LIGHTNING PROTECTION SYSTEM

A UL, Master Label certified lightning protection system will be provided in compliance with NFPA 780. Down conductors will be run to ground rods placed at every other column.

FIRE ALARM SYSTEM

The fire alarm system will be an addressable, stand alone system designed to provide evacuation notification of building occupants. The system will also monitor and control the mechanical equipment smoke control functions. The Fire Alarm Control Panel (FACP) will be installed in the main electric room. The FACP will be sized for an anticipated maximum quantity of detection appliances and notification appliances.

Fire Alarm Equipment

Control Equipment

- Control equipment are modular in construction, UL listed, and housed in a surface-mounted steel cabinet. Operating voltage is 24 V DC. Standby power is furnished by a 24-hour self-contained emergency battery power supply.
- The main fire alarm control panel includes solid state construction, plug-in modules and dead front construction. Signaling line circuits and initiating device circuits are arranged so that the number of connected devices does not exceed 75% of circuit capacity. The fire alarm annunciator is an LCD display with minimum 40 character capacity.

Remote Annunciators

- Remote annunciators are LCD display type to mimic all outputs from the main fire alarm control panel and are provided at a location convenient to the building occupants and the fire department. 11" x 17" fire alarm system floor plans are framed with glass and installed adjacent to the remote annunciator.

Alarm Initiating Devices

- Alarm initiating devices includes addressable manual pull stations, fire suppression flow switches, monitor modules, duct detectors, and smoke detectors. Addressable monitor modules are provided for nonaddressable devices including sprinkler water flow switches, sprinkler pressure switches, and valve tamper switches. System will initiate an alarm upon receipt of initiating signal from the dry chemical fire suppression system.

Notification Devices

- Alarm signaling devices will consist of alarm horns and strobe lights.
- Auxiliary functions are performed by control modules located within 36" of the controls for the equipment to be operated.
- Alarm signaling devices shall provide a sound pressure level of 15 decibels (dBA) above the ambient level. Maximum sound pressure level for alarm devices shall be 100 dBA.

System Operation

- Upon activation of any alarm initiating device, the following response will automatically occur:
    - Speakers will sound and strobe lights will flash throughout the building.
    - The activated alarm device are visually identified on the main fire alarm control panel and the remote annunciator panel.
    - Control modules will stop air handling units serving the affected areas.
    - Control modules will unlock the stair doors.
    - Remote station connection will automatically activate to transmit fire alarm signals to a central monitoring station.
    - Initiate elevator recall.
    - Initiate fire shutter closure

COMMUNICATIONS SYSTEMS

Structured Cabling System

The structured cabling system is a manufacturer-certified system that warranties channel performance. It will support administrative telephone service and high speed data distribution. It will consist of backbone distribution cables, horizontal distribution cables, and patch cables.

A category 6 channel shall be provided for voice services. Channel shall run from the IDF room to each work station. The cable shall be terminated in an 8-pin modular jack patch panel in the IDF room and an 8-pin modular jack at the information outlet. Outlet quantities and locations shall be per the Room Data Sheets.

A category 6 channel shall be provided from the IDF room to each work station for data service. The cable shall be terminated in an 8-pin modular jack patch panel in the IDF room and an 8-pin modular jack at the information outlet. Outlet quantities and locations shall be per the Room Data Sheets.

A series-6 (RG-6) cable shall be provided from the IDF room to each video outlet located in the VTC room. Series-11 (RG-11) cable shall be provided for backbone connections and horizontal connections in excess of 250'. The cable shall be terminated on a wall-mounted patch panel. Outlet quantities and locations shall be per the Room Data Sheets.

A Category 6A channel shall be provided from the IDF room to each drop in the USCA space. 8 pin patch panel and jack shall be provided. Outlet quantities and locations shall be per the Room Data Sheets.

Multimode fiber optic cable (50/125µm) and single-mode fiber optic cable (8.3/125µm) shall be provided from each of the IDF rooms to the main equipment (MDF) room to serve as a data communications backbone. Fiber optic cables are terminated in fiber optic adapter panels installed in equipment racks utilizing LC Connectors for multimode and SC connectors for single mode.

A category 6 multiconductor riser-rated cable shall be provided from each IDF room to the main equipment (MDF) room to serve as the voice backbone. The cable shall be terminated on wall-mounted (110) blocks on both ends.

Fiber optic cable (8.3/125 µm) shall be installed from the main equipment (MDF) room through underground conduit to the point of connection designated by the service provider.

Equipment Rooms (MDF & IDF):

Equipment rooms shall be located and sized as indicated on the plans and shall be fitted out as indicated in the Room Data Sheets.

Low Resistance Grounding System

A separate grounding system will be provided. Electrostatic discharge grounding will be provided for laboratories as indicated in the Room Data Sheets.

Audio/Visual System

A/V scope and equipment layout is reflected in the respective Room Data Sheet. An empty system of conduits will be provided for the installation of cabling.

Wireless Access Points (WAP)

Provide wireless access coverage throughout the building and survey the building to ensure all “dead zones” are eliminated. Provide access points as indicated in the Room Data Sheets.

MECHANICAL

General

The following text is intended to establish a minimum standard for the design of the Heating, Ventilating and Air Conditioning (HVAC) system. All spaces within the facility shall be heated, cooled and/or ventilated in accordance with the requirements herein.

The building shall be divided into two separate groups of spaces; (1) the Laboratory spaces, which includes both "Wet Chemistry" and "Dry" labs as well as the Low High Bay, and (2) the remainder of the building including general office space, public areas, restrooms, etc. and support spaces. The HVAC system will be divided into two different systems as the functions for Laboratories are quite different from that of general office spaces.

The building's HVAC systems will be designed to allow for continuity of services to Laboratory spaces by utilizing robust equipment and materials as well as designing resiliency features in utility sources, equipment redundancy and selective dispatch of non-critical loads.

The design and specification of the mechanical systems will include consideration of flexibility, reliability, maintainability, redundancy, and future changes.

Main HVAC equipment shall be located to allow for ease of maintenance, repair and replacement without intruding into Laboratory spaces. System distribution routes will be selected to allow for flexible delivery of services and to minimize maintenance intrusion into Laboratory spaces.

Primary mechanical equipment will consist of air-cooled chillers, gas-fired condensing boilers, chilled and hot water pumps, variable volume air handlers, numerous terminal units with electric heat (office spaces) or venturi air valves with hot water coils (lab spaces), plus microprocessor based building wide energy management system (EMCS) and associated devices.

Central cooling and heating will be provided for the Laboratory spaces using central plant equipment and pumping geometries. Laboratory exhaust equipment will include multiple pieces of equally-sized equipment to provide n+1 redundancy, which will maintain minimum airflows in the spaces. This will allow for routine maintenance of the equipment or even failure of a single fan without adversely impacting fume hood operation.

Codes and Standards

The following codes, standards and references will be utilized as minimum requirements:

- International Building Code, 2012 Edition with South Carolina Amendments (IBC-2012),
- International Mechanical Code, 2012 Edition with South Carolina Amendments (IMC-2012),
- International Plumbing Code, 2012 Edition with South Carolina Amendments (IPC-2012),
- International Energy Conservation Code, 2009 Edition (IEC-2009). This Code references the ASHRAE/IESNA Standard 90.1 – 2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- National Electrical Code, NFPA 70, 2011 Edition.
- ASHRAE Standard 62.1 - 2010, Ventilation for Acceptable Indoor Air Quality,
- ASHRAE Standard 170 – 2008, Ventilation of HealthCare Facilities,
- NFPA 101 – 2015, Life Safety Code,
- NFPA 30 – 2015, Flammable and Combustible Liquids Code,

- NFPA 45 – 2015, Standard on Fire Protection for Laboratories Using Chemicals.
- ANSI 29.5 – 2012, Laboratory Ventilation
- LEED V.3.0 – USGBC, LEED BD+C - NC

Current Standards as published by:

- Air Diffusion Council (ADC),
- Air Movement and Control Association (AMCA),
- American Air Balance Council (AABC),
- American Bearing Manufacturers Association (ABMA),
- American Conference of Government Industrial Hygienists (ACGIH),
- American Society for Testing and Materials (ASTM),
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE),
- American Refrigeration Institute (ARI),
- American Society of Mechanical Engineers (ASME),
- American National Standards Institute (ANSI),
- American Welding Society (AWS),
- Associated Air Balance Council (AABC),
- Manufactures Standardization Society of the Valve and Fittings Industry (MSS),
- National Electrical Manufacturers Association (NEMA),
- National Environmental Balancing Bureau (NEBB),
- National Fire Protection Association (NFPA),
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA),
- Underwriters Laboratories (UL).

Assumptions

The HVAC system design shall be based on the following criteria:

Outdoor Design Temperatures: Heating and cooling calculations are based on the weather information included in the 2013 Edition of the ASHRAE Handbook – Fundamentals, Chapter 14, World Meteorological Organization location, WMO# 722180 for Augusta, Georgia as follows:

(1) Outdoor Design Temperatures (1%)
   a) Summer = 95°F db / 76°F wb (1%)
   b) Winter = 18°F db (99%)
   c) Elevation = 150 feet

(2) Heating and Cooling Degree Day Data included in the 2007 ASHRAE Standard 90.1, Table D-1:
   a) Cooling Degree Days (CDD50) = 5519,
   b) Heating Degree Days (HDD65) = 2565,

Indoor Design Temperatures:

Occupant comfort is the overriding criterion in selecting indoor design temperatures:

(1) All Areas unless otherwise noted,
  a) Summer Cond. = 75°F db and 50% relative humidity (RH),
  b) Winter Cond. = 72°F db,
  c) Night time setback of 55°F to 85°F db.
(2) Computer/Server Room: 68°F db and 45% RH.
(3) Mechanical/Electrical Rooms
  a) Summer Cond. = 85°F db,
  b) Winter Cond. = 65°F db.

Ventilation:

The design shall conform to the ventilation rates/method prescribed in either the 2012 International Mechanical Code, Table 403.3, ASHRAE 62.1-2010, Table 6-1 or ASHRAE 170-2013, Table for calculation of the fresh air requirements. Variable volume systems shall be designed with positive outside air introduction (i.e. supply fans, etc.) to ensure that ventilation minimums are maintained at lowest operating airflows. ASHRAE 62.1-2010 requires both an occupant (cfm/person) and area (cfm/sf) component to the total ventilation rate, while the IMC-2012 Table 403.3 only utilizes an occupant (cfm/person) rate. Ventilation rates are based on ASHRAE 62.1-2010, Table 6-1, or ASHRAE 170-2008, Table 7-1 are summarized as follows:

(1)	All Labs:	2 ACH + 6-12 ACH total, 100% exhaust (ASHRAE 170),
(2)	Manufacturing:	10 cfm/person + 0.18 cfm/sf (ASHRAE 62),
(3)	Low High Bay Areas:	10 cfm/person + 0.18 cfm/sf (ASHRAE 62),
(4)	Offices:	5 cfm/person + 0.06 cfm/sf (ASHRAE 62),
(5)	Conference Rms.:	5 cfm/person + 0.06 cfm/sf (ASHRAE 62),
(6)	Lobbies:	5 cfm/person + 0.06 cfm/sf (ASHRAE 62),
(7)	Corridors:	0.06 cfm/sf,
(8)	Unoccupied spaces:	0.00 cfm/sf
(9)	Remaining spaces:	5 cfm/person + 0.06 cfm/sf (ASHRAE 62),

Occupancy loads are based on the actual furniture layout, user input or occupancy rates included in the Table 403.3 or ASHRAE 62-2010.

Electrical Lighting Loads:

Lighting loads are given in watts per square foot (W/sf) and comply with the more stringent of either the IEC 2009 or ASHRAE 90.1-2007:

(1)	Laboratory Areas:	1.0 W/sf,
(2)	Manufacturing Areas:	1.2 W/sf,
(3)	Low High Bay Areas:	1.1 W/sf,
(4)	Public Lobbies:	1.0 W/sf,
(5)	Corridors:	0.2 W/sf,
(6)	Offices:	0.8 W/sf,
(7)	Conference/Training:	1.1 W/sf,
(8)	Restrooms:	0.8 W/sf,
(9)	Storage / Unoccupied:	0.5 W/sf,
(10)	Mech. / Elect Rooms:	1.0 W/sf.

Final lighting loads shall be based on actual lighting design.

Electrical Process Loads:

Process loads are given in watts per square foot (W/sf) and generally exceed IEC 2009 (as well as ASHRAE 90.1-2007), and are based on User provided data, when available, or on standard engineering assumptions.

Envelope Heat Transfer Coefficients:

Below are the estimated heat transfer coefficients used in the design calculations. These factors equal or exceed those from Chapter 5 of the International Energy Code, 2009, Table 502.2(1) and 502.3 or ASHRAE 90.1-2007 Building Envelope Requirements Table: 5.5-3 (Zone 3A). As the project will be a LEED certified level design, the target values for the building envelop are as follows:

(1) Roofs (insulation above deck):
- Thermal Performance: $U_{maximum}$ = 0.043 btuh/sf°F ($R_{minimum}$ = 23),
- Solar Performance: SRI = 0.78

(2) Slab on Grade (unheated): F = 0.730 (Insulation Not Required),

(3) Walls
- Steel frame: $U_{maximum}$ = 0.076 btuh/sf°F,
- Mass: $U_{maximum}$ = 0.085 btuh/sf°F ($R_{minimum}$ = 12 c.i.),

(4) Partitions: $U_{maximum}$ = 0.30 btuh/sf°F ($R_{minimum}$ = 3.5),

(5) Opaque Doors (swinging): $U_{maximum}$ = 0.70 btuh/sf°F,

(6) Glazing (<40% glazing to gross wall area): $SC_{maximum}$ = 0.27 and SHCG = 0.23
- a) Curtainwall/storefront/metal frame: $U_{maximum}$ = 0.35 btuh/sf°F,
- b) Metal Frame (entrance door): $U_{maximum}$ = 0.80 btuh/sf°F.

Heating/Cooling Load and Energy Calculations:

The Trane Company's Trace Load 700 Version 6.3.2.0 Analysis program shall be used to calculate the building's heating and cooling load.

Energy Performance Criteria:

The International Energy Conservation Code, 2009 edition, includes by reference ASHRAE/IESNA 90.1 Energy Efficient Design of New Buildings, 2007.

Seismic Design

Based on the International Building Code, Chapter 16, Section 1621, Earthquake Loads, this building is classified as Seismic Design Category C with the HVAC Systems' Component Importance Factor I_P=1.0.

Per Code paragraph 1621.3.9 and 1621.3.10, the ducting and piping systems need not be seismically restrained if the contractor takes care to not allow the duct supports' "swing arms" to extend beyond 12 inches to structure.

All equipment shall be restrained using Component Amplification Factors and Component Response Modification Factors described in Table 1621.3 of the Code.

Acoustical Design Criteria:

The User desires a level of background sound, which is unobtrusive in quality and low enough in level that it does not interface with the occupancy requirements of the space being served. Generally, the ambient sound level within building should not exceed the Room Criteria (RC) level given below (these values are taken from Chapter 48, Table 1 in the ASHRAE Applications Handbook, 2015 Edition):

(1)	Laboratories:	RC(N) = 50,
(2)	Manufacturing Areas:	RC(N) = 55,
(3)	Enclosed Offices:	RC(N) = 30,
(4)	Open Offices:	RC(N) = 40,
(5)	Conference Rooms:	RC(N) = 30
(6)	Video Conference / VTR:	RC(N) = 25,
(7)	All Public Areas (U.N.O.):	RC(N) = 45,
(8)	Server Room/IDF Closets:	RC(N) = 50,
(9)	Mechanical Rooms:	RC(N) = 55,
(10)	Electrical Rooms:	RC(N) = 55.

Filtration

Filters shall be installed in all air handling units, terminal units' plenum suctions, and in any other location generated by User duty. The efficiency of the system filtration required shall correspond with the individual spaces served by the system. In general, provide 30% efficient MERV 8 pre-filters and 85% efficient MERV-13 final filters at each air handler and 30% efficient MERV 7 filters for each terminal unit plenum suction.

HVAC System Selection Criteria:

Mechanical cooling include:

- Air-cooled chiller and chilled water,
- Rooftop VAV air handling units.

Heating sources include:

- Gas-fired Hydronic heat (base case),
- Gas-fired heat for the Low Bay (alternate)
- Electric heat for Offices and support areas (alternate).

Additional features related to the HVAC systems include:

- Rooftop air handling equipment to minimize indoor mechanical equipment space.
- Water pumping: pairs of water pumps are redundant and allow the building to operate without interruptions for pump maintenance.
- Variable air volume air handlers with zone terminal units allow zone control for multiple uses and schedules; good humidity control; are energy efficient and are cost effective.
- Office Spaces to utilize a rooftop VAV air handler, with multiple supply fans for minimum redundancy.
- Lab Spaces to utilize a rooftop 100% OA VAV air handler with multiple supply fans (minimum 4) which offer redundancy for unit maintenance or failure of any single fan.
- Lab Spaces will be exhausted to maintain a negative pressurization from the remaining building.

- To comply with ASHRAE 90.1-2007, energy recovery shall be provided in the form of a glycol water loop consisting of coils in both the exhaust system and air handling unit, distribution pumps (2), expansion tank, air separator, storage tank and associated controls.
- The project goal of LEED Certified.

Description

The following is a brief overview of the systems being proposed. The narrative is broken into main component areas and systems: cooling plant; heating plant; typical air conditioning systems; typical air distribution; building management system; sundry systems.

Cooling Plant:

The cooling plant is composed of a chilled water pipe loop served by two outdoor air-cooled chillers and serving rooftop air handlers. The chilled water loop has two (both duty) centrifugal water pumps. The pumps direct flow to the air-cooled chillers located outdoors.

The loop delivers 44ºF water to each air handler (with a chilled-water, cooling coil) located around the building, absorbing their heat and returning it at 54ºF to the chiller. The water loop shall utilize variable primary flow.

Each chiller shall be sized at minimum 60% of the block cooling load of the building, and shall be staged according to the cooling load. Chiller isolation control valves shall be provided to each chiller. Each chiller shall use non-CFC refrigerant.

Pumping systems shall provide chilled water to the building. Each chilled water pump shall be equipped with variable frequency drives for variable flow to match the cooling load. Chilled water supply temperature shall be between 42°F and 45°F; chilled water return temperature difference (return - supply) shall range between 10°F and 14°F. A diaphragm expansion tank and air separator shall protect the chilled water system. A shot-type chemical treatment feeder shall be provided for manual treatment of the chilled water system. Provide gauges in all water pumps to read discharge pressure, suction inlet pressure, and suction pressure before strainer. Due to the volume of water in the system, a buffer tank is needed to eliminate chiller cycling. The pumps, expansion tank, air separator, shot feeder, buffer tank and controls shall be factory assembled on a skid for delivery to the project site.

Distribution piping shall be arranged in either as a direct-return or reverse-return scheme with automatic flow control valves at coils for balancing purposes. All systems' components must be rated to 125# WOG; the piping shall be constructed of type K copper or schedule 40 black steel. Fittings may be screwed, welded, sweated or groove-lock fittings. Either fiberglass (interior) or foam glass (exterior) insulation shall be provided on all chilled water piping. All piping or insulation jacketing shall be painted; colors shall be coded according to design criteria. Water system identification and flow direction markings shall be applied to outside of all pipes.

The pump VFD with H.O.A. switches should be left on "auto" to enable the EMCS to sequence. Switch to "off" only during maintenance or to "on" to continuously operate a specific pump. A pressure differential switch at each pump indicates status to the EMCS.

Heating Plant:

As natural gas is available at this location, gas-fired equipment will be used to provide space heating for the Lab Spaces. The heating plant shall incorporate multiple (at least three) boilers, sized to provide minimum backup (each at 40% of the total load) if any boiler is out of service. The heating hot water system shall utilize a hot water loop

(primary variable flow arrangement similar to the chilled water) to distribute hot water to each terminal unit.

The boilers will be condensing type able to operate between 95°F and 140°F return water temperatures. The design pressures shall be 50 psig or less for hot water boilers and a minimum of 90% AFUE efficiency. Boiler trim shall include in-line centrifugal pump, safety valves, stop valves, water column, blow-off valves, piping and tank, low water cutoff, flame safety system and control panel.

Provide multiple base mounted centrifugal pumps (minimum 2) each sized to match the equipment flow required. The heating equipment shall include both two and three way valves to obtain proper temperature control. Heating hot water supply temperature shall be between 120°F and 180°F; heating hot water return temperature difference (return - supply) shall range between 20°F and 40°F. A diaphragm expansion tank and air separator shall protect the heating hot water system. A shot-type chemical treatment feeder shall be provided for manual treatment of the heating hot water system. Provide gauges in all water pumps to read discharge pressure, suction inlet pressure, and suction pressure before strainer. The pumps, expansion tank, air separator, shot feeder and controls shall be factory assembled on a skid for delivery to the project site.

Distribution piping shall be arranged in either as a direct-return or reverse-return scheme with automatic flow control valves at coils for balancing purposes. All systems' components must be rated to 125# WOG; the piping shall be constructed of Schedule 40 black steel. Fittings may be screwed, welded, sweated or groove-lock fittings. Provide pre-formed type, fiberglass insulation with all service jacket on all heating hot water piping. All piping or insulation jacketing shall be painted; colors shall be coded according to design criteria. Water system identification and flow direction markings shall be applied to outside of all pipes.

The pump VFD with H.O.A. switches should be left on "auto" to enable the EMCS to sequence. Switch to "off" only during maintenance or to "on" to continuously operate a specific pump. A pressure differential switch at each pump indicates status to the EMCS.

Energy Recovery Loop:

The Lab system shall include a glycol energy recovery loop to transfer energy from the lab exhaust to the outside air being introduced through the roof top 100% OA unit. Water systems shall utilize a 40% Propylene glycol solution, which has a freezing point of -8 deg F (-22 deg C), to freeze protection of water coils in air handlers and exhaust fan unit.

Provide multiple in-line centrifugal pumps (minimum 2) each sized to match the equipment flow required. The water coils shall include three way valves to obtain proper temperature control. A diaphragm expansion tank and air separator shall protect the glycol water system. A shot-type chemical treatment feeder shall be provided for manual treatment of the glycol hot water system. An automatic glycol feed system shall ensure that the system maintains an acceptable level of concentration for the glycol. Provide gauges in all water pumps to read discharge pressure, suction inlet pressure, and suction pressure before strainer.

Distribution piping shall be arranged in either as a direct-return or reverse-return scheme with automatic flow control valves at coils for balancing purposes. All systems' components must be rated to 125# WOG; the piping shall be constructed of Schedule 40 black steel. Fittings may be screwed, welded, sweated or groove-lock fittings. Provide pre-formed type, fiberglass insulation with all service jacket on all heating hot water piping. All piping or insulation jacketing shall be painted; colors shall be coded according to design criteria. Water system identification and flow direction markings shall be applied to outside of all pipes.

The pump starter H.O.A. switches should be left on "auto" to enable the EMCS to sequence. Switch to "off" only during maintenance or to "on" to continuously operate a specific pump. A pressure differential switch at each pump indicates status to the EMCS.

Typical Air Handling Units:

There will be two primary cooling systems serving the building; (1) Office spaces and (2) Lab Spaces. Each system will be a commercial grade, double-wall, chilled-water, horizontal draw-through, modular rooftop air-handlers. Ventilation air will be introduced through the unit's intake. Variable speed drives vary the supply airflows. The air handling units will be located on the roof as shown. Each system will consist of the following components:

- Outside air and Supply Air airflow monitoring stations,
- 30% efficient MERV-7 prefilters,
- 85% efficient MERV-14 filters,
- Energy Recovery Coil, Glycol,
- Hot Water Preheat (Lab unit, 100% OA),
- Chilled-water cooling coil(s) with UVC lights,
- Centrifugal (or plug) supply fan (or fan array),
- Double-wall, IAQ construction,
- Microprocessor control,
- Variable speed drive.

Each air handling unit will be connected via medium pressure ducts to numerous terminal units, in a combination of variable-air volume terminal (VAV), constant volume series fan-powered terminals (SFPU) and parallel fan-powered terminals (PFPU) or venturi air valves (lab spaces).

Air returns from the office floors through an above-ceiling air plenum to return air intake ducts. Return air ducts route to the air handling units. Leaving-air temperature sensors located immediately downstream of their respective coils to control the air unit's cooling coils.

Lab spaces will be 100% OA air handlers, therefore, only exhaust duct will be included for those areas.

Typical Air Distribution System:

The air distribution system for the office area systems will be variable air volume systems using variable-air volume (VAV) and parallel or series fan-powered terminals. Series fan-powered and constant-volume terminal units offer constant air delivery, uniform acoustical qualities, and multiple zone control. Series boxes also offer temperature blending of supply air and induced plenum air, enabling a low supply air temperature. The low supply air temperature in turn allows smaller central air fans, smaller supply ducts, and smaller primary air valves. Constant volume terminals are ideally suited to conference rooms and other assembly areas requiring minimum air change rates.

Each terminal unit will consist of the following components:

- Primary, pressure independent air valve,
- Discharge air temperature sensor,
- Filtered plenum inlet (as appropriate),

- Fan and motor (as appropriate),
- Electric heating coil (as appropriate), and
- Microprocessor based controls.

For the lab areas the air distribution systems shall consist of multiple Venturi Valves to maintain a desired airflow regardless of duct pressure. This is accomplished with a cone and spring-loaded piston inside the cone. As the duct pressure increases, the spring compresses and pushes the cone further into the shell. This mechanism keeps the volumetric flow rate constant as air travels through the valve and duct pressure varies.

Venturi Valves utilize fast-acting electric actuators that provide a rapid response to changing conditions. This rapid response ensures the airflow is maintained at desired levels, which is critical in areas requiring a specific threshold of air flow in order to protect individuals from airborne chemicals or particulates.

Stainless Steel Venturi Valve shall be used on exhaust system and is constructed primarily with 316 stainless steel and features a blend of stainless steel and Teflon® components to extend valve life while keeping energy costs to a minimum. The Stainless Steel Venturi Valve is pressure independent, and maintains a constant CFM at a specific actuator position over a range of 0.75" to 3" w.c. with accuracy of +/- 5%. It will not require long straight runs for proper operation. Stainless Steel Venturi Valves are available in 8", 10", or 12" diameters, can be mounted horizontally or vertically, and arrive on-site calibrated and ready for installation.

Air Distribution:

The air will be delivered to each space through an overhead duct system constructed of sheet metal. All supply, return and outside air ductwork will be insulated.

Slot type diffusers will be used at perimeter locations within the office areas. The exterior zone terminal units will have electric heating coils.

Except for installations involving extremely short or extremely long throws a maximum velocity of 500 fpm through the nominal area of sidewall supply grilles or ceiling diffusers will be used.

For linear diffusers, use catalog data because of the wide variation in free areas available.

For VAV systems, select 1000 fpm for maximum CFM, if NC is 35 or less.

For return air panels, use 400-500 fpm over nominal area.

For exhaust grilles, use 300-400 fpm over nominal area.

For most of our applications, a maximum noise level of NC 35 shall be used in selecting these devices.

A maximum pressure drops through any kind of outlet shall be +/- 0.10" water.

Zoning:

Where not established by partitions, the zoning will be designed so that an exterior zone of approximately 15 feet is established around the inside perimeter of the building. This zone will be provided with both cooling and heating to offset the thermal effects of the building envelope, as well as the interior loads, such as people, lights and equipment. Spaces with dissimilar occupancies or different occupied schedules will not be grouped into a zone. Interior and exterior spaces will not be grouped into a zone. Maximum area for any temperature control zone will be approximately 1500 SF. Typically, a maximum of three offices will be grouped to create a zone.

Building Exhaust:

Toilets: All toilets will be exhausted directly to the outside. The flow rate for this exhaust system will be a minimum of two cfm per square foot of floor area or as required by code.

The restrooms and janitors closets will be exhaust-ventilated via either in-line centrifugal or rooftop centrifugal exhaust fans. These fans will be controlled along with the base building systems.

General room exhaust will be provided where required.

The Laboratories will be exhausted via two separate systems; (1) one for the "Wet Labs" and (2) one for the "Dry Labs". Both systems will utilize a manifold exhaust fan / energy recovery combined into a single package. The exhaust fans shall consist of a three (3) fan arrangement, each at 50% of full flow to ensure a level of redundancy for fan operation.

Sundry Systems:

Each Communication Room (IDF or MDF) and Electrical Rooms will be conditioned by a ductless split system air conditioner, with its own thermostat. This affords the room 24/7 operation capability. The condensing unit portion of the system will be located on the roof.

The Server Room on Level 2 will be conditioned by a Computer Room Air Conditioner (CRAC) with air-cooled remote condenser located on the adjacent roof.

Building Management System:

The project will include a new direct digital control (DDC) system. This will be a standalone system with a network controller and terminal controllers. The controllers will be linked to a single field panel with an interface terminal. The EMS will be supplied by the manufacturer of the major HVAC equipment (i.e. chillers, air handlers, terminal units, etc.).

The EMS will be a PC-based system that is capable of operating all of the mechanical equipment, as well as receiving alarms from all mechanical systems. The system configuration will include a printer to provide hard copies of alarms, trend logs, maintenance schedules and operating conditions. The system will be provided with a modem and compatible lap-top computer.

System Control: In addition to code mandated functions, the system will control the following, either automatically or through manual operation:

- Start-stop of all equipment,
- Air handler supply air temperature setpoint,
- Outdoor air quantity setpoint,
- Start-stop of required exhaust systems,
- Temperature control of all occupied spaces
- Direct digital control of all terminal units,
- Supply air reset,
- Chiller and hot water temperature resets.

Louvers:

The louver has the blade turned back at each edge with no break in the blade, and shall be 6" thick and extruded aluminum is standard. For very small louvers, it may be desirable to go to a 2" thick extruded aluminum louver. The final louver specified will be coordinated with the Architect.

Screens shall be 2" mesh bird screen. Screens are normally installed on the interior of the louver for the sake of appearance. Interior screens can be cleaned from outside, if accessible. Otherwise, provide for access through the intake plenum.

The mechanical plans show approximate dimensions, which the Architect can vary slightly to work into brick coursing or other components of the structure. The mechanical plans shall refer the contractor to the architectural drawings for louver mounting details.

The following performance criteria shall be used for specifying louvers:

- Air velocity at which water penetration begins (as 0.01 ounces per square foot of free area): 1200 FPM, based on 48" by 48".
- Maximum static pressure at 1000 feet per minutes through the free area: 0.125 inches water gauge.
- Exhaust louvers of about 10 sq. ft. or larger shall be designed for a maximum face velocity of 750 fpm over the gross area.

Ductwork:

Sizing:

- For low pressure supply ducts, use 1400 fpm maximum velocity and the following maximum unit pressure drops:
  - From fan discharge to first outlet, 0.15"/100-LF.
  - Remainder of system, 0.10"/100-LF, dropping off to 0.08"/100-LF in branches.
  - Reducing the allowable unit pressure drop toward the ends of the runs gives some static regain effect and for the air quantities normally encountered drops velocities to 600-900 fpm.
- For medium pressure ductwork, use 2500 with 3000 fpm maximum velocity and 0.30" or 0.35"/100-LF unit pressure drop, dropping back progressively to 0.12 or .15"x100-LF at ends of runs. Final velocity at inlet to the box is determined by the inlet size of the box. This gives the same partial static regain and velocity reduction effects as discussed for low pressure ducts above.
- Size exhaust air, return air and outside air ducts for 1000-1200 fpm maximum, and about 0.10 or 0.08"x100-LF pressure drop. The point of connection to a louver, an outside air duct shall be enlarged to reduce velocity to maximum allowable through a louver.

General:

- Do not use ductwork with smallest dimension less than 6", regardless of calculated velocity and pressure drop.
- Sizes shown for ducts are net inside. To determine outside clearances, add insulation thickness.
- Velocity determines noise level and pressure drop affects fan's horsepower. Where lengths of duct runs vary considerably, higher unit pressure drops will be used in shorter runs without exceeding acceptable velocities.
- Transitions cost money. Rule of thumb is to transition not more than every 15 feet (i.e. three 5 foot sections of duct).

Air Handling Units and Air Handling Apparatus:

Supply Fans:

- Allowable outlet velocity goes up as total pressure goes up;
- a fan coil unit operating against 0.5" pressure would require an outlet velocity in the range of 1000-1100 fpm;
- an air handling unit operating at 2" might operate acceptably with an outlet velocity of 1600-1750 fpm.

Cooling Coils:

- Maximum coil face velocity 500 fpm (schedule as minimum face area).
- Maximum waterside pressure drop (where applicable) 15 ft.
- Maximum airside pressure drop 0.75".
- Do not allow as a substitute spiral fin – avoid problems with carryover.

Heating Coils:

- Maximum coil face velocity 500 fpm.
- Maximum pressure drop 0.25" + (0.10 for reheat coils).
- Maximum waterside pressure drop (where applicable) 10 ft.

Air Filters:

- Maximum face velocity 500 fpm.
- Pre-filter (MERV 8) maximum pressure drop of 0.5", (0.25” initial PD).
- After-Filter (MERV 15) maximum pressure drop of 1.5”, (0.5” initial PD).

Water Piping Sizing:

The water piping shall be sized for about a 2 psi (5 ft.) drop per 100 ft. of pipe. ASHRAE's flow charts (use fairly rough pipe chart for steel pipe).

In addition to pressure drop limitation, water velocity shall be held to less than 8 ft./sec. Do not use 3-1/2 pipe. The design shall use reverse return where feasible.

For steel pipe, the following chart taken from ASHRAE graph gives range of flow rates vs. nominal pipe sizes in tabular form:

Pipe	mm	GPM Flow	L/S (max.)	Max. Vel. Ft./Sec.	m/Sec.	Ft./100¢	kPA/m
¾"	20(19.0)	2-4	0.25	2.5	0.76	5.0	0.49
1"	25(25.4)	4-8	0.50	3.0	0.91	5.0	0.49
1¼"	30(31.75)	8-16	1.0	3.5	1.1	5.0	0.49
1½"	40(38.1)	16-24	1.5	3.8	1.2	5.0	0.49
2	50(50.8)	24-48	3.0	4.5	1.4	5.0	0.49
2½"	65(63.5)	48-75	4.7	5.0	1.5	4.5	0.44
3"	80(76.2)	75-140	8.8	6.0	1.8	4.5	0.44
4"	100(101.6)	140-290	18.3	7.0	2.3	4.5	0.44
6"	150(152.4)	540-900	56.8	10.0	3.1	4.5	0.44

Freeze Protection:

For mechanical room, freeze protection will utilize electric unit heaters.

Water Treatment System:

Water treatment is required for: Chillers, Boiler and Glycol Loop including circulating chilled and heating water. This project will utilize manual shot feeders to deliver the appropriate chemicals to maintain acceptable chemistry for these closed water systems.

PLUMBING

Description

This document establishes plumbing design criteria for the proposed Savannah River Nuclear Solutions Advance Manufacturing Collaborative Building to be constructed in Aiken, SC and will be used to supplement local, state and national codes and laws which are applicable to the work being undertaken. In case of conflict, the more stringent requirement will govern.

The contractor will furnish all material, labor, transportation, tools, equipment and supervision to completely install and leave ready for operation, complete plumbing systems in accordance with this narrative. The work will include, but not necessarily be limited to, the following general items:

- Domestic cold water system.
- Domestic hot water system.
- Non-Potable laboratory cold water system.
- Non-Potable laboratory hot water system.
- Sanitary waste and vent system.
- Storm drainage system.
- Natural gas system.
- Plumbing fixtures and equipment.
- Compressed air system.
- Piped compressed gas systems.

Codes

All work will comply with the following:

- International Building Code, 2012 Edition, with South Carolina modifications.
- International Plumbing Code, 2012 Edition, with South Carolina modifications.
- International Fuel Gas Code, 2012 Edition, with South Carolina modifications.
- International Fire Code, 2012 Edition, with South Carolina modifications.
- National Electrical Code, 2011 Edition
- International Energy Conservation Code, 2009 Edition
- ADA (American Disabilities Act), 2010 Edition
- ANSI A117.1

Pipe Materials

- Domestic water piping (potable and non-potable) will be CPVC.
- Sanitary, waste, vent and storm drain piping will be schedule 40 DWV PVC.

- Compressed air and all compressed gas piping will be Type L hard drawn copper tubing "Cleaned for Oxygen Service" with Pro-Press HNBR joints.
- Natural gas piping will be black steel with screwed, welded or ProPress joints.

Plumbing Fixtures

Fixtures are as follows:

- Water Closets: Wall hung, vitreous china, electronic flush valve type (1.28 gallons per flush). Handicapped accessible fixtures will be mounted at appropriate height.
- Urinals: Wall hung, vitreous china, electronic flush valve type (0.125 gallons per flush).
- Lavatories: Wall-hung, countertop self-rimming or countertop under-mount, vitreous china fixtures with electronic faucets. Handicapped accessible fixtures will have offset tailpieces, p-traps and insulated traps and water supplies.
- Break Room Sink: Single compartment, countertop mounted stainless steel with single lever faucet and hose spray.
- Counter Sink: Single compartment, countertop mounted stainless steel with single lever operated faucet.
- Service Sink: Floor mounted terrazzo service sink with wall mounted faucet and vacuum breaker.
- Water Coolers: Will be wall-mounted, self-contained units with bi-level dispensers and stainless steel finish, meeting ADA mounting requirements.
- Lab Sink for Labs: Single compartment, integral resin with lever controlled faucet.
- Emergency Shower/Eyewashes: Free standing combination units with "emergency" yellow coating.

Plumbing Systems

Backflow Prevention

- Two reduced pressure zone backflow preventers will be installed in parallel on the incoming domestic water service to the building. The backflow preventers will be installed above grade in the central energy plant. The air gap drain piping will be routed full size to the nearest floor drain.
- Two reduced pressure zone backflow preventers in parallel will be installed on a branch of the domestic cold water system to separate the potable from the non-potable (Lab) water.
- A reduced pressure zone backflow preventer will be provided at possible points of contamination such as makeup water to the mechanical system.
- Small, in-line backflow preventers will be provided at each piece of applicable equipment in the breakroom such as coffee makers, ice makers, water dispensers, etc.
- All hose bibbs and wall hydrants will be provided with vacuum breakers.

Domestic Water Heating

- The domestic water heating system for the toilet areas will be comprised of two, electric, storage type water heaters, one in each of the toilet areas. One heater will supply a janitor's sink and the lavatories in the adjacent toilet rooms. The other heater will supply a janitor's sink, the lavatories in the adjacent toilet rooms and two showers. The water heaters will store hot water at 140°F. Thermostatic mixing valves will be provided to temper the hot water down to 120°F for delivery to the applicable plumbing fixtures. Recirculating piping and pumps will be provided for each system.
- For remote fixtures, such as in a breakroom or coffee bar, instantaneous electric water heaters will be provided to supply the domestic hot water requirements.
- The non-potable water heating system will be comprised of a single gas-fired, condensing water heater with an integral storage tank. A neutralization kit will be provided on the condensate drain before spilling into a floor drain. The water heater will store hot water at 140°F and a thermostatic mixing valve will be provided to temper the hot water down to 120°F for delivery to the applicable plumbing fixtures. Another thermostatic mixing valve will be provided at each emergency shower/eyewash to temper the hot water further down to approximately 85°-90°. Recirculating piping and a pump will be used to circulate the hot water back to the water heater to maintain 110°-120° in the hot water mains at all times.

Sanitary Waste and Vent

A complete sanitary waste and vent system will be provided to convey waste from plumbing fixtures, floor drains, hub drains, etc. to the site sanitary piping system. Floor drains will be provided in each janitor's room, in each toilet room with more than two fixtures, at each emergency shower/eyewash, at each piece of equipment requiring drainage and in the central plant for general floor drainage.

Storm Drainage

Roof drainage will primarily be accomplished with external rain collectors at scupper drains and gutters with downspouts. The collectors will be metal "boxes" attached to the side of the parapet and each will have an emergency overflow opening. Drain piping or downspouts will be connected to the bottom of the boxes and will be routed down to below grade or down to a lower roof depending on the location. The below grade piping will be routed to the site storm drain system. A few internal roof drains may be used in certain areas where the collectors are not feasible or desired.

Natural Gas

Natural gas piping will be routed to one of the domestic water heaters, HVAC boilers, gas fired space heaters, etc. It will not be routed to the labs. Vented pressure regulators will be provided where required.

Compressed Air

A tank mounted, rotary screw air compressor will be provided to supply all of the compressed air needed in the facility. A refrigerated air dryer and associated filters will also be provided. The system will be capable of supplying 98 CFM of compressed air and the tank will have a capacity of 120 gallons. The air will be distributed at 125 psi.

Compressed Gasses

Argon and nitrogen will be supplied to the building by a private gas company. The containers will be stored outside of the building on a chain-link fenced concrete pad, and will connect to the interior piping at a point on the exterior wall where the containers are located.

Laboratories Specific

LAB	REQUIREMENT
Plastic Additive Materials	b, c, e
SRNS Lab	a, c, e
Scientific Computation Lab	b, d, f
Virtual Reality Lab	b, d, f
Cyber / Wireless Lab	b, c, e
Smart Manufacturing Lab	a, c, e
Characterization Lab	a, c, e
Mechanical and Electrical Lab	c, e, g
Wet Lab 2	c, e, h
Wet Lab 1	c, e, h
Wet Lab 3	c, e, h
Robotics Lab	c, e, i
Metal Additives Manufacturing Lab	d, e, j, k
USCA Engineering Lab	d

a. Non-potable cold water, compressed air, argon, and nitrogen will be routed to labs that require them for the lab's initial purpose at construction and three "manifolds" will be provided. In general, this means one manifold on the north wall of the lab, one on the south wall and one in the ceiling, roughly center of the lab space. All four of the utilities will be located together with enough space between them for proper operation of valves.

b. Non-potable cold water, compressed air, argon, and nitrogen will be stubbed out for certain labs that do not require these utilities at initial construction. In general, this means a valved and capped short branch from the piping mains for each utility that can be extended at a later time when required.

c. Sinks will be provided in labs that require them for the lab's initial purpose at construction.

d. Hot water, cold water and drain/vent piping capped stubouts will be provided for the labs that do not require a sink at initial construction.

e. Combination shower/eyewashes will be provided in labs that require them for the lab's initial purpose at construction.

f. Hot and cold water piping capped stubouts will be provided for the labs that do not require a combination shower/eyewash at initial construction.

g. In the Mechanical & Electrical Lab, the compressed air and non-potable water will be piped as in note (a) above. The other gasses will be stubbed out as in note (b) above.

h. In Wet Labs 1 & 2 and in the Wet Lab 3, the gasses will be piped as in note (a) above, except that the non-potable water will only be routed to the hoods and not the manifolds.

i. In the Low High Bay Robotics Lab, the manifolded gasses and water will be piped the same as in note (a) above except there will be no overhead manifold. One manifold will be on each wall of the lab (3 total). Also, additional compressed air drops will be provided along each of the 3 walls at intervals of approximately 20 feet.

j. In the Metal Additives Manufacturing Lab, the emergency shower/eyewash will be provided just outside of the room near the door. The compressed gasses will be stubbed out as in note (b) above except that compressed air will be routed to 2 hose reels in the ceiling and to 2 drops along the "short" wall of the lab. A 200 gallon compressed air "surge tank" will be provided for times of high air use.

k. For the Metal Additives Manufacturing Lab, a 1-cylinder x 1-cylinder helium manifold with automatic changeover will be provided. The operating pressure of the helium system will be 12 psig. The manifold will be installed in the adjacent Robotics Lab.

Laboratories General

a. A floor drain will be provided in every lab to receive waste from the emergency shower/eyewash whether or not the lab is provided with the fixture during initial construction.

b. All applicable hoods will be supplied with piped gasses.

c. The utility manifolds in the labs will consist of the following:

1. Non-potable water: Ball valve for isolation and 3" pipe extension from valve with a removable cap.
2. Compressed air: Ball valve for isolation, pressure regulator (capable of approximately 50-125 psi) and 3" pipe extension from valve with a removable cap.
3. Argon: Ball valve for isolation and 3" pipe extension from valve with a removable cap.
4. Nitrogen: Ball valve for isolation and 3" pipe extension from valve with a removable cap.

Plumbing General

- A pressure reducing station consisting of two high capacity pressure reducing valves (one large and one small) will be installed in parallel on the domestic water service to reduce the pressure to 80 psi maximum.
- All domestic water piping, potable and non-potable, other than exposed water piping to plumbing fixtures, will be insulated with fiberglass insulation with the thickness complying with the Energy Code.
- Wall hydrants will be provided around the perimeter of the building spaced approximately every 75 feet.
- Sump pumps will be provided in the elevator shaft sump pit.
- Valves will be provided to properly isolate all plumbing equipment, plumbing fixtures or groups of plumbing fixtures.
- All ball valves will be 3-piece, full port type.
- All floor drains will be provided with trap seal device (i.e. Trap Guard).
- Water hammer arrestors will be provided on cold water lines serving flush valve plumbing fixtures.
- The plumbing components shall be properly anchored or braced to resist seismic forces as required by the Building Code.
- Brace suspended pipes in accordance with the SMACNA Seismic Restraint Manual, 1991 Edition, for Seismic Design Category C.

FIRE PROTECTION

Description

This document establishes automatic sprinkler design criteria for the proposed Savannah River Nuclear Solutions, LLC to be constructed in Aiken, South Carolina and shall be used to supplement local, state and national codes and laws which are applicable to the work being undertaken. In case of conflict, the more stringent requirement shall govern.

Contractor shall furnish all material, labor, transportation, tools, equipment and supervision to completely install and leave ready for operation, complete automatic systems in accordance with this narrative. The work shall include, but not necessarily be limited to, the following general items:

- Sprinkler piping.
- Sprinklers.
- Pipe hangers.
- Fire entrance riser and accessories.

Codes

All work shall comply with the following:

- International Building Code, 2012 with South Carolina modifications
- International Fire Code, 2012 with South Carolina modifications
- NFPA 13: Installation of Automatic Sprinkler Systems, 2010
- NFPA 17: Standard for Dry Chemical Extinguishing Systems, 2009.
- NFPA 484: Standard for Combustible Metals

Automatic Sprinkler Pipe Materials

- Exterior Fire Main - Ductile iron, cement lined
- Interior Sprinkler Piping - Schedule 40 seamless black steel piping with 150 or 200 lb. malleable fittings as required.

Flow Test Information

A current flow test was conducted and the following information is available:

Date of Flow Test:	April 22, 2016
Time:	10:30 am
Location:	Scholar Loop between University Parkway and College Station Drive
Test Made by:	Danny A. Breaker, City of Aiken
Static Pressure:	105 psi
Residual Pressure:	90 psi

Pitot Tube Reading: 80 psi

Flow: 1,410 gpm

Coefficient of Discharge: 0.90

Fire Protection Design Criteria

The building shall be classified as follows:

Occupancy Classification: ..... Light Hazard

Density: ..... 0.10 gpm/sq.ft.

Hydraulic Remote Area:..... 1,500 sq.ft.

Sprinkler Orifice Size: ..... 1/2"

Hose Stream Allowance: ..... 100 gpm

Duration of Supply: ..... 30 min.

Maximum Coverage/Sprinkler Head: ..... 225 sq.ft.

Incidental spaces such as the mechanical rooms, janitor's closets, and storage areas shall be classified as follows:

Occupancy Classification: ..... Ordinary Hazard, Gr. I

Density: ..... 0.15 gpm/sq.ft.

Hydraulic Remote Area:..... 1,500 sq.ft.

Sprinkler Orifice Size: ..... 1/2"

Hose Stream Allowance: ..... 250 gpm

Duration of Supply: ..... 60 min.

Maximum Coverage/Sprinkler Head:- ..... 130 sq.ft.

Laboratories shall be classified as follows:

Occupancy Classification: ..... Ordinary Hazard, Gr. II

Density: ..... 0.20 gpm/sq.ft.

Hydraulic Remote Area:..... 1,500 sq.ft.

Sprinkler Orifice Size: ..... 17/32"

Hose Stream Allowance: ..... 250 gpm

Duration of Supply: ..... 60 min.

Maximum Coverage/Sprinkler Head: ..... 130 sq.ft.

Loading Dock shall be classified as follows:

Occupancy Classification: ..... Ordinary Hazard, Gr. I

Density: ..... 0.15 gpm/sq.ft.

Hydraulic Remote Area:..... 1,500 sq.ft.

Sprinkler Orifice Size: ..... 1/2"

Hose Stream Allowance: ..... 250 gpm

Duration of Supply: ..... 60 min.

Maximum Coverage/Sprinkler Head: .....130 sq.ft.

Preliminary Hydraulic Calculations

Assumptions:

- Maximum Sprinkler Coverage = 100 sf/sprinkler
- Water Density = 0.30 gpm/sf
- Choose a 10' x 10' spacing = 100 sf/sprinkler
- Use a gridded sprinkler system
- Hydraulic Remote Area = 2,500 sf
- 2,500 sf / 100 sf/sprinkler = 25 sprinklers
- 0.30 gpm/sf x 100 sf/sprinkler = 30 gpm / sprinkler

Fire Protection Water Demand:

0.30 gpm/sf x 2,500 sf = 750 gpm x 1.25 (overage) = 938 gpm + 500 gpm (outside hose stream allowance) = 1,438 gpm. Flow test indicates approximately 90 psi available at this flow rate.

Fire Pump

It is not anticipated that a fire pump will be required, so none is included in the GMP; but a final determination cannot be made until final hydraulic calculations are completed.

Special Hazard Protection

The metal additives manufacturing lab shall not be equipped with automatic sprinkler protection. Protection of this space shall be provided by a "Class D" dry chemical, fixed extinguishing system. This system shall include a fixed temperature and rate of rise heat activated fire detection system to automatically activate the dry chemical system upon fire detection. Manual activation switches shall also be provided at each exit from the space. Design of the system shall be in accordance with NFPA 484: Standard for Combustible Metals and NFPA 17: Standard for Dry Chemical Extinguishing System.

Seismic

Brace suspended pipes in accordance with the SMACNA Seismic Restraint Manual, 1991 Edition, for Seismic Design Category C.

ENERGY-LEED

SUMMARY OF MEANS AND STRATEGIES FOR MAXIMIZING ENERGY CONSERVATION, SUSTAINABLE DESIGN and LEED CERTIFICATION

Sustainability

This portion of the narrative describes the Sustainable related design issues. This section contains LEED Goals, energy related design goals, simulation methodology and a LEED points summary. The facility shall be designed and constructed per USGBC LEED BD+C-NC v.3.0. The goal of this project is to meet the requirements to attain LEED Certification.

LEED Goals

General Description: A New Advanced Manufacturing Collaborative building will be owned by Aiken Advanced Manufacturing Partnership, LLC and located adjacent to the University of South Carolina Aiken and will serve to allow research for Savannah River Nuclear Solutions. The building will be a two-story new building containing approximately 64,400 gross square feet. *See the architectural and mechanical narratives for more detail.*

Scope of Work Description: Provide guidance for the design team to be able to achieve LEED Certification.

LEED Specific Criteria and References:

- LEED NC version 3.0 reference manual and relevant LEED directives.
- International Building Codes 2012 Edition, with South Carolina Amendments.
- Energy Efficient Design of New Buildings Except New Low-Rise Residential Buildings, ASHRAE/IESNA Standard 90.1-2007, and Appendix G of this standard.

Energy Goals Summary

Objectives

The project team has established a goal of LEED Certified for this facility. Currently the design team has set a goal to meet ASHRAE 90.1-2007, Appendix G.

This Summary sub-section is intended to show how the energy goal will be optimized. The summary sheet at the end of this sub-section gives an overview of the LEED points that are pursued with the present components. The energy goals are intended to integrate the information for team members that affect energy savings.

Budget/Baseline Building: The Budget/Baseline Building is based on minimum requirements by ASHRAE / IESNA Standard 90.1-2007, and Appendix G-Building Performance Rating Method. Note that this is not the Energy Cost Budget Method used by ASHRAE for standard code compliance calculations.

Proposed Building: The goals for this facility are given in the following sub-section.

Energy and Water Systems Design Criteria

The project team is familiar with the current version of the following standards and will use them in making energy design decisions for the project:

- Lighting Handbook - Reference and Application, 10th Edition, by Illuminating Engineering Society of North America (ISEHA)
- ANSI/ASHRAE/IES 90.1-2007, Energy Efficient Design of New Buildings (ASHRAE Standard 90.1), and Appendix G – Building Performance Rating Method American Society of Heating, Refrigerating, and Air Conditioning Engineers.
- American National Standard Institute
- ASHRAE Standard 62-2010, Ventilation for Acceptable Indoor Air Quality and current addenda

The project is located in Aiken County, South Carolina, which is in ASHRAE climate zone 3A The A/E team will address the following design components in the design of the project:

- Building site orientation and envelope for optimum summer shading given the site constraints.
- Fully weatherized building envelope with insulated wall and roofing systems, and low emissivity insulated exterior windows.
- Energy-efficient lighting systems.
- Energy efficient HVAC systems.
- Life cycle comparison of major energy-saving Design Alternatives.
- Systems or control strategies for reducing electric demand costs.
- Energy Management System (EMS).

The following criteria outline specific insulation, glazing, lighting, HVAC, and EMS design standards, established to satisfy the project's energy objectives.

Architectural/Envelope

Design envelope criteria are outlined here.

Table 1 – Envelope

Zone A	AMC Lab Goal	Code 90.1-2007 App. G
Overall Wall-mass U-Value, Btuh/Sq. Ft.	NA	NA
Walls above grade- Steel-framed	U = 0.076	U = 0.084
Roof-Insulation above deck	U = 0.043 R = 23	U = 0.048
Roof Solar Reflectance Index (SRI)	0.78	0.30
Wall Below Grade (Minimum R-Value)	C - 1.140	C – 1.140
Exposed Floors-steel joist	U = 0.057	U = 0.057
Slab-on-Grade-unheated	F – 0.73	F – 0.74
Opaque doors-swinging	U = 0.70	U = 0.70
Opaque doors-non-swinging	U = 1.45	U = 1.45

Table 2 – Glazing

Zone 3a	AMC Lab Goal	Code 90.1-2007 App. G
Vertical Glazing (0% - 40%) Curtainwall/Storefront	U = 0.35	U = 0.60
Vertical Glazing (0% - 40%) Entrance door	U = 0.80	U = 0.90
SHGC - All	0.25	0.25
Shading Coefficient - All	0.29	0.29

Glazing Low Emissivity, Insulating, and High performance type.

Window/wall ratio AMC <= 40%

The energy code shading coefficient is based on a glass ratio of 0%-40% of gross wall area. Note that walls with over 40% glass will be compared to a 40% glass wall for energy comparisons, and will utilize overhangs and external shading, and other techniques to minimize solar heat gain and maximize light transmittance.

Concepts that minimize windows on east and west exposures will also be considered.

See Electrical Narrative and Room Data Sheets for equipment loads.

Lighting

Table 3 – Lighting

Zone 3a	AMC Lab Goal	Code 90.1-2007 App. G
	W/sf	
Building Area requirement-rage for whole building - Manufacturing	1.00	1.3
Wet Labs	1.00	1.4
Detailed Manufacturing-Dry Labs	1.20	2.1
Classrooms	1.00	1.4
Office - Open / Closed	0.08	1.1
Conference/Meeting	1.1	1.3
High Bay Manufacturing >25'	1.1	1.7
Lobby	1.00	1.3
Circulation	0.50	0.5
Restrooms	0.80	0.9
Electrical/Mechanical	1.00	1.5

See 90.1 section 9 for control requirements

In order to meet the team's goal, we will use:

- Occupancy sensors,
- Low voltage lighting control system, free standing and monitored by BAS

Office areas to employ a task/ambient lighting to reduce energy consumption and to provide individual occupants with lighting control.

Interior and exterior fixtures will be selected to minimize spill light. This can be in the form of interior light spilling form the building to the exterior, as well as exterior light spill across property lines.

Fixtures with a Color-Rendering Index (CRI) of 78 or better are used in offices and computer areas. All lamps have a color temperature of 3500K. See the Electrical narrative for more detail.

HVAC & Plumbing Systems

Primary Cooling Equipment: Chilled water is provided from roof mounted air cooled chillers. The chilled water will be supplied at 57°F or lower temperature. The building will utilize roof mounted air handling cooling systems and roof mounted air cooled chillers. Chilled water will be circulated by variable flow pumps. See the Mechanical narrative for more detail.

Table 4 – HVAC

	AMC Lab Goal	Code 90.1-2007 App. G
Air-Cooled Split System at 24 hr areas < 65,000 Btu/h	SEER: 15	SEER: 13.0
Air Cooled Chillers >=65 tons, Electric Heating	Full Load EER: 12.0 IPLC EER: 14	Full Load EER: 9.7 IPLC EER: 9.4

No CFCs or HCFCs will be used on this project.

Pump and Fan Motor Efficiencies: See Table 5

Primary Heating Equipment: Space heating is provided by gas fired hydronic system unless an alternate is chosen. Hot water will be circulated by variable flow pumps, and will utilize AHUs, VAV terminal units. See the Mechanical narrative for more detail.

Air Handling Systems: Space heating, cooling and ventilation is provided mostly by roof top chilled water air handling units (excluding the 24 hour areas). Outside air flow control is through centrifugal fans with variable frequency drive (VFD) fan speed control.

- Office Central Circulation Air Handling Units: A multiple zone, variable air volume unit will be installed on the roof.
- Lab Central Circulation Air Handling Units: A multiple zone, variable air volume unit will be installed on the roof. 100% outside air.
- Packaged Energy Recovery Units: Two packaged energy recovery units will provide tempered air to the floor air handling units. The units will have Enthalpy Wheels with variable speed controls.
- Computer Room Air Conditioning Units: Floor- or ceiling-mounted computer room air conditioning units will be installed to serve computer/server rooms.

EMS System DDC Controls

The temperature control system will be a Direct Digital Control (DDC) type. DDC system will be capable of measuring building energy usage to meet the requirements of LEED EAc5.

The following items will be measured directly and will be recorded to provide monthly and annual energy consumption data:

- Chilled Water: Flow (gpm) and energy (kBtu)
- Heating Hot Water: Flow (gpm) and Energy (kBtu)
- Pumps: Energy (kW-hrs) from VFD output
- Variable Speed Fans: Energy (kW-hrs) from VFD output
- Domestic Cold Water: Usage (kgals)
- Building Electricity: Usage (kW-hr) from the building electric meter.

Toilet and Wet Area Plumbing Fixtures

All fixtures except janitor's closets will use low flow fixtures with a goal to achieve a 30% savings per LEED WE credit 3 or greater.

Table 5 - FAN MOTOR EFFICIENCIES:

HP	Design Effic.	90.1 Effic.
1	85.5	82.5
1.5	86.5	84
2	86.5	84
3	89.5	86.5
5	89.9	87.5
7.5	91	88.5
10	91.7	89.5
15	93	91
20	93	91
25	96.6	91.7
30	94.1	92.4
40	94.1	9.3
50	94.5	93
60	95	93.6
75	95.4	94.1
100	95.4	94.1

Energy Simulations Methodology

General: The simulations may be made on the Trane TRACE700 program in accordance with ASHRAE 90.1-2007, Appendix G. Submittals will be in accordance with LEED EA prerequisite 02 and credit 1 requirements.

Energy Goals Summary

The project team has established a goal of LEED Certified for this facility. We will strive to achieve the highest energy savings that that provides an economic payback within the project's parameters.

LEED Points Projection

The following is a listing of projected points that are being pursued on this project. Each point has a related team member who has the primary responsibility to incorporate the requirements into the design, and / or later, into the construction of the project.

As the design progresses, deviation from the following score card may occur.

PRELIMINARY GMP PHASE LEED CREDITS LIST

AMC PROJECT 15-Aug-2016

USC Aiken, SC

HEERY Project: 16006-00

LEED Project ID = 1000069586

Goal is "CERTIFIED"

LEED NC VERSION 3.0

40 - 49 points	Certified
50 - 59 points	Silver
60 - 79 points	Gold
80+ points	Platinum

HEERY SRNS

52	**YES items projected-PRELIMINARY EST.**
1	Reasonable to become YES with effort
53	*possible points*

Yes	?	No	AMC PROJECT		Primary Responsibility- Lead person for this task
Y			PI-1	Minimum Program Requirements	HEERY LEED-Bellamy
Y			PI-2	Project Summary Details	HEERY LEED-Bellamy
Y			PI-3	Occupancy	HEERY LEED-Bellamy
Y			PI-4	Schedule & Documents	HEERY LEED-Bellamy
17	8	0	SUSTAINABLE SITES		
Y			SS Prereq 1	Construction Activity Pollution Prevention	CIVIL Hilderbrand
1	0	0	SS Credit 1	Site Selection	CIVIL Hilderbrand
5	0	0	SS Credit 2	Development Density and Community Connectivity	HEERY LEED-Bellamy
0	0	0	SS Credit 3	Brownfield Redevelopment	
0	6	0	SS Credit 4.1 Reg	Alternative Transportation - Public Transportation Access	HEERY LEED-Bellamy
1	0	0	SS Credit 4.2	Alternative Transportation - Bicycle Storage and Changing Rooms	HEERY ARCH-Wellborn
3	0	0	SS Credit 4.3	Alternative Transportation - Low-Emitting and Fuel-Efficient Vehicles	SRNS-T Adams
2	0	0	SS Credit 4.4	Alternative Transportation - Parking Capacity	CIVIL Hilderbrand
0	1	0	SS Credit 5.1	Site Development - Protect or Restore Habitat	CIVIL Hilderbrand
1	0	0	SS Credit 5.2	Site Development - Maximize Open Space	CIVIL Hilderbrand
1	0	0	SS Credit 6.1 Reg	Stormwater Design - Quantity Control	CIVIL Hilderbrand
1	0	0	SS Credit 6.2	Stormwater Design - Quality Control	CIVIL Hilderbrand
0	1	0	SS Credit 7.1	Heat Island Effect - Non-roof	CIVIL Hilderbrand
1	0	0	SS Credit 7.2	Heat Island Effect - Roof	HEERY ARCH-Wellborn -
1	0	0	SS Credit 8	Light Pollution Reduction	HEERY ELEC-Dogru
Yes	?	No			
6	1	3	WATER EFFICIENCY		

Yes	?	No	AMC PROJECT					Primary Responsibility- Lead person for this task
Y			WE Prereq 1				Water Use Reduction - 20%	HEERY PLUMB-Anderson
4	0	0	WE Credit 1				Water Efficient Landscaping	
			WE Credit 1		2	0	Irrig reduction-Reduce by 50%	LANDSCAPE-TBD
			WE Credit 1		2	0	Irrig reduction-No Potable Water Use or Irrigation	LANDSCAPE-TBD
0	0	2	WE Credit 2				Innovative Wastewater Technologies	
2	1	1	WE Credit 3				Water Use Reduction	
			WE Credit 3		2	0	Water Red-Reduce by 30%	HEERY PLUMB-Anderson
			WE Credit 3		0	1	Water Red-Reduce by 35%	HEERY PLUMB-Anderson
			WE Credit 3	Reg	0	0	Water Red-educe by 40%	HEERY PLUMB-Anderson
Yes	?	No						
7	6	22	ENERGY & ATMOSPHERE					
Y			EA Prereq 1				Fundamental Commissioning of Building Energy Systems	Cx-TBD
Y			EA Prereq 2				Minimum Energy Performance	HEERY MECH-Barron
Y			EA Prereq 3				Fundamental Refrigerant Management	HEERY MECH-Barron
0	3	16	EA Credit 1				Optimize Energy Performance	
			EA Credit 1		0	0	Energy-Improve by 12% for New Buildings or 8% for EB	HEERY MECH-Barron
			EA Credit 1		0	0	Energy-Improve by 14% for New Buildings or 10% for EB	HEERY MECH-Barron
			EA Credit 1		0	0	Energy-Improve by 16% for New Buildings or 12% for EB	HEERY MECH-Barron
			EA Credit 1		0	0	Energy-Improve by 18% for New Buildings or 14% for EB	HEERY MECH-Barron
			EA Credit 1		0	0	Energy-Improve by 20% for New Buildings or 16% for EB	HEERY MECH-Barron
			EA Credit 1		0	0	Energy-Improve by 22% for New Buildings or 18% for EB - NEED THIS TO GET TO LEED GOLD	HEERY MECH-Barron
			EA Credit 1		0	1	Energy-Improve by 24% for New Buildings or 20% for EB	HEERY MECH-Barron
			EA Credit 1		0	1	Energy-'Improve by 26% for New Buildings or 22% for EB.	HEERY MECH-Barron
			EA Credit 1		0	1	Regional - Energy-Improve by 28% for New Buildings or 24% for EB	HEERY MECH-Barron
0	1	6	EA Credit 2				On-Site Renewable Energy	
			EA Credit 2	Reg	0	1	1% Renewable Energy	SRNS-T Adams
2	0	0	EA Credit 3				Enhanced Commissioning	Cx-TBD
2	0	0	EA Credit 4				Enhanced Refrigerant Management	HEERY MECH-Barron
3	0	0	EA Credit 5				Measurement and Verification	HEERY MECH-Barron
0	2	0	EA Credit 6				Green Power	SRNS-T Adams
0	1	0	EA Credit 6				Green Power-exemplary	SRNS-T Adams
Yes	0	No						
6	0	8	MATERIALS & RESOURCES					

AMC PROJECT							Primary Responsibility-
Yes	?	No					Lead person for this task
Y			MR Prereq 1			Storage and Collection of Recyclables	SRNS-T Adams
0	0	3	MR Credit 1.1			**Bld Reuse** - Maintain Exist Walls, Floors and R	
0	0	1	MR Credit 1.2			**Building Reuse** - Maintain Interior Nonstructural Elements	-
2	0	0	MR Credit 2			**Construction Waste Management**	
			MR Credit 2	1	0	**CWM-50% Recycled or Salvaged**	TURNER
			MR Credit 2			CWM-50% Recycled or Salvaged	HEERY LEED-Bellamy
			MR Credit 2	1	0	**CWM-75% Recycled or Salvaged**	TURNER
0	0	2	MR Credit 3			**Materials Reuse**	
2	0	0	**MR Credit 4**			**Recycled Content**	
			MR Credit 4	1	0	**Recycled - 10% of Content**	TURNER
			MR Credit 4	1	0	**Recycled - 20% of Content**	TURNER
1	0	1	**MR Credit 5**			**Regional Materials**	
			MR Credit 5	1	0	**Regional-10% of Materials**	TURNER
			MR Credit 5	0	0	**Regional-20% of Materials**	TURNER
0	0	1	MR Credit 6			**Rapidly Renewable Materials**	
1	0	0	MR Credit 7			**Certified Wood**	TURNER
Yes	0	No					
11	3	1	INDOOR ENVIRONMENTAL QUALITY				
Y			EQ Prereq 1			**Minimum Indoor Air Quality Performance**	HEERY MECH-Barron
Y			EQ Prereq 2			**Environmental Tobacco Smoke (ETS) Control**	SRNS-T Adams
Y			EQ Prereq 2			Environmental Tobacco Smoke (ETS) Control	SRNS-T Adams
1	0	0	EQ Credit 1			**Outdoor Air Delivery Monitoring**	HEERY MECH-Barron
0	1	0	EQ Credit 2			**Increased Ventilation**	
1	0	0	EQ Credit 3.1			**Construction Indoor Air Quality Management Plan - During Construction**	TURNER
			EQ Credit 3.1			Construction Indoor Air Quality Management Plan - During Construction	HEERY LEED-Bellamy
1	0	0	EQ Credit 3.2			**Construction Indoor Air Quality Management Plan - Before Occupancy**	TURNER
			EQ Credit 3.2			Construction Indoor Air Quality Management Plan - Before Occupancy	TURNER
1	0	0	EQ Credit 4.1			**Low-Emitting Materials - Adhesives and Sealants**	TURNER
1	0	0	EQ Credit 4.2			**Low-Emitting Materials - Paints and Coatings**	TURNER
1	0	0	EQ Credit 4.3			**Low-Emitting Materials - Flooring Systems**	TURNER
			EQ Credit 4.4			Low-Emitting Materials - **Composite Wood and Agrifiber Products**	HEERY ARCH-Wellborn
1	0	0	EQ Credit 4.4			**Low-Emitting Materials - Composite Wood and Agrifiber Products**	TURNER
			EQ Credit 5			Indoor Chemical and Pollutant Source Control	HEERY ARCH-Wellborn
			EQ Credit 5			Indoor Chemical and Pollutant Source Control	HEERY ARCH-Wellborn
1	0	0	EQ Credit 5			**Indoor Chemical and Pollutant Source Control**	TURNER
1	0	0	EQ Credit 6.1			**Controllability of Systems - Lighting**	HEERY ELEC-Dogru
0	1	0	EQ Credit 6.2			**Controllability of Systems** - Thermal Comfort	HEERY MECH-Barron
1	0	0	EQ Credit 7.1	Reg		**Thermal Comfort - Design**	HEERY MECH-Barron
1	0	0	EQ Credit 7.2			**Thermal Comfort - Verification**	HEERY MECH-Barron
0	0	1	EQ Credit 8.1			**Daylight and Views** - Daylight	
0	1	0	EQ Credit 8.2			**Daylight and Views** - Views	HEERY LEED-Bellamy
Yes	0	No					
3	3	0	INNOVATION IN DESIGN				

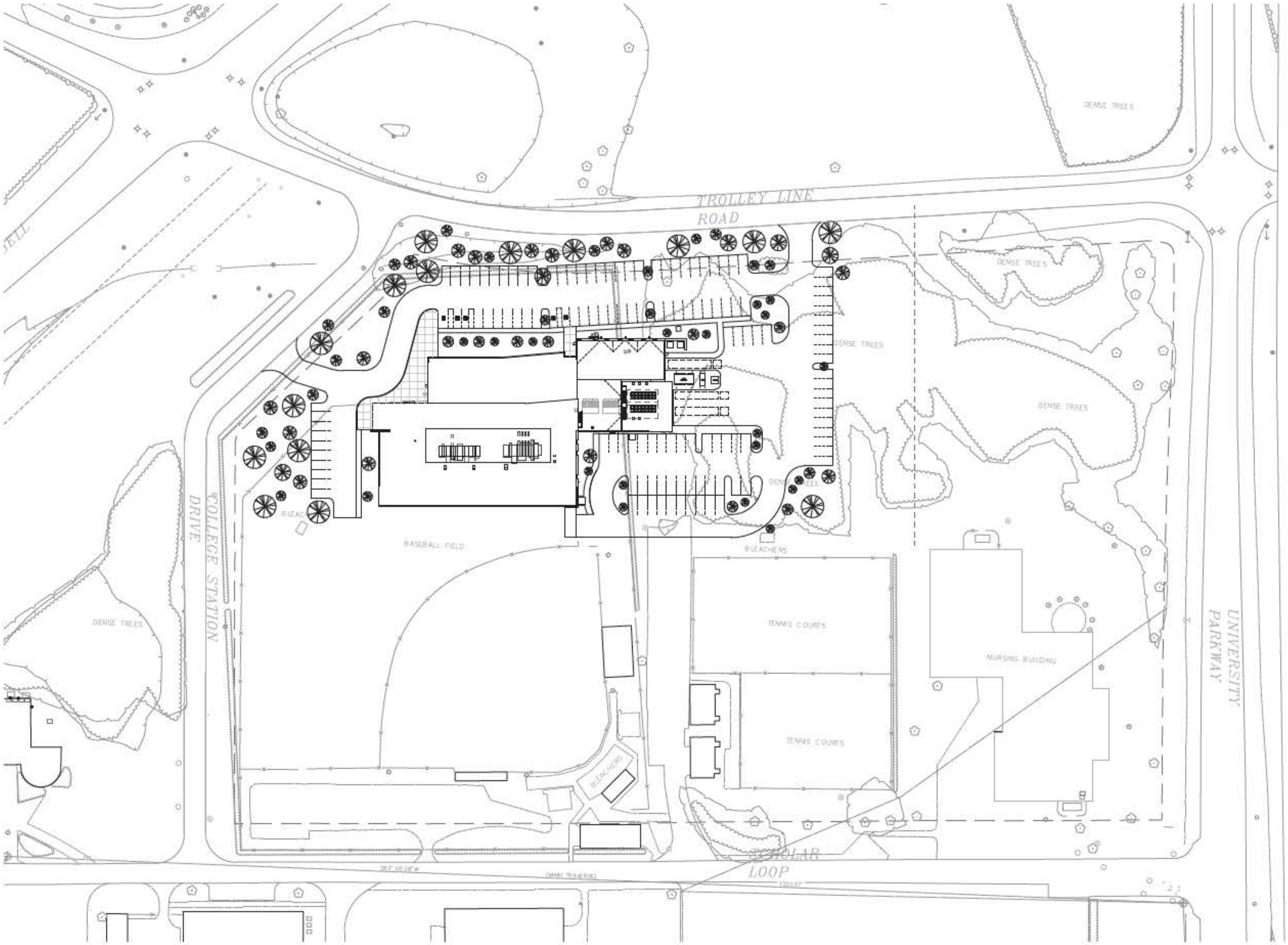
AMC PROJECT						Primary Responsibility-
Yes	?	No				Lead person for this task
2	3	0	IN Credit 1		Innovation in Design	
			IN Credit 1.1	0 1	Innovation Performance-low mercury lamps	HEERY ELEC-Dogru
			IN Credit 1.2	0 1	Innovation Performance-sustainable educ. Program	SRNS-T Adams
			IN Credit 1.2b	0 1	Exemplary Performance-recycle 95% of const. waste	TURNER
			IN Credit 1.3	1 0	Innovation-Green Pest Mgt Plan	SRNS-T Adams
			IN Credit 1.4	0 0	Exemplary - Comprehensive Transp. Mgt Plan	HEERY LEED-Bellamy
			IN Credit 1.5	0 1	Innovation-Low VOC furniture	HEERY INT-Hart
			IN Credit 1.6	1 0	Innovation Indoor Green cleaning Program	SRNS-T Adams
			IN Credit 1.7	0 1	Exemplary MRc4.0 = 30% recycled content	TURNER
1	0	0	IN Credit 2		LEED® Accredited Professional	HEERY LEED-Bellamy
Yes	0	No				
2	0	2	REGIONAL PRIORITY - 6 points in list			
2	0	2	RP Credit 1		Regional Priority - 29801	
			RP Credit 1.1	0 1	Regionally Defined Credit Achieved-SS 4.1	
			RP Credit 1.2	1 0	Regionally Defined Credit Achieved-SS 6.1	
			RP Credit 1.3	0 0	Regionally Defined Credit Achieved-WE 3.0 - 40%	
			RP Credit 1.4	0 0	Regionally Defined Credit Achieved-EA 1.0 In. 28%	
			RP Credit 1.5	0 0	Regionally Defined Credit Achieved-EA 2.0 - 1%	
			RP Credit 1.6	1 0	Regionally Defined Credit Achieved-EQ 7.1	
Yes	0	No				
52	21	36	PROJECT TOTALS (Certification Estimates)			

AMC AIKEN

ENTRY VIEW

AUGUST 19, 2016

HEERY design



HEERY design

Heery International Inc.
999 Peachtree Street, NE,
Suite 300
Atlanta, GA 30309-3953
404.881.9880

project number
1600600

ECONOMIC DEVELOPMENT PARTNERSHIP

ADVANCED MANUFACTURING COLLABORATIVE

consultants/construction managers

CIVIL ENGINEERS
Hass & Hildebrand, Inc.
133 Greenville Street SW
Aiken, SC 29801
803.649.1316

seal/signature

issued for	date
GMP PACKAGE	08/19/2016

item	date

NOT FOR CONSTRUCTION

SCALE: 1" = 40'

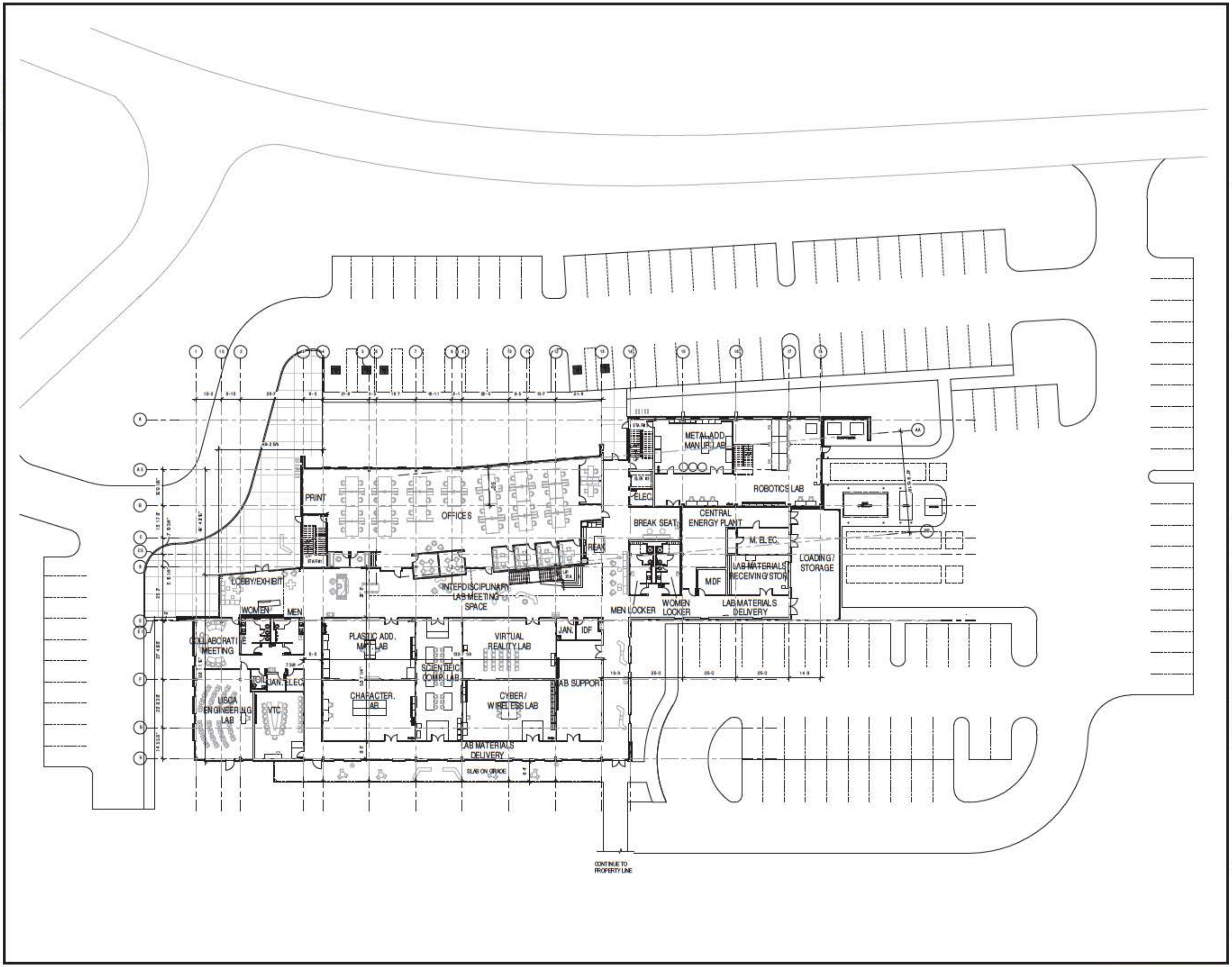
key plan
sheet title

ARCHITECTURAL SITE PLAN

sheet number
AS-101

drawn by Author checked by Checker

C:\HILFRJAM1616\D60AMC_ARCH_hwaltburl.rvt
8/3/2016 4:22:37 PM



HEERY design

Heery International Inc.
999 Peachtree Street, NE,
Suite 300
Atlanta, GA 30309-3953
404.881.9880

project number

1600600

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consultants/construction managers

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Hass & Hildebrand, Inc.
133 Greenville Street SW
Aiken, SC 29801
803.649.1316

seal/signature

issued for	date
GMP PACKAGE	08/19/2016

item	date

SCALE: 1/16" = 1'-0"

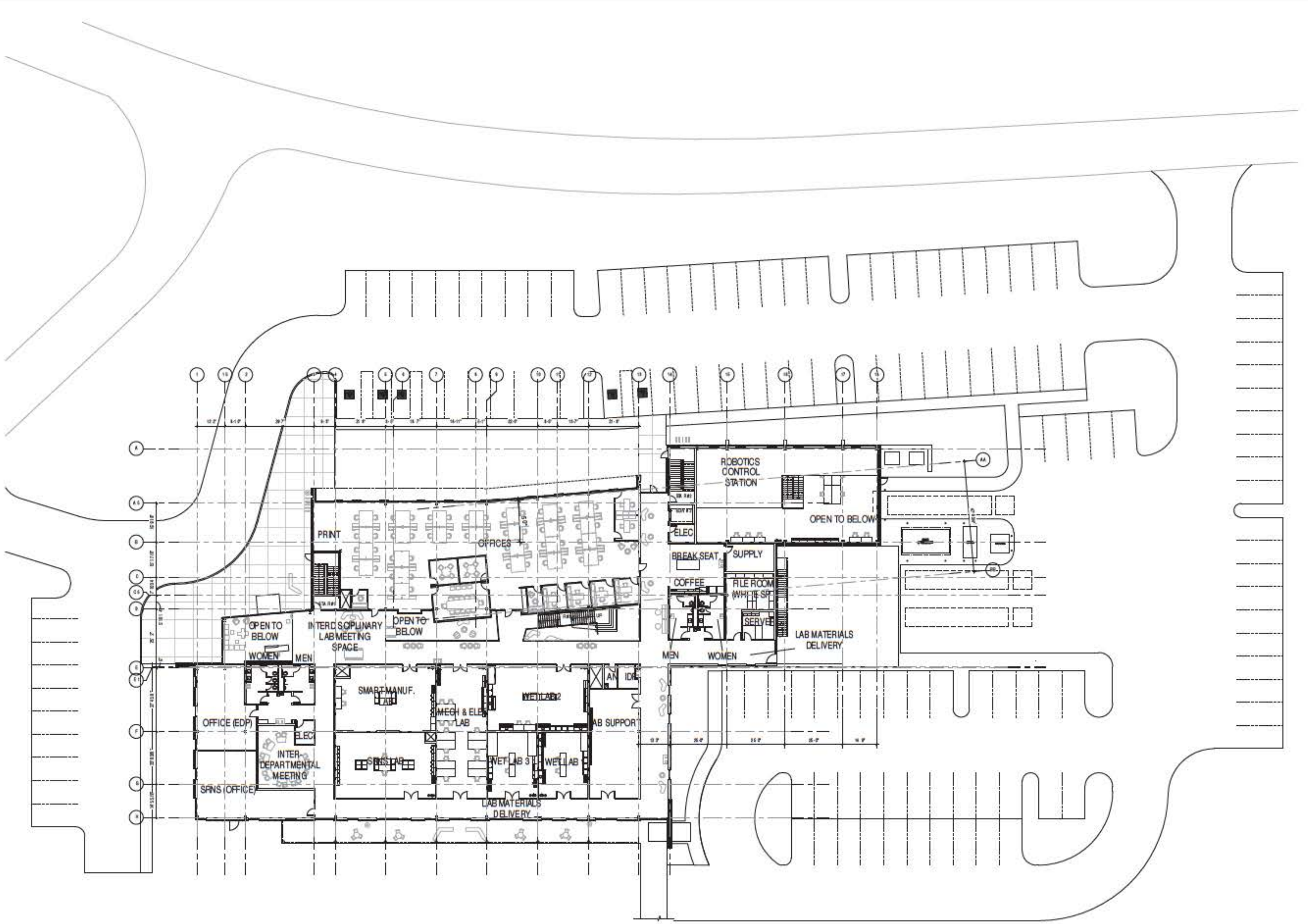
key plan
sheet title

OVERALL FLOOR PLAN LEVEL 01

sheet number

AF101

drawn by Author checked by Checker



HEERY design

Heery International Inc.
999 Peachtree Street, NE,
Suite 300
Atlanta, GA 30309-3953
404.881.9880

project number

1600600

ECONOMIC DEVELOPMENT PARTNERSHIP

ADVANCED MANUFACTURING COLLABORATIVE

consultants/construction managers

CIVIL ENGINEERS
Hass & Hildebrand, Inc.
133 Greenville Street SW
Aiken, SC 29801
803.649.1316

seal/signature

issued or	date
GMP PACKAGE	08/19/2016

item	date

SCALE: 1/16" = 1'-0"

key plan

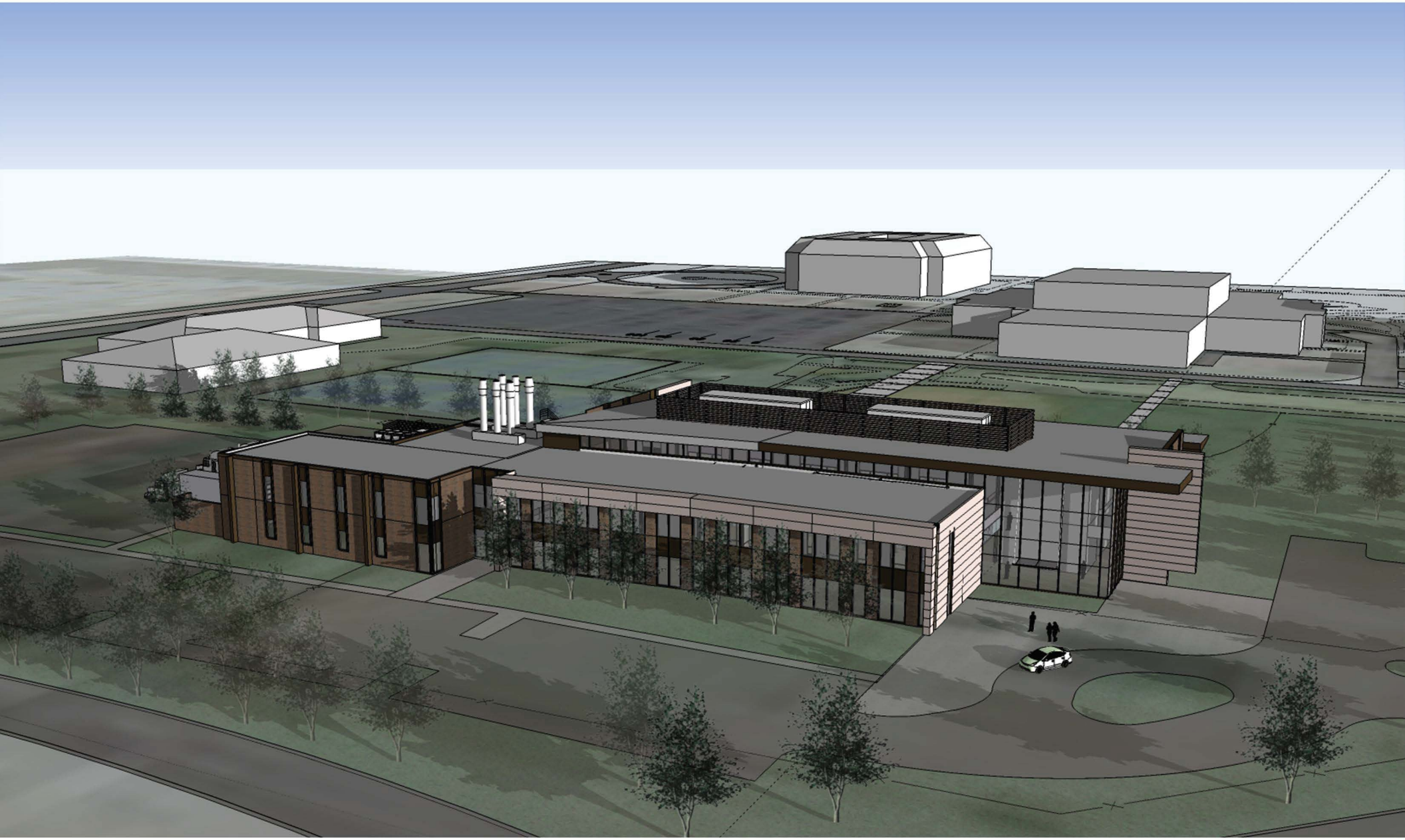
sheet title

OVERALL FLOOR PLAN LEVEL 02

sheet number

AF102

drawn by Author checked by Checker



AMC AIKEN

NORTH AERIAL VIEW

AUGUST 19, 2016

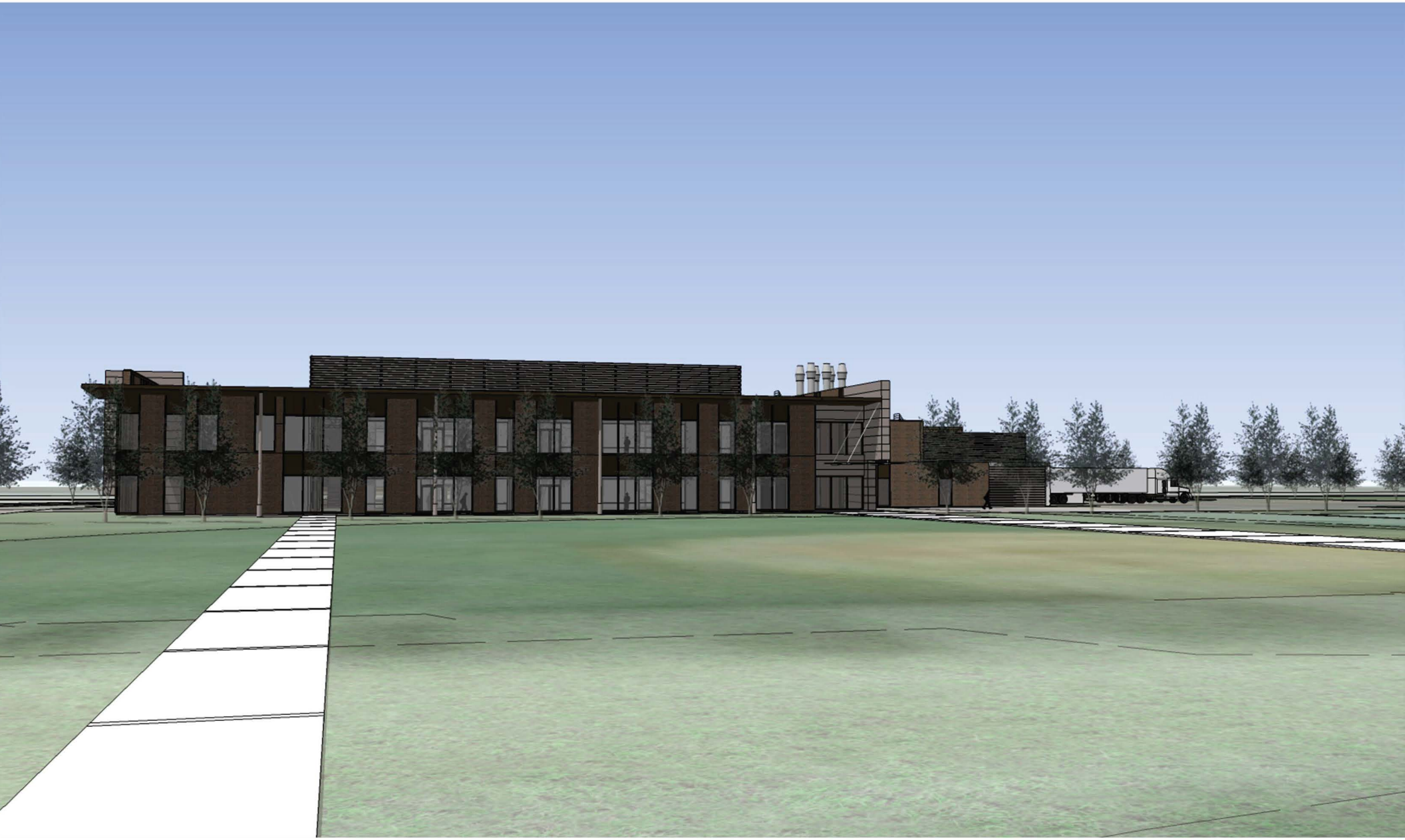
HEERY design

AMC AIKEN

WEST VIEW

AUGUST 19, 2016

HEERY design



AMC AIKEN

SOUTH CAMPUS VIEW

AUGUST 19, 2016

HEERY design

AMC AIKEN

NORTHEAST VIEW

AUGUST 19, 2016

HEERY design

"General Decision Number: SC20210032 01/01/2021

Superseded General Decision Number: SC20200032

State: South Carolina

Construction Type: Building

Counties: Aiken and Edgefield Counties in South Carolina.

DOES NOT INCLUDE SAVANNAH RIVER SITE IN AIKEN COUNTY.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.95 for calendar year 2021 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.95 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2021. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/01/2021

ELEC1579-001 10/01/2017

	Rates	Fringes
ELECTRICIAN	$ 24.56	13.41

Work from swinging boson chairs, spiders, and/or similar devices: 20% per hour additional.

PLAS0148-002 07/01/2011

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 22.00	6.34

* PLUM0150-005 10/01/2018

	Rates	Fringes
PIPEFITTER	$ 25.56	13.96

SUSC2011-028 08/31/2011

	Rates	Fringes
BRICKLAYER	$ 18.00	0.00
CARPENTER (Drywall Hanging Only)	$ 16.32	1.50
CARPENTER (Form Work Only)	$ 13.23	0.02
CARPENTER, Excludes Drywall Hanging, and Form Work	$ 15.14	3.16
HVAC MECHANIC (HVAC Duct Installation Only)	$ 19.71	1.93
LABORER: Common or General	$ 9.55	0.00
LABORER: Landscape	$ 9.45	0.49
LABORER: Mason Tender-Brick/Concrete/Cement/Stone	$ 11.00	0.00
LABORER: Pipelayer	$ 14.69	2.08
OPERATOR: Backhoe/Excavator/Trackhoe	$ 16.81	2.67
OPERATOR: Bulldozer	$ 17.07	2.65
OPERATOR: Crane	$ 19.39	2.02
OPERATOR: Grader/Blade	$ 17.50	1.78
OPERATOR: Loader	$ 14.18	1.99
PAINTER: Brush, Roller and Spray	$ 12.00	0.00
PLUMBER	$ 16.86	0.95
ROOFER	$ 12.21	0.00
TRUCK DRIVER	$ 14.05	3.18

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave

for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates

the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator

(See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==========

END OF GENERAL DECISION
"

	A	B	C	D	E
1	**PART III - LIST OF DOCUMENTS, EXHIBITS, AND OTHER ATTACHMENTS**				
2	**SECTION J - LIST OF ATTACHMENTS**				
3	**ATTACHMENT J-9: MASTER SUBMITTAL LOG**				
4	**Submittal Schedule Key: M = Prior to Mobilization; W = Prior to Commencing Field Work; F= Prior to Fabrication; A = Prior to Final Acceptance; Z = As Required**				
5	**Annually = ANL; Semi-Annually = SA; Monthly = MTH; Weekly = WKY; Daily = DAY**				
6	**Reviewers Key: COR = Contracting Officer Representative; ENGR = Engineering;**				
7					
8	**Item No.**	**Submittal Title**	**Action (A) or Information (I)**	**Contract Reference (Note that some submittals may have additional applicable references)**	**Schedule**
9	**Non-Attachment J-1*Specifications* Submittals**				
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PART III – LIST OF DOCUMENTS, EXHIBITS, AND OTHER ATTACHMENTS

SECTION J – LIST OF ATTACHMENTS

ATTACHMENT J-10 – QUALITY ASSURANCE PROJECT GRADED APPROACH

Contractor shall submit a QA Program compliant with EM Corporate QAP (EM-QA-001 Rev 1) using the graded approach as prescribed in the following criteria from DOE O 414.1D.

Graded Approach.

The process of ensuring that the levels of analyses, documentation, and actions used to comply with requirements are commensurate with:

(1) the relative importance to safety, safeguards, and security;

(2) the magnitude of any hazard involved;

(3) the life-cycle stage of a facility or item;

(4) the programmatic mission of a facility;

(5) the particular characteristics of a facility or item;

(6) the relative importance to radiological and nonradiological hazards; and,

(7) any other relevant factors. (10 C.F.R. § 830.3)

QUALITY ASSURANCE CRITERIA

1. Criterion 1— Management/Program

a. Establish an organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work.

b. Establish management processes, including planning, scheduling, and providing resources for the work.

2. Criterion 2— Management/Personnel Training and Qualification

a. Train and qualify personnel to be capable of performing their assigned work.

b. Provide continuing training to personnel to maintain their job proficiency.

3. Criterion 3— Management/Quality Improvement

a. Establish and implement processes to detect and prevent quality problems.

b. Identify, control, and correct items, services, and processes that do not meet established requirements.

c. Identify the causes of problems, and include prevention of recurrence as a part of corrective action planning.

d. Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement.

4. Criterion 4— Management/Documents and Records

a. Prepare, review, approve, issue, use, and revise documents to prescribe processes, specify requirements, or establish design.

b. Specify, prepare, review, approve, and maintain records.

5. Criterion 5— Performance/Work Processes

a. Perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements using approved instructions, procedures, or other appropriate means.

b. Identify and control items to ensure proper use.

c. Maintain items to prevent damage, loss, or deterioration.

d. Calibrate and maintain equipment used for process monitoring or data collection.

6. Criterion 6— Performance/Design

a. Design items and processes using sound engineering/scientific principles and appropriate standards.

b. Incorporate applicable requirements and design bases in design work and design changes.

c. Identify and control design interfaces.

d. Verify or validate the adequacy of design products using individuals or groups other than those who performed the work.

e. Verify or validate work before approval and implementation of the design.

7. Criterion 7— Performance/Procurement

a. Procure items and services that meet established requirements and perform as specified.

b. Evaluate and select prospective suppliers on the basis of specified criteria.

c. Establish and implement processes to ensure that approved suppliers continue to provide acceptable items and services.

8. Criterion 8— Performance/Inspection and Acceptance Testing

a. Inspect and test specified items, services, and processes using established acceptance and performance criteria.

b. Calibrate and maintain equipment used for inspections and tests.

9. Criterion 9— Assessment/Management Assessment.

a. Ensure that managers assess their management processes and identify and correct problems that hinder the organization from achieving its objectives.

10. Criterion 10— Assessment/Independent Assessment.

a. Plan and conduct independent assessments to measure item and service quality, to measure the adequacy of work performance, and to promote improvement.

b. Establish sufficient authority and freedom from line management for independent assessment teams.

c. Ensure persons who perform independent assessments are technically qualified and knowledgeable in the areas to be assessed.

SUSPECT/COUNTERFEIT ITEMS PREVENTION

1. PURPOSE. To set forth requirements for DOE and its contractor organizations, as part of their QAPs, to establish, document and implement effective controls and processes that will: (1) ensure items and services meet specified requirements; (2) prevent entry of Suspect/Counterfeit Items (S/CIs) into the DOE supply chain; and (3) ensure detection, control, reporting, and disposition of S/CIs.

2. REQUIREMENTS. The organization's QAP must:

   a. Include a S/CI oversight and prevention process commensurate with the facility/activity hazards and mission impact.

   b. Identify the position responsible for S/CI activities and for serving as a point of contact with the Office of Health, Safety, and Security.

   c. Provide for training and informing managers, supervisors, and workers on S/CI processes and controls (including prevention, detection, and disposition of S/CIs).

   d. Prevent introduction of S/CIs into DOE work by—

      (1) engineering involvement:

         (a) in the development of procurement specifications;

         (b) during inspection and testing; and

         (c) when maintaining, replacing, or modifying equipment;

      (2) identifying and placing technical and QA requirements in procurement specifications;

      (3) accepting only those items that comply with procurement specifications, consensus standards, and commonly accepted industry practices; and

      (4) inspecting inventory and storage areas to identify, control, and disposition for S/CIs.

   e. Include processes for inspection, identification, evaluation, and disposition of S/CIs that have been installed in safety applications and other applications that create potential hazards. Also address the use of supporting engineering evaluations for acceptance of installed S/CI as well as marking to prevent future reuse.

   f. Conduct engineering evaluations to be used in the disposition of identified S/CIs installed in safety applications/systems or in applications that create potential hazards. Evaluations must consider potential risks to the environment, the public and workers along with a cost/benefit impact, and a schedule for replacement (if required).

g. Perform the evaluation to determine whether S/CIs installed in non-safety applications pose potential safety hazards or may remain in place. Disposition S/CIs identified during routine maintenance and/or inspections to prevent future use in these applications.

h. Report to the DOE Inspector General per paragraph 3. below, and DOE O 221.1B, *Reporting Fraud, Waste, and Abuse to the Office of Inspector General*, dated 09-27-16 (or latest version).

i. Collect, maintain, disseminate, and use the most accurate, up to date information on S/CIs and suppliers. Sources are identified on the Suspect/Counterfeit and Defective Items website (https://energy.gov/ehss/policy-guidance-reports/databases/suspectcounterfeit-and-defective-items).

j. Conduct trend analyses for use in improving the S/CI prevention process.

Note: DOE O 210.2A, *DOE Corporate Operating Experience Program*, dated 04-08-11 (or latest version) requires review of existing lessons learned reports and submittal of new lessons learned reports for use in improving the S/CI prevention process.

3. INSPECTOR GENERAL. Contact the DOE Inspector General (IG), before destroying or disposing of S/CIs and corresponding documentation, to allow the IG to determine whether the items and documentation need to be retained for criminal investigation or litigation.

4. OCCURRENCE REPORTING. S/CIs must be reported in accordance with DOE O 232.2A, *Occurrence Reporting and Processing of Operations Information*, dated 08-30-11 (or latest version).

FINAL REPORT OF SUBSURFACE EXPLORATION
AND
GEOTECHNICAL EVALUATION

SAVANNAH RIVER NUCLEAR SOLUTIONS, AMC PROJECT
COLLEGE STATION DRIVE AND TROLLEY LINE ROAD
AIKEN, SOUTH CAROLINA
ECS PROJECT No.: 38:1459

Prepared For

TURNER CONSTRUCTION COMPANY

Prepared By

JUNE 14, 2016

ECS CAROLINAS, LLP

"Setting the Standard for Service"

Geotechnical • Construction Materials • Environmental • Facilities

SC Registered Engineering Firm 3240
NC Registered Engineering Firm F-1078
NC Registered Geologists Firm C-406

June 14, 2016

Mr. Ben Sousa
Turner Construction Company
3495 Piedmont Road, NE
Building 11, Suite 700
Atlanta, Georgia 30305

Reference: Final Report of Subsurface Exploration and Geotechnical Evaluation
Savannah River Nuclear Solutions, AMC Projects
College Station Drive and Trolley Line Road
Aiken, South Carolina
ECS Project No.: 38:1459

Dear Mr. Sousa:

As authorized by your acceptance of our Proposal Number 38-776 dated April 14, 2016, ECS Carolinas, LLP (ECS) has completed the subsurface exploration and geotechnical evaluation for the Savannah River Nuclear Solutions, AMC Project site. This report contains the results of our subsurface exploration, as well as our recommendations regarding the geotechnical design and construction aspects of the project.

We appreciate the opportunity to be of service to you during the design phase of this project and look forward to our continued involvement during the construction phase. If you have any questions concerning the information and recommendations presented in the accompanying report, or if we can be of further assistance, please do not hesitate to contact us.

Sincerely,

ECS CAROLINAS, LLP represented by;

Brennan J. Hoy, E.I.
Geotechnical Project Manager

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER 6/14/16 No. 32655 WILLIAM M. PORTER, II

William M. Porter, P.E.
Branch Manager
South Carolina License No. 32655

Winslow E Goins, P.E.
Principal Engineer
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SOUTH CAROLINA ECS CAROLINAS, LLP No. C3239 CERTIFICATE OF AUTHORIZATION

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1.0 PROJECT INFORMATION

The project site is located southeast of the intersection of Trolley Line Road and College Station Drive in Aiken, South Carolina. The proposed construction will include and approximately 70,000 SF two-story building which will house laboratories, offices, and support spaces. One area of the building, approximately 5000 SF, will be approximately 100 feet in height. We understand that the maximum column foundation load for the 100 foot high structure will be 400 kips.

We have not been provided existing topographic or proposed site grading information at this time. However, existing topography appears to vary minimally across the site. Based on the available Google Earth topographic information, existing site grades range from an approximate high elevation of 405 feet to an approximate low elevation of 397 feet. We also understand conceptual finished floor elevation (FFE) for the proposed structure is approximately elevation 402 feet. We assume the site will have limited cut and fill depths on the order of 3 to 5 feet. No other information was available at the time of this report.

2.0 EXPLORATION PROCEDURES

2.1 Soil Test Borings

Eight (8) soil test borings were drilled on the project site as shown on the Testing Location Plan in the Appendix. Borings B-1 through B-8 were located in the proposed building footprint and were extended to depths ranging from approximately 20 to 40 feet below the existing ground surface. The boring locations were established using handheld GPS technology and existing landmarks as reference. The boring locations indicated on the Testing Location Plan should be considered approximate. Borings logs are included in the Appendix.

The soil test borings were performed using a truck mounted (CME 55) drill rig equipped with an auto-hammer spilt-spoon driving assembly. The auto-hammer generally delivers more energy downhole to the sampler than the standard cat-head driving assembly, therefore, the recorded standard penetration test (SPT) N-Values are lower than the N_{60}-Values recorded from using the cat-head assembly. Although the differences in energy will vary, it is common to assume the auto hammer delivers about 1.3 times the energy of the cat-head assembly. The N-values recorded in the field using the auto-hammer assembly are reported on the Boring Logs in the Appendix.

Representative soil samples were obtained by means of the split-barrel (split-spoon) sampling procedure in accordance with ASTM D 1586. In this procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval is termed the Standard Penetration Test (SPT) N-value and is indicated for each sample on the boring logs. This value can be used as a qualitative indication of the in-place relative density of cohesionless soils. In a less reliable way, it also indicates the consistency of cohesive soils. This indication is qualitative, since many factors can affect the standard penetration resistance value and prevent a direct correlation with drilling crews, equipment and procedures. Split-spoon samples were obtained at 2½-foot intervals within the upper 10 feet of the borings and at 5-foot intervals thereafter.

After recovery, each sample was removed from the sampler and visually classified. Representative portions of each sample were then sealed in air tight containers and brought to our laboratory for visual classification in general accordance with the Unified Soil Classification System (USCS as described in ASTM D 2487).

2.2 Hand Auger Borings

Four (4) hand auger borings with associated Wildcat© Dynamic Cone Penetrometer (WDCP) testing were performed at the project site as shown on the Testing Location Plan in the Appendix. Hand auger borings HA-1 through HA-4 were located in the proposed parking and driveway areas and were extended to a depth of approximately 5 feet below the existing ground surface. The hand auger boring logs are included in the Appendix.

Representative soil samples for hand auger borings were obtained by means of the hand operated auger sampling procedure in general accordance with ASTM Specification D 1452. In this procedure, the auger boring was made by rotating and advancing the auger bucket to the desired depths while periodically removing the bucket from the hole to clear and examine the auger cuttings. After recovery, each sample was removed from the sampler and visually classified. Representative portions of each sample were then sealed in air tight containers and brought to our laboratory for visual classification in general accordance with the Unified Soil Classification System (USCS as described in ASTM D 2487).

In WDCP testing, a cone with a diameter of 1.47 inches is driven into the soil by a 34.94-pound hammer falling 15 inches. The number of blows required to drive the cone through 10 centimeter intervals is recorded. The blows obtained from WDCP can be correlated to Standard Penetration Test (SPT) N-values. Soil samples were not collected during the WDCP testing and the logs are included in the Appendix.

2.3 Refraction Microtremor (ReMi) Survey

A Refraction Microtremor (ReMi) survey was performed on the project site using one (1) ReMi array traverse. The data was gathered in the field using standard refraction seismic equipment to measure site characteristics using ambient vibrations (microtremors) as a seismic source. Data was collected using a 24-channel exploration seismograph, with 16 geophones at 10-foot spacing. Ten unfiltered 30-second records were recorded along the array.

The data was processed using proprietary SeisOpt® ReMi™ software to reveal a one-dimensional shear-wave (S-wave) velocity image of the subsurface materials beneath the array. The survey also provided the average shear wave velocity to a depth of 100 feet that was used to help assess the seismic Site Class in accordance with the International Building Code 2012 (IBC 2012). The ReMi array location indicated on the Testing Location Plan should be considered approximate. ReMi array results are included in the Appendix.

2.4 Laboratory Testing

Representative soil samples were selected and tested in our laboratory to check visual classifications and to determine pertinent engineering properties. The laboratory testing program included pH and resistivity testing. A laboratory testing summary is in the Appendix of this report.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Observations

The proposed construction will occur southeast of the intersection of Trolley Line Road and College Station Drive in Aiken, South Carolina. The proposed project site is comprised of a grassed area adjacent to an existing baseball field on the western half of the site and a wooded area on the eastern half of the site. An existing batting cage with a concrete slab and several existing light poles with concrete foundations are present on the project site. An existing asphalt driveway extends from Pacer Downs and runs north and south between the grassed area and wooded area. Existing site grades in the area of the proposed construction range from elevation 397 feet to elevation 405 feet.

3.2 Area Geology

The project site is located in the Upper Coastal Plain Physiographic Province of South Carolina, just east of its interface with the Piedmont Physiographic Province. The natural soils of the Coastal Plains are sedimentary deposits consisting of interbedded sands, silts and clays associated with former levels of the Atlantic Ocean. These deposits vary in thickness from a thin veneer along the western edge, near the Piedmont, to more than a few thousand feet near the coast.

The natural geology of portions of the site was modified in the past by grading activities resulting in the placement of fill materials. The quality of man-made fills can vary significantly, and it is often difficult to assess the engineering properties of fill. Furthermore, there is no specific correlation between N-values from standard penetration tests performed in soil test borings and the degree of compaction of existing fill soils. However, a qualitative assessment of existing fills can sometimes be made based on the N-values obtained and observations of the materials sampled in the test borings.

3.3 Subsurface Conditions

3.3.1 Soil Test Borings

Surficial Materials: Approximately 2 to 4 inches of topsoil was encountered at the ground surface in borings B-3 through B-8.

Existing Fill: Approximately 1 foot of existing fill was encountered at the ground surface in boring B-1. The existing fill encountered in the boring generally consisted of fine to medium sand (SP) with trace clay. It is our experience that soil test borings often do not properly or fully characterize existing fills soils, especially in regard to quantities of deleterious debris.

Natural Soils: Natural, Coastal Plain soils were encountered at the ground surface or beneath the surficial materials or existing fill and extended to the termination depths of the borings performed. The natural soils sampled by the borings generally consisted of fine to medium sand (SP and SP-SC) with varying amounts of clay. N-values recorded in these soils typically ranged from 3 to 46 blows per foot (bpf).

3.3.2 Hand Auger Borings

Surficial Materials: Approximately 4 inches of topsoil was encountered at the ground surface in hand auger borings HA-1 through HA-4.

Natural Soils: Natural, Coastal Plain soils were encountered beneath the surficial materials and extended to the termination depths of the hand auger borings performed. The natural soils sampled by the borings generally consisted of fine to medium sand (SP) with trace clay. WDCP blow counts recorded in these soils typically ranged from 4 to 25+ blows per increment (bpi)

3.3.3 Groundwater Conditions

Groundwater was not encountered while drilling or at the 24-hour reading within the termination depths of the borings performed, but cave-in was noted at depths ranging from approximately 9.5 to 20 feet below the existing ground surface. The highest groundwater observations are normally encountered in the late winter and early spring, and our current observations are expected to be representative. Groundwater elevations should be expected to vary depending on seasonal fluctuations in precipitation, surface water absorption characteristics, and other factors not readily apparent at the time of our exploration, and may be higher or lower than inferred from the recent test boring data.

4.0 ANALYSIS AND CONCLUSIONS

The borings performed at this site represent the subsurface conditions at the location of the borings. Due to inconsistencies associated with the prevailing geology, there can be changes in the subsurface conditions over relatively short distances that have not been disclosed by the results of the test location performed. Consequently, there may be undisclosed subsurface conditions that require special treatment or additional preparation once these conditions are revealed during construction.

Our evaluation of foundation support conditions has been based on our understanding of the site, project information and the data obtained in our exploration. The general subsurface conditions utilized in our foundation evaluation have been based on interpolation of subsurface data between and away from the borings. In evaluating the boring data, we have examined previous correlations between penetration resistance values and foundation bearing pressures observed in soil conditions similar to those at your site.

4.1 Seismic Site Class and Design Parameters

South Carolina has adopted the International Building Code (IBC 2012), and the IBC 2012 requires that a seismic Site Class be assigned for new structures. The seismic Site Class for a site is determined by calculating a weighted average of the shear wave velocities of subsurface materials to a depth of 100 feet. Based on the average shear wave velocity data obtained to a depth of 100 feet below the existing ground surface from the refraction microtremor survey, the soil profile type in the area of the performed array fall in the range of seismic Site Class "C" as defined in IBC 2012. The shear wave velocity profiles generated from the ReMi testing are shown in the Appendix of this report.

Based on the information obtained from our subsurface exploration, it is our opinion that the potential for liquefaction of the native soils at the site due to earthquake activity is relatively low. The spectral response accelerations and site coefficients for the site are provided in the following table:

Seismic Design Parameters

IBC	Site Class	S_s	S_1	F_a	F_v	S_{DS}	S_{D1}
2012	C	0.331g	0.121g	1.200	1.679	0.265g	0.136g

ECS developed a site specific Acceleration Response Spectrum (ARS) in accordance with the general procedure as outlined in ASCE 7-10 and IBC 2012. The recommended Response Spectrum based on the results of this analysis is shown in the Appendix of this report.

4.2 Foundation Design

Provided the foundation subgrades are prepared in strict accordance with the **Site and Subgrade Preparation** and **Engineered Fill** sections of this report, the proposed building can be supported on conventional shallow foundations consisting of isolated column and continuous wall footings. For foundations bearing in approved engineered fill or surficial natural Coastal

Plain soils, footings can be proportioned for a maximum net allowable soil bearing pressure of 2,500 pounds per square foot (psf). Alternatively, footings bearing in natural soils having a minimum SPT N-value of 13 bpf could be proportioned for a maximum net allowable soil bearing pressure of 4,500 psf; however, the footings would need to extend to a depth of approximately 8 feet below existing site grades. The net allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. If necessary, a 1/3 increase in the maximum net allowable soil bearing pressure may be used for wind, seismic, and other transient loadings. ECS should be consulted if a greater increase in the maximum net allowable soil bearing pressure for transient loadings is desired.

Footings should bear at a depth to provide adequate frost cover protection and develop the recommended soil bearing pressure. We recommend foundations bear at a minimum depth of 18 inches below the adjacent ground surface. To reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" failures, we recommend that continuous footings have a minimum width of 18 inches and isolated column footings have a minimum lateral dimension of 30 inches.

Conventional shallow foundations can also be designed to resist uplift and lateral loads. As presented in the **Below Grade Walls** section of this report, the lateral earth pressure coefficients can be used to calculate lateral earth pressure loads on shallow foundation walls. Resistance to lateral load can be provided by passive resistance of soil adjacent to the foundation. The passive resistance should only be used in situations where the soil adjacent to the foundation will not be eroded or otherwise removed in the future. Resistance to sliding can be provided by friction between the bottom of the foundation and the underlying soils. For foundations bearing on existing fill, new engineered fill, or natural soils, a coefficient of friction of 0.35 should be used for design. For backfill placed over installed foundations in accordance with the **Engineered Fill** section of this report, a moist unit weight of 110 pounds per cubic foot (pcf) should be used for design. Care should be taken during excavation of foundations, as disturbance to the adjacent soils could adversely influence the resistance to lateral and uplift loads.

Settlement of a structure is a function of the compressibility of the natural soils, the design bearing pressure, column loads, fill depths, and the elevation of the footing with respect to the original ground surface. If our recommendations are strictly followed, the maximum total settlement should be on the order of 1 inch or less. Differential settlement between adjacent columns is expected to be about ½ of the anticipated total settlement. These settlement values are based on our engineering experience of the subsurface conditions and the anticipated structural loading, and are to guide the structural engineer with his design. We emphasize the need for verifying the suitability of footing subgrades, and that the bearing material assumed for the design extends across the full footing area.

4.3 Floor Slab Design

Provided the slab subgrades are prepared in accordance with the **Site and Subgrade Preparation** and **Engineered Fill** sections of this report, a modulus of subgrade reaction value of 150 pci is appropriate provided the subgrades are properly prepared. We recommend slabs-on-grade are underlain by a minimum of 4 inches of granular material having a maximum aggregate size of 1½ inches and no more than 2 percent fines. Prior to placing the granular

material, the floor subgrade soil should be properly compacted, proofrolled, and free of standing water, mud and frozen soil.

A granular capillary break layer can often eliminate the need for a moisture/vapor retarder and can assist in more uniform curing of concrete. If a moisture/vapor retarder is used, special attention should be given to the surface curing of the slabs to minimize uneven drying of the slabs and associated cracking and/or slab curling. The use of a blotter or cushion layer above the vapor retarder can also be considered for project specific reasons. Please refer to ACI 302.1R96 Guide for Concrete Floor and Slab Construction and ASTM E 1643 "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs" for additional guidance on this issue.

We recommend that slabs-on-grade be isolated from the foundation footings so settlement of the foundations will not induce shear stresses in the floor slab. Also, in order to reduce the crack width of shrinkage cracks that may develop near the surface of the slab, we recommend mesh reinforcement be placed in the floor slab. The Wire Reinforcement Institute recommends the mesh reinforcement be placed 2 inches below the slab surface or upper one-third of slab thickness, whichever is closer to the surface. Adequate construction joints, contraction joints and isolation joints should also be provided in the slab to reduce the impacts of cracking and shrinkage. Please refer to ACI 302.1R96 Guide for Concrete Floor and Slab Construction for additional information regarding concrete slab joint design.

4.4 Below Grade Walls

ECS understands that below grade walls are anticipated for a cantilevered retaining wall and basement construction. For wall conditions where outward wall movement on the order of 0.5 percent of the wall height can be tolerated, the "Active" earth pressure should be used. In the design of below grade walls to restrain compacted backfill, engineered fill or in-situ natural soils, the coefficient of lateral earth pressure can be used to determine lateral earth pressure loads.

Please note that the values presented on the below are for on-site SP materials. ECS should be contacted to review the lateral earth pressure coefficients provided once the overall site plan has been completed. Moderately to highly elastic/plastic soils (CL, MH, and CH) should not be utilized behind earth retaining structures.

Lateral Earth Pressure Parameters for On-Site Soils

Soil Parameter	Coefficient of Lateral Earth Pressure
"At Rest" Earth Pressure (K_o)	0.53
"Active" Earth Pressure (K_a)	0.36
"Passive" Earth Pressure (K_p)	2.77

The lateral earth pressure values presented in the above table assume level backfill fill behind the wall, and do not account for hydrostatic pressures against the walls or surcharge loads from overlying or nearby construction.

Resistance to sliding can be provided by friction between the bottom of the wall foundation and the underlying soils and by passive resistance of soil adjacent to the wall foundation. The

passive resistance should only be used in situations where the soil adjacent to the toe of the wall will not be eroded or otherwise removed in the future. A coefficient of friction of 0.35 for concrete bearing on approved soils is recommended.

Drainage behind below grade retaining walls is considered essential towards relieving hydrostatic pressures. Drainage can be established by providing a perimeter drainage system outlet. This system should consist of "perforated pipe" or "porous wall", closed-join drain lines. These drain lines should be surrounded by a minimum 6 inches of free-draining, granular filter material having a gradation compatible with the size of the openings utilized in the drain lines and the surrounding soils to be retained, or by gravel wrapped in filter fabric. The space between the interior face of the wall and the earth fill should be backfilled with a granular fill of porous quality or better extending from the perimeter drainage system to just below the top of the wall. To prevent frost heave effects from acting against these walls, the granular backfill should extend a minimum of 12 horizontal inches behind the wall. The granular backfill should be capped with pavement, concrete, or a 12-inch layer of low permeable silt or clay to minimize the seepage of water into that backfill from the surface. The ground surface adjacent to the below-grade walls should be kept properly graded to prevent ponding of water adjacent to the walls.

4.5 Cut and Fill Slopes

We recommend that permanent cut slopes with less than 10 feet crest height through undisturbed natural soils be constructed at 2:1 (horizontal: vertical) or flatter. Permanent fill slopes less than 10 feet tall may be constructed using controlled fill at a slope of 2.5:1 or flatter. A slope of 3:1 or flatter may be desirable to permit establishment of vegetation, safe mowing, and maintenance. The surface of all cut and fill slopes should be adequately compacted. Permanent slopes should be protected using vegetation or other means to prevent erosion.

A slope stability analysis should be performed on cut and fill slopes exceeding 10 feet in height to determine a slope inclination resulting in a factor of safety greater than 1.4. Upon finalization of site civil drawings, ECS should be contacted to perform slope stability analysis and determine if further exploration is necessary.

The outside face of building foundations and the edges of pavements placed near slopes should be located an appropriate distance from the slope. Buildings or pavements placed at the top of fill slopes should be placed a distance equal to at least 1/3 of the height of the slope behind the crest of the slope. Buildings or pavements near the bottom of a slope should be located at least ½ of the height of the slope from the toe of the slope. Slopes with structures located closer than these limits or slopes taller than the height limits indicated should be specifically evaluated by the geotechnical engineer and may require approval from the building code official.

Temporary slopes in confined or open excavations should perform satisfactorily at inclinations of 1.5:1 or flatter. All excavations should conform to applicable OSHA regulations. Appropriately sized ditches should run above and parallel to the crest of all permanent slopes to divert surface runoff away from the slope face. To aid in obtaining proper compaction on the slope face, the fill slopes should be overbuilt with properly compacted structural fill and then excavated back to the proposed grades.

4.6 Pavements

Provided the pavement subgrades are prepared in strict accordance with the **Site and Subgrade Preparation** and **Engineered Fill** sections of this report, new pavements may be supported on approved existing fill, new engineered fill, or natural soils. We have developed the pavement sections recommended below using AASHTO guidelines based on an estimated design CBR value of 8. The design value accounts for materials variability with respect to the results of the CBR testing conducted in the laboratory.

Light duty pavements are expected to receive passenger vehicle traffic with only occasional trucks. Heavy duty pavements are expected to receive light to moderate truck traffic, but our recommended section is not intended to be routinely trafficked by heavy trucks. Traffic loading conditions used in the analysis include equivalent single axle loadings (ESAL's) of 100,000 and 10,000 for heavy duty and light duty pavements, respectively. It is important to understand the recommended sections do not take into account construction traffics. The pavement sections below are based on a design life of 20-years.

Material Designation	Light Duty Asphalt Pavement	Heavy Duty Asphalt Pavement	Light Duty Portland Cement Concrete Pavement	Heavy Duty Portland Cement Concrete Pavement
Asphalt Surface Course (Type C)	2 inches	1 inch	-	-
Binder/ Intermediate Course (Type C)	-	2 inches	-	-
Portland Cement Concrete	-	-	4.5 inches	5.5 inches
Graded Aggregate Base Course	6 inches	8 inches	-	-

Base course materials beneath pavements should be compacted to at least 95 percent of their modified Proctor maximum dry density (ASTM D 1557). The asphalt concrete and all crushed stone materials should conform to the SC DOT Standard Specifications. PCC sections should consist of concrete having a minimum flexural strength of 600 psi. Appropriate steel reinforcing jointing should be incorporated into the design of PCC pavements. Heavy duty pavements are expected to receive light to moderate truck traffic, but our recommended section is not intended to be routinely trafficked by heavy trucks. Rigid pavements are recommended for trash dumpster and other areas where heavy wheel loads will be concentrated.

An important consideration with the design, construction and performance of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrades and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should help reduce the possibility of the subgrade materials becoming saturated during the normal service period of the pavement.

4.7 Soil Resistivity, Corrosion, and Radon Potential

There are a number of other factors that contribute to corrosive potential; however, apparent resistivity is considered a reliable indicator of corrosivity in soil. Based on the results of our laboratory testing, the resistivity of the tested sample was 21,000 ohm-cm which indicates relatively low potential for corrosion. Soil corrosion potential was also evaluated based on the results of laboratory pH testing. Laboratory testing of the selected sample indicates a pH of 6.5 which indicates relatively low potential for corrosion.

The amount of radon in a building is dependent upon several factors including geology, intrusion paths, and ventilation rates. Radon is transported more readily through increased permeable soils and it can enter structures through cracks, utility penetrations, sumps, and floor drains. According to the US EPA Map of Radon Zones for South Carolina, Aiken County is in Zone 3 which is considered “Low Potential”. Nonetheless, we recommend testing for Radon, regardless of zone designation.

5.0 CONSTRUCTION RECOMMENDATIONS

5.1 Site and Subgrade Preparation

The first step in preparing the site for the proposed construction should be to remove existing vegetation or topsoil, and other soft, unsuitable, or deleterious material from the existing ground surface. Existing utilities that traverse the planned building area should be removed, but may remain in place in planned pavement areas. These operations should extend at least 10 feet beyond the building area and 5 feet beyond the planned pavement areas, where practical.

Approximately 8 feet of relatively loose near surface natural soils are present on the site. The relativity loose near surface natural soils within the proposed building pad should be partially undercut after removal of the surficial materials, but prior to placement of new fill or other at-grade construction. Partial undercutting on the order of 3 feet and re-densification of the underlying soils by multiple passes with a large vibratory roller should be anticipated within the proposed building pad. The undercut near surface natural soils can be stockpiled for reuse as engineered fill.

The prepared subgrade should then be evaluated by an experienced geotechnical engineer or his authorized representative. The evaluation should include proofrolling the subgrade with an approved piece of equipment (such as a loaded dump truck, having an axle weight of at least 10 tons) to identify soft, loose and yielding areas. Based on the recommendations of the engineer, unsuitable materials encountered during the proofrolling operations should be repaired in-place by additional densification, or be removed and replaced with engineered fill that is placed and compacted in accordance with the recommendations of this report.

Backfill over existing utility lines warrants special attention during the subgrade evaluation. At the discretion of the geotechnical engineer, the evaluation of these areas may include test pits or hand auger borings to help assess the suitability of the soils.

The preparation of proposed building and pavement subgrades, as well as fill subgrades, should be observed on a full-time basis by a representative of ECS. These observations should be performed by an experienced geotechnical engineer, or his representative, to document that unsuitable materials have been removed and that the prepared subgrade is suitable for support of the proposed construction and/or fills.

Based on the results of the soil test borings, we expect that the soils encountered in the areas explored should generally be excavatable with conventional earth moving equipment such as pans/scrapers, loaders, bulldozers, rubber tired backhoes, etc.

5.2 Engineered Fill

Fill placed for support of the proposed structure and pavements, and for backfill of undercut areas and utility lines within expanded structure and pavement limits should consist of engineered fill. Engineered fill should be an approved material, free of organic matter and other deleterious materials, and have a Liquid Limit (LL) and a Plasticity Index (PI) less than 40 and 20, respectively. We also recommend that fills within structural areas have a standard Proctor (ASTM D 698) maximum dry density of at least 95 pounds per cubic foot (pcf). Unsuitable fill

materials include topsoil, organic materials, lightweight material with a maximum dry density less than 95 pcf, and highly plastic silts (MH) and clays (CH).

Mass engineered fill placed within the building and pavement areas should be placed in lifts and moisture conditioned to within their working range of optimum moisture content, and compacted to a minimum of 95 percent of their standard Proctor maximum dry density, as determined in accordance with ASTM D 698. The upper one foot of soil supporting structures, pavements, slabs-on-grade, sidewalks, should be compacted to a minimum of 98 percent of the maximum dry density obtained in accordance with ASTM D 698.

Similarly, isolated non-structural areas of engineered fill, such as trench line backfill, should be placed in lifts not exceeding 6 inches and moisture conditioned as mentioned above. The working range of optimum is typically within approximately 3 percent of the optimum moisture content.

On site natural soils should typically be suitable for re-use as engineered fill. Excavated existing fill may also be suitable for re-use as new fill provided it is not too wet or contain detrimental materials, and should be further evaluated for suitability at the time of construction.

Prior to the commencement of fill operations and/or utilization of off-site borrow materials, the contractor should provide representative samples of the soil materials to ECS to assess the material's suitability for use as engineered fill, and to develop moisture-density relationships in accordance with the recommendations provided herein. Samples should be provided to the geotechnical engineer at least 5 days prior to their use to allow for the appropriate laboratory testing to be performed.

The maximum loose lift thickness depends upon the type of compaction equipment use. The table below provides maximum loose lifts that may be placed based on compaction equipment utilized.

LIFT THICKNESS RECOMMENDATIONS

Equipment	Maximum Loose Lift Thickness, in.
Large, Self-Propelled Equipment (CAT 815, CAT CS56, etc.)	12
Small, Self-Propelled or Remote Controlled (Rammax, etc.)	8
Hand Operated (Plate Tamps, Jumping Jacks, Wacker-Packers)	6

ECS recommends that fill operations be observed and tested by an engineering technician to document that if compaction requirements are being met. The testing agency should perform a sufficient number of tests to document that compaction is being achieved. For mass grading operations we recommend a minimum of one density test per 2,500 SF per lift of fill placed or per 1 foot of fill thickness, whichever results in more tests. When dry, the majority of the site soil should provide adequate subgrade support for fill placement and construction operations. When wet, the soil may degrade quickly with disturbance from construction traffic. Good site drainage should be maintained during earthwork operations to prevent ponding water on exposed subgrades.

We recommend at least one test per 1 foot thickness of fill for every 100 linear feet of utility trench backfill. Where fill will be placed on existing slopes, we recommend that benches be cut in the existing slope to accept the new fill. Fill slopes should be overbuilt and then cut back to expose compacted material on the slope face. While compacting adjacent to below-grade walls, heavy construction equipment should maintain a horizontal distance of 1(H):1(V). If this minimum distance cannot be maintained, the compaction equipment should run perpendicular, not parallel to, the long axis of the wall.

The pavement and building areas should be well defined during fill placement by maintaining grade controls. Filling operations should be observed on a full-time basis by ECS to document that the recommended degree of compaction is achieved. The elevation and location of the in-place density tests should be accurately identified at the time of fill placement. Areas which fail to achieve the required degree of compaction should be re-compacted and re-tested until the recommended compaction is achieved. Failing test areas may require moisture adjustments or other suitable remedial activities in order to achieve the required compaction.

Fill materials should not be placed on frozen, frost-heaved or wet soils. Such materials should be removed prior to fill placement. Borrow fill materials should not contain wet or frozen materials at the time of placement. Wet or frost-heaved soils should also be removed prior to placement of granular sub-base materials, foundation or slab concrete, and asphalt pavement materials.

If difficulties are encountered during the site grading operations, or if the actual site conditions differ from those encountered during our subsurface exploration, the geotechnical engineer should be notified immediately.

5.3 Foundation Construction

It is very important that the final footing subgrades be evaluated by ECS personnel to document that the bearing soils are capable of supporting the recommended net allowable bearing pressure and suitable for foundation construction. These evaluations should include visual observations, hand rod probing, and dynamic cone penetrometer (ASTM STP 399) testing, or other methods deemed appropriate by the geotechnical engineer at the time of construction, in each column footing excavation and at intervals not greater than 25 feet in continuous footing excavations.

Exposure to the environment may weaken the soils at the foundation bearing elevation if the foundation excavations remain exposed during periods of inclement weather. Therefore, foundation concrete should be placed the same day the foundations are excavated. If the bearing soils are softened by water or exposure to the environment, the softened soils must be removed from the foundation excavation bottoms prior to placement of concrete. If the excavation must remain open overnight, or if inclement weather is imminent while the bearing soils are exposed, we recommend that a 2 to 3-inch thick "mud-mat" of "lean" concrete be placed over the exposed bearing soils before the placement of reinforcing steel.

5.4 Temporary Support of Excavations

If a temporary excavation support system is required, a free draining system consisting of soldier piles and wood lagging with internal bracing or tie-backs would be appropriate for all

sides of the excavation. The design of the earth retention system is, however, beyond the scope of this report. Therefore, the spacing of the soldier piles should be determined by structural analysis. Nonetheless, we recommend that the maximum center to center spacing of the soldier piles not exceed 8 feet. Furthermore, we recommend that the soldier beam and lagging system be designed with a minimum lateral pressure component of 30H. Temporary earthwork retention design criteria are suitable for design of this system. Either a braced or a tie-back system may be utilized.

The contractor should avoid stockpiling excavated materials immediately adjacent to the excavation walls. We recommend that stockpiled materials be kept back from the excavation a minimum distance equal to 1/2 the excavation depth to limit surcharging the excavation walls. If this is impractical due to space constraints, the excavation walls should be retained with bracing designed for the anticipated surcharge load. In addition, the earth retention system design should consider surcharge loads from cranes and other construction equipment during construction.

5.5 Site Drainage

The long term continuous groundwater table at the site is expected to be below the termination depths of our borings. One of the more cost effective techniques that can be utilized for construction dewatering and groundwater control, we believe, is through the prudent utilization of site drains, and in planning utility installations. For example, any utility installation that requires a gravity feed, such as sewer lines, can be effectively converted into a drainage line to help assist in groundwater control during construction. Such lines may not be relied on for pavement drainage unless constructed as permanent drains.

Positive drainage should be provided around the perimeter of structures to minimize the potential for moisture infiltration into the foundation and slab subgrade soils. We recommend that landscaped areas adjacent to these structures be sloped away from the construction and maintain a fall of at least 6 inches for the first 10 feet outward from the structures. The parking lots, sidewalks, and any other paved areas should also be sloped to divert surface water away from the proposed building.

The proper diversion of surface water during site grading and construction will help reduce the potential for delays associated with periods of inclement weather. Please note that the need for construction dewatering should be determined at the time of construction. If grading operations are performed during the wet seasons (i.e. fall and winter) the use of gravity flow ditches may be necessary to divert precipitation and surface water away from the construction areas. The proper diversion of surface water is especially critical since portions of the site soils are expected to be moisture sensitive. Based upon our past experience, the use of “crowning” large areas of exposed soils should be useful to help divert surface water from the prepared subgrades.

5.6 Construction Considerations

It is imperative to maintain good site drainage during earthwork operations to help maintain the integrity of the surface soils. The surface of the site should be kept properly graded to enhance drainage of surface water away from the proposed construction areas during the earthwork phase of this project. We recommend that surface drainage be diverted away from the

proposed building and pavements areas without significantly interrupting its flow. Other practices would involve sealing the exposed soils with a smooth-drum roller at the end of the day's work to reduce the potential for infiltration of surface water into the exposed soils.

The key to minimizing disturbance problems with the soils is to have proper control of the earthwork operations. Specifically, it should be the earthwork contractor's responsibility to maintain the site soils within a workable moisture content range to obtain the required in-place density and maintain a stable subgrade. Scarifying and drying operations should be included in the contractor's price and not be considered an extra to the contract. In addition, construction equipment should not be permitted to randomly run across the site, especially once the desired final grades have been established. Construction equipment should be limited to designated lanes and areas, especially during wet periods to minimize disturbance of the site subgrades.

6.0 CLOSING

This report has been prepared in accordance with generally accepted geotechnical engineering practice. No other warranty is expressed or implied. Our evaluation of foundation support conditions is based on our understanding of the site and project information, and the data obtained in our exploration. The general subsurface conditions used in our foundation evaluation are based on interpolation of subsurface data between the borings. In evaluating the boring data, we have reviewed previous correlations between penetration resistance values and foundation bearing pressures observed in soil conditions similar to those at your site. Once the final project design criteria are established, please contact us so that our recommendations can be reviewed and modified, if necessary. The discovery of any site or subsurface conditions during construction which deviate from the data outlined in this exploration should be reported to us for our evaluation. *Furthermore, ECS should be provided a copy of the final plans and specifications in advance of construction to verify that our recommendations have been correctly interpreted.* The assessment of site environmental conditions for the presence of pollutants in the soil, rock, and groundwater of the site was beyond the scope of this exploration.

APPENDIX

Site Location Diagram

Testing Location Plan

Unified Soil Classification System

Reference Notes for Boring Logs

Boring Logs (B-1 to B-8)

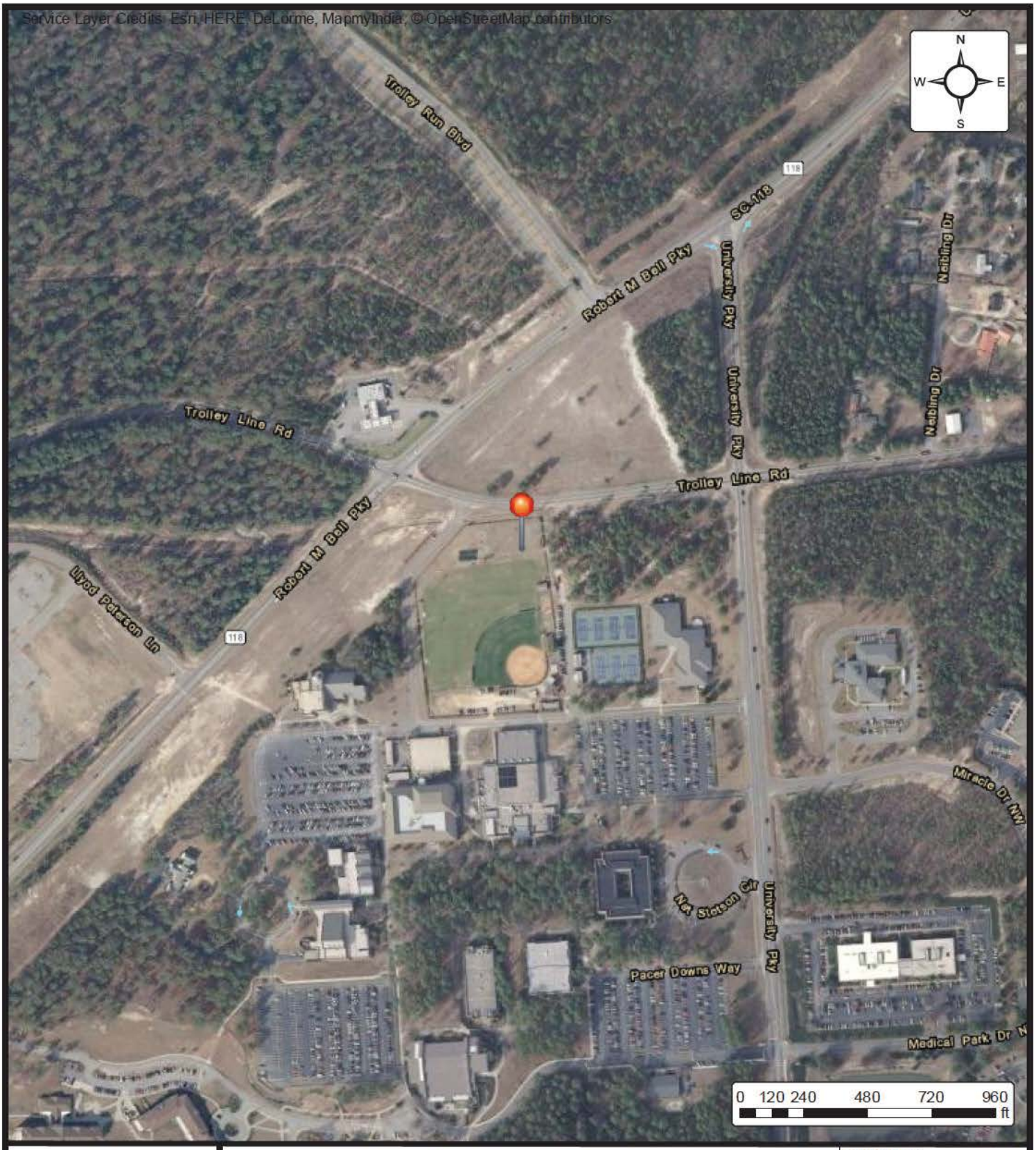
Hand Auger Logs (HA-1 to HA-4)

Wildcat Dynamic Cone Penetrometer Logs (HA-1 to HA-4)

Lab Summary

ReMi Survey (S-1)

Acceleration Response Spectrum (ARS)

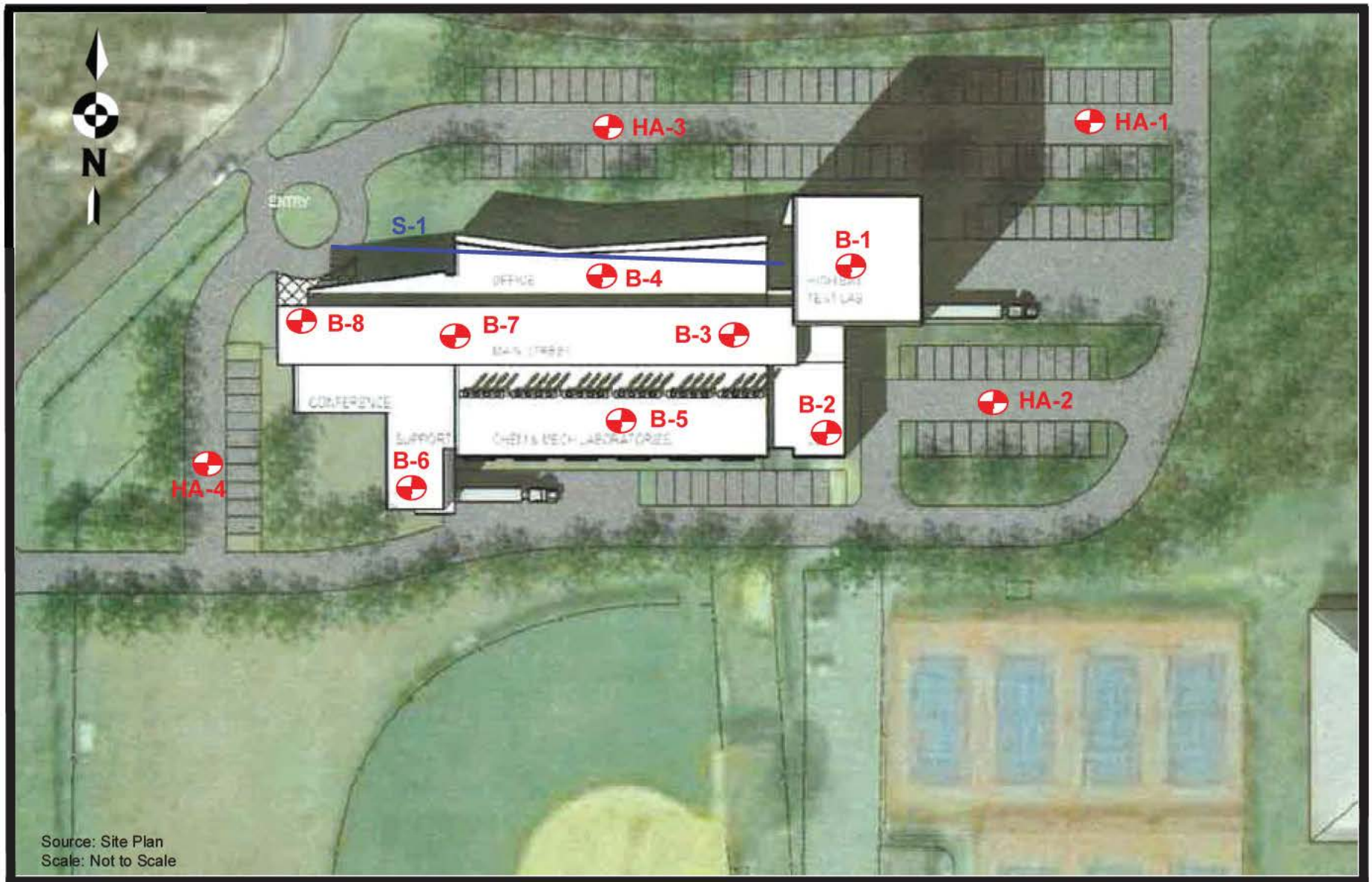


Site Location Diagram

SAVANNAH RIVER NUCLEAR SOLUTIONS, AMC PROJECT

TURNER CONSTRUCTION COMPANY
AIKEN, SC

ENGINEER	
SCALE	1 " = 500 '
PROJECT NO.	38:1459
SHEET	1 OF 1
DATE	5/11/2016



LEGEND

⊕	Boring Locations (Approximate)
B/HA-#	Boring/Hand Auger Number
—	ReMi Survey Location (Approximate)
S-1	ReMi Survey Number

Testing Location Plan
Savannah River Nuclear Solutions, AMC Project
Aiken, South Carolina
ECS Project No.: 38:1459

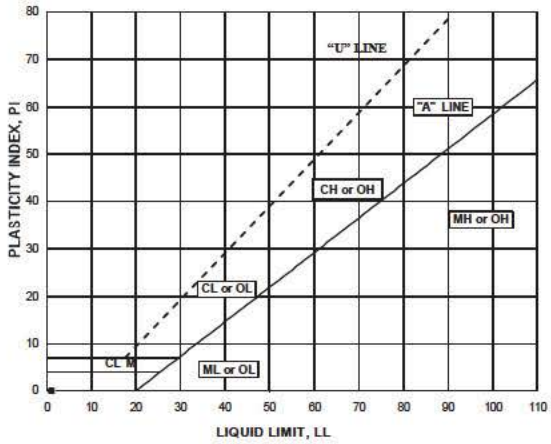
Unified Soil Classification System
(ASTM Designation D-2487)

Major Division		Group Symbol	Typical Names	Classification Criteria
Coarse-grained soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 4 $C_z = (D_{30})^2/(D_{10}xD_{60})$ Between 1 and 3
		GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW
		GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4
		GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits plot above "A" line and plasticity index greater than 7
	Sands: More than 50% of coarse fraction passes No. 4 sieve	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 6 $C_z = (D_{30})^2/(D_{10}xD_{60})$ Between 1 and 3
		SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW
		SM	Silty sands, sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4
		SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above "A" line and plasticity index greater than 7
Fine-grained soils: 50% or more passing No. 200 sieve	Silts and Clays: Liquid limit 50% or less	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		OL	Organic silts and organic silty clays of low plasticity	
	Silts and Clays: Liquid limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
		CH	Inorganic clays of high plasticitiy, fat clays	
		OH	Organic clays of medium to high plasticity	
Highly organic soils		Pt	Peat, muck and other highly organic soils	Fibrous organic matter; will char, burn, or glow

Classification on basis of percentage of fines

Less than 5% Pass No. 200 sieve	GW, GP, SW, SP
More than 12% Pass No. 200 sieve	GM, GC, SM, SC
5% to 12% Pass No. 200 sieve	Borderline classification requiring use of dual symbol

Note: U-line represents approximate upper limit of LL and PI combinations for natural soils (empircally determined) ASTM-D2487



Plasticity chart for the classification of fine-grained soils.
Tests made on fraction finer than No. 40 sieve

UNIFIED SOIL CLASSIFICATION SYSTEM

REFERENCE NOTES FOR BORING LOGS

I. Drilling and Sampling Symbols:

SS:	Split Spoon Sampler	RB:	Rock Bit Drilling
ST:	Shelby Tube Sampler	BS:	Bulk Sample of Cuttings
RC:	Rock Core; NX, BX, AX	PA:	Power Auger (no sample)
PM:	Pressuremeter	HSA:	Hollow Stem Auger
DC:	Dutch Cone Penetrometer	WS:	Wash Sample

Standard Penetration (Blows/Ft) refers to the blows per foot of a 140 lb. hammer falling 30 inches on a 2 inch O.D. split spoon sample, as specified in ASTM D-1586. The blow count is commonly referred to as the N value.

II. Correlation of Penetration Resistances to Soil Properties:

Relative Density of Cohesionless Soils

SPT-N	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
51 or more	Very Dense

Consistency of Cohesive Soils

SPT-N	Consistency
0 - 2	Very Soft
3 - 4	Soft
5 - 8	Medium Stiff
9 - 15	Stiff
16 - 30	Very Stiff
31 - 50	Hard
50 or more	Very Hard

III. Unified Soil Classification Symbols:

GP:	Poorly Graded Gravel	ML:	Low Plasticity Silts
GW:	Well Graded Gravel	MH:	High Plasticity Silts
GM:	Silty Gravel	CL:	Low Plasticity Clays
GC:	Clayey Gravel	CH:	High Plasticity Clays
SP:	Poorly Graded Sands	OL:	Low Plasticity Organics
SW:	Well Graded Sands	OH:	High Plasticity Organics
SM:	Silty Sands	CL - ML:	Dual Classification (Typical)
SC:	Clayey Sands		

IV. Water Level Measurement Symbols:

WL:	Water Level	BCR:	Before Casing Removal
WS:	While Sampling	ACR:	After Casing Removal
WD:	While Drilling	WCI:	Wet Cave In
		DCI:	Dry Cave In

The water levels are those water levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when auguring, without adding fluids, in a granular soil. In clays and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.

The elevations indicated on the boring logs should be considered approximate and were not determined using accepted surveying techniques.

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-1	1 OF 2

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

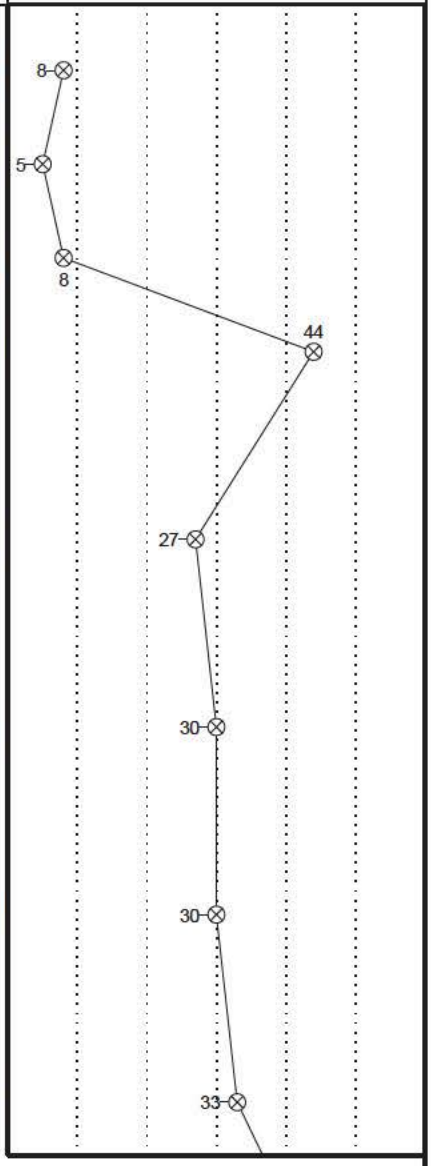
ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					(SP FILL) FINE TO MEDIUM SAND, Trace Clay, Contains Asphalt, Brown to Tan, Moist			
	S-1	SS	18	16	(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Loose			4 4 4
	S-2	SS	18	18				2 2 3
5	S-3	SS	18	17				3 4 4
	S-4	SS	18	18	(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Medium Dense to Dense			12 20 24
10	S-5	SS	18	15				6 8 19
15	S-6	SS	18	17				7 12 18
20	S-7	SS	18	18				10 13 17
25	S-8	SS	18	16				9 14 19
30								

BOTTOM OF CASING | LOSS OF CIRCULATION | SURFACE ELEVATION



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THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 20.0'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-1	2 OF 2

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					BOTTOM OF CASING ▶ LOSS OF CIRCULATION TOC			
					SURFACE ELEVATION			
					(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Medium Dense to Dense			
35	S-9	SS	18	17				11 20 26
	S-10	SS	18	17				10 18 27
40					END OF BORING @ 40.0'			
45								
50								
55								
60								

THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 20.0'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-2	1 OF 1

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

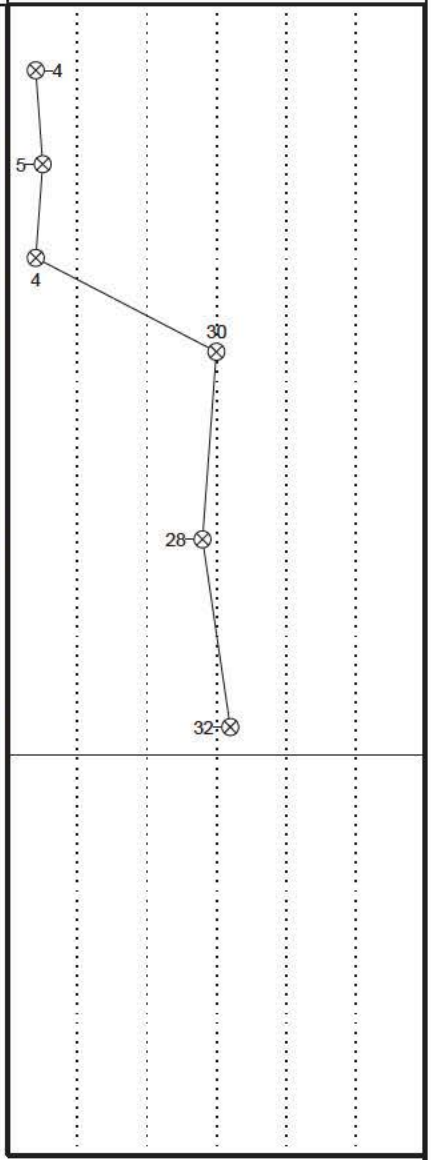
CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Very Loose to Loose			3 2 2
	S-1	SS	18	14				
								2 2 3
	S-2	SS	18	17				
5								
	S-3	SS	18	16				2 2 2
	S-4	SS	18	18	(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to Red, Moist, Medium Dense to Dense			9 13 17
10								
								8 10 18
	S-5	SS	18	18				
15								
								10 13 19
	S-6	SS	18	17				
20					END OF BORING @ 20.0'			
25								
30								



THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 10.0'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-3	1 OF 1

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

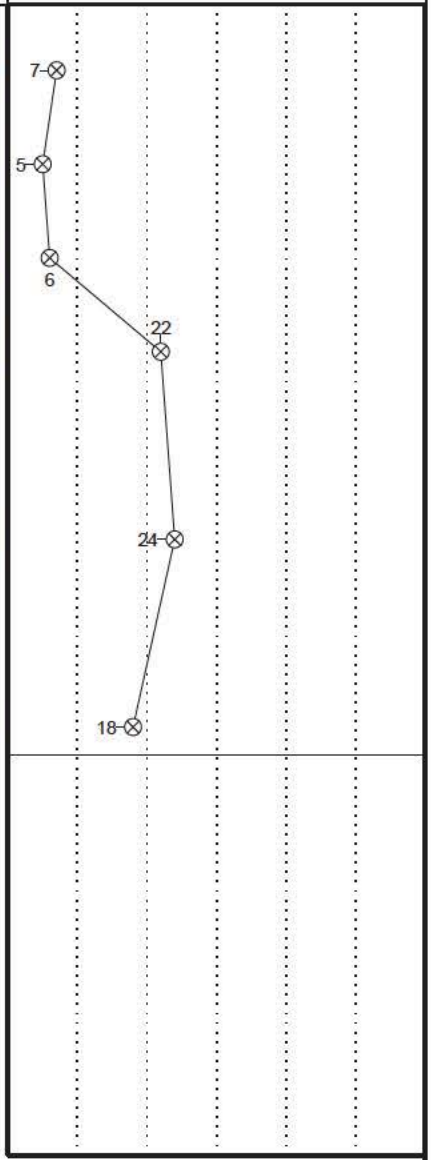
CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [3"]			
	S-1	SS	18	18	(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Loose			3 4 3
	S-2	SS	18	15				1 2 3
5	S-3	SS	18	18				2 3 3
	S-4	SS	18	17	(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to White, Moist, Medium Dense			5 7 15
10	S-5	SS	18	18				5 11 13
15	S-6	SS	18	17	(SP-SC) FINE TO MEDIUM SAND WITH CLAY, Tan to Brown, Moist, Medium Dense			3 7 11
20					END OF BORING @ 20.0'			
25								
30								



THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 10.5'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-4	1 OF 1

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [4"]			
	S-1	SS	18	18	(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Very Loose to Loose			3 4 3
	S-2	SS	18	18				2 1 2
5	S-3	SS	18	16				3 3 2
	S-4	SS	18	17	(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to White, Moist, Medium Dense			5 14 16
10					(SP-SC) FINE TO MEDIUM SAND WITH CLAY, Tan to Brown, Moist, Medium Dense			
	S-5	SS	18	14				7 11 13
15								
	S-6	SS	18	17				10 10 16
20					END OF BORING @ 20.0'			
25								
30								

THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 9.5'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-5	1 OF 1

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

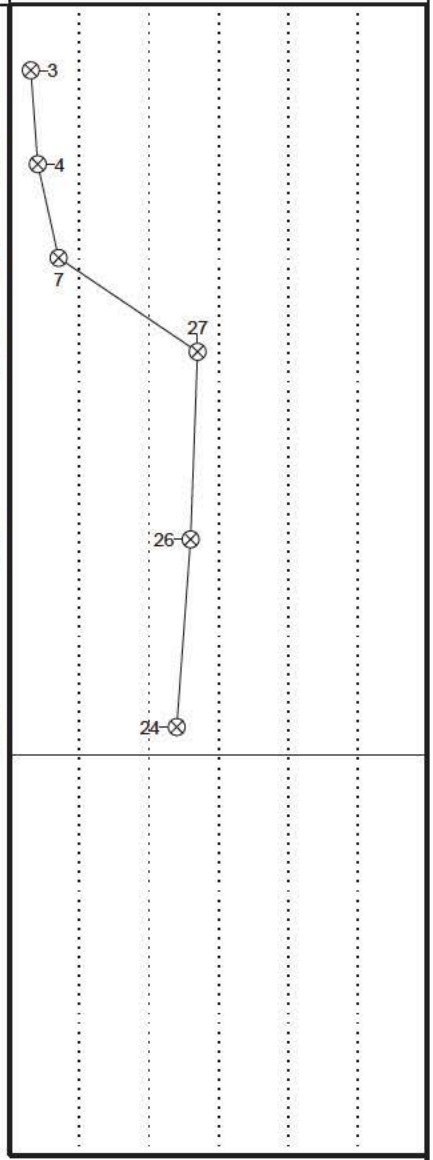
CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [4"]			
	S-1	SS	18	17	(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Very Loose to Loose			1 1 2
	S-2	SS	18	17				2 2 2
5	S-3	SS	18	16				3 4 3
	S-4	SS	18	18	(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to White, Moist, Medium Dense			9 10 17
10					(SP-SC) FIND TO MEDIUM SAND WITH CLAY, Tan to Brown, Moist, Medium Dense			
	S-5	SS	18	18				6 13 13
15								
	S-6	SS	18	16				9 11 13
20					END OF BORING @ 20.0'			
25								
30								



THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 11.0'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-6	1 OF 1

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [4"]			
	S-1	SS	18	15	(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Very Loose to Loose			3 2 2
	S-2	SS	18	17				1 3 3
5	S-3	SS	18	16				3 3 4
	S-4	SS	18	18	(SP-SC) FINE TO MEDIUM SAND WITH CLAY, Tan to White, Moist, Medium Dense			4 6 7
10	S-5	SS	18	16				9 10 12
15	S-6	SS	18	14				7 11 13
20					END OF BORING @ 20.0'			
25								
30								

THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 12.0'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-7	1 OF 1

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

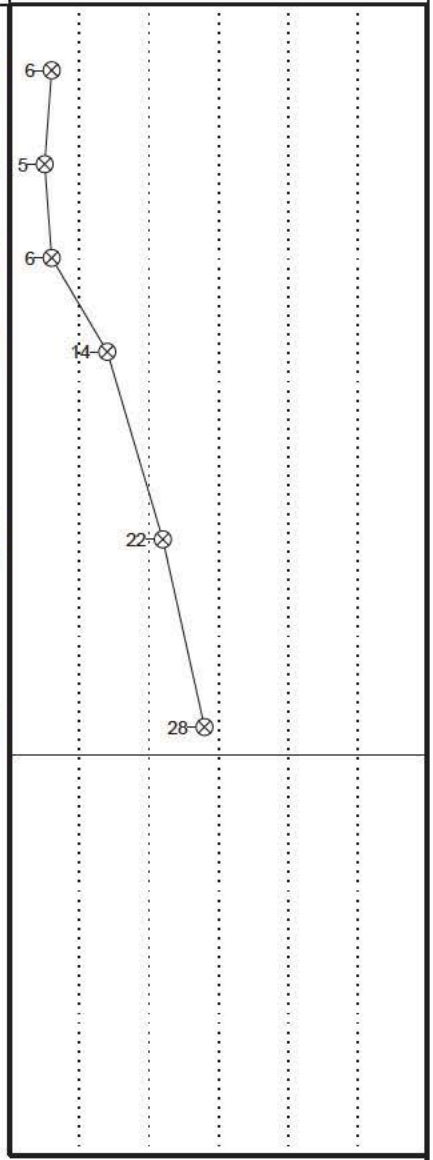
CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [3"]			
	S-1	SS	18	12	(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Loose			4 3 3
	S-2	SS	18	17				1 2 3
5	S-3	SS	18	16				2 3 3
	S-4	SS	18	14	(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to Red, Moist, Medium Dense			4 7 7
10	S-5	SS	18	18				6 10 12
15	S-6	SS	18	16	(SP-SC) FINE TO MEDUIM SAND WITH CLAY, Tan to Brown, Moist, Medium Dense			9 12 16
20					END OF BORING @ 20.0'			
25								
30								



THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 11.5'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

CL ENT	JOB #	BORING #	SHEET
Turner Construction Company	38:1459	B-8	1 OF 1

PROJECT NAME: Savannah River Nuclear Solutions, AMC Project

ARCHITECT-ENG NEER:

SITE LOCATION: College Station Drive and Trolley Line R, Aiken, Aiken County, SC

NORTH NG | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ——

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (N)	DESCRIPTION OF MATERIAL (ENGLISH UNITS)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [2"]			
	S-1	SS	18	18	(SP) FINE TO MEDIUM SAND, Trace Clay, Brown to Tan, Moist, Loose			2 2 3
	S-2	SS	18	17				1 3 3
5					(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to White, Moist, Loose to Medium Dense			3 3 4
	S-3	SS	18	16				4 6 7
	S-4	SS	18	18				
10								6 11 18
	S-5	SS	18	17				
15					(SP-SC) FINE TO MEDIUM SAND WITH CLAY, Tan to Brown, Moist, Medium Dense			5 9 10
	S-6	SS	18	17				
20					END OF BORING @ 20.0'			
25								
30								

THE STRATIFICATION L NES REPRESENT THE APPROX MATE BOUNDARY LINES BETWEEN SOIL TYPES. N-SITU THE TRANSITION MAY BE GRADUAL.

WL WS☐ WD☐	BOR NG STARTED 05/10/16	CAVE IN DEPTH @ 11.0'
WL(SHW) WL(ACR)	BOR NG COMPLETED 05/10/16	HAMMER TYPE Auto
WL	RIG CME 55 FOREMAN Southern Drill, Inc.	DRILLING METHOD HSA

PROJECT NAME:		HAND AUGER #
Savannah River Nuclear Solutions, AMC Project		HA-1
CLIENT:	JOB #:	SURFACE ELEVATION
Turner Construction Company	38:1459	
LOCATION: College Station Drive and Trolley Line Road, Aiken, SC	ARCH./ENG:	

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Depth [4"]					
		(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to Brown, Moist					
1							
2							
3			E			S-1	
4							
5		END OF HAND AUGER @ 5.0'					
6							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: While Drilling ▽ After Drilling ▼ | EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Before Drilling:	Groundwater:
JB/GC	05/05/16	Feet			NE

PROJECT NAME:		HAND AUGER #
Savannah River Nuclear Solutions, AMC Project		HA-2
CLIENT:	JOB #:	SURFACE ELEVATION
Turner Construction Company	38:1459	
LOCATION: College Station Drive and Trolley Line Road, Aiken, SC	ARCH./ENG:	

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Depth [4"]					
		(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to Brown, Moist					
1							
2							
3			E			S-1	
4							
5		END OF HAND AUGER @ 5.0'					
6							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: While Drilling ▽ After Drilling ▼ | EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Before Drilling:	Groundwater:
JB/GC	05/05/16	Feet			NE

PROJECT NAME:		HAND AUGER #
Savannah River Nuclear Solutions, AMC Project		HA-3
CLIENT:	JOB #:	SURFACE ELEVATION
Turner Construction Company	38:1459	
LOCATION: College Station Drive and Trolley Line Road, Aiken, SC	ARCH./ENG:	

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Depth [4"]					
		(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to Brown, Moist					
1							
2							
3			E			S-1	
4							
5		END OF HAND AUGER @ 5.0'					
6							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: While Drilling ▽ After Drilling ▼ | EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Before Drilling:	Groundwater:
JB/GC	05/05/16	Feet			NE

PROJECT NAME:			HAND AUGER #
Savannah River Nuclear Solutions, AMC Project			HA-4
CLIENT:	JOB #:		SURFACE ELEVATION
Turner Construction Company	38:1459		
LOCATION: College Station Drive and Trolley Line Road, Aiken, SC	ARCH./ENG:		

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Depth [4"]					
		(SP) FINE TO MEDIUM SAND, Trace Clay, Tan to Brown, Moist					
1							
2							
3			E			S-1	
4							
5		END OF HAND AUGER @ 5.0'					
6							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: While Drilling ▽ After Drilling ▼ EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Before Drilling:	Groundwater:
JB/GC	05/05/16	Feet			NE

WILDCAT DYNAMIC CONE LOG

ECS Carolinas, LLP
2031 Industrial Boulevard
Lexington, SC 29072

PROJECT NUMBER: 38:1459
DATE STARTED: 05-06-2016
DATE COMPLETED: 05-06-2016

HOLE #: HA-1
CREW: JB/GC
PROJECT: Savannah River Nuclear Solutions, AMC Project
ADDRESS: College Station Drive and Trolley Line Road
LOCATION: Aiken, SC

SURFACE ELEVATION:
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	11	48.8	••••••••••••••	13	MEDIUM DENSE	STIFF
- 1 ft	12	53.3	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	8	35.5	•••••••••••	10	LOOSE	STIFF
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
- 2 ft	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
- 3 ft	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
- 1 m	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	6	23.2	••••••	6	LOOSE	MEDIUM STIFF
- 4 ft	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
-	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
-	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
- 5 ft	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
-	8	30.9	••••••••	8	LOOSE	MEDIUM STIFF
-	6	23.2	••••••	6	LOOSE	MEDIUM STIFF
- 6 ft	9	34.7	•••••••••	9	LOOSE	STIFF
-	11	42.5	••••••••••••	12	MEDIUM DENSE	STIFF
- 2 m	12	46.3	••••••••••••	13	MEDIUM DENSE	STIFF
- 7 ft	15	51.3	••••••••••••••	14	MEDIUM DENSE	STIFF
-	17	58.1	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	14	47.9	••••••••••••••	13	MEDIUM DENSE	STIFF
- 8 ft	16	54.7	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	17	58.1	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	17	58.1	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 9 ft	16	54.7	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	19	65.0	••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
-	22	75.2	••••••••••••••••••••	21	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	23	78.7	••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

ECS Carolinas, LLP
2031 Industrial Boulevard
Lexington, SC 29072

PROJECT NUMBER: 38:1459
DATE STARTED: 05-06-2016
DATE COMPLETED: 05-06-2016

HOLE #: HA-2
CREW: JB/GC
PROJECT: Savannah River Nuclear Solutions, AMC Project
ADDRESS: College Station Drive and Trolley Line Road
LOCATION: Aiken, SC

SURFACE ELEVATION:
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	11	48.8	••••••••••••••	13	MEDIUM DENSE	STIFF
- 1 ft	12	53.3	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	8	35.5	•••••••••••	10	LOOSE	STIFF
- 2 ft	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
- 3 ft	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
- 1 m	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	6	23.2	••••••	6	LOOSE	MEDIUM STIFF
- 4 ft	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
-	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
-	6	23.2	••••••	6	LOOSE	MEDIUM STIFF
- 5 ft	6	23.2	••••••	6	LOOSE	MEDIUM STIFF
-	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
-	10	38.6	••••••••••••	11	MEDIUM DENSE	STIFF
- 6 ft	9	34.7	•••••••••••	9	LOOSE	STIFF
-	11	42.5	••••••••••••	12	MEDIUM DENSE	STIFF
- 2 m	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
- 7 ft	16	54.7	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	16	54.7	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	13	44.5	••••••••••••	12	MEDIUM DENSE	STIFF
- 8 ft	18	61.6	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	16	54.7	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	15	51.3	•••••••••••••••	14	MEDIUM DENSE	STIFF
- 9 ft	18	61.6	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	15	51.3	•••••••••••••••	14	MEDIUM DENSE	STIFF
-	25	85.5	•••••••••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	25	85.5	•••••••••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

ECS Carolinas, LLP
2031 Industrial Boulevard
Lexington, SC 29072

PROJECT NUMBER: 38:1459
DATE STARTED: 05-06-2016
DATE COMPLETED: 05-06-2016

HOLE #: HA-3
CREW: JB/GC
PROJECT: Savannah River Nuclear Solutions, AMC Project
ADDRESS: College Station Drive and Trolley Line Road
LOCATION: Aiken, SC

SURFACE ELEVATION:
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
- 1 ft	8	35.5	•••••••••	10	LOOSE	STIFF
-	8	35.5	•••••••••	10	LOOSE	STIFF
-	14	62.2	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 2 ft	12	53.3	••••••••••••••	15	MEDIUM DENSE	STIFF
-	11	48.8	•••••••••••••	13	MEDIUM DENSE	STIFF
-	9	40.0	•••••••••••	11	MEDIUM DENSE	STIFF
- 3 ft	7	31.1	••••••••	8	LOOSE	MEDIUM STIFF
- 1 m	7	31.1	••••••••	8	LOOSE	MEDIUM STIFF
-	8	30.9	••••••••	8	LOOSE	MEDIUM STIFF
- 4 ft	10	38.6	•••••••••••	11	MEDIUM DENSE	STIFF
-	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
-	12	46.3	••••••••••••	13	MEDIUM DENSE	STIFF
- 5 ft	14	54.0	••••••••••••••	15	MEDIUM DENSE	STIFF
-	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
-	8	30.9	••••••••	8	LOOSE	MEDIUM STIFF
- 6 ft	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
-	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
- 2 m	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
- 7 ft	11	37.6	•••••••••	10	LOOSE	STIFF
-	14	47.9	••••••••••••	13	MEDIUM DENSE	STIFF
-	16	54.7	••••••••••••••	15	MEDIUM DENSE	STIFF
- 8 ft	17	58.1	•••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	14	47.9	••••••••••••	13	MEDIUM DENSE	STIFF
-	13	44.5	••••••••••••	12	MEDIUM DENSE	STIFF
- 9 ft	12	41.0	•••••••••••	11	MEDIUM DENSE	STIFF
-	17	58.1	•••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	22	75.2	••••••••••••••••••••	21	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	25	85.5	••••••••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

ECS Carolinas, LLP
2031 Industrial Boulevard
Lexington, SC 29072

PROJECT NUMBER: 38:1459
DATE STARTED: 05-06-2016
DATE COMPLETED: 05-06-2016

HOLE #: HA-4
CREW: JB/GC
PROJECT: Savannah River Nuclear Solutions, AMC Project
ADDRESS: College Station Drive and Trolley Line Road
LOCATION: Aiken, SC

SURFACE ELEVATION:
WATER ON COMPLETION:
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	9	40.0	••••••••••••	11	MEDIUM DENSE	STIFF
- 1 ft	8	35.5	••••••••••	10	LOOSE	STIFF
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	12	53.3	••••••••••••••••	15	MEDIUM DENSE	STIFF
- 2 ft	13	57.7	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	14	62.2	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
- 3 ft	8	35.5	••••••••••	10	LOOSE	STIFF
- 1 m	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
- 4 ft	9	34.7	••••••••••	9	LOOSE	STIFF
-	8	30.9	••••••••	8	LOOSE	MEDIUM STIFF
-	11	42.5	••••••••••••	12	MEDIUM DENSE	STIFF
- 5 ft	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
-	13	50.2	••••••••••••••	14	MEDIUM DENSE	STIFF
-	10	38.6	••••••••••••	11	MEDIUM DENSE	STIFF
- 6 ft	8	30.9	••••••••	8	LOOSE	MEDIUM STIFF
-	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
- 2 m	7	27.0	•••••••	7	LOOSE	MEDIUM STIFF
- 7 ft	15	51.3	••••••••••••••	14	MEDIUM DENSE	STIFF
-	17	58.1	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	13	44.5	••••••••••••	12	MEDIUM DENSE	STIFF
- 8 ft	17	58.1	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	19	65.0	••••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
-	18	61.6	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 9 ft	18	61.6	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	15	51.3	••••••••••••••	14	MEDIUM DENSE	STIFF
-	20	68.4	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	24	82.1	••••••••••••••••••••••••	23	MEDIUM DENSE	VERY STIFF
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

ECS CAROLINAS, LLP
Columbia, SC
Laboratory Testing Summary

Date: 05/18/16

Project Number: 38:1459 **Project Name: Savannah River Nuclear Solutions, AMC Project**

Project Engineer: BJH **Principal Engineer:WEG** **Summary By: BJH**

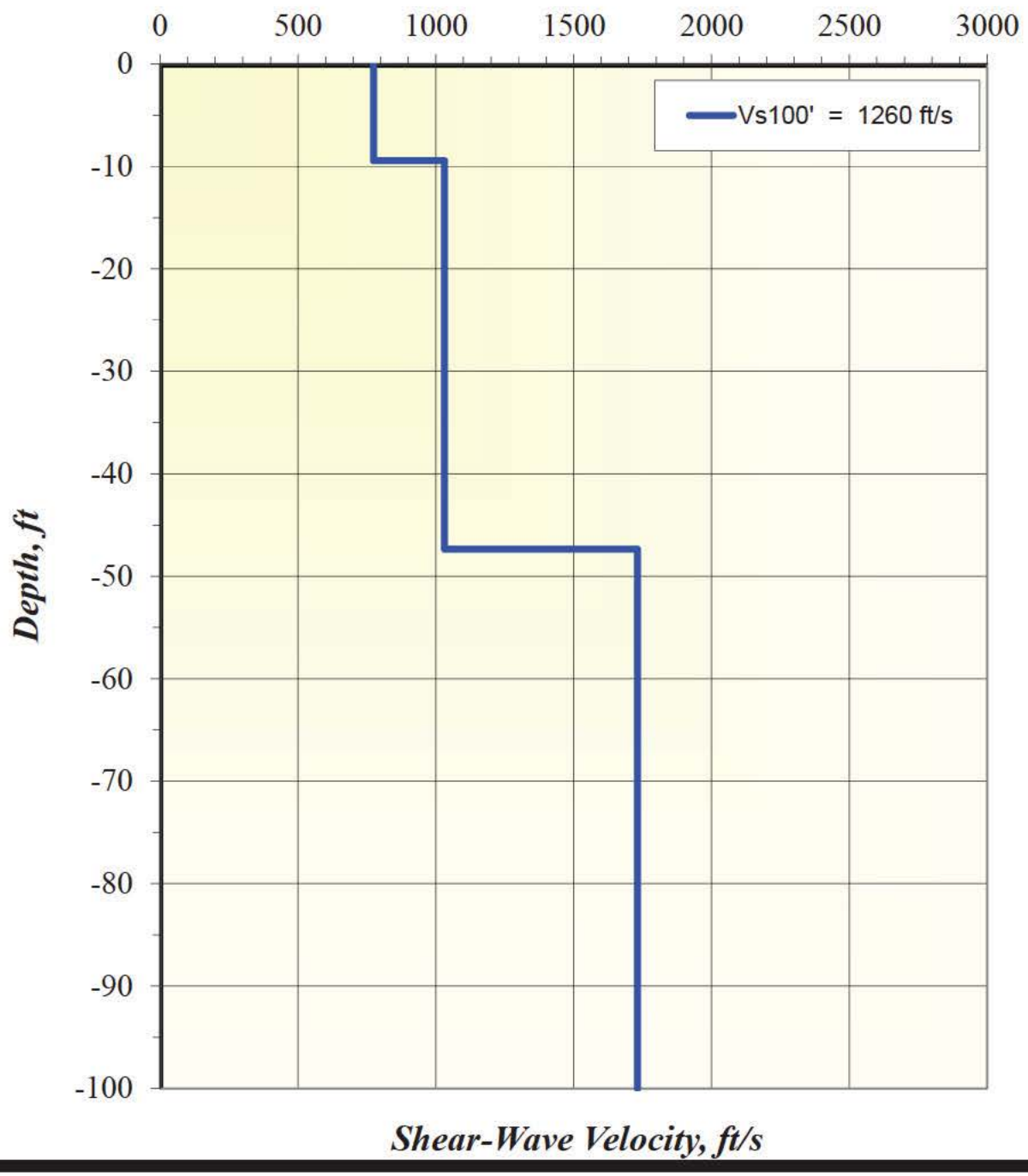
Boring/Test Pit Number	Sample Number	Depth (feet)	Moisture Content (%)	USCS	Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing No. 200 Sieve	Compaction		pH	Soil Resistivity (ohms-cm)	Other
									Maximum Density (pcf)	Optimum Moisture (%)			
B-2	S-1	1.5-2.0		SP								21000	
B-1	S-2	3.5-5.0		SP							6.5		

Summary Key:

SA = See Attached
S = Standard Proctor
M= Modified Proctor
V = Virginia Test Method
OC = Organic Content

Hyd = Hydrometer
Con = Consolidation
DS = Direct Shear
GS = Specific Gravity
NP = Non-Plastic

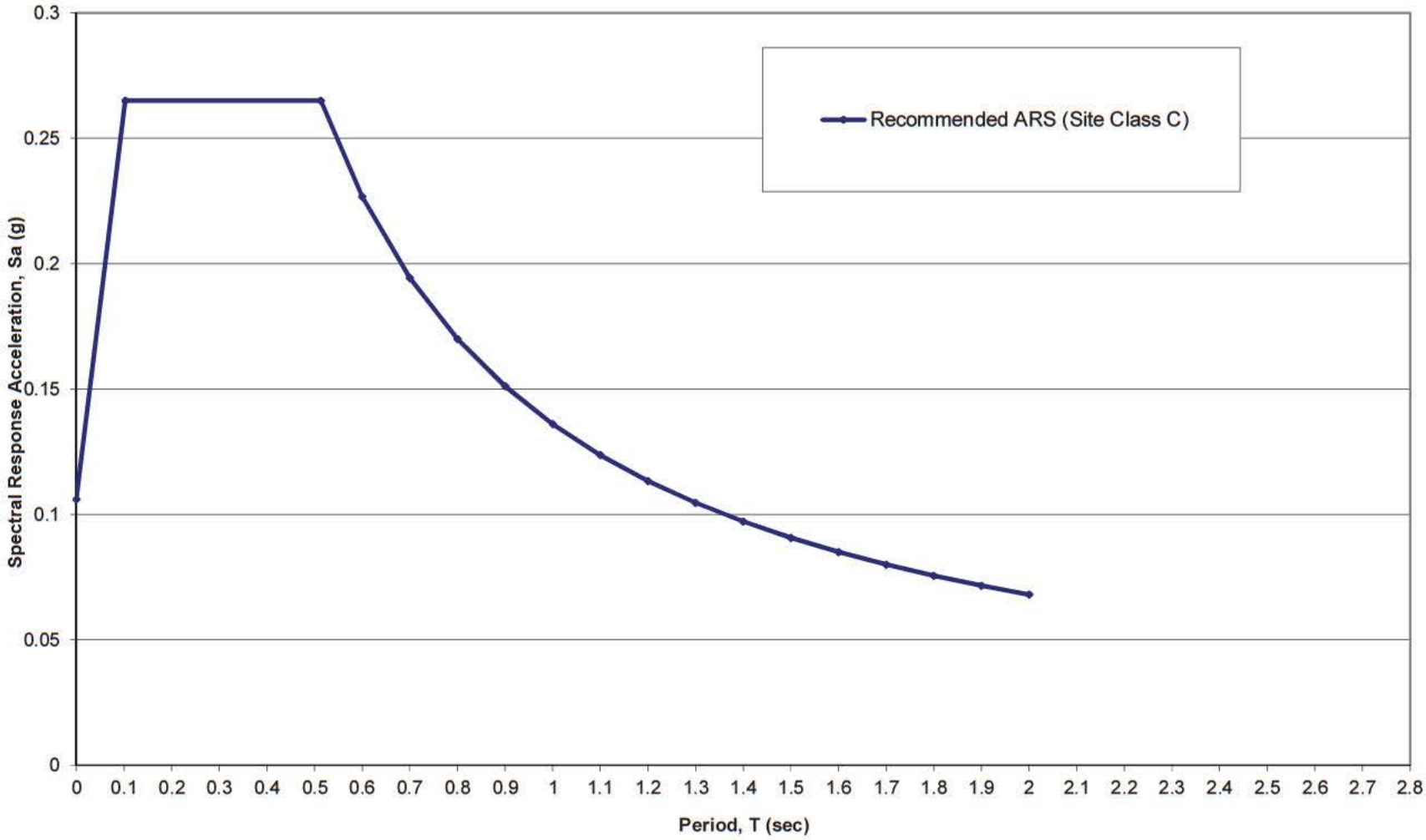
UCS = Unconfined Compression Soil
UCR = Unconfined Compression Rock
LS = Lime Stabilization
CS = Cement Staibilization



Shear Wave Velocity Model – ReMi Survey

ReMi Test Results
S-1
Site Class 'C'

Savannah River Nuclear Solutions,
AMC Project
Aiken, South Carolina
ECS Project No.:38:1459



ECS PROJECT NO.: 38:1459 **May 23, 2016**		**ACCELERATION REPSONSE SPECTRUM, 5 % DAMPING** **2% PROBABILITY OF EXCEEDNACE IN 50 YEARS** **SAVANNAH RIVER NUCLEAR SOLUTIONS, AMC PROJECT** **AIKEN, SOUTH CAROLINA**

Savannah River
NUCLEAR SOLUTIONS℠
FLUOR • NEWPORT NEWS NUCLEAR • HONEYWELL

Advanced Manufacturing Collaborative (AMC) Facility

National Environmental Policy Act (NEPA) Strategy

SRNS-TR-2020-00328 Rev. 0

September 2020

CONCURRENCE / APPROVAL

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