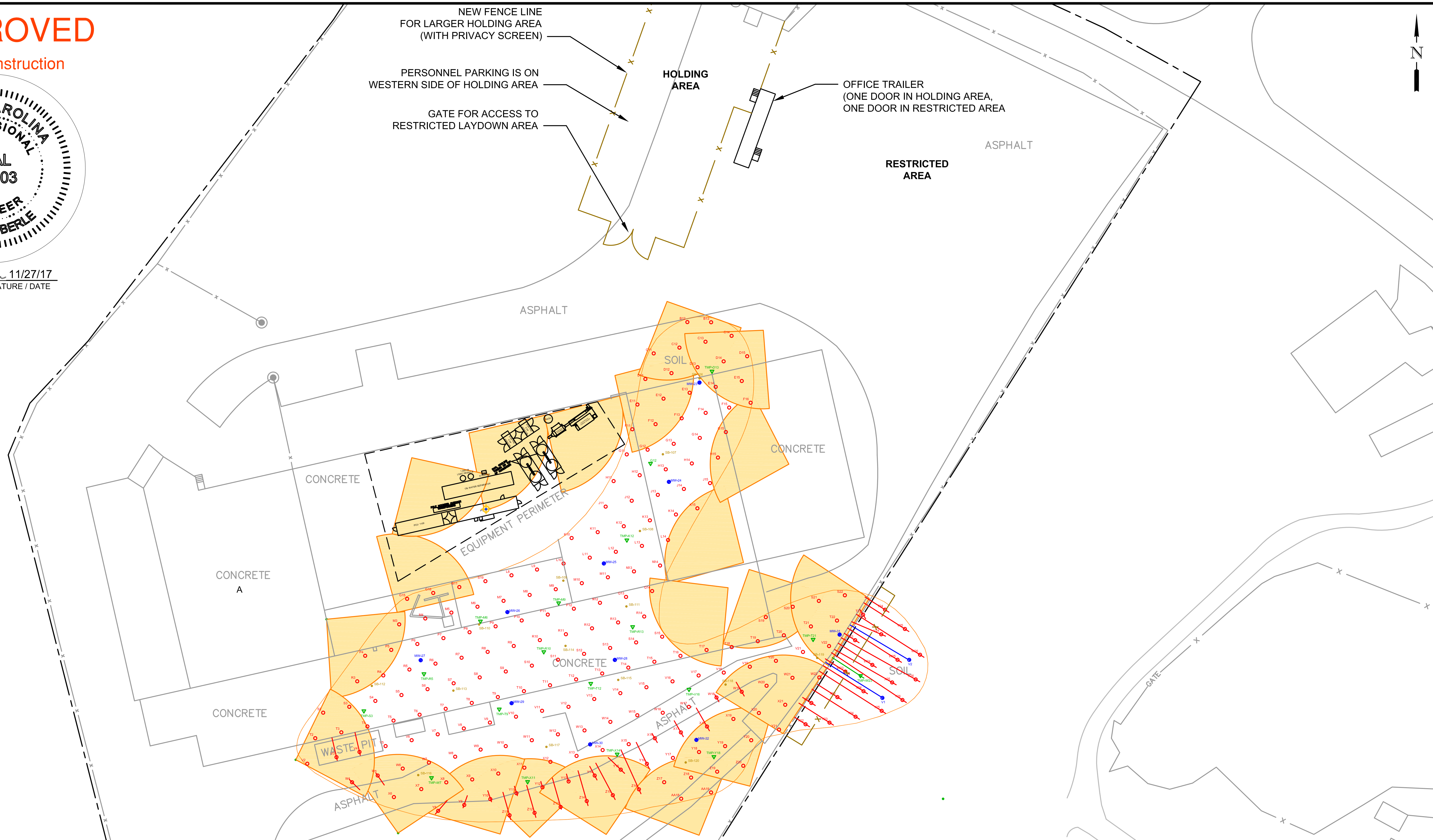
DESIGNED BY E. CROWNOVER	SITE	CTS OF ASHEVILLE SUPERFUND SITE	
DRAWN BY A. PEABODY	LOCATION	ASHEVILLE, NORTH CAROLINA	
CHECKED BY D. OBERLE	CLIENT	CTS CORPORATION	
PROJECT MANAGER C. BLUNDY	SECURITY MOTION SENSOR PLAN		
QSAT REVIEW 2017.NOV.27	APPROVED FOR CONSTRUCTION BY DATE	DATE 2017.NOV.20	PROJECT NC.ASH.1821
		SHEET Y-3	

APPROVED

For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17
ENGINEER SIGNATURE / DATE



LEGEND

- VERTICAL ELECTRODE (QTY. 186)
- ANGLED ELECTRODE (QTY. 43)
- TEMPERATURE MONITORING POINT (18)
- SB-1 SOIL BORING (15)
- MW-1 MONITORING WELL CLUSTER (10)
- V1 ANGLED VAPOR RECOVERY WELL (2)
- VIDEOFIED SECURITY CAMERA

0 30 60 120
SCALE IN FEET

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27

SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

SECURITY CAMERA PLAN

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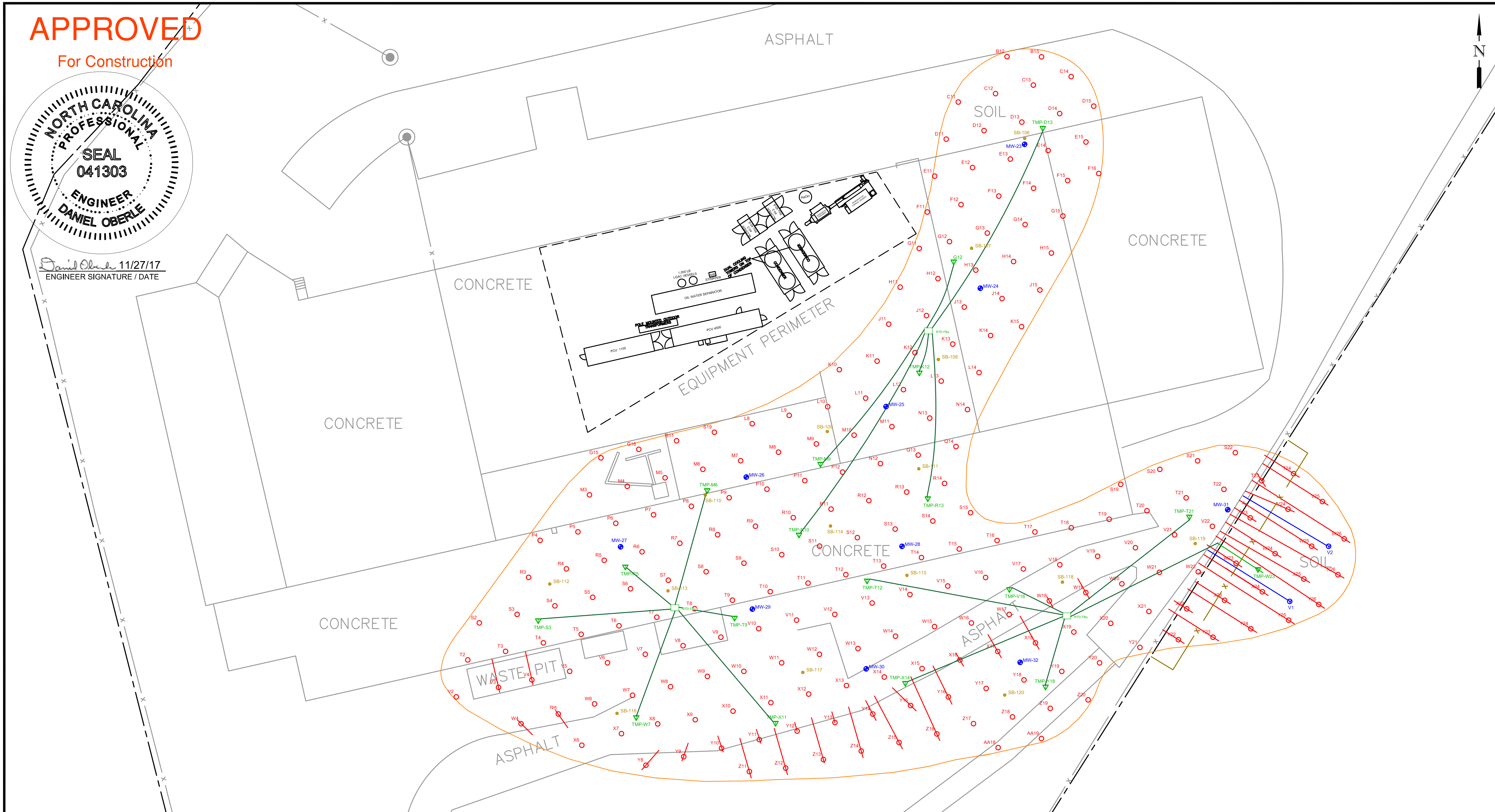
BY ____________

DATE ____________

DATE	2017.NOV.20
PROJECT	NC.ASH.1821
SHEET	Y-4



LEGEND

- VERTICAL ELECTRODE (QTY. 186)
- ANGLED ELECTRODE (QTY. 43)
- TEMPERATURE MONITORING POINT (18)
- SB-1 SOIL BORING (15)
- MW-1 MONITORING WELL CLUSTER (10)
- V1 VAPOR RECOVERY WELL (2)
- RTD FBx RTD FIELD BOX (QTY. 3)
- RTD WIRING

0 20 40 80
SCALE IN FEET

TRS Accelerating Value
TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27

SITE: CTS OF ASHEVILLE SUPERFUND SITE
LOCATION: ASHEVILLE, NORTH CAROLINA
CLIENT: CTS CORPORATION

TEMPERATURE MONITORING POINT WIRING PLAN

APPROVED FOR CONSTRUCTION
BY
DATE

DATE: 2017.NOV.15
PROJECT: NC.ASH.1821
SHEET: Y-5

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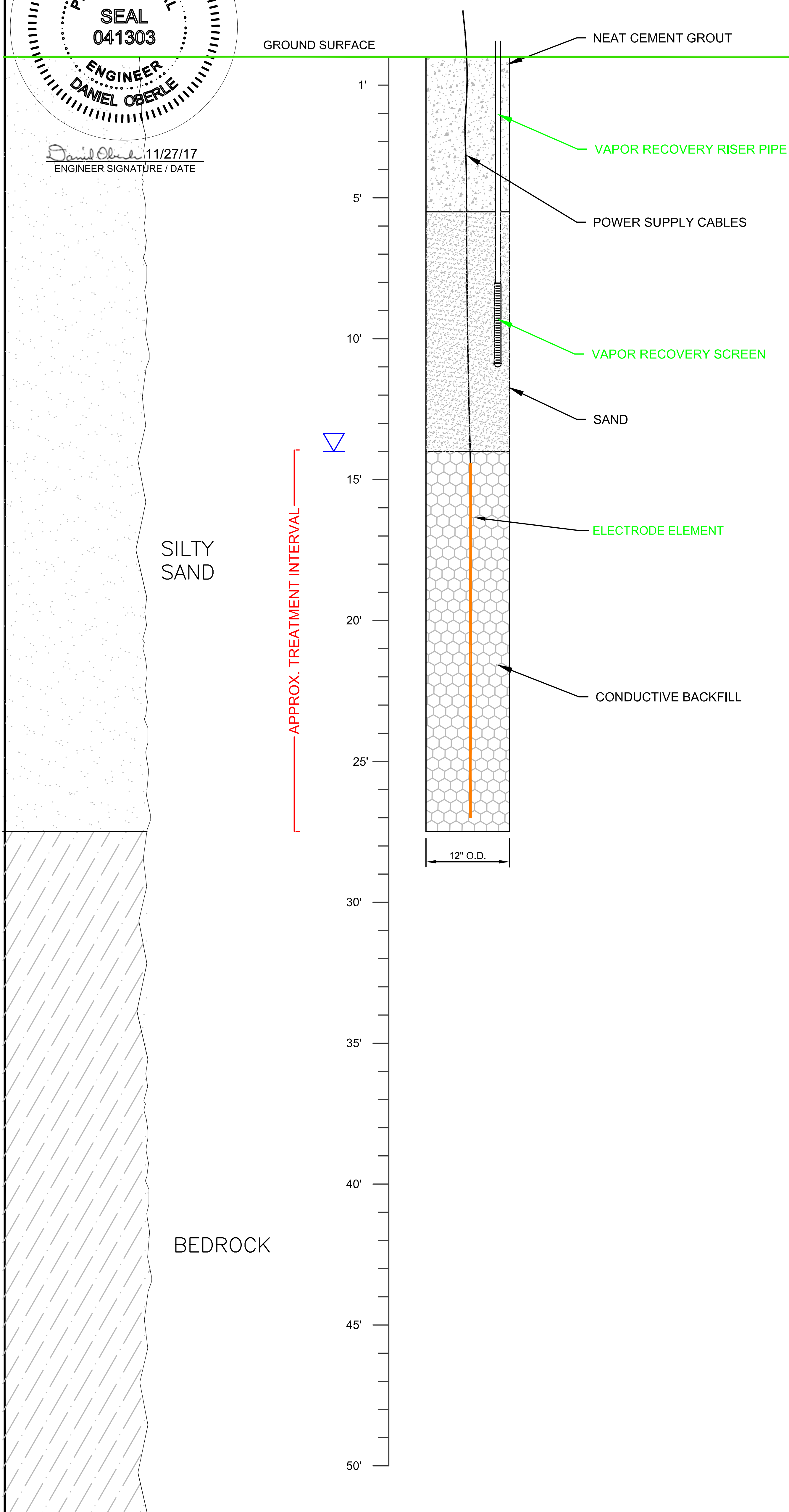
NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17
ENGINEER SIGNATURE / DATE

SINGLE ELEMENT VERTICAL ELECTRODE



NOTES:

1. DEPTHS IN DRAWING REPRESENT TREATMENT INTERVALS FROM TOP OF WATER TABLE TO TOP OF BEDROCK INTERFACE
2. DEPTHS OF TREATMENT WILL BE DETERMINED BASED UPON FIELD OBSERVATIONS
3. ALL ELECTRODES WILL BE DRILLED TO REFUSAL USING HOLLOW STEM AUGER
4. ELEMENT NUMBER WILL VARY BY LOCATION BASED UPON DISTANCE BETWEEN WATER TABLE AND REFUSAL, SOIL ELECTRICAL RESISTIVITY TESTING, AND LITHOLOGIC CHANGES OBSERVED DURING INSTALLATION.

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	J. ERARIO
CHECKED BY	PENDING APPROVAL
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27
SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

SINGLE ELEMENT VERTICAL ELECTRODE DETAIL

APPROVED FOR CONSTRUCTION	
BY	
DATE	
DATE	2017.NOV.20
PROJECT	NC.ASH.1821
SHEET	M-1

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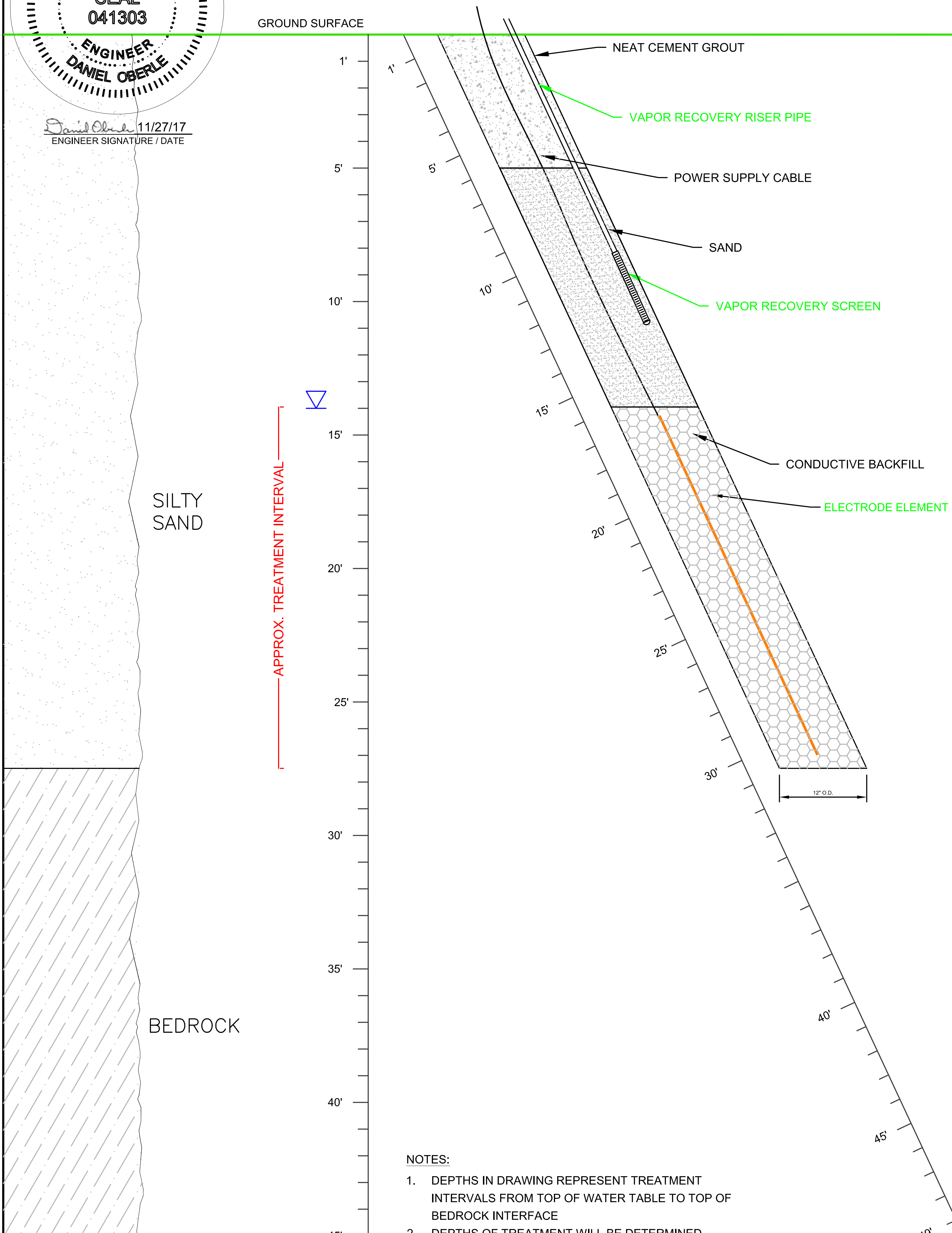
For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17

ENGINEER SIGNATURE / DATE

ANGLED ELECTRODE



NOTES:

1. DEPTHS IN DRAWING REPRESENT TREATMENT INTERVALS FROM TOP OF WATER TABLE TO TOP OF BEDROCK INTERFACE
2. DEPTHS OF TREATMENT WILL BE DETERMINED BASED UPON FIELD OBSERVATIONS
3. ANGLES WILL VARY BY LOCATION BASED UPON TOPOGRAPHY CHANGES AND TO MINIMIZE IMPACT TO NEIGHBORING PROPERTY
4. ELEMENT NUMBER WILL VARY BY LOCATION BASED UPON DISTANCE BETWEEN WATER TABLE AND REFUSAL, SOIL ELECTRICAL RESISTIVITY TESTING, AND LITHOLOGIC CHANGES OBSERVED DURING INSTALLATION.

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	J. ERARIO
CHECKED BY	PENDING APPROVAL
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27
SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

ANGLED ELECTRODE DETAIL

APPROVED FOR CONSTRUCTION

BY ______________

DATE ______________

DATE	2017.NOV.20
PROJECT	NC.ASH.1821
SHEET	M-2

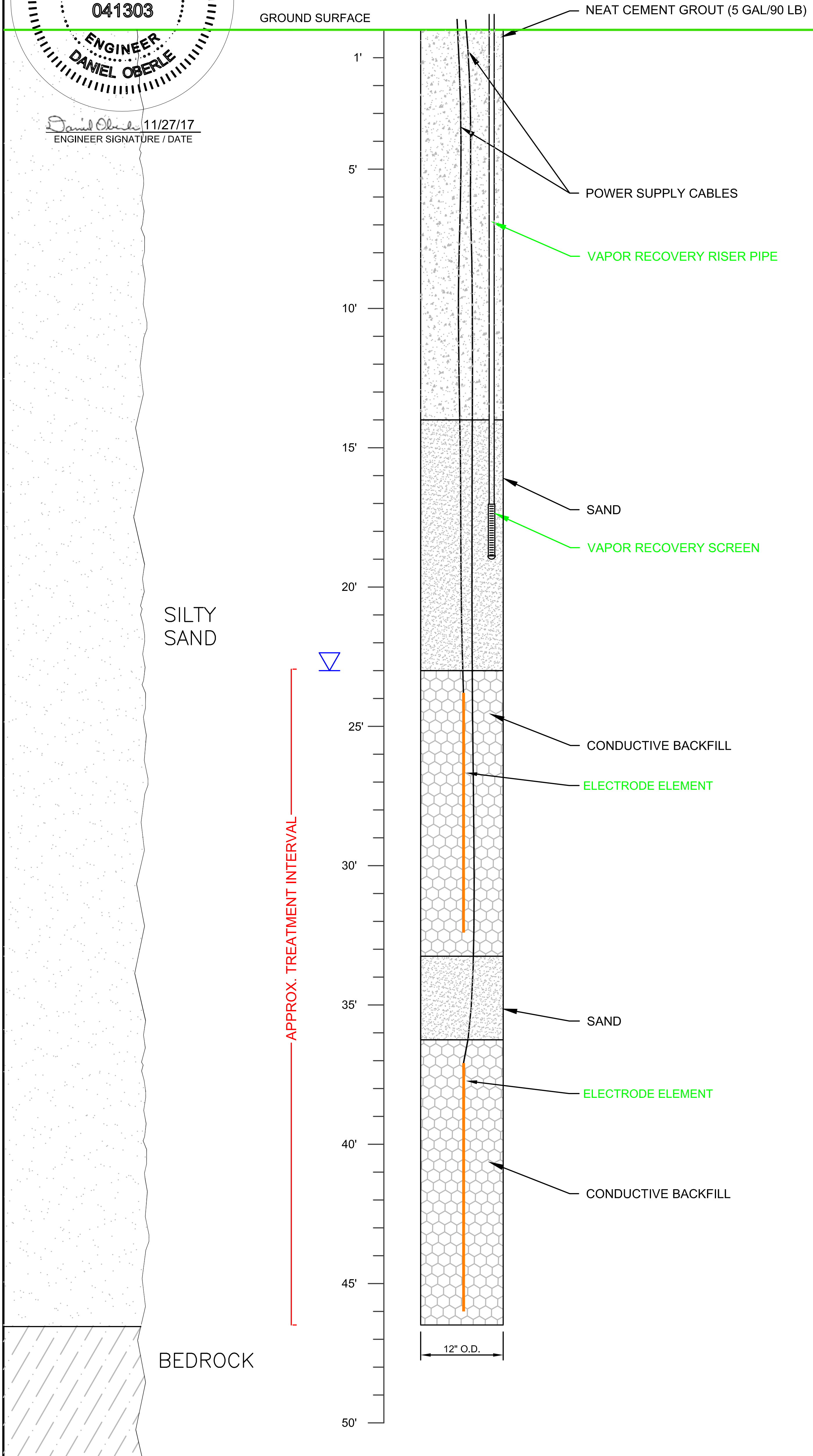
APPROVED

For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17
ENGINEER SIGNATURE / DATE

DUAL ELEMENT VERTICAL ELECTRODE



NOTES:

1. DEPTHS IN DRAWING REPRESENT TREATMENT INTERVALS FROM TOP OF WATER TABLE TO TOP OF BEDROCK INTERFACE
2. DEPTHS OF TREATMENT WILL BE DETERMINED BASED UPON FIELD OBSERVATIONS
3. ALL ELECTRODES WILL BE DRILLED TO REFUSAL USING HOLLOW STEM AUGER
4. ELEMENT NUMBER WILL VARY BY LOCATION BASED UPON DISTANCE BETWEEN WATER TABLE AND REFUSAL, SOIL ELECTRICAL RESISTIVITY TESTING, AND LITHOLOGIC CHANGES OBSERVED DURING INSTALLATION.

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	J. ERARIO
CHECKED BY	PENDING APPROVAL
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27
SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

DUAL ELEMENT VERTICAL ELECTRODE DETAIL

APPROVED FOR CONSTRUCTION	
BY	
DATE	
DATE	2017.NOV.13
PROJECT	NC.ASH.1821
SHEET	M-3

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For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17

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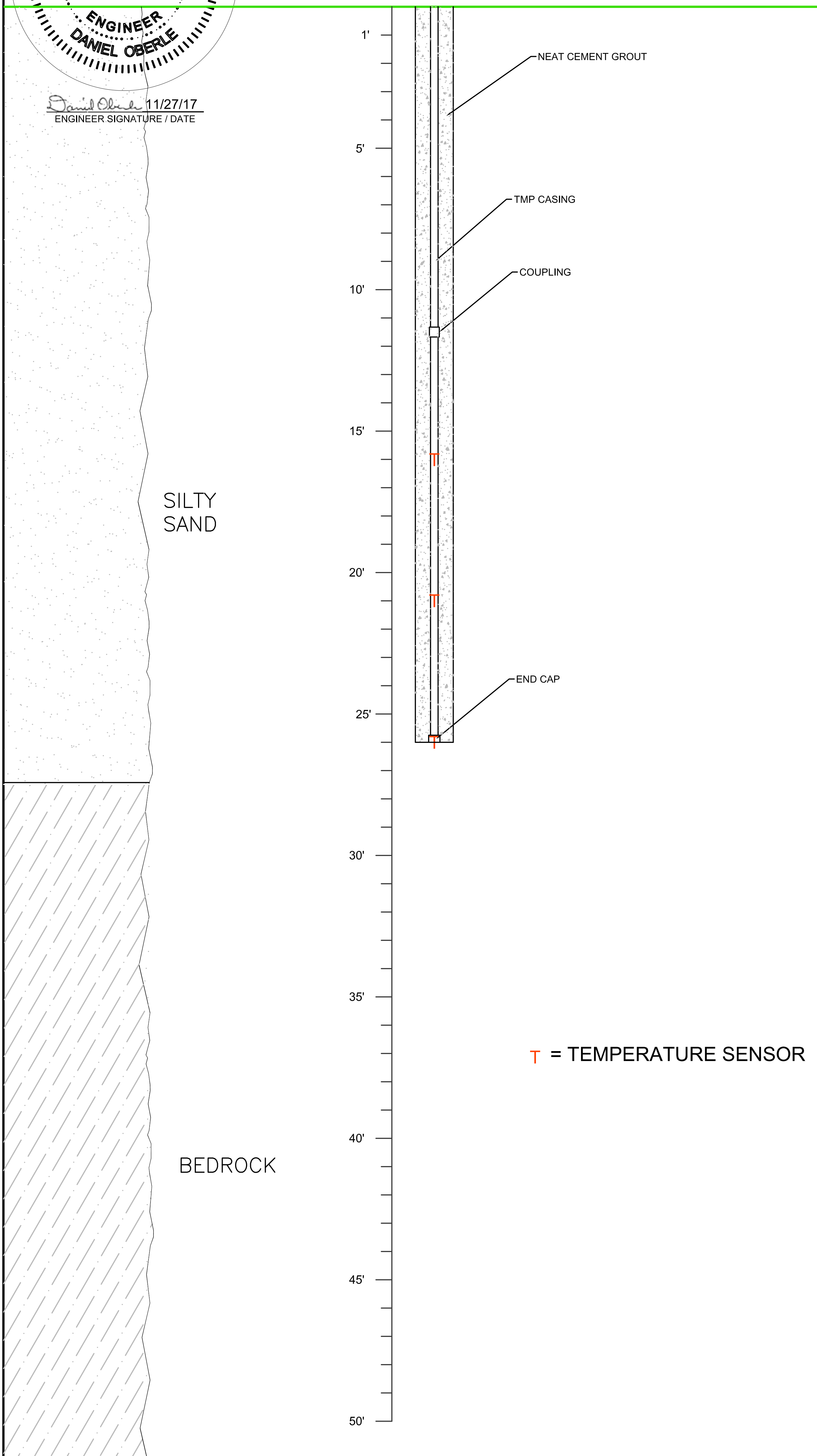
TEMPERATURE MONITORING POINT



NOTES:

1. DEPTHS WILL BE DETERMINED BASED UPON TREATMENT INTERVAL EXTENTS OF SURROUNDING ELECTRODE INSTALLATIONS
2. THE DEEPEST TEMPERATURE SENSOR WITHIN THE CASING WILL BE SET TWO FEET ABOVE THE SHALLOWEST OF THE THREE SURROUNDING ELECTRODES.

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	PENDING APPROVAL
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27
SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

TEMPERATURE MONITORING POINT DETAIL

APPROVED FOR CONSTRUCTION	
BY	
DATE	
DATE	2017.NOV.20
PROJECT	NC.ASH.1821
SHEET	M-4

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For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

ENGINEER SIGNATURE / DATE

11/27/17

ENGINEER SIGNATURE / DATE

LEGEND

	ELECTRONIC SIGNAL
	ELECTRICAL CABLE
3	PROCESS LINE LABELING SEE SHEET P-2 FOR DESCRIPTION
S	SOLENOID
	BALL VALVE
	BUTTERFLY VALVE
	ANTI-SIPHON VALVE
	PVC TRUE UNION BALL VALVE
	SAMPLE PORT
	CHECK VALVE
	SELF-CONTAINED PRESSURE REGULATOR
	SPIGOT
	BACKFLOW PREVENTER
	FLANGE
	VACUUM RELEASE VALVE
XX XX	PIPING SPEC. # CHANGE
	PUMP
	BLOWER
	ROTARY LOBE BLOWER
	DIAPHRAGM PUMP
	COMPRESSED AIR FILTER
	HEATER COIL
SDTX	STEP DOWN TRANSFORMER

YC 1	COMPUTER OPERATED MONITORING, DATA COLLECTION AND CONTROLS
YC 1	HARDWIRE CONTROLS
PI	PRESSURE INDICATOR
PCV	PRESSURE CONTROL VALVE
PSL	PRESSURE SWITCH LOW
PSH	PRESSURE SWITCH HIGH
FE	FLOW ELEMENT
FI	FLOW INDICATOR
FQI	FLOW QUANTITY INDICATOR
FT	FLOW TRANSMITTER
LI	LEVEL INDICATOR
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH-HIGH
LSL	LEVEL SWITCH LOW
LSLL	LEVEL SWITCH LOW-LOW
TAH	TEMPERATURE ALARM HIGH
TE	TEMPERATURE ELEMENT
TSL	TEMPERATURE SWITCH LOW
TI	TEMPERATURE INDICATOR
TSH	TEMPERATURE SWITCH HIGH
YC	CONTROLLER
T	TEMPERATURE SENSOR
CS	CARBON STEEL
CPVC	SCH 40. CPVC PIPE
PEX	PEX TUBING
FCV	FLOW CONTROL VALVE

P&ID LINE COLORS

- SOFTENED/POTABLE/CLEAN WATER
- PROCESS WATER
- AIR
- STEAM
- AIR/STEAM MIX
- SOLVENT/CHEMICALS
- BLOWDOWN
- FUEL
- COMPUTER OPERATED CONTROLS
- HARDWIRE CONTROLS

NOTES

1. THIS IS AN ALL INCLUSIVE LEGEND SHEET. NOT ALL SYMBOLS WILL APPEAR ON EACH SHEET.

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27

SITE: CTS OF ASHEVILLE SUPERFUND SITE
LOCATION: ASHEVILLE, NORTH CAROLINA
CLIENT: CTS CORPORATION

LEGEND
PROCESS AND INSTRUMENTATION DIAGRAMS

APPROVED FOR CONSTRUCTION
BY ____
DATE ____

DATE: 2017.NOV.20
PROJECT: NC.ASH.1821
SHEET: P-1

APPROVED

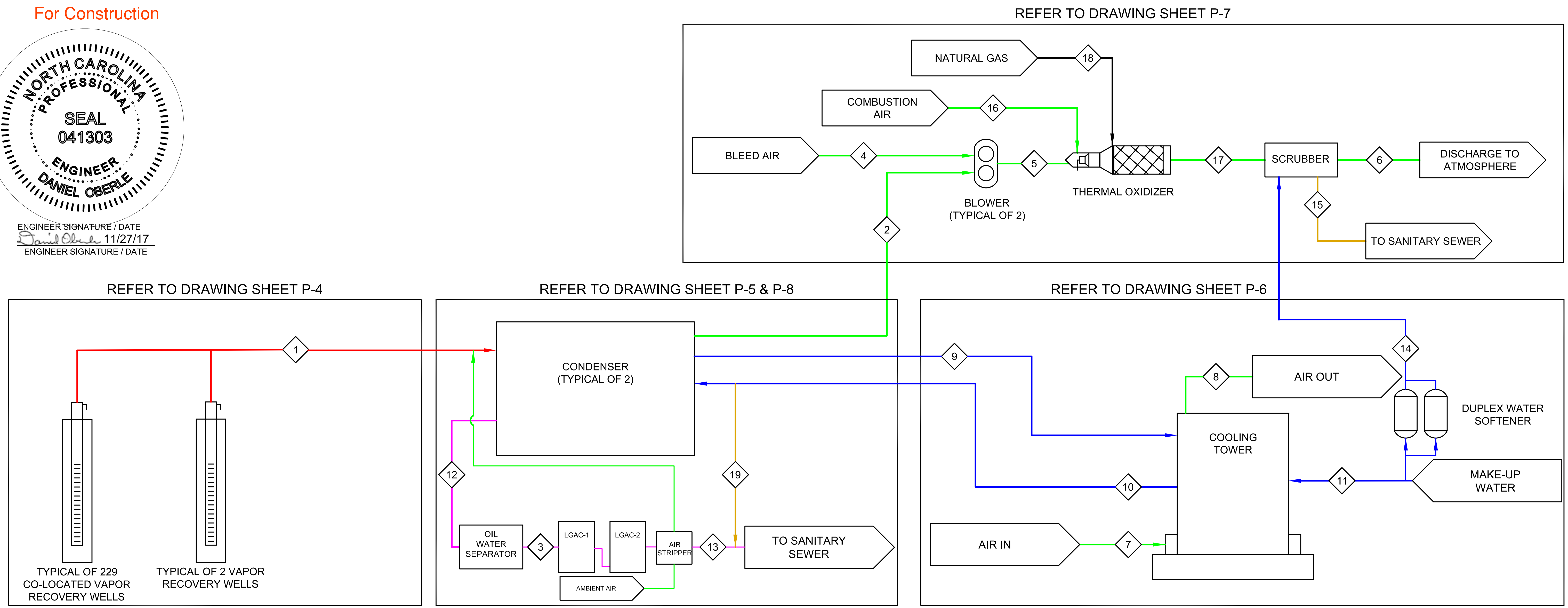
For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

ENGINEER SIGNATURE / DATE

11/27/17

ENGINEER SIGNATURE / DATE



P&ID LINE COLORS

- SOFTENED/POTABLE/CLEAN WATER
- PROCESS WATER
- AIR
- AIR/STEAM MIX
- BLOWDOWN
- FUEL

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27
SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

PROCESS FLOW DIAGRAM

APPROVED FOR CONSTRUCTION

BY

DATE

DATE	2017.NOV.20
PROJECT	NC.ASH.1821
SHEET	P-2

APPROVED

For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

ENGINEER SIGNATURE / DATE

11/27/17

ENGINEER SIGNATURE / DATE

Process Stream Description	Location #
Extracted air and steam from vapor recovery system	1
Discharge air from condenser after steam removal	2
Condensate discharge from oil water separator to LGAC	3
Bleed air to rotary lobe blower	4
Discharge air from rotary lobe blower	5
Discharge air from scrubber to atmosphere	6
Cooling air into cooling tower	7
Air exhaust from cooling tower	8
Recirculation water from condenser to cooling tower	9
Recirculation water from cooling tower to condenser	10
Make-up water for cooling tower from potable source	11
Condensate discharge to oil water separator	12
Condensate discharge after LGAC treatment	13
Scrubber make-up water	14
Scrubber blowdown water	15
Combustion air to regenerative thermal oxidizer	16
Discharge air from regenerative thermal oxidizer to scrubber	17
Natural gas to regenerative thermal oxidizer	18
Cooling tower blowdown	19

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY E. CROWNOVER	SITE CTS OF ASHEVILLE SUPERFUND SITE	
DRAWN BY A. PEABODY	LOCATION ASHEVILLE, NORTH CAROLINA	
CHECKED BY D. OBERLE	CLIENT CTS CORPORATION	
PROJECT MANAGER C. BLUNDY	PROCESS FLOW DIAGRAM STREAM LEGEND	
QSAT REVIEW 2017.NOV.27	APPROVED FOR CONSTRUCTION BY DATE	DATE 2017.NOV.20 PROJECT NC.ASH.1821 SHEET P-3

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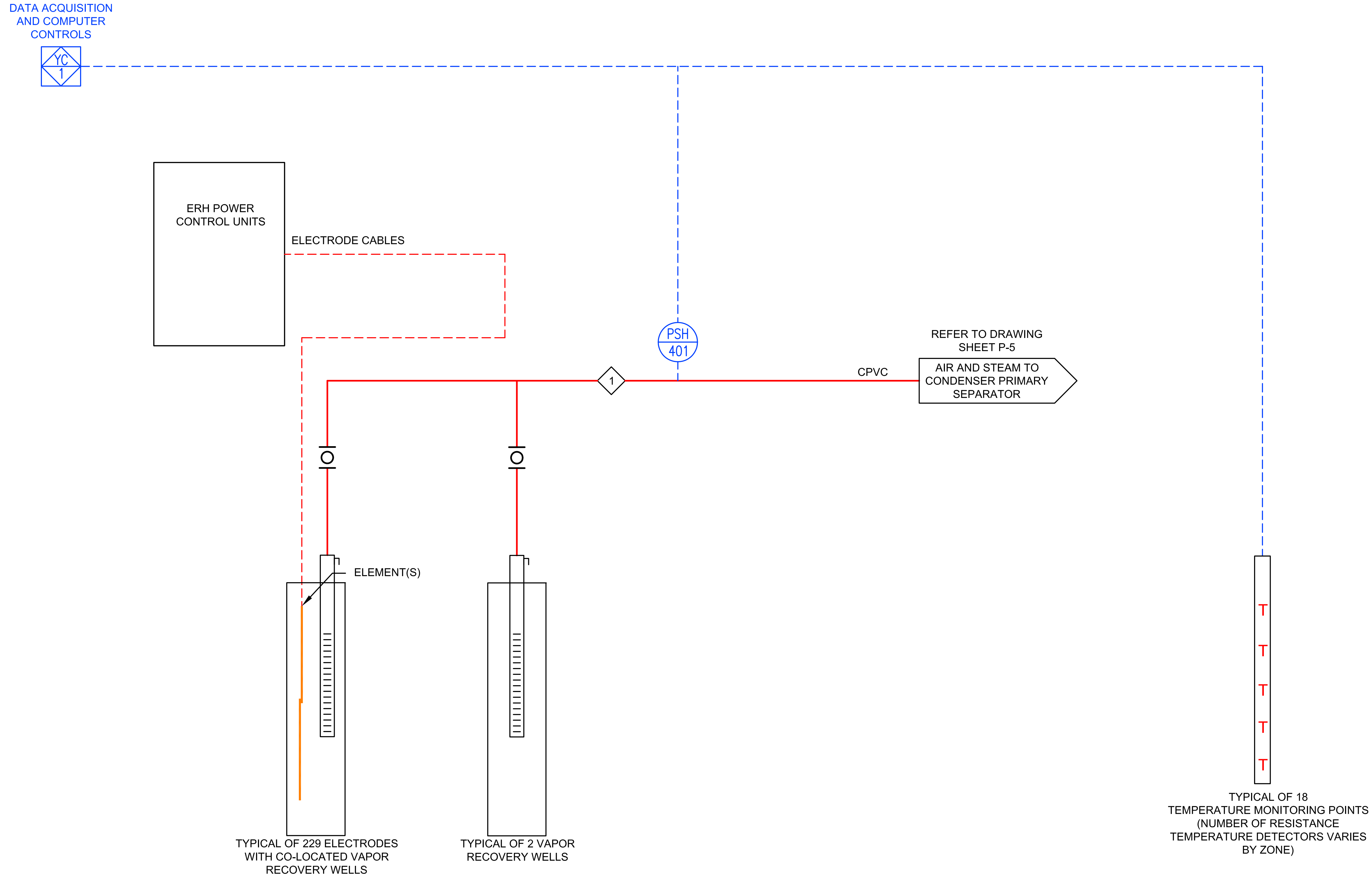
For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

ENGINEER SIGNATURE / DATE

11/27/17

ENGINEER SIGNATURE / DATE



NOTES

1. SEE THE ELECTRODE AND TEMPERATURE MONITORING POINT DETAILS FOR MORE INFORMATION ON THEIR CONSTRUCTION.

2. PSH-401 WILL SHUT DOWN THE PCU IN THE EVENT OF A LOW FIELD VACUUM (LESS THAN 2" H_20).

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY E. CROWNOVER	SITE CTS OF ASHEVILLE SUPERFUND SITE		
	LOCATION ASHEVILLE, NORTH CAROLINA		
DRAWN BY A. PEABODY	CLIENT CTS CORPORATION		
CHECKED BY D. OBERLE	FIELD PROCESS AND INSTRUMENTATION DIAGRAM		
PROJECT MANAGER C. BLUNDY	APPROVED FOR CONSTRUCTION	DATE 2017.NOV.20	PROJECT NC.ASH.1821
QSAT REVIEW 2017.NOV.27	BY ____ DATE ____	SHEET P-4	

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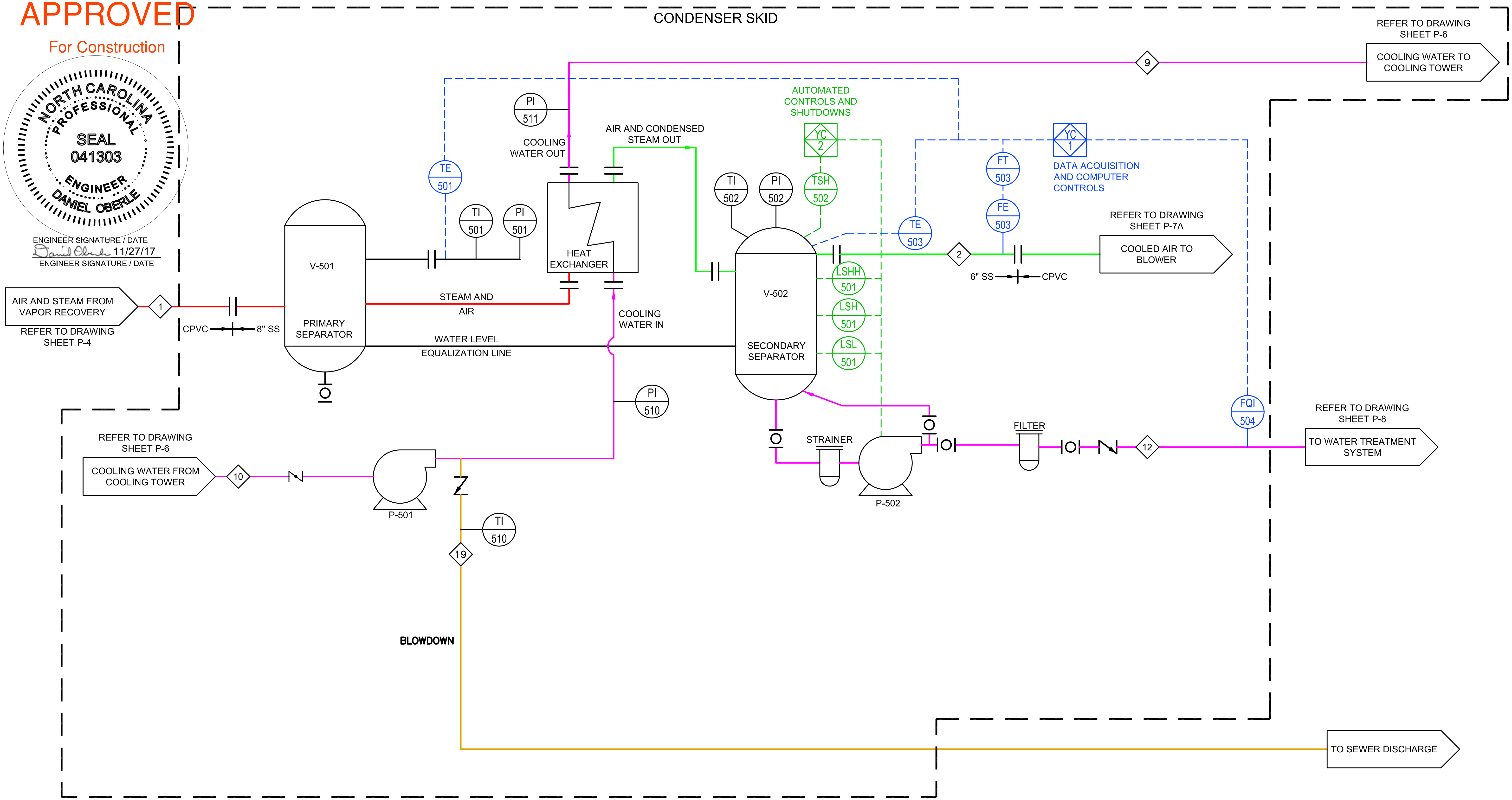
For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

ENGINEER SIGNATURE / DATE

11/27/17

ENGINEER SIGNATURE / DATE



NOTES:
1. LSHH-501 WILL SHUT DOWN THE VAPOR RECOVERY BLOWER AND POWER TO THE ELECTRODES.
2. TSH-502 WILL SHUT DOWN THE VAPOR RECOVERY BLOWER. TEMPERATURE SET POINT IS 140°F.
3. PROCESS LINE 9 SPLITS WITH HALF THE TOTAL FLOW (PROCESS LINE 9A) GOING TO EACH COOLING TOWER (SEE P-6).
4. THE HEAT EXCHANGER IS ASME 2 RATED.

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E.CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27

SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

CONDENSER

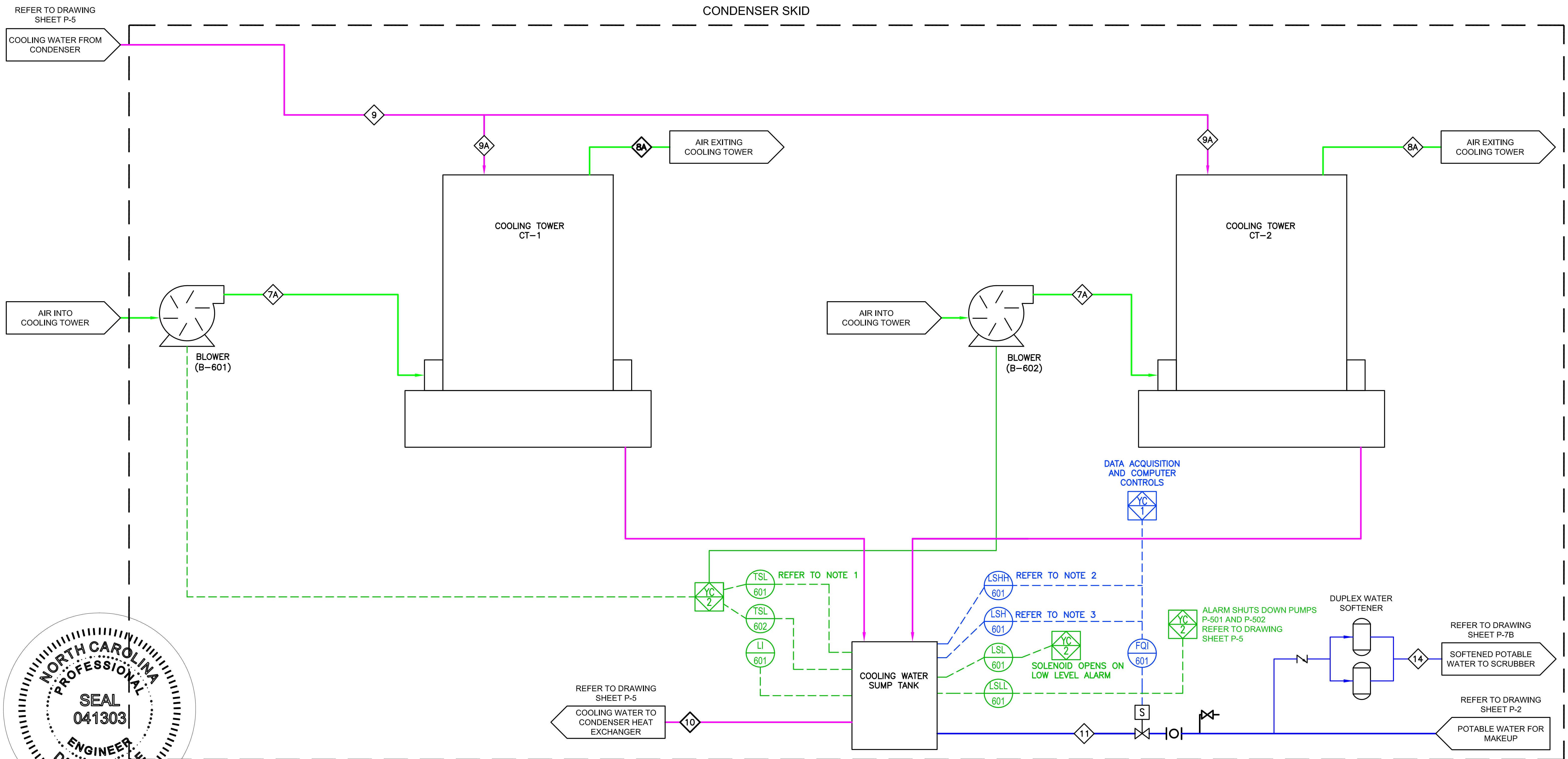
PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION

BY

DATE

DATE	2017.NOV.20
PROJECT	NC.ASH.1821
SHEET	P-5



NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

ENGINEER SIGNATURE / DATE
11/27/17
ENGINEER SIGNATURE / DATE

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For Construction

NOTES
1. TSL-601 AUTOMATICALLY SHUTS DOWN THE COOLING TOWER FAN AT 45° F. TSL-602 TURNS ON AN IMMERSION HEATER IN THE COOLING TOWER SUMP.
2. LSHH-601 SHUTS DOWN SYSTEM
3. LSH-601 OPENS BLOWDOWN SOLENOID AT CONDENSER.
4. LSL-601 MUST BE AT LEAST 2 FEET ABOVE PUMP INTAKE.
5. POTABLE MAKEUP WATER IS SUPPLIED TO THE COOLING WATER SUMP TANK, AS NEEDED, AT AN AVERAGE RATE OF 3-5 GPM IN 30 SECOND INCREMENTS.
6. PROCESS LINE 7 SPLITS WITH HALF THE TOTAL FLOW (PROCESS LINE 7A) GOING TO EACH COOLING TOWER (SEE P-2).
7. PROCESS LINE 8 IS THE COMBINATION OF PROCESS LINES 8A (ONE FROM EACH COOLING TOWER, SEE P-2).
8. PROCESS LINE 9 SPLITS WITH HALF THE TOTAL FLOW (PROCESS LINE 9A) GOING TO EACH COOLING TOWER (SEE P-2)

TRS Accelerating Value
TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY: E. CROWNOVER	SITE: CTS OF ASHEVILLE SUPERFUND SITE		
	LOCATION: ASHEVILLE, NORTH CAROLINA		
	CLIENT: CTS CORPORATION		
DRAWN BY: A. PEABODY	COOLING TOWER PROCESS AND INSTRUMENTATION DIAGRAM		
CHECKED BY: D. OBERLE			
PROJECT MANAGER: C. BLUNDY	APPROVED FOR CONSTRUCTION	DATE: 2017.NOV.20	PROJECT: NC.ASH.1821
QSAT REVIEW: 2017.NOV.27	BY ______ DATE ______	SHEET: P-6	

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For Construction

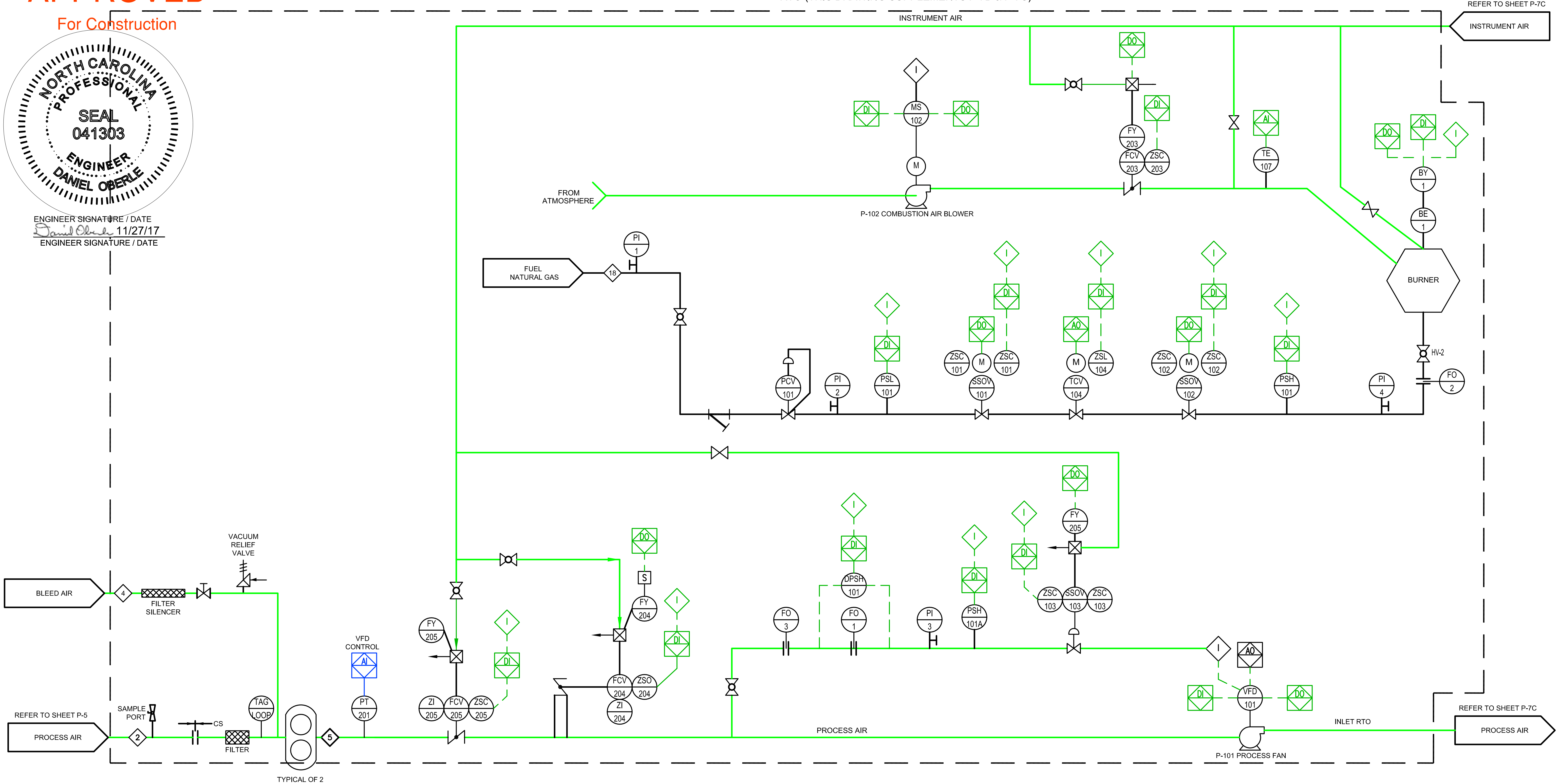
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 041303 DANIEL OBERLE

ENGINEER SIGNATURE / DATE

11/27/17

ENGINEER SIGNATURE / DATE

RTO (THIS DRAWING SUPPLEMENTS P-7B & P-7C)



TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY: E. CROWNOVER	SITE: CTS OF ASHEVILLE SUPERFUND SITE	
DRAWN BY: A. PEABODY	LOCATION: ASHEVILLE, NORTH CAROLINA	
CHECKED BY: D. OBERLE	CLIENT: CTS CORPORATION	
PROJECT MANAGER: C. BLUNDY	BLOWER AND THERMOX PROCESS AND INSTRUMENTATION DIAGRAM	
QSAT REVIEW: 2017.NOV.27	APPROVED FOR CONSTRUCTION BY ____ DATE ____	DATE 2017.NOV.20; PROJECT NC.ASH.1821; SHEET P-7A

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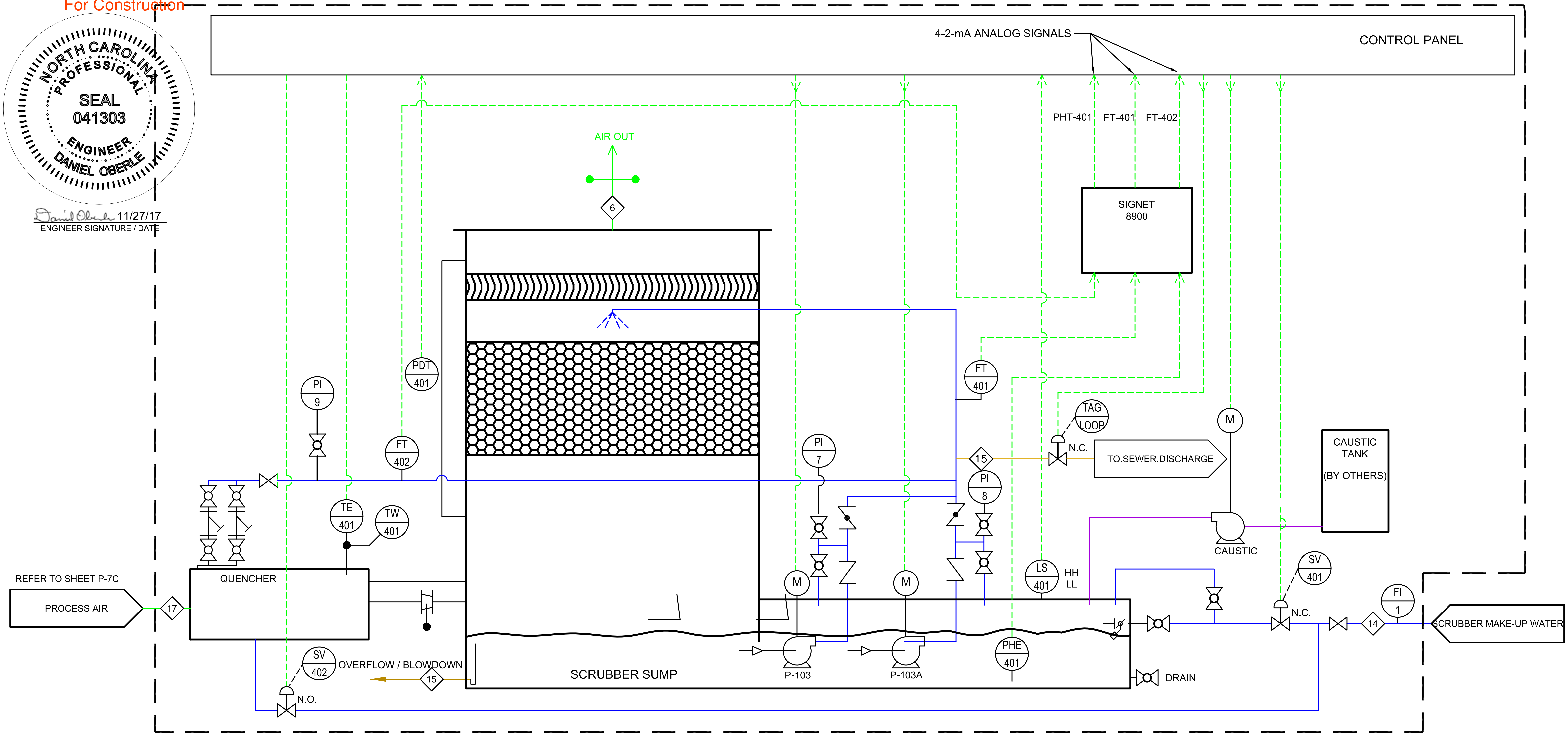
For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

11/27/17

ENGINEER SIGNATURE / DATE

RTO SCRUBBER (THIS DRAWING SUPPLEMENTS P-7A & P-7C)



TRS Accelerating Value

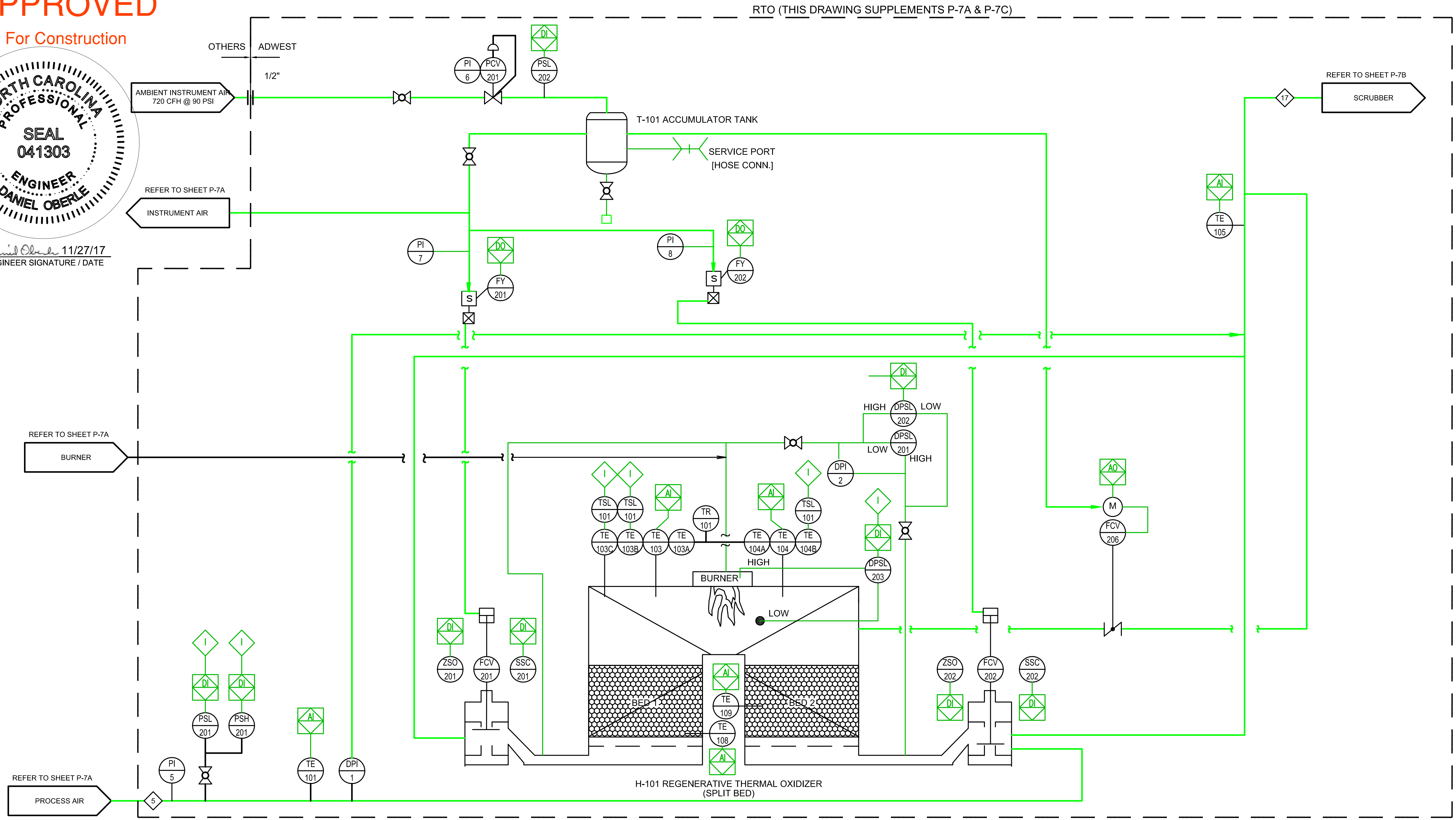
TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY E. CROWNOVER	SITE / LOCATION / CLIENT	CTS OF ASHEVILLE SUPERFUND SITE ASHEVILLE, NORTH CAROLINA CTS CORPORATION	
DRAWN BY A. PEABODY	BLOWER AND THERMOX PROCESS AND INSTRUMENTATION DIAGRAM		
CHECKED BY D. OBERLE			
PROJECT MANAGER C. BLUNDY	APPROVED FOR CONSTRUCTION	DATE 2017.NOV.20	PROJECT NC.ASH.1821
QSAT REVIEW 2017.NOV.27	BY ______ DATE ______	SHEET	P-7B

APPROVED
For Construction

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 041303 DANIEL OBERLE

11/27/17
ENGINEER SIGNATURE / DATE



DESIGNED BY	SITE	CTS OF ASHEVILLE SUPERFUND SITE
E. CROWNOVER	LOCATION	ASHEVILLE, NORTH CAROLINA
DRAWN BY A. PEABODY	CLIENT	CTS CORPORATION
CHECKED BY D. OBERLE	BLOWER AND THERMOX PROCESS AND INSTRUMENTATION DIAGRAM	
PROJECT MANAGER C. BLUNDY	APPROVED FOR CONSTRUCTION	DATE 2017.NOV.20 / PROJECT NC.ASH.1821
QSAT REVIEW 2017.NOV.27	BY ____ DATE ____	SHEET P-7C

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

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For Construction

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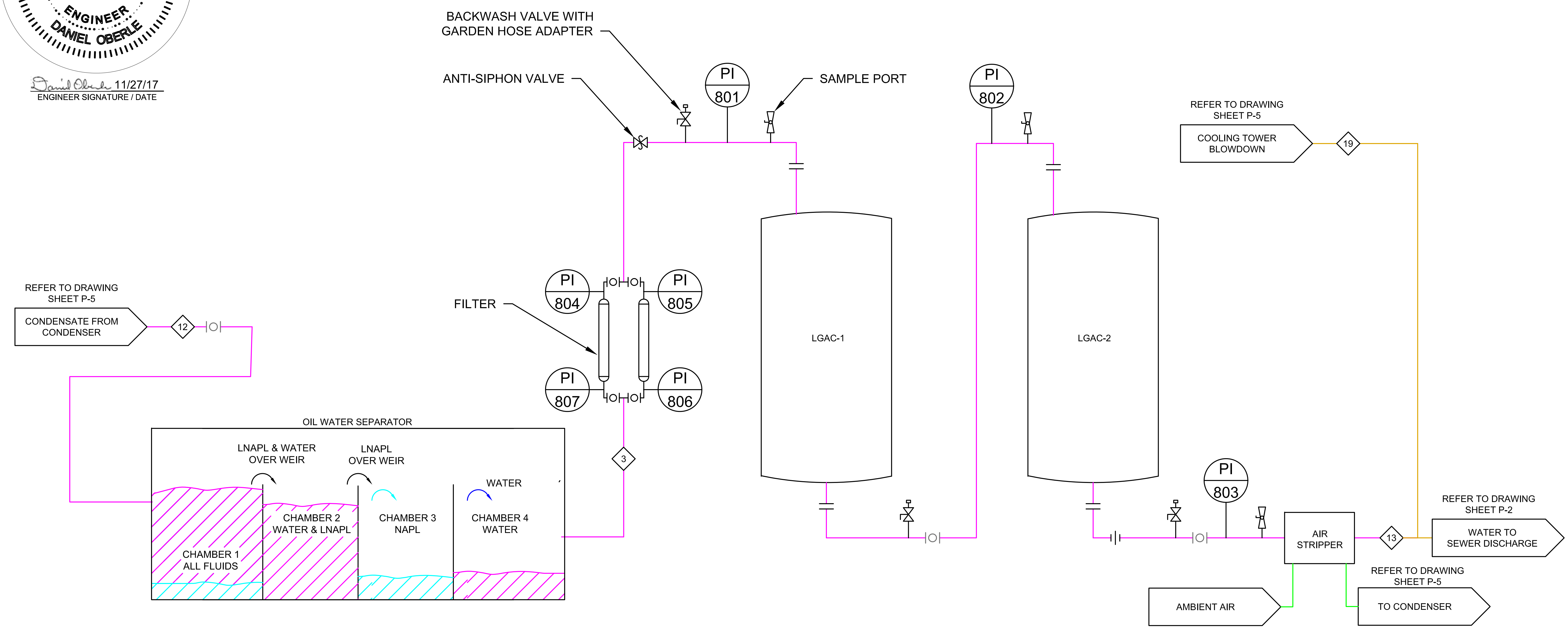
[signature] 11/27/17

ENGINEER SIGNATURE / DATE



TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27

SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

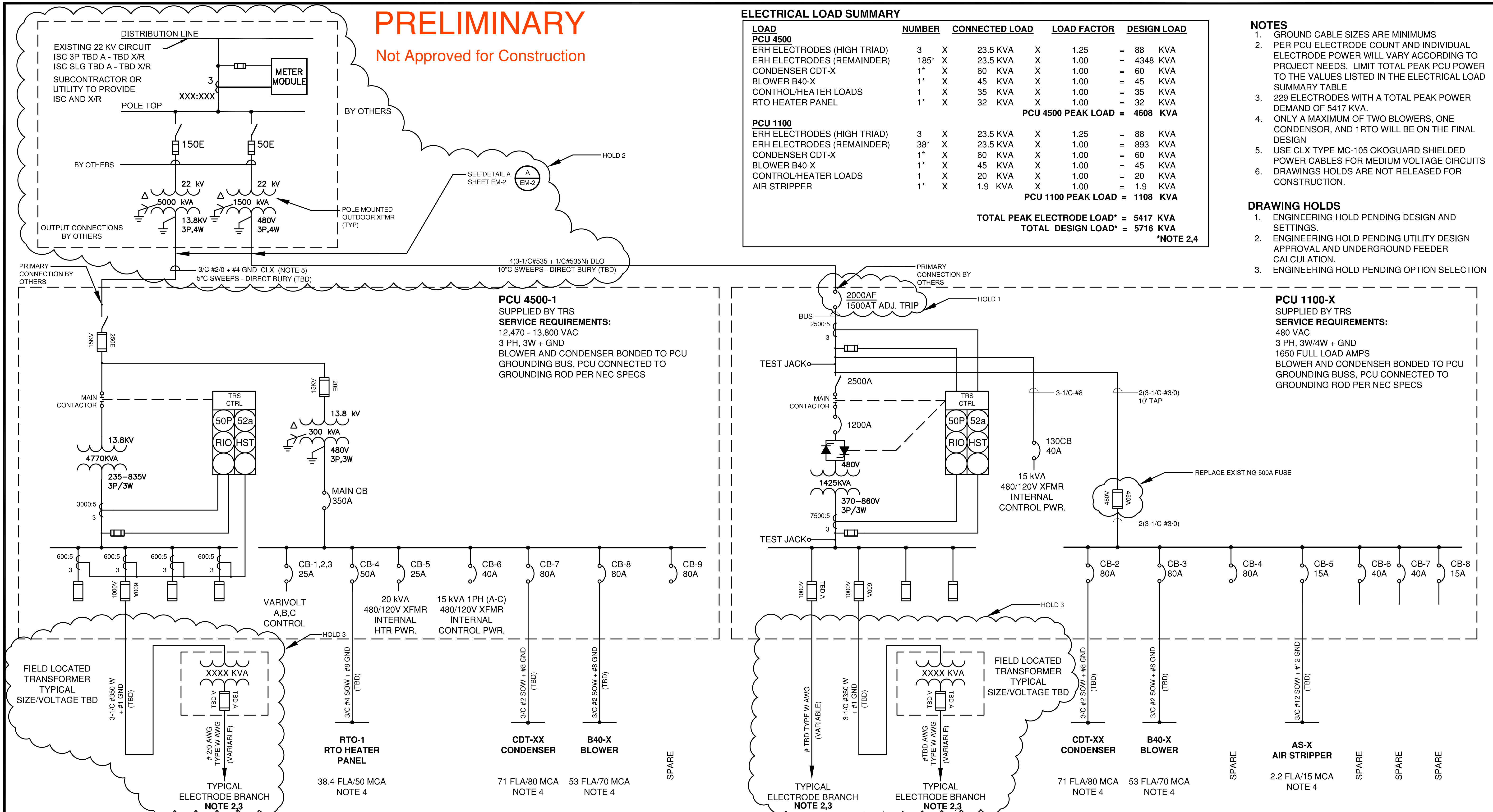
WATER TREATMENT PROCESS AND INSTRUMENTATION DIAGRAM

APPROVED FOR CONSTRUCTION

BY ____________

DATE ____________

DATE	2017.NOV.20	PROJECT	NC.ASH.1821
SHEET	P-8		



ELECTRICAL LOAD SUMMARY

LOAD	NUMBER		CONNECTED LOAD		LOAD FACTOR		DESIGN LOAD
PCU 4500							
ERH ELECTRODES (HIGH TRIAD)	3	X	23.5 KVA	X	1.25	=	88 KVA
ERH ELECTRODES (REMAINDER)	185*	X	23.5 KVA	X	1.00	=	4348 KVA
CONDENSER CDT-X	1*	X	60 KVA	X	1.00	=	60 KVA
BLOWER B40-X	1*	X	45 KVA	X	1.00	=	45 KVA
CONTROL/HEATER LOADS	1	X	35 KVA	X	1.00	=	35 KVA
RTO HEATER PANEL	1*	X	32 KVA	X	1.00	=	32 KVA
					PCU 4500 PEAK LOAD	=	4608 KVA
PCU 1100							
ERH ELECTRODES (HIGH TRIAD)	3	X	23.5 KVA	X	1.25	=	88 KVA
ERH ELECTRODES (REMAINDER)	38*	X	23.5 KVA	X	1.00	=	893 KVA
CONDENSER CDT-X	1*	X	60 KVA	X	1.00	=	60 KVA
BLOWER B40-X	1*	X	45 KVA	X	1.00	=	45 KVA
CONTROL/HEATER LOADS	1	X	20 KVA	X	1.00	=	20 KVA
AIR STRIPPER	1*	X	1.9 KVA	X	1.00	=	1.9 KVA
					PCU 1100 PEAK LOAD	=	1108 KVA
					TOTAL PEAK ELECTRODE LOAD*	=	5417 KVA
					TOTAL DESIGN LOAD*	=	5716 KVA
							*NOTE 2,4

NOTES

1. GROUND CABLE SIZES ARE MINIMUMS
2. PER PCU ELECTRODE COUNT AND INDIVIDUAL ELECTRODE POWER WILL VARY ACCORDING TO PROJECT NEEDS. LIMIT TOTAL PEAK PCU POWER TO THE VALUES LISTED IN THE ELECTRICAL LOAD SUMMARY TABLE
3. 229 ELECTRODES WITH A TOTAL PEAK POWER DEMAND OF 5417 KVA.
4. ONLY A MAXIMUM OF TWO BLOWERS, ONE CONDENSOR, AND 1RTO WILL BE ON THE FINAL DESIGN
5. USE CLX TYPE MC-105 OKOGUARD SHIELDED POWER CABLES FOR MEDIUM VOLTAGE CIRCUITS
6. DRAWINGS HOLDS ARE NOT RELEASED FOR CONSTRUCTION.

DRAWING HOLDS

1. ENGINEERING HOLD PENDING DESIGN AND SETTINGS.
2. ENGINEERING HOLD PENDING UTILITY DESIGN APPROVAL AND UNDERGROUND FEEDER CALCULATION.
3. ENGINEERING HOLD PENDING OPTION SELECTION

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

DESIGNED BY: B. BRACKENSICK	SITE: CTS OF ASHEVILLE SUPERFUND SITE		
	LOCATION: ASHEVILLE, NORTH CAROLINA		
	CLIENT: CTS CORPORATION		
DRAWN BY: A. PEABODY	ELECTRICAL ONE-LINE DIAGRAM		
CHECKED BY: PENDING APPROVAL			
PROJECT MANAGER: C. BLUNDY	APPROVED FOR CONSTRUCTION	DATE: 2017.OCT.16	PROJECT: NC.ASH.1821
QSAT REVIEW: 2017.NOV.27	BY ______ DATE ______	SHEET	E-1

APPENDIX D

CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL PLAN

CONSTRUCTION QUALITY ASSURANCE/ QUALITY CONTROL PLAN

CTS OF ASHEVILLE, INC. SUPERFUND SITE

235 Mills Gap Road
Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
Consent Decree – Civil Action No. 1:16-cv-380

Prepared for:

CTS Corporation
2375 Cabot Drive
Lisle, Illinois 60532

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
1308 Patton Avenue
Asheville, North Carolina 28806

Amec Foster Wheeler Project 6252-16-2012

November 27, 2017

TABLE OF CONTENTS

LIST OF ACRONYMS

CD	Consent Decree
CQA/QCP	Construction Quality Assurance/Quality Control Plan
ERH	electric resistivity heating
FI	Field Inspector
IRA	Interim Remedial Action
LNAPL	light non-aqueous phase liquid
NCDEQ	North Carolina Department of Environmental Quality
OWS	oil water separator
PC	Project Coordinator
PCU	power control unit
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
RAO	remedial action objective
RTO	regenerative thermal oxidizer
SM	Site Manager
SOW	Statement of Work
TCE	trichloroethene
USEPA	United States Environmental Protection Agency

DOCUMENT REVISION LOG

Revision	Date	Description
0	9/29/2017	Initial Issuance (with ERH Preliminary Remedial Design)
1	11/27/2017	Revised and submitted with ERH Final Remedial Design

1.0 INTRODUCTION

This Construction Quality Assurance/Quality Control Plan (CQA/QCP) describes the construction quality program for the proposed interim remedial action (IRA) at the CTS of Asheville, Inc. Superfund Site (Site) located at 235 Mills Gap Road in Asheville, Buncombe County, North Carolina. The construction quality assurance (QA) and quality control (QC) activities described herein will be performed to comply with Paragraphs 3.5(h) and 6.7(f) of the Statement of Work (SOW) of the Consent Decree for Interim Remedial Design/Remedial Action (CD) at the Site between the United States of America and CTS Corporation, Mills Gap Road Associates, and Northrop Grumman Systems Corporation.

This CQA/QCP pertains to construction activities performed at the Site related to the electric resistivity heating (ERH) portion of the IRA as described in the Final Remedial Design, dated November 27, 2017.

1.1 OBJECTIVE

The objective of the CQA/QCP is to identify procedures that ensure overall project management is maintained, production and quality are in compliance with project requirements, and construction deficiencies are identified and corrected in a timely manner.

The CQA/QCP describes planned and systematic activities that provide confidence that the remedial action construction will satisfy plans, specifications, and related requirements.

1.2 IMPLEMENTATION

Implementation of the CQA/QCP requires an appropriate organizational structure and a feedback system accomplishing the following key processes:

- Describes procedures that ensure site tasks/construction will be in accordance with project plans and specifications.
- Establishes personnel responsibility for tasks and communication procedures for successful completion of the project.

- Identifies and tracks construction deficiencies through corrective action.
- Provides technical review, follow-up, and correction.
- Documents quality activities and retaining quality documents.

2.0 PROJECT ORGANIZATION

An organizational structure has been developed to provide overall technical and administrative management control to accomplish the project task and quality objectives. This organizational structure assures that project objectives are defined and that competent team members have been assigned responsibility for performing the work.

The project organizational chart is included in Appendix A.

2.1 REGULATORY AGENCIES

The United States Environmental Protection Agency (USEPA) is the lead agency overseeing design and implementation of the IRA. The USEPA will review/approve plans and reports related to design and implementation of the IRA. The USEPA Remedial Project Manager is Mr. Craig Zeller, P.E.

The North Carolina Department of Environmental Quality (NCDEQ) will consult with USEPA during design and implementation of the IRA. NCDEQ will review submittals and provide comments to USEPA.

2.2 SETTLING DEFENDANTS

The Settling Defendants are designated in the CD as CTS Corporation, Mills Gap Road Associates, and Northrop Grumman Systems Corporation. Mr. George Lytwynyshyn of CTS Corporation is the Settling Defendants' Project Coordinator (PC), as defined in the CD, and will provide overall responsibility for procuring contractors/consultants, budgeting and assuring the requirements of the IRA are achieved. Mills Gap Road Associates is the owner of the property located at 235 Mills Gap Road, and will provide access to the Site. Northrop Grumman Systems Corporation will provide additional review of project documents.

2.3 SUPERVISING CONTRACTOR

Amec Foster Wheeler is the Supervising Contractor procured by CTS Corporation to direct and supervise the technical aspects of designing and implementing the IRA.

The Amec Foster Wheeler Project Manager (PM) is Mr. Matthew Wallace, P.E. The Project Manager's primary responsibility is executing the project and achieving quality in the delivery of services for the project.

The Amec Foster Wheeler Site Manager (SM) and CQA Manager is Ms. Susan Avritt, P.E., L.G. As the SM, Ms. Avritt will monitor and approve each contractor's quality and progress submittals to ensure construction activities are in accordance with project plans and specifications. As the CQA Manager, Ms. Avritt will perform actions necessary for the completion of the QA and QC program in accordance with project plans and specifications. The CQA Manager or designee is assigned to the project full time and has the authority to stop work when quality objectives are not met.

Amec Foster Wheeler Field Inspectors (FIs) will monitor day-to-day activities of the contractor to ensure compliance with project plans and specifications, good workmanship and the QC requirements. The FIs will maintain accurate records of the contractor's work and will complete inspection and testing/inspection documentation.

Amec Foster Wheeler's activities will be performed in accordance with the firm's Quality Management Plan (revision number 3, dated June 10, 2016), which was prepared in accordance with the USEPA's QA/R-2 requirements for Quality Management Plans.

2.4 ERH CONTRACTOR

TRS Group, Inc. (TRS) is the ERH contractor responsible for design and implementation of the ERH IRA. TRS will contract with CTS, with technical support and oversight by Amec Foster Wheeler. The TRS Project Manager is Mr. Chris Blundy. TRS has a team of task managers, engineers, technicians and safety personnel to support the project, including a QC Manager.

2.5 ERH TECHNICAL CONSULTANT

Haley & Aldrich, Inc. (H&A) is the ERH technical consultant responsible for providing additional technical review of the ERH design. H&A will contract with CTS, and provide technical support to CTS and Amec Foster Wheeler. The H&A Principal Consultant is Dr. Michael Basel.

2.6 DRILLING CONTRACTORS

The drilling contractor(s) will be contracted by CTS with technical support and oversight by Amec Foster Wheeler. Amec Foster Wheeler will perform oversight of the drilling activities for installation of subsurface ERH system components and monitoring well/soil borings. TRS will also provide oversight of the installation of the subsurface ERH system components which will be performed by the drilling contractor(s). The drilling contractors are AE Drilling Services, LLC and Geologic Exploration, Inc.

2.7 ANALYTICAL LABORATORIES

Pace Analytical Services will be contracted by Amec Foster Wheeler to perform laboratory analyses of soil and water samples. ALS Environmental will be contracted by Amec Foster Wheeler to perform laboratory analyses of air samples. The Pace Analytical Services Quality Assurance Manual was included in the Remedial Design Work Plan: Quality Assurance Project Plan dated April 19, 2017. The ALS Environmental Quality Assurance Manual was included with the Vapor Intrusion Assessment Work Plan: Quality Assurance Project Plan (Revision 4) dated March 14, 2014. Current/updated versions of these laboratory Quality Assurance Manuals, if applicable, will be obtained and submitted to USEPA prior to implementation of the IRA.

3.0 MAJOR SITE TASKS AND OPERATIONS

The overall remedial action objective (RAO) of the IRA is a 95 percent reduction of trichloroethene (TCE) concentrations in subsurface media in the two identified remediation areas of the Site. This CQA/QCP pertains to the ERH IRA.

ERH will be implemented in an approximate 1.2-acre portion of the Site. This area is generally considered the source area and, in addition to TCE, contains light non-aqueous phase liquid (LNAPL) consisting of weathered fuel oil. In this area, TCE exists in three states: dissolved in groundwater, sorbed to soil, and partitioned in the petroleum LNAPL. The RAO of a 95 percent reduction of TCE will be applied to soil, groundwater and LNAPL samples in this 1.2-acre source area.

3.1 INSTALLATION OF ELECTRODES AND SUBSURFACE MONITORING EQUIPMENT

Prior to ground disturbance activities, ground penetrating radar will be performed in the treatment area to identify underground utilities, such as water and natural gas lines.

A North Carolina-licensed surveyor will document the perimeter of the treatment area and the preconstruction topographic grades prior to installing the electrodes in the treatment area. The surveyor will mark the designated electrode and monitoring locations within the treatment area. The boring locations include electrodes, temperature monitoring points, monitoring well pair locations (one shallow and one deep), and soil boring locations.

A North Carolina-licensed well contractor will install borings to drilling refusal or prescribed depths to accommodate placement of the subsurface ERH components. Amec Foster Wheeler and TRS personnel will be onsite to observe and document the details of the constructed ERH components. Drilling and electrode/monitoring equipment installation information will be recorded and compared to design plans and specifications.

3.2 TREATMENT OF EXTRACTED WATER

A water management system will be designed and constructed by TRS to collect, handle and treat water generated during operation of the system. Treated water will be discharged to the Metropolitan Sewerage District of Buncombe County municipal sewer. Amec Foster Wheeler will coordinate permitting and construction of the discharge piping to the sewer system. Amec Foster Wheeler will be responsible for collection of effluent wastewater samples that will be submitted to the laboratory for analysis in accordance with permit conditions.

3.3 TREATMENT OF EXTRACTED VAPORS

A vapor treatment system will be designed, constructed and operated by TRS. Extracted vapors will be treated using a regenerative thermal oxidizer (RTO). TRS will be responsible for operation of the RTO and will provide documentation that the RTO is operating within the design specifications.

Amec Foster Wheeler will observe the installation and operation of the vapor treatment system. Amec Foster Wheeler will be responsible for collection of influent and effluent air samples that will be submitted to the laboratory for analysis.

3.4 SYSTEM OPERATION AND MONITORING

Once system equipment is constructed by TRS, TRS will provide the labor and resources to operate and maintain the ERH system. The power control units (PCUs), energized power lines, electrodes, and vapor/water treatment systems will be monitored and maintained by experienced professionals familiar with the ERH system. System status, operating times, and maintenance activities will be documented on daily, weekly, and monthly reports, as necessary to document operation and performance of the system. Operational information will be maintained in an electronic database.

3.5 WASTE MANAGEMENT

The waste streams generated from site activities (drill cuttings, spent liquid-phase granular activated carbon, LNAPL) will be managed by Amec Foster Wheeler as described in the Final Remedial Design.

4.0 VERIFICATION AND INSPECTION ACTIVITIES

4.1 GENERAL CONSTRUCTION INSPECTION AND VERIFICATION REQUIREMENTS

QA inspection/testing will be used to evaluate the sufficiency and effectiveness of the contractor QC program. To confirm construction quality and maintain compliance with design drawings and specifications, inspections of work will be conducted in three phases:

- Initial
- Progress
- Final

The CQA Manager or a designee will perform the phased inspections for each major construction task at a minimum. Inspections will be documented. Construction quality inspection of each major construction task, as described in Section 3.0, is listed below.

4.1.1 Initial Inspections

An initial inspection will be performed before the beginning of a major construction task focusing on the work area, materials and equipment. The delineated work area will be inspected to confirm it is free of obstructions that could impact the construction tasks. Materials and equipment will be inspected for defects and compliance with project plans and specifications prior to use. In addition, the CQA Manager and the ERH Contractor will confirm field personnel have clear understandings of tasks to be completed and the CQA and HASP requirements.

4.1.2 Progress Inspections

Daily construction progress inspections will be conducted by the CQA Manager. These inspections will focus on the quality of construction and compliance with CQA, HASP and project plans and specifications. Inspection information and photographs will be recorded. Defects or non-compliance with project plans and specifications will be communicated to the ERH Contractor and Supervising Contractor PM for timely resolution.

4.1.3 Final Inspections

A final inspection will be performed by the CQA Manager at the completion of each major site task for quality, completeness, and compliance with project plans and specifications.

Final inspections will be documented and reported by the Supervising Contractor PM. If defects are identified during final inspections, they will be corrected and re-inspected before the task is considered complete.

4.2 QC TESTING

The ERH Contractor will be responsible for establishing a program to identify, perform and document required QC testing. The test program will be comprised of a system of daily testing reports that will record QC tests. Daily testing reports will created by the CQC Manager and submitted to the CQA Manager prior to the start of the next day's work. The CQA Manager will review daily test results for non-conformance and hold discussions with the contractor for potential corrective action.

4.3 QA TESTING

The CQA Manager will be responsible for the QA testing and inspection program which will verify the sufficiency and effectiveness of the contractor's QC testing. QA testing shall be performed independent of and in addition to QC testing as the discretion of the CQA Manager. Typical test frequencies shall be: one QA test for every ten to fifteen construction contractor QC tests. However more frequent testing, such as during initial start-up, may be necessary to meet project plans and specifications as determined by the CQA Manager. When QA and QC tests differ greatly or do not compare, additional testing may be required to validate results.

4.4 CONSTRUCTION AUDITS

The ERH Contractor will establish and document a system to verify their (or their subcontractors) conformance to the QC procedures defined in this plan. Audits shall be performed by properly trained personnel who are familiar with the QC program. Non-conformance conditions identified will be re-audited to evaluate the effectiveness of the corrective action.

5.0 CONSTRUCTION DEFICIENCIES

Construction deficiencies (non-conformance with project plans or specifications) will be tracked from identification through corrective action.

5.1 IDENTIFICATION OF CONSTRUCTION DEFICIENCIES

Construction deficiencies will be identified when a performed work, material, or installation does not meet project plans or specifications.

5.2 CONTROL OF CONSTRUCTION DEFICIENCIES

When a construction deficiency is identified, the CQA Manager (or designee) will ensure the deficiency is controlled to prevent unintended use or further deficient action. The CQA Manager will notify the Supervising Contractor PM who will then notify the ERH Contractor of the deficiency and applicable foregoing requirements. The ERH Contractor will take corrective action after notification. The CQA Manager will verify that corrective actions have been completed.

Minor deficiencies include items that will not result in significant deviations from the project plan or specification if corrected immediately. Since minor deficiencies do not require significant repair work to correct, they will be noted in the Daily Construction Report and verbally communicated to the contractor by the CQA Manager (or designee). These deficiencies should be corrected quickly and by agreement with the contractor and should not require further action.

Major deficiencies include major deviations or non-conformance with project plans or specifications or quality standards and must be formally documented for corrective action by the PM in non-conformance reports. A log of non-conformances will be tracked through verification that the non-conformance has been corrected. Minor deficiencies not corrected by the contractor within five days of notification will also result in a major deficiency.

5.3 CORRECTION OF CONSTRUCTION DEFICIENCIES

After notification of the construction deficiency, the ERH Contractor will implement correction actions to remedy the work, material, or installation which does not meet project plans or specifications. The corrective actions will remove and replace deficient work in accordance to procedures set forth by the Supervising Contractor PM. Replacement of work will be completed under the QC/QA inspection and testing requirements.

6.0 DOCUMENTATION

6.1 DAILY RECORD KEEPING

Daily inspection and test documentation will be prepared and signed by personnel performing the corresponding inspection or test. The documentation will vary depending on the inspection or test but at a minimum will include: location of inspection activity or location sample was collected, observation, test data, results of inspection/test, and personnel involved.

Daily construction reports will be prepared and signed and at a minimum will include a summary of the contractor's daily activities, descriptions of problems or delays, and progress photos. Daily inspection and test documentation will be attached to the daily construction reports.

Daily construction reports will be submitted to the project QC/QA file and maintained as part of the project permanent record. The reports will be reviewed by the Supervising Contractor PM and CQA Manager.

6.2 RECORD/AS-BUILT DRAWINGS

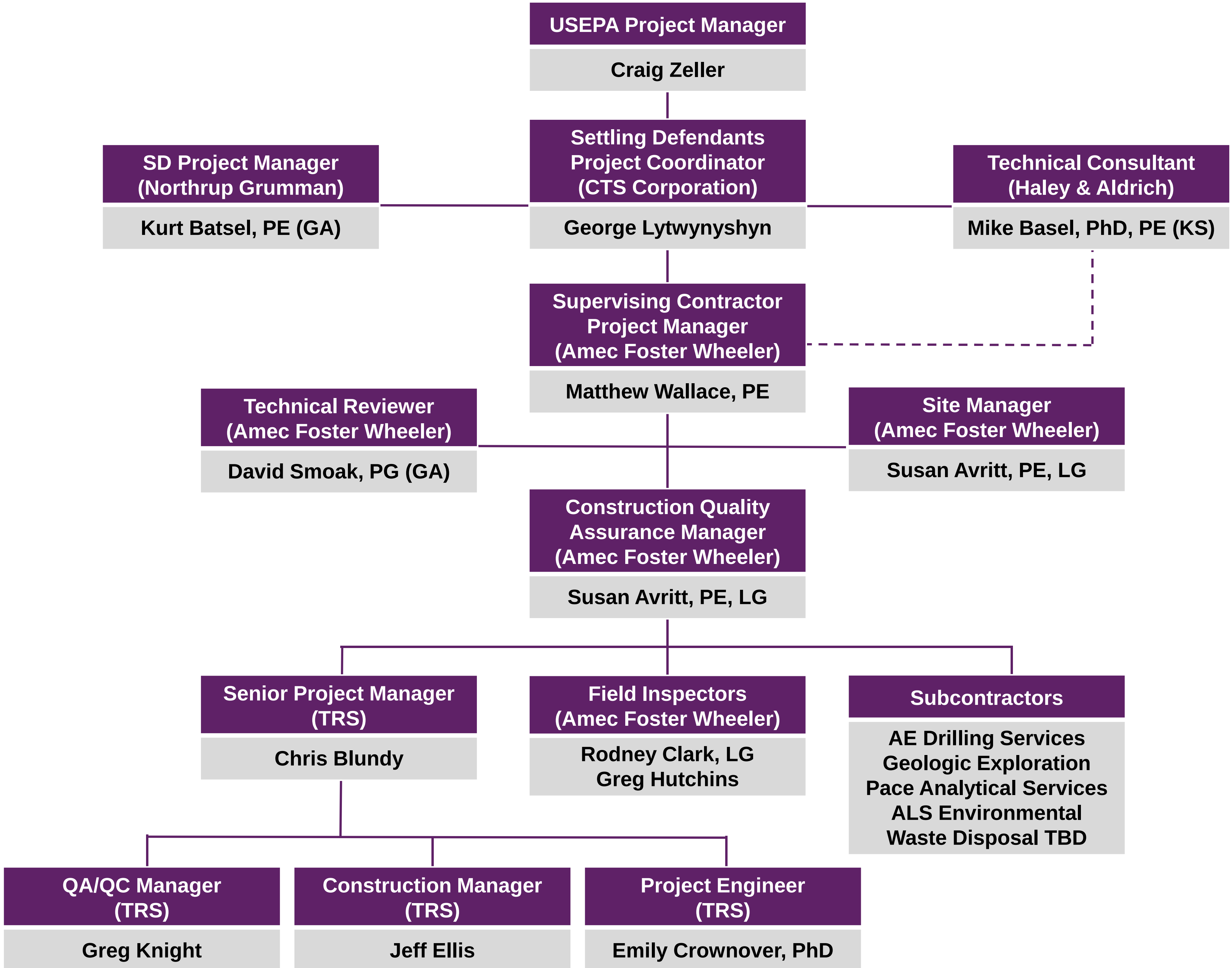
The Supervising Contractor will survey as-built features, in consultation with the ERH Contractor. The ERH Contractor will submit as-built process drawings, if different from the construction drawings, to the Supervising Contractor PM for review and comment. The ERH Contractor will address comments and submit finalized record drawings.

6.3 RETENTION AND CONTROL OF QUALITY RECORDS

The CQA Manager maintains copies of quality records including daily construction reports, inspection checklists, and non-conformance reports. Documentation will be stored in files maintained by Amec Foster Wheeler. Quality records will be available for inspection and audit.

APPENDIX A

PROJECT ORGANIZATION CHART


USEPA Project Manager
Craig Zeller
Settling Defendants Project Coordinator (CTS Corporation)
George Lytwynyshyn
SD Project Manager (Northrup Grumman)
Kurt Batsel, PE (GA)
Technical Consultant (Haley & Aldrich)
Mike Basel, PhD, PE (KS)
Supervising Contractor Project Manager (Amec Foster Wheeler)
Matthew Wallace, PE
Technical Reviewer (Amec Foster Wheeler)
David Smoak, PG (GA)
Site Manager (Amec Foster Wheeler)
Susan Avritt, PE, LG
Construction Quality Assurance Manager (Amec Foster Wheeler)
Susan Avritt, PE, LG
Senior Project Manager (TRS)
Chris Blundy
Field Inspectors (Amec Foster Wheeler)
Rodney Clark, LG
Greg Hutchins
Subcontractors
AE Drilling Services
Geologic Exploration
Pace Analytical Services
ALS Environmental
Waste Disposal TBD
QA/QC Manager (TRS)
Greg Knight
Construction Manager (TRS)
Jeff Ellis
Project Engineer (TRS)
Emily Crownover, PhD