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Infrastructure, environment, buildings

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Ms. Carol C. Minsk
Project Manager

Mr. Lucas Berresford
Engineering Associate
Division of Site Assessment and Remediation
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Subject:
Pre-Remedial Design Investigation Work Plan
Adjacent to AVX Corporation, Myrtle Beach, South Carolina Facility
801 17th Avenue South
Horry County, Myrtle Beach, South Carolina
SCD 062 690 557

Date:
August 2, 2010

Contact:
Mark B. Hanish

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Our ref:
B0007393

Dear Ms. Minsk and Mr. Berresford:

On behalf of AVX Corporation (AVX), ARCADIS respectfully submits five copies of this *Pre-Remedial Design Investigation Work Plan* (Work Plan) to the South Carolina Department of Health and Environmental Control (SCDHEC) for the AVX site located at 801 17th Avenue South in Horry County, Myrtle Beach, South Carolina (site) (Figure 1). AVX has prepared this Work Plan to collect additional hydrogeological and soil/water quality information to support design of potential future off-site groundwater remedies. The focus of this investigation is on off-site properties located primarily to the northeast of the site (Figure 2).

Background

Groundwater quality at the off-site properties to the north of the site has been studied during multiple phases of investigation beginning in January 2007. The results of the first three phases of investigation were reported in the May 2007 *Off-Site Groundwater Investigation Report*[1]. Data from the fourth phase of investigation was reported in the March 2008 *Additional Off-Site Groundwater and Surface-Water*

[1] ARCADIS. 2007. Off-Site Groundwater Investigation Report, AVX Myrtle Beach, South Carolina Site, prepared for AVX Corporation. May 2007.

Investigation Report[2]. Since that time, feasibility study- (FS-) related investigations have been performed, including membrane interface probe/cone penetrometer testing and enhanced reductive dechlorination (ERD) pilot studies that began in late 2008 and have continued through to present.

Investigation Objectives

The objective of the proposed work is to improve our understanding of the groundwater hydraulics and the horizontal and vertical extent of chlorinated volatile organic compounds (VOCs) to the northeast of the site. This information will be important for the design of any final remedy that is chosen through the FS process. Specific areas on which the investigation will focus include (Figure 2):

- *The Nance Property*: Assessment of groundwater/soil quality to refine our understanding of the lateral extent of VOCs.

- *The Horry Land Company Property and Public Property*:

    - Assessment of hydraulic head field (area-wide water elevations), hydraulic parameters, and groundwater quality in a more broadly spaced set of groundwater monitoring wells. The wells will provide data key to refinement of the site groundwater flow model, which will be a tool in developing the basis of design of the final groundwater remedy.

    - Vertical delineation of the groundwater quality in one deeper well completed within the Peedee Formation, in proximity to existing nested monitoring well pair MW-23D and MW-23DD.

Additional scope details are provided in the following section of this Work Plan.

Scope of Work

The scope of work will include the following tasks:

- Site Preparation

[2] ARCADIS. 2008. Additional Off-Site Groundwater and Surface-Water Investigation Report, AVX Myrtle Beach, South Carolina Site, prepared for AVX Corporation. March 2008.

- Direct-Push Groundwater Sampling
- Soil Sampling
- Groundwater Monitoring Well Installation
- Groundwater Level Gauging and Sampling
- Hydraulic Conductivity Testing
- Decontamination
- Investigation-Derived Waste (IDW) Management
- Surveying
- Refinement of Groundwater Flow Model
- Reporting

These tasks are described in greater detail below.

Site Preparation

The following preparatory activities will be completed before the investigation begins.

- Apply for and obtain SCDHEC well permits.
- Obtain access to drill on the Horry Land Company and Nance Properties and the City/County right of way along 13th Avenue South.
- Locate underground utilities in the vicinity of investigation areas.

Direct-Push Groundwater Sampling

Six borings will be advanced on the Nance Property at the approximate locations shown on Figure 2. Borings will be advanced by direct-push technology or sonic drilling method to a maximum depth of approximately 30 to 40 feet below ground surface (bgs), consistent with the known depth to the base of the Lower Terrace

Deposits in this area. Actual termination depths will be based upon field interpretation of geologic data generated during the collection of select soil cores and on drilling conditions (e.g., refusal) encountered. Any soil cores collected during drilling will be characterized by the supervising geologist, who will record the lithology and field-screen the recovered soil for VOCs using a photoionization detector (PID).

A groundwater sample will be collected from the upper (approximately 20 feet bgs) and lower portion (approximately 30 to 40 feet bgs) of the water-bearing zone within the Lower Terrace Deposits, consistent with the depths of direct-push groundwater sample borings completed during previous off-site investigations performed nearby.

Groundwater sampling will be performed using a peristaltic pump with dedicated disposable tubing. Each location will be purged prior to sampling, if possible, to reduce the amount of suspended sediment in the groundwater sample. The groundwater samples will be analyzed for chlorinated VOCs by United States Environmental Protection Agency (USEPA) SW-846 Method 8260. Some or all of the groundwater samples may be analyzed on an accelerated laboratory turnaround schedule, if necessary, to provide data to help select the final location of the new longer-term monitoring well that will be installed on the Nance Property (see below).

Samples from at least one location on the Nance Property will be analyzed for an expanded parameter list, including: VOCs, semivolatile organic compounds (SVOCs) by USEPA SW-846 Method 8270C, and Target Analyte List (TAL) metals by USEPA SW-846 Method 6010B.

After samples have been collected, the boreholes will be grouted, from the bottom to the top of the borehole, by pumping grout through the sampling rods as those rods are being extracted.

Soil Sampling

Two soil samples will be collected for laboratory analysis from one of the direct-push groundwater sample boring locations identified on Figure 2. The first soil sample will be collected from the surface or near-surface interval (0 to 2 feet bgs). The second soil sample will be collected from the 2-foot interval above the water table. Samples will be analyzed for VOCs, SVOCs and TAL metals by USEPA SW-846 Methods 8260B, 8270C, and 6010B, respectively.

Samples for VOCs will be collected first, as grab samples, directly from the acetate liner, using a Terracore sampler or similar. After the samples have been collected for VOC analysis, the remaining volume of soil from the sampled interval will be placed in a pre-cleaned stainless steel bowl and homogenized using a pre-cleaned stainless steel trowel or disposable plastic trowel. The sample containers for SVOCs, metals, and any other remaining analyses will then be filled from the homogenized soil. All reusable soil sampling equipment will be decontaminated prior to first use and between samples.

All samples will be logged on chain of custody forms and placed in coolers on ice for preservation and shipping. The samples will be transported by overnight courier to a South Carolina-certified laboratory.

Groundwater Monitoring Well Installation

Six monitoring wells will be installed on the off-site properties located to the north and downgradient from the site, at the approximate locations shown on Figure 2. Five of these will be installed and screened within the Lower Terrace Deposits at locations that will provide a broader area of coverage primarily for collection of hydraulic information but also for collection of water quality information.

The sixth well will be installed in the Peedee Formation, to delineate the vertical extent of chlorinated VOCs observed in groundwater at existing Peedee monitoring well MW-23DD. The following describes the proposed well drilling and completion methods and well development procedures. Alternative methods may be substituted, but not without prior discussion with and approval by the SCDHEC.

<u>Lower Terrace Deposit Monitoring Well Installation</u>

The five monitoring wells will be installed to screen the base of the Lower Terrace Deposits, at a depth of approximately 40 feet bgs, consistent with the depths of existing Lower Terrace Deposit (D-series) monitoring wells in the area. The final location of the proposed D-series monitoring well on the Nance Property will be based on the results of the direct-push groundwater samples collected from the two locations at the edge of Parcel 12 (see Figure 2).

Monitoring wells will be installed using either hollow-stem augers, mud rotary, or sonic drilling methods. Based on the drilling method chosen, soil cores will be collected continuously during drilling. The recovered cores will be logged and field-screened for VOCs with a PID by the supervising geologist.

Monitoring wells will be constructed with 2-inch-diameter, Schedule 40 polyvinyl chloride (PVC) riser pipe and 10 feet of Schedule 40 PVC screen with 0.010 inch machine slots. A sand filter pack, sized for a 0.010 inch slot well screen, will be placed from the bottom of the boring to a minimum of 2 feet above the top of the well screen. A minimum of 2 feet of non-coated bentonite pellets will be placed above the sandpack. The balance of the annular space will be filled with a cement/bentonite grout to approximately 2 feet bgs.

Where possible, the monitoring wells will be completed as above-grade stickups, surrounded by a 4-inch-diameter steel protective casing secured by a locking cover, and set within a concrete surface pad. At locations where it is not possible to install an above-grade surface completion, monitoring wells will be completed flush with the ground surface, secured within a flush-mounted, traffic-bearing road box.

Peedee Formation Monitoring Well Installation

The depth and screened interval of the proposed Peedee Formation monitoring well will depend on the lithology encountered during drilling. The objective is to install the monitoring well so that the screened interval is below a confining unit. Such a confining or semiconfining unit composed of cemented sand/limestone or clay has been observed at other Peedee Formation monitoring well locations. A confining layer was not encountered during the drilling of existing deep zone well MW-23DD, which was installed at a depth of 60 feet bgs; so the installation depth of this new deeper well could be 100 feet bgs or more.

The Peedee Formation monitoring well will be installed using either mud rotary or sonic drilling methods. Drilling will begin by advancing a pilot hole to characterize the lithology at the location, with soil cores being collected continuously during drilling. The recovered cores will be logged and field-screened for VOCs with a PID. If a confining unit is encountered, an isolation casing will be installed a minimum of 2 feet into the confining unit to seal off the subsurface from the confining unit to the ground surface. If the well is installed using mud-rotary drilling methods, the isolation casing will be installed as a 10-inch-diameter permanent casing, which will be pressure-grouted into place with a cement bentonite grout installed from bottom up using a tremie-pipe or similar method. The borehole, in which the isolation casing is installed, will be drilled large enough to allow for the installation of the grout seal as described above. After the grout has been allowed to cure at least 24 hours, drilling will proceed through the isolation casing through the confining unit and into the next permeable water-bearing unit. If the well is installed using sonic drilling methods, a temporary isolation casing will be installed using large-diameter sonic drilling rods. The well will then be drilled to depth and installed through the temporary casing using smaller-diameter sonic rods. The temporary casing will remain in place until the well has been installed and completed, which will likely take less than 24 hours. If the confining unit is a layer of cemented sand/limestone, it will be cored and logged. The well depth will be selected such that the screen is located entirely within the top portion of the water-bearing unit immediately beneath the confining unit.

The deep monitoring well will be constructed with 2-inch-diameter, Schedule 40 PVC riser and between 5 and 10 feet of Schedule 40 PVC screen with 0.010 inch machine slots. A sand filter pack, sized for a 0.010 inch slot well screen, will be placed from the bottom of the boring to a minimum of 2 feet above the top of the well screen. A minimum of 2 feet of non-coated bentonite pellets will be placed above the sandpack. The balance of the annular space will be filled with a cement/bentonite grout to approximately 2 feet bgs. The well will be completed flush with the ground surface, secured within a flush-mounted, traffic-bearing road box set in a concrete pad.

Well Development

The primary objectives of well development are to significantly reduce the amount of suspended sediment in groundwater samples collected from the wells and to improve the hydraulic communication between the wells and the adjacent formation. To achieve these objectives, all wells will be developed by surging and purging. Field personnel will monitor purge-water parameters of turbidity, pH, conductivity, and temperature periodically during development. Development will be discontinued once these parameters have stabilized.

Groundwater Gauging and Sampling

Two rounds of groundwater levels will be measured from all on-site and off-site monitoring wells. These data will be used to develop a refined groundwater potentiometric surface interpretation for the site.

After the groundwater elevations have been measured, the newly installed groundwater monitoring wells will be sampled following low-flow sampling procedures. Samplers will monitor field parameters (pH, conductivity, dissolved oxygen, temperature, and oxidation-reduction potential) of the groundwater at each monitoring well during purging using a field water quality meter (YSI or similar). Monitoring wells will be sampled after the field parameters are observed to have stabilized to within the required tolerances specified by the low-flow sampling method.

All samples will be analyzed for VOCs by USEPA Method 8260B. One blind duplicate, one equipment blank, one trip blank, and a matrix spike/matrix spike duplicate will be collected as quality control samples. All samples will be logged on chain of custody forms and placed in coolers on ice for preservation and shipping. The samples will be transported by overnight courier to a South Carolina-certified laboratory.for analysis of VOCs by SW-846 USEPA Method 8260

Hydraulic Conductivity Testing

Specific-capacity testing will be conducted at each of the six new monitoring wells and at existing wells P-1D, P-2D, P-3D, and P-4D. Data from the specific-capacity test will be used to estimate the hydraulic conductivity for the water-bearing formation surrounding the intake of the tested well. The specific-capacity tests will involve pumping groundwater from each well at a constant rate and quantifying the pumping rate and magnitude of drawdown inside the tested well after a known duration of pumping. The hydraulic conductivity may be estimated using single-well time-drawdown method with multiple drawdown measurements, or by using a specific-capacity procedure with one drawdown measurement.

Decontamination

Equipment used during drilling and sample collection will be decontaminated prior to use, between uses, and after final use. Equipment requiring decontamination will include all drilling equipment that comes in direct contact with subsurface materials and all reusable groundwater sampling equipment (e.g., bladder pumps).

IDW Management

IDW will be segregated according to type of waste generated. The IDW will consist of:

- soil cuttings

- decontamination-derived water
- disposable sampling equipment and personal protective equipment (PPE)

Soil cuttings will be placed in appropriate Department of Transportation- (DOT-) approved containers and staged at the AVX facility pending off-site disposal. After logging, any soil cores will be segregated into plastic bags and retained until completion of the drilling program. At that time, all soil cores that are no longer required for further assessment or analysis will be placed in a DOT-approved drum for disposal. Purge water and/or decontamination water generated at specific boring locations will be contained in drums, transported to the AVX facility and treated by the AVX's groundwater treatment system. Disposable sampling equipment and PPE will be placed in DOT-approved drums and staged at the AVX facility pending off-site disposal.

All waste streams will be sampled and analyzed for waste disposal characteristics identified by the disposal facility. The IDW will be transported to an appropriate off-site facility for disposal in accordance with applicable regulations.

Surveying

The locations of all new soil borings and monitoring wells will be surveyed into the coordinate system currently in use at the site by a South Carolina-licensed surveyor. Surveyors will also measure the ground surface elevations at all new soil boring locations, the ground surface, and the top of PVC riser casing elevations at all new monitoring wells.

Refinement of Groundwater Flow Model

Following completion of the field investigation, the existing site groundwater flow model will be refined and recalibrated. The following new data will be considered in the updated model:

- Water level, hydraulic and geologic data from monitoring wells, and soil borings installed during the time since the groundwater flow model was created.(2009)
- Hydraulic data obtained from ERD injections and pilot testing.

- The hydraulic response to shutdown of the Upper Terrace Deposit extraction wells.

The recalibration process will involve adjusting the values of hydraulic parameters used in the model, such as transmissivity, so the predicted groundwater flow patterns match those observed at the site as closely as possible. Data describing the observed hydraulic response and concentration trends collected during the total organic carbon injections, completed at the investigation area during April 2010, will be used to help recalibrate the model as well, if possible.

The site solute transport model will be updated and recalibrated in conjunction with the groundwater flow model during this effort, by matching predicted concentration trend data to those observed across the site.

The refined groundwater flow and solute transport model may be used to run predictive simulations to assess the effect of proposed remedial actions.

Reporting

A summary of the work performed will be submitted in a report, which will include the following information:

- a description of field activities
- geologic logs and well construction diagrams for all soil borings and monitoring wells completed during the investigation
- survey data for all new soil borings and monitoring wells
- tabulated groundwater and surface-water quality data and laboratory data sheets
- a modeling summary write up presenting the refinements and recalibrations completed on the groundwater flow and solute transport model and the results of any predictive simulations performed
- results, conclusions, and recommendations

Schedule

The estimated schedule of activities is as follows:

- *Mobilization* – approximately 3 weeks following the SCDHEC's approval of this Work Plan.
- *Field Activities* – completed within approximately 3 weeks of mobilization.
- *Laboratory Analysis of Samples* – completed within approximately 4 weeks from receiving last field sample.
- *Updating Groundwater Flow Model, Data Analysis, and Reporting* – completed within approximately 8 weeks of receiving final laboratory data.

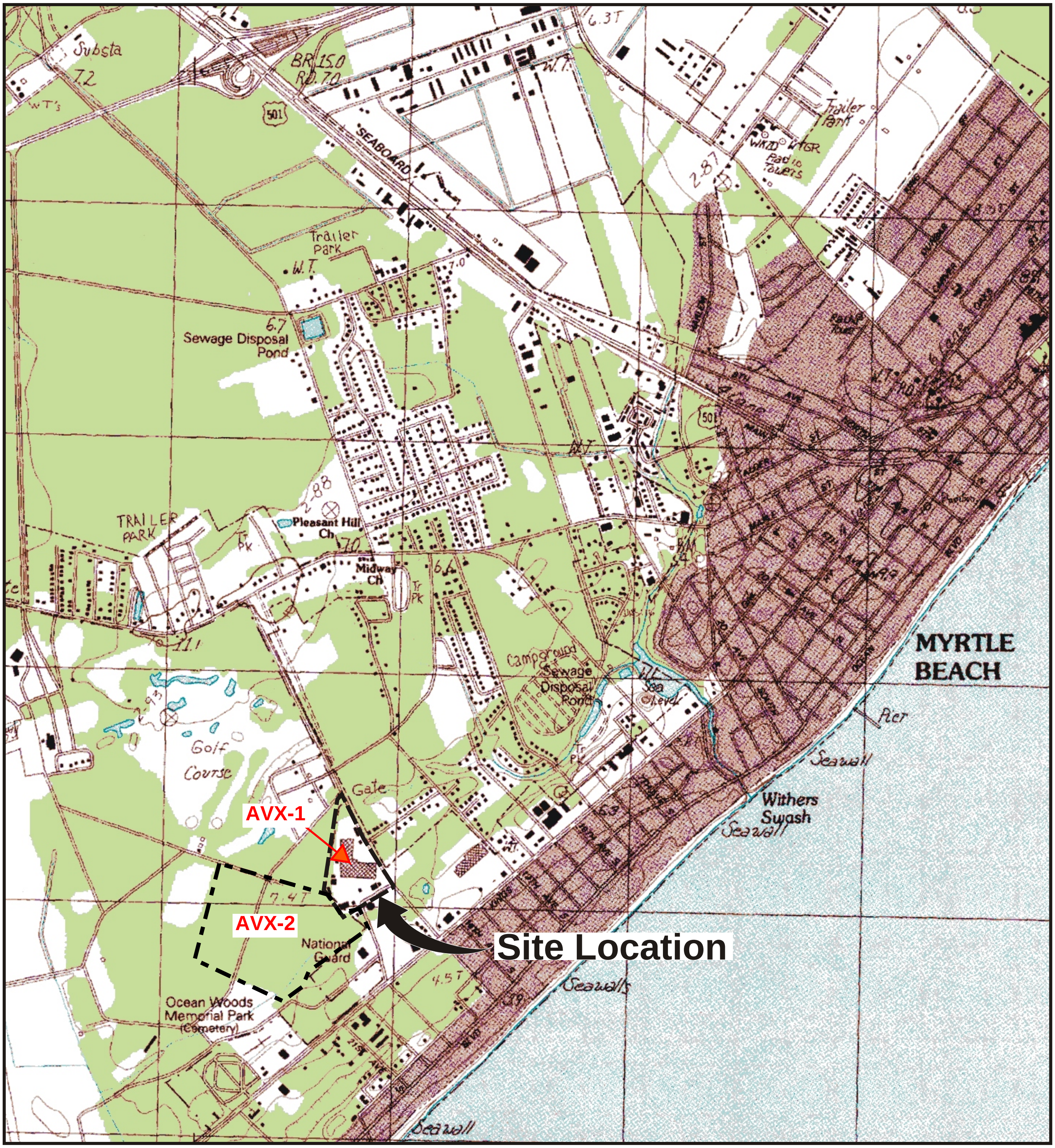
If you have any questions, please do not hesitate to call Mr. Larry Blue at 843.946.0395 or me at 724.742.9180 ext 518.

Sincerely,

ARCADIS U.S., Inc.

Mark B. Hanish
Project Manager

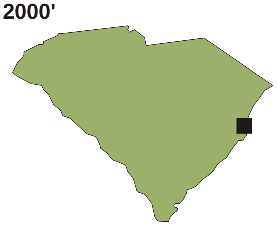
Copies:
Mr. Larry Blue, AVX Corporation
Mr. Evan Slavitt, AVX Corporation
Mr. Max E. Justice, Parker Poe
Mr. William B. Popham, ARCADIS
Mr. Jeff Beckner, ARCADIS



REFERENCE: BASE MAP USGS 7.5 MIN. QUAD., MYRTLE BEACH, SOUTH CAROLINA, PHOTOREVISED 1984.

2000' 0 2000'

Approximate Scale: 1" = 2000'



Area Location

AVX CORPORATION
MYRTLE BEACH FACILITY
MYRTLE BEACH, SOUTH CAROLINA

SITE LOCATION MAP

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FIGURE
1

01/31/08 SYR-D85-DJH
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LEGEND:

- LOCATION OF MONITORING WELL SCREENED IN THE UPPER TERRACE DEPOSITS
- LOCATION OF MONITORING WELL SCREENED IN THE LOWER TERRACE DEPOSITS
- LOCATION OF MONITORING WELL SCREENED IN THE PEEDEE FORMATION
- LOCATION OF MONITORING WELL SCREENED IN THE UPPER & LOWER TERRACE DEPOSITS
- LOCATIONS OF PUMPING WELL SCREENED IN THE UPPER TERRACE DEPOSITS
- LOCATION OF PRODUCTION WELL SCREENED IN THE UPPER & LOWER TERRACE DEPOSITS
- LOCATION OF INJECTION WELL SCREENED IN THE LOWER TERRACE DEPOSITS
- LOCATION OF FORMER MONITORING WELL THAT WAS ABANDONED OR DESTROYED
- LOCATION OF SOIL VAPOR EXTRACTION WELL (CURRENTLY USED FOR GROUNDWATER ELEVATION MONITORING)
- APPROXIMATE LOCATION OF PROPOSED MONITORING WELL SCREENED IN THE LOWER TERRACE DEPOSITS
- APPROXIMATE LOCATION OF PROPOSED MONITORING WELL SCREENED IN THE PEEDEE FORMATION
- APPROXIMATE LOCATION OF PROPOSED DIRECT-PUSH GROUNDWATER SAMPLING LOCATION
- APPROXIMATE LOCATION OF PROPOSED DIRECT-PUSH GROUNDWATER AND SOIL SAMPLING LOCATION

NOTES:

1. LOCATIONS OF ROADS AND PROPERTY LINES ARE APPROXIMATE.

0 300' 600'

GRAPHIC SCALE

AVX CORPORATION
MYRTLE BEACH FACILITY
MYRTLE BEACH, SOUTH CAROLINA

PROPOSED ADDITIONAL OFFSITE GROUNDWATER INVESTIGATION LOCATIONS

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FIGURE
2