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FINAL
**Post-BERA Investigation Work Plan for Operable Unit 1,
Marine Corps Air Station Cherry Point, North Carolina**

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The purpose of this technical memorandum is to present a work plan for follow-up investigation activities at Operable Unit 1 (OU1). These activities are being proposed as a result of the potential risk identified in the Final Baseline Ecological Risk Assessment (BERA) conducted for OU1 (CH2M HILL, 2005). The BERA included evaluation of potential inputs from multiple Installation Restoration (IR) sites to determine if previous releases pose a potential risk to ecological receptors in habitat areas across OU1.

The objectives of this memorandum are to:

- Summarize ecological risk assessment results for OU1;
- Describe the hydrology of OU1 relative to the Sandy Branch Aquatic System;
- Propose remediation goals (RGs) for a subset of the chemicals of potential concern (COPCs) identified in the BERA;
- Propose a sampling plan to define the distribution of COPCs; and
- Describe the methodology for delineating wetlands at OU1 that could potentially be impacted by a remedy.

1.0 Ecological Risk Assessment Summary

By area, results of the ecological risk assessment for OU1 are summarized below. Additional details may be found in the original reports. As presented in the Step 3A Addendum (CH2M HILL, 2003) and the Final BERA (CH2M HILL, 2005), risks were identified for Soil Grouping 2, Soil Grouping 3, and the Sandy Branch Aquatic System.

1.1 Soil Grouping 2

Site 17, which is located just south of the Naval Aviation Depot (NADEP) (Figure 1), was identified as posing an ecological risk. The drainage ditch and adjacent grassy area at this site were identified as posing an ecological risk because it represents a continuing source of COPCs to downgradient aquatic systems (School House Branch and East Prong Slocum Creek), posing potential risks to upper-trophic-level receptors (CH2M HILL, 2003). These COPCs consist primarily of polychlorinated biphenyls (PCBs), and also a cluster of elevated cadmium, chromium, lead, mercury, silver, and zinc. Since ecological risks had already been identified and defined for this site (i.e., no additional risk assessment was necessary), it was recommended that Site 17 be excluded from the BERA investigation and included in the OU1 Feasibility Study (FS) or an Engineering Evaluation/ Cost Assessment (EE/CA). The approach for addressing Site 17 will be presented to the Marine Corps Air Station (MCAS) Cherry Point Tier I Partnering Team under separate cover at a future date.

1.2 Soil Grouping 3

Soil Grouping 3 is a set of terrestrial habitats in the eastern end of OU1 (Figure 1) that includes several sites (e.g., Site 16, BRAC Site 5, and Site 83) (CH2M HILL, 2005). As presented in the Step 3A Addendum report (CH2M HILL, 2003), a portion of Soil Grouping 3 was identified as posing potential ecological risk that required further evaluation through the BERA.

In the BERA Work Plan (CH2M HILL, 2004), the area posing a potential risk was divided into two smaller areas of ecological concern (AOECs), because each had been subject to different types of release and disposal. These areas were referred to as the southwest (SW) and southeast (SE) AOECs (Figure 2). For the BERA, multiple surface soil samples were collected within the AOECs in May 2004 and analyzed for chemical constituents. In addition, all samples were subjected to 28-day springtail (*Folsomia candida*) toxicity tests (OECD, 1990).

In the BERA, the following two assessment endpoints were established for the AOECs of Soil Grouping 3:

1. Protection of the soil invertebrate community from negative effects (i.e., decreased growth, survival, reproduction) associated with COPCs in soil; and
2. Protection of populations of insectivorous mammalian species from negative effects (i.e. decreased growth, survival, reproduction) associated with mercury in site soils.

Based on the analysis of collected data, assessment endpoint #1 was not met. Soil-associated receptors (e.g., soil invertebrates) are at potential risk from direct exposure to chemical contamination in three samples (SS-108, SS-110 and SS-113) along the hillside that forms the eastern boundary of SE AOEC, adjacent to Site 83 (previous location of Buildings 96 and 97) (Figure 2). Potential risk-driving chemicals in these samples include inorganics (e.g., cadmium, chromium, copper and lead) and pesticides (alpha- and gamma-chlordane). It was determined that risks to soil-associated receptors in SW AOEC are unrelated to IR releases or activities and there are no site-related risks for SW AOEC receptors.

Assessment endpoint #2 was met; there were no unacceptable food web risks identified. Furthermore, although there was no specific assessment and measurement endpoints

developed in the BERA work plan for upper trophic level risk from chemicals other than mercury, supplemental food web modeling was performed to address the prevalence of bioaccumulative chemicals in the samples collected to support the BERA. The modeling results suggested that there is no food web risk from any of the detected bioaccumulative chemicals at Soil Grouping 3.

The area where SE AOEC samples (SS-108, SS-110 and SS-113) are posing potential risk to soil invertebrates consists of a steep hillside vegetated with trees and scrubby, invasive plants indicative of disturbance. The area posing a risk is a small percentage of the total habitat area in this portion of OU1. In addition, risks were identified for soil invertebrates only. The most valuable ecological aspect of the hillside is the trees. They provide nesting and roosting areas for birds and help to stabilize the soil, reducing erosion and subsequent deposition of soils into East Prong Slocum Creek. Contamination aside, the quality of soils on the steep hillside is poor for soil invertebrates, the only receptors at risk. The soil is sandy and there is little retention of moisture and organic material. Given that exposure is limited and a previous cleanup in 1996 (Figure 2) resulted in the removal of much of the contamination in the area, risks, while identified, are not considered significant. It is recommended that the Tier I Partnering Team consider closing the site with no further action.

1.3 Sandy Branch Aquatic System

The Sandy Branch Aquatic System comprises the main Sandy Branch channel and its two tributaries, Tributaries 1 and 2 (Figure 1). Multiple sites, including Site 42 (the Industrial Wastewater Treatment Plant [IWTP]), Site 98 (VOC in groundwater near Building 4032) and SWMU C-4 are adjacent to this aquatic system. As presented in the Step 3A Addendum report (CH2M HILL, 2003), portions of the Sandy Branch Aquatic System were identified as posing potential ecological risks that required further evaluation through the BERA.

In accordance with the BERA Work Plan (CH2M HILL, 2004), multiple sediment samples were collected across the Sandy Branch Aquatic System in May 2004 and analyzed for chemical constituents (see Attachment A for BERA Figure 2-3). In addition, a subset of samples collected in the Tributary 2 channel were subjected to 35+ day midge fly (*Chironomus tentans*) larvae (USEPA, 2000; ASTM, 2001) and 10-day northern leopard frog (*Rana pipiens*) whole sediment toxicity tests (NAVFAC, 2004).

The assessment endpoint for the Sandy Branch Aquatic System in the Final BERA was the protection of sediment-associated receptors from negative effects associated with exposure to sediment-related COPCs (cadmium and PCBs) or other chemicals. Based on the analysis of all collected data, this assessment endpoint was not met. The midge test results indicated there is significant toxicity, and thus risk to benthic macroinvertebrates from chemical contamination within Tributary 2 and portions of its drainage area and floodplain. Following the frog toxicity tests, only slight growth reduction was observed for samples which elicited severe toxicity to midge. Therefore, it was concluded that potential risks to amphibians were negligible and the primary at-risk population is the benthic macroinvertebrates.

Using the midge toxicity test results for Tributary 2 samples, the Apparent Effects Threshold (AET) approach was used to develop site-specific effect levels, or thresholds, for risk-driving chemicals in the Sandy Branch Aquatic System. As described in the BERA (CH2M HILL,

2005), the AETs were established after the sample-specific toxicity test results were used to identify samples as “impacted” (site-related toxicity) and “unimpacted” (no site-related toxicity) (see Attachment A for BERA Table 2-15). The AETs represent a no observed effect level (NOEL) and are equal to the highest concentration in “unimpacted” samples (see Attachment A for BERA Table 2-16). To identify COPCs, the AETs were then compared to contaminant concentrations measured in all samples across the Sandy Branch Aquatic System (see Attachment A for BERA Table 2-17).

Based on the comparison of detected chemicals to AETs, no significant risks were identified for sediment-associated receptors in the main Sandy Branch channel or at the confluence of Sandy Branch and East Prong Slocum Creek (i.e., detected chemicals in these areas were below AETs). In Tributary 2, there were several chemicals at multiple locations with concentrations in excess of AETs. These COPCs included three inorganic constituents (cadmium, chromium, lead) eight pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan sulfate, endrin, endrin aldehyde, alpha-BHC, and gamma-chlordane), total polycyclic aromatic hydrocarbons (PAHs), and three non-PAH SVOCs (2,4-dimethylphenol, 4-methylphenol, and bis[2-ethylhexyl]phthalate).

Although no assessment and measurement endpoints were developed in the BERA work plan to evaluate upper trophic level risk, supplemental food web modeling was performed to address the bioaccumulative chemicals detected in BERA samples. The food web modeling suggested that great blue heron feeding in the Tributary 2 area may be at risk from exposure to sediment-associated mercury via the food chain. The Tier I Partnering Team, however, has chosen to focus on mitigating risks identified for sediment-associated receptors in Tributary 2 and adjoining wetlands. The information to support the declaration of a risk is much stronger for these receptors than for piscivorous birds. In addition, any actions taken to address risks to sediment-associated receptors would fully eliminate any modest level of risk that may exist for piscivorous birds.

The Final BERA represents a complete identification of risk drivers (COPCs) for the Sandy Branch Aquatic System. Based on these risks, it was recommended that supplemental sampling and analysis be performed in and adjacent to Tributary 2 in order to: 1) more fully understand the source of contaminants observed in Tributary 2; and 2) complete the contaminant delineation of the stretches of the Tributary 2 stream channel and portions of drainage area and floodplain that pose an unacceptable risk to sediment-associated receptors.

2.0 OU1 Hydrogeology Relative to the Sandy Branch Aquatic System

Groundwater is a potential migration pathway for COPCs to the Sandy Branch Aquatic System. In order to determine if groundwater is contributing contaminants to sediment, groundwater monitoring will be conducted along Tributary 2.

Groundwater flow in the vicinity of Tributary 2 is towards the surface water body of the tributary. Contaminants identified in the vicinity of Building 133 have the potential to migrate northwest to the tributary (Figure 3). There is no historical information that indicates that there were activities north of the tributary which would contribute

contamination to Tributary 2 and, therefore, no groundwater data will be gathered north of Tributary 2.

Two existing monitoring wells, OU1-MW37 and 51EX10, are located on the southeast side of Tributary 2 (see Figure 3). Sampling from these wells during previous investigations have identified the presence of VOCs above the North Carolina groundwater standards, known as the NC 2Ls. In order to adequately measure any groundwater contamination reaching Tributary 2, the installation and sampling of two additional wells is proposed. One well will be placed between existing OU1-MW37 and 51EX10 and a second will be placed to the southwest of OU1-MW37. The wells will be installed in the upper surficial aquifer and will serve as sentinel wells for contaminants reaching Tributary 2. Groundwater samples collected from all four wells will be analyzed for VOCs, SVOCs, pesticides/PCBs, and inorganics. During sampling, groundwater parameters will be monitored which include pH, conductivity, turbidity, temperature, and dissolved oxygen.

3.0 Proposed Remediation Goals

Based on the conclusions of the BERA, further investigation to define the distribution of COPCs and consideration of remediation were recommended for Tributary 2 and surrounding wetlands/floodplain. Contaminants conveyed via Tributary 2 may have been deposited in the surrounding wetland/floodplain area. To guide the additional sampling and analysis, calculation of proposed RGs was necessary. The AETs were the most appropriate starting point for developing RGs because they are derived from site-specific toxicity information. The following subsections discuss the selection of COPCs for which RG were developed, methods of calculation, and proposed RGs.

3.1 COPC Considerations

AETs were developed for chemicals with concentrations that were negatively correlated with sediment toxicity test performance. As presented in BERA Table 2-16 (see Attachment A), AETs were calculated for the following 27 COPCs:

- Inorganics – cadmium, chromium and lead;
- Pesticides – 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan sulfate, endrin, endrin aldehyde, alpha-BHC, and gamma-chlordane;
- Individual PAH compounds– 2-methylnaphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene);
- Total PAHs; and
- Non-PAH SVOCs – 2,4-dimethylphenol, 4-methylphenol, and bis(2-ethylhexyl)phthalate.

Upon review of the 27 COPCs for which AETs were developed, opportunities to decrease the number of RGs were identified. First, a total DDT concentration was calculated for each sample as a means of consolidating 4,4'-DDD, 4,4'-DDE and 4,4'-DDT data. As for PAHs, it is believed that calculating a total DDT concentration better represents the potential for risk. Because it is believed that the individual compounds will be addressed by addressing the

sums, individual PAH compounds and the specific DDT family chemicals (i.e., 4,4'-DDD, 4,4'-DDE and 4,4'-DDT) were removed from the list of COPCs requiring RGs.

Two chemicals (endosulfan sulfate and endrin) were never detected in toxicity test samples (see Attachment A for BERA Table 2-16). The negative correlation between concentrations of these chemicals and toxicity test performance was simply an artifact of the sample-specific detection limits. As such, no RGs were developed for these two compounds. Another chemical, 2,4-dimethylphenol, was detected at 420 µg/kg in one of seven toxicity test samples. Although the sample was identified as impacted, the detected concentration was less than the AET. As a result, this compound was also excluded from RG development.

RGs were developed for the following 10 COPCs:

- Cadmium
- Chromium
- Lead
- DDT, total
- Endrin aldehyde
- alpha-BHC
- gamma-Chlordane
- 4-Methylphenol
- bis(2-ethylhexyl)phthalate
- PAHs, total

3.2 RG Development

While AETs are analogous to a NOEL, or the maximum concentration in “unimpacted” samples, they do not suggest how much higher concentrations can be before they might illicit a negative effect. Therefore, AETs should not be used as RGs, but rather as a tool to evaluate potential site-related risk as was done in the BERA. The lowest observed effect level (LOEL) is assumed to be the concentration in “impacted” samples that is the next highest above the AET concentration. The AET and LOEL are assumed to bound the actual threshold concentration. That is, the level thought to illicit a negative effect at the site is assumed to be somewhere between these concentrations. RGs were calculated as the geometric mean between the AET and the LOEL. The geometric mean is conservative in that the RG will be closer to the AET than the LOEL.

Table 1 presents the AETs, LOELs, and RGs for the 10 COPCs. The RGs were compared to applicable sediment screening values to determine their appropriateness as clean-up goals. Any RG below a screening value was considered too conservative and inappropriate as a clean-up level.

The geometric means of two COPCs (4-methylphenol and total PAHs) were below screening values. The geometric mean of the AET and LOEL for 4-methylphenol was 268.7 µg/kg, which is less than the Region 3 screening value of 670 µg/kg (USEPA, 2005). There was no Region 4 screening benchmark available (USEPA, 2001).

The benchmark selected for total PAHs was 1,610 µg/kg. This value is a consensus-based sediment quality guideline for freshwater sediment (MacDonald et al., 2000) and is conservatively based on 1 percent TOC (i.e., assumes maximum bioavailability; most

conservative). It is also the Region 3 screening value. The Region 4 screening value (1,684 µg/kg) is an earlier value developed by McDonald (1994). Because the RGs will likely be used to guide remediation, it was important to modify the screening value for the percent TOC in the sediments of Tributary 2. Based on the average TOC of 6.7 percent (see Attachment A for BERA Table 2-3), a benchmark of 10,787 µg/kg was calculated. Because the geometric mean of the NOEL and LOEL for total PAHs (3,131 µg/kg) was less, 10,787 µg/kg was adopted as the RG.

4.0 Delineation of COPC Extent

For the 10 COPCs, the extent of contamination will be delineated. This section presents a sampling and analysis work plan designed to achieve that objective.

4.1 Study Area

To facilitate the delineation of contaminants in the Tributary 2 habitat, CH2M HILL ecologists conducted a field survey September 19-20, 2005 to define the boundary of potential COPC influence. Assuming that Tributary 2 itself is the source of COPCs to the surrounding habitat, the extent of contamination is assumed to be limited to the tributary itself and its floodplain. That is, during periods of high precipitation or when beavers have dammed the area it is assumed that COPCs associated with sediment particulate may have been distributed to areas flooded by stream surface water overflow. These areas will be the focus of the sampling effort.

The CH2M HILL ecologists walked the entire Tributary 2 habitat corridor and identified the boundaries of potential COPC influence by observing topography, wetland/upland vegetation, and soil characteristics (e.g., degree of inundation, organic matter, and anoxia indicators) were used as cues to identify the outer boundaries of the floodplain. Points along the entire study boundary were marked in the field with sequentially-numbered flagging. A Trimble Pro-XRS Global Positioning System (GPS) unit was used to locate each of the flags. The GPS locations were downloaded onto aerial photography of the site. Figure 4 depicts the boundaries established on September 19-20, 2005. As shown, the potentially affected habitat was divided into four study "Areas" by segment of Tributary 2 and its adjacent floodplain. The following table summarizes the location and approximate size of these four areas.

| Study Area (Figure 4) | Location | Size |
|--------------------------|---|-------------------------------------|
| Area 1 | between the Walking Bridge 1 and 2 | 0.43 acres (18,600 sq. feet) |
| Area 2 | between Walking Bridge 1 and SD-109 | 0.83 acres (36,180 sq. feet) |
| Area 3 | Between SD-109 and SD-11 | 0.48 acres (20,800 sq. feet) |
| Area 4 | Between SD-11 and the confluence of Tributary 1 and 2. The boundaries of Area 4 are defined in the most upgradient portion only. | 0.19 acres (8,090 sq. feet) |
| TOTAL¹ | | 1.9 acres (83,700 sq. feet), |

¹ Total does not include approximately 500 feet of Tributary 2 channel and floodplain downgradient of Area 4

The segment of Tributary 2 east of Walking Bridge 2 will be excluded from further investigation. Based on previous sampling and observations during the survey work, the contamination in this area is negligible. The concentrations of COPCs in samples collected from this area (SD-100, SD-101, and SD32; see Attachment A for BERA Table 2-3) are all below the selected RGs (Table 1). Furthermore, there were no visual signs or odors indicating significant contamination in this segment. In areas west of Walking Bridge 2, a prominent sheen was observed when the sediment was disturbed and a strong chemical odor was apparent.

4.2 Sampling and Analysis

A total of 50 sediment samples are proposed across the Tributary 2 study area. Figures 5, 6, 7, and 8 present the proposed sample locations for Areas 1, 2, 3, and 4, respectively. Forty-two (42) samples will be collected from within the established boundaries of Areas 1 through 4. Four additional samples will be collected in Area 4 from a previously unsampled segment of Tributary 2 between the bounded portion of Area 4 and the confluence with Tributary 1 (Figure 8). Two more samples will be collected in Area 4 in the forested wetland complex east of Tributary 2. Within Area 4, Tributary 2 becomes a deep channel through which water is conveyed to Sandy Branch. As such, minimal to no COPC contamination is expected in the forested wetland.

Finally, two additional samples are proposed to be collected north (upgradient) of the study area from drainages that feed into Tributary 2 (Figure 5). These drainages carry stormwater from adjacent parking facilities into Tributary 2. The purpose of these upgradient samples is to determine if the civilian vehicles using the lot are contributing to the elevated levels of PAHs in Tributary 2 (i.e., determined if they are non-IR site related). Information from these samples could potentially be used to modified RGs upward if levels of contaminants in the sediment samples were higher than RGs.

Each sample, except for the two upgradient samples, will be analyzed for all 10 COPCs plus TOC. The two upgradient samples will only be analyzed for PAHs and TOC. All containers for these samples will be provided by the laboratory subcontractor as defined in the Master FSP (Brown and Root Environmental, April 1998a). Laboratory-grade de-ionized water will be provided by the laboratory subcontractor for equipment blanks. A standard 28-day

turnaround time will be used for all analytical samples. All sediment samples will be collected in a downstream-to-upstream fashion to prevent sample cross contamination.

Details on field-related quality assurance/quality control (QA/QC) samples are provided in Section 3.3 of the Master QAP for MCAS Cherry Point (Brown and Root Environmental, 1998b). The general type and collection frequency of QA/QC samples is presented in Table 2. Table 3 provides a summary of the number of samples that will be collected and the corresponding QA/QC samples.

5.0 Wetland Delineation

Once samples are collected and analyzed and RGs are applied to determine what areas will be the subject of remedy consideration, a jurisdictional wetland delineation will be performed. The first step will be a preliminary “desktop delineation” to initially determine the extent of wetlands and waterbodies in the vicinity of Tributary 2. Sources of information that will be reviewed will include the US Fish & Wildlife Service (US FWS) National Wetland Inventory (NWI) maps, US Geological Survey (USGS) 7.5 Minute Topography Quadrangle maps, the Natural Resource Conservation Service (NRSC) Soil Survey for Craven County, and Federal Emergency Management Agency (FEMA) Flood Insurance Rate maps. During the desktop delineation phase, information on the Sandy Branch Aquatic System will also be requested from MCAS Cherry Point natural resource personnel.

Following the desktop delineation, a jurisdictional wetland delineation will be performed over the area potentially subject to invasive remediation. This delineation will be performed to identify and flag the boundaries of wetlands and open waters regulated as “Waters of the United States.” Wetlands will be field-delineated in accordance with the Routine Determination Method outlined in the Corps of Engineers Wetland Delineation Manual (U.S. Army Corps of Engineers, 1987) and any applicable State guidance.

Areas meeting the technical criteria set forth in the Corps of Engineers Wetland Delineation Manual will be marked in the field with sequentially numbered wetland flagging. A Global Positioning System (GPS) unit will be used to document the location of each flag. The GPS locations will then be downloaded onto aerial photography of the site.

6.0 References

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Tables

Table 1
Proposed Remediation Goals (RGs) for Tributary 2 Sediment
OU 1 Post-BERA Ecological Investigation at OU 1, MCAS Cherry Point, North Carolina

| Chemical Group | Chemical | Samples Subjected to the Midge (<i>C. tentans</i>) Toxicity Tests | | | | | | | | | | Geometric Mean ³ | Applicable Screening Value | Proposed PRG |
|--|----------------------------|---|---------|--------|----------------------------|----------|--------|---------|---------|-------------------|----------|-----------------------------|----------------------------|--------------|
| | | Unimpacted | | | | Impacted | | | | LOEL ² | | | | |
| | | SD-100 | SD-104 | SD-107 | NOEL ¹ (AET) | SD-102 | SD-110 | SD-112 | SD-113 | | | | | |
| Inorganics (MG/KG) | Cadmium | 50.4 | 44.9 | 38.0 | 50 | 58.9 | 27.2 | 125 | 108 | 59 | 54.5 | 1.0 | Region 4 (USEPA 1999) | 54 |
| | Chromium | 646 | 239 | 325 | 646 | 353 | 196 | 490 | 947 | 947 | 782.2 | 52.3 | Region 4 (USEPA 1999) | 782 |
| | Lead | 396 | 283 | 184 | 396 | 246 | 130 | 743 | 306 | 743 | 542.4 | 30.2 | Region 4 (USEPA 1999) | 542 |
| Pesticides (UG/KG) | DDT, total | 420.0 | 1,428.0 | 598.0 | 1,428 | 1648.5 | 401.0 | 1,475.0 | 151.0 | 1,475 | 1451.3 | 3.3 | Region 4 (USEPA 1999) | 1,451 |
| | Endrin aldehyde | 1,300 J | 4,600 J | 990 J | 4,600 | 4,300 J | 660 J | 2,100 J | 7,900 J | 7,900 | 6,028.3 | NSV | -- | 6,028 |
| | alpha-BHC | 170 J | 270 J | 160 J | 270 | 190 J | 84.0 J | 69.0 J | 310 J | 310 | 289.3 | 6 | Region 3 (USEPA 2005) | 289 |
| | gamma-Chlordane | 44.0 J | 120 J | 34.0 J | 120 | 87.0 J | 32.0 J | 81.0 J | 190 J | 190 | 151.0 | 1.7 | Region 4 (USEPA 1999) | 151 |
| Other Semivolatile Organic Compounds (UG/KG) | 4-Methylphenol | ND | ND | 190 J | 190 | ND | 930 | ND | 380 J | 380 | 268.7 | 670 | Region 3 (USEPA 2005) | 670 |
| | bis(2-Ethylhexyl)phthalate | 2,900 | 4,300 | 8,600 | 8,600 | 2,800 | 5,500 | 14,000 | 21,000 | 14,000 | 10,972.7 | 182 | Region 4 (USEPA 1999) | 10,973 |
| | PAHs, total | 2,380 | 1,693 | 1,881 | 2,380 | 1,111 | 951 | 46,800 | 4,120 | 4,120 | 3,131.4 | 10,787.0 | Region 3 (USEPA 2005) | 10,787 |

Notes:

ND = not detected

NSV = no screening value

Footnotes:

¹No observed effects level, referred to as the Apparent Effects Threshold; maximum concentration in unimpacted samples

²Lowest observed effect level; relative to AET, next highest concentration in impacted samples

³Geometric mean of the NOEL (AET) and the LOEL

Table 2
 General Requirements for Quality Control (QC) Sample Collection
OU 1 Post-BERA Ecological Investigation at OU 1, MCAS Cherry Point, North Carolina

| Type of QC Sample | Frequency Collected |
|-------------------------------------|---|
| Field Duplicate | One per matrix for each group of up to 10 samples |
| Field Blank | One per sampling event (sample is water only) |
| Equipment Blank | One per day if equipment is decontaminated for reuse (sample is water only) |
| Trip Blank | One per day per cooler containing samples for VOC analysis (sample is water only) |
| Matrix Spike/Matrix Spike Duplicate | One for each group of up to 20 samples sent to a single laboratory |

Table 3
 Summary of Sediment Samples to be Submitted for Analysis
 OU 1 Post-BERA Ecological Investigation at OU 1, MCAS Cherry Point, North Carolina

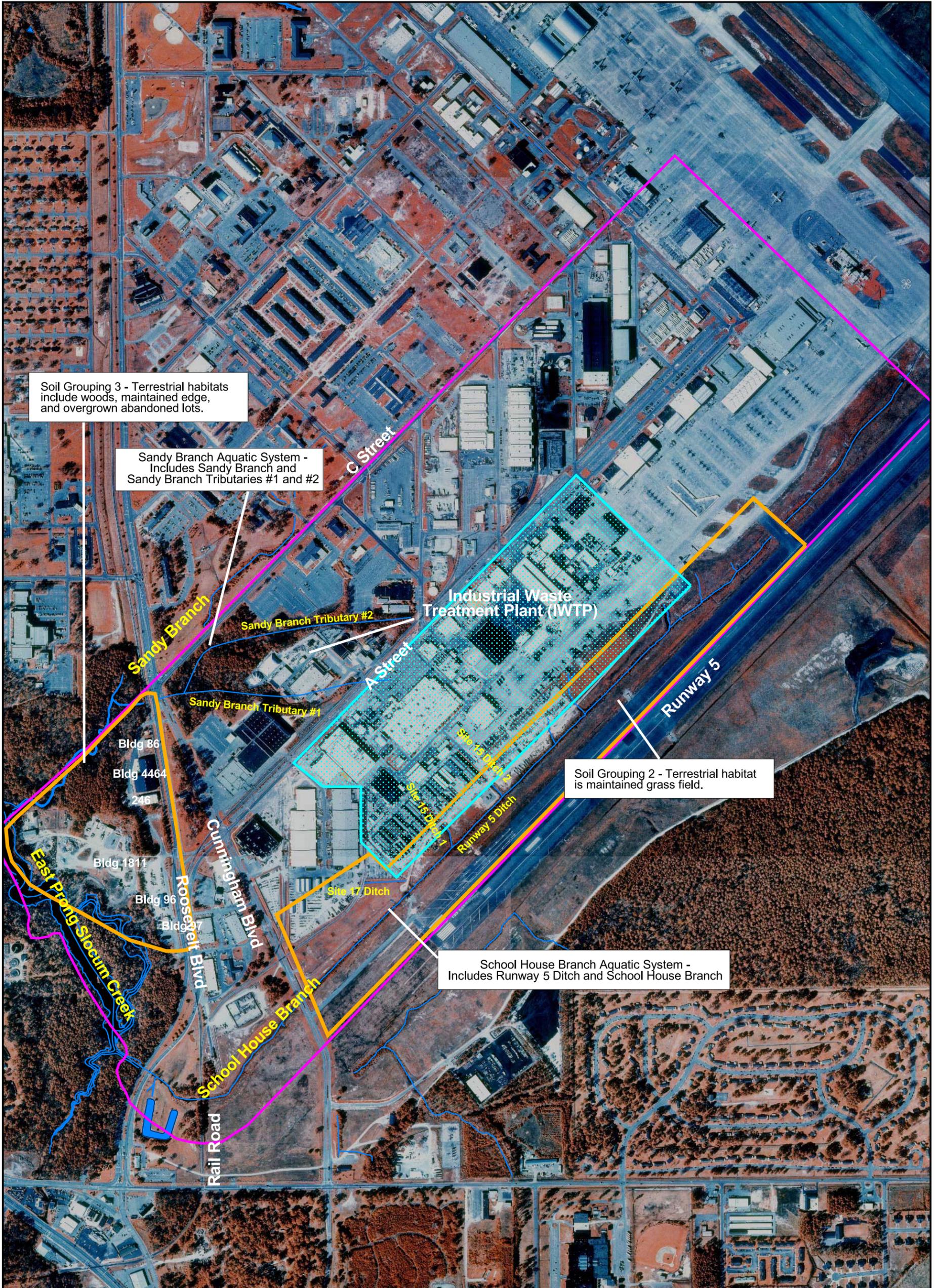
| Parameter Group | Analyses | COPCs to be analyzed | Samples | Field Duplicates | Field Blanks ^a | Equipment Blanks ^b | Total Samples | Matrix Spike ^c |
|-----------------|--|--|---------|------------------|---------------------------|-------------------------------|---------------|---------------------------|
| SVOCs | USEPA CLP OLM04 or latest version | 4-Methylphenol and bis(2-Ethylhexyl)phthalate | 50 | 5 | 1 | 5 | 61 | 1 / 1 |
| SVOCs | SW-846 8270 Selective Ion Monitoring (SIM) | PAHs | 50 | 5 | 1 | 5 | 61 | 1 / 1 |
| Inorganics | USEPA CLP ILM04 or latest version | Cadmium, Chromium and Lead | 50 | 5 | 1 | 5 | 61 | 1 / 1 |
| TOC | 415.2/9060 | Total Organic Carbon | 50 | 5 | 0 | 0 | 55 | |
| Pesticides/PCBs | USEPA CLP OLM04 or latest version | 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, Endrin aldehyde, alpha-BHC and gamma-Chlordane | 50 | 5 | 1 | 5 | 61 | 1 / 1 |

^aOne field blank will be collected during the entire sampling event and consist of laboratory-grade water

^bOne equipment blank will be collected each day re-usable equipment will be used (assumed 5 days of sampling)

^cConsists of two samples, one matrix spike (MS) and one matrix spike duplicate (MSD)

Figures



Soil Grouping 3 - Terrestrial habitats include woods, maintained edge, and overgrown abandoned lots.

Sandy Branch Aquatic System - Includes Sandy Branch and Sandy Branch Tributaries #1 and #2

Industrial Waste Treatment Plant (IWTP)

Soil Grouping 2 - Terrestrial habitat is maintained grass field.

School House Branch Aquatic System - Includes Runway 5 Ditch and School House Branch

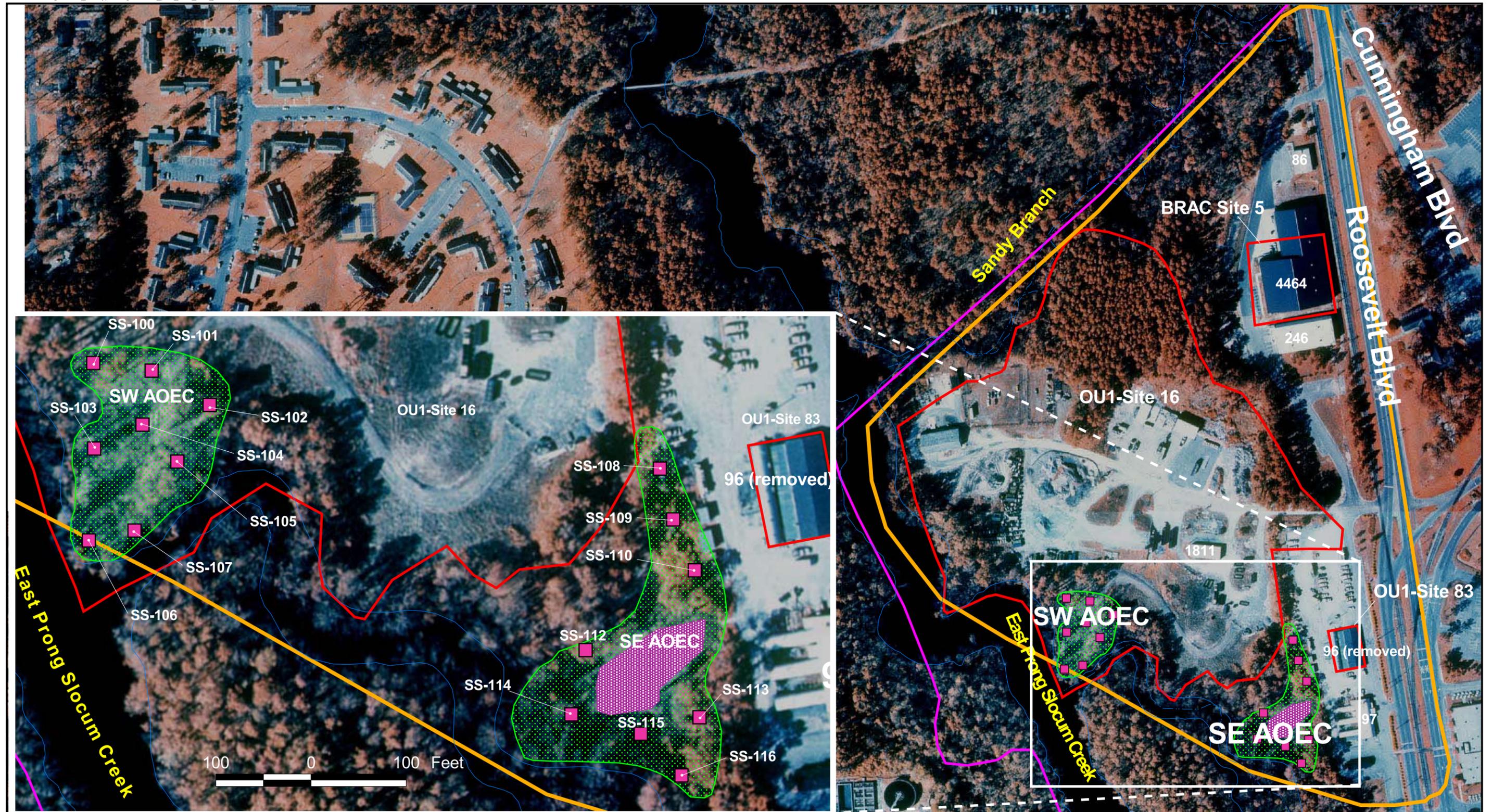
LEGEND

-  Naval Aviation Depot (NADEP)
-  Approximate OU-1 Boundary
-  Areas containing terrestrial habitat
-  Aquatic Habitats



0 800 1600 Feet

Figure 1
Operable Unit 1
MCAS Cherry Point, NC



LEGEND

- Physicochemical and toxicity test sample
 - ▭ Soil Grouping 3 Boundary
 - ▭ Site Boundaries
 - ▭ Water Body or Stream
 - ▭ Approximate OU1 Boundary
 - ▭ Area of Ecological Concern (AOEC)
 - ▭ Approximate area of soil removal/cleanup (1996)
- Note: White numbers reference base building numbers.

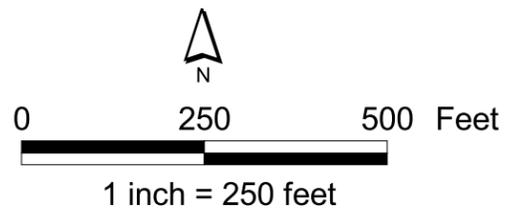
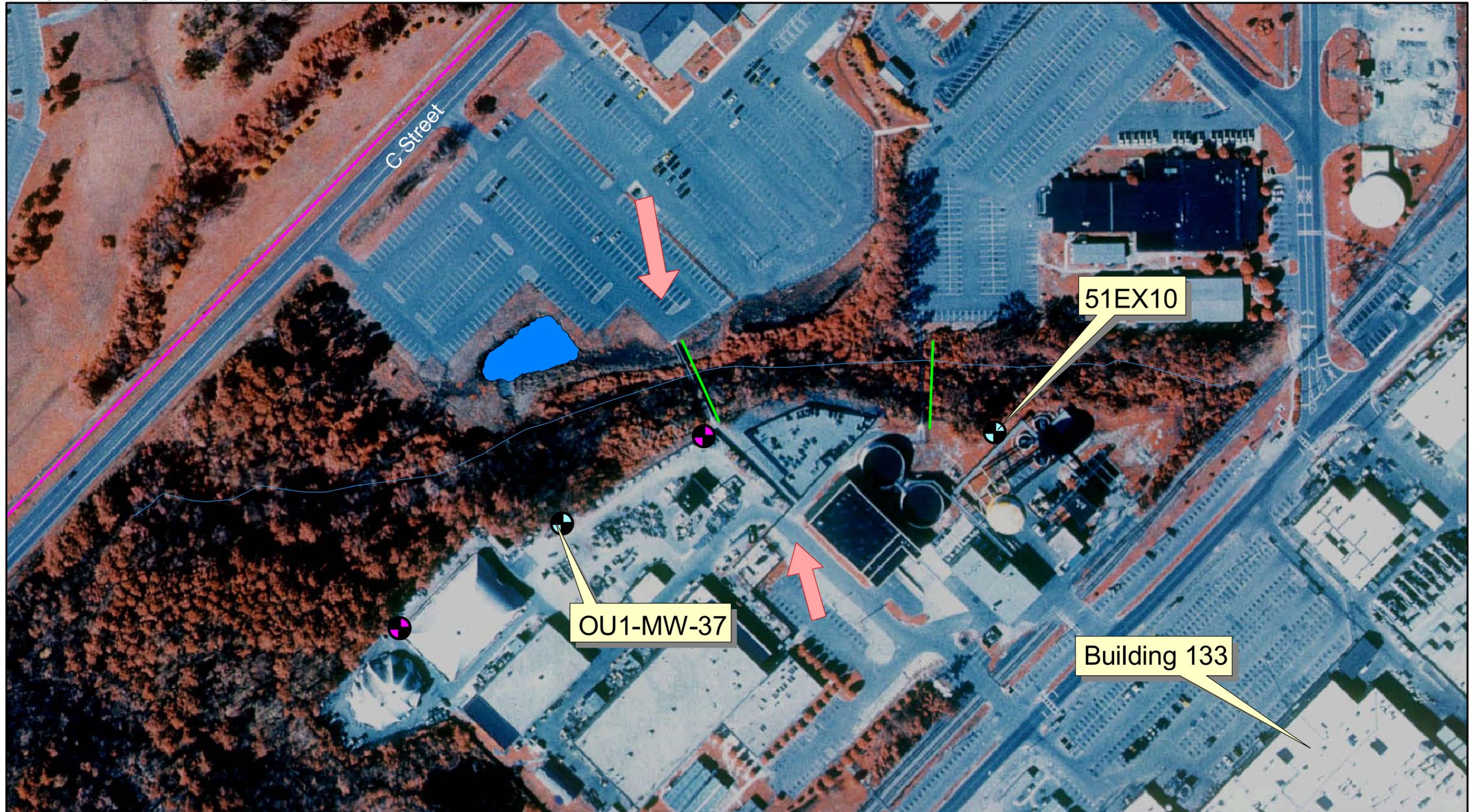


Figure 2
 Surface Soil Sample Locations (May 2004):
 Soil Grouping 3
 Operable Unit 1 (OU1)
 MCAS Cherry Point, NC



LEGEND

- Proposed Monitoring Wells
- Existing Monitoring Wells
- ~ Water Body or Stream
- ~ Walking Bridge

- OU-1 Boundary
- ➔ Groundwater Flow Direction

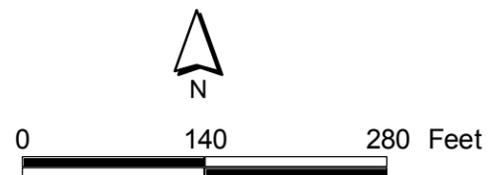
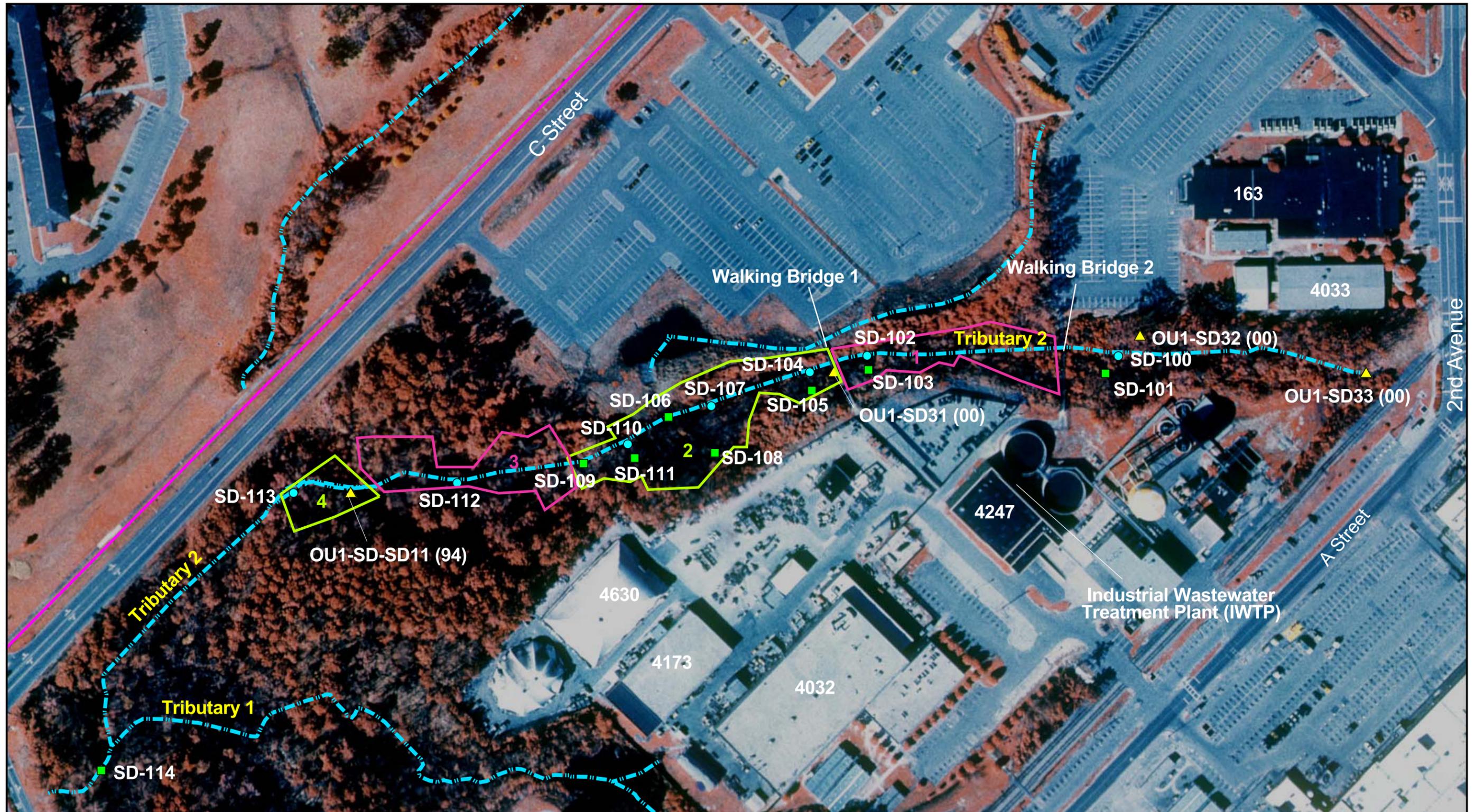


Figure 3
Existing and Proposed Monitoring Wells
Operable Unit 1 (OU1)
MCAS Cherry Point, North Carolina



LEGEND

- ▲ Historical Sample Locations (collected by Tetra Tech NUS)
- Physicochemical analysis only
- Physicochemical analysis and toxicity testing
- Approximate OU-1 Boundary
- Water Body or Stream

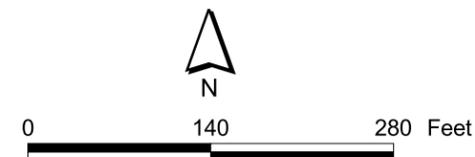


Figure 4
COPC Delineation Areas of Tributary 2
Operable Unit 1 (OU1)
MCAS Cherry Point, NC



LEGEND

- Sediment Sample Location
- ▲ Historical Sample Locations (collected by Tetra Tech NUS)
- Physicochemical analysis only
- Physicochemical analysis and toxicity testing
- Approximate OU-1 Boundary
- ▬ Water Body or Stream

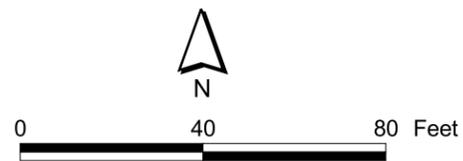
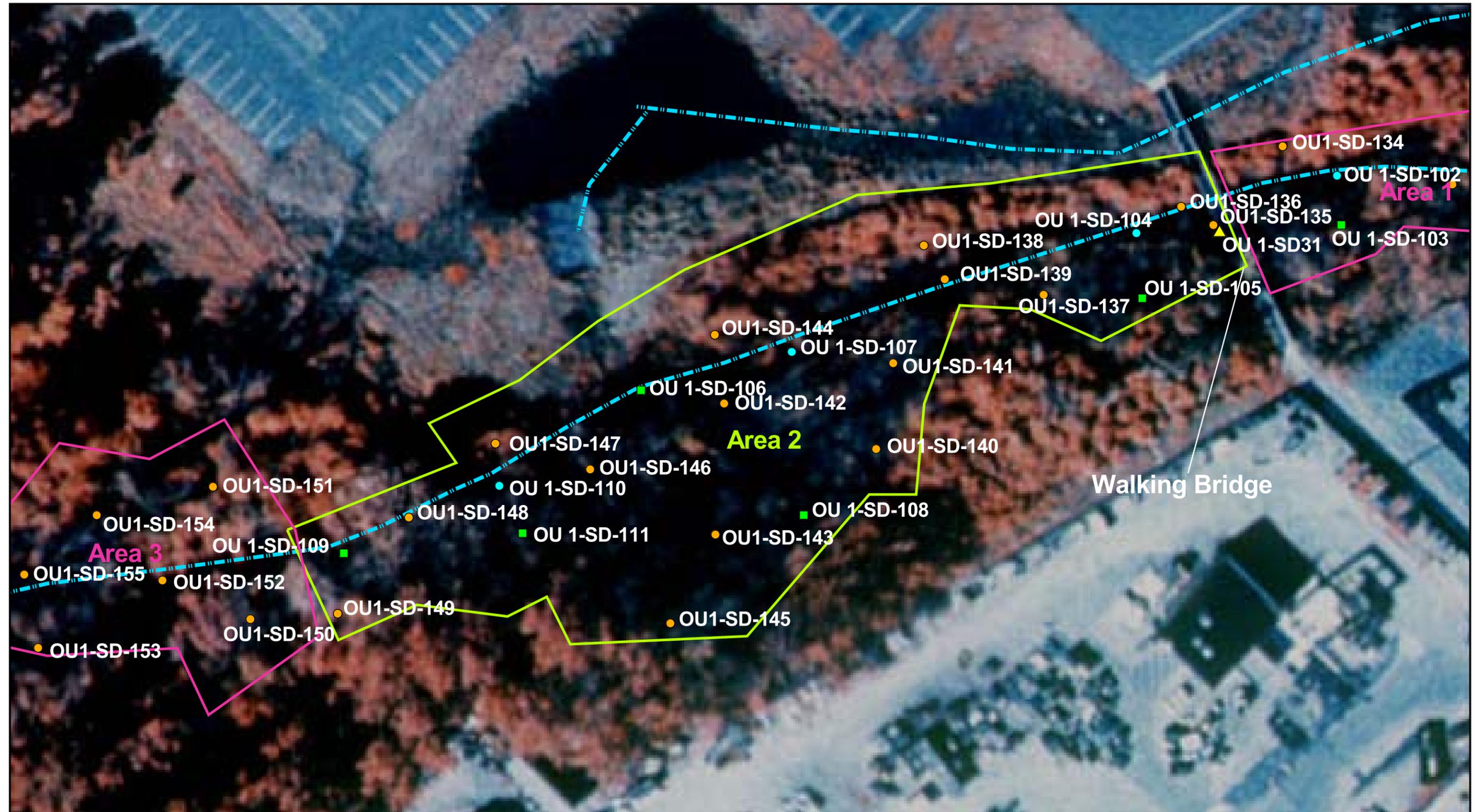


Figure 5
Sediment Sample Locations
COPC Delineation Area 1
Operable Unit 1 (OU1)
MCAS Cherry Point, NC



LEGEND

- Sediment Sample Location
- ▲ Historical Sample Locations (collected by Tetra Tech NUS)
- Physicochemical analysis only
- Physicochemical analysis and toxicity testing
- Approximate OU-1 Boundary
- ▬ Water Body or Stream

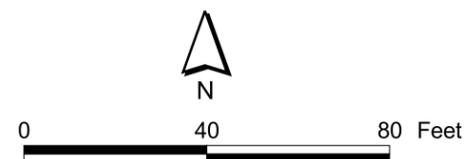
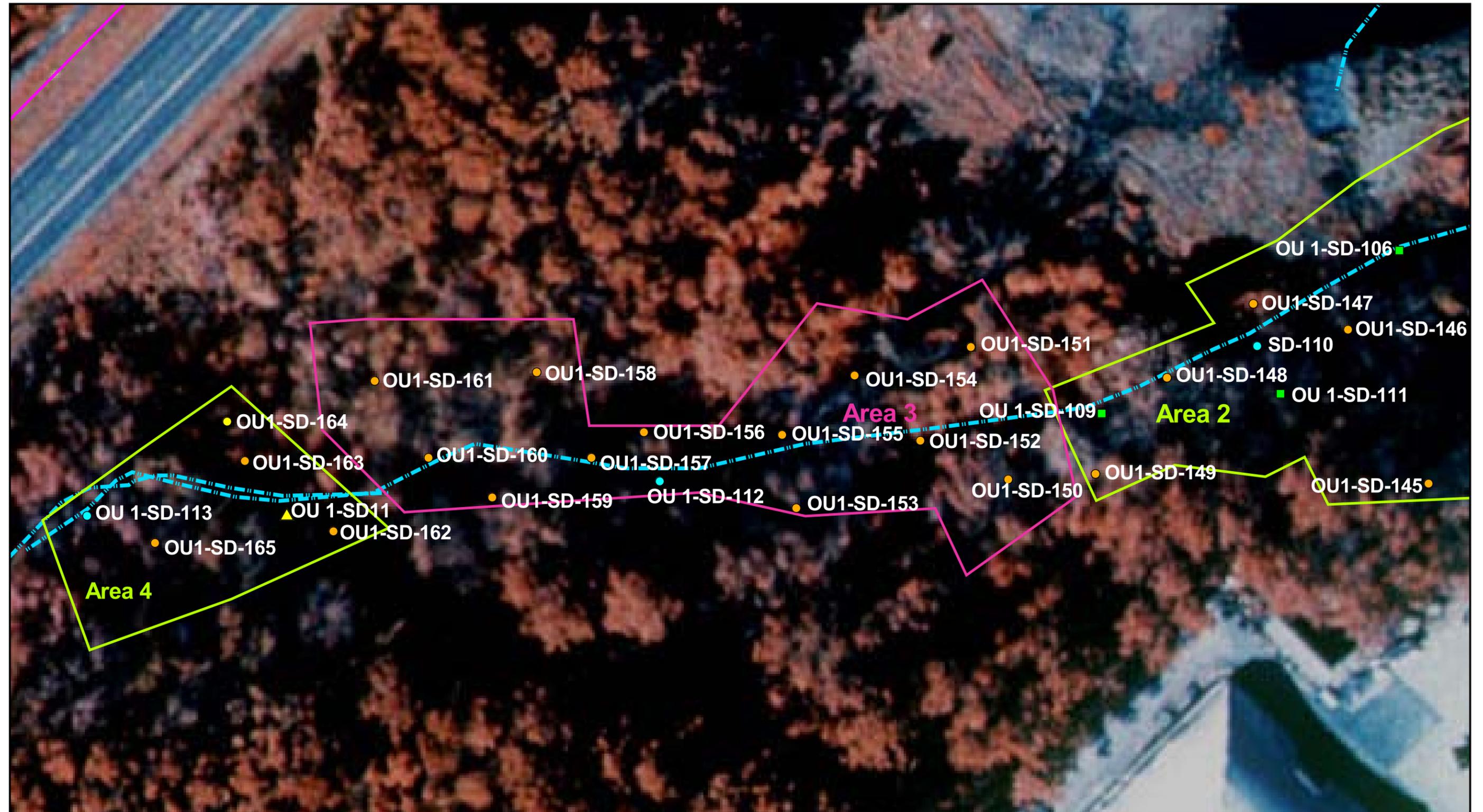


Figure 6
Sediment Sample Locations
COPC Delineation Area 2
Operable Unit 1 (OU1)
MCAS Cherry Point, NC



LEGEND

- Sediment Sample Location
- ▲ Historical Sample Locations (collected by Tetra Tech NUS)
- Physicochemical analysis only
- Physicochemical analysis and toxicity testing
- Approximate OU-1 Boundary
- Water Body or Stream

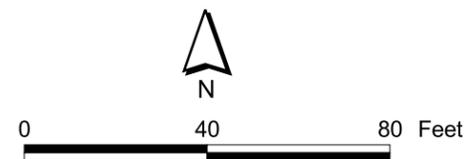


Figure 7
Sediment Sample Locations
COPC Delineation Area 3
Operable Unit 1 (OU1)
MCAS Cherry Point, NC



LEGEND

- Sediment Sample Location
- ▲ Historical Sample Locations (collected by Tetra Tech NUS)
- Physicochemical analysis only
- Physicochemical analysis and toxicity testing
- Approximate OU-1 Boundary
- ▬ Water Body or Stream

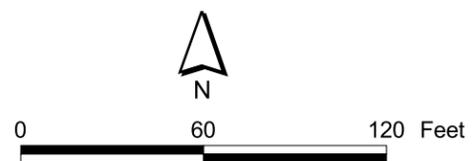


Figure 8
Sediment Sample Locations
COPC Delineation Area 4
Operable Unit 1 (OU1)
MCAS Cherry Point, NC

Attachment A
BERA Figures and Tables

| Table 2-15 Identification of Site-Impacted Samples Based on Midge Toxicity Test Results <i>OU 1 BERA, MCAS Cherry Point, North Carolina</i> | | | | | | |
|---|--|--------|----------|--|--------------------------------|-----------|
| Sample | STEP 1: does the sample exhibit toxicity? | | | STEP 2: is the toxicity site-related (i.e., site-related impacts)? | | |
| | Significantly reduced compared to Control? | | Toxicity | Significantly reduced compared to REF-SD-01? | | Impacted? |
| | Survival | Growth | | Survival | Growth | |
| OU1-SD-REF-01-04B | Yes | Yes | Yes | | | |
| OU1-SD-100-04B | No | No | No | → No | | |
| OU1-SD-102-04B | Yes | -- | Yes | Yes | <i>no survival = no growth</i> | Yes |
| OU1-SD-104-04B | No | Yes | Yes | No | No | No |
| OU1-SD-107-04B | No | No | No | → No | | |
| OU1-SD-110-04B | Yes | Yes | Yes | Yes | Yes | Yes |
| OU1-SD-112-04B | Yes | -- | Yes | Yes | <i>no survival = no growth</i> | Yes |
| OU1-SD-113-04B | Yes | -- | Yes | Yes | <i>no survival = no growth</i> | Yes |

Note:

Midge survival and growth data are presented on Figure 2-21

"--" indicates growth not possible because there was no survival in these samples; statistical analysis not possible.

Table 2-16
Apparent Effect Threshold (AET) Concentrations for Sandy Branch Aquatic System Sediment
OU 1 BERA, MCAS Cherry Point, North Carolina

| Chemical Group | Chemical | Samples Subjected to the Midge (<i>C. tentans</i>) Toxicity Tests | | | | | | | | |
|--|--|---|---------|---------|----------------------------|----------|---------|----------|----------|-----------------------|
| | | Unimpacted | | | | Impacted | | | | |
| | | SD-100 | SD-104 | SD-107 | NOEL ¹ (AET) | SD-102 | SD-110 | SD-112 | SD-113 | LOEL ² |
| Inorganics (MG/KG) | Cadmium | 50.4 | 44.9 | 38.0 | 50.4 | 58.9 | 27.2 | 125 | 108 | 58.9 |
| | Chromium | 646 | 239 | 325 | 646 | 353 | 196 | 490 | 947 | 947 |
| | Lead | 396 | 283 | 184 | 396 | 246 | 130 | 743 | 306 | 743 |
| Pesticides (UG/KG) | 4,4'-DDD | 30.0 UJ | 28.0 UJ | 28.0 UJ | 30 | 37.0 J | 19.0 J | 62.0 J | 21.0 J | 37.0 |
| | 4,4'-DDE | 30.0 UJ | 28.0 UJ | 28.0 UJ | 30 | 23.0 UJ | 44.0 UJ | 26.0 UJ | 260 UJ | 44.0 |
| | 4,4'-DDT | 390 J | 1,400 J | 570 J | 1400 | 1,600 J | 360 J | 1,400 J | 4,500 R | 1,600 |
| | Endosulfan sulfate | 30.0 UJ | 28.0 UJ | 28.0 UJ | 30 | 23.0 UJ | 44.0 UJ | 26.0 UJ | 260 UJ | 44.0 |
| | Endrin | 30.0 UJ | 28.0 UJ | 28.0 UJ | 30 | 23.0 UJ | 44.0 UJ | 26.0 UJ | 260 UJ | 44.0 |
| | Endrin aldehyde | 1,300 J | 4,600 J | 990 J | 4600 | 4,300 J | 660 J | 2,100 J | 7,900 J | 7,900 |
| | alpha-BHC | 170 J | 270 J | 160 J | 270 | 190 J | 84.0 J | 69.0 J | 310 J | 310 |
| | gamma-Chlordane | 44.0 J | 120 J | 34.0 J | 120 | 87.0 J | 32.0 J | 81.0 J | 190 J | 190 |
| Polycyclic Aromatic Hydrocarbons (UG/KG) | 2-Methylnaphthalene | 590 U | 130 J | 120 J | 130 | 170 J | 99.0 J | 35,000 | 850 | 170 |
| | Benzo(a)anthracene | 190 J | 96.0 J | 100 J | 190 | 60.0 J | 48.0 J | 10,000 U | 130 J | <i>see total PAHs</i> |
| | Benzo(a)pyrene | 180 J | 79.0 J | 110 J | 180 | 63.0 J | 45.0 J | 10,000 U | 130 J | <i>see total PAHs</i> |
| | Benzo(b)fluoranthene | 270 J | 160 J | 180 J | 270 | 78.0 J | 75.0 J | 10,000 U | 170 J | <i>see total PAHs</i> |
| | Benzo(g,h,i)perylene | 160 J | 120 J | 130 J | 160 | 56.0 J | 71.0 J | 10,000 U | 140 J | <i>see total PAHs</i> |
| | Benzo(k)fluoranthene | 100 J | 570 U | 62.0 J | 100 | 460 UJ | 440 U | 10,000 U | 510 U | 440 |
| | Chrysene | 240 J | 140 J | 150 J | 240 | 110 J | 77.0 J | 10,000 U | 310 J | 310 |
| | Fluoranthene | 460 J | 390 J | 370 J | 460 | 290 J | 170 J | 9,100 J | 1,000 | 1,000 |
| | Indeno(1,2,3-cd)pyrene | 130 J | 88.0 J | 99.0 J | 130 | 460 UJ | 52.0 J | 10,000 U | 130 J | <i>see total PAHs</i> |
| | Naphthalene | 590 U | 100 J | 170 J | 590 | 78.0 J | 64.0 J | 10,000 U | 510 U | <i>see total PAHs</i> |
| | Phenanthrene | 260 J | 170 J | 160 J | 260 | 96.0 J | 110 J | 2,700 J | 880 | 880 |
| | Pyrene | 390 J | 220 J | 230 J | 390 | 110 J | 140 J | 10,000 U | 380 J | <i>see total PAHs</i> |
| | PAHs, total | 2,380 | 1,693 | 1,881 | 2,380 | 1,111 | 951 | 46,800 | 4,120 | 4120 |
| | Other Semivolatile Organic Compounds (UG/KG) | 2,4-Dimethylphenol | 590 U | 570 U | 560 U | 590 | 460 U | 420 J | 10,000 U | 510 U |
| 4-Methylphenol | | 590 U | 570 U | 190 J | 190 | 460 U | 930 | 10,000 U | 380 J | 380 |
| bis(2-Ethylhexyl)phthalate | | 2,900 | 4,300 | 8,600 | 8600 | 2,800 | 5,500 | 14,000 | 21,000 | 14,000 |

Notes:

shaded cells indicates detected concentrations

1 - No observed effects level, referred to as the Apparent Effects Threshold; maximum concentration in unimpacted samples; italicized AETs are maximum reporting limits

2 - Lowest observed effect level; next highest concentration in impacted samples, relative to the AET; italicized LOELs are reporting limits

Table 2-17
AET Exceedences of Detected Concentrations in Sandy Branch Aquatic System Sediment Samples
OU 1 BERA, MCAS Cherry Point, North Carolina

| Chemical Group | Chemical | AET (Table 2-12) | Impacted Samples (Table 2-13) | | | | Non-toxicity Tested Samples | | | | | | | Maximum in other samples | | |
|--|----------------------------|---------------------|-------------------------------|--------|---------|---------|-----------------------------|--------|--------|--------|--------|---------|--------|--------------------------------|-------------------------------------|--------------------------|
| | | | SD-102 | SD-110 | SD-112 | SD-113 | SD-101 | SD-103 | SD-105 | SD-106 | SD-108 | SD-109 | SD-111 | SB ¹ (Table 2-4) | SB/EPSC ² (Table 2-5) | REF-SD-01 (Table 2-6) |
| Inorganics (MG/KG) | Cadmium | 50.4 | 58.9 | 27.2 | 125 | 108 | 5.90 | 31.9 | 53.7 | 676 | 66.5 | 120 | 64.5 | 13.4 | 22.9 | 7.2 |
| | Chromium | 646.0 | 353 | 196 | 490 | 947 | 86.6 | 221 | 246 | 911 | 665 | 888 | 180 | 107 | NA ⁴ | 20 |
| | Lead | 396 | 246 | 130 | 743 | 306 | 37.2 | 189 | 319 | 1,150 | 459 | 673 | 220 | 45.5 | NA | 42 |
| Pesticides (UG/KG) | 4,4'-DDD | 30 | 37.0 J | 19.0 J | 62.0 J | 21.0 J | | 13.0 J | 53.0 J | 57.0 J | 17.0 J | 95.0 J | 56.0 J | 1.5 | NA | 6.1 |
| | 4,4'-DDE | 30 | | | | | | | 11.0 J | | | | | 1.6 | NA | 6.1 |
| | 4,4'-DDT | 1400 | 1,600 J | 360 J | 1,400 J | | 380 J | 350 J | 340 J | 190 J | 480 J | 1,100 J | 190 J | 110 | NA | 120 |
| | Endosulfan sulfate | 30 | | | | | 7.00 J | | | | | | | ND ³ | NA | ND ⁴ |
| | Endrin | 30 | | | | | | | | | | | 10.0 J | ND | NA | ND |
| | Endrin aldehyde | 4600 | 4,300 J | 660 J | 2,100 J | 7,900 J | 800 J | 590 J | 550 J | 310 J | 800 J | 1,600 J | 290 | ND | NA | 160 |
| | alpha-BHC | 270 | 190 J | 84.0 J | 69.0 J | 310 J | 130 J | 110 J | 40.0 J | 130 J | 100 J | 120 J | 19.0 J | 11 | NA | 20 |
| gamma-Chlordane | 120 | 87.0 J | 32.0 J | 81.0 J | 190 J | 28.0 J | 27.0 J | 44.0 J | 13.0 J | 58.0 J | 100 J | 21.0 J | 9.1 | NA | 9.9 | |
| Polycyclic Aromatic Hydrocarbons (UG/KG) | 2-Methylnaphthalene | 130 | 170 J | 99.0 J | 35,000 | 850 | 210 J | | 120 J | 220 J | | 250 J | 160 J | ND | NA | ND |
| | Benzo(a)anthracene | 190 | 60.0 J | 48.0 J | | 130 J | 54.0 J | 160 J | 90.0 J | 140 J | 410 J | 240 J | | ND | NA | ND |
| | Benzo(a)pyrene | 180 | 63.0 J | 45.0 J | | 130 J | | 140 J | 86.0 J | | 360 J | 250 J | | ND | NA | ND |
| | Benzo(b)fluoranthene | 270 | 78.0 J | 75.0 J | | 170 J | 65.0 J | 310 J | 190 J | 140 J | 740 J | 510 J | 110 J | ND | NA | 84 |
| | Benzo(g,h,i)perylene | 160 | 56.0 J | 71.0 J | | 140 J | | 170 J | 100 J | | 460 J | 330 J | 92.0 J | ND | NA | 87 |
| | Benzo(k)fluoranthene | 100 | | | | | | 110 J | 71.0 J | | 250 J | 140 J | | ND | NA | ND |
| | Chrysene | 240 | 110 J | 77.0 J | | 310 J | 77.0 J | 230 J | 150 J | 170 J | 560 J | 390 J | 96.0 J | ND | NA | ND |
| | Fluoranthene | 460 | 290 J | 170 J | 9,100 J | 1,000 | 610 | 470 J | 250 J | 210 J | 950 J | 580 J | 120 J | 73 | NA | 72 |
| | Indeno(1,2,3-cd)pyrene | 130 | | 52.0 J | | 130 J | | 130 J | 79.0 J | | 380 J | 240 J | 66.0 J | ND | NA | ND |
| | Naphthalene | 590 | 78.0 J | 64.0 J | | | 110 J | | | 150 J | | 210 J | 120 J | ND | NA | ND |
| | Phenanthrene | 260 | 96.0 J | 110 J | 2,700 J | 880 | 71.0 J | 230 J | 170 J | 140 J | 600 J | 400 J | 130 J | ND | NA | ND |
| | Pyrene | 390 | 110 J | 140 J | | 380 J | 110 J | 350 J | 210 J | 470 J | 930 J | 570 J | 160 J | ND | NA | 92 |
| | PAHs, total | 2380 | 1,111 | 951 | 46,800 | 4,120 | 1307 | 2300 | 1458 | 1640 | 5640 | 4110 | 1054 | ND | NA | 335 |
| Other Semivolatile Organic Compounds (UG/KG) | 2,4-Dimethylphenol | 590 | | 420 J | | | 790 | | | | | | | ND | NA | ND |
| | 4-Methylphenol | 190 | | 930 | | 380 J | 490 | | | 120 J | 330 J | 180 J | ND | NA | ND | |
| | bis(2-Ethylhexyl)phthalate | 8600 | 2,800 | 5,500 | 14,000 | 21,000 | 1,900 | 2,700 | 1,000 | 12,000 | 3,900 | 3,700 | 600 J | 550 | NA | 690 |

Notes:

shaded cells indicates concentrations above the AETs

blank cells indicated undetected chemicals

1 - Samples collected from main Sandy Branch channel

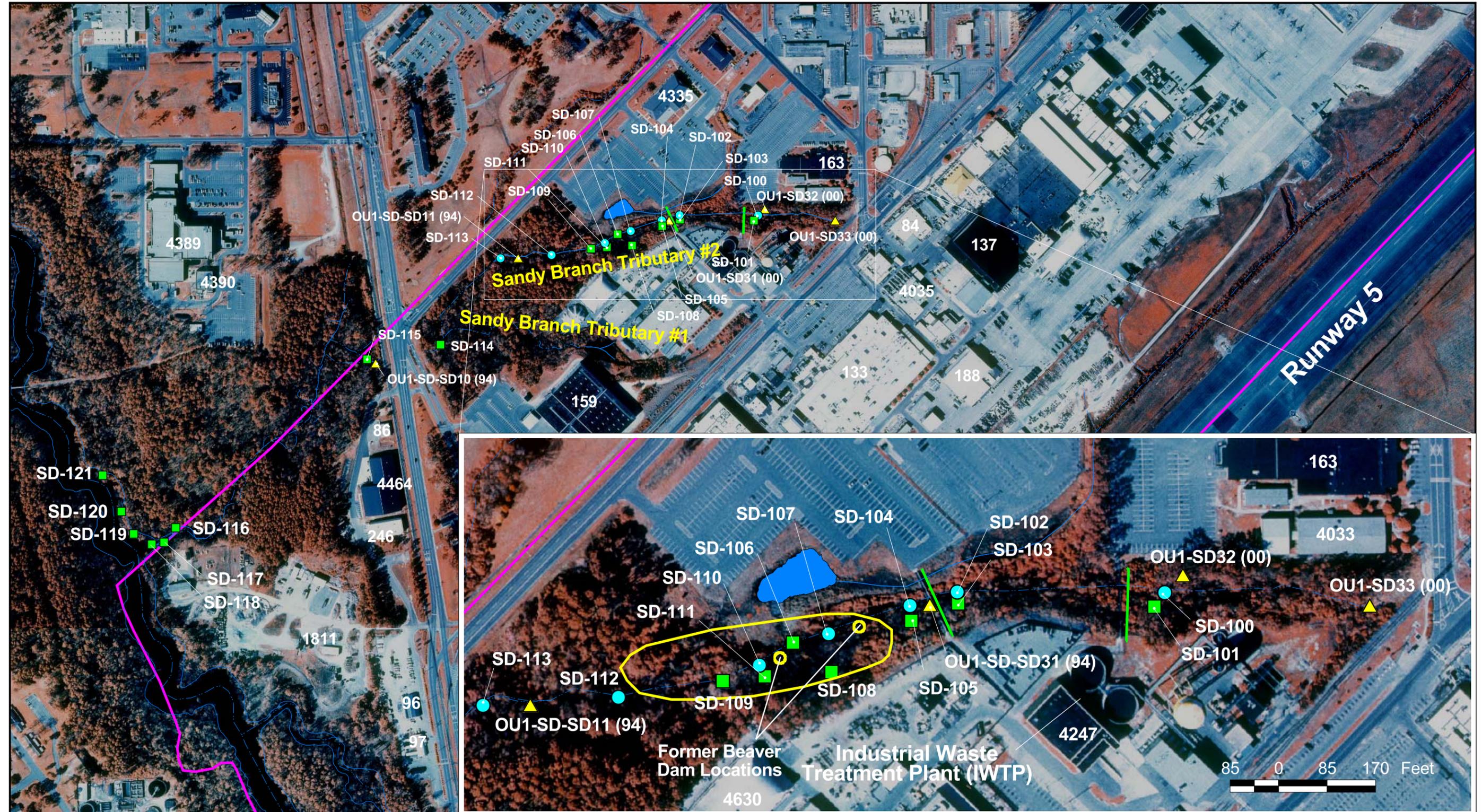
2 - Samples collected from Confluence of East Prong Slocum Creek and Sandy Branch; analyzed only for cadmium

3 - ND means not detected

4 - NA means not analyzed

Table 2-3
Detected Constituents of Sandy Branch Tributary 2
OU 1 BERA, MCAS Cherry Point, North Carolina

| Chemical | Summary Statistics | | | | | | Sample-Specific Concentrations (Samples shaded black were subjected to <i>C. tentans/R. pipiens</i> toxicity testing) | | | | | | | | | | | | | | |
|---|-----------------------|------------------------|---------|----------------------|-------------------|--------------------|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | Reporting Limit Range | Frequency of Detection | Maximum | Sample ID of Maximum | Mean ¹ | Standard Deviation | OU1-SD-100 OU1-SD-100-04B 05/18/04 | OU1-SD-101 OU1-SD-101-04B 05/18/04 | OU1-SD-102 OU1-SD-102-04B 05/18/04 | OU1-SD-103 OU1-SD-103-04B 05/18/04 | OU1-SD-104 OU1-SD-104-04B 05/18/04 | OU1-SD-105 OU1-SD-105-04B 05/18/04 | OU1-SD-105P-04B OU1-SD-105P-04B 05/18/04 | OU1-SD-106 OU1-SD-106-04B 05/18/04 | OU1-SD-107 OU1-SD-107-04B 05/18/04 | OU1-SD-108 OU1-SD-108-04B 05/18/04 | OU1-SD-109 OU1-SD-109-04B 05/18/04 | OU1-SD-110 OU1-SD-110-04B 05/18/04 | OU1-SD-111 OU1-SD-111-04B 05/18/04 | OU1-SD-112 OU1-SD-112-04B 05/18/04 | OU1-SD-113 OU1-SD-113-04B 05/18/04 |
| Inorganics (MG/KG) | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | 27.8 - 90.7 | 14 / 14 | 22300 | OU1-SD-108-04B | 7330.00 | 5726.5 | 7.010 | 1.520 | 3.630 | 6.010 | 4.360 | 7.780 | 6.900 | 6.510 | 4.400 | 22.300 | 16.300 | 2.430 | 10.900 | 6.140 | 3.330 |
| Antimony | 8.4 - 27.2 | 14 / 14 | 6.8 | OU1-SD-100-04B | 3.30 | 1.7 | 6.80 J | 0.88 J | 2.30 J | 2.50 J | 2.10 J | 3.80 J | 2.60 J | 5.20 J | 3.20 J | 5.40 J | 4.80 J | 1.30 J | 1.90 J | 2.60 J | 3.40 J |
| Arsenic | 1.4 - 4.5 | 13 / 14 | 9.4 | OU1-SD-106-04B | 4.30 | 3.1 | 2.80 | 0.52 U | 2.10 | 2.50 J | 4.00 | 4.80 | 4.80 | 2.00 | 9.00 | 9.30 | 1.50 | 1.50 | 7.00 | 7.00 | 1.90 |
| Barium | 27.8 - 90.7 | 14 / 14 | 112 | OU1-SD-109-04B | 46.56 | 26.8 | 51.2 | 9.80 J | 23.8 J | 28.8 J | 39.0 | 45.7 J | 40.6 | 70.9 | 32.9 J | 79.3 J | 112 | 18.1 J | 47.2 | 54.4 | 38.8 |
| Beryllium | 0.7 - 2.3 | 14 / 14 | 0.8 | OU1-SD-109-04B | 0.37 | 0.2 | 0.41 J | 0.062 J | 0.21 J | 0.25 J | 0.28 J | 0.53 J | 0.50 J | 0.56 J | 0.19 J | 0.70 J | 0.80 J | 0.13 J | 0.57 J | 0.36 J | 0.15 J |
| Boron | 2.1 - 6.8 | 4 / 14 | 11.3 | OU1-SD-108-04B | 2.98 | 3.1 | 2.90 U | 2.20 U | 2.50 U | 3.90 U | 2.70 U | 4.10 U | 2.90 U | 4.50 | 2.70 U | 11.3 | 8.20 | 2.10 U | 3.20 U | 3.30 | 2.50 U |
| Cadmium | 0.7 - 4.5 | 14 / 14 | 676 | OU1-SD-106-04B | 105.06 | 168.0 | 50.4 | 5.90 | 58.9 | 31.9 | 44.9 | 49.0 | 53.7 | 676 | 38.0 | 66.5 | 120 | 27.2 | 64.5 | 125 | 108 |
| Calcium | 696 - 2270 | 14 / 14 | 10700 | OU1-SD-108-04B | 3479.29 | 2808.6 | 3,040 | 1,290 | 1,600 | 2,660 | 1,580 | 2,340 | 1,970 | 4,840 | 2,560 | 10,700 | 8,550 | 1,140 | 2,640 | 3,600 | 2,170 |
| Chromium | 1.4 - 4.5 | 14 / 14 | 947 | OU1-SD-113-04B | 456.69 | 300.0 | 646 | 86.6 | 353 | 221 | 239 | 246 | 206 | 911 | 325 | 665 | 888 | 196 | 180 | 490 | 947 |
| Cobalt | 7 - 22.7 | 14 / 14 | 16.8 | OU1-SD-109-04B | 8.02 | 4.4 | 10.0 | 0.71 J | 10.0 | 4.70 J | 4.50 J | 4.80 J | 4.40 J | 9.80 | 9.60 | 11.6 J | 16.8 J | 3.20 J | 3.70 J | 11.7 | 11.2 |
| Copper | 3.5 - 11.3 | 14 / 14 | 240 | OU1-SD-109-04B | 99.48 | 66.3 | 103 | 14.6 | 41.5 | 121 | 56.1 | 89.9 | 71.9 | 165 | 89.1 | 216 | 240 | 45.1 | 47.6 | 87.3 | 76.5 |
| Cyanide | 0.17 - 0.56 | 9 / 14 | 2.7 | OU1-SD-106-04B | 0.87 | 0.8 | 0.51 | 1.30 | 0.61 | 0.32 U | 0.66 | 0.45 | 0.62 | 2.70 | 0.25 U | 0.56 U | 1.60 | 0.18 U | 0.26 U | 1.30 | 2.10 |
| Iron | 13.9 - 45.3 | 14 / 14 | 31000 | OU1-SD-109-04B | 7337.14 | 7865.2 | 5,300 | 1,600 | 2,830 | 7,500 | 3,290 | 6,750 | 5,550 | 5,920 | 4,860 | 17,800 | 31,000 | 2,230 | 5,870 | 4,360 | 3,410 |
| Lead | 0.42 - 1.4 | 14 / 14 | 1150 | OU1-SD-106-04B | 381.09 | 295.4 | 396 | 37.2 | 246 | 189 | 283 | 319 | 268 | 1,150 | 184 | 459 | 673 | 130 | 220 | 743 | 306 |
| Magnesium | 696 - 2270 | 14 / 14 | 12300 | OU1-SD-108-04B | 460.07 | 323.1 | 498 J | 115 J | 175 J | 259 J | 456 J | 407 J | 557 J | 332 J | 1,230 J | 1,050 J | 1,050 J | 174 J | 540 J | 453 J | 233 J |
| Manganese | 2.1 - 6.8 | 14 / 14 | 87 | OU1-SD-109-04B | 30.25 | 20.3 | 29.0 | 9.80 | 23.7 | 25.1 | 19.5 | 21.8 | 17.0 | 28.5 | 30.8 | 59.8 | 87.0 | 10.6 | 18.3 | 25.8 | 33.8 |
| Mercury | 0.027 - 0.08 | 14 / 14 | 1.1 | OU1-SD-100-04B | 0.52 | 0.3 | 1.10 | 0.15 | 0.33 | 0.52 | 0.28 | 0.34 | 0.42 | 0.53 | 0.30 | 0.95 | 1.10 | 0.20 | 0.32 | 0.59 | 0.27 |
| Molybdenum | 0.7 - 2.3 | 14 / 14 | 10.4 | OU1-SD-100-04B | 4.34 | 2.8 | 10.4 | 1.20 | 4.20 | 4.30 | 1.60 | 2.30 | 1.90 | 3.80 | 4.50 | 7.50 | 8.10 | 1.70 | 1.30 | 5.40 | 4.50 |
| Nickel | 5.6 - 18.1 | 14 / 14 | 280 | OU1-SD-106-04B | 71.79 | 66.6 | 75.2 | 21.7 | 39.7 | 38.2 | 47.9 | 45.5 | 44.1 | 280 | 48.9 | 93.8 | 128 | 26.5 | 26.0 | 71.7 | 62.0 |
| Potassium | 696 - 2270 | 14 / 14 | 1100 | OU1-SD-108-04B | 373.78 | 289.5 | 357 J | 88.9 J | 128 J | 304 J | 236 J | 406 J | 346 J | 338 J | 280 J | 1,100 J | 872 J | 135 J | 542 J | 297 J | 169 J |
| Selenium | 0.7 - 2.3 | 12 / 14 | 2.9 | OU1-SD-109-04B | 1.23 | 0.8 | 1.40 | 0.42 U | 0.75 J | 1.30 | 1.10 | 1.30 J | 0.96 J | 1.30 | 1.10 | 2.70 | 2.90 | 0.48 J | 1.30 | 1.10 | 0.46 U |
| Silver | 1.4 - 4.5 | 14 / 14 | 54.3 | OU1-SD-106-04B | 11.47 | 13.1 | 5.50 | 1.30 J | 6.90 | 4.80 | 11.3 | 7.10 | 6.30 | 54.3 | 5.20 | 12.8 | 18.6 | 5.50 | 6.10 | 11.6 | 9.60 |
| Sodium | 696 - 2270 | 2 / 14 | 305 | OU1-SD-109-04B | 102.13 | 81.1 | 211 U | 95.6 U | 105 U | 145 U | 126 U | 159 U | 114 U | 154 U | 208 U | 271 J | 305 J | 89.0 U | 165 U | 130 U | 120 U |
| Thallium | 1.4 - 4.5 | 1 / 14 | 0.92 | OU1-SD-106-04B | 0.44 | 0.2 | 0.70 U | 0.54 U | 0.60 U | 0.95 U | 0.65 U | 0.98 U | 0.70 U | 0.92 J | 0.66 U | 1.60 U | 1.50 U | 0.50 U | 0.77 U | 0.56 U | 0.60 U |
| Vanadium | 7 - 22.7 | 14 / 14 | 92.5 | OU1-SD-108-04B | 24.81 | 23.7 | 28.9 | 4.20 J | 9.00 | 20.6 | 10.6 | 25.4 | 22.4 | 22.7 | 13.5 | 92.5 | 55.0 | 5.60 J | 33.3 | 16.3 | 9.70 |
| Zinc | 2.8 - 9.1 | 14 / 14 | 899 | OU1-SD-108-04B | 345.64 | 227.6 | 316 | 207 | 177 | 403 | 171 | 275 | 256 | 531 | 415 | 899 | 705 | 117 | 201 | 242 | 180 |
| Pesticides (UG/KG) | | | | | | | | | | | | | | | | | | | | | |
| 4,4'-DDD | 5.7 - 260 | 10 / 14 | 95 | OU1-SD-109-04B | 34.57 | 25.9 | 30.0 UJ | 22.0 UJ | 37.0 J | 13.0 J | 28.0 UJ | 53.0 J | 28.0 J | 57.0 J | 28.0 UJ | 17.0 J | 95.0 J | 19.0 J | 56.0 J | 62.0 J | 21.0 J |
| 4,4'-DDE | 5.7 - 260 | 1 / 14 | 11 | OU1-SD-106-04B | 22.41 | 31.6 | 30.0 UJ | 22.0 UJ | 23.0 UJ | 37.0 UJ | 28.0 UJ | 69.0 UJ | 31.0 UJ | 11.0 J | 28.0 UJ | 58.0 UJ | 12.0 UJ | 44.0 UJ | 6.60 UJ | 26.0 UJ | 260 UJ |
| 4,4'-DDT | 28 - 1400 | 13 / 13 | 1600 | OU1-SD-102-04B | 673.08 | 507.6 | 390 J | 380 J | 1,600 J | 350 J | 1,400 J | 270 J | 340 J | 190 J | 570 J | 480 J | 1,100 J | 360 J | 190 J | 1,400 J | 4,500 R |
| Endosulfan sulfate | 5.7 - 260 | 1 / 14 | 7 | OU1-SD-101-04B | 21.55 | 32.0 | 30.0 UJ | 7.00 J | 23.0 UJ | 37.0 UJ | 28.0 UJ | 6.90 UJ | 31.0 UJ | 5.70 UJ | 28.0 UJ | 58.0 UJ | 12.0 UJ | 44.0 UJ | 6.60 UJ | 26.0 UJ | 260 UJ |
| Endrin | 5.7 - 260 | 1 / 14 | 10 | OU1-SD-111-04B | 22.31 | 31.6 | 30.0 UJ | 22.0 UJ | 23.0 UJ | 37.0 UJ | 28.0 UJ | 6.90 UJ | 31.0 UJ | 5.70 UJ | 28.0 UJ | 58.0 UJ | 12.0 UJ | 44.0 UJ | 10.0 J | 26.0 UJ | 260 UJ |
| Endrin aldehyde | 28 - 1400 | 14 / 14 | 7900 | OU1-SD-113-04B | 1913.57 | 2201.1 | 1,300 J | 800 J | 4,300 J | 590 J | 4,600 J | 420 J | 310 J | 570 J | 990 J | 800 J | 1,600 J | 800 J | 2,100 J | 2,100 J | 7,900 J |
| alpha-BHC | 3.3 - 130 | 14 / 14 | 310 | OU1-SD-113-04B | 135.86 | 81.0 | 170 J | 130 J | 190 J | 110 J | 270 J | 30.0 J | 40.0 J | 130 J | 160 J | 100 J | 120 J | 84.0 J | 19.0 J | 69.0 J | 310 J |
| gamma-Chlordane | 2.8 - 130 | 14 / 14 | 190 | OU1-SD-113-04B | 62.79 | 48.8 | 44.0 J | 28.0 J | 87.0 J | 27.0 J | 120 J | 30.0 J | 44.0 J | 13.0 J | 34.0 J | 58.0 J | 100 J | 32.0 J | 21.0 J | 81.0 J | 190 J |
| Semivolatile Organic Compounds (UG/KG) | | | | | | | | | | | | | | | | | | | | | |
| Polycyclic Aromatic Hydrocarbons | | | | | | | | | | | | | | | | | | | | | |
| 2-Methylnaphthalene | 440 - 10000 | 11 / 14 | 35000 | OU1-SD-112-04B | 2756.71 | 9282.7 | 590 U | 210 J | 170 J | 740 U | 130 J | 120 J | 90.0 J | 220 J | 120 J | 1,200 U | 250 J | 99.0 J | 160 J | 35,000 | 850 |
| Benzo(a)anthracene | 440 - 10000 | 12 / 14 | 410 | OU1-SD-108-04B | 503.43 | 1298.5 | 190 J | 54.0 J | 60.0 J | 160 J | 96.0 J | 87.0 J | 90.0 J | 140 J | 100 J | 410 J | 240 J | 48.0 J | 660 U | 10,000 U | 130 J |
| Benzo(a)pyrene | 440 - 10000 | 10 / 14 | 360 | OU1-SD-108-04B | 520.21 | 1293.3 | 180 J | 450 U | 63.0 J | 140 J | 79.0 J | 71.0 J | 86.0 J | 570 U | 110 J | 360 J | 250 J | 45.0 J | 660 U | 10,000 U | 130 J |
| Benzo(b)fluoranthene | 440 - 10000 | 13 / 14 | 740 | OU1-SD-108-04B | 571.29 | 1288.4 | 270 J | 65.0 J | 78.0 J | 310 J | 160 J | 190 J | 170 J | 140 J | 180 J | 740 J | 510 J | 75.0 J | 110 J | 10,000 U | 170 J |
| Benzo(g,h,i)perylene | 440 - 10000 | 11 / 14 | 460 | OU1-SD-108-04B | 524.21 | 1293.1 | 160 J | 450 U | 56.0 J | 170 J | 120 J | 100 J | 100 J | 570 U | 130 J | 460 J | 330 J | 71.0 J | 92.0 J | 10,000 U | 140 J |
| Benzo(k)fluoranthene | 440 - 10000 | 6 / 14 | 250 | OU1-SD-108-04B | 540.21 | 1286.5 | 100 J | 450 U | 460 UJ | 110 J | 570 U | 71.0 J | 620 U | 570 U | 62.0 J | 250 J | 140 J | 440 U | 660 U | 10,000 U | 510 J |
| Chrysene | 440 - 10000 | 13 / 14 | 560 | OU1-SD-108-04B | 550.00 | 1287.9 | 240 J | 77.0 J | 110 J | 230 J | 140 J | 150 J | 140 J | 170 J | 150 J | 560 J | 390 J | 77.0 J | 96.0 J | 10,000 U | 310 J |
| Fluoranthene | 440 - 10000 | 14 / 14 | 9100 | OU1-SD-112-04B | 1069.29 | 2326.6 | 460 J | 610 | 290 J | 470 J | 390 J | 220 J | 250 J | 210 J | 370 J | 950 J | 580 J | 170 J | 120 J | 9,100 J | 1,000 |
| Indeno(1,2,3-cd)pyrene | 440 - 10000 | 10 / 14 | 380 | OU1-SD-108-04B | 509.57 | 1295.9 | 130 J | 450 U | 460 UJ | 130 J | 88.0 J | 79.0 J | 79.0 J | 570 U | 99.0 J | 380 J | 240 J | 52.0 J | 66.0 J | 10,000 U | 130 J |
| Naphthalene | 440 - 10000 | 8 / 14 | 210 | OU1-SD-109-04B | 561.93 | 1285.7 | 590 U | 110 J | 78.0 J | 740 U | 100 J | 690 U | 620 U | 150 J | 170 J | 1,200 U | 210 J | 64.0 J | 120 J | 10,000 U | 510 U |
| Phenanthrene | 440 - 10000 | 14 / 14 | 2700 | OU1-SD-112-04B | 436.93 | 689.4 | 260 J | 71.0 J | 96.0 J | 230 J | 170 J | 170 J | 160 J | 140 J | 160 J | 600 J | 400 J | 110 J | 130 J | 2,700 J | 880 |
| Pyrene | 440 - 10000 | 13 / 14 | 930 | OU1-SD-108-04B | 662.14 | 1268.1 | 390 J | 110 J | 110 J | 350 J | 220 J | 200 J | 210 J | 470 J | 230 J | 930 J | 570 J | 140 J | 160 J | 10,000 | |



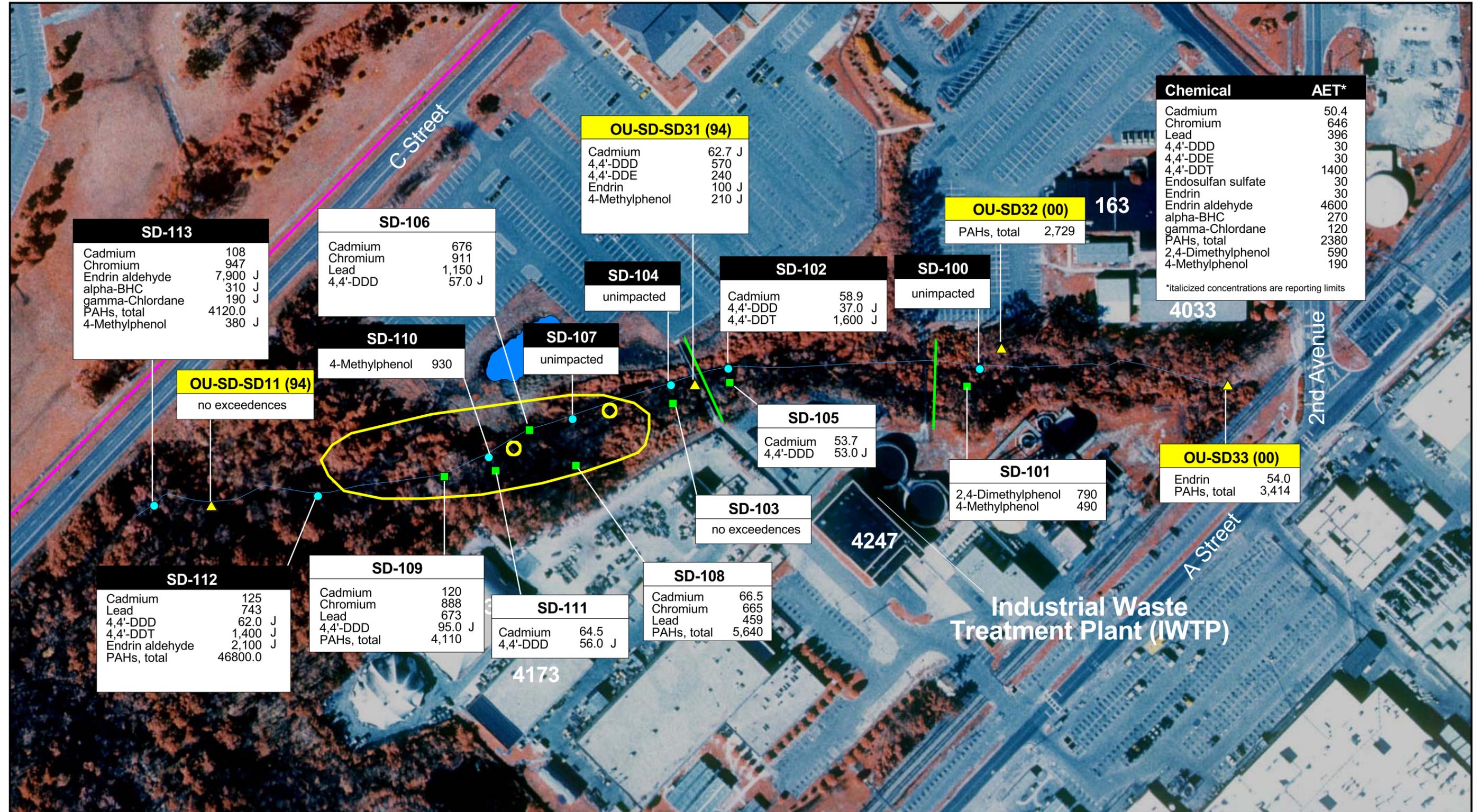
LEGEND

- ▲ Historical Sample Locations (collected by Tetra Tech NUS)
- Physicochemical analysis only
- Physicochemical analysis and toxicity testing
- ~ Water Body or Stream
- ~ Area of Previous Beaver Damming Activity
- ~ Walking Bridge
- ~ Area of Previous Beaver Damming Activity
- Approximate OU-1 Boundary

Note: White numbers reference base building numbers.



Figure 2-3
Sediment Sample Locations
Sandy Branch Aquatic System
Operable Unit 1 (OU 1)
MCAS Cherry Point, NC



LEGEND

- ▲ Historical Sample Locations (collected by Tetra Tech NUS)
- Physicochemical analysis only
- Physicochemical analysis and toxicity testing
- ▬ Water Body or Stream
- ▬ Area of Previous Beaver Damming Activity
- ▬ Walking Bridge
- ▬ Area of Previous Beaver Damming Activity
- ▭ Approximate OU-1 Boundary

Notes:
Boxes present concentrations greater than AETs; Inorganic chemical concentrations are mg/kg, all other chemical concentrations are µg/kg. Samples shaded black were subjected to midge toxicity tests, samples shaded yellow were collected by Tetra Tech.

White numbers reference base building numbers.

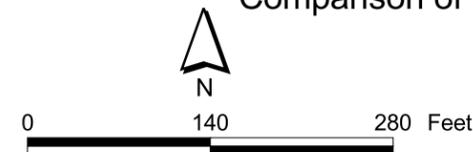


Figure 2-24
Comparison of Tributary 2 Sediment Concentrations to AETs
Operable Unit 1 (OU 1)
MCAS Cherry Point, NC