IN-SITU CHEMICAL OXIDATION PRE-DESIGN INVESTIGATION WORK PLAN

CTS OF ASHEVILLE, INC. SUPERFUND SITE

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

Prepared for:

CTS Corporation
2375 Cabot Drive
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Prepared by:

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Amec Foster Wheeler Project 6252-16-2012

April 19, 2017

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April 19, 2017

Mr. Craig Zeller, P.E.
Superfund Remedial and Site Evaluation Branch
U.S. Environmental Protection Agency
61 Forsyth Street, S.W.
Atlanta, Georgia 30303-8960
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Subject: **ISCO Pre-Design Investigation Work Plan**
CTS of Asheville, Inc. Superfund Site
235 Mills Gap Road, Asheville, Buncombe County, North Carolina
Amec Foster Wheeler Project 6252-16-2012
EPA ID: NCD003149556
Consent Decree – Civil Action No. 1:16-cv-380

Dear Mr. Zeller:

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

If you have questions regarding this PDI Work Plan, please contact us at (828) 252-8130.

Sincerely,

Amec Foster Wheeler Environment & Infrastructure, Inc.

NORTH CAROLINA LICENSED SEAL 1955 GEOLOGIST SUSAN E. KELLY 4/19/17

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ACRONYMS

bgs	below ground surface
cis-1,2-DCE	cis-1,2-dichloroethene
CD	Consent Decree
DPT	direct-push technology
ECD	electron capture device
FSAP	Field Sampling and Analysis Plan
HASP	Health and Safety Plan
IROD	Interim Record of Decision
ISCO	in-situ chemical oxidation
MIP	membrane interface probe
NAPL	non-aqueous phase liquid
NOD	natural oxidant demand
PDI	Pre-design Investigation
PWR	partially weathered rock
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RAO	remedial action objective
TCE	trichloroethene (also, trichloroethylene)
TCL	Target Compound List
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

DOCUMENT REVISION LOG

Revision	Date	Description
0	4/19/2017	Initial Issuance

1.0 INTRODUCTION

Pursuant to Paragraph 3.3(a) of the Statement of Work, this document presents the In-situ Chemical Oxidation (ISCO) Pre-design Investigation Work Plan (PDI Work Plan) for the CTS of Asheville, Inc. Superfund Site (Site) located at 235 Mills Gap Road in Asheville, Buncombe County, North Carolina (Figure 1). The activities described in this PDI Work Plan will be performed to comply with the Consent Decree (CD) for Interim Remedial Design/Remedial Action (Interim RD/RA) at the Site between the United States of America and CTS Corporation, Mills Gap Road Associates, and Northrup Grumman Systems Corporation. The CD was entered on March 7, 2017.

1.1 SITE DESCRIPTION

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

1.2 BACKGROUND

Previous investigations have identified a dissolved-phase volatile organic compound (VOC) groundwater plume in the Northern Area of the Site, with trichloroethene (TCE) being the primary contaminant. ISCO using emplaced potassium permanganate will be implemented in the Northern Area to reduce TCE concentrations in groundwater. The remedial action objective is to reduce TCE concentrations in Northern Area groundwater by 95 percent.

Additional information is required to design the proposed remedial alternative. This PDI Work Plan describes data gaps to be addressed and investigation methods intended to fill the identified data gaps.

1.3 PRE-DESIGN INVESTIGATION OBJECTIVES

The objective of the PDI is to collect additional information in the Northern Area of the Site where ISCO will be implemented. The area proposed for remediation is approximately 1.9 acres (the Northern Area). One objective of the PDI is to gather data to better understand the distribution of VOC contamination in the Northern Area groundwater plume so that treatment can be focused in the areas of the highest contamination, both horizontally and vertically. Another objective is to collect additional soil and groundwater data to provide information for the design of the ISCO Treatability Study and the full-scale Remedial Design.

2.0 NORTHERN AREA CONCEPTUAL SITE MODEL

The following Conceptual Site Model is based on data collected to date related to the overburden formation in the Northern Area of the Site.

2.1 SITE PHYSICAL SETTING

The area surrounding the Site is considered rural and contains residential and light commercial properties. The Site is situated on a topographic “saddle” between two prominent mountains - Busbee Mountain to the north and Brown Mountain to the south and southwest. Properties northwest and southeast are topographically downgradient of the Site. The majority of the Site is relatively flat and natural surface drainage at the Site is to the northwest. The surrounding area contains mountains and rolling hills, typical of the eastern flank of the Appalachian Mountain range.

2.2 GEOLOGY

Fill material and residual soil (overburden) have been identified in the Northern Area of the Site. Fill material, consisting of loose silty sand with gravel, has been observed to a depth of approximately 20 feet below ground surface (bgs) (monitoring well MW-5 and soil boring SB-01) in the northwestern portion of the Site where two apparent natural intermittent surface water drainage channels were historically backfilled for development/grading. Overburden is located below the fill material, where present, and has been observed to a depth of approximately 81 feet bgs (monitoring well MW-6A) in the Northern Area of the Site, where the apparent top of bedrock is encountered. The uppermost zone of overburden generally consists of fine to medium sand with 10 to 15 percent silt. The overburden “fabric” ranges from massive (i.e., no apparent structure) to strongly foliated. Foliated zones were observed to be approximately horizontal to steeply dipping. Quartz veins ranging in thickness from less than 0.5 inches to approximately 12 inches, and consisting of sand to gravel-sized fragments, have been observed in the overburden. The partially weathered rock (PWR), which is a zone of less weathered rock than the shallower overburden, has been observed to be approximately 15 feet thick in the Northern Area and typically samples as fine to coarse sand with minor amounts of silt and gravel-sized rock fragments. The fabric of the PWR is similar to the overburden fabric (MACTEC, 2009).

The depth to bedrock in the Northern Area ranges from approximately 50 feet bgs to approximately 81 feet bgs, based on the depth to drilling refusal using rotary/roller cone drilling equipment (MACTEC, 2009) and direct-sensing equipment (Amec, 2014).

2.3 HYDROGEOLOGY

A groundwater divide is present in the overburden in the north-central portion of the Site. As previously discussed, the Site is located on a topographic saddle between mountains to the north and south. A portion of groundwater that is flowing from each mountain (i.e., from a higher elevation) is presumed to be toward the saddle. Therefore, a groundwater divide has developed where groundwater in the overburden flows from the mountains and turns east or west to respective discharge zones. The position and shape of the groundwater divide likely changes in response to precipitation/infiltration.

The direction of shallow groundwater flow (water table) and groundwater flow in the PWR zone are similar. Groundwater flow in the southern portion of the Site appears to flow radially, to the north and east. From the north/central portion of the Site, groundwater flows northwest and east/southeast toward the respective groundwater discharge zones.

In January 2015, the depth to groundwater in the Northern Area of the Site ranged from approximately 17 to 33 feet bgs in monitoring wells MW-7 and MW-6, respectively. Considering the depth to the water table and the depth to bedrock, the aquifer thickness ranges from approximately 30 to 60 feet. The horizontal hydraulic gradient in the shallow overburden in the central portion of the Site is approximately 0.031. The horizontal hydraulic gradient in the shallow overburden in the Northern Area of the Site toward the discharge zone east of the Site is approximately 0.066 and the horizontal gradient from Northern Area of the Site toward the discharge zone west of the Site is approximately 0.015 (Amec Foster Wheeler, 2015a).

The horizontal hydraulic gradient in the PWR in the source area at the Site is approximately 0.018. The horizontal hydraulic gradient in the PWR from the Northern Area of the Site toward the discharge zone east of the Site is approximately 0.063 and the horizontal gradient from the Site toward the spring west of the Site is approximately 0.014 (Amec Foster Wheeler, 2015a).

Upward and downward vertical hydraulic gradients were measured between proximal overburden shallow and PWR monitoring wells, based on the January 2015 monitoring event. An upward gradient (-0.12) was measured at the MW-6/6A well pair and a relatively small downward vertical gradient (0.0009) was measured at the MW-7/7A well pair. The presence of essentially such a slight vertical gradient at the MW-7/7A well pair is indicative of a groundwater divide at, or in the vicinity of, the well pair.

Groundwater elevations have fluctuated since monitoring wells were installed in 2009. From 2009 to 2013, groundwater elevations in the Northern Area of the Site increased 10.8 feet and 12.5 feet at monitoring wells MW-7A and MW-6A, respectively. Groundwater elevation increases in the shallow (water table) monitoring wells were similar during this period (i.e., 11.1 feet at MW-7 and 11.2 feet at MW-6). From 2013 to 2015, groundwater elevations decreased approximately 3 to 5 feet in the Northern Area of the Site.

The groundwater seepage velocity (v) is calculated as:

$v = ki/n_e$, where
k = hydraulic conductivity
i= hydraulic gradient
n_e = effective porosity

Based on the average hydraulic conductivity of 2.3×10^{-4} cm/sec determined by slug testing conducted for the non-aqueous phase liquid (NAPL) Area FFS Report (Amec Foster Wheeler, 2015) and an assumed effective porosity of 0.25, the groundwater seepage velocity from the Northern Area (monitoring well pairs MW-6/6A and 7/7A) ranges from 13 feet per year to the western discharge zone, to 63 feet per year to the eastern discharge zone.

2.4 NATURE AND EXTENT OF CONTAMINATION

As determined from previous investigations, and confirmed during the 2013/2014 NAPL Investigation, the contamination source area is located below the south-central portion of the former building and extends to the immediate south. The nature of the chlorinated VOC contamination, whether from pure product or from a mixed material/liquid containing a portion of chlorinated VOCs, is unknown. The primary release mechanism(s) associated with the chlorinated VOC contamination observed at the Site is also unknown.

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

Based on results from the NAPL Investigation, a significant portion of TCE has partitioned into (i.e., dissolved into) the petroleum NAPL. Based on geochemical parameters, primarily the octanol-water coefficient, TCE will more readily partition into the petroleum NAPL than dissolve into groundwater; however, via equilibrium conditions, the TCE will dissolve into groundwater over time (Amec, 2014). Therefore, the petroleum NAPL acts as the primary source to the dissolved-phase groundwater plume, which extends north from the north lobe of the NAPL zone, and east from the east lobe of the NAPL zone. From the Northern Area of the Site, the dissolved-phase groundwater plume extends east and west to discharge zones. There is no evidence of NAPL (either light or dense) in the overburden in the Northern Area of the Site (Amec, 2014).

2.4.1 Unsaturated Soil

Unsaturated soil samples collected to date from the overburden in the Northern Area of the Site do not indicate a source of soil contamination that contributes to the contaminated groundwater plume in the Northern Area of the Site. For instance, four unsaturated soil samples collected by USEPA subcontractors in late 2007/early 2008 did not indicate the presence of Site-related VOCs in the Northern Area of the Site (TNA, 2008). Also, an unsaturated soil sample collected from the MW-6 soil boring in September 2008 did not indicate Site-related VOCs (MACTEC, 2009).

In 2010, the facility's sanitary sewer line was located and unsaturated soil samples were collected within approximately two feet below the identified sewer line, which extends from the eastern portion of the former building to Mills Gap Road. Five unsaturated soil samples (SS-126 through SS-130) were collected below the sewer line in the Northern Area of the Site and minor concentrations of TCE were reported in two of the samples (e.g., 5.4 and 8.1 micrograms per kilogram in SS-127 and SS-128, respectively; MACTEC, 2010).

During the 2013/2014 NAPL Investigation, an electron capture device (ECD) was used to qualitatively measure the concentration/amount of chlorinated VOCs, such as TCE, adjacent to the ECD probe as it was advanced down through the overburden. The ECD probe was advanced at 14 locations in the Northern Area of the Site. Elevated ECD responses indicating the presence of chlorinated VOCs were not measured in the unsaturated soil, and in many cases, the estimated depth of the water table was consistent with the beginning of positive ECD responses indicating the presence of the dissolved-phase chlorinated VOC plume in groundwater (Amec, 2014).

2.4.2 Groundwater

The dissolved-phase chlorinated VOC plume in overburden, primarily consisting of TCE, extends from the source NAPL Area to the Northern Area and then east and west toward groundwater discharge zones. Based on data collected during the NAPL Investigation (Amec, 2014) and the Western Area Remedial Investigation (Amec Foster Wheeler, 2015b), the Northern Area dissolved-phase groundwater plume likely does not extend north of Mills Gap Road. The core of the Northern Area groundwater plume (i.e., TCE groundwater concentrations greater than 5,000 micrograms per liter, µg/L, and elevated ECD responses observed during the NAPL Investigation) is depicted in Figure 3 and is the focus of this PDI.

TCE is the primary chlorinated VOC present in groundwater in the Northern Area of the Site. Minor concentrations of chlorinated VOC degradation products, such as 1,2-cis-dichloroethene (cis-1,2-DCE), have been detected in groundwater samples collected from the Northern Area. The lack of elevated concentrations of degradation products indicates that natural biodegradation does not appear to be readily occurring in the Northern Area.

Based on the January 2015 sampling event, the pH of shallow groundwater in the Northern Area of the Site (MW-6 and MW-7) was approximately 5, which could be one of the factors limiting the ability of microbes to anaerobically biodegrade TCE to cis-1,2-DCE (Amec Foster Wheeler, 2015). The pH of the deeper groundwater in the Northern Area of the Site is approximately 7 and 9 in monitoring wells MW-6A and MW-7A, respectively. It should be noted that the initial pH in groundwater purged from the deeper monitoring wells after installation in 2009 ranged from 11 to 12, indicating likely grout/concrete “contamination” from the alkaline grout/cement emplaced in the annulus of the monitoring wells (Nielsen, 2006). The “elevated” pH readings in the January 2015 measurements in the PWR wells could be a result of the continuing effect of the alkaline grout/cement used in the well construction.

Concentrations of TCE vary horizontally and vertically in the Northern Area. Based on TCE concentrations in collected groundwater samples and ECD responses, chlorinated VOC concentrations generally increase with depth (Note: the ECD probe did not advance to the depth of bedrock due to limitations of the drilling equipment; the ECD probe generally advanced to a depth of approximately 50 feet bgs). The relatively significant upward vertical hydraulic gradient (i.e., -0.015 in 2009 and -0.12 in 2015) at the MW-6/6A monitoring well pair is likely the reason TCE concentrations in shallow groundwater at MW-6 are higher as compared to TCE concentrations in shallow groundwater at MW-7, where the vertical hydraulic gradient is very low (i.e., 0.004 upward in 2009 and 0.0009 downward in 2015).

Petroleum constituents have not been detected at elevated concentrations in groundwater samples collected in the Northern Area of the Site. Relatively minor concentrations of petroleum constituents (i.e., compared to reported TCE concentrations) were detected in groundwater samples collected in January 2015 from monitoring well MW-6, as well as in groundwater samples collected from SB-05 and SB-10 during the NAPL Investigation. These minor concentrations indicate that the groundwater plume in the Northern Area of the Site does contain a relatively small proportion of petroleum constituents. In general, the petroleum constituents that have been detected are short-chain hydrocarbons (e.g., benzene, toluene, and xylenes) which more readily dissolve into groundwater from a petroleum fuel source, such as the petroleum NAPL in the source area. Petroleum constituents in groundwater in the Northern Area are not considered to contribute significant mass to the overall contaminated groundwater plume.

2.5 FATE AND TRANSPORT

The fate and transport of contaminants in soil and groundwater is influenced by numerous factors, including the primary and secondary release mechanisms; the physical and chemical properties of the constituents that were released; and the characteristics of the subsurface medium through which the contaminants migrate.

2.5.1 Contaminants of Concern

The primary constituent of concern for the Northern Area is TCE.

2.5.2 Contaminant Transport Pathways

The primary transport pathway for contamination in the overburden in the Northern Area is via groundwater. The unsaturated soil pathway, where contaminants leach from the soil to the underlying groundwater, is not considered a transport pathway, as evidence of contamination in the unsaturated soil has not been identified in the Northern Area. The dissolved-phase groundwater plume in the Northern Area discharges at surface water features east and west of the Site resulting in an airborne contaminant pathway via volatilization of VOCs, as well as a surface water contaminant transport pathway.

2.5.3 Mass Distribution

The NAPL source area at the Site contains the largest mass of contaminants. The downgradient dissolved-phase plume contains chlorinated VOC degradation compounds and minor concentrations of petroleum constituents. Groundwater in the Northern Area contains concentrations of TCE ranging from hundreds µg/L to tens of thousands µg/L. As previously described, concentrations of TCE vary horizontally and vertically in groundwater in the Northern Area.

3.0 SCOPE OF WORK

The PDI will be conducted using qualitative and quantitative field techniques collected via real-time direct-sensing equipment, as well as traditional laboratory methods.

3.1 SAMPLING AND ANALYSIS PLANS

The Remedial Design Work Plan contains a Field Sampling and Analysis Plan (FSAP) and a Quality Assurance Project Plan (QAPP) that are associated with this PDI scope of work.

The FSAP describes the data gathering methods, sampling equipment and procedures, borehole abandonment procedures, decontamination procedures, and procedures for management of investigative derived waste.

The QAPP describes the project objectives and organization, functional activities, and the quality assurance and quality control protocols that will be used to achieve the desired data quality objective for the project.

3.2 HEALTH AND SAFETY

A Site Health and Safety Plan (HASP) has been developed specific to the Site activities and has been submitted to the USEPA under separate cover. The HASP applies to Amec Foster Wheeler employees and Amec Foster Wheeler subcontractors, only. Field teams will have a copy of the HASP during field activities. Personnel working at the Site during the PDI will be required to read, understand, and conform to the requirements of the HASP.

3.3 MEMBRANE INTERFACE PROBE

The membrane interface probe (MIP) allows for the real-time qualitative analysis of VOCs in the subsurface. The MIP tool consists of a semi-permeable membrane mounted on the outside of a stainless steel drive point, which is attached to direct-push technology (DPT) equipment/rods. The membrane is heated to 100 to 120 degrees Celsius and a constant flow of non-reactive carrier gas sweeps behind the membrane. VOCs present in the subsurface (soil or groundwater) diffuse across the membrane and are carried to gas phase detectors at ground surface via the carrier gas. Different gas phase detectors are available for identifying VOCs, and most commonly include: photoionization detector (PID), ECD, and flame ionization detector (FID). The detectors provide a “screening” response rather than a concentration. The PID and FID are responsive to VOCs. However, the ECD responds only to chlorinated VOCs, such as TCE, with a detection limit as low as 250 parts per billion. The PID/FID responses, in combination with the ECD response, are relative to the concentration of the VOC(s) encountered. However, the ECD cannot discern the “phase” of the detected VOCs (i.e., sorbed, dissolved, or non-aqueous phase liquid), nor can the MIP identify the constituent(s) comprising the VOCs.

The drive point also contains a device for measuring the electrical conductivity of the formation (soil and groundwater), which provides real-time lithology information. The lithology information, in combination with the MIP results, can be used to potentially identify preferential pathways for contaminants.

The MIP system will be used to provide real-time VOC and conductivity profiling to more fully characterize the distribution of VOCs in the dissolved phase plume in the Northern Area of the Site. MIP data was collected in the Northern Area during the NAPL Investigation in 2013/2014, and this data will be used in association with this proposed PID MIP data.

Borings will generally be located in a grid pattern. Up to 35 borings are proposed for this phase of work. Proposed boring locations have been established for 32 locations, as depicted in Figure 3, and three borings will be advanced at the end of the investigation to collect additional data where it is determined necessary based on the results of the 32 established locations. The MIP sampling procedure is described in Section 5.2 of the FSAP.

3.4 SOIL SAMPLING

Soil samples will be collected adjacent to the MIP borings at up to ten locations. The soil cores will be visually examined to determine the soil type. Up to 20 soil samples will be collected from various soil types and submitted for analysis of permanganate natural oxidant demand (NOD) according to ASTM D 7262-07, Standard Test Method for Estimating the Permanganate National Oxidant Demand of Soil and Aquifer Solids. The permanganate NOD values will be used to determine the amount of permanganate required for emplacement to achieve remedial goals.

Up to ten soil samples will also be collected adjacent to select MIP borings and submitted for analysis of Target Compound List (TCL) VOCs according to USEPA Method 8260. The VOC analytical data will be evaluated to determine the relative portion of contamination that is sorbed to the soil (i.e., not dissolved in groundwater). The soil sampling procedure is described in Section 5.4 of the FSAP.

3.5 GROUNDWATER SAMPLING

Groundwater samples will be collected adjacent to select MIP borings at up to ten locations. The groundwater samples will be submitted for analysis of TCL VOCs according to USEPA Method 8260. The analytical data will be evaluated in correlation with the MIP data to develop an interpretation of the magnitude and distribution of contamination in the ISCO remediation area. The groundwater sampling procedure is described in Section 5.5 of the FSAP.

4.0 SCHEDULE

The proposed schedule for the implementation of the PDI Work Plan and ISCO Treatability Study, is presented in Appendix D of the Remedial Design Work Plan.

5.0 REFERENCES

Amec, 2012. NAPL Investigation Work Plan (Revision 1), CTS of Asheville, Inc. Superfund Site, November 9, 2012.

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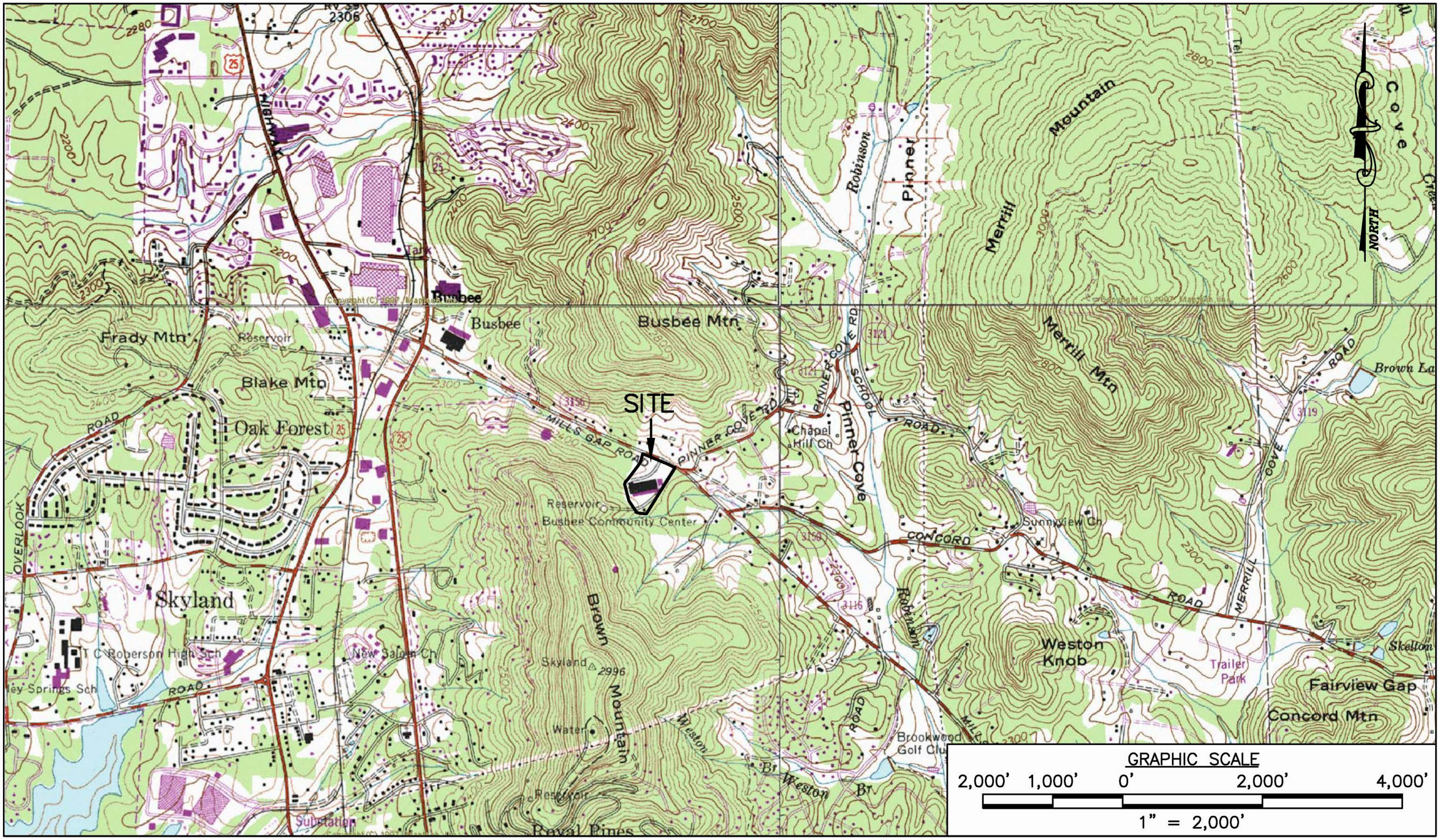
FIGURES

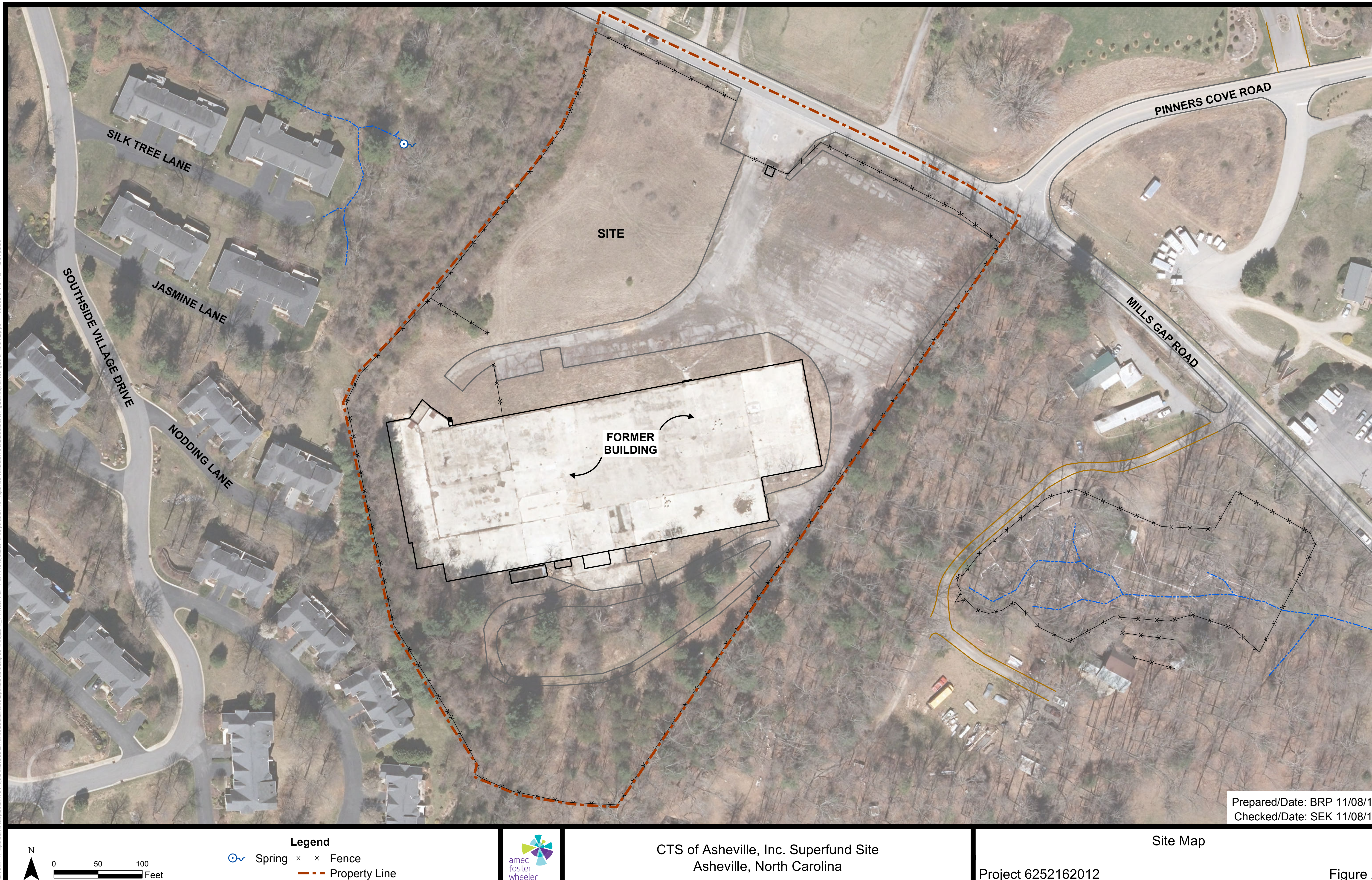


TOPOGRAPHIC SITE MAP
CTS OF ASHEVILLE, INC. SUPERFUND SITE
ASHEVILLE, NORTH CAROLINA

amec foster wheeler

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

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



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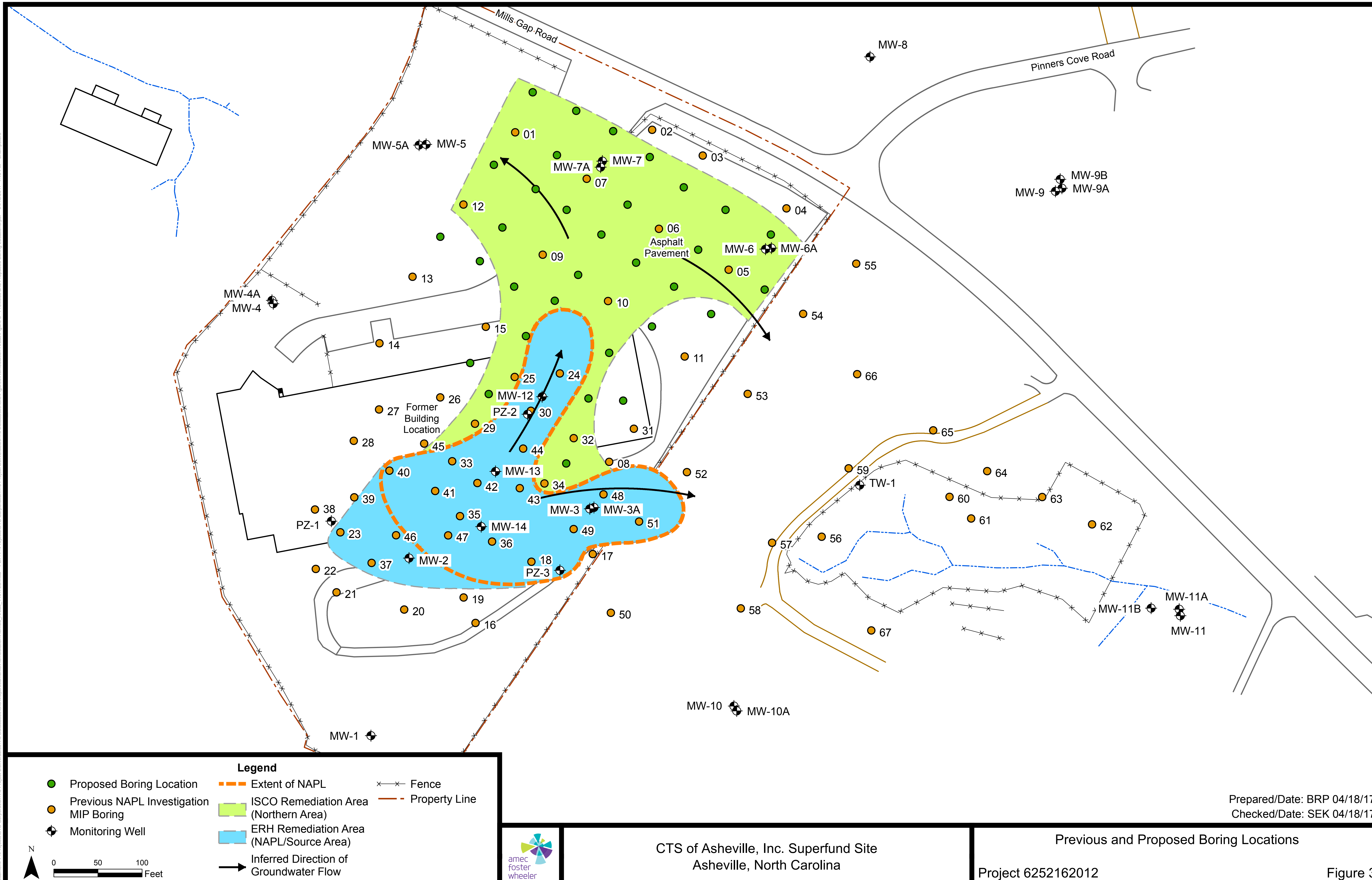
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

Site Map

Project 6252162012

Figure 2



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

Previous and Proposed Boring Locations

Project 6252162012

Figure 3