Hazardous Waste Section

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September 24, 2015

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Raleigh, NC 27699-1646

Attn: Ms. Mary Siedlecki

Re: Revised Risk-Based Remedial Action Plan
AB Carter, Inc.
Gastonia, North Carolina
EPA # NCD 003 154 010
H&H Job No. ABC-019

Dear Mary:

H&H is pleased to submit the revised Risk-Based Remedial Action Plan on behalf of AB Carter, Inc. Should you have any questions or need any additional information, please feel free to contact me.

Sincerely,

***Hart & Hickman, PC***

Leonard C. Moretz

Leonard Moretz, PG
Senior Consultant

Enclosure

cc: Al Abedi, AB Carter
Lee Pennington, AB Carter
Rick Craig, AB Carter

# Remedial Action Plan
# For Risk-Based Remediation

## AB Carter, Inc.
## Gastonia, North Carolina
## EPA ID No. NCD 003 154 010

H&H Job No. ABC-019
September 24, 2015

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**Remedial Action Plan For**
**Risk-Based Remediation**
**AB Carter, Incorporated**
**Gastonia, North Carolina**
**H&H Job No. ABC-019**

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**Remedial Action Plan for**
**Risk-Based Remediation**
**AB Carter, Incorporated**
**Gastonia, North Carolina**
**H&H Job No. ABC-019**

## 1.0 Introduction

This Remedial Action Plan (RAP) has been prepared by Hart & Hickman, P.C. (H&H) on behalf of AB Carter, Incorporated (AB Carter) to address impacted groundwater at the AB Carter plant (Site) located at 4801 York Highway (US 321) in Gastonia, North Carolina (NC). A Site location map is included as Figure 1. A Site map is included as Figure 2.

In 2011, Session Law 2011-186 (House Bill 45) was signed by the Governor of NC for the following:

> *"An Act to Allow the use of Risk-Based Remediation to Accelerate the Cleanup of Contaminated Industrial Sites for the Purpose of Limiting Human and Environmental Exposure to Safe Levels, to Protect Current and Likely Future Uses of Groundwater, and to Ensure the Cost-Effective Application of Limited Public and Private Resources"*

This law is codified under NC General Statute (NCGS) Chapter 130A, Section 310, Article 9 (Solid Waste Management) (NCGS §130A-310, Art 9). The law provides owners and operators of eligible industrial sites with the opportunity to develop site-specific risk-based remediation standards in lieu of the more stringent NC Administrative Code 2L Groundwater Quality Standards (NC 2L Standards) if the responsible party can demonstrate the environmental conditions do not pose an unacceptable risk to human health and the environment.

In a letter dated December 4, 2014, AB Carter notified the Department of Environment and Natural Resources (DENR) Hazardous Waste Section (HWS) of their intent to pursue no further action (NFA) through Risk-Based Remediation of Industrial Sites pursuant to NCGS. § 130A-310.65 through 310.77. DENR indicated in a letter dated January 5, 2015, that the Site meets the eligibility criteria.

The purpose of this RAP is to identify constituents of concern (COCs) at the Site, identify potential receptors, evaluate risk to human health and the environment, and develop Site-specific risk-based remedies to mitigate risk so the Site can receive NFA.

# 2.0 Site Background Information

## 2.1 Site Background

The AB Carter plant has been in operation since March 1, 1969, and has historically manufactured textile machine parts and accessories. Facility operations currently focus on the production of plastic molded parts and copper-coated wire. Operations that were eliminated included plating, stamping, machining, and parts cleaning.

The facility currently operates a wastewater treatment facility for the management of wastewater generated from wire operation. Wire cleaning and copper flash coating processes conducted at AB Carter generates approximately 3,000 gallons of wastewater per day. Treatment is necessary to remove copper and to neutralize the pH of the wastewater. A dewatering system is currently used to separate sludge from the treated wastewater, which is discharged into the City of Gastonia's sanitary sewer system. The sludge is listed as Environmental Protection Agency (EPA) non-hazardous waste. The average weight of the sludge is approximately 12,000 pounds every six months. The sludge is temporarily stored on-Site behind the plant in a covered metal roll-off bin for less than 180 days prior to off-Site disposal.

Historically this wastewater treatment facility was also used to treat process water from electroplating and wire cleaning operations. Prior to 1986, treated process wastewater and associated sludge were stored on-Site in a storage pond and two sludge beds, respectively (Figure 2). The storage pond and sludge beds (beds) were excavated and closed in-place as landfills, and the Site is undergoing post-closure care under the Resource Conservation and Recovery Act (RCRA). Groundwater impacted with nickel and sulfate above NC 2L Standards has been attributed to the former pond and beds. Volatile organic compounds (VOCs) have also been detected in Site groundwater at concentrations exceeding NC 2L Standards. The presence of VOCs within groundwater has not been attributed to the closed pond and beds but to historic non-point source *de-minimus* releases.

## 2.2 Wastewater Storage Pond and Sludge Bed Closure

In July 1986, AB Carter replaced the wastewater and sludge storage units with the sludge dewatering system, described above. The wastewater storage pond and sludge beds were excavated and closed in-place as landfills. Information about the contents in the former sludge ponds and treated wastewater storage pond and closure specifications are available in the Closure Plan submitted to the DENR – Solid and Hazardous Waste Management Branch on August 26, 1985, as amended in letters of March 31, 1986, and May 22, 1987.

Post-excavation confirmation soil samples were collected from the wastewater storage pond and sludge beds and submitted for analysis of total RCRA metals and nickel and extractable metals by the Extraction Procedure (EP) Toxicity Test Method. A summary of the analytical results is provided in Table 1. As shown in Table 1, arsenic was detected in two confirmatory samples collected from the wastewater storage pond at 10 mg/kg. This is slightly above the current DENR Inactive Hazardous Sites Branch (IHSB) Industrial Health-Based Preliminary Soil Remediation Goal (PSRG) of 3 mg/kg and the current DENR IHSB Protection of Groundwater (POG) PSRG of 5.8 mg/kg. Although total arsenic was detected above the PSRGs, leachable arsenic was not detected above the laboratory reporting limit when subjected to the EP Toxicity Test. Nickel was detected in the soil samples at a concentration above the current DENR IHSB POG PSRG. Although the eight RCRA metals plus nickel were analyzed, results of the EP Toxicity Test indicated that nickel was the primary metal detected above the current NC 2L Standard.

## 2.3 Historical Groundwater Monitoring

Groundwater monitoring, as required by the RCRA Post Closure Permit, has been conducted since the closure of SWMU #1 and SWMU #2 in 1986. Quarterly sampling was conducted at the Site from 1988 to 2002. A semi-annual sampling schedule was used from 2003 to 2008; and beginning in August of 2009, groundwater monitoring was reduced to an annual basis. Samples were generally analyzed for RCRA metals and sulfate. Additionally, groundwater samples were analyzed for Appendix IX constituents in certain point of compliance wells on an annual basis and then after a permit modification on a 5-year basis. After VOCs were detected during

Appendix IX sampling in 2007, those constituents were analyzed during routine monitoring and during other events as requested by DENR.

### 2.4 Historical Groundwater Remedial Actions

To comply with the Groundwater Protection Standards established in the Site's RCRA Part B Permit for post closure care, AB Carter operated a groundwater recovery system from 1989 until 2009 to address nickel impacts. By 2009, the nickel plume had reached an asymptotic steady state condition. Based upon this condition, AB Carter requested the recovery system be shut down, and with DENR's approval, the system was shut down in November of 2009.

In 2007, post-closure monitoring for the closed SWMUs included Appendix IX analyses. During this event the VOCs 1,1-dichloroethene (1,1-DCE) and tetrachloroethene (PCE) were detected in excess of NC 2L Standards at that time. A comprehensive groundwater monitoring event was conducted in September 2008 to evaluate the extent of VOC groundwater impacts. Constituents detected in groundwater included 1,1,1-trichloroethane (1,1,1-TCA), 1,1-DCE, 1,1-dichloroethane (1,1-DCA), chloroform, methyl tert-butyl ether, and PCE. Of the VOCs detected, only 1,1-DCE and PCE were detected above their NC 2L Standards at that time. In 2013, the NC 2L Standard for 1,1-DCE was increased from 7 µg/L to 350 µg/; and 1,1-DCE is no longer present above the current NC 2L Standard.

In February 2010, H&H conducted the first monitoring event since the shutdown of the recovery system. The monitoring event was designed to determine how the system shut down was affecting the stability of the nickel and sulfate plumes, and to determine whether monitored natural attenuation (MNA) was a suitable remedy for the Site. Results of the MNA evaluation indicated that natural attenuation processes at the Site were expected to prevent nickel and VOCs from exceeding their applicable 2B Surface Water Standards in the tributary to Crowders Creek. A RCRA permit modification was developed with MNA as the selected remedy and the modification was formally approved by DENR on January 25, 2013.

Since shutdown of the groundwater recovery system groundwater monitoring has included nickel and sulfate and the VOC scan has been expanded to include 1,4-dioxane. Since 2010, groundwater monitoring indicates that in addition to nickel and sulfate, three VOCs; PCE, 1,2-dichloroethane (1,2-DCA) and 1,4-dioxane have consistently been present above their respective 2L Standards. During the most recent sampling event conducted in August 2015 an additional VOC, 1,1-dichloroethane (1,1-DCA) was detected in one well (MW-23A) at a concentration just above the NC 2L Standard. However, 1,1-DCA has not been historically detected above the NC 2L Standard.

Because sulfate, nickel, PCE, 1,4-dioxane, and 1,2-DCA have been consistently present in groundwater at concentrations above the NC 2L Standard, these two inorganics and three VOCs are considered potential constituents of concern (PCOCs) in Site groundwater. Details of the concentration and distribution of these constituents are discussed in Section 4.

# 3.0 Current Site Conditions

## 3.1 Topography

The topographic high of approximately 750 feet (ft) above mean sea level (msl) is located on the western portion of the property where the Site building is located (Figure 1). The topography at the Site slopes easterly toward the tributary of Crowders Creek at an approximate six percent grade. The elevation at the tributary is approximately 680 ft msl.

## 3.2 Surrounding Land Use

As shown on Figure 3, land use surrounding the Site is zoned as I-2 General Industrial or C-3 General Commercial. The I-2 General Industrial zoning extends to approximately 1,100 ft east of the property boundary and tributary before transitioning to R-1 Single Family Limited. The land use approximately 1,000 ft north of the Site is zoned as I-3 Exclusive Industrial. A small area approximately 3,500 ft southwest of the Site is zoned as RMF Residential Multi-Family.

## 3.3 Geology and Hydrogeology

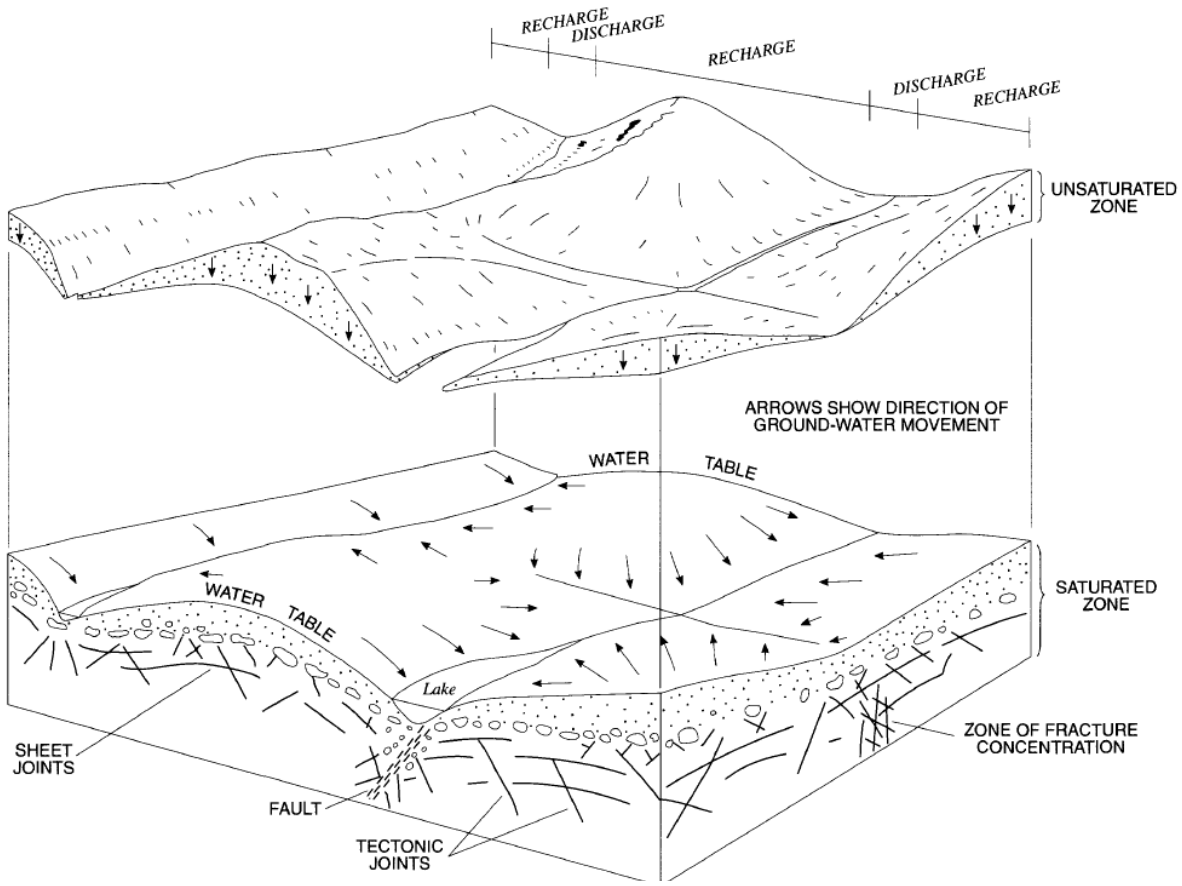
### 3.3.1 Regional Geology and Hydrogeology

The Site is located on the High Shoals Granite within the Kings Mountain Belt of the Piedmont Physiographic Province. The Kings Mountain Belt extends from the Catawba River in North Carolina southwest for about 130 miles to the Gaffney area of South Carolina. The High Shoals Granite is described as a very light gray, coarse-grained, generally porphyritic, commonly gneissoid biotite granite occupying an area of batholithic size within the Kings Mountain Belt. The bedrock in the area of the Site is mantled by a thick layer of regolith consisting of soil and saprolite. Tributaries are not deeply incised and have not eroded through the underlying regolith into bedrock. The rate of weathering at the regolith-bedrock boundary exceeds, or at least keeps pace with, the rate of erosion at the land surface (Daniel and Dahlen, 2002).

In the area of the Site, topography consists primarily of well-rounded hills and northwest-southeast trending ridges resulting from northwest-southeast tensional forces; with drainage features primarily trending north-northwest to south-southeast that originate within the valleys of the northwest-southeast trending ridges.

It is widely accepted that groundwater flow within the Piedmont can be conceptualized as occurring in compartments that are longitudinally bound by the recharge and discharge areas of topographic ridges and streams, respectively; and bound on the sides by topographic "spurs" (ridges that branch from a main crest). The local flow systems commonly lie between adjacent topographic divides that range from a few thousand feet to a few miles (Daniel et al., 1997).

As depicted in the figure below taken from Daniel et al. (1992), within the accepted conceptual regional model, groundwater does not flow beyond perennial streams, as they are considered groundwater discharge areas and serve as hydrogeologic boundaries. The groundwater divide located at the topographic ridges and spurs may shift slightly over time but maintain fairly consistent locations.




Within the regional model, there is a downward vertical component to groundwater flow in the recharge zones and an upward component in the discharge zones. In the recharge zone, infiltrating water travels vertically through the vadose zone until it hits the water table; once at the water table, the predominant flow direction is horizontal.

Within the regional conceptual model, there are three vertical layers of differing properties: competent bedrock, transition zone, and saprolite/soil. At the base is competent crystalline bedrock, where the occurrence and movement of groundwater is controlled by secondary joints, fractures, faults, and dikes. Above the bedrock lies the transition zone, which is a zone of relatively high permeability resulting from incomplete mechanical and chemical alteration of the bedrock. Above the transition zone is saprolite and soil generally termed as regolith. Saprolite is unconsolidated weathered material that maintains the relic structure and foliation of the parent rock, and lacks the degree of clay mineral formation seen in the more weathered soil above.

Further chemical and physical weathering of saprolite leads to soil, and hence, there is a gradation from saprolite to soil moving up the profile.

The flow paths that groundwater follows within fractures is less torturous than the path that groundwater takes through porous media. Therefore, groundwater velocities are often greater within fractured rock, and once in fractured rock, contaminants can migrate quickly.

### 3.3.2 Site Geology

The Site geology is consistent with the regional geology discussed above. The AB Carter facility is located on the east side of a low broad ridge oriented in a north/south direction. The east side of the ridge slopes to an unnamed tributary of Crowders Creek. This tributary is a perennial stream of low flow and low energy (approximately 1 to 3 cubic feet/second (cfs)). The tributary appears to have developed in a uniformly weathered material and is characterized by a wide (approximately 420 ft) floodplain. The change in elevation across the Site, from the highest point near AB Carter's main manufacturing area to the stream, is approximately 70 ft. Topography of the Site is depicted in Figure 1.

Similar to the regional hydrogeologic model described above, the Site sits upon fractured crystalline rock with a transition zone, saprolite, and soil above it. Boring logs indicate the depth to competent rock across the Site is somewhat variable but is typically around 60 ft below ground surface (bgs) with an approximate 10-ft-thick transition zone.

Across the Site, soil/saprolite has been classified in boring logs as sandy silts and silty sands. In 1987, S&ME Inc. conducted a grain size distribution analysis of samples from multiple intervals from multiple borings. Their work indicated that the soil and saprolite from 10 to 40 ft bgs is a micaceous silty sand.

According to the Soil Survey Division within the USDA-Natural Resources Conservation Service, the soil type at the Site is predominately a "Cecil sandy clay loam". This is a hydrologic group B soil, which is moderately well drained. A different soil type (Chewacla loam) is

mapped in the flood plain/riparian buffer; it is described as a frequently flooded, somewhat poorly drained, Group C soil. Group C soils have a slow rate of water transmission.

The geology of the Site is depicted in geologic cross-sections A-A', oriented longitudinally with groundwater flow, and B-B', oriented orthogonal with groundwater flow and are attached. A cross-section location map depicting the locations of cross-sections A-A' and B-B' is included as Figure 4 and cross-sections A-A' and B-B' are depicted in Figures 5 and 6, respectively.

### 3.3.3 Site Hydrogeology

As previously discussed, it is widely accepted that groundwater flow within the Piedmont can be conceptualized as occurring in compartments that are longitudinally bound by the recharge and discharge areas of topographic ridges and streams, respectively; and bound on the sides by topographic "spurs" (ridges that branch from a main crest). The local flow systems commonly lie between adjacent topographic divides that range from a few thousand feet to a few miles (Daniel et al., 1997).

Historic and recent groundwater elevations indicate groundwater flows easterly beneath the Site toward the tributary of Crowders Creek. This is consistent with the conceptual model of typical Piedmont hydrogeology described above, where groundwater flows from a topographic high to a perennial stream. Figure 7 depicts the generalized Site groundwater flow system, including the local Site groundwater divide and generalize groundwater flow lines. The local Site groundwater divide depicted on Figure 7 has been delineated based on topographic highs and the topographic lows, specifically the tributary. A topographic profile beginning near the Site boundary and extending approximately 800 ft east of the tributary is also depicted on Figure 7. Based on the topography east of the tributary, the groundwater east of the tributary would be expected to belong to a separate groundwater flow system with groundwater flow to west towards the tributary.

Figure 8 depicts the potentiometric surface and resulting groundwater flow direction based on groundwater elevations measured in August 2014. A cross-section depicting the Site conceptual groundwater flow model based on the generally accepted conceptual model of the Piedmont hydrogeology is shown on Figure 5. Figure 5 is a longitudinally oriented cross-

section that displays lithology, topography, and conceptualized groundwater flow lines. This illustrates the Site groundwater flows from the topographic high near the plant building and discharges to the tributary of Crowders Creek. The average horizontal hydraulic gradient across the Site based on the August 2014 groundwater elevations, measured from monitoring wells MW-12 and MW-24, is approximately 0.03 ft/ft (Figure 8).

### 3.3.4 Site Aquifer Hydraulic Properties

Within the RCRA Part B Post Closure Permit Renewal, submitted in 1995, hydraulic conductivity (K) was evaluated by conducting a pump test and several slug tests. A pump test was conducted using recovery well RW-10 and observation wells MW-9 and MW-9A. Calculations from the test resulted in K values of 8.8 ft per day (ft/d) (3.1 x $10^{-3}$ centimeters per second [cm/sec]) and 9.9 ft/d (3.5 x $10^{-3}$cm/sec).

Slug tests were conducted on monitoring wells MW-7, MW-7A, MW-8, and MW-9. The slug test results indicated K values of 2.8 ft/d (1.0 x $10^{-3}$ cm/s) at MW-7, 1.1 ft/d (3.8 x $10^{-4}$ cm/s) at MW-7A, 3.1 ft/d (1.1 x $10^{-3}$ cm/s) at MW-8, and 1.0 ft/d (3.5 x $10^{-4}$ cm/s) at MW-9.

### 3.3.5 Groundwater Flow Velocity

Because a slug test evaluates K in the immediate vicinity of the monitoring well's screened interval and several slug test data are available for the Site; a mean K value of 2 ft/d (7.06 x $10^{-4}$ cm/sec) was determined using the slug test data. This value was utilized for calculation of general Site groundwater flow velocity. Based on the available Site specific hydraulic values described above and published data, groundwater velocity was estimated for the Site using the following equation:

$$V_L = \frac{K}{n_e}\frac{dh}{dx}$$

Where:

$V_L$ = Horizontal linear groundwater velocity;

$K$ = Hydraulic conductivity;

$n_e$ = Effective porosity; and

$\frac{dh}{dx}$ = Horizontal hydraulic gradient

Utilizing a mean K of 2 ft/d ($7.06 \times 10^{-4}$ cm/sec), a hydraulic gradient of 0.03 ft/ft, and an effective porosity for silt of 30%, or 0.30 (Dawson and Istok, 1991), the shallow horizontal linear groundwater velocity is estimated to be approximately 0.3 ft/d ($1.05 \times 10^{-4}$ cm/sec) or approximately 110 ft/yr.

## 4.0 Constituents of Potential Concern

Constituents of potential concern (COPCs) at the Site include arsenic in soil; and sulfate, nickel, PCE, 1,2-DCA, and 1,4-dioxane in groundwater. The constituents are considered COPCs because they have been detected in samples above their screening levels. The following sections provide brief summaries of their occurrence, distribution, and whether the compound has been selected as a COC at the Site.

### 4.1 Arsenic

Arsenic was detected in two soil samples, both at a concentration of 10 mg/kg, collected as post excavation confirmatory samples from the former wastewater pond excavation during the 1987 closure. These detections are above the current IHSB Industrial Health-Based PSRG of 3 mg/kg for arsenic. Consistent with literature studies on background metals in Piedmont soils (Canova, 1999) and studies on soils in general (Lindsay, 1979; Shacklette and Boerngen, 1984), metals such as arsenic are considered to be naturally occurring constituents of the soil. Given that metal concentrations in soils impacted by an anthropogenic source would be significantly higher than natural (background) concentrations, a background soil screening criteria of two times the mean concentrations was used as the Site-specific background metals soil screening criteria. According to Canova (1999), the mean arsenic concentration in Piedmont soils is 11 mg/kg. This method is consistent with the EPA Region 4 Human Health Risk Assessment Supplemental Guidance (EPA, 2014), where the on-site maximum detected concentration can be compared to two times the background concentration; and the compound can be eliminated as a constituent of potential concern if it is less than two times the background concentration. Note that arsenic was not detected above the laboratory reporting limit during the EP Toxicity Test indicating that arsenic will not readily leach from site soil into groundwater (Table 1).

Because the highest detected arsenic concentration (10 mg/kg) is less than two times the background concentration (22 mg/kg) and the results of the Extraction Procedure Toxicity Test indicate that arsenic will not readily leach from site soil into groundwater, arsenic is not considered a Site COC. Table 5 summarizes the occurrence, distribution, and rationale for not selecting arsenic as a COC at the Site.

## 4.2 Nickel

Nickel has been identified as a COPC since the mid-1980s. It was detected in soil samples collected during the excavation of the former wastewater storage pond and former sludge beds and also in groundwater downgradient of the former sludge beds above the NC 2L Standard. Nickel was not detected in soil at a concentration above the IHSB Industrial Health-Based PSRG, and; therefore, does not pose a risk to industrial site workers. Although nickel has been detected at concentrations in soil above the IHSB POG PSRG and detected in soil extract at concentrations above the NC 2L Standard (Table 1), nickel is already considered a groundwater COC at the Site; and therefore, is not considered a COC in soil. Table 5 summarizes the occurrence, distribution, and rationale for not selecting nickel as a COC in soil at the Site. Table 6 summarizes the occurrence, distribution, and rationale for selecting nickel as a COC in groundwater at the Site.

Nickel is relatively immobile under neutral pH groundwater conditions. According to the EPA document *Partition Coefficients for Metals in Surface Water, Soil, and Waste* (Allison et al., 2005), nickel has been documented as having a partitioning coefficient ranging from 1.0 to 3.8.

Using a mean Kd value of 2.4, an estimated bulk density of 1.855 grams per cubic centimeter ($g/cm^3$) (based on an estimated porosity of 30%), and an effective porosity of 30%, a retardation factor (Rf) was calculated using the equation below to evaluate the rate in which nickel will migrate in groundwater. Rf is the rate in which a particular contaminant will travel with respect to groundwater.

$$Rf = 1 + (\rho_b/n_e)Kd$$

Where:

$\rho_b$ = soil bulk density (g/cubic centimeter);

$n_e$ = effective porosity; and

$Kd$ = portioning coefficient

Based on the equation above and noted input parameters, nickel has an estimated Rf of 15.84, indicating that nickel will travel 15.84 times slower than surrounding groundwater. As noted in Section 3.3, the shallow horizontal linear groundwater velocity is estimated to be approximately 0.3 ft/d or approximately 110 ft/yr. With an Rf of 15.84, nickel would be expected to migrate at a rate of 0.019 ft/d or 6.9 ft/yr.

Nickel groundwater concentration trend graphs are provided in Appendix A. As shown in Appendix A, the nickel plume has remained stable for many years, indicating that nickel is generally immobile in Site groundwater. AB Carter operated a groundwater recovery system from 1989 until 2009 to address nickel impacts. Nickel has remained stable since the groundwater recovery system was shut down in 2009 (Appendix A).

The most current sampling event, with nickel analyses, as required by the current RCRA permit, was performed in August 2013. Nickel concentrations from that event are summarized in Table 2 and ranged from <0.010 milligrams per liter (mg/L) to 0.98 mg/L. The NC 2L Standard for nickel in groundwater is 0.10 mg/L. Nickel has generally reached a steady state in the impacted monitoring wells MW-7, MW-7A, MW-8A, MW-9, MW-9A, MW-11A and PM-1, as shown on the trend graphs in Appendix A. A summary of the most recent nickel monitoring data collected in August 2013 is provided on Figure 9. As shown on Figure 9, the extent of nickel-affected groundwater above the NC 2L Standard is well defined and encompasses approximately 0.4 acres of the Site. The downgradient extent of nickel-affected groundwater above the NC 2L Standard is approximately 400 ft upgradient of the tributary, as shown on Figure 9.

### 4.3 Sulfate

Historically, sulfate concentrations in groundwater samples collected from monitoring wells MW-7, MW-8, and MW-11A (Figure 2) have exceeded the NC 2L Standard of 250 mg/l. A summary of the most recent sulfate monitoring data collected in August 2013 is provided in Table 2 and on Figure 10. Sulfate concentrations in groundwater samples collected in August 2013 ranged from <1.0 mg/L in MW-22 to 290 mg/L in MW-11A. Sulfate was only detected at a concentration above the NC 2L Standard in MW-11A. As shown on Figure 10, the

extent of sulfate-affected groundwater above the NC 2L Standard is well defined and encompasses less than 3 acres of the Site. The downgradient extent of sulfate-affected groundwater above the NC 2L Standard is approximately 500 ft from the tributary, as shown on Figure 10.

Sulfate concentration trend graphs are provided in Appendix A. As shown on the trend graphs, sulfate concentrations in monitoring wells MW-7A, MW-8A, MW-12, MW-16A, MW-16R, MW-18, BG-2, PM-1 and PM-2 have reached steady-state conditions. Monitoring well MW-9 has shown a slight increase in sulfate concentration while monitoring wells MW-7, MW-8, and MW-9A, MW-11A have shown a decreasing trend.

Because sulfate is has consistently been present in groundwater above the NC 2L Standard, sulfate is considered a COC at the Site. Table 6 summarizes the occurrence, distribution, and rationale for selecting sulfate as a COC in groundwater at the Site.

### 4.4 VOCs

VOCs including PCE, 1,2-DCA, and 1,4-dioxane are present in Site groundwater at concentrations exceeding NC 2L Standards. The presence of VOCs in groundwater has not conclusively been attributed to the identified SWMUs at the Site. The most recent VOC results from the August 2015 groundwater and October 2014 surface water monitoring events are summarized in Tables 2 and 3, respectively. The August 2015 groundwater and October 2014 surface water monitoring results are also summarized on Figure 11.

#### 4.4.1 PCE

PCE has not been identified as a chemical currently or historically used by AB Carter; however, it has been detected at low concentrations in groundwater at the Site. The concentrations of PCE in groundwater samples collected during the August 2015 monitoring event ranged from <0.50 to 1.6 micrograms per liter (µg/L). The downgradient extent of PCE-affected groundwater above the NC 2L Standard is delineated by monitoring wells MW-24 and MW-25 located within the tributary

floodplain. Figure 11 depicts the extent of VOC-affected groundwater above the NC 2L Standard as accepted by DENR on March 3, 2015, which encompasses 4.9 acres.

The highest concentration of PCE detected at the Site during the August 2015 monitoring event was detected in monitoring well MW-22 at a concentration of 1.6 µg/L. A PCE concentration trend graph is provided in Appendix A. As shown on the trend graph, PCE concentrations in monitoring wells MW-16A, MW-18, MW-22, MW-23, and MW-23A are generally decreasing with time.

Although PCE concentrations are decreasing, PCE remains present in groundwater above the NC 2L Standard and; therefore, PCE is considered a COC at the Site. Table 6 summarizes the occurrence, distribution, and rationale for selecting PCE as a COC in groundwater at the Site.

#### 4.4.2 1,2-DCA

The VOC 1,2-DCA has historically been detected in groundwater collected from one monitoring well, MW-23, at a concentration above the NC 2L Standard. 1,2-DCA was detected in the groundwater sample collected from MW-23 in August 2015 at a concentration of 0.53 µg/L, just above the NC 2L Standard of 0.4 µg/L (Table 3). No other groundwater samples collected during the August 2015 monitoring event contained 1,2-DCA above the laboratory reporting limit. 1,2-DCA has not been identified as a chemical currently or historically used by AB Carter. The extent of 1,2-DCA-affected groundwater above the NC 2L Standard is limited to a very small portion of the Site in the vicinity of monitoring well MW-23 (Figure 11).

Because 1,2-DCA remains present in groundwater above the NC 2L Standard, 1,2-DCA is considered a COC at the Site. Table 6 summarizes the occurrence, distribution, and rationale for selecting 1,2-DCA as a COC in groundwater at the Site.

#### 4.4.3 1,4-Dioxane

Results of the August 2015 groundwater sampling event indicated 1,4-dioxane at concentrations ranging from 8.5 to 23 µg/L, exceeding the NC 2L Standard of 3 µg/L (Table 3). Figure 11 depicts

the extent of VOC-affected groundwater above the NC 2L Standard as accepted by DENR on March 3, 2015, which encompasses 4.9 acres. The presence of 1,4-dioxane, which was used as a stabilizer for chlorinated VOCs, is likely associated with historical, *de-minimus* releases of 1,1,1-TCA and potentially PCE.

1,4-dioxane was not detected at a concentration above the laboratory reporting limit in downgradient monitoring wells MW-24 and MW-25, located within the tributary floodplain, during the August 2015 sampling event. Because 1,4-dioxane was previously detected in groundwater sampled from MW-24 and MW-25 at concentrations above the NC 2L Standard in August 2014, four surface water samples, SW-1 through SW-4, were collected from the tributary in October 2014 for analysis of 1,4-dioxane. The locations of SW-1 through SW-4 are depicted on Figure 11. Of the four samples, only SW-2 contained a concentration of 1,4-dioxane (3.6 µg/l) above the laboratory reporting limit. The surface water analytical results are summarized in Table 4. The detected concentration of 1,4-dioxane at the SW-2 location is below the NC 2B Human Health standard of 80 µg/l but above the NC 2B Water Supply standard of 0.35 µg/l. However, the tributary and Crowders Creek are classified by DENR as a Class C surface water body (recreational use only), and not classified for use as a water supply (Classes WS-I through WS-IV). Therefore, as previously agreed upon by DENR in an email dated July 22, 2015, the applicable screening level for the tributary is the NC 2B Human Health Standard of 80 µg/l. The two downgradient samples, SW-3 and SW-4, did not contain detectable concentrations of 1,4-dioxane indicating that 1,4-dioxane is rapidly degrading and not migrating off-Site.

A 1,4-dioxane concentrations vs. time graph is provided in Appendix A. As shown on the graph, 1,4-dioxane concentrations in monitoring wells MW-16A, MW-18, MW-22, MW-23, and MW-23A appear to be stable or slightly decreasing. Although the 1,4-dioxame plume may extend to the tributary, 1,4-dioxane is not expected to discharge to the tributary at a concentration above the Human Health standard of 80 µg/l.

Because 1,4-dioxane is present in groundwater above the NC 2L Standard, 1,4-dioxane is considered a COC at the Site. Table 6 summarizes the occurrence, distribution, and rationale for selecting 1,4-dioxane as a COC in groundwater at the Site.

## 5.0 Potential Receptors

Potential receptors include off-Site groundwater users, the unnamed tributary, and Site industrial and utility workers. No COCs have been identified in soil and; therefore, there are no potential receptors associated with soil. A conceptual site model identifying the source of contaminants, exposure mediums and routes, and potential receptors is provided as Table 7. An evaluation of each potential receptor is provided below.

### 5.1 Off-Site Groundwater Users

Groundwater is the primary source of drinking water for several communities in the area. As shown on Figure 12, 24 private water supply wells have been identified within an approximate 0.5-mile radius of the Site property boundary.

Maps previously produced by DENR during the investigations of the Rhone-Poulenc site (Site ID No. NCD 986 182582) and the Hemphill Road TCE site (Site ID No. NC0 002 374 445) which depict numerous water supply wells are included in Appendix B. These maps also depict which wells have been impacted by groundwater contamination associated with the Rhone-Poulenc and Hemphill Road TCE sites. Note that H&H has annotated the AB Carter Site location on the DENR maps for reference. As shown on the DENR maps, dozens of water supply wells in the vicinity have been sampled by DENR, and many have been impacted with VOCs associated with historical releases from the Rhone-Poulenc and Hemphill Road sites. It is important to note that the COCs from the AB Carter site have NOT been detected in the wells at either the Rhone-Poulenc or Hemphill Road sites.

An evaluation of Off-Site groundwater users as potential receptors has determined that Off-Site groundwater users are not considered at risk because the exposure pathway is not considered complete, as supported by the following.

- Twenty-four water supply wells are present within an approximate 0.5-mile radius of the Site property boundary as shown on Figure 12. As previously discussed, it is widely

accepted that groundwater flow within the Piedmont can be conceptualized as occurring in compartments that are longitudinally bound by the recharge and discharge areas of topographic ridges and streams, respectively; and bound on the sides by topographic "spurs" (ridges that branch from a main crest). The local flow systems commonly lie between adjacent topographic divides that range from a few thousand feet to a few miles (Daniel et al., 1997), as depicted in the figure below taken from Daniel et al. (1992).

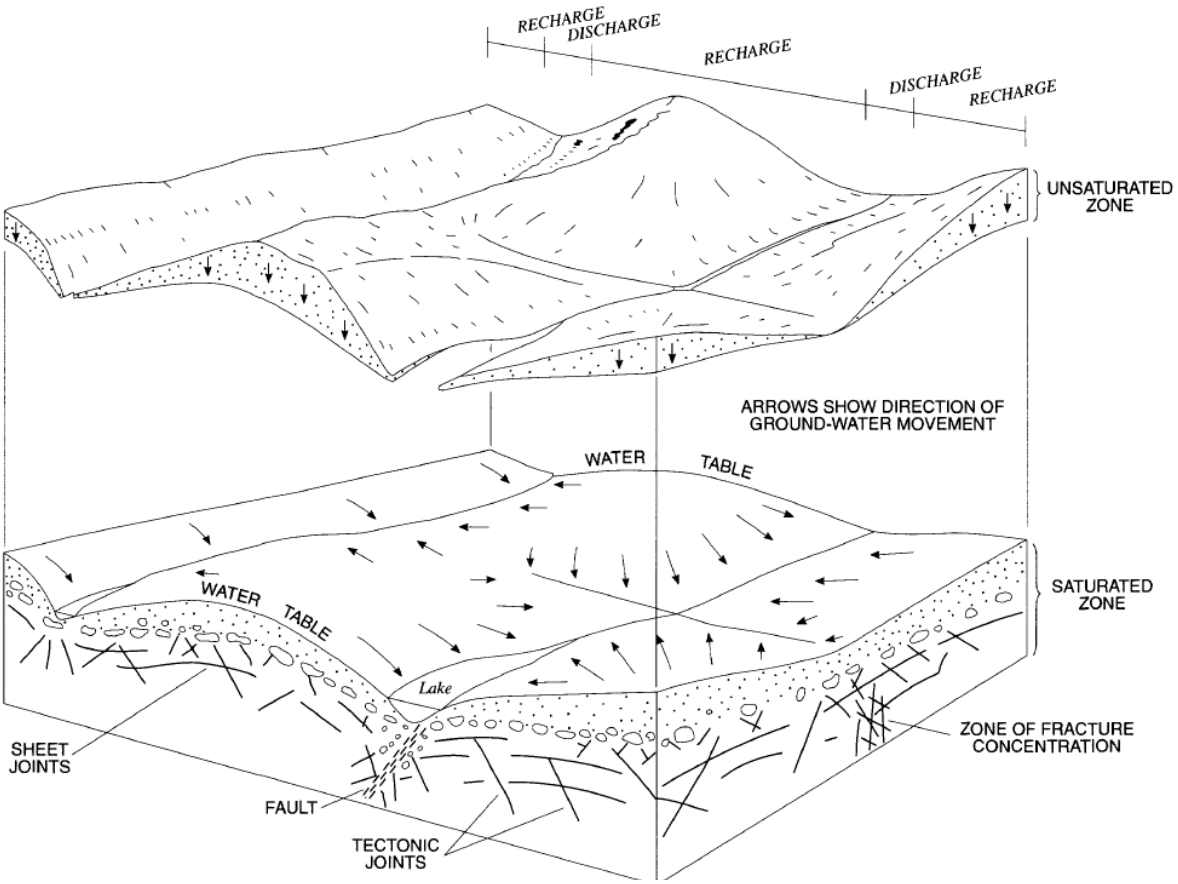



Figure 7 depicts the local Site groundwater flow system based on a topographic evaluation. Based on a topographic evaluation and the accepted Piedmont hydrogeologic model, all 24 water supply wells are located outside of the local site groundwater flow system. Groundwater at the Site is expected to flow from topographical highs near the Site building towards the unnamed tributary of Crowders Creek.

- In August 2014, 1,4-dioxane was detected in groundwater at the Site including monitoring wells MW-24 and MW-25, located within 10 ft of the unnamed tributary of Crowders Creek. According to the accepted Piedmont hydrogeologic model, groundwater containing 1,4-dioxane should be discharging to the tributary. Four surface water samples were collected from the tributary in October 2014 for analysis of 1,4-dioxane to determine if the 1,4-dioxane impacted groundwater is affecting the tributary. The surface water sample collected from the SW-2 location, located east of monitoring well MW-24, contained 1,4-dioxane at a concentration of 3.6 µg/L, below the applicable NC 2B Human Health Standard of 80 µg/L. The presence of 1,4-dioxane in the unnamed tributary of Crowders Creek indicates that the local Site groundwater flow system is consistent with the accepted Piedmont hydrogeologic model, where groundwater flows from topographic highs towards a groundwater discharge boundary and will not migrate past this boundary in the future.

- There are two offsite water supply wells, WSW-16 and WSW-17 as identified by H&H (identified by DENR as RP01 and RP02 or RP-001-GW and RP-002-GW, respectively on the Appendix B figures), east of the tributary (Figure 12). Based on the accepted Piedmont hydrogeologic model, these two water supply wells are expected to be within a separate local groundwater flow system with groundwater flowing from topographic highs, easterly, towards the tributary. Water supply wells WSW-16 and WSW-17, have been sampled as part of the Hemphill Road TCE site. As shown on the DENR Figure 3 in Appendix B, the extent of the TCE plume associated with the Hemphill Road TCE site, as defined by DENR, extends from the Hemphill Road site to water supply wells WSW-16 and WSW-17 and towards the unnamed tributary of Crowders Creek. This is consistent with the accepted Piedmont hydrogeologic model. The fact that the Hemphill Road TCE plume extends to WSW-16 and WSW-17 indicates that groundwater flows southwesterly on the east side of the tributary east of the Site; and indicates that water supply wells WSW-16 and WSW-17 are located in a local groundwater flow system separate from the AB Carter Site.

- As shown on the DENR Maps in Appendix B, several water supply wells have been impacted with TCE. Note that TCE is not a Site COC. Based on DENR's water supply

well investigations, Site COCs have not been detected in the offsite water supply wells. Further evidence that the accepted Piedmont hydrogeologic model of separate basins influences groundwater flow in this area and restricts contaminants on the AB Carter facility to the Site.

## 5.2 Unnamed Tributary

The unnamed tributary of Crowders Creek is a potential receptor as it is the groundwater discharge boundary (hydrogeologic flow boundary) for groundwater associated with the Site. Crowders Creek is classified by DENR as a Class C surface water body. Per DENR, a Class C surface water body is defined as noted below.

> *"Waters protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner."*

PCE, 1,2-DCA, and 1,4-dioxane are present in Site groundwater above NC 2L Standards. Analyses of the groundwater samples collected in August 2014 and August 2015 from monitoring wells MW-24 and MW-25, located just upgradient of the tributary (Figure 2), did not detect the presence of PCE or 1,2-DCA. This indicates that PCE and 1,2-DCA are degrading due to natural processes prior to reaching the monitoring wells, and subsequently the tributary. However, the analyses did indicate the presence of 1,4-dioxane above its NC 2L Standard in the August 2014 groundwater samples.

In October 2014, H&H collected four surface water samples from the tributary for analysis of 1,4-dioxane to determine if the 1,4-dioxane impacted groundwater is affecting the tributary. Figure 11 depicts the surface water sample locations and analytical results. Of the four samples, only the sample collected from the SW-2 location contained 1,4-dioxane at a concentration above the laboratory reporting limit. 1,4-dioxane was detected in the sample collected from the SW-2

location at a concentration of 3.6 µg/L, slightly above the NC 2B Water Supply Standard of 0.35 µg/L but significantly below the NC 2B Human Health Standard of 80 µg/L. Although the concentration of 1,4-dioxane detected at the SW-2 location exceeded the NC 2B Water Supply Standard, per DENR, the unnamed tributary to Crowders Creek is a Class C surface water body intended for recreational use; and is not classified as a water supply surface water body (Classes WS-I through WS-IV). Therefore, as previously agreed upon by DENR in an email dated July 22, 2015, the applicable screening level for the tributary is the NC 2B Human Health Standard of 80 µg/L.

The samples collected from SW-3 and SW-4 did not contain 1,4-dioxane above laboratory detection limits indicating that the presence of 1,4-dioxane is limited to a small portion of the tributary. Because the tributary is considered a hydrogeologic flow boundary, and 1,4-dioxane was not detected in the downgradient SW-3 and SW-4 sample locations, the data shows that 1,4-dioxane is not migrating off-Site or downstream.

Because 1,4-dioxane is present in the tributary, the exposure pathway is considered complete. However, the concentration of 1,4-dioxane detected in the tributary is below the applicable NC 2B Human Health Standard, and; therefore, the presence of 1,4-dioxane is not considered a risk to human health.

### 5.3 Site Personnel

Site personnel are potential receptors due to possible exposure of groundwater constituents through future groundwater use and potential vapor intrusion. As discussed Section 4.2, although arsenic has been detected in soil above the IHSB Industrial Health-Based PSRG, arsenic is not a COC because it is not present above background levels found in Piedmont soils; and therefore, arsenic in soil does not pose a risk to Site personnel. Risk to site workers from exposure to groundwater constituents through future groundwater use and potential vapor intrusion is discussed below.

### 5.3.1 Future Site Groundwater Use

Currently, there are no water supply wells utilized on-Site because municipal water is provided. Therefore, there is no current risk to Site personnel by exposure of groundwater constituents through on-Site water supply wells. There is; however, a potential future risk of exposure to groundwater constituents through the potential future use of water supply wells.

### 5.3.2 Vapor Intrusion Evaluation

H&H evaluated the potential for vapor intrusion in accordance with the current DENR Division of Waste Management (DWM) Vapor Intrusion Guidance. VOC concentrations in Site groundwater were compared to the DENR DWM Residential and Non-Residential Groundwater Screening Levels to evaluate the potential for vapor intrusion into a Site structure. The structure closest to impacted groundwater is the process wastewater treatment plant, which is located > 400 ft upgradient of impacted groundwater and is not a routinely occupied structure. The closest routinely occupied structure is the AB Carter plant building located > 750 ft upgradient of impacted groundwater.

Three VOCs, PCE, 1,2-DCA, and 1,4-dioxane are present in Site groundwater above NC 2L Standards. The DENR DWM does not have a vapor intrusion screening level for 1,4-dioxane. A comparison of Site groundwater concentrations to DENR DWM Vapor Intrusion Screening Levels is provided below.

| VOC | Highest Concentration Detected in Groundwater (Location/Date) | Residential Vapor Intrusion Screening Level | Non-Residential Vapor Intrusion Screening Level |
|---|---|---|---|
| PCE | 1.6 µg/L (MW-22/8-19-15) | 11.5 µg/L | 48.4 µg/L |
| 1,2-DCA | 0.53 µg/L (MW-23/8-20-15) | 22.4 µg/L | 97.8 µg/L |

As shown in the table above, the PCE and 1,2-DCA concentrations detected in groundwater are significantly below both the DENR DWM Residential and Non-Residential Groundwater Screening Levels for vapor intrusion. PCE trend graphs provided in Appendix A indicate that PCE concentrations in groundwater are decreasing at the Site. 1,2-DCA has only been detected in

monitoring well MW-23, and the detected concentrations are stable. Because the concentrations of PCE and 1,2-DCA are low with respect to the DENR DWM screening levels, and concentrations of PCE and 1,2-DCA in groundwater are stable or decreasing, and the lack of occupied structures in the vicinity of groundwater impacts, the vapor intrusion pathway is not considered complete and; therefore, vapor intrusion is not considered to be a risk to human health.

## 6.0 Ecological Risk Evaluation

An ecological risk evaluation was completed in preparation of this RAP to identify and evaluate potential ecological receptors at the Site. During the evaluation, one potential ecological receptor, the unnamed tributary to Crowders Creek, was identified at the Site. Crowders Creek is classified by DENR as a Class C surface water body. The unnamed tributary to Crowders Creek was identified as a potential ecological receptor due to the detected presence of 1,4-dioxane in 1 of 4 surface water samples (SW-1 through SW-4) collected from the tributary in October 2014. The locations of SW-1 through SW-4 are depicted on Figure 11. The surface water analytical results are summarized in Table 4.

Because 1,4-dioxane has been detected in the tributary, the risk pathway is considered complete. Of the four samples, only SW-2 contained a concentration of 1,4-dioxane (3.6 µg/L) above the laboratory reporting limit. 1,4-dioxane was not detected in the surface water sample SW-3, located approximately 120 ft downstream of SW-2, indicating that 1,4-dioxane is entering the tributary in a limited area and it's residence time in the tributary is very short. Analytical results from the August 2015 groundwater sampling event did not indicate 1,4-dioxane above the reporting limit in monitoring wells MW-24 and MW-25, located just upgradient of the tributary indicating the 1,4-dioxane plume may no longer extend to the tributary.

The detected concentration of 1,4-dioxane at the SW-2 location is below the NC 2B Human Health standard of 80 µg/L but above the NC 2B Water Supply standard of 0.35 µg/L. There is no established 1,4-dioxane NC 2B Standard for Freshwater Aquatic Life.

The tributary is not considered at risk and, therefore, no ecological risks have been identified at the Site because:

- There is no established 1,4-dioxane NC 2B Standard for Freshwater Aquatic Life and 1,4-dioxane does not exceed other applicable screening criteria.
- The concentration of 1,4-dioxane detected in the tributary is low and the 1,4-dioxane presence is the tributary is limited to a small area.

- Concentrations of 1,4-dioxane in groundwater are decreasing or stable indicating that 1,4-dioxane impacts to the tributary are not expected to increase.

## 7.0 Public Notice

H&H prepared and submitted a public notice on May 12, 2015 to all adjacent land owners, regulatory, and government entities in accordance with NCGS §130A-310.70. A copy of the Public Notice is included as Appendix C. As indicated in the public notice, a 60-day public comment period was offered between May 15, 2015 and July 13, 2015. No comments were received during the 60-day public comment period.

As indicated in the public notice, AB Carter hosted a public meeting at the Site on June 24, 2015. A list of attendees is provided below. No adjacent or nearby landowners were present for the public meeting. The attendees provided no comments or concerns regarding the proposed permit modification during the public meeting.

| Attendee | Affiliation |
|---|---|
| Al Abedi | AB Carter, Inc. |
| Rick Craig | AB Carter, Inc. |
| Rob McDaniel | NCDENR |
| Leo Moretz | Hart & Hickman, PC |
| Lee Pennington | AB Carter, Inc. |
| Mike Bynum | Two Rivers Utilities/City of Gastonia |
| Mary Siedlecki | NCDENR |

# 8.0 Proposed Risk-Based Remedial Remedy

## 8.1 Risk-Based Remediation Remedy Objectives

Potential receptors have been identified and potential risks to the identified receptors have been evaluated. Based on the evaluation, there is a potential future risk of exposure to impacted groundwater by Site personnel through the potential future use of on-Site water supply wells. Therefore, the risk-based remediation remedy objective for this Site is to identify a risk-based remedy to protect Site personnel from exposure to impacted groundwater through the potential use of future water supply wells.

## 8.2 Proposed Risk-Based Remediation Remedy

COCs in groundwater include nickel, sulfate, PCE, 1,2-DCA, and 1,4-dioxane. These compounds have been identified as COCs in Site groundwater only and are not a potential concern in Site soils or ambient air. Data analysis indicates that no COCs above applicable NC 2L or NC 2B Standards are migrating off-Site. The extent of groundwater impacts as agreed upon by AB Carter and DENR, and documented in a letter dated March 3, 2015 is depicted on Figure 13.

Because COCs are limited to the Site groundwater, land use restrictions (LURs) can be employed to mitigate potential exposure to impacted groundwater. Therefore, the proposed risk-based remediation remedy for eliminating the potential for groundwater exposure to Site personnel is to restrict Site groundwater use through implementation of LURs negotiated by DENR and AB Carter. Once the LURs and an updated plat are finalized, they will be filed with the property deed at the Gaston County Registrar of Deeds. As required by DENR, AB Carter will annually certify the restrictions remain in place.

## 9.0 Summary and Conclusions

In 2011, Session Law 2011-186 (House Bill 45) was signed which provides owners and operators of eligible industrial Sites with the opportunity to develop Site-specific risk-based remediation standards in lieu of the more stringent NC 2L Standards if the responsible party can demonstrate that the environmental conditions do not pose an unacceptable risk to human health and the environment.

In a letter dated December 4, 2014, AB Carter notified the DENR HWS of their intent to pursue NFA through Risk-Based Remediation of Industrial Sites pursuant to NCGS. § 130A-310.65 through 310.77. DENR indicated in a letter dated January 5, 2015, that the Site meets the eligibility criteria.

The purpose of this RAP is to identify COCs at the Site, identify potential receptors, evaluate risk to human health, and develop Site-specific risk-based remedial remedies to protect human health and the environment. These components of this RAP are summarized below.

### 9.1 Constituents of Concern

No COCs have been identified in soil and ambient air at the Site. COCs in the Site groundwater above NC 2L Standards include sulfate, nickel, PCE, 1,2-DCA, and 1,4-dioxane. Additionally, 1,4-dioxane has been detected in the unnamed tributary of Crowders Creek, but below the applicable NC 2B Human Health Standard.

### 9.2 Potential Receptors

Potential receptors include off-Site groundwater users, surface water, and on-Site groundwater users. The potential risk of exposure to the identified receptors was evaluated and is summarized below:

- Off-Site Groundwater Users – As discussed in Section 5.1, the exposure pathway to off-Site groundwater users is incomplete for the following reasons:

- All 24 offsite water supply wells are located outside of the local Site groundwater flow system.
- The presence of 1,4-dioxane in the unnamed tributary of Crowders Creek indicates that the local Site groundwater discharges to the unnamed tributary of Crowders Creek and that the tributary is the Site groundwater discharge boundary.
- The Hemphill Road site TCE plume extends to WSW-16 and WSW-17 indicating that groundwater flows southwesterly on the east side of the tributary and also indicates that water supply wells WSW-16 and WSW-17 are located in a local groundwater flow system separate from the AB Carter site.
- As shown on the DENR Maps in Appendix B, several water supply wells have been impacted with TCE and TCE is not a Site COC.

- Surface Water – An unnamed tributary to Crowders Creek, which is classified as a Class C stream for recreational use, serves as the downgradient border of the Site. This surface water feature also serves as a hydrogeologic boundary because groundwater discharges to it. In October 2014, 1,4-dioxane was detected in one out of four surface water samples collected from this tributary. However, the detected concentration was well below the 2B Human Health Surface Water Standard. Because 1,4-dioxane was detected in the surface water, the risk pathway is considered complete. However, because the detected concentration is well below the applicable 2B surface water standard there is no risk to potential surface water users.

- On-Site Groundwater Users – As agreed upon with DENR, there are 4.9 acres of impacted groundwater on-Site. Currently, there are no water supply wells utilized on-Site because municipal water is provided. Therefore, there is no current risk to Site personnel by exposure of groundwater constituents through on-Site water supply wells. There is however, a potential future risk of exposure to groundwater constituents through the potential future use of water supply wells.

## 9.3 Proposed Risk-Based Remedial Remedy

A potential future risk to Site personnel through the potential future use of water supply wells has been identified. The proposed risk-based remediation remedy for eliminating the potential for groundwater exposure to Site personnel is to employ LURs that restrict the locations of potential future water supply wells to locations on the Site where their use will not influence or capture impacted Site groundwater, as approved by DENR.

## 9.4 Conclusion

Based on the findings if this RAP, no current risks to human health and the environment have been identified. A potential future risk of exposure to impacted groundwater through the potential future use of on-Site water supply wells has been identified. The proposed risk-based remedial remedy for mitigating the potential future risk is to employ LURs to restrict the use of groundwater on the Site.

# Table 1
## Summary of Sludge Basin and Wastewater Storage Pond Closure Soil Samples
## AB Carter, Inc.
## Gastonia, North Carolina
## H&H Job No. ABC-019

| Sample ID | Preliminary Residential Health-Based Soil Remediation Goal (µg/kg) | Preliminary Industrial Health-Based Soil Remediation Goal (µg/kg) | Protection of Groundwater Preliminary Soil Remediation Goal (µg/kg) | NC 2L Standard (mg/L) | Upper Sludge Basin | | | | | | | | | Lower Sludge Basin | | | | | | | | | Wastewater Storage Pond | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Sample #1 SW Corner | Sample #2 NW Corner | Sample #3 NE Corner | Sample #4 SE Corner | Sample #5 Center | Sample A Sidewall | Sample B Sidewall | Sample C Sidewall | Sample D Sidewall | Sample #6 SW Corner | Sample #7 NW Corner | Sample #8 NE Corner | Sample #9 SE Corner | Sample #10 Center | Sample E Sidewall | Sample F Sidewall | Sample G Sidewall | Sample H Sidewall | Sample #11 NE Corner | Sample #12 SE Corner | Sample #13 SW Corner | Sample #14 NW Corner | Sample #15 Center |
| **Sample Date** | | | | | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** | **2/25/87** |
| Total Metals | µg/kg | | | | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| Arsenic | 0.67 | 3.0 | 5.8 | -- | <5 | <5 | <5 | <10 | <25 | <10 | <0.5 | <0.5 | <0.5 | <9 | <10 | <5 | 1.5 | <9 | <0.5 | 0.5 | 1.0 | 1.0 | 0.5 | <4 | 0.81 | **10** | **10** |
| Barium | 3,000 | 44,000 | 580 | -- | 114 | 69 | 60 | 79 | 44 | 40 | 66 | 28 | 19 | 79 | 64 | 45 | 40 | 48 | 86 | 54 | 39 | 49 | 93 | 66 | 36 | 77 | 50 |
| Cadmium | 14 | 200 | R | -- | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.4 | <2.4 | <2.3 | <2.3 | <2.5 | <2.5 | <2.5 | <2.2 | <2.3 | <2.5 | <2.5 | <2.5 | <2.4 | <2.1 | <2.0 | <2.4 | <2.5 |
| Chromium (VI) | 24,000 | 100,000 | 360,000 | -- | 163 | 72 | 323 | 88 | 50 | 413 | 1,274 | 1,346 | 579 | 583 | 394 | 25 | 204 | 397 | 581 | 48 | 45 | 118 | 31 | 27 | 40 | 63 | 31 |
| Lead | 400 | 800 | 270 | -- | 30 | 20 | 45 | 20 | 25 | 30 | 193 | 43 | 32 | 69 | 69 | 15 | 25 | 39 | 68 | 15 | 10 | 20 | 15 | 83 | 16 | 10 | 10 |
| Mercury | 1.9 | 8.0 | 1.0 | -- | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | 0.15 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Selenium | 78 | 1,200 | 2.1 | -- | <5 | <5 | <5 | <5 | <12 | <2.5 | <2.4 | <2.4 | <2.3 | <5 | <5 | <2.5 | <5 | <5 | <2.3 | <2.5 | <2.5 | <5 | <5 | <2.1 | <2.0 | <2.4 | <0.25 |
| Silver | 78 | 1,200 | 3.4 | -- | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | <2.4 | <2.4 | <2.3 | <2.3 | <2.5 | <2.5 | <2.5 | <2.2 | <2.3 | <2.5 | <2.5 | <2.5 | <2.4 | <2.1 | <2.0 | <2.4 | <2.5 |
| Nickel | 300 | 4,400 | 130 | -- | 906 | 635 | 1,100 | 252 | 750 | 741 | 3,113 | 2,132 | 1,037 | 1,510 | 1,350 | 71 | 288 | 703 | 1,752 | 64 | 68 | 192 | 20 | 16 | 46 | 57 | 37 |
| Extraction Procedure Toxicity Test | | | | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| Arsenic | -- | -- | -- | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Barium | -- | -- | -- | 0.70 | 0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.6 | <0.1 | <0.1 | 0.6 | 0.1 | <0.1 | <0.1 | 0.2 | **1.1** | <0.1 | <0.1 | 0.2 | <0.1 | **0.1** | <0.1 | <0.1 | <0.1 |
| Cadmium | -- | -- | -- | 0.002 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | **0.0068** | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Chromium | -- | -- | -- | 0.010 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | **0.07** | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Lead | -- | -- | -- | 0.015 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Mercury | -- | -- | -- | 0.001 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Selenium | -- | -- | -- | 0.020 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Silver | -- | -- | -- | 0.020 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Nickel | -- | -- | -- | 0.100 | **2.8** | **0.35** | **1.99** | **0.41** | **0.45** | **1.73** | **9.5** | **1.04** | **0.31** | **3.5** | **2.9** | 0.10 | 0.09 | **2.8** | **7.70** | 0.07 | **0.12** | **0.94** | **0.13** | **0.98** | **0.12** | 0.10 | **0.12** |

Notes:
Bolded text indicates exceedance of Industrial Health-Based PSRG (March 2015) or NC 2L Standard (April 2013)
Shaded text indicated exceedance of Protection of Groundwater PSRG (March 2015)





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**Table 2**
**Summary of Groundwater Nickel and Sulfate Analytical Results**
**AB Carter, Inc.**
**Gastonia, North Carolina**
**H&H Job No. ABC-019**

| Well ID | MW-8 | MW-9 | MW-11A | MW-12 | MW-16A | MW-18 | MW-22 | MW-23 | MW-23A | MW-24 | MW-25 | PM-1 | PM-2 | NCAC 2L GW Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Collected | 8/08/13 | 8/07/13 | 8/08/13 | 8/08/13 | 8/07/13 | 8/07/13 | 8/07/13 | 8/09/13 | 8/09/13 | 8/09/13 | 8/09/13 | 8/08/13 | 8/07/13 | |
| Nickel (EPA Method 6010B) | **0.36** | **0.15** | <0.010 | 0.027 | <0.010 | NM | <0.010 | <0.010 | <0.010 | NM | NM | **0.98** | <0.010 | 0.100 |
| Sulfate (Method 9056A) | 220 | 150 | **290** | <1.0 | 31 | NM | <1.0 | 81 | 29 | 31 | 50 | 50 | 54 | 250 |

**Notes:**
Nickel and Sulfate are reported in milligrams per liter (mg/L)
NM = Not Measured
**Bold** indicates exceeds NCAC 2L Groundwater Standard

**Table 3**
**Summary of Groundwater VOC Analytical Results**
**AB Carter, Inc.**
**Gastonia, North Carolina**
**H&H Job No. ABC-019**

| Well ID | MW-8 | | | | MW-9 | | | | MW-16A | | | | MW-18 | | | | MW-22 | | | | NC 2L GW Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Collected | 8/20/15 | 8/19/14 | 8/08/13 | 8/21/12 | 8/18/15 | 8/21/14 | 8/07/13 | 8/21/12 | 8/20/15 | 8/19/14 | 8/07/13 | 8/20/12 | 8/18/15 | 8/19/14 | 8/07/13 | 8/21/12 | 8/19/15 | 8/19/14 | 8/07/13 | 8/20/12 | |
| ***VOCs (EPA Method 8260B)*** | | | | | | | | | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | 1.6 | 2.6 | 2.7 | 2.8 | <0.50 | <0.50 | <0.50 | <0.50 | 5.6 | 8.3 | 10 | 10 | 1.6 | 3.0 | 3.2 | 4.4 | 3.9 | 3.4 | 3.9 | 4.3 | **200** |
| 1,1-Dichloroethane | 1.2 | 1.9 | 1.2 | 1.8 | <0.50 | <0.50 | <0.50 | <0.50 | 4.1 | 4.8 | 5.1 | 4.7 | 4.2 | 5.4 | 4.1 | 4.2 | 3.6 | 2.4 | 2.1 | 1.8 | **6** |
| 1,1-Dichloroethene | 12 | 18 | 20 | 13 | <0.50 | <0.50 | <0.50 | <0.50 | 36 | 54 | 60 | 39 | 12 | 22 | 21 | 26 | 19 | 19 | 20 | 16 | **350** |
| 1,2-Dichloroethane | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | **0.4** |
| Chloroform | 4.0 | 3.0 | 3.9 | 2.6 | <0.50 | <0.50 | <0.50 | <0.50 | 0.83 | 0.82 | 0.87 | 0.66 | 3.2 | 3.2 | 3.2 | 3.7 | 0.54 | <0.50 | 0.51 | <0.50 | **70** |
| Chlorobenzene | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 0.5 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | **50** |
| cis-1,2-Dichloroethene | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 0.53 | 0.79 | 1.2 | 1.5 | <0.50 | <0.50 | <0.50 | <0.50 | 0.80 | 8.6 | 1.3 | 1.2 | **70** |
| Methyl-tert-butyl-ether (MTBE) | 0.60 | 0.95 | 1.3 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 0.55 | 0.65 | 0.52 | <0.50 | 1.9 | 2.4 | 2.4 | 2.6 | <0.50 | <0.50 | <0.50 | <0.50 | **20** |
| Tetrachloroethene | <0.50 | 0.59 | <0.50 | **1.0** | <0.50 | <0.50 | <0.50 | <0.50 | **0.86** | **1.6** | **3.2** | **3.8** | <0.50 | 0.57 | **0.84** | **1.2** | **1.6** | **1.8** | **3.6** | **3.4** | **0.7** |
| Toluene | <0.50 | 1.1 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 1.7 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | **600** |
| Trichloroethene | <0.50 | 0.59 | 0.53 | 0.60 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | 0.61 | 0.75 | 0.86 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | **3** |
| ***VOCs (EPA Method 8260 SIM)*** | | | | | | | | | | | | | | | | | | | | | |
| 1,4-Dioxane | **9.5** | **18** | NS | **17** | <3.0 | <3.0 | NS | <3.0 | **23** | **39** | NS | **23** | **9.6** | **13** | NS | **12** | **7.7** | **8.5** | NS | **4.2** | **3** |

| Well ID | MW-23 | | | | MW-23A | | | | MW-24 | | | | MW-25 | | | | PM-1 | | | | NCAC 2L GW Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Collected | 8/20/15 | 8/21/14 | 8/09/13 | 8/20/12 | 8/20/15 | 8/21/14 | 8/09/13 | 8/20/12 | 8/18/15 | 8/20/14 | 8/09/13 | 8/21/12 | 8/18/15 | 8/20/14 | 8/09/13 | 8/21/12 | 8/19/15 | 8/20/14 | 8/08/13 | 8/21/12 | |
| ***VOCs (EPA Method 8260B)*** | | | | | | | | | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | 4.4 | 4.6 | 5.6 | 6.8 | 4.5 | 5.0 | 7.0 | 8.2 | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | NS | <0.50 | 0.97 | 1.6 | 1.1 | **200** |
| 1,1-Dichloroethane | 2.3 | 2.0 | 1.8 | 1.6 | **7.3** | 4.7 | 5.8 | 5.0 | 1.1 | 1.1 | <0.50 | NS | <0.50 | <0.50 | 0.56 | NS | <0.50 | 0.56 | 0.65 | <0.50 | **6** |
| 1,1-Dichloroethene | 30 | 34 | 38 | 30 | 29 | 32 | 48 | 37 | 8.0 | 7.4 | <0.50 | NS | <0.50 | <0.50 | 4.1 | NS | 3.5 | 4.3 | 6.0 | 5.0 | **350** |
| 1,2-Dichloroethane | **0.53** | **0.51** | <0.50 | **0.53** | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | <0.50 | **0.4** |
| Chloroform | 8.8 | 6.6 | 8.9 | 10.0 | 2.9 | 2.2 | 2.8 | 3.0 | <0.50 | <0.50 | 18.0 | NS | 17 | 16 | <0.50 | NS | <0.50 | <0.50 | <0.50 | <0.50 | **70** |
| Chlorobenzene | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | NS | <0.50 | 0.82 | <0.50 | <0.50 | **50** |
| cis-1,2-Dichloroethene | <0.50 | <0.50 | <0.50 | 0.57 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | <0.50 | **70** |
| Methyl-tert-butyl-ether (MTBE) | 3.8 | 3.7 | 3.6 | 3.2 | 3.7 | 4.0 | 4.4 | 3.7 | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | <0.50 | **20** |
| Tetrachloroethene | **1.1** | **1.1** | **1.8** | **1.8** | **0.92** | **0.82** | **1.6** | **1.4** | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | <0.50 | **0.7** |
| Toluene | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | NS | <0.50 | 0.7 | <0.50 | <0.50 | **600** |
| Trichloroethene | 0.54 | 0.6 | 0.76 | 0.84 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | NS | <0.50 | <0.50 | <0.50 | <0.50 | **3** |
| ***VOCs (EPA Method 8260 SIM)*** | | | | | | | | | | | | | | | | | | | | | |
| 1,4-Dioxane | **18** | **36** | NS | **17** | **17** | **32** | NS | **22** | <3.0 | **6.3** | NS | NS | <3.0 | **3.6** | NS | NS | <3.0 | **8.5** | NS | <3.0 | **3** |

**Notes:**
VOCs are reported in micrograms per liter (µg/L)
VOCs = Volatile Organic Compounds
ND = Non Detect
NS = Not Sampled
**Bold** indicates exceeds NC 2L Groundwater Standard





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**Table 4**
**Summary of Surface Water Analytical Results**
**AB Carter, Inc.**
**Gastonia, North Carolina**
**H&H Job No. ABC-019**

| Well ID | SW-1 | SW-2 | SW-D* | SW-3 | SW-4 | NC 2B Surface Water Standard Human Health |
|---|---|---|---|---|---|---|
| **Date Collected** | **10/27/14** | **10/27/14** | **10/27/14** | **10/27/14** | **10/27/14** | |
| 1,4-Dioxane | <3.0 | 3.6 | <3.0 | <3.0 | <3.0 | **80** |

**Notes:**
1,4-Dioxane analyzed using EPA Method 8260 SIM
* SW-D is a duplicate sample collected contemporaneously with SW-2
1,4-Dioxane reported in micrograms per liter (µg/L)

**Table 5**
**Occurrence, Distribution, and Selection of Constituents of Concern - Subsurface Soil**
**AB Carter, Inc.**
**Gastonia, North Carolina**

**H&H Job No. ABC-019**

| |
|---|
| Scenario Timeframe: Current/Future |
| Medium: Soil |
| Exposure Medium: Subsurface Soil |

| Exposure Point | CAS Number | Chemical | Minimum Concentration | Maximum Concentration | Units | Location of Maximum Concentration | Detection Frequency | Range of Detection Limits[1] | Detected Concentration Used for Screening | Background Value[2] | Screening Toxicity Value[3] | Chemical of Potential Concern (Y/N) | Rationale for Selection or Deletion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Former Wastewater Storage Pond and Sludge Beds | 7440-38-2 | Arsenic | <0.5 | 10 | mg/kg | Wastewater Storage Pond | 2/23 | Not Available | 10 | 11 | 3.0 | N | Detected Concentration < 2 x Background |
| Former Wastewater Storage Pond and Sludge Beds | 7440-02-0 | Nickel | 16 | 3,113 | mg/kg | Upper Sludge Basin Sidewall | 23/23 | Not Available | 3,113 | 9 | 4,400 | N | Detected Concentration < Screening Toxicity Value |

Notes:

1- Analytical laboratory report unavailable, only DHS 3191 Forms from the 1987 wastewater storage pond closure are available which do not report detection limits.

2 - Background value for Piedmont soils as reported by Canova, J., 1999. Elements in South Carolina Inferred Background Soil and Stream Sediment Samples.

3 - Inactive hazardous Sites Branch Industrial Health-Based Preliminary Soil Remediation Goal

**Table 6**
**Occurrence, Distribution, and Selection of Constituents of Concern - Groundwater**
**AB Carter, Inc.**
**Gastonia, North Carolina**

**H&H Job No. ABC-019**

| |
|---|
| Scenario Timeframe: Current/Future |
| Medium: Water |
| Exposure Medium: Groundwater |

| Exposure Point | CAS Number | Chemical | Minimum Concentration | Maximum Concentration | Units | Location of Maximum Concentration | Detection Frequency | Concentration Used for Screening | Background Value | Screening Toxicity Value[1] | Chemical of Potential Concern (Y/N) | Rationale for Selection or Deletion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Groundwater | 7440-02-0 | Nickel[2] | <0.010 | 0.98 | mg/L | PM-1 | 4/10 | 0.98 | Not Available | 0.10 | Y | Detected Concentration > Screening Toxicity Value |
| | 14808-79-8 | Sulfate[2] | <1.0 | 290 | mg/L | MW-11A | 10/12 | 290 | Not Available | 250 | Y | Detected Concentration > Screening Toxicity Value |
| | 127-18-4 | Tetrachloroethene[3] | <0.50 | 1.6 | µg/L | MW-22 | 4/10 | 1.6 | Not Available | 0.7 | Y | Detected Concentration > Screening Toxicity Value |
| | 123-91-1 | 1,2-Dichloroethene | <0.50 | 0.53 | µg/L | MW-23 | 1/10 | 0.53 | Not Available | 0.4 | Y | Detected Concentration > Screening Toxicity Value |
| | 123-91-1 | 1,4-Dioxane[3] | <3.0 | 23 | µg/L | MW-16A | 6/10 | 23 | Not Available | 3.0 | Y | Detected Concentration > Screening Toxicity Value |

Notes:
1 - NC 2L North Carolina Groundwater Quality Standard
3- Data from most recent August 2013 monitoring event used
2- Data from August 2015 monitoring event used

**Table 7**
**Conceptual Model for Exposure Pathways**
**AB Carter, Inc.**
**Gastonia, North Carolina**

**H&H Job No. ABC-019**

| Primary Source | | Secondary Source | Exposure Medium | Exposure Route | Potential Receptor | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | On-Site | | | Off-Site | |
| | | | | | C/F Commercial Industrial Worker | C/F Commercial Utility Worker | Unnamed Tributary of Crowders Creek | C/F Commercial Utility Worker | C/F Resident |
| Former Sludge Basins and Wastewater Pond | Release | Subsurface Soil | Excavation of Soil | Dermal Contact | NA | NA | NA | NA | NA |
| | | | | Incidental Ingestion | NA | NA | NA | NA | NA |
| | | | | Inhalation | NA | NA | NA | NA | NA |
| | | | | | | | | | |
| | | Groundwater | Water Supply Use | Dermal Contact | * | * | NA | NA | NA |
| | | | | Incidental Ingestion | * | * | NA | NA | NA |
| | | | | Inhalation | * | * | NA | NA | NA |

Notes:

C/F = Current/Future

* - Pathway is or might be complete

NA - Pathway is incomplete, or is complete but not at risk





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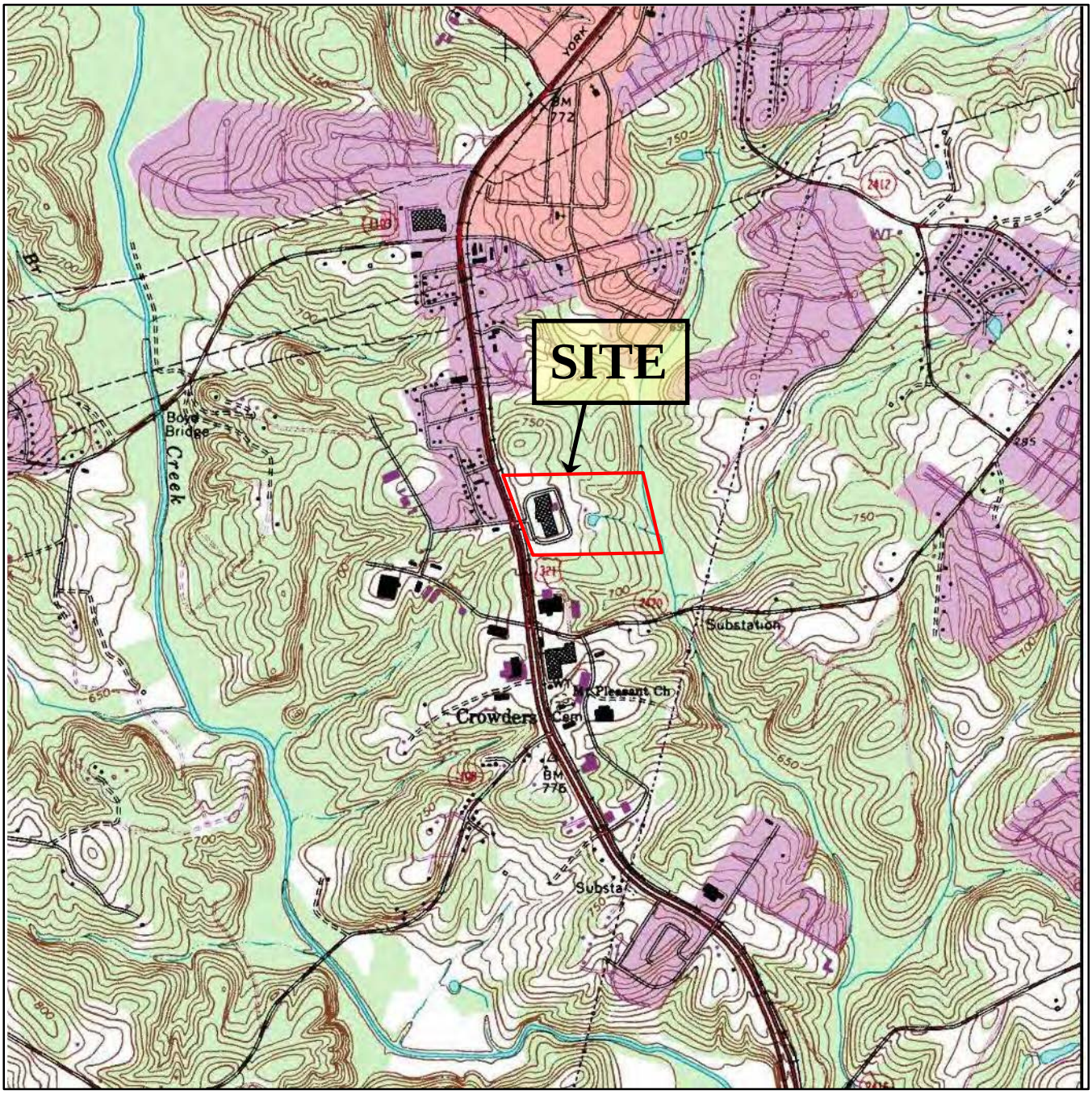



N

APPROXIMATE

0 2000 4000

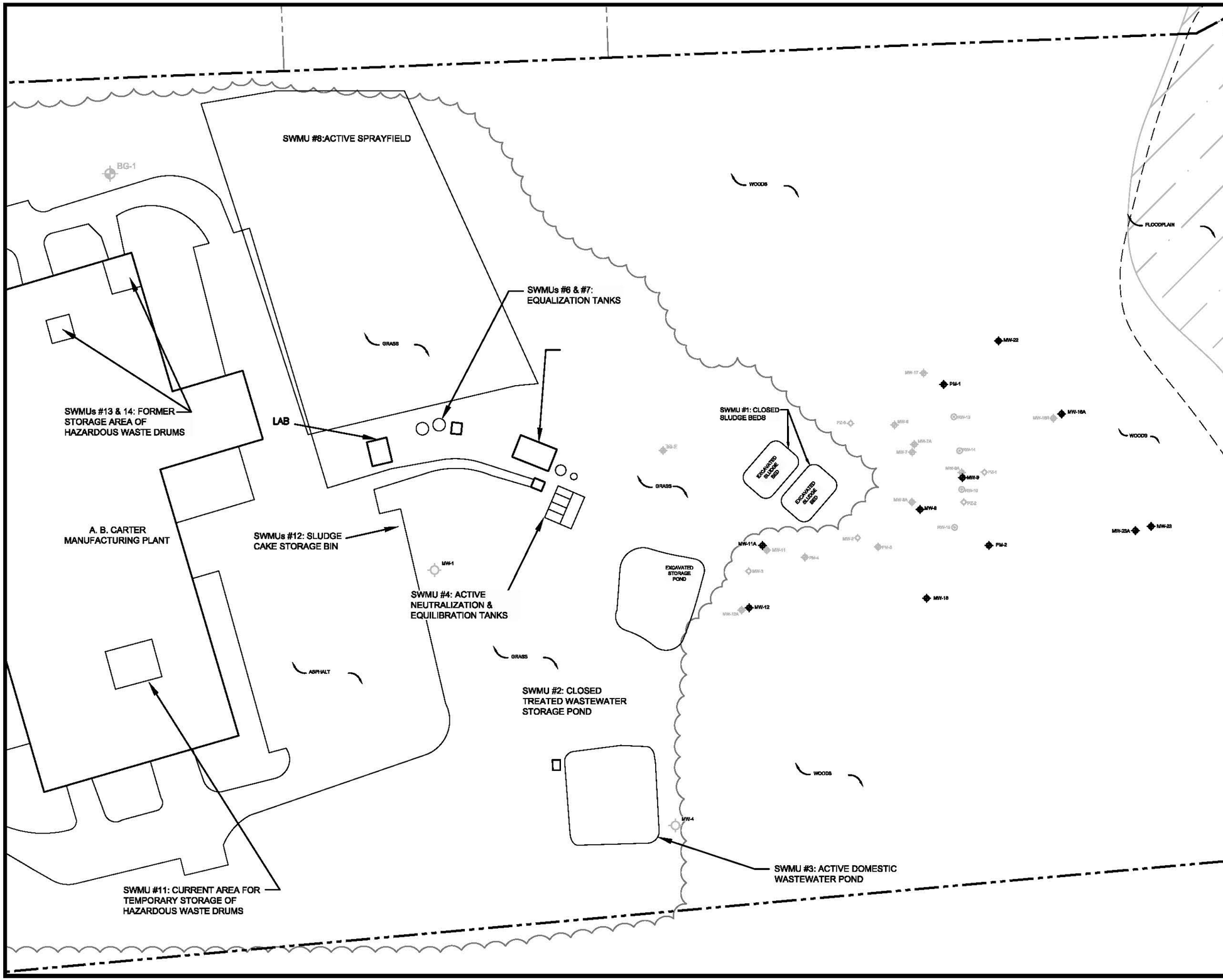
SCALE IN FEET

U.S.G.S. QUADRANGLE MAP

**GASTONIA SOUTH, 1993**

QUADRANGLE
7.5 MINUTE SERIES (TOPOGRAPHIC)

| | |
|---|---|
| TITLE | SITE LOCATION MAP |
| PROJECT | AB CARTER<br>GASTONIA, NORTH CAROLINA |
| hart hickman<br>SMARTER ENVIRONMENTAL SOLUTIONS | 2923 South Tryon Street-Suite 100<br>Charlotte, North Carolina 28203<br>704-586-0007 (p) 704-586-0373 (f) |
| DATE: 4-14-15 | REVISION NO: 0 |
| JOB NO: ABC-019 | FIGURE: 1 |




LEGEND

- PROPERTY BOUNDARY
- SERVICE ROAD
- STREAM
- MONITORING NETWORK WELL
- NON-MONITORING NETWORK WELL
- INACTIVE RECOVERY WELL
- PIEZOMETER

N

APPROXIMATE

0 100 200

SCALE IN FEET

TITLE

SITE MAP

PROJECT

AB CARTER
4801 YORK HIGHWAY (US321)
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS

3334 Hillsborough Street
Raleigh, North Carolina 27607
919-847-4241(p) 919-847-4261(f)
License # C-1269 / #C-245 Geology

| | |
|---|---|
| DATE: 07–22–15 | REVISION NO. 0 |
| JOB NO. ABC–018 | FIGURE NO. 2 |

SITE BOUNDARY

NOTES:

1.BLUE SHADING INDICATES I-2 GENERAL INDUSTRIAL
2.BLUE HATCHED SHADING INDICATED I-3 EXCLUSIVE INDUSTRIAL
3.RED SHADING INDICATES C-3 GENERAL COMMERCIAL
4.GREEN SHADING INDICATES RMF RESIDENTIAL MULTI FAMILY
5.NO SHADING INDICATES R-1 SINGLE FAMILY LIMITED

N

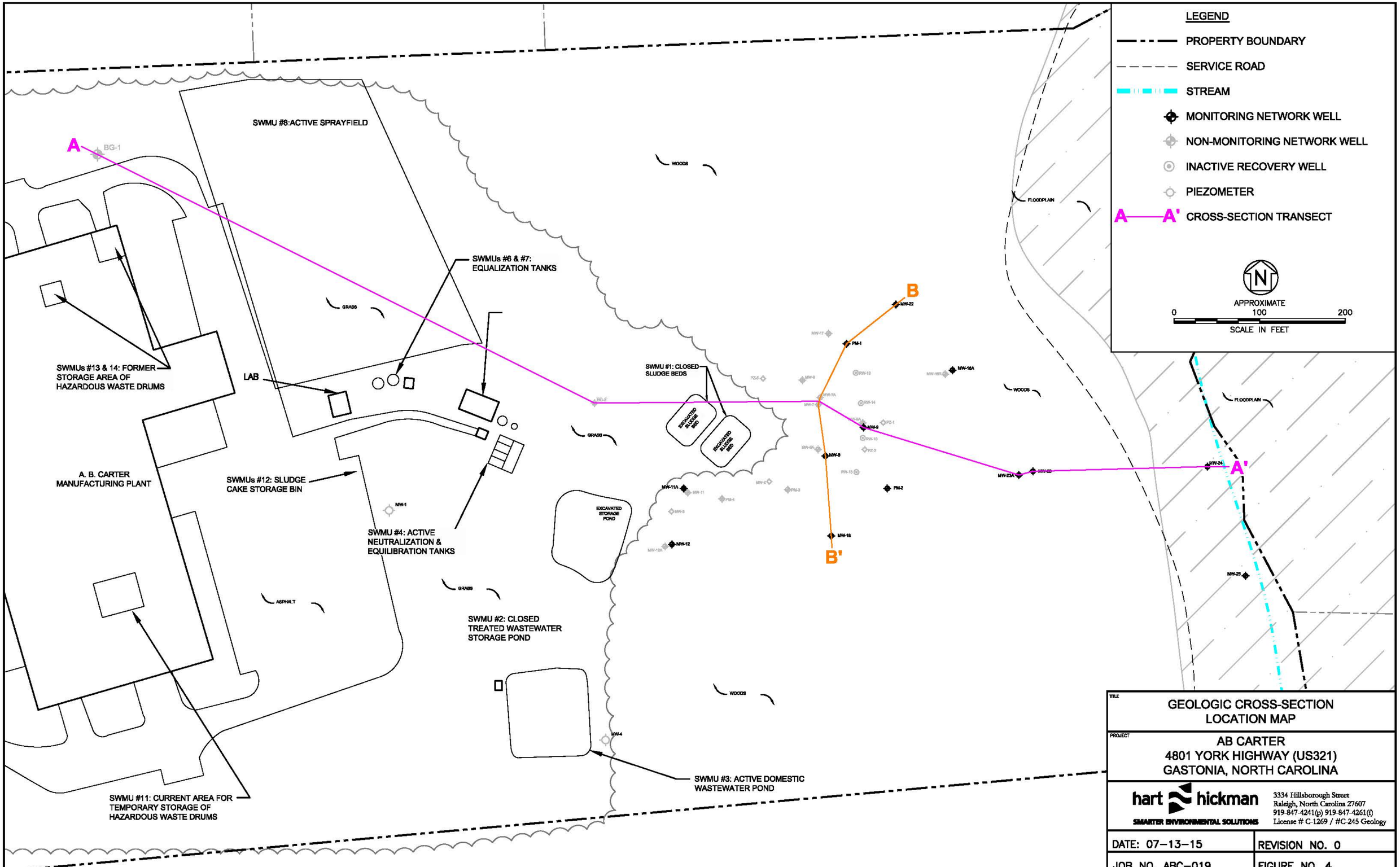
APPROXIMATE
0 1000 2000
SCALE IN FEET

IMAGERY SOURCE: GASTON COUNTY GIS, 2014

| | |
|---|---|
| TITLE | SURROUNDING LAND USE MAP |
| PROJECT | AB CARTER<br>GASTONIA, NORTH CAROLINA |

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007 (p) 704-586-0373 (f)

| | | | |
|---|---|---|---|
| DATE: | 7/15/15 | REVISION NO: | 0 |
| JOB NO: | ABC-019 | FIGURE: | 3 |



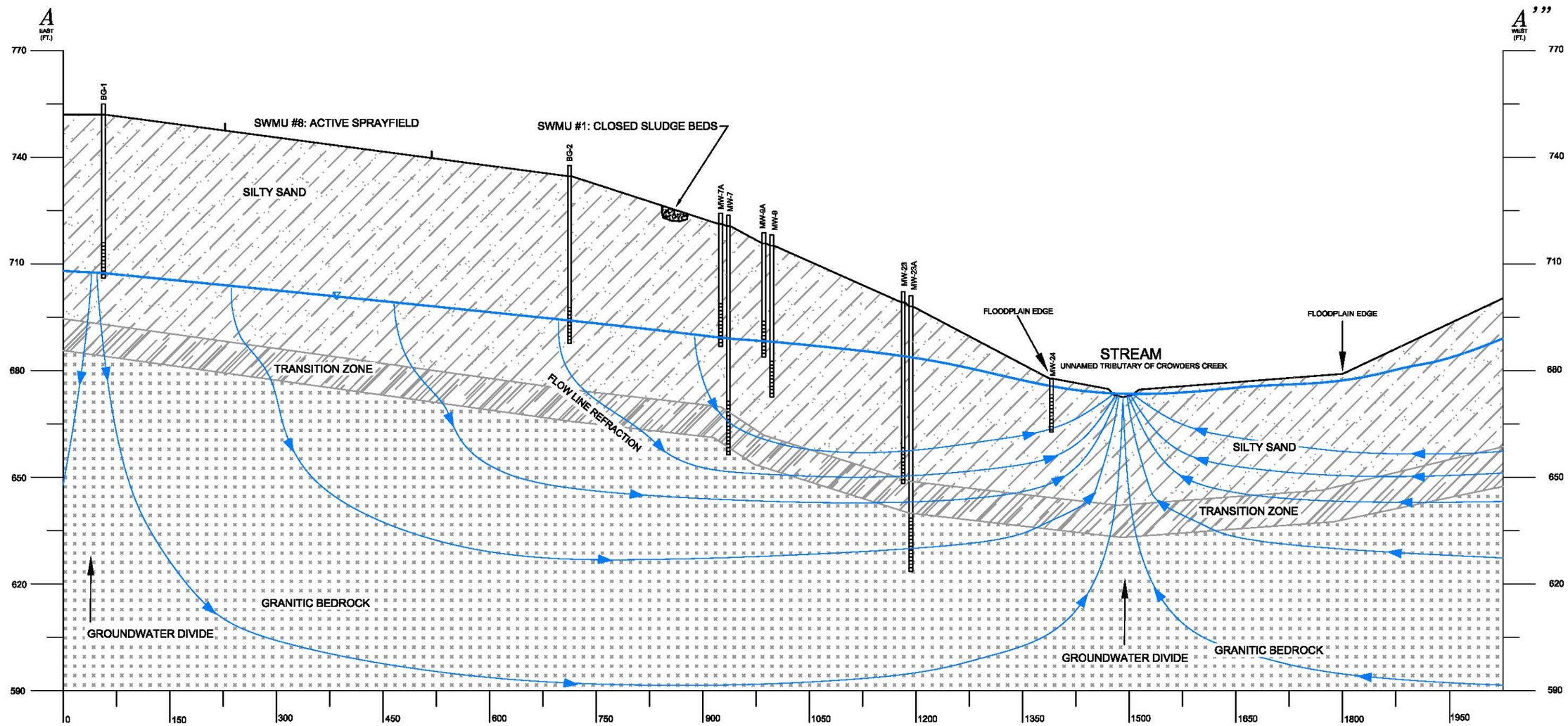

TITLE
GEOLOGIC CROSS-SECTION LOCATION MAP

PROJECT
AB CARTER
4801 YORK HIGHWAY (US321)
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS

3334 Hillsborough Street
Raleigh, North Carolina 27607
919-847-4241(p) 919-847-4261(f)
License # C-1269 / #C-245 Geology

| | |
|---|---|
| DATE: 07–13–15 | REVISION NO. 0 |
| JOB NO. ABC–019 | FIGURE NO. 4 |




**LEGEND**

MONITORING WELL LOCATION

WATER TABLE

SILTY SAND

TRANSITION ZONE

BEDROCK

30

APPROXIMATE

0 150

SCALE IN FEET

NOTES:
WELL LOCATIONS AND ELEVATIONS BASED UPON TABLES AND FIGURES FROM HISTORIC REPORTS.

FLOWLINES ARE CONCEPTUAL AND REFRACT AT INTERFACES OF DIFFERING PERMEABILITY IN ACCORDANCE WITH SNELL'S LAW. FLOWLINE ARROWS WITHIN THE MORE PERMEABLE TRANSITION ZONE ARE DRAWN LONGER TO EMPHASIZE THE CONCEPTUALIZATION THAT GROUNDWATER FLOW TAKES THE PATH OF LEAST RESISTANCE.

TITLE

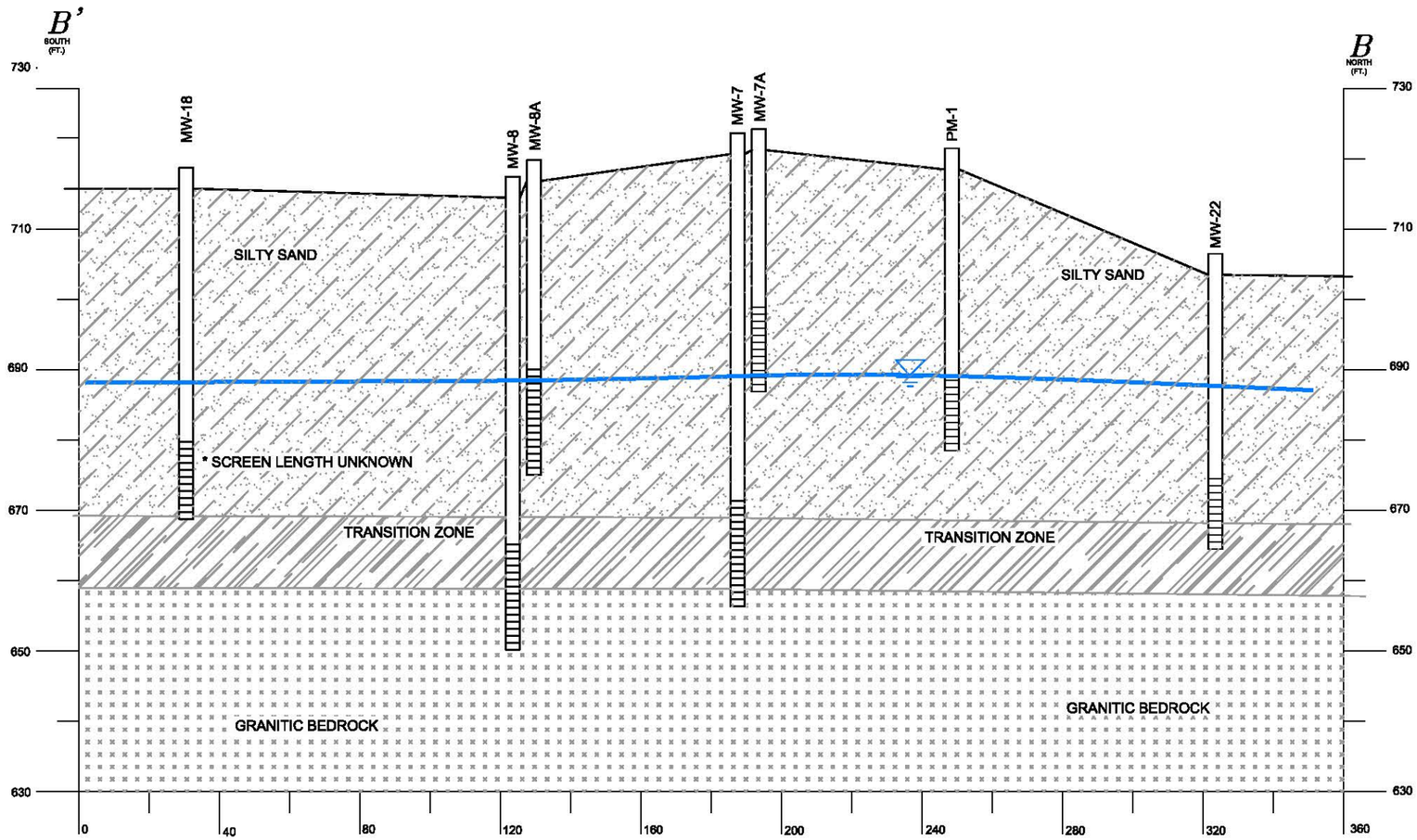
**GEOLOGIC CROSS-SECTION A-A'**

PROJECT

**A B CARTER**
4801 YORK HIGHWAY (US 321)
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)
License # C-1269 / #C-245 Geology

| | |
|---|---|
| DATE: 07–13–15 | REVISION NO. 0 |
| JOB NO. ABC–019 | FIGURE NO. 5 |




**LEGEND**

MONITORING WELL LOCATION

WATER TABLE

SILTY SAND

TRANSITION ZONE

BEDROCK

**NOTE:**

WELL LOCATIONS & REPORTS BASED UPON TABLES & FIGURES FROM HISTORICAL REPORTS.




TITLE

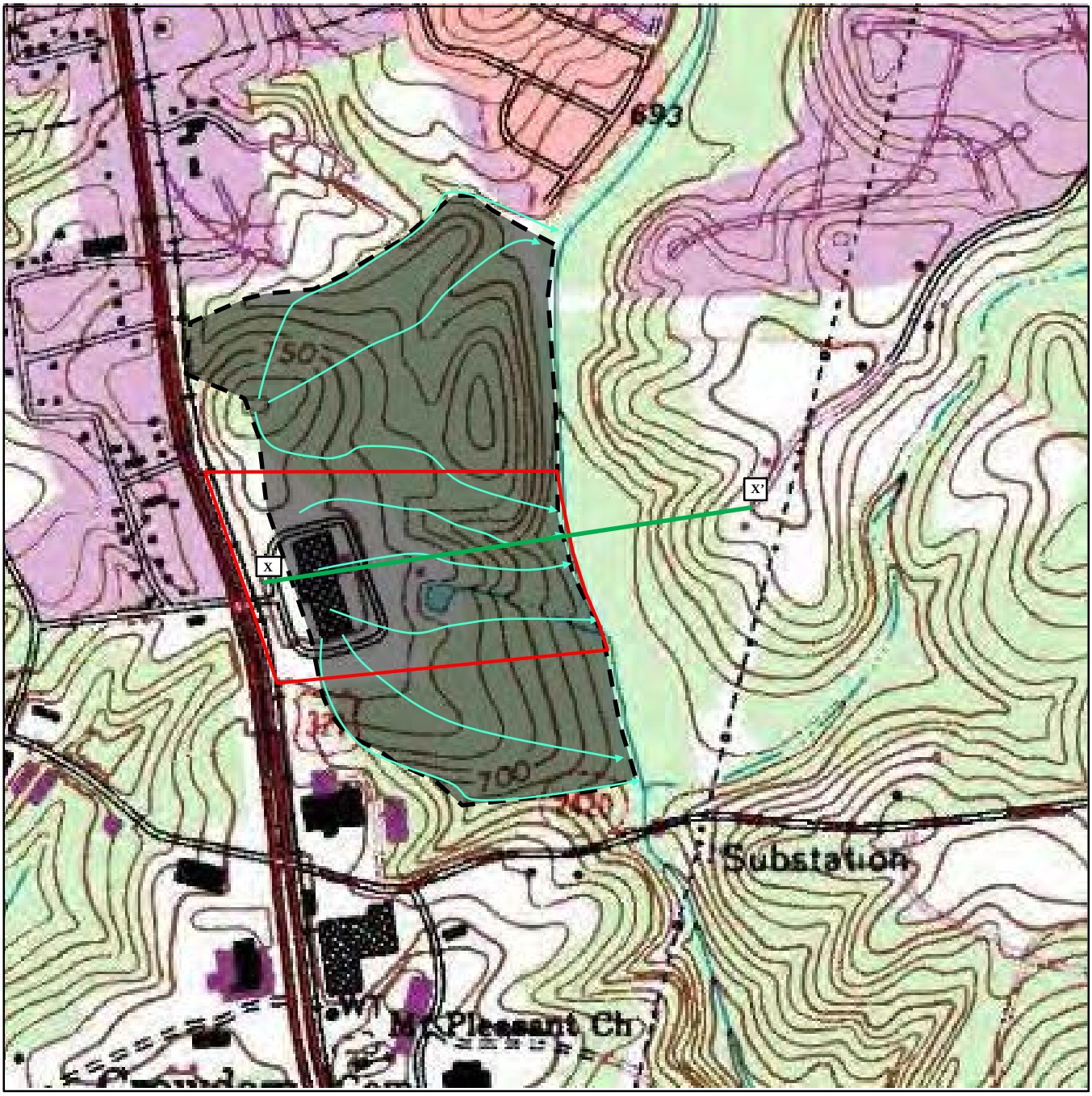
**GEOLOGIC CROSS-SECTION B-B'**

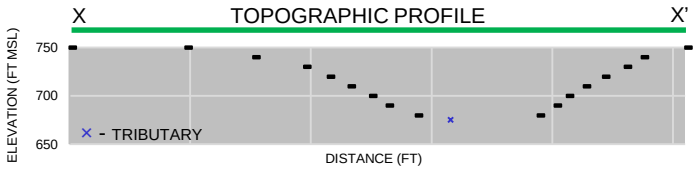
PROJECT

**A B CARTER**
4801 YORK HIGHWAY (US 321)
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)
License # C-1269 / #C-245 Geology

| | |
|---|---|
| DATE: 07–13–15 | REVISION NO. 0 |
| JOB NO. ABC–019 | FIGURE NO. 6 |




VERTICAL: 1 INCH = 200 FT
HORIZONTAL: 1 INCH = 800 FT
V.E.= 4X

SITE BOUNDARY

LOCAL GROUNDWATER FLOW BOUNDARY

GENERALIZED GROUNDWATER FLOW LINE

APPROXIMATE
0 800 1600
SCALE IN FEET

U.S.G.S. QUADRANGLE MAP
GASTONIA SOUTH, 1993
QUADRANGLE
7.5 MINUTE SERIES (TOPOGRAPHIC)

N

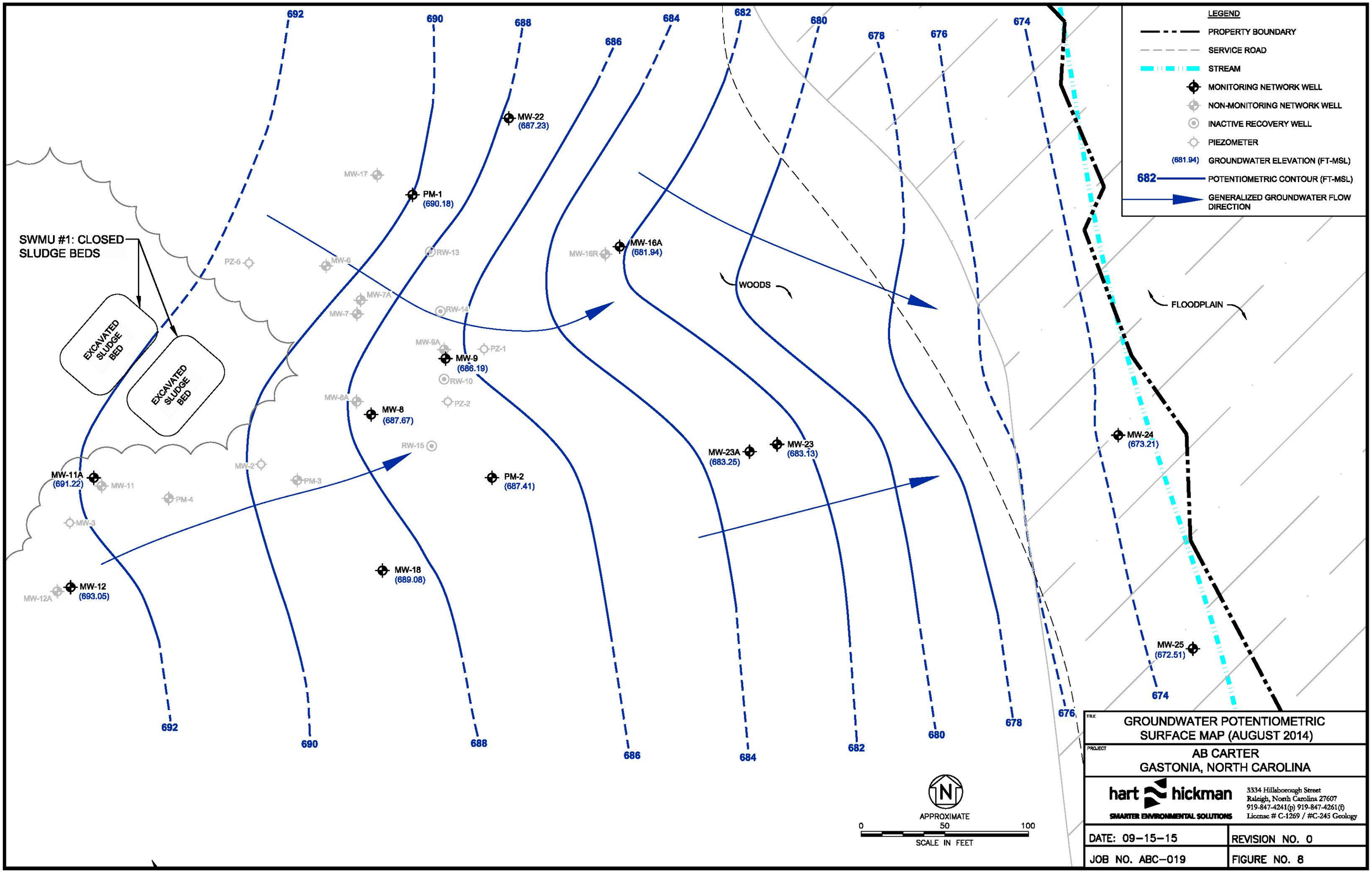
TITLE
GENERALIZED SITE GROUNDWATER FLOW SYSTEM

PROJECT
A B CARTER
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS

2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007 (p) 704-586-0373 (f)

| | | | |
|---|---|---|---|
| DATE: | 9-10-15 | REVISION NO: | 0 |
| JOB NO: | ABC-019 | FIGURE: | 7 |



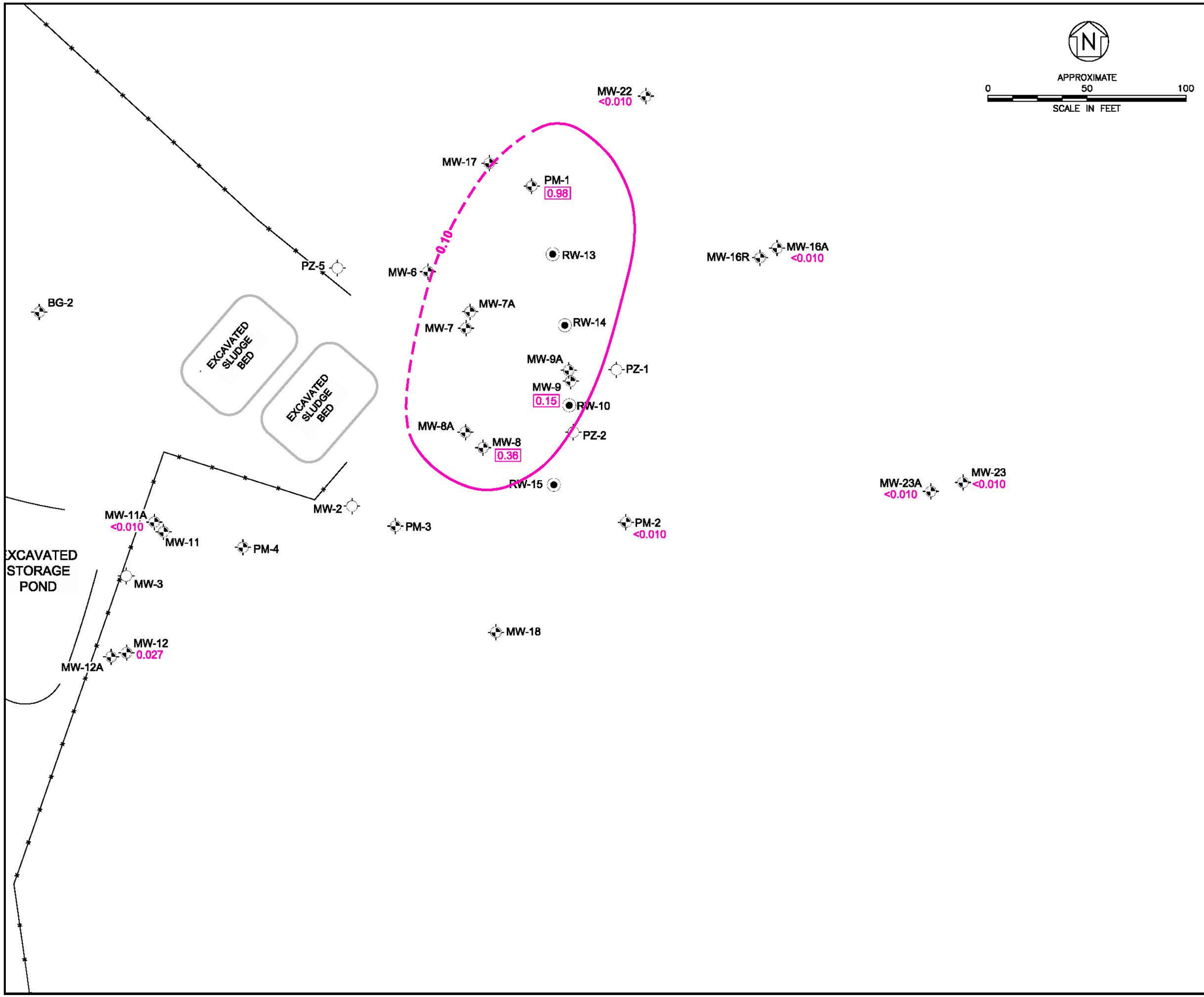

TITLE: GROUNDWATER POTENTIOMETRIC SURFACE MAP (AUGUST 2014)

PROJECT: AB CARTER
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS

3334 Hillsborough Street
Raleigh, North Carolina 27607
919-847-4241(p) 919-847-4261(f)
License # C-1269 / #C-245 Geology

| | |
|---|---|
| DATE: 09–15–15 | REVISION NO. 0 |
| JOB NO. ABC–019 | FIGURE NO. 8 |




LEGEND

- SITE PROPERTY BOUNDARY
- FENCE LINE
- PIEZOMETER
- RECOVERY WELL
- QUARTERLY MONITORING WELL
- <0.010 NICKEL CONCENTRATION (mg/L)
- 0.10 NICKEL ISOCONCENTRATION ABOVE 2L STANDARD 0.100 mg/L

MW = MONITORING WELL
PZ = PIEZOMETER
BG = BACKGROUND WELL
RW = RECOVERY WELL

NOTE:

DENOTES EXCEEDANCE OF 2L STANDARD 0.100 mg/L

TITLE

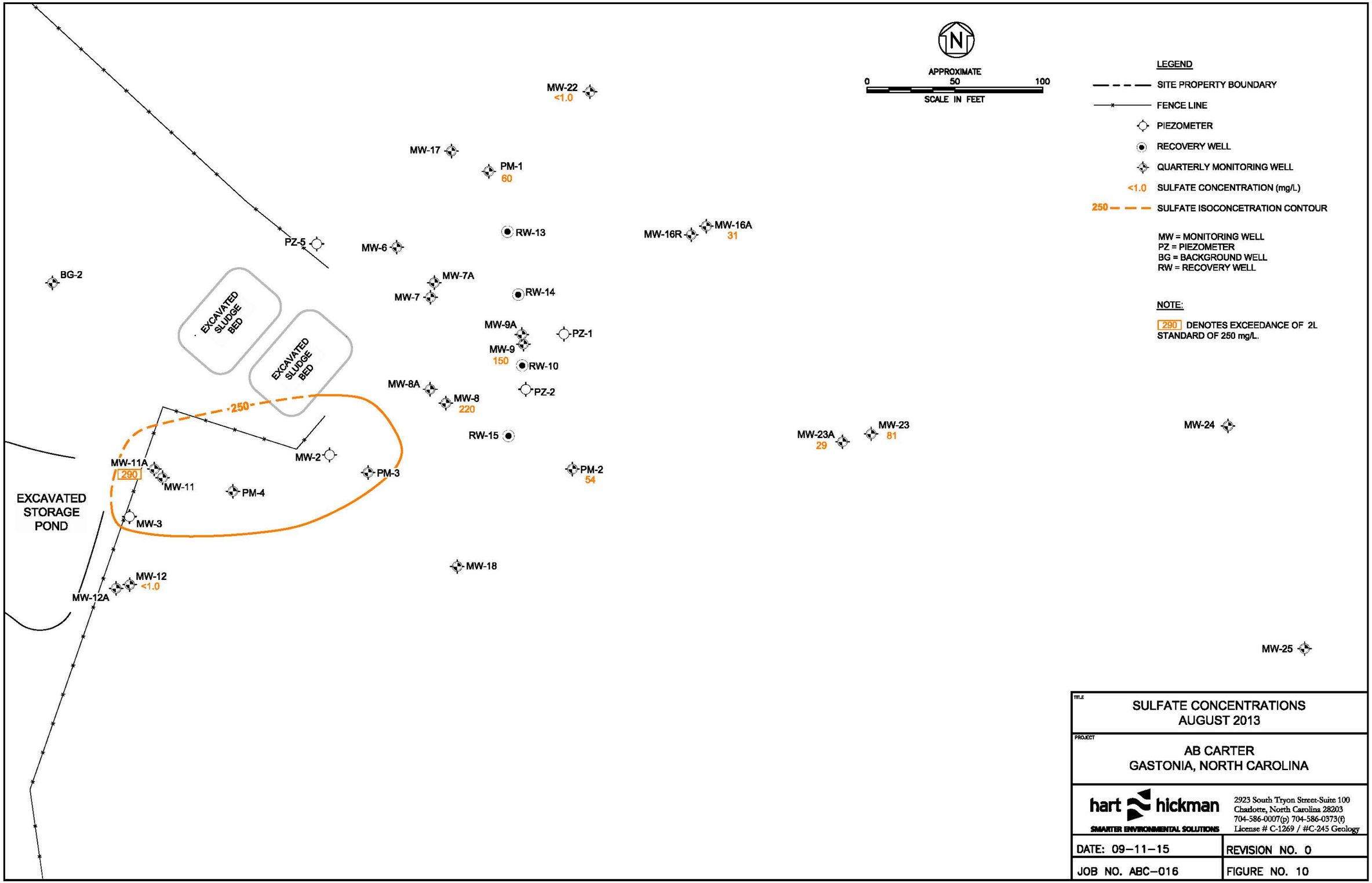
NICKEL CONCENTRATIONS
(AUGUST 2013)

PROJECT

AB CARTER
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)
License # C-1269 / #C-245 Geology

| | |
|---|---|
| DATE: 09-11-15 | REVISION NO. 0 |
| JOB NO. ABC-019 | FIGURE NO. 9 |




TITLE

SULFATE CONCENTRATIONS
AUGUST 2013

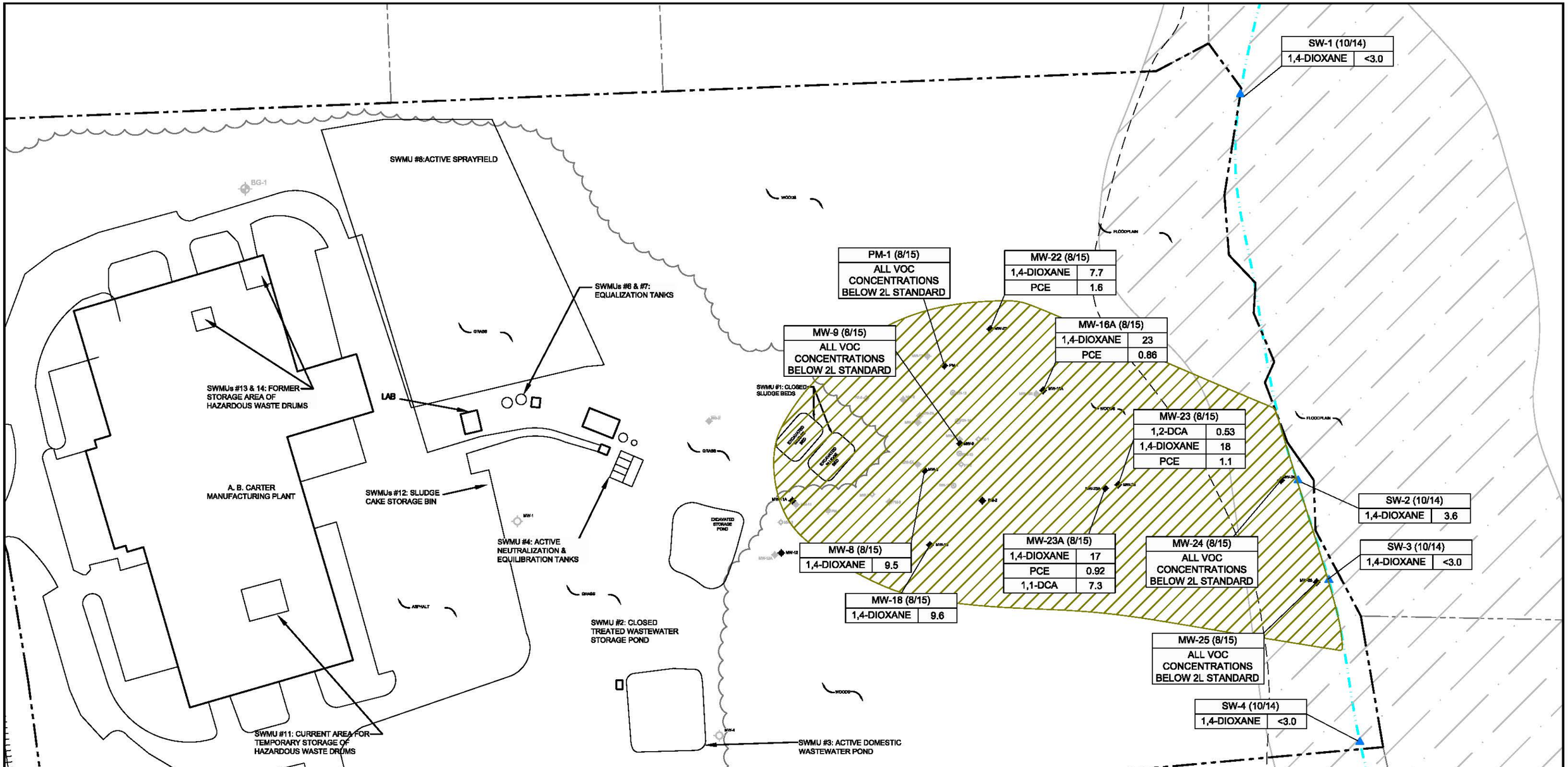
PROJECT

AB CARTER
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS

2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)
License # C-1269 / #C-245 Geology

| | |
|---|---|
| DATE: 09-11-15 | REVISION NO. 0 |
| JOB NO. ABC-016 | FIGURE NO. 10 |




LEGEND

- PROPERTY BOUNDARY
- SERVICE ROAD
- STREAM
- MONITORING NETWORK WELL
- SURFACE WATER SAMPLE LOCATION
- EXTENT OF VOCs PLUME

SAMPLE ID & DATE

| MW-8 (8/15) | |
|---|---|
| 1,4-DIOXANE | 9.5 |

CONSTITUENT — CONCENTRATION (µg/L)

N

APPROXIMATE

0 120 240

SCALE IN FEET

TITLE

VOC CONCENTRATIONS (AUGUST 2015)

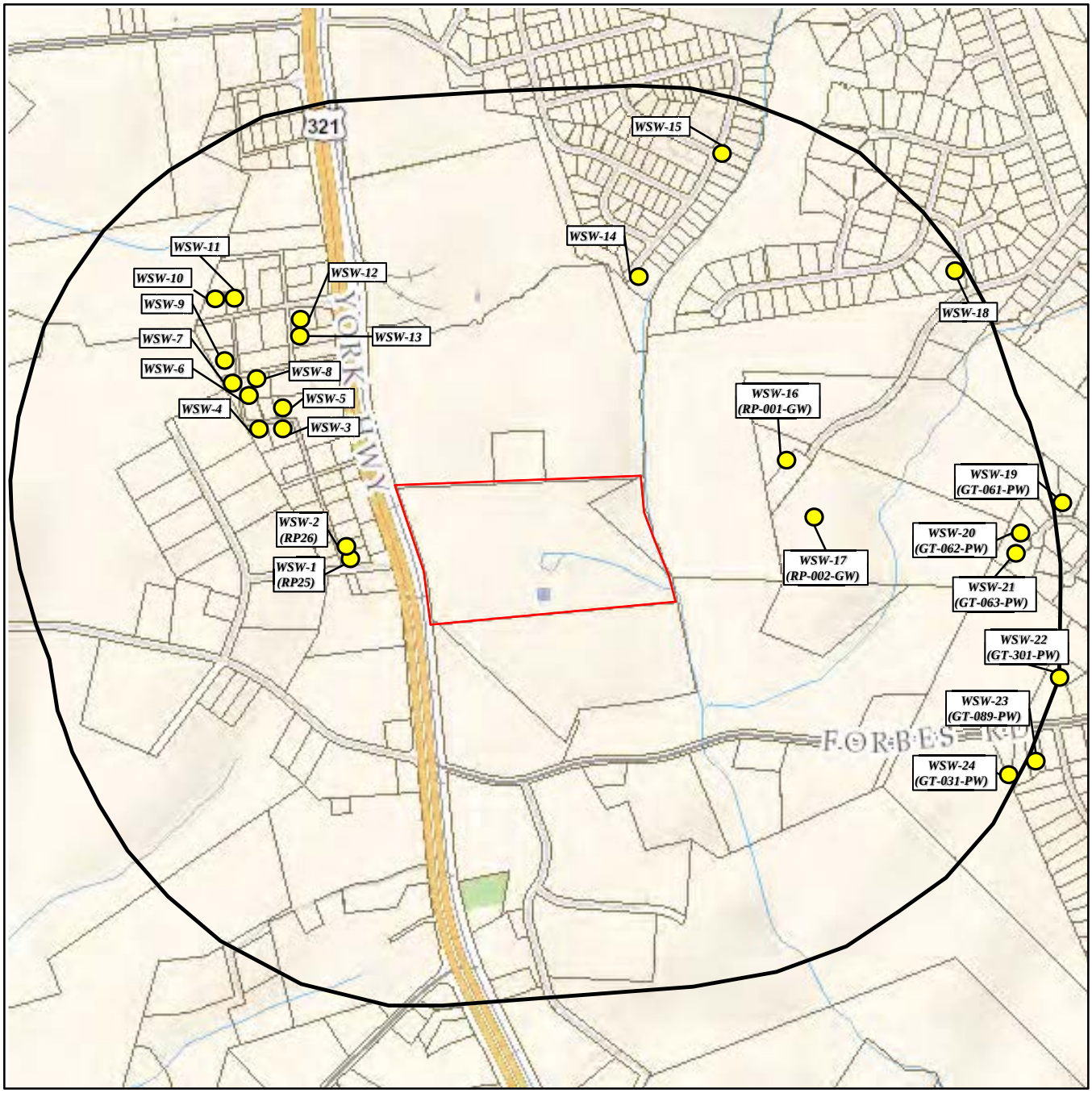
PROJECT

A.B. CARTER
4801 YORK HIGHWAY (US321)
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS

3334 Hillsborough Street
Raleigh, North Carolina 27607
919-847-4241(p) 919-847-4261(f)
License # C-1269 / #C-245 Geology

| | |
|---|---|
| DATE: 09–28–15 | REVISION NO. 0 |
| JOB NO. ABC–019 | FIGURE NO. 11 |




SITE BOUNDARY

APPROXIMATE 0.5-MILE RADIUS

APPROXIMATE WATER SUPPLY WELL LOCATION

WSW-24 (GT-031-PW) — HART & HICKMAN ASSIGNED WELL ID

NC DENR ASSIGNED WELL ID (WHERE APPLICABLE)

N

APPROXIMATE

0 1000 2000

SCALE IN FEET

BASEMAP OBTAINED FROM GASTON COUNTY GIS (8/27/15)

TITLE

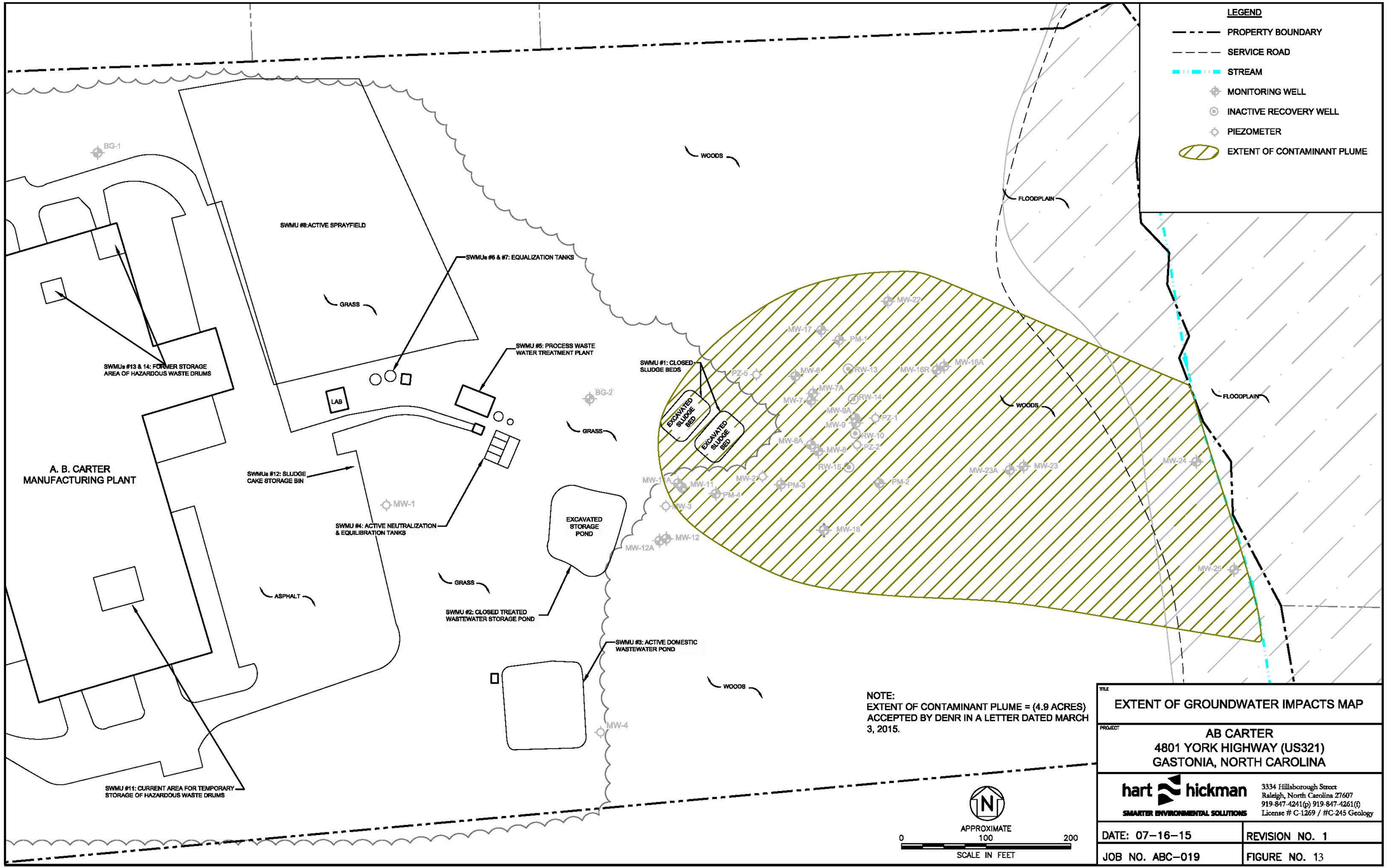
WATER SUPPLY WELL LOCATION MAP

PROJECT

A B CARTER
GASTONIA, NORTH CAROLINA

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007 (p) 704-586-0373 (f)

| | | | |
|---|---|---|---|
| DATE: | 8-27-15 | REVISION NO: | 0 |
| JOB NO: | ABC-019 | FIGURE: | 12 |




TITLE

EXTENT OF GROUNDWATER IMPACTS MAP

PROJECT

AB CARTER
4801 YORK HIGHWAY (US321)
GASTONIA, NORTH CAROLINA

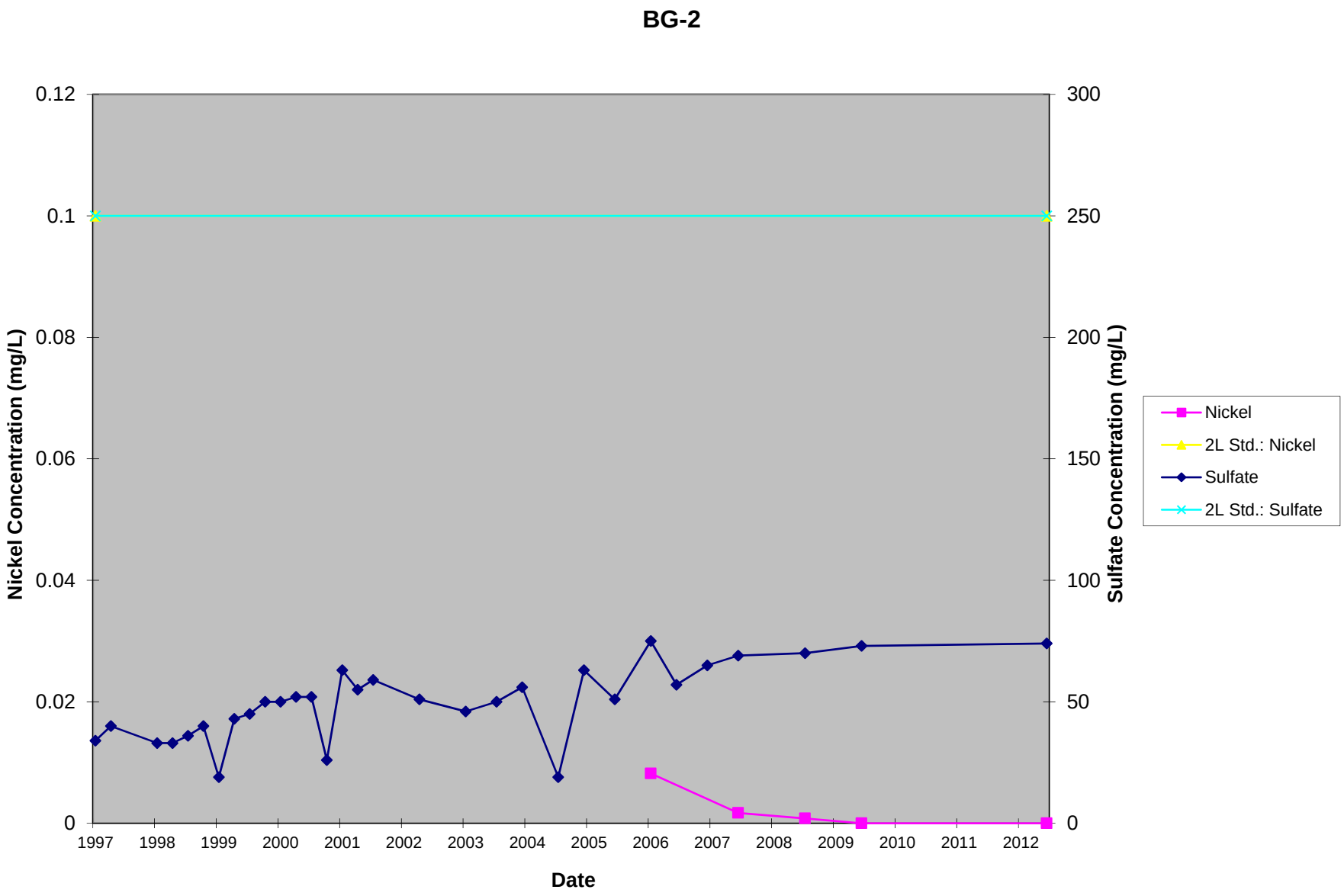
hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS

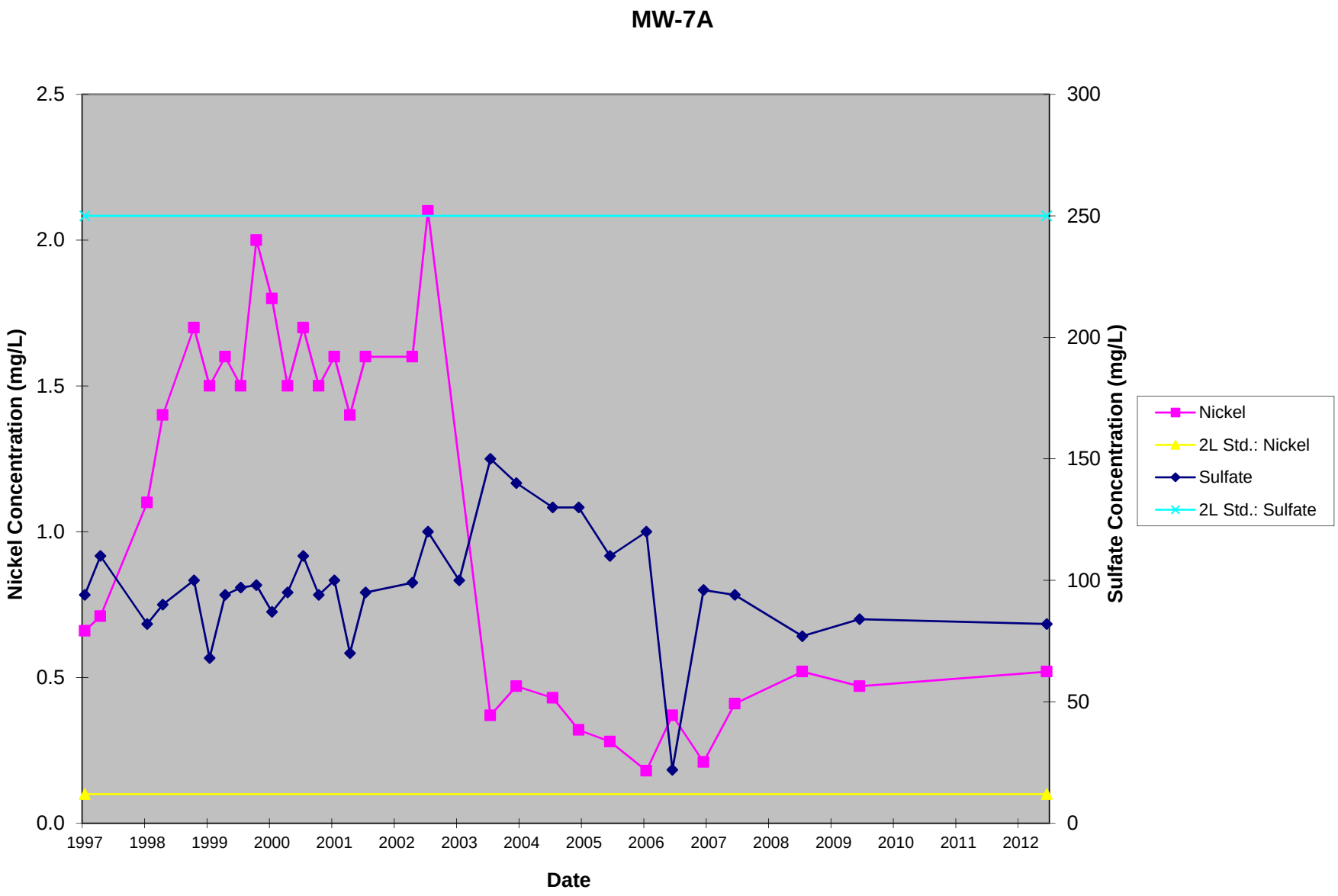
3334 Hillsborough Street
Raleigh, North Carolina 27607
919-847-4241(p) 919-847-4261(f)
License # C-1269 / #C-245 Geology

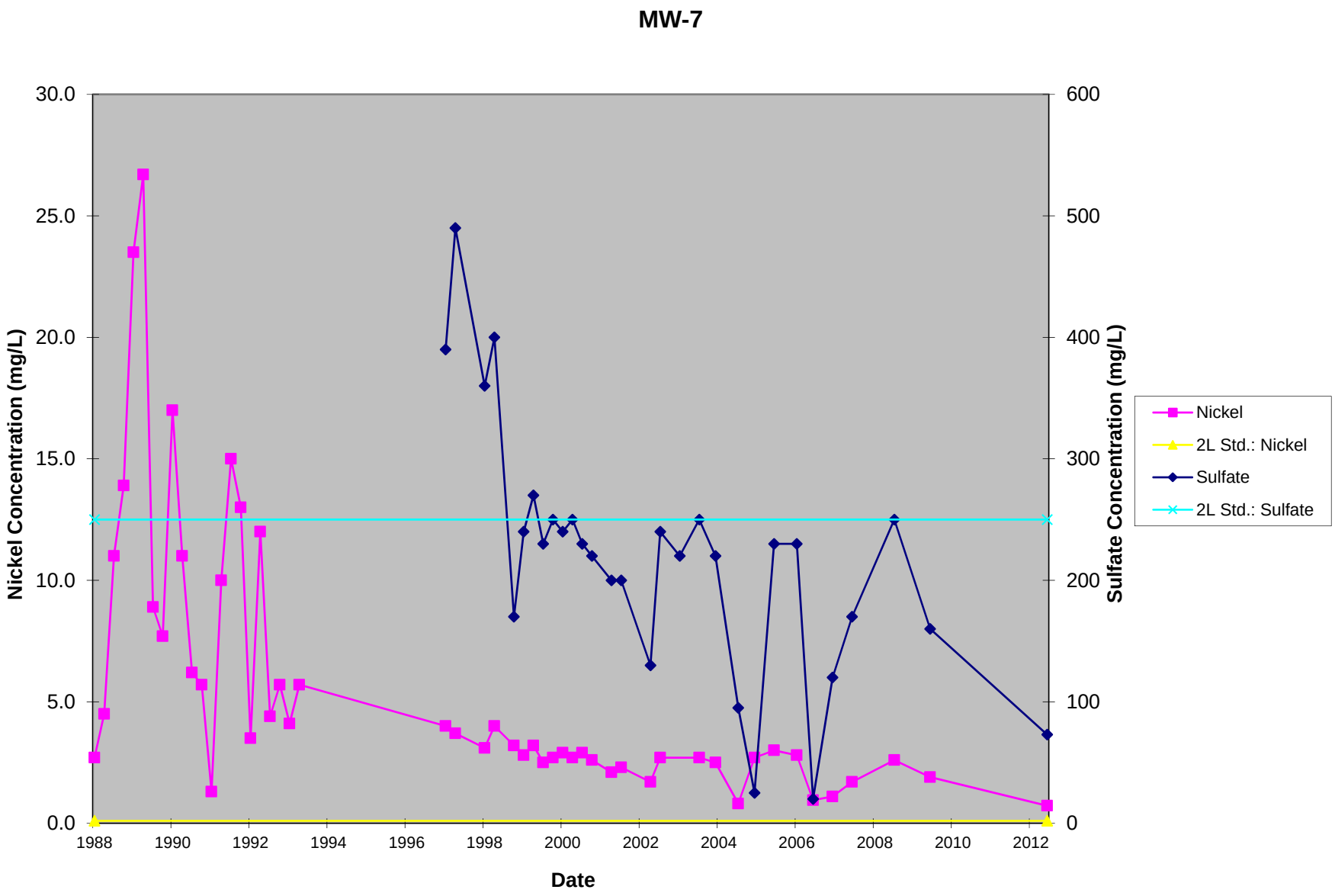
| | |
|---|---|
| DATE: 07–16–15 | REVISION NO. 1 |
| JOB NO. ABC–019 | FIGURE NO. 13 |

# Appendix A

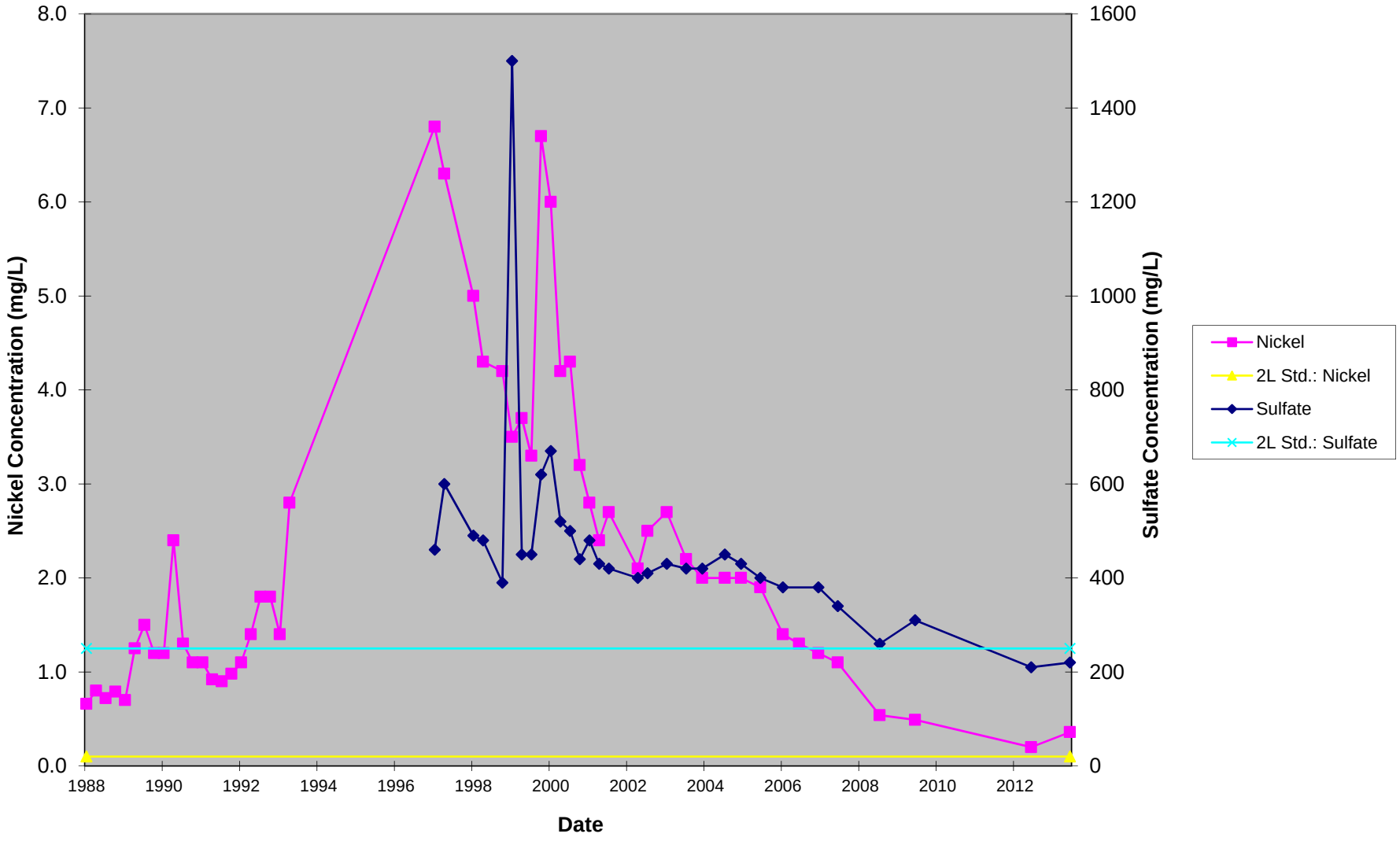
# Concentration Trend Graphs

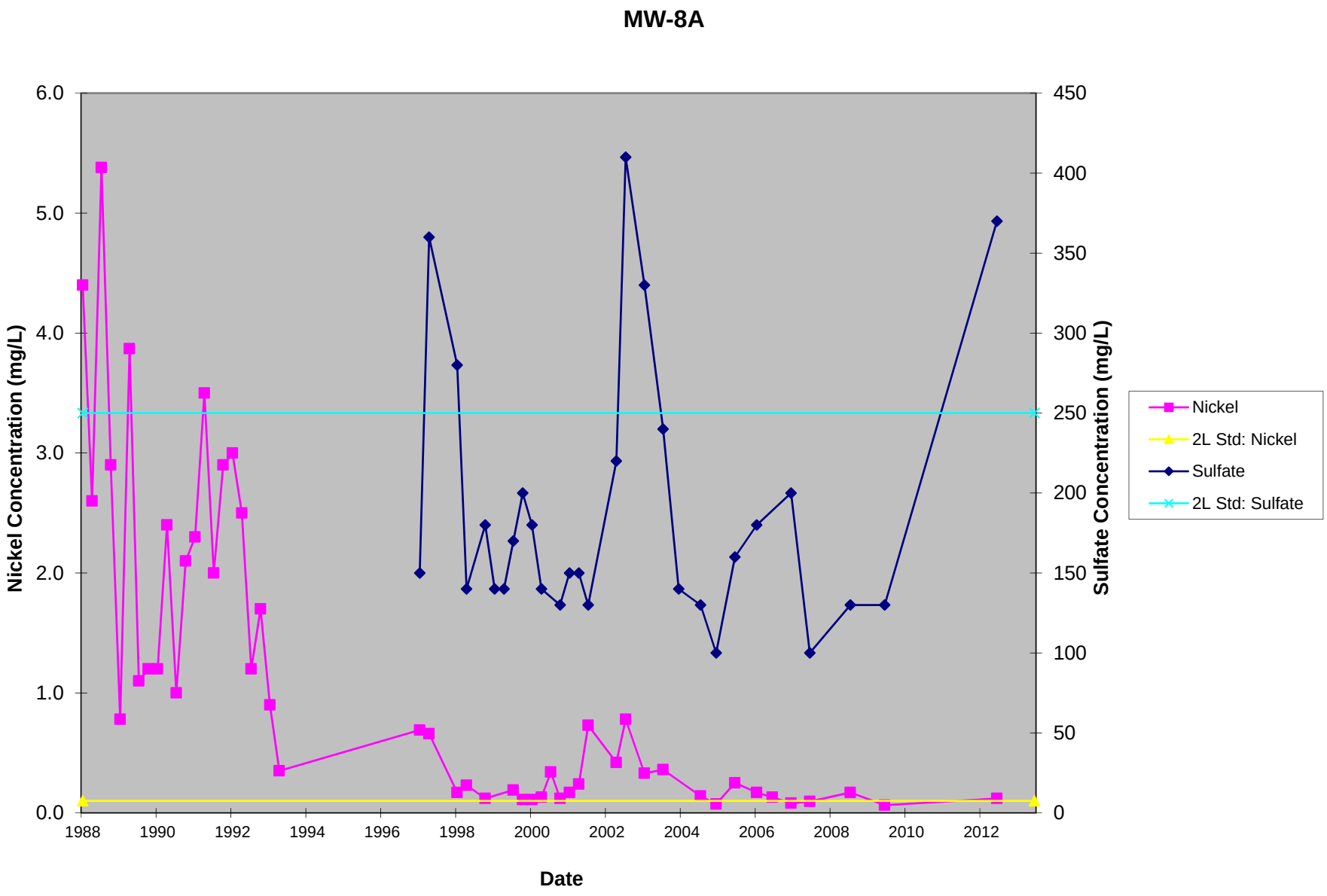

BG-2
0.12
0.1
0.08
0.06
0.04
0.02
0
Nickel Concentration (mg/L)
300
250
200
150
100
50
0
Sulfate Concentration (mg/L)
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Date
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate

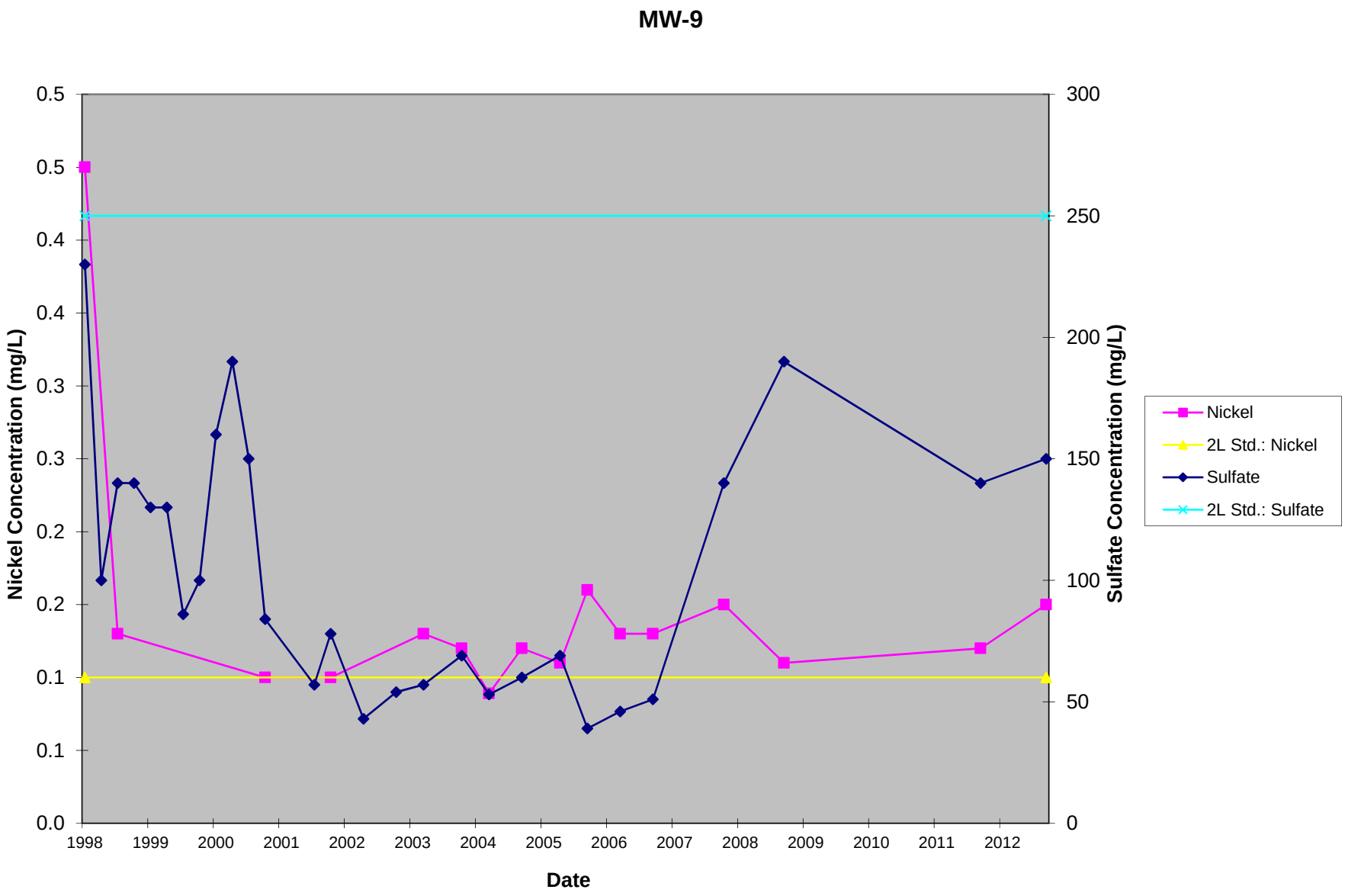

MW-7A
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
2.5
2.0
1.5
1.0
0.5
0.0
300
250
200
150
100
50
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate

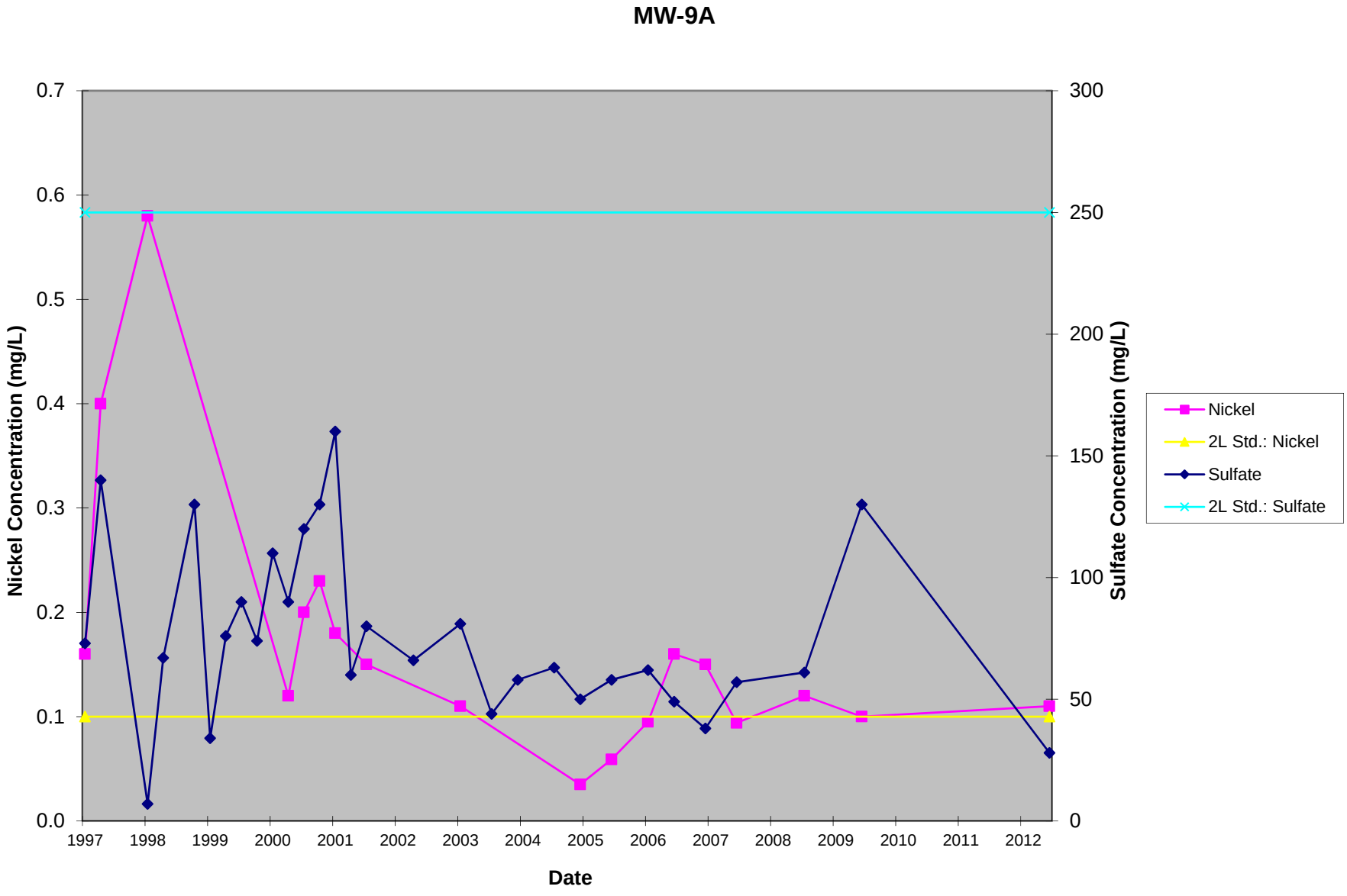

MW-7
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
30.0
25.0
20.0
15.0
10.0
5.0
0.0
600
500
400
300
200
100
0
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate

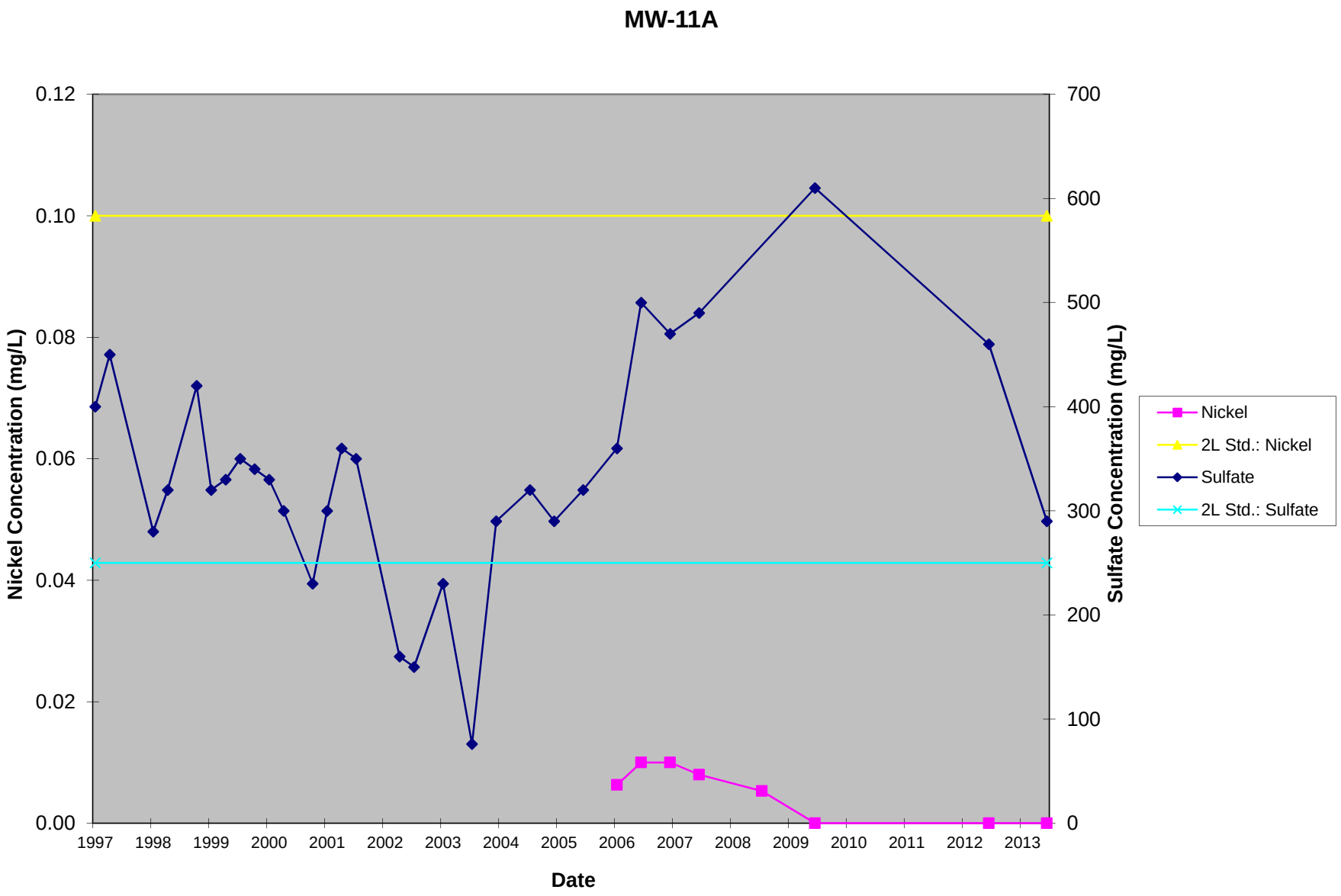
# MW-8

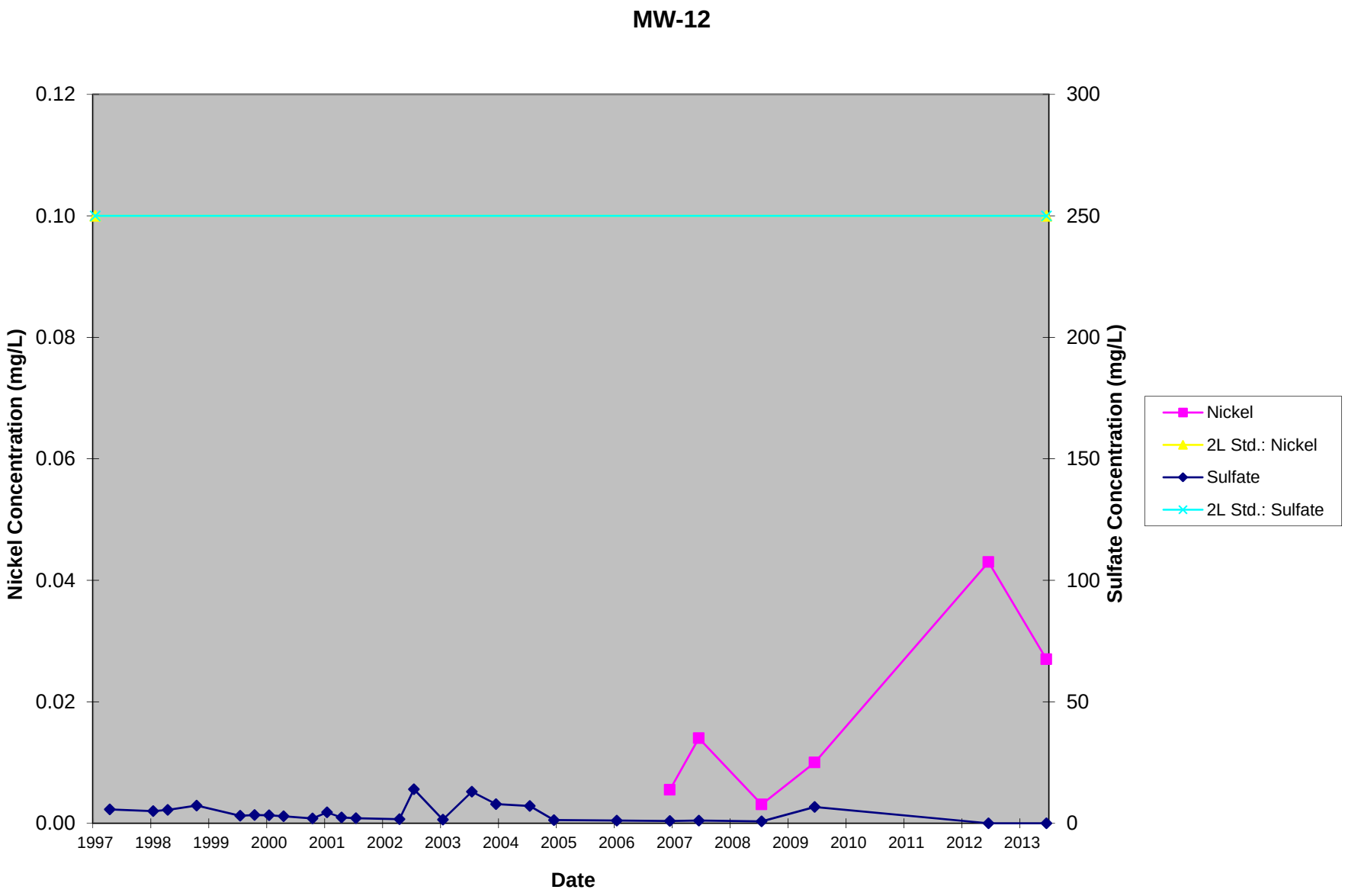

8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Nickel Concentration (mg/L)
1600
1400
1200
1000
800
600
400
200
0
Sulfate Concentration (mg/L)
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Date
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate

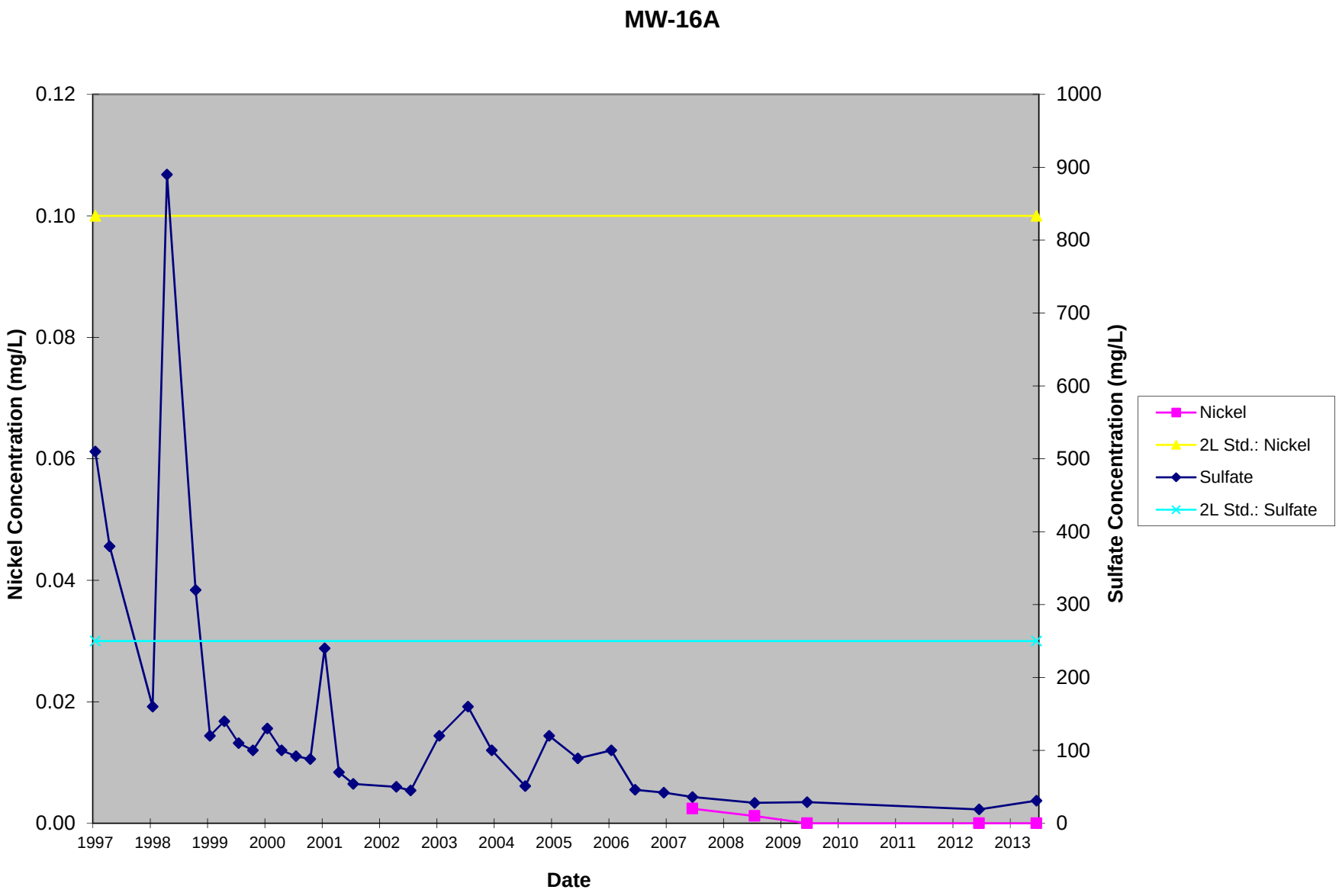

MW-8A
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
6.0
5.0
4.0
3.0
2.0
1.0
0.0
450
400
350
300
250
200
150
100
50
0
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Nickel
2L Std: Nickel
Sulfate
2L Std: Sulfate

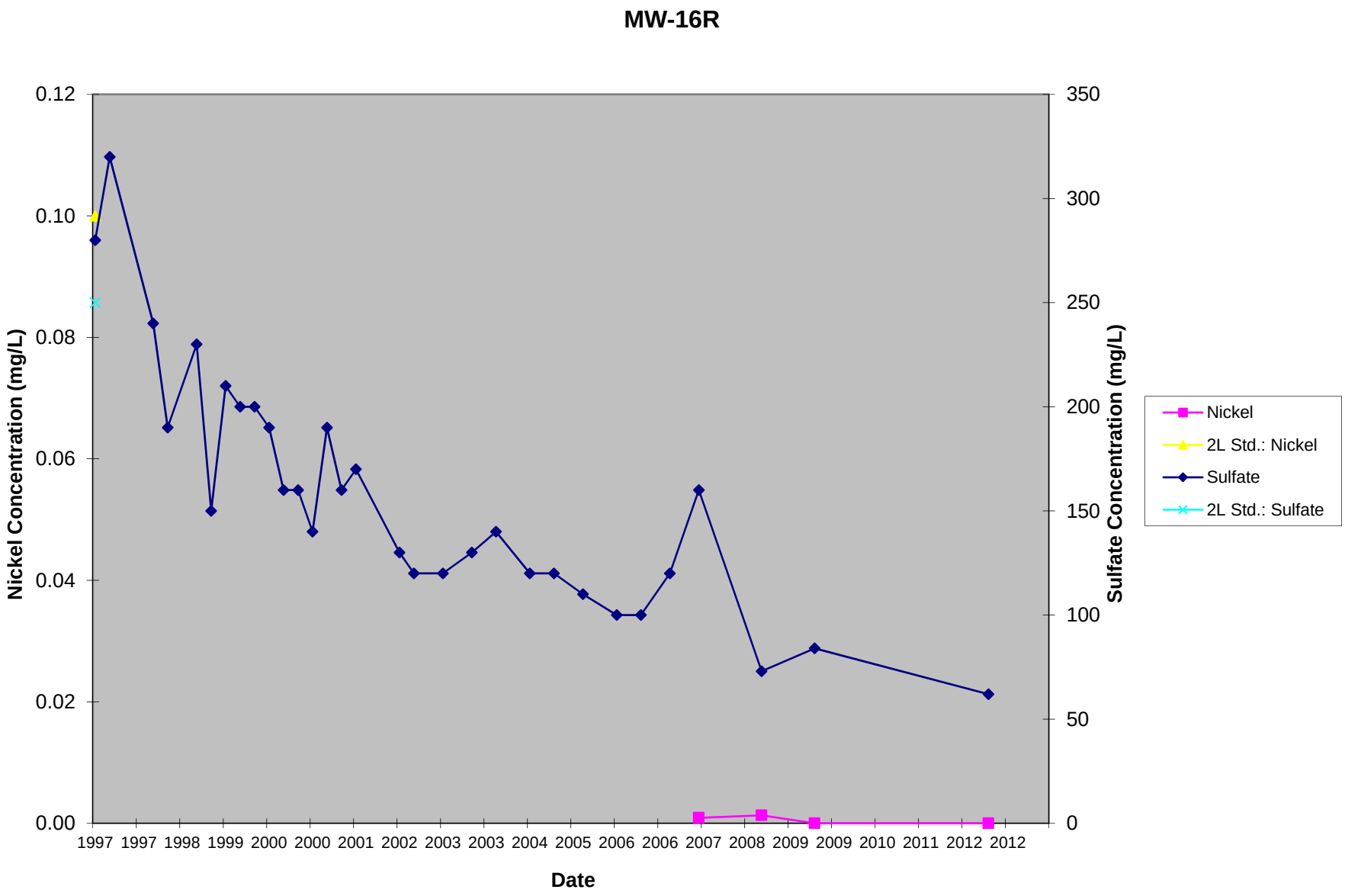

MW-9
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
0.5
0.5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
300
250
200
150
100
50
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate

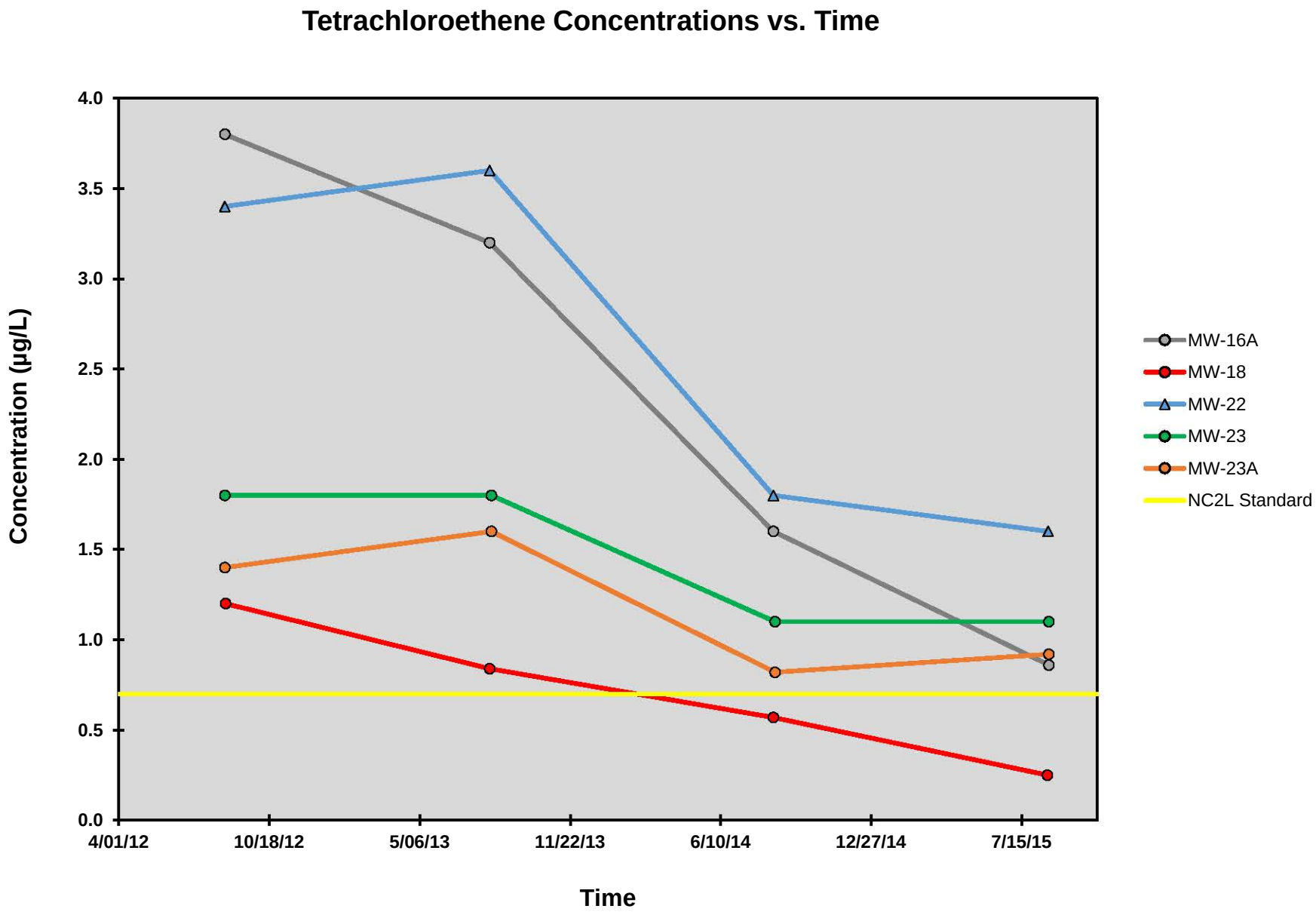

MW-9A
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
50
100
150
200
250
300
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate


MW-11A
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
0.12
0.10
0.08
0.06
0.04
0.02
0.00
700
600
500
400
300
200
100
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate

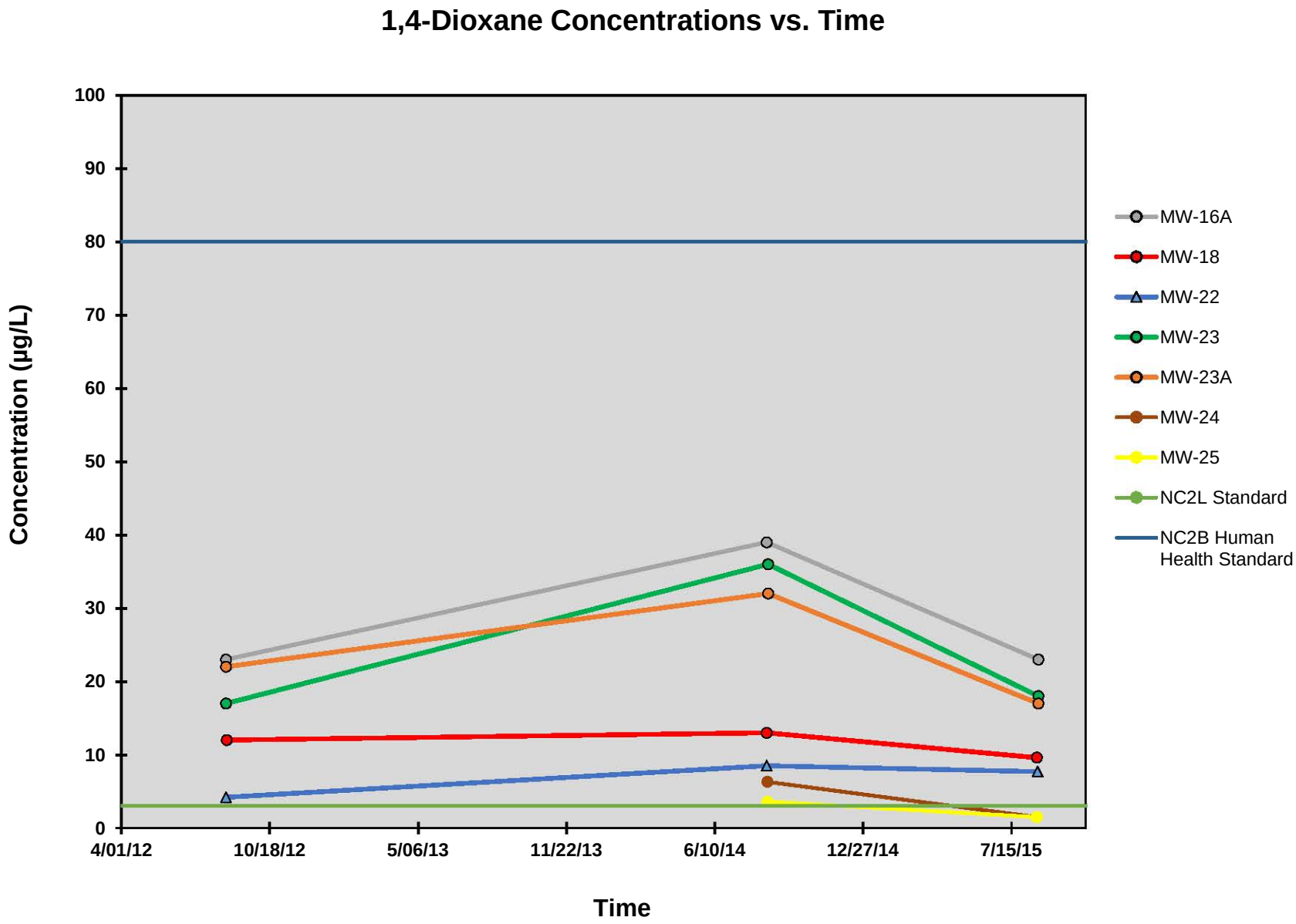

MW-12
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
0.12
0.10
0.08
0.06
0.04
0.02
0.00
300
250
200
150
100
50
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate


MW-16A
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
0.12
0.10
0.08
0.06
0.04
0.02
0.00
1000
900
800
700
600
500
400
300
200
100
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate


MW-16R
Nickel Concentration (mg/L)
Sulfate Concentration (mg/L)
Date
0.12
0.10
0.08
0.06
0.04
0.02
0.00
350
300
250
200
150
100
50
0
1997 1997 1998 1999 2000 2000 2001 2002 2003 2003 2004 2005 2006 2006 2007 2008 2009 2009 2010 2011 2012 2012
Nickel
2L Std.: Nickel
Sulfate
2L Std.: Sulfate



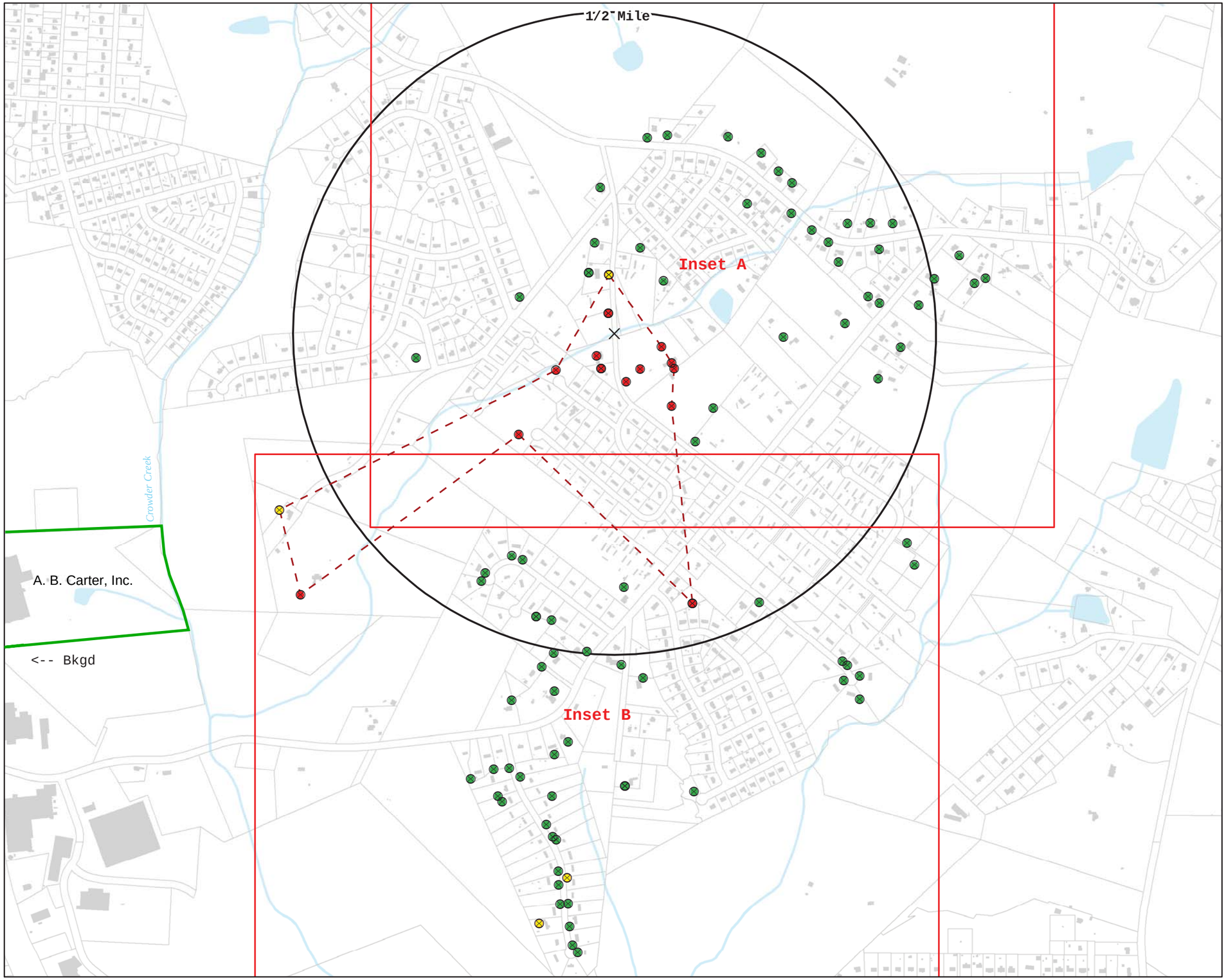

Note: Laboraotry reporting limit is 0.25 µg/L. Half the laboratory reporting limit (0.25 µg/L) used for graphing purposes when detected below the reporting limit.




Note: Laboraotry reporting limit is 3.0 µg/L. Half the laboratory reporting limit (1.5 µg/L) used for graphing purposes when detected below the reporting limit.

**Appendix B**

**NC DENR Water Supply Well Location Maps**




# HEMPHILL ROAD TCE SITE
# HALF-MILE GROUNDWATER USE

| | |
|---|---|
| Fig: | 3. Sample Locations |
| Site: | NC0 002 374 445 |
| City | Gastonia, NC |
| County: | Gaston |
| Date: | 02/27/2013 |
| Drawn By: | SMM |

- Detection - Level I (TCE)
- Detection - Level II (w/TCE)
- No Detection of TCE
- Site/Extent of Plume

North American Datum 1983
North Carolina State Plane (3200)

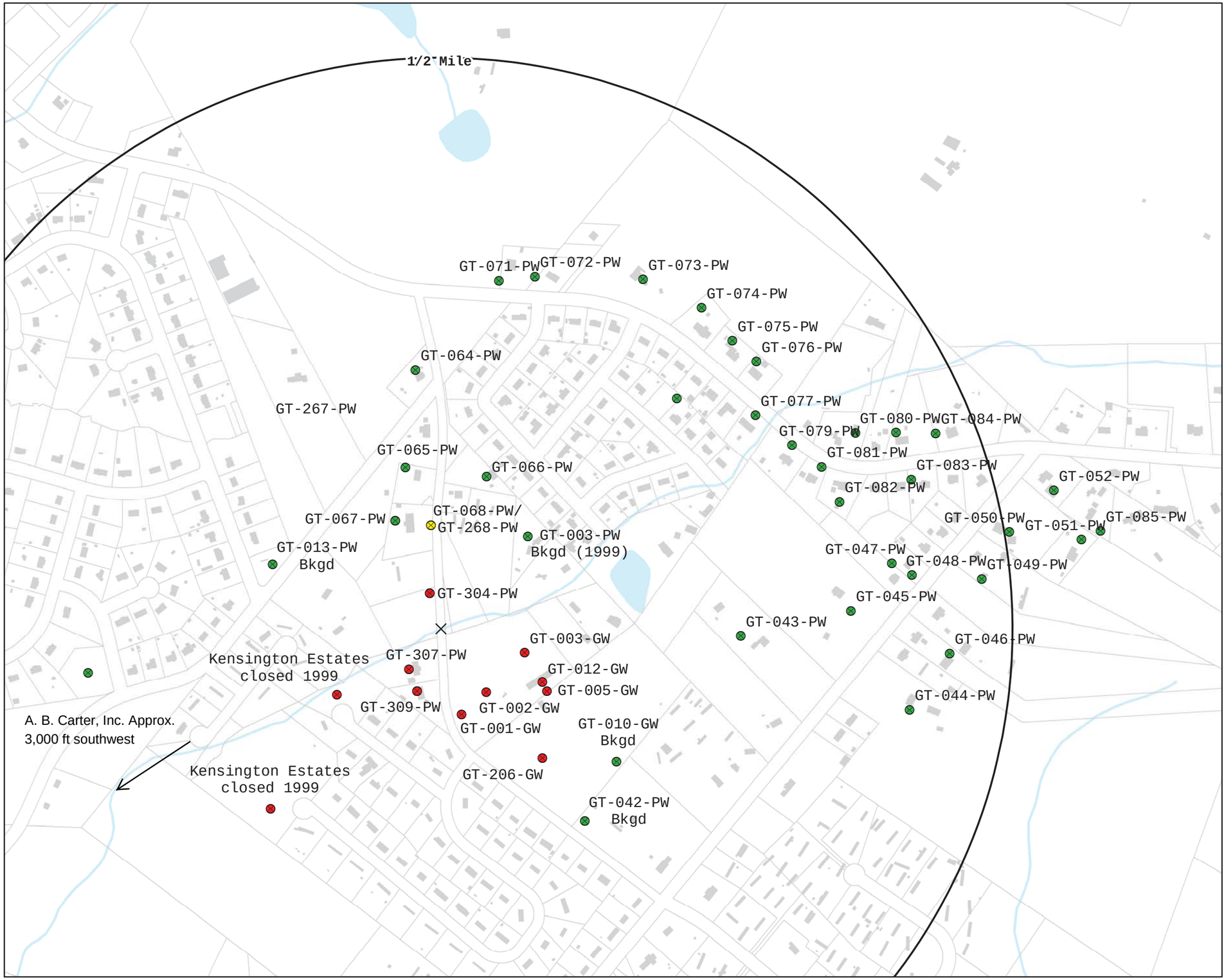
Contour Interval 4 Feet

1 inch = 800 feet

Miles

0.2 0.1 0 0.2

Source: Gaston County, Parcels; Well Sample Locations, NC Division of Waste Management




# (A) HEMPHILL ROAD TCE SITE HALF-MILE GROUNDWATER USE

| | |
|---|---|
| Fig: | 3-A. Sample Locations |
| Site: | NC0 002 374 445 |
| City | Gastonia, NC |
| County: | Gaston |
| Date: | 02/27/2013 |
| Drawn By: | SMM |

Detection - Level I (TCE)

Detection - Level II (w/TCE)

No Detection of TCE

N
W E
S

North American Datum 1983
North Carolina State Plane (3200)

Contour Interval 4 Feet

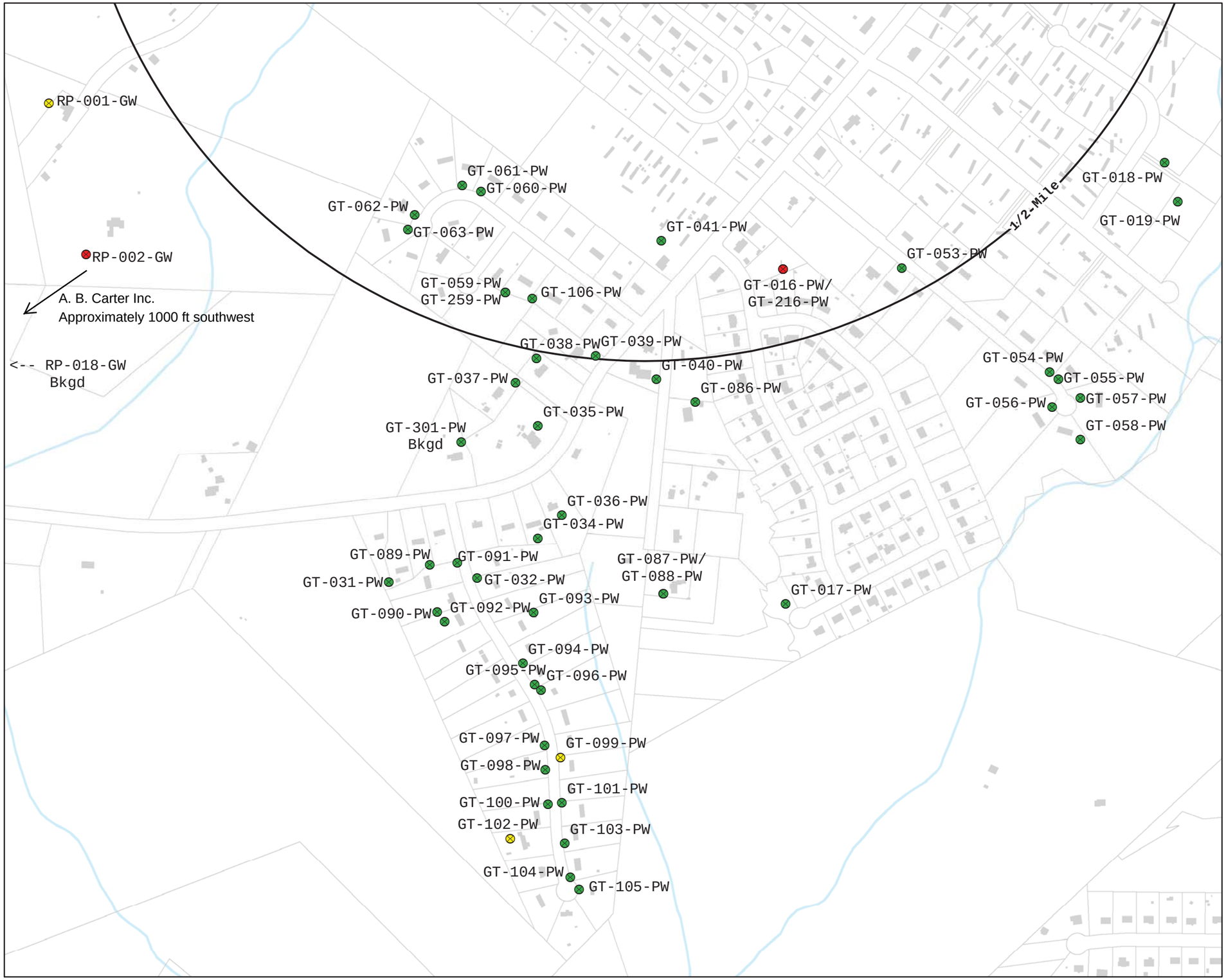
1 inch = 450 feet

Miles

0.1 0.05 0 0.1

NCDENR

Source: Gaston County, Parcels; Well Sample Locations, NC Division of Waste Management




# (B) HEMPHILL ROAD TCE SITE HALF-MILE GROUNDWATER USE

| | |
|---|---|
| Fig: | 3-B. Sample Locations |
| Site: | NC0 002 374 445 |
| City | Gastonia, NC |
| County: | Gaston |
| Date: | 02/27/2013 |
| Drawn By: | SMM |

Detection - Level I (TCE)

Detection - Level II (w/TCE)

No Detection of TCE

N
W E
S

North American Datum 1983
North Carolina State Plane (3200)

Contour Interval 4 Feet

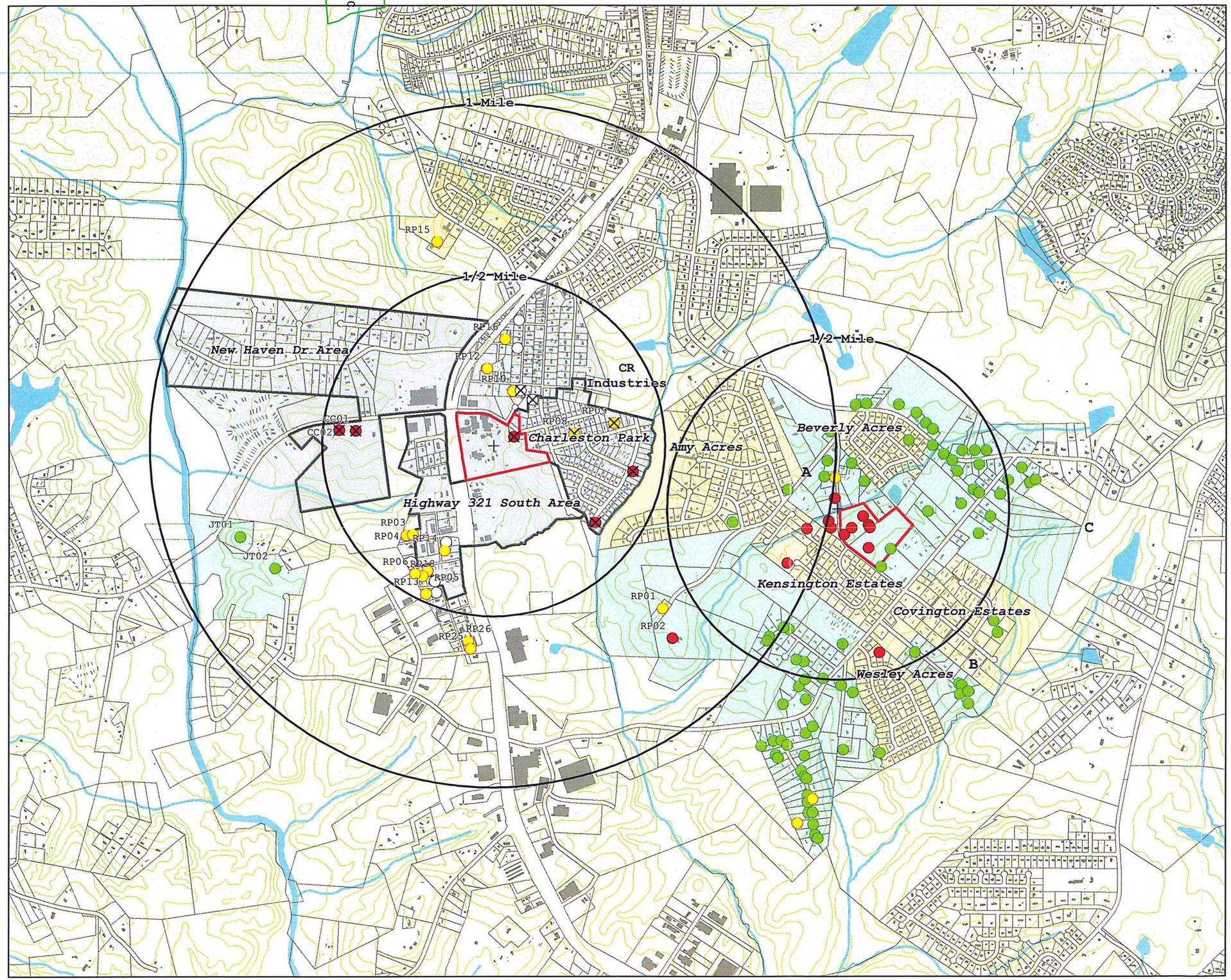
1 inch = 450 feet

Miles

0.1 0.05 0 0.1

NCDENR

Source: Gaston County, Parcels; Well Sample Locations, NC Division of Waste Management; Contour, NC DOT (Derived from 2007 LIDAR)




# RHONE-POULENC RHODIA GROUNDWATER TARGET SUMMARY

| | |
|---|---|
| Fig: | GW Target Summary |
| Site: | NCD 986 182 582 |
| City | Gastonia, NC |
| County: | Gaston |
| Date: | 07/26/2013 |
| Drawn By: | SMM |

Drinking Water Sampling Results

- Well Not Used as Water Source
- Detection > MCL
- Detection < MCL
- No Detection
- Not Sampled
- City Well
- Community Well
- Private Well

N
W E
S

North Ameri[illegible]
North Carolina State Plane (3200)

Contour Interval 4 Feet

1 inch = 1,500 feet

Miles

0 0.25 0.5

NCDENR

Source: Gaston County, Parcels; Well Sample Locations, NC Division of Waste Management; Contour, NC DOT (Derived from 2007 LIDAR)

# Appendix C

# Public Notice

# PUBLIC NOTICE OF THE INTENT TO REMEDIATE

# REQUEST FOR APPROVAL OF CLASS 3 PERMIT MODIFICATION

**A.B. CARTER, INC.**
**4801 YORK HIGHWAY (US 321)**
**GASTONIA, NORTH CAROLINA 28052**

**NOTICE:** In accordance with Title 40 of the Code of Federal Regulations, 40 CFR 270.42(b), this is a notice to the public of a request by A.B. Carter Inc. for a permit modification to the existing Resource Conservation and Recovery Act (RCRA) Part B facility permit. The proposed permit modification is for a transition of the current Corrective Action by Monitored Natural Attenuation (MNA) to a No Further Remediation Determination through Risk-Based Remediation of Industrial Sites pursuant to N.C.G.S. 130A-310.65 to 310.77.

The A.B. Carter plant in Gastonia has operated since 1969 and has historically manufactured textile machine accessories. The facility operates a wastewater treatment facility for the management of wastewater generated from their operations. Groundwater at the site has been assessed and monitored since 1986. The site's constituents of concern (COCs) in groundwater are nickel, sulfate, and two volatile organic compounds (VOCs), tetrachloroethene and 1,4-dioxane. A Corrective Action (pump & treat) was initiated in 1989 to address impacted groundwater. In 2009, as approved by the North Carolina Department of Environment and Natural Resources (NC DENR), the pump & treat system was shut down because the COCs had reached low, steady state concentrations. The nickel and sulfate plumes are limited to the interior portion of the property and are stable and slow moving as a result of natural attenuation processes. Low levels of tetrachloroethene and 1,4-dioxane, are present in groundwater in the eastern portion of the site which is bordered by Crowders Creek. Crowders Creek is located at the site's eastern property boundary and is classified by NC DENR as a Class C surface water for recreational use only. Additionally, Crowders Creek is a local groundwater discharge area and serves as a groundwater divide; therefore, no site COCs are leaving A.B. Carter's property. This has been confirmed by sampling of Crowder's Creek. Because site groundwater and water from Crowders Creek are not used for human consumption, the COCs do not pose a risk to human health.

A.B. Carter, Inc. will be developing a Remedial Action Plan (RAP) which will propose changes to the current groundwater remediation goals based on a risk evaluation pursuant to North Carolina Law SL2011-186 that allows the development of site-specific risk-based remediation goals for No Further Remediation Determination.

The administrative record, compliance history, RCRA permit and various investigative and monitoring reports may be viewed online at NCDENR's CARA website: https://edm.nc.gov/DENR-Portal/.

**COMMENT PERIOD:** A 60-day public comment period will commence on May 15, 2015 and end on July 13, 2015. During this period, the public is invited to submit written comments regarding the proposed permit modification.

**PUBLIC MEETING:** In accordance with 40 CFR 270.42(b)(4), a Public Meeting will be held at 1:00 pm on June 24, 2015, at the A.B. Carter, Inc. Facility, located at 4801 York Highway (US 321), Gastonia, NC 28053. Attendees will have the opportunity to ask questions, provide comments, and discuss the proposed permit modification.

During the public comment period, written comments may be submitted to Mr. Al Abedi at the address provided below. Comments (both oral and written) received during the public comment period will be considered during the development of the RAP. For additional information regarding the permit modification process, contact Mary Siedlecki, NC Division of Waste Management at (919) 707-8208.

Mr. Al Abedi
AB Carter, Inc.
PO Box 518
Gastonia, NC 28053