FINAL
POST REMEDIAL ACTION REPORT

SOILS OPERABLE UNIT 1
MIDDLESEX SAMPLING PLANT
MIDDLESEX, NEW JERSEY

September 2010

Prepared for:

New York District
CENAN
U.S. Army Corps of Engineers

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Prepared under:

Contract Number: W912DQ-04-D-0017
Task Order 009

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POST REMEDIAL ACTION REPORT

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MIDDLESEX SAMPLING PLANT
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CERCLIS ID# NJ0890090012

September, 2010

I hereby certify that the enclosed Post Remedial Action Report is to be incorporated with Contract Number W912DQ-04-D-0017, Task Order 009, Soils Operable Unit 1, Middlesex Sampling Plant, Middlesex, NJ. This Post Remedial Action Report is in compliance with contract specifications, and is submitted for Government approval.

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Disc3	Appendix Q4-4-D (QCSR 4 w/lab data)
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LIST OF ACRONYMS AND ABBREVIATIONS

µCi/g	microcuries per gram
µCi/ml	microcuries per milliliter
µg/kg	microgram per kilogram
µg/L	micrograms per liter
µR	microrem
µR/hr	microrem per hour
AEC	US Atomic Energy Commission
AF	area factor
ALARA	as low as reasonably achievable
ANCO	ANCO Environmental Services, Inc.
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
bgs	below ground surface
Bq	Becquerel
CCS	Cell Characterization Survey
CENAN	U.S. Army Corps of Engineers-New York District
CENWK	U.S. Army Corps of Engineers-Kansas City District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CHP	Certified Health Physicist
CL	confidence level
cm	centimeters
CMP	corrugated metal pipe
COC	contaminants of concern
COR	Contracting Officer Representative
CQCP	Contractor Quality Control Plan
cu m	cubic meter
cu yd	cubic yards
DCGL	Derived Concentration Guidelines
$DCGL_W$	DCGL wide
DFW	Definable Feature of Work
DOE	US Department of Energy
DOT	US Department of Transportation
dpm	disintegrations per minute
DQCR	Daily Quality Control Report
DQO	data quality objective
ECC	Environmental Chemical Corporation
EE/CA	Engineering Evaluation/Cost Analysis
EMA	Elevated Measurement Areas
EMC	elevated measurement comparison
EML	Environmental Measurement Laboratory
FIDLER	Field Instrument for the Detection of Low-Energy Radiation
FS	Feasibility Study
FSS	Final Status Survey
FSSP	Final Status Survey Plan
ft	foot/feet
FUSRAP	Formerly Utilized Sites Remedial Action Program

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

GAC	granular activated carbon
gpm	gallons per minute
GPS	global positioning system
GWS	Gamma Walkover Survey
Ha	hectare
HIPO	high loss potential
HPT	Health Physics Technician
in	inch
J	estimated
km	kilometer
LCS/LCSD	Laboratory Control Sample/Laboratory Control Sample Duplicate
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCUA	Middlesex County Utilities Authority
MD	minimum difference
MDA	Minimum Detectable Activity
MDC	minimal detectable concentration
MDCR	minimum detectable count rate
MED	Manhattan Engineer District
mg/Kg	milligrams per kilogram
mg/L	milligrams per liter
mi	mile
MML	Middlesex Municipal Landfill
mrem	millirem
mrem/hr	millirem per hour
mrem/yr	millirem per year
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSP	Middlesex Sampling Plant
NAD	normalized absolute difference
NaI	sodium iodide
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
ND	not detected
NELAC	National Environmental Laboratory Accreditation Conference
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NPL	National Priority List
NRC	US Nuclear Regulatory Commission
NYSDEC	New York State Department of Environmental Conservation
O&M	operation and maintenance
ORNL	Oak Ridge National Laboratory
OSHA	Occupation Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, comparability
PCB	polychlorinated biphenyls
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
pCi/mg	picoCuries per milligram
PCOR	Preliminary Close Out Report

pH	hydrogen ion concentration
PHP	Project Health Physicist
POV	Personally Owned Vehicle
PQL	practical quantitation limit
PRAR	Post Remedial Action Report
PVC	polyvinyl chloride
QA/QC	quality assurance and quality control
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCSM	Quality Control System Manager
QCSR	Quality Control Summary Report
R	rejected
Ra	Radium
RAM	Radioactive Material
RAO	Remedial Action Objective
RASS	Remedial Action Support Surveys
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RDCSCC	Residential Direct Contact Soil Cleanup Criteria
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPD	Relative Percent Difference
SARA	Superfund Amendments and Reauthorization Act
SOR	sum of the ratio
sq ft	square foot
sq meter	square meter
SSHS	Site Safety and Health Specialist
SSHP	Site Safety and Health Plan
SU	Survey Unit
SVOC	semivolatile organic compound
TAL	Target Analyte List
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
TPH	total petroleum hydrocarbons
UCL	Upper Confidence Level
U-nat	natural uranium
UR	Unrestricted Release
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
VP	vicinity property
WAC	Waste Acceptance Criteria
WRS	Wilcoxson Rank Sum
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

This Final Post Remedial Action Report (PRAR) describes the remedial action completed at the Formerly Utilized Sites Remedial Action Program (FUSRAP) Middlesex Sampling Plant (MSP) and presents data that documents the attainment of remedial action cleanup goals. The remedial action was performed for the US Corps of Engineers-New York District (CENAN) by Environmental Chemical Corporation (ECC) under the US Army Corps of Engineers (USACE) Pre-placed Remedial Action Contract Number W912DQ-04-D-0017, Task Order 0009. The site (or Property) is identified on the National Priorities List as the Middlesex Sampling Plant with the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number NJ0890090012. This PRAR was prepared in accordance with the U.S. Environmental Protection Agency (USEPA) Office of Solid Waste and Emergency Response Directive 9320.2.09A-P, *Close-out Procedures for National Priorities Sites*, EPA-540-R-98-016, dated January, 2000. The information included in this PRAR consists of the remedial action guidelines, the remedial action activities performed, and the post-remedial sample results that were collected under the requirements of the *Final Status Survey Plan* (FSSP), (ECC, 2006b).

The MSP is approximately 9.54 acres in area and is located at the intersection of Mountain Avenue and South Avenue in the Borough of Middlesex, Middlesex County, New Jersey, 18 miles southwest of Newark, New Jersey. A detailed description of the location, environmental setting, and operational history of the site can be found in Section 1 of this report.

The Soils Operable Unit (OU-1), Record of Decision (ROD) for the Middlesex Sampling Site (USACE, 2005) was signed into agreement by CENAN and USEPA in September 2005. The overall cleanup strategy established in the Soils OU-1 ROD for MSP soils was to remove contaminated site media (i.e., surface and subsurface soils, asphalt pads, and demolition debris) to established cleanup goals and dispose of them off-site at an approved and permitted facility. The removal of the contaminated media has resulted in the removal of potential sources that may further impact the groundwater. The Soils OU-1 ROD is contained in the Administrative Record established for the MSP, and is available for review at the FUSRAP Public Information Center in the Middlesex Township Public Library. Groundwater, sediment, and surface water are being addressed under a separate OU (OU-2).

The CENAN conducted the remedial action at MSP between August 2006 and June 2008. Remediation included excavation of soil, Final Status Survey (FSS) activities, backfilling of excavations, and site restoration consisting of regrading and hydroseeding. The total volume of material removed from the MSP and shipped off site to a licensed disposal facility was 41,244 *in-situ* cubic yards (cu yd), or 79,706 tons, of radiologically impacted soil and debris, and approximately 4,454 *in-situ* cu yd, or 7,984 tons of chemically impacted waste.

Following soil remedial activities, post-remedial action measurements (referred to as the Final Status Survey or FSS) were collected to determine if the cleanup goals had been attained. The methodology for collecting FSS measurements was derived from the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)-based approach as outlined in the *FSSP* (ECC, 2006b*)* and addenda.

The FSS survey consisted of the following:

- Performance of a gamma walkover survey over 100% of accessible areas; and
- Collection, then gamma and alpha spectrometry analysis of systematic surface and subsurface soil samples.

The Remedial Action Objective (RAO) established for this Property in the Soils OU-1 ROD is designated as "Unrestricted Use" and is therefore subjected to the cleanup criteria presented in Section 2.0 for radiological and non-radiological contaminants in both surface and subsurface soil (USACE, 2005). **Table ES-1** compares the RAOs stated in the Soils OU-1 ROD with the work completed.

Table ES-1
Performance Results Compared with Remedial Action Objectives
Middlesex Sampling Plant
Middlesex, New Jersey

Remedial Action Objectives	Performance Results
Soil excavation to an unrestricted use cleanup level as identified in the MSP Soils OU-1 ROD. Off-site disposal of the excavated radiologically and chemically impacted soils at licensed and permitted facilities.	45,698 *in-situ* cu yd, or 87,690 tons of material were removed from the Property and disposed off site at a licensed disposal facility. Remedial activities for OU-1 included the excavation and shipment of 41,244 *in-situ* cu yd, or 79,706 tons, of radiologically impacted soil and debris, and approximately 4,454 *in-situ* cu yd, or 7,984 tons of chemically impacted waste.
Demolition, removal and off-site disposal of contaminated former storage pads and below-grade structures at licensed and permitted facilities.	Legacy building foundations, drainage structures, and the settling basin were also removed from the Property during excavation, and shipped with contaminated soil to off-site disposal facility.
Certification of the Property for unrestricted re-use.	Upon completion of excavation activities and prior to backfilling of each survey unit (SU), a FSS of each of the twenty-three (23) Class 1 impacted SUs was performed in accordance with MARSSIM protocol. The MARSSIM FSS Null Hypothesis was "rejected" for all SUs, which means that remaining soil in all SUs is below the cleanup criteria for radionuclides. Analytical results of final status chemical and lead samples were compared directly to the cleanup criteria for each of the individual polynuclear aromatic hydrocarbons (PAH) or metal constituent. All chemical and metal samples results were well below the clean-up criteria for each of the five PAHs and lead. Following the completion of remediation activities, the site was backfilled with certified clean backfill and restored to the established final grade; and top soil was placed and seeded as required by the contract and approved by the township of Middlesex. All soils met MSP Soils OU-1 ROD criteria, which allows for unrestricted re-use of the MSP property.
Minimize potential health hazards to personnel performing the remedial action.	The *Site Safety and Health Plan* SSHP (ECC, 2006h) was followed. Contamination control methods were successfully implemented to avoid personnel contamination events or intakes above established limits.

CENAN reviewed site characterization and post excavation sampling information at the MSP. This information was compared to the New Jersey Department of Environmental Protection (NJDEP) Soil Cleanup Criteria (reference New Jersey Administrative Code [NJAC] 7:26D), promulgated June 2008. All analytical results from soil samples presented in the Remedial Investigations (RIs) were evaluated (including Site Investigation samples from 1991, 2000, and 2001) combined, totaling approximately 120 samples.

An analysis of RI data compared to final soil excavation survey and post excavation sampling information indicates the following:

- Two samples/results are identified as potentially "left in the ground" (Samples 9508 and PC-49).
- One semi-volatile organic compound (SVOC) compound, benzo(k)fluoranthene, was detected above the New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC) in sample 9508, however this is attributed to the presence of surficial asphalt related to historical culvert replacement that was conducted in this area of the site.
- Lead was identified at one location (PC-49) at a sample depth greater than excavation depth. It is important to note that lead was sampled as part of the final status survey for SU-17, and the results for this SU were all below the NJDEP residential clean up criteria for lead.

Given the extent of the removal action performed, the volume of contaminated material removed at the MSP site, and based on lead sampling results from SU-17; the one slightly elevated lead exceedance (PC-49) is considered to be *de minimis*.

Remedial and restorative activities for the Soils OU are complete for the MSP. The MSP soils were completely remediated, and the analytical data presented in this report demonstrates compliance with the “Unrestricted Use” cleanup criteria as set forth in the Soils OU-1 ROD; thereby ensuring that the substantive requirement of NJAC 7:28-12.8(a) (NJAC, 1997b) is not exceeded. CENAN’s letter requesting NJDEP’s approval of the Draft PRAR is included in this report as Attachment 1. Moreover, NJDEP’s approval of the Draft PRAR can be found in this report as Attachment 2.

1.0 INTRODUCTION

This Final Post Remedial Action Report (PRAR) for the Middlesex Sampling Plant (MSP) site was developed by Environmental Chemical Corporation (ECC) for the US Army Corps of Engineers (USACE), in accordance with Contract Number W912DQ-04-D-0017, Task Order 0009. This contract was implemented under the USACE Formerly Utilized Sites Remedial Action Program (FUSRAP).

The US Atomic Energy Commission (AEC), a predecessor agency of the US Department of Energy (DOE), established the FUSRAP in 1974 to identify and decontaminate sites where radioactive contamination remained from activities carried out under contract to the Manhattan Engineering District (MED) and the AEC.

The MSP is listed on the USEPA's National Priorities List (NPL) (CERCLIS ID# NJ0890090012, January 19, 1999). Responsibility for execution of the FUSRAP at sites declared eligible by the DOE was first transferred by Congress to the USACE in Public Law 105-62, 13 October 1997, and programmatic authority was provided to USACE in Public Law 106-60, Section 611, 29 September 1999.

The MSP Remedial Action was subject to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The USACE is the lead agency for the MSP site's CERCLA response actions, and the USEPA Region 2 is the support agency with oversight responsibilities. The MSP Remedial Action was completed according to the substantive requirements of the New Jersey Department of Environmental Protection (NJDEP) NJAC 7:26E Technical Requirements for Site Remediation (NJAC, 1997a).

1.1 Report Organization

This report consists of 14 text sections. Listed are the sections and a brief summary of their contents:

- Section 1.0 provides an introduction, describes the site characteristics, operational history, previous investigations and removal activities.
- Section 2.0 provides background information, including clean-up criteria and the remedial design.
- Section 3.0 provides a chronology of the site history and work performed (in tabular format).
- Section 4.0 presents a summary of site construction activities including excavation, water treatment design and operation, remediation, site restoration and demobilization activities.
- Section 5.0 presents a summary of the post-remedial action survey results, demonstrating all MSP project clean-up criteria were met.
- Section 6.0 discusses the performance standards and project quality control (QC) including construction QC, descriptions of Health and Safety Systems, and OC procedures used to generate and assess chemical and radiological data.
- Section 7.0 is a summary of the final inspections performed and certifications obtained for the MSP site.
- Section 8.0 addresses operations and maintenance (O&M) requirements and activities.

- Section 9.0 summarizes the Environmental Surveillance Program as part of the FUSRAP.
- Section 10.0 is a summary of administrative activities including the administrative record and Right-of-Entry Agreements.
- Section 11.0 is a summary of project costs.
- Section 12.0 provides an overview of observations and lessons learned.
- Section 13.0 describes the MSP project team, including CENAN, ECC and its subcontractors.
- Section 14.0 presents references.

1.2 Operable Units

The MSP site is divided into two OUs (Operable Units), addressing independent portions of the MSP site conditions. These are:

- Soils (OU-1): contaminated site media (i.e., surface and subsurface soils, asphalt pads, and demolition debris) and below-grade structures; and
- Groundwater (OU-2): contaminated groundwater, sediment, and surface water.

The MSP Soils OU-1 Remedial Action is addressed in this report. The primary threats posed by the MSP Soils OU-1 were surface and subsurface soil and debris contaminated primarily with radionuclides; elevated levels of five select polynuclear aromatic hydrocarbons (PAH) [benzo(a)pyrene, benzo(a)anthracene, dibenzo(a,h)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene]; and lead that could result in human exposures above acceptable risk levels under commercial, industrial, or residential use.

1.3 General

This report documents that the USACE completed the MSP Soils OU-1 Remedial Action at the MSP in accordance with *Close Out Procedures for National Priorities List Sites,* (*OSWER Directive 9320.2-09A-P* (OSWER, 2000), and as promulgated in the Soils OU-1 Record of Decision (ROD), (USACE, 2005). CENAN, the remedial contractor (ECC), USEPA, and NJDEP conducted a Final Inspection at the MSP on 28 July 2008 that verified the project team completed the remedial and restoration work at the MSP site in accordance with the approved remedial design.

1.4 Name, Location, and Description

The MSP site is located at 239 Mountain Avenue, in the Borough of Middlesex, Middlesex County, New Jersey, approximately 29 kilometers (km) [18 miles (mi)] southwest of Newark, New Jersey (**Figure 1-1**). The 3.9-hectare (Ha) [9.6-acre] site is surrounded by a 2.1-meter [7-foot (ft)] chain link fence. **Figure 1-2** is an aerial photograph of the site. **Figure 1-3** is a Surface Water and Sediment Sampling Locations map showing surface water and sediment sampling locations, and **Figure 1-4** shows the locations of the environmental monitoring stations at the site. The former legacy buildings were previously used as an administration office and garage. There were also two building slabs remaining from demolition of a boiler house and process building. All of the building slabs were removed during MSP Soils OU-1 remediation efforts. The majority of the site was paved, except for a grassy area around the administration building and east of the garage.

Two asphalt pads formerly used for the interim storage of the Middlesex Municipal Landfill (MML) soil pile and the vicinity property (VP) soil pile covered the southern two-thirds of the site. These piles were the result of interim cleanup actions at the MML and properties in the vicinity of the MSP. The MML and VP soil piles were removed and disposed of off site in 1998 and 1999, respectively. The asphalt pad was removed during the MSP Soils OU-1 remediation effort in 2006-2007.

The MSP site surface sloped toward the south at approximately a one-percent grade and was underlain by three abandoned subsurface stormwater drainage lines. The two eastern-most drainage lines, constructed of 0.45 meters (18 inch [in]) corrugated metal pipe (CMP), drained the northern one third of the MSP site and the Wood Avenue catch basin. The western-most subsurface drainage line consisted of a 0.30 meters (12 in) diameter polyvinyl chloride (PVC) pipe and received surface water runoff from a portion of the northern end of the MSP site. A sump in the former process building also discharged water to the subsurface stormwater system. Due to concerns about radionuclide migration, the stormwater system was plugged with concrete in 1996, and the Wood Avenue drainage line was rerouted along the eastern perimeter of the MSP site.

A settling basin near the southern MSP site boundary, was approximately 2.6 meters (8.6 ft) deep, and received storm water runoff from the surface water collection system that surrounded the two asphalt pads. Water in the settling basin discharged to the South Drainage Ditch through a concrete headwall on the southern boundary of the site. The South Drainage Ditch was approximately 350 meters (1,150 ft) in length and flowed through an unoccupied field to Main Stream. Main Stream flowed in a southwesterly direction for approximately 640 meters (2,100 ft) through a wooded area and discharged into Ambrose Brook. An *in situ* granular activated carbon (GAC) filter was installed behind the drainage ditch headwall in 1996 to reduce the likelihood of potential off-site migration of radionuclides into the ditch from discharging groundwater. Significant residential development of the area south of the MSP site boundary occurred during this remedial action. Site activities had little or no impact on construction to the south.

The east side of the MSP site borders residential homes, small businesses, and open fields (**Figure 1-2**). The west side borders an industrial vehicle salvage facility. The property to the south consists of marshy land and fields, and includes the South Drainage Ditch, which carries surface water runoff from the MSP site north of Main Stream. The entrance to the MSP facility (Mountain Avenue) is on the north side of the MSP site, which also borders Lehigh Valley Railroad.

1.5 Environmental Setting

Topographic surface elevations on the MSP site range from approximately 18 meters (58 ft) above mean sea level at the north end to 15 meters (49 ft) above mean sea level along the south end, with an average slope of approximately 1 percent. Soils at the MSP are silty to sandy loams with thickness ranging from 0.45 meter to more than 3.5 meters (1.5 ft to more than 11 ft) over weathered bedrock. Soil mapping by the US Department of Agriculture (USDA) Natural Resources Conservation Service in Middlesex County shows that the northern part of the MSP site consists of moderately deep to shallow, moderately well drained soil. The southern part of the MSP site consists of moderately deep, poorly drained soil. The northern soils were glacially derived, while the southern soils formed from weathered bedrock. Native soils in the area around the MSP have been disturbed, stripped, or altered by urban development.

The Soils OU-1 ROD (USACE, 2005) identified stratigraphic units at the MSP (from the surface downwards) as: asphalt and crushed stone, fill material that can include sewer pipe bedding, gravelly sand, clayey sand and sandy silt, silt, weathered bedrock, and unweathered bedrock (USACE, 2005). Groundwater at the MSP fluctuates between the shallow fill (overburden aquifer), weathered bedrock, and unweathered fractured bedrock (**Figure 1-5**).

1.6 Operational History

The known history of the MSP dates back to 1910. Construction of a plant for manufacturing asphalt paint was the first documented use of the MSP site. This plant included a brick warehouse, boiler house, garage, administration building, dye warehouse, and four smaller buildings.

In October 1943, the MED leased the brick warehouse from the American Marietta Corporation and converted it into a process building to sample, store, test, and transfer ores containing uranium (U), thorium, and beryllium. Between 1943 and 1955, uranium assay was the primary operation at the MSP. Uranium ores were received in burlap bags that were stacked and stored on the ground. The ore was thawed (if necessary), dried, crushed, screened, and collected in hoppers, and sampled for analysis. Ores were packaged, weighed, and shipped to processing facilities. No chemical processing of ore materials was performed at the MSP. The handling of ore bags likely resulted in spillage, and subsequent migration mechanisms caused localized radiological contamination, both on- and off-site.

In 1946, the MED was deactivated and MSP operations were continued under the direction of the AEC. The AEC purchased the leased facility by condemnation and various new buildings were constructed. These new structures included replacements for the administration building and garage, a thaw house, and a storage house. A chain-link fence was installed around the MSP site and most of the property was paved with asphalt for use as a drum storage area. Throughout the late 1940s and early 1950s, MSP received and shipped various research and decontamination wastes and incinerated low-level combustible waste. The incinerated ashes and noncombustible scrap were placed in drums and transported off-site for disposal.

During 1951 and 1952, the MSP became an intermediate shipment point for uranium bars sent off site for experimental machining into slugs. Scraps from the slug machining operation were returned to the MSP for shipment to a uranium recovery processor. The site also assayed beryllium ore for shipment.

The AEC ceased primary operations at the MSP in 1955. The site continued to be used for storage and limited sampling of thorium residues. All AEC activities terminated in September 1967 after the structures were decontaminated and the site was certified for unrestricted release (UR). In 1968, AEC returned the MSP property to the General Services Administration, which transferred the property to the US Department of the Navy.

Operations at the site resulted in off-site migration of radiological contamination, which resulted in contamination of the VPs. In 1948, materials with residual radioactivity had been trucked from the plant and disposed of at the MML, approximately 0.5 mi from the MSP. Contaminated residential VPs were remediated by DOE in the 1980s. Contaminated materials from this cleanup activity were brought back to the MSP site and stored in a specially constructed stockpile known as the VP pile. Also in the 1980s the contaminated materials disposed of at the

MML were excavated and transported back to the MSP for storage in a specially constructed stockpile known as the MML pile.

Based on the results of the 1976 Oak Ridge National Laboratory (ORNL) investigation (ORNL, 1977 and 1980), the MSP was placed in DOE custody in 1980 after contamination above then-current guidelines was found on both the MSP and surrounding VPs.

1.7 Previous Site Investigation Results

Numerous environmental investigations were conducted at the MSP. In 1967, after decontamination and before release of the MSP by AEC, the MSP site was radiologically surveyed and found suitable for release for unrestricted use. Due to a lack of documentation of the property's radiological status after its release and the implementation of the "as low as reasonably achievable (ALARA)" policy, the MSP site was resurveyed for radiological constituents in 1976 by the ORNL (ORNL, 1977). The results of this study identified radiological contamination above then-current guidelines at the MSP and VPs.

An environmental surveillance program was established at the MSP in 1981 to identify and quantify the effect of site removal action activities initiated by the DOE in 1980 on the surrounding environment and public health. This was completed to ensure that the environment and public health were adequately protected from contamination.

A 1983 radiological survey was conducted to prepare for future remediation at the MSP. The survey estimated the area and depth of radiological contamination on the MSP grounds and under the process building, boiler house, administration building, and garage. Contaminated soils were identified around and under the process building and extended south past the former thaw house. The highest contamination levels were found near the process building and in the southern portion of the MSP site.

In November 1991, a chemical characterization study was conducted on both the VP and MML stockpiles and in situ soils. These stockpiles resulted from interim cleanup actions at the MML and at properties in the vicinity of the MSP. Target Analyte List (TAL) metals (except cyanide), lanthanides, polychlorinated biphenyls (PCB), total petroleum hydrocarbons (TPH), and Resource Conservation and Recovery Act (RCRA) toxicity characteristic constituents were selected for analysis in the VP and MML stockpile samples. In situ soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and pesticides.

In August 1995, an investigation was completed to evaluate the fill behind the outfall headwall of the surface water drainage system. The results indicated the soil was contaminated behind the headwall in the fill material to a depth of approximately 1.5 meters (5 ft) below ground surface (bgs). Subsequent results from gamma logging showed radioactive contamination in the drain lines or the fill around the drainage pipes. The results of this investigation were used to plan the MSP Soils OU-1 RI. The MSP Soils OU-1 RI, which provided the basis for the MSP Soil OU-1 Feasibility Study (FS), was initiated in 2000. It included extensive surface and subsurface soil sampling and analysis for radiological and chemical contamination (USACE, 2004a, -2004b). SVOCs, lead, and radionuclides were identified in these investigations as contaminants of concern (COC), which contribute to unacceptable human health risks.

1.8 Previous Removal Activities

In 1980, the DOE initiated Phase I of a removal action to remediate the radionuclide-impacted VPs. Two of these parcels, a church rectory and a residence less than 1 mi from the MSP site, were contaminated by fill that was transported from the MSP during a 1948 site grading program. Contaminated fill subsequently transported to the MML during 1948 also required cleanup. As part of the Phase I activities, an asphalt pad was constructed at the south end of the MSP to accommodate placement of the waste materials from the VP cleanups. Improvements to the on-site drainage system were also made at this time. The old drainage system was replaced with a new system to collect surface water runoff in a below-grade settling basin prior to its discharge to the South Drainage Ditch. In 1984, the Phase II removal action addressed the remaining contaminated VP parcels, including the remediation of residual radioactivity in parcels of land adjacent to the MSP site and along both the South Drainage Ditch and Main Stream.

During the Phase I and II removal actions, 26,912 cubic meters (cu m) (35,200 cu yd) of radioactively contaminated soil that had been removed from the VP properties was transported to the MSP, thereby creating the VP interim stockpile. The contaminated soil was placed on an asphalt pad, covered, and sealed with a synthetic fabric. Organic materials collected during excavation, including tree stumps and railroad ties, were burned on site. The ashes were placed on a separate mat, covered with a synthetic fabric, and sealed.

A second interim stockpile, which accommodated radioactive wastes excavated from the MML, was constructed at the MSP in 1984. The contaminated materials removed from MML were originally generated as a result of grading operations at the MSP in 1948, when excess soil containing small amounts of a high-grade uranium ore was excavated and disposed of at the MML. The contaminated material was subsequently covered to varying depths during landfill operations.

A 1960 radiological survey at the MML resulted in the identification and removal of approximately 497 cu m (650 cu yd) of contaminated material near the surface of the landfill. Two subsequent radiological surveys indicated the need for an additional removal action at the MML. Excavation of this radioactively contaminated material began in 1984 when approximately 11,927 cu m (15,600 cu yd) of material were transported to the MSP for interim storage. In 1986, removal actions continued to excavate the remaining 11,927 cu m (15,600 cu yd) of radioactively contaminated material from the landfill, for a total of 23,854 cu m (31,200 cu yd) excavated. The contaminated material from the landfill was placed in a curbed area on a synthetic liner at the MSP. A sand drainage layer was installed between the contaminated material and the liner, which was intended to collect leachate from the pile. The MML interim storage pile then was covered with another synthetic liner and sealed to encapsulate the pile material. In 1997, CENAN prepared an Engineering Evaluation/ Cost Analysis (EE/CA) to address the MML pile that remained at the MSP site (USACE, 1997).

In 1997 the contaminated process buildings were demolished and the steel from the structures was stockpiled for recycling. In 1998 CENAN recycled and disposed of the stockpiled steel. In addition, CENAN disposed of approximately 25,230 cu m (33,000 cu yd) of contaminated soil contained within the MML pile at an off-site disposal facility. In 1999, CENAN prepared an EE/CA to address the VP pile that remained at the MSP site (USACE, 1999).

Between August and November 1999, approximately 26,762 cu m (35,000 cu yd) of contaminated soil from the VP pile were disposed of at an off-site disposal facility by ECC for

CENAN. For details on the VP pile removal, see **Appendix A** – *Interim Pile Removal Closure Report* (ECC, 2000).

In August 2006, following the signing of the Final MSP Soils OU-1 ROD (USACE, 2005) and the approval of the MSP Final Remedial Action/Remedial Design, CENAN awarded a contract for the demolition of several ancillary structures at the MSP. Building demolition was performed under an EE/CA as a precursor for implementation of the *MSP Soils OU-1 ROD* (USACE, 2005). The *Closure Report for Building Demolition* (ECC, 2006i) for this effort is located in **Appendix B** of this report.

2.0 OPERABLE UNIT BACKGROUND

The following sections describe the background of the MSP Soils OU-1 at the MSP. Specifically, this section discusses the land use, radiological and non-radiological cleanup objectives, requirements outlined in the *MSP Soils OU-1 ROD* (USACE, 2005) and the scope of work described in the *Remedial Action Work Plan* (RAWP) (ECC, 2006e).

2.1 Land Use

According to the US Census Bureau in 2006, the population of New Jersey is 8,724,560 with 786,971 people residing in Middlesex County. The population of Middlesex County has steadily increased over the past 30 years, with an overall growth of about 21 percent. Population projections for Middlesex County over the next 20 years indicate an increase of approximately 13 percent (US Bureau of Census 1998/Middlesex County Planning Department). Approximately 96 percent of the county is urban or suburban. The area within 0.8 km (0.5 mi) of the MSP is a mixture of residential homes, commercial and industrial properties, and undeveloped land and the residential population is approximately 1,150 people. This demographic data is derived from US Census Bureau population estimates.

There are no environmentally sensitive areas within the fenced borders of the site. The MSP is zoned Industrial by the Borough of Middlesex Planning Commission. The MSP is bordered by a heavy industrial zone approximately 914 meters (3,000 ft) to the west, a commercial/light manufacturing/wholesale zone 61 meters (200 ft) to the north, and an attached residential cluster 640 meters (2,100 ft) to the east. The property to the south of the MSP is within Piscataway Township and is zoned Residential and Light Industrial. The master plans for the Middlesex and Piscataway Townships do not recommend changes in zoning for the MSP and its vicinity, and it is unclear whether future land use at the MSP is expected to change. However, there is recent significant residential development to the south of the MSP site with the construction of condominiums that encroach on the southern MSP boundary.

The location of the adjacent salvage yard and current industrial zoning reduces the potential for residential development at the MSP. With the recent construction of condominiums south of the MSP site, there is no available room for further development, south and southeast of the site. The MSP borders an area of residential zoning and experiences the pressures of expanding residential development.

2.2 Cleanup Objectives

The cleanup standards for the MSP Soils OU-1 site were defined in the ROD for the MSP Soils OU-1 (USACE, 2005). The *MSP Soils OU-1 ROD* (USACE, 2005) identified cleanup goals for radium (Ra)-226; lead; and the five PAH compounds (benzo(a)pyrene, benzo(a)anthracene, dibenzo(a,h)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene) in the soil at the MSP. Additionally, it should be noted that the MSP ROD addressed the cleanup of total uranium by using the cleanup goal for radium as a surrogate for total uranium. Soil remediation goals (cleanup levels) as specified in the *MSP Soils OU-1 ROD* (USACE, 2005) and in the Remedial Investigation/Feasibility Study (RI/FS) documents, are summarized below and in **Table 2-1**.

Table 2-1
Record of Decision Cleanup Levels
Middlesex Sampling Plant
Middlesex, New Jersey

PAHs	Selected Criteria Residential Soil Cleanup (mg/Kg)	Units	Basis
Benzo(a)pyrene	0.66	mg/Kg	PQL (1 x 10^{-5} risk)
Benzo(a)anthracene	0.9	mg/Kg	1 x 10^{-6} risk
Dibenzo(a,h)anthracene	0.66	mg/Kg	PQL (1 x 10^{-5} risk)
Benzo(b)fluoranthene	0.9	mg/Kg	1 x 10^{-6} risk
Indeno(1,2,3-c,d)pyrene	0.9	mg/Kg	1 x 10^{-6} risk
Lead	400	mg/Kg	1 x 10^{-6} risk
Radionuclides	**Selected Criteria Residential Soil Cleanup (pCi/g)**	**Units**	**Basis**
Ra-226	5.0 (above background)	pCi/g	15 mrem/ year dose
U-nat*	17	pCi/g	

Notes:
mg/Kg = milligrams per kilogram
mrem = millirem
PAH = polynuclear aromatic hydrocarbon
pCi/g = picoCuries per gram
PQL = Practical Quantitation Limit
Ra-226 = radium 226
U-nat* = natural uranium; see Section 2.2.1
The 0.66 mg/Kg cleanup levels for benzo(a) pyrene and dibenzo(a,h)anthracene are based on the Practical Quantitation Limits (PQLs) for these two chemicals, since risk-based levels were lower than the achievable PQLs. The use of these PQLs, although not at 10^{-6} risk, will result in a cleanup that removes contaminants to an acceptable risk range. See Section 2.2.2 of this PRAR for details.

2.2.1 Radiological Soil Remediation Goals

The development of the OU-1 soil radiological remediation goals took into account radiation doses from the soil itself via dust inhalation, soil ingestion, and direct radiation. Secondary impacts were also considered through ingestion of plants growing in the contaminated soil and through their impact on groundwater that may be contaminated from the MSP site soils. The primary criterion that was used in each equation was the acceptable annual radiation dose of 15 millirems per year (mrem/yr) (NJAC 7:28-12.8) (NJAC, 1997b). These values are scenario-specific, site-wide averages, as demonstrated by the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (USEPA 402-R-97-016-Rev 1 *Multi-Agency Radiation Survey and Site Investigation Manual* survey approach (USEPA, 2000b).

Remedial investigation and historical sampling data and documentation were used during development of the *MSP Soils OU-1 ROD* (USACE, 2005) COC criteria for the MSP

remediation project. The FS determined Derived Concentration Guidelines (DCGLs) of 6.8 pCi/g for Ra-226 and 17 pCi/g for natural (or isotopic) uranium (U-nat). However, based on site-wide data, an assumption was made that uranium and radium were at or near secular equilibrium. Therefore, it was determined that a DCGL of 5 pCi/g for Ra-226 would account for the risk from uranium and was used as an effective surrogate for uranium contamination. Simply stated, expectations were if Ra-226 was remediated to a level of less than 5 pCi/g, the uranium content would not exceed 17 pCi/g and therefore meet the MSP cleanup objectives.

Radiological survey and sample analysis plans and/or procedures were developed based on these assumptions. Initially, at least 10 percent of FSS samples were to be analyzed for U-nat according to the original RAWP.

During a review of sample analysis data from the first three Survey Units (SUs) to be remediated, (SUs 20, 21, and 22), it became apparent that the radium surrogate was not appropriate in all cases. Approximately 10 percent of uranium data indicated that the use of Ra-226 as a surrogate was not appropriate. Therefore, the decision was made to analyze 100 percent of the final status soil samples for U-nat directly and to not rely on Ra-226 as a surrogate for U-nat. As remediation of the MSP property progressed, excavation generally proceeded from the north to the south, from SU22 though SU1, and finally, SU-23, which was located south of SU1. SUs 20, 21, and 22 were reanalyzed for U-nat (See Section 5.2.3. of this PRAR).

2.2.2 Non-Radiological Soil Remediation Goals

The remedial goals for the carcinogenic PAHs that posed unacceptable risks are based on the New Jersey Soil Cleanup Criteria, which have been identified as "To Be Considered" (TBC) guidance (NJAC, 1997). These criteria are identified to reduce the risk due to the described exposure pathways and are also considered to be protective of groundwater. It should be noted that the 0.66-mg/Kg cleanup levels for benzo(a)pyrene and dibenzo(a,h)anthracene are based on the Practical Quantitation Limits (PQLs) for these two chemicals, since risk-based cleanup levels were lower than their 0.66-mg/Kg PQLs for the analytical method. The use of these PQLs, although not at 10^{-6} risk, still results in a protective CERCLA cleanup. These values are scenario-specific, site-wide averages, as demonstrated by a statistical based sampling approach. The residential land use remedial goals for non-radiological compounds (specific PAHs and lead) are listed in **Table 2-1**.

2.3 Record of Decision Requirements

The *MSP Soils OU-1* ROD (USACE, 2005) for the MSP Soils OU-1 was issued in September 2005, and identified cleanup goals for Ra-226; lead; and the five PAH compounds (benzo(a)pyrene, benzo(a)anthracene, dibenzo(a,h)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene). The *MSP Soils OU-1 ROD* (USACE, 2005) identified the selected remedy for the MSP site, which includes the following:

- Soil excavation to an unrestricted use cleanup level;
- Off-site disposal of the excavated soil at a licensed and permitted facility; and
- Demolition, removal, and off-site disposal of contaminated former storage pads and below-grade structures at a licensed and permitted facility.

2.4 Remedial Design

The remedy described in the *RAWP* (ECC, 2006e) represents one of two planned response actions for the MSP site. The *MSP Soils OU-1 ROD* (USACE, 2005) addresses remediation of contaminated soils and debris (i.e., soil, fill, and below-grade structures) in accordance with the Remedial Action Objectives (RAOs) established in Section 2.8 of the Decision Summary. The RAOs for the Groundwater OU-2 will address potential groundwater, sediment, and surface water contamination at the MSP site.

The overall cleanup strategy for MSP soils was to remove contaminated site media (i.e., surface and subsurface soils, asphalt pads, and demolition debris), to established cleanup goals, and dispose of these materials off site at an approved and permitted facility. The remedial design was based on the extent of contamination as presented in previous investigation reports and decision documents such as the *2004 Soils OU-1 Final Remedial Investigation Report* (USACE, 2004b) and the *MSP Soils OU-1 ROD* (USACE, 2005). Removal of the contaminated media resulted in removal of potential sources that is likely to have a positive impact on the MSP groundwater. The MSP site cleanup criteria established for the radiological and chemical contamination at the MSP site are summarized in **Table 2-1**.

The major components of the selected remedy from the *MSP Soils OU-1 ROD* (USACE, 2005) used to achieve cleanup levels specified in **Table 2-1** included the following:

- Soil excavation to an unrestricted-use cleanup level. Prior to excavation, the MSP site was surveyed and staked into a grid of approximate 10-meter by 10-meter squares to locate the individual SUs. **Figure 1-2** illustrates the SU locations that were utilized for the MSP Remedial Action.
- Transportation and Off-site disposal of the excavated soil and fill material.
- Demolition, removal, and off-site disposal of contaminated former storage pads and below-grade structures to a minimum of 2 ft bgs.
- Release of the property for unrestricted use (*i.e.*, no engineering or institutional controls required).
- Protection of groundwater through proper management and disposal of storm water and collected groundwater.
- Reduction in toxicity, mobility, and volume of on-site contaminants through removal of source materials.

3.0 CHRONOLOGY OF THE MIDDLESEX SAMPLING PLANT SITE HISTORY AND REMEDIAL WORK

The following provides a chronological summary of major events since inception of the Middlesex Sampling Plant.

DATE	EVENT
1910	The MSP site began operations as a plant for the manufacture of asphalt paint.
1943	The MED leased the brick warehouse from the American Marietta Corporation and converted it into a process building to sample, store, test, and transfer ores containing uranium, thorium, and beryllium.
1948	Materials containing residual radioactivity were trucked from the MSP and disposed at the MML
1943-1955	Uranium assay was the primary operation at the MSP, MED deactivated – AEC purchases MSP.
1955	AEC ceased primary operations at the MSP.
1967	AEC activities terminated in September.
1968	AEC returned the MSP property to the General Services Administration, which transferred the property to the US Department of the Navy.
1976	ORNL Site Investigation.
1980	The MSP was placed in DOE custody based on 1976 ORNL Investigation. DOE initiates Phase I of a Removal Action to remediate the VP.
1984	Approximately 15,600 cu yd of material was transported from the MML to the MSP for interim storage.
1984	DOE initiates Phase II Removal Action, consolidating material from remaining VPs into the VP pile at the MSP.
1986	MML Removal Actions continued, the remaining 15,600 cu yd of radioactively contaminated material from the landfill was transported to the MSP for a total of 35,200 cu yd.
1997	DOE transfers FUSRAP Program to CENAN (Fiscal Year 1998).
1997	Process buildings demolished and steel staged for recycling (ECC subcontracator).
1998	CENAN recycles and disposes of stockpiled steel from legacy buildings. CENAN also disposes of 33,000 cu yd of contaminated soil from the MML Pile. (ECC subcontracator).
1999	CENAN prepared an EE/CA to address the VP pile that remained at the MSP site. Between August 1999 and November 1999, approximately 35,000 cu yd of contaminated soil from the VP pile was disposed at an off-site disposal facility.
May 2004	CENAN completed the Soils RI/FS.
March 2005	Proposed Remedial Action Plan for MSP Soils OU-1 submitted for public comment.
August-September 2005	Demolition and off-site waste and debris disposal of the Administrative Building and the Garage performed under the EE/CA.
September 2005	The MSP Soils OU-1 Record of Decision for the Middlesex Sampling Plant Site, Middlesex, New Jersey is issued by the USACE.
February 2006	The MSP Soils OU-1 Remedial Action Work Plan (ECC, 2006e) was completed for implementing the selected remedy of the Soils OU-1 ROD (USACE, 2005).
July 2006	The USACE awards contract W912DQ-04-D-0017 to execute the selected remedy of the Soils OU-1 ROD (USACE, 2005).
August 2006	CENAN Contractor (ECC) mobilizes to MSP and begins remedial activities.
January 31, 2008	Chemically-impacted soil remediation, transportation and disposal completed.
February 28, 2008	Water treatment completed (total of 1,452,168 gallons treated).
March 19, 2008	Lead waste transportation completed.
March 27, 2008	Demobilization of water treatment facility.

DATE	EVENT
April 17, 2008	Radiologically-impacted soil remediation, transportation, and disposal to US Ecology's Idaho burial facility completed.
April 21, 2008	Radiologically-impacted waste remediation, transportation and disposal to Energy Solution's Utah burial facility completed.
May 8, 2008	Survey and free release of legacy equipment / materials completed.
May 13, 2008	All site FSS Reports completed and accepted by CENAN.
May 14, 2008	Backfill of survey units completed
May 28, 2008	Site grading completed.
June 13, 2008	Site restoration completed (top soil, seeding, asphalt paving, permanent fencing, and abandonment of monitoring wells.
June 13, 2008	Site demobilization (equipment and materials).
June 26, 2008	New monitoring wells installed.
July 28, 2008	Final Inspection of OU-1 Restoration Activities.
September 30, 2008	Draft PRAR submitted to CENAN.
December, 2008	Draft Final PRAR submitted to CENAN.
January, 2009	Draft Final PRAR submitted to USEPA

4.0 CONSTRUCTION ACTIVITIES

The MSP Soils OU-1 remedial activities detailed in this PRAR were accomplished in three separate actions. Two of these actions were completed under the EE/CA, with the third executed as the selected remedy of the *MSP Soils OU-1 ROD* (USACE, 2005):

- The first action completed under the EE/CA was the Interim Soil Stockpile Removal in 1999.
- The second action completed under the EE/CA was the demolition and off-site disposal of the administration building, the garage/shed, and associated waste in 2005.
- The third and final action of the MSP Soils OU-1 closure effort was to implement the selected remedy of the Soils OU-1 ROD (USACE, 2005). This effort included excavation and off-site disposal of contaminated soils within the MSP site boundaries.

The *Interim Pile Removal Closure Report* (ECC, 2000) is included as **Appendix A**. The *Closure Report for Building Demolition* (ECC, 2006i) is included as **Appendix B**. **Appendix C** contains the Well Abandonment Reports. The details of the excavation and off-site disposal of contaminated soils at the MSP (the primary focus of this report) are described in the following sections. The MSP Soils OU-1 remediation process flow diagram is presented in **Figure 4-1,** which demonstrates the process implemented for conducting the remediation excavations, radiological and chemical surveys, cleanup monitoring and verification, transportation and disposal, backfilling, site restoration, and reporting. **Appendix D** contains photo documentation of the MSP Soils OU-1 remedial activities.

4.1 Site Excavation

This section describes the activities performed to implement the Soils OU-1 ROD (USACE, 2005) selected remedy. Specifically addressed are actions taken to remove, ship, and dispose of soil, subsurface structures, and building foundations.

4.1.1 Mobilization and Site Preparatory Work for Site Excavation

During mobilization, the MSP site was made ready for excavation activities in accordance with the Soils OU-1 ROD selected remedy and approved plans. In summary, the following significant preparatory activities occurred prior to startup of site operations:

- A baseline civil survey of the MSP site was performed by Geod Corporation, a subcontracted licensed local surveyor. The survey provided the baseline topographic survey and physically marked out the boundaries of the individual survey units, as shown in **Figure 4-2**. This information was used to subsequently calculate volumes excavated from each SU.
- An on-site Gamma spectroscopy lab was established.
- A baseline radiological survey was performed on leased equipment, structures, and trucks.
- MSP work zones were established to delineate the exclusion zone (radiological control area), contaminant reduction zone, and support zone. Work zones, including the areas to be used by trucks, were delineated by ropes, signs, and spray paint on the asphalt.
- Four mobile office trailers were placed and electrical utilities established.

- MSP site workers were required to read and sign applicable project plans and procedures. Safety orientation training was provided to all project team members.

Following completion of the MSP site preparation activities, work assignments, project objectives, and individual responsibilities were reviewed with the staff, and site-specific health and safety issues were discussed as part of the overall health and safety readiness of the project team.

4.1.2 Erosion and Sediment Control Plan and Storm Water Permit

Pursuant to the New Jersey Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 *et. Seq.*, and Chapter 251, P.L. 1975, and as amended by C. 264, P.L. 77 and C. 459, P.L. 79, the Freehold Soil Conservation District granted certification of the *Soil and Erosion Control Plan* (ECC, 2006f) for the MSP Remedial Action Project. This plan was developed to describe methods to:

- Reduce flood damage
- Minimize runoff
- Maintain adequacy of existing storm water structures
- Prevent non-point source pollution
- Maintain the integrity of natural features
- Reduce erosion
- Protect downstream water quality

To accomplish these objectives, storm water and existing surface water was managed by controlling run-on and run-off, capturing and treating potentially contaminated water, and implementing work-practice controls.

The New Jersey Pollutant Discharge Elimination System (NJPDES) Permit number NJG008823 was submitted and approved by the Freehold Soil Conservation District. **Appendix E** presents the approved *Storm Water Management, Soil Erosion, and Sediment Control Plan*. (ECC, 2006g).

4.2 Water Treatment Design and Facility Construction

This section provides an overview of the wastewater treatment system used at the MSP as part of the remediation activities during the period of performance. The section includes a description of the Waste Water Treatment Plant (WWTP) process design, facility construction, facility operations, and the Middlesex County Utility Authority (MCUA) Permit discharge and reporting requirements.

4.2.1 Process Design

The waste water pre-treatment system was designed to meet the discharge criteria required by MCUA. Principally, the system was designed for particulate removal, carbon adsorption, and radionuclide-specific ion-exchange. A conventional design was developed to effectively pre-treat wastewater collected from the excavated areas resulting from storm-water runoff,

precipitation, and groundwater. The conceptual design included an influent storage tank, pre-filtration, carbon vessel, ion-exchange resin vessel, and a treated water storage tank.

The MSP WWTP process flow diagram is included in **Figure 4-3**. The MCUA Temporary Discharge Approval is included as **Appendix F**, and the WWTP Discharge Monitoring Reports are included as **Appendix G**.

The analytical data indicated suspended solid matter, PAH, and radioactive isotopes as the primary COCs for MSP wastewater. Based on these COCs, the results of a treatability study, and the MCUA discharge criteria, the WWTP design relied on particulate settling and filtration, carbon adsorption, and ion exchange as the primary treatment technologies. A routine monitoring, sampling and analysis program ensured that all water discharged from the site to the MCUA met the discharge criteria.

The WWTP was initially operated in 50,000-gallon batches until the analytical results of the treated water consistently indicated compliance with the discharge criteria. After demonstrating effective water treatment, the treated water was discharged continuously or intermittently, as required, and in compliance with the MCUA Temporary Discharge Permit.

Treated water samples were collected weekly and sent to Eberline Services for analysis of Gross Alpha, Gross Beta/Gamma, Ra-226, Ra-228, and total uranium. Treated water samples were collected monthly and sent to Chemtech Laboratory for analysis of metals, VOCs, SVOCs, PCBs, pesticides, TPH, hydrogen ion concentration (pH), mercury, and hexavalent chromium. A total of 5,159,137 liters (1,362,900 gallons) of wastewater were compliantly discharged to MCUA during the WWTP operations from April 2007 to February 2008. Residual solids such as cartridge filters, sediment, and tank liners were disposed of as waste, along with the radiologically-impacted soil and debris.

4.2.2 Middlesex County Utility Authority Permit

A temporary discharge permit was applied for and approved to allow discharge of treated water to the MCUA Central Water Treatment Plant in Sayreville, New Jersey. The approved permit is provided in **Appendix F** including permit requirements and the discharge criteria.

4.2.3 Discharge Reporting

As required by the MCUA approved permit, monthly Self Monitoring Reports were prepared and submitted to the MCUA. All reports were submitted and received compliantly. The Self Monitoring Reports are included in **Appendix G**.

4.3 Remediation Activities

This section provides an overview of the remediation activities performed in accordance with the *MSP Soils OU-1 ROD* (USACE, 2005) at the MSP. The overview includes a SU size summary table and descriptions of the remediation effort employed at the MSP to remove radiologically, chemically, and lead-contaminated soil and debris. Additionally, removal of underground storage tanks (UST), legacy building foundations, blank small arms ammunition, and demolition and removal of the legacy storm water settling basin are discussed.

Table 4-1 presents the radionuclide surface contamination screening level criteria. **Table 4-2 and Table 4-3** present the final excavation confirmation sampling results for radiological and chemical contaminants, respectively.

4.3.1 Survey Unit Size Summary

The MSP site was divided into 22 SUs in accordance with MARSSIM guidance to execute remedial activities in manageable-sized parcels within the MSP site boundary. During the removal action, another parcel was identified outside and to the south of the MSP Property as SU-23 due to data results indicating the exceedance of radiological cleanup goals in sediments. The following chart presents the size of each of the 23 SUs in square meters (sq meters) and in square feet (sq ft).

Survey Unit	Size (sq meters)	Size (sq ft)
SU-1	1,939	21,091
SU-2	1,799	19,375
SU-3	1,799	19,375
SU-4	1,707	18,385
SU-5	1,799	19,375
SU-6	1,799	19,375
SU-7	1,671	17,997
SU-8	1,799	19,375
SU-9	1,799	19,375
SU-10	1,707	18,385
SU-11	1,799	19,375
SU-12	1,799	19,375
SU-13	1,668	17,966
SU-14	1,799	19,375
SU-15	1,615	17,395
SU-16	1,741	18,750
SU-17	1,741	18,750
SU-18	1,999	21,528
SU-19	1,799	19,375
SU-20	1,799	19,375
SU-21	1,799	19,375
SU-22	1,382	14,885
SU-23	480	5,170

4.3.2 Remediation of Radiologically Contaminated Soil and Debris

Excavation of radiologically contaminated soil began in SU-22 (at the northern portion of the MSP Site) and proceeded southward towards SU-1, SU-2 and SU-3 (Figure 4-2). Health Physics Technicians (HPTs) performed Remedial Action Status Surveys (RASS) to determine when soil in a given SU had met the project clean up levels listed in **Table 2-1.** Demolition debris and

other non-soil debris was surveyed by HPTs to determine if it was radiologically contaminated, and to determine the appropriate decontamination or disposal requirements according to the radionuclide surface contamination screening level criteria listed in **Table 4-1**.

Radiologically contaminated soil was excavated and loaded into haulers for transport to the designated on-site staging stockpile. The on-site staging stockpiles were occasionally placed on backfilled areas on liners (SUs -05, -08, -10, -11, -14 and -21). Once this soil was transported off-site, the SU was re-surveyed according to FSS protocols. Hence the original and supplemental data (SUPP) is presented in the Table 4-2 to document cleanup was attained below the backfill; then re-confirmed "clean" on top of the backfill once the waste was removed.

Soil stockpiles were also covered at the end of each day. Subsequently, radiologically contaminated soil from the staging stockpiles was placed in lined trucks or other appropriate shipping containers, and prepared for shipment to the appropriate disposal facility, depending on the level of radioactivity of the source material.

Soils exhibiting activity levels less than 500 microrem per hour (μR/hr) were stockpiled with other material for disposal at the US Ecologies disposal facility in Idaho. Soils in excess of 500 μR/hr but less than 1 millirem per hour (mrem/hr) were blended with other radiologically contaminated soils of lower concentration. The resultant waste stream was compliant with the US Ecology's Idaho disposal facility Waste Acceptance Criteria (WAC). This waste stream was transported to the Lehigh Valley rail transfer facility where it was loaded into gondola train cars for transport to US Ecology's Idaho disposal facility.

Soil, rock, and debris exceeding 1 mrem/hr was segregated and loaded into (4) B-25 waste containers (B-25 containers have dimensions of 96 cubic feet (4 ft by 4 ft by 6 ft); are typically made of carbon steel, aluminum, and stainless steel; and utilized for transportation of radiologically-contaminated materials.). The B-25 boxes were shipped to Energy Solution's disposal facility located in Clive, Utah.

4.3.3 Remediation of Chemically Impacted Soil and Debris

Chemically impacted soils were often found co-mingled with radiologically contaminated soil. In these instances, chemically impacted and radiologically contaminated soil were excavated in unison and placed in designated stockpiles for subsequent shipment to the US Ecology disposal facility in Grand View, ID. There was no observed direct correlation between chemical, metal, and radiological soil contaminant concentrations.

In SUs 4, 5, 7, 8, and 11, significant lenses of chemically contaminated soil were encountered below radiologically contaminated soil. In these areas, gamma walk-over surveys (GWS) were performed while excavating the chemically-impacted soil to ensure direct gamma readings were below project and disposal facility limits. The chemically-contaminated soils exhibited PAH concentrations above the project cleanup goals, as measured by the certified off-site lab. In general, the chemically-contaminated soils were stained black, and existed as a visually distinct layer below the radiologically contaminated soils. The chemically contaminated soils were excavated and placed in SU-specific stockpiles for subsequent shipment to Allied Landfill's RCRA Subtitle D disposal facility in Niagara Falls, NY. Waste characterization sampling

included the collection of five soil samples from the chemical-waste stockpile for VOCs. VOC results from these samples were below Federal action levels, and were found to be acceptable for disposal at the Allied Landfill's RCRA Subtitle D disposal facility in Niagara Falls, NY.

The project team developed plans and procedures to segregate prohibited waste from waste that was acceptable for disposition at the Allied Landfill in Niagara Falls, New York. The MSP team excavated known radioactive soils in accordance with the *MSP Soils OU-1 ROD* (USACE, 2005) and the RAWP. To screen for radiologically impacted soil, HPTs used direct reading sodium iodide (NaI) detectors and performed in-situ scans of soil as it was being excavated. After field instrumentation indicated radioactive materials had been sufficiently removed, the MSP Team performed a MARSSIM-compliant FSS on top of the chemically impacted soil.

After this FSS was accepted by CENAN, HPTs performed and documented GWSs for every subsequent 2-foot lift of chemically impacted soil removed from an affected SU. The 2-foot lift surveys were required by the State of New York and Allied Landfill to mitigate the possibility of radiologically contaminated soil reaching the landfill. The results were documented on excel spreadsheet survey forms submitted to the State of New York for approval prior to soil shipment. As an added precaution, constant RASS were performed during chemical soil excavation. Heavy equipment operators removed chemically-impacted soil in 6-in lifts.

During removal of chemically impacted soil, one HPT constantly scanned soil in the excavation area while another HPT scanned the waste stockpile to ensure potential discreet pockets of radiologically-impacted soil and debris were isolated or removed from the chemically-impacted soil stockpile destined for disposal at the Allied Landfill.

Chemically impacted soils were stockpiled according to individual SU and physically segregated from other SUs and radioactively contaminated soils. Prior to shipping soil to Allied Landfill, the New York State Department of Environmental Control (NYSDEC) and Allied Landfill reviewed the waste characterization documentation from each SU excavation and stockpile to ensure no radiological contamination was present. Once approvals were obtained to ship and dispose the stockpile of excavated soil from each chemically-impacted SU, the soil was loaded into trucks and transported to a rail transfer station in North Bergen, New Jersey. The waste was then transported by rail to the Allied Landfill in Niagara, New York.

4.3.4 Removal of Underground Storage Tanks

During remedial excavation activities, ECC encountered two 1,893 liter (550-gallon) USTs. One UST (UST #1) was located in SU-21 and was likely associated with the former administration building; the other (UST #2) was located in SU-18. **Figure 4-4** presents the locations of the USTs. Both USTs contained No. 2 heating oil. ECC contracted with a NJDEP-licensed UST closure firm, ANCO Environmental Services, Inc. (ANCO), to remove and dispose of the UST contents, oversee UST removal, obtain and analyze post-excavation soil samples, and prepare a UST closure report. The ANCO UST Closure Report in presented in **Appendix H** (ANCO, 2007).

Waste generated during the UST removal included approximately 1,135 liters (300 gallons) of residual petroleum product from UST #1, and 5,299 liters (1,400 gallons) of residual petroleum product, and petroleum-impacted water collected from the tank contents and associated excavation for UST #2. Additionally, approximately 77 US-short tons of petroleum contaminated soil co-mingled with radiologically impacted soils was generated.

All petroleum liquid wastes were disposed of at Clean Water of New York (Manifest Numbers AN2006-37 and AN2007-09). The impacted soils were subsequently sent to US Ecology Idaho, Inc. as part of the shipments of other radiologically impacted soils generated from the remedial activities at the MSP site. Waste quantities and certificates of disposal are presented in Appendix J.

Post-excavation soil samples were collected and analyzed from each UST excavation as part of the UST closure effort. The analytical results indicated that TPH concentrations ranged from non-detected (ND) to a maximum of 52 mg/Kg. A follow-up priority pollutant+40 analysis of a sample collected during the UST #2 removal (52 mg/Kg) was within NJDEP compliance limits for all parameters.

A "No Further Action" classification of the former UST sites was requested for the soils based on the UST closure activities and the UST removal analytical results. Although the UST Closure Report was submitted to NJDEP, the final determination of "No Further Action" will be evaluated during review of this PRAR by the NJDEP. Impact to groundwater resulting from the release of UST contents is being evaluated as part of the MSP Groundwater OU-2 monitoring activities. Groundwater monitoring is currently underway as part of MSP Groundwater OU-2 for the MSP site.

4.3.5 Removal of Former Building Foundations

Prior to work required to implement the Soils OU-1 ROD selected Remedy; the MSP team performed decontamination and demolition of the MSP Garage and Administrative Building under the MSP EE/CA (Task Order 003). This demolition resulted in the removal of 45 tons of building material and construction debris that was staged, later combined with the MSP radiologically contaminated soils waste stream, and disposed of during the *MSP Soils OU-1 ROD* (USACE, 2005) implementation. Sub-surface building foundations, drainage culverts, piping, and the south settling basin were also removed using heavy equipment. All of these structures were found to be radiologically contaminated or in contact with radiologically contaminated soil. Therefore, all sub-surface debris was considered radiologically contaminated, and was combined with waste material shipped to US Ecology or Energy Solutions, depending on the level of radioactivity. **Figure 4-4** presents the locations of the legacy building foundations.

4.3.6 Removal of Blank Small Arms Ammunition

During remedial excavation activities of radiologically impacted soils within SU-10, a small cache of blank small arms ammunition was unearthed. The location of the small arms ammunition cache is shown on **Figure 4-4**. The blank ammunition was removed and stored for subsequent disposal.

After consultation with ECC's internal senior unexploded ordnance technician, it was determined that the blank ammunition could be safely handled by MSP HPTs. The HPTs removed gross contamination from the surface of the munitions cartridges, and rinsed them with water. All waste soils and water generated during this activity were addressed as part of the on-going chemical and radiological soil remedial activities at the MSP site. The cartridges were placed in Marinelli sampling containers (to ensure a reproducible geometry) for gamma spectrometry analysis and then analyzed at the on-site gamma-spectrometry laboratory. Analytical data indicated the cartridges did not contain radioactive isotopes above background levels established for the MSP site (see waste profile sheet in **Appendix I**).

Approximately 0.07 cu m (2.5 cu ft) of blank munitions were disposed of through Clean Harbors and sent to their Colfax, LA facility (USEPA ID# LAD981055791). A Certificate of Disposal for this material is documented in **Appendix J**.

4.3.7 Demolition and Removal of Storm Water Settling Basin

Storm water was sampled and drained from the settling basin adjacent to SU-2. The majority of stored storm water was used on-site for dust control in contaminated SUs; the remaining volume was pumped into holding tanks, transported to the onsite treatment facility and transferred into the influent holding tank. The water was processed, sampled and released in accordance with site procedures and the applicable site discharge permit.

Once the settling basin was drained, the MSP team severed all stormwater piping and demolished the storm water settling basin using heavy equipment, hydraulic hammers, and grapples. This debris was determined to be radiologically contaminated, reduced in size, transported, and stockpiled on the MSP site. It was eventually added to the radiologically-contaminated soil and disposed of at the US Ecology Idaho facility.

4.3.8 Waste Disposal Summary

The following summarizes waste types, quantities, and disposal facilities used during the MSP site removal action. The volume of radiological waste and chemically impacted waste removed from the site was based on the pre- and post-excavation civil surveys performed by GEOD Corporation, a licensed, local civil survey company. A copy of the GEOD volume report, along with field confirmation of volume (by truck-count) is included in **Appendix J.** The weight of the disposed waste was based on the waste receipt certification as measured at the disposal facility.

Waste Type	Volume	Weight	Disposal Facility
Radiological Waste (Soil and Debris)	31,510 *in-situ* cu m (41,231 cu yd)	7.23 X 10^7 Kg (79,687 tons)	US Ecology Idaho, Inc. PO Box 400 20400 Lemley Rd Grand View, Idaho 83624
Regulated Radiological Waste (Soil and Debris)	10 *ex-situ* cu m (13.3 cu yd)	16,846 Kg (18.57 tons)	Energy Solutions, LLC Clive Disposal Site (Bulk Waste Facility) Interstate 80, Exit 49 Clive, Utah 84029
Small Arms Blank	0.07 *ex-situ* cu m	90.72 Kg	Clean Harbors, Colfax, LLC

Cartridge Waste	(2.5 cu ft)	(200 lbs)	3763, Highway 471 Colfax, Louisiana 71417
Chemically Impacted Waste (Soil and Debris)	3,405 *in-situ* cu m (4,454 cu yd)	7.24 X 10^6 Kg (7,984 tons)	Allied Waste Niagara Falls Landfill 56th Street and Niagara Falls Blvd Niagara Falls, New York 14304
Non-Hazardous/ DOT Combustible Liquid Waste Oil (UST Contents)	6,435 *ex-situ* liters (1,700 gallons)	n/a	Clean Water of New York 3249 Richmond Terrace Staten Island, NY 10303
Waste Water from Impacted Survey Units	5,159,134 *ex-situ* liters (1,362,899 gallons), pre-treated on site and compliantly discharged	n/a	Middlesex County Utilities Authority (MCUA) 2571 Main Street Sayreville, New Jersey 08872

Kg = Kilogram cu m = cubic meters cu yd = cubic yards

Disposal of the wastewater from the impacted survey units is documented in the MCUA Discharge Monitoring Reports, as **Appendix G**. Disposal of the residual waste oil and petroleum-impacted water from the UST removals is documented in the UST Closure Report as **Appendix H**. Waste profiles are included as **Appendix I**, and Certificates of Disposal from the waste disposal facilities are included as **Appendix J**.

4.4 Site Restoration

Site restoration activities included demobilizing equipment and temporary facilities, discontinuing all utility services, backfilling the MSP site to the original grade, and grading and seeding the MSP site to allow for beneficial future use. The MSP site has been restored to the specifications identified in the *MSP Soils OU-1 ROD* (USACE, 2005).

4.4.1 Geotechnical Requirements for Backfill

Soil used to backfill the excavated areas consisted of soils considered acceptable by CENAN and as defined in the NJAC. 7:26E-6.4(b) (NJAC, 1997a) and *1998 Revised Guidance Document for Remediation of Contaminated Soils* (NJDEP, 1998). Backfill soil was not permitted to contain large rocks (>20.32 centimeters [cm] [8 in]), man-made materials or trash, organic material (roots, leaves, compost, humus, etc.) or frozen soil. The approved backfill material was tested for the following geotechnical parameters per the MSP project specification and RAWP.

- Modified proctor;
- Atterburg Limits;
- Grainsize distribution;
- Unified Soil Classification System; and
- Permeability.

The soil removed as part of the remedial action was not native soil. Therefore, the NJAC regulations require that the fill material be of equal or less permeability than the native soil in or adjacent to the MSP site. Permeability tests were conducted on both the on-site native soil (outside the excavation limits) and the imported backfill material to ensure the backfill permeability requirement was met.

The approved backfill sources and associated testing results are documented in Project Transmittal #19998 and **Appendix K** (backfill acceptance and compaction documentation).

4.4.2 Backfill Source and Placement

Multiple sources of backfill were evaluated and compared against the requirements of NJAC 7:26E-6.4(b) (NJAC, 1997a) and *1998 Revised Guidance Document for Remediation of Contaminated Soils* (NJDEP, 1998). The approved common backfill material was acquired from three separate local borrow sources exhibiting similar characteristics to the native soil at the MSP site. Approximately 51,225 cu m (67,000 cu yd) (ex-situ) of common backfill material was imported and placed at the MSP site following remediation activities, prior to topsoil placement. Seven additional sources were evaluated and rejected for one or more of the chemical, radiological or physical characteristic criteria. Only backfill material compliant with the MSP project chemical, radiological, and geotechnical criteria was accepted for use at the MSP.

Documentation of the quality of the fill was provided by a certification stating that it is virgin uncontaminated material. The certification documents:

- The name of the affiant and relationship to the source of the fill;
- The location where the fill was obtained including the street, town, lot and block, county, and state (as available);
- A brief history of the source site; and
- A statement that the fill is not contaminated pursuant to any applicable standards and a description of the steps taken to confirm it is not contaminated.

Backfill was placed in lifts no greater than 8 in thick. The backfill was compacted to 85 percent maximum density of the modified Proctor Test per the requirements of American Society for Testing and Materials (ASTM) Standard D698. Moisture and compaction were routinely determined using a nuclear density gauge operated by a certified operator to demonstrate placement and compaction methods were compliant with contract specifications. Compaction testing results are presented in **Appendix K**. The approved backfill sources and associated testing results are documented in Project Transmittal #19998 and are also presented in **Appendix K**.

4.4.3 Radiological Requirements for Backfill

Approved backfill sources were sampled and tested for radiological parameters including:

- Radium 226/228, (Ra-226 and Ra-228)
- Thorium 230/232; and
- U-nat.

Radiological analytical results of the backfill material were compared to the on-site cleanup goals, the NJAC criteria, and background levels established from a population of soil samples collected from two local public parks. The approved backfill sources and associated testing results are documented in Project Transmittal #19998 and **Appendix K**.

4.4.4 Chemical Requirements for Backfill

Approved backfill sources were sampled and tested for chemical parameters including:

- VOCs – total and Toxicity Characteristic Leaching Procedure (TCLP),
- SVOCs (PAHs),
- Pesticides,
- Herbicides – TCLP,
- PCBs; and
- Metals – TAL/TCLP.

Chemical analytical results of the backfill material were compared to the on-site cleanup goals and the NJAC criteria. The approved backfill sources and associated testing results are documented in Project Transmittal #19998 and **Appendix K**.

4.4.5 Topsoil Placement

Topsoil sources were evaluated using the same chemical and radiological testing requirements as the common backfill, described above. Geotechnical testing required for the placed and compacted backfill was not applicable to the topsoil. All topsoil was obtained from a single certified and approved source, as documented in Project Transmittal #19998. The topsoil was spread approximately 10 to 15 cm (4 in to 6 in) thick across the backfilled portions of the MSP site to promote a suitable bed for grass seed. The topsoil was amended with lime and fertilizer, per recommendations of the Rutgers Cooperative Agricultural Extension Center based on soil sample analysis.

4.4.6 Final Grading and Drainage Control

A New Jersey-licensed Professional Engineer prepared a Grading and Drainage Control Plan (ECC, 2007) to establish the final topography of the MSP site to promote proper drainage and to leave the MSP site in a suitable state for unrestricted re-use. This grading plan was reviewed and approved by the Township of Middlesex prior to implementation. In general, the completed final grade of the MSP site sloped from the north to the south, with a relief of approximately 3.35 meters (11 ft). Two minor drainage swales, one along each long side of the MSP site, drain to a single outfall at the center of the south side of the MSP site. The outfall is protected by a small retention area lined with rip-rap for sediment control. The outfall drains to an existing drainage ditch that historically accepted run-off from the MSP site as well as the local municipal storm sewers. Following placement of topsoil, the entire site was surveyed as shown on the Final Grading As-built drawing (**Figure 4-5**).

4.4.7 Seeding

A mixture of rye and red fescue grass seed was broadcast over the topsoil as recommended by the Freehold Soil Conservation District and the approved *Storm Water Management, Soil Erosion and Sediment Control Plan* (ECC, 2006g). Following placement of the grass seed, mulch was placed on the topsoil to promote rapid seed germination and water retention. A 1-year warranty is in place to ensure adequate grass growth across the MSP site.

4.5 Demobilization

Site demobilization occurred in June 2008. This effort required radiological survey and unconditional release of project tools, heavy equipment, site office trailers, wastewater storage tanks, and legacy government equipment. Release surveys were performed in accordance with *Termination of Operating Licenses for Nuclear Reactors,* Regulatory Guide 1.86 (US Nuclear Regulatory Commission [NRC], 1974). Heavy equipment, job site trailers, and wastewater storage tanks were picked up by their respective rental vendors. Legacy government equipment was managed per direction by CENAN described below.

4.5.1 Decontamination of Heavy Equipment and Storage Tanks

Decontamination activities were completed on 20 waste water holding tanks and various pieces of heavy equipment used at the MSP site during the remedial action. Workers used high pressure water and mechanical methods during the decontamination process. Project HPTs performed unconditional release surveys in accordance with Regulatory Guide 1.86 (NRC, 1974).

4.5.2 Transportation and/or Disposal of Legacy Government Equipment

Numerous legacy items belonging to CENAN were stored at the MSP site. The CENAN Project Engineer and Contracting Officer Representative (COR) determined what items were to be retained. These items were surveyed for unconditional release, loaded into sea-land containers, and transported to the Maywood FUSRAP site. Other contaminated or potentially contaminated items of little or no value were disposed of along with the radiologically impacted soil and debris.

4.5.3 Archiving of Final Status Soil Samples

All radiological samples collected during FSSs were returned by the laboratories, grouped by SU, bagged, and placed into a B-25 container. The B-25 container was transported and resides at the Maywood FUSRAP site as of December 2008.

5.0 POST REMEDIAL ACTION SURVEY SUMMARY

Remedial and restorative activities were completed for the MSP site and applicable adjacent areas. The MSP site originally consisted of 22 MARSSIM Class 1 SUs (Survey Units) (USEPA, 2000b). Adjacent properties contaminated included Middlesex Municipal Property Block 318 Lots 1 and 47 (identified as SU-23), the Absolute Auto property adjacent to SU-16 and the area east of SU-22 adjacent to Mountain Avenue.

For PAH, lead and radionuclide-contaminated soil at the MSP site, the *MSP Soils OU-1 ROD* (USACE, 2005) selected remedy was complete excavation and off-site disposal. The selected remedy was also applied to the adjacent properties identified above.

Post-remedial action measurements (FSSs) were performed to demonstrate that the MSP site can be released for "Unrestricted Use" without any institutional controls. FSS activities at the MSP site were conducted using a MARSSIM-based approach established in the MSP *Final Status Survey Plan* (ECC, 2006b) and amended in the Addendum to the *Radiological and Chemical Data Quality Management Plan*, (ECC, 2006d) hereafter referred to together as the "FSSP." FSS at the MSP consisted of the following primary activities:

- Performance of a GWS over 100 percent of accessible areas;
- Collection and gamma spectroscopy screening of systematic surface and subsurface soil samples;
- Collection and analysis of biased surface and subsurface soil samples;
- Offsite laboratory analysis of all FSS radiological, PAH and Lead samples; and,
- Comparison of results to site DCGLs to determine property condition.

The 23 SUs were completely remediated and radiologically surveyed. The analytical data presented in this report demonstrates compliance with "Unrestricted Use" cleanup criteria as set forth in the *MSP Soils OU-1 ROD* (USACE, 2005).

CENAN reviewed site characterization and post excavation sampling information at the MSP. This information was compared to the NJDEP Soil Cleanup Criteria (reference NJAC 7:26D), promulgated June 2008. All analytical results from soil samples presented in the RI were evaluated, including site investigation samples from 1991, 2000, and 2001, combined, totaling approximately 120 samples.

An analysis of RI data compared to final soil excavation survey and post excavation sampling information indicates the following:

- Two samples/results are identified as potentially "left in the ground" (Samples 9508 and PC-49).
- One SVOC compound, benzo(k)fluoranthene, was detected above the RDCSCC in sample 9508, however this is attributed to the presence of surficial asphalt related to historical culvert replacement that was conducted in this area of the site.

- Lead was identified at one location (PC-49) at a sample depth greater than excavation depth. It is important to note that lead was sampled as part of the final status survey for SU-17, and the results for this SU were all below the NJDEP residential clean up criteria for lead.

Given the extent of the removal action performed, the volume of contaminated material removed at the MSP site, and based on lead sampling results from SU-17, the one slightly elevated lead exceedance (PC-49) is considered to be *de minimis*.

This report demonstrates that results of the clean-up effort at the MSP are complete and in compliance with substantive requirements of NJAC 7:28-12.8(a) (NJAC, 1997b) and the *MSP Soils OU-1 ROD* (USACE 2005). No other FUSRAP-related contamination in excess of regulatory guidelines remains on the MSP site.

5.1 Radiological Final Status Surveys

The MARSSIM process was applied to demonstrate compliance to radiological soil cleanup criteria. The major components of the MARSSIM process were to establish a background reference area with associated background values, to determine whether the areas at MSP were impacted or non-impacted, to identify the class of the impacted areas, and performance of FSS. Radiological FSSs were conducted for 23 SUs at the MSP. The survey protocol was defined in the *MSP Final Status Survey Plan* (ECC, 2006b) (**Appendix L**).

After field FSS data were collected, the Project Health Physicist (PHP) evaluated the residual radioactivity status of the MSP site. GWS and bias sample data were evaluated to resolve identified areas of potentially elevated radioactivity. Systematic soil sampling data were evaluated using the non-parametric statistical methods established in the MARSSIM and the FSSP.

The primary goal of each FSS was to establish whether the "Null Hypothesis," which states "the median concentration in the SU exceeds the median concentration in the reference area by more than the DCGL," was accepted or rejected for each SU. The Null Hypothesis is an assumption that the SU exceeds the release criteria, and there are two methods for rejecting it:

- If all systematic sample results are less than the DCGL, the Null Hypothesis is automatically rejected.
- If any systematic sample result exceeds the DCGL by more than the lowest background reference area measurement result, the non-parametric Wilcoxson Rank Sum (WRS) Test is required to be performed. The WRS is used in situations where the contaminant is present in background and establishes with sufficient statistical probability that the median concentration in the SU does not exceed the DCGL. The WRS Test outcome must exceed the "critical value" in order to reject the Null Hypothesis.

5.2 Background Reference Areas

Background values were determined by collecting a series of samples at local un-impacted areas. A total of 14 background reference area samples were collected for the MSP remedial action.

Seven samples were randomly collected from the Mountain View Park area with an additional seven background samples collected at Veteran's Park (**Figure 5-1**). Analytical results from background sampling are found in **Table 5-1**. The average background value for Ra-226 obtained in the reference area was 0.92 pCi/g. The average background value for U-nat obtained in the reference area is 1.47 pCi/g. **Table 5-1** summarizes the calculated average background levels for Ra-226 and U-nat.

5.2.1 Survey Unit Classification

The entire excavation area at the MSP was designated as an impacted Class 1 Area per MARSSIM guidelines. Class 1 Areas have the greatest potential for contamination and, therefore, receive the highest degree of survey effort.

5.2.2 Radiological Clean Up Criteria

Radiological DCGLs were based on acceptable dose equivalent limits and were the soil cleanup criteria established in the *MSP Soils OU-1 ROD* (USACE, 2005) for radiological contamination at the MSP site. The radiological soil cleanup criterion (above the naturally occurring background) of 5 pCi/g for Ra-226, and 17 pCi/g for U-nat was established for MSP. Remediating the site to below these levels eliminated the possibility of exceeding the CERCLA risk threshold, meeting the requirements of NJDEP 7:28-12 (NJAC, 1997b), cleanup goals presented in **Table 2-1**.

5.2.3 Final Status Survey Scanning Methodology

A scanning survey for external gamma exposure was performed during each FSS. The following discussion presents the elements of the scanning survey.

Initially, scanning at the MSP was performed using a 2 in by 2 in NaI detector coupled with a scaler/ratemeter. Subsequent to discovery of unusually high uranium to radium ratios, the project team replaced the 2 in by 2 in NaI detectors with a more efficient Field Instrument for the Detection of Low Energy Radiation, (FIDLER) NaI detectors. A technical memorandum calculating the Minimum Detectable Concentration (MDC) scan value was presented as an addendum to the FSSP (**Appendix L**).

After the results of the first three SUs were evaluated, it became apparent that the surrogate approach may not meet project data quality objectives (DQOs). The alternate approach using the FIDLER detector was developed to ensure sufficient quality data was collected to make decisions regarding the remaining SU.

Data from the initial three SUs were evaluated by the project team for, data quality issues, trends, and potential solutions. As a conservative approach; 100% of samples were reanalyzed for uranium (U), and results compared directly to the U DCGL. Then all areas of elevated U results were conservatively excavated (excavated areas were larger than actually required) and resurveyed and resampled using the new approach.

General area and integrated readings were recorded for each SU using a global positioning system (GPS) unit. HPTs performed the GWSs by holding the FIDLER detector close to the ground surface while slowly walking the SU area.

The FIDLER survey instrumentation and technique were capable of detecting radiological contamination at 50% of the radiological DCGLs.

The percentage of the DCGL was verified by ensuring that the selected scanning method adequately detected elevated areas of contamination. To verify that an adequate scanning method is selected, the MDC for the radiological DCGLs was calculated and identified.

The presence of contamination outside the SU at the time of the survey resulted in a range of a scan MDCs. The FSSP discusses the selection and evaluation of the selected scanning method (Appendix L).

5.2.4 Frequency of Sampling

SUs were limited to a maximum of approximately 2,000 sq meters (21,527 sq ft) as evaluated for a Class 1 SU (MARSSIM) (USEPA, 2000b) for the MSP project. As an example, an initial estimate of the number of samples required for the FSS was determined as follows.

Using an approximate standard deviation of 1.67, a lower bound grey region of 2.5, a β value of 0.05, a α value of 0.05, and a DCGL wide ($DCGL_W$) of 5.0, the number of samples is 14. The number of samples was determined using the statistical data generated from the Cell Characterization Survey (CCS).

Final status sampling was performed using a random-start systematic pattern and triangular grids. The surface area for the grids eligible for final status was estimated and the following equation was used to determine the spacing of the systematic pattern:

where,

$$L = \sqrt{\frac{A}{0.866n}}$$

n = Number of samples (14)

A = Surface area of grids eligible for final status

L = Spacing of the systematic pattern

A random number generator was used to identify a coordinate location (i.e., N5060, E10060). After L was determined, a row of points was identified parallel to the x-axis, at intervals of L. Subsequently, a second row of points was then developed parallel to the initial row at a distance 0.866*L from the first row. Sampling locations along the second row were midway (on the X-axis) between the points on the first row. This process was repeated to determine the sampling locations in each grid. If sampling locations fell outside the grid, additional sampling locations were determined using the process described above. This process was continued until

the sufficient number of samples (or greater) were identified. This process typically yielded 16 sample locations per SU.

5.2.5 Sampling Protocol

Pre-determined soil sample locations were identified using a GPS unit. Samples were collected by HPTs in the field and placed in plastic bags. Samples were homogenized and vegetation and large rocks were removed to the extent practical. The sample media was then placed in Marinelli containers which were surveyed for radiological contamination and then transported to the onsite laboratory. The samples were initially screened using one of the on-site gamma spectroscopy units, and then sent to approved laboratories for final analysis. The offsite laboratories used for analysis of MSP samples were certified by National Environmental Laboratory Accreditation Conference (NELAC) and NJDEP.

5.2.6 Biased Soil Sample Collection

As required in the FSSP, a minimum of one bias sample was collected in each SU from the location corresponding to the maximum GWS measurement. Additional bias samples were collected, as necessary, to address areas of interest. The GWS maps, which are used to help identify bias sampling locations, are provided in the FSS Reports, included as **Appendix M**.

5.2.7 Data Evaluation

The post-remedial soil sample results were compared directly to the cleanup criteria detailed in **Table 2-1**. SUs exhibiting post-remedial soil sample results with all concentrations less than the cleanup criteria (the DCGL), are deemed radiologically appropriate for release and no further remediation is required. However, if any of the post-remedial sample results exceed the release criteria, the non-parametric WRS Test is performed to statistically compare the results to background levels in accordance with guidance from USEPA 402-R-97-016-Rev 1 *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (USEPA, 2000).

For contaminants with differing times of maximum dose (as in the case of U-nat and radium at the MSP) it is overly conservative to apply a sum of the ratios (SOR) approach. However, it is recognized that MARSSIM suggests this approach and in doing so is conservative. As an added measure of conservatism CENAN re-ran the WRS test using a DCGL of one (1) for all survey units. All survey units still passed the WRS test. The additional WRS test is included in each individual FSS Report contained in **Appendix M**.

On very few occasions during final status sampling, initial FSS samples were found to exceed one or more of the site DCGLs. Although the survey unit as a whole may still have passed the WRS test when averaged with the other samples from that SU, the project team conservatively chose to excavate the location. On the few times this occurred, the area was re-identified using GPS guidance and hand held instrumentation. The area was locally excavated and the deeper sample location re-sampled. The subsequent sample used the original nomenclature and was substituted wholly for the failed sample.

5.3 Non-Radiological Final Status Surveys

Non-radiological FSSs were conducted in a total of 23 SUs at the MSP. The survey protocol was defined in the MSP *Final Status Survey Plan* (ECC, 2006b, -2006d) and incorporates the applicable standards from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846) (USEPA, 1996).

5.3.1 Chemical and Metal Clean Up Criteria

The purpose of non-radiological sampling was to ensure that the MSP Site COCs are remediated to cleanup levels in **Table 2-1**. Analytical parameters for FSS included:

- Benzo(a)pyrene
- Benzo(a)anthracene
- Dibenzo(a,h)anthracene
- Benzo(b)fluoranthene
- Indeno(1,2,3-c,d)pyrene
- Lead

5.3.2 Frequency of Chemical and Lead Sampling

The appropriate number of non-radiological laboratory sample locations for the MSP site was determined in accordance with SW-846. Non-radiological sampling was conducted using a triangular grid approach similar to that used for the radiological samples. The resulting number of sample locations for the MSP site was 45 with a distance of 34.9 meters (115 ft) between sampling points. The number of non-radiological samples was determined using a number of factors including:

- Average concentration from preliminary studies for each COC;
- Standard deviation from the average concentration for each COC;
- Action level concentrations for each COC; and
- The intended power of the uncertainty *(i.e.,* 90 percent, 95 percent confidence).

The calculated mean and variance from the data set are evaluated using the following equation from SW-846:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Where:

n = number of sample measurements

X_i = individual sample result

$\overline{X}$ = average sample population

The estimate of variance (S^2) was obtained using the following equation (SW-846, 1996):

$$S^2 = \frac{\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2 / n}{n-1}$$

where:

S^2 = estimated standard deviation

Non-Radiological Sampling locations were established east and west of the initial random starting location. Sampling locations were at intervals of 34.9 meters (115 ft). The second row of sampling locations was parallel to the first row at a distance of 30.23 meters (99 ft). The sampling locations in the second row were midway between those of the first row. The sampling location distance was appropriate for a triangular grid system. This was repeated for 45 sampling locations.

Initially, the MSP team utilized PAH field test kits to determine if an individual SU was eligible for non-radiological FSS or whether additional excavation was needed. Based on these test kits, a volume of approximately 986 cu m (1,290 cu yd) of suspected chemically impacted material was stockpiled. Additional testing and comparison of certified laboratory results versus test kit results indicated that the test kit results were significantly higher than those from the certified laboratory. Subsequently, chemically impacted stockpiles were re-sampled, and analyzed by a certified laboratory. The resulting analytical data indicated all samples were well below the *MSP Soils OU-1 ROD* (USACE, 2005) directed clean-up goals for PAH contamination, and the stockpiled soil was used for backfill in SUs 20, 21 and 22. Fixed lab results were used in lieu of the PAH field test kits for the remainder of the project.

5.3.3 Non-Radiological Sampling Protocol

Pre-determined soil sample locations were identified using a GPS unit. After an area was surveyed for radiological release, non-radiological surface samples were collected by HPTs in the field. Samples were homogenized and vegetation and rocks removed to the extent practical. Soil samples were placed in amber glass jars and sent to pre-approved laboratories for analysis. Offsite laboratories used for sample analysis were certified by NELAC and NJDEP.

5.3.4 Chemical and Lead Data Evaluation

Any sampling location found to have non-radiological contamination in concentrations above the MSP site cleanup criteria in **Table 2-1** was excavated and stockpiled for disposal. Sample results that indicate the cleanup criteria for lead was achieved were evaluated to determine the confidence level (CL) of the data population.

For the set of data, $\bar{x}$, S^2, the standard deviation (S), and the standard error of the mean (S) was calculated. The formula for calculating S follows (SW-846):

$$S = \sqrt{S^2}$$

The formula for calculating S_x follows (SW-846):

$$S_{\bar{x}} = \frac{S}{\sqrt{n}}$$

The CL is then determined. The formula for calculating the CL follows (SW-846):

$$CL = \bar{x} \pm t_{.20} * S_{\bar{x}}$$

$$n = t^2_{.20} s^2 / \Delta^2$$

The population set is considered uncontaminated if a sufficient number of samples were collected and the upper limit of the CL is less than the cleanup criteria for each chemical COC. The number of samples for lead and each PAH COC is calculated in the sample $\bar{x}$ and S2. Based on these calculations, all of the MSP SUs were determined to meet chemical clean up goals.

5.4 Discussion of Final Status Survey Results

FSSs were performed on 23 SUs at MSP in accordance with the approved *Final Status Survey Plan* (ECC, 2006b, -2006d). A FSS Report was prepared for each of the 23 SUs and submitted to CENAN prior to backfilling any prospective SU. Six SUs underwent FSS, but were subsequently re-impacted by site operations. Survey units 5, 8, 10, 11, and 14 were impacted by storage of radioactive material (RAM); additionally SU-21 contained the influent tank for the site WWTP. These SUs were subjected to a second FSS following the identical protocol as the first FSS at that SU. For each of the six SUs impacted by storage of RAM or the WWTP, **Appendix M** of this report includes two (2) FSS Reports. The Null hypothesis for these six SUs was rejected; therefore all of the "RAM" or "WWTP" SUs passed FSS requirements. All SUs were approved for backfill based on the FSS Reports. Upon approval of the FSS Report for each SU, the elevation of the excavated surface was surveyed by a New Jersey-licensed civil survey to document the extent of the excavation. The topographic surfaces of the excavation following remediation of both radiologically and chemically contaminated soils are shown in **Figures 5-2 and 5-3**, respectively.

The statistical analysis for determining whether or not a cleanup goal has been met is explained in the FSS Reports, and is based on MARSSIM for radiological parameters, and USEPA SW-846 for chemical COCs. Based on SU size, nominal sampling density, and analytical results for each SU, a 95% upper confidence level (UCL) is used as a criteria for determining compliance with the cleanup goals.

Two small areas were identified where FSS samples exceeded the DCGL:

- In SU-15 one soil sample exceeded the DCGL. Sample FSS-SU15-R-1-011 had a laboratory reported value of 7.05 pCi/g for Ra-226. MARSSIM addresses small areas of elevated activity by using a simple comparison to the investigation level as an approved methodology. Using the elevated measurement comparison (EMC) process represents a conservative approach, in that every measurement is required to be below an action level based on the surface area of residual contamination. In SU-15 an EMC calculation was performed for a single sample area surrounding FSS-SU15-R-1-011. The EMC calculation for SU-15 is presented in the SU-15 FSS Report (**Appendix M)**. Given that the area surrounding sample FSS-SU15-R-1-011 passes the EMC and all other sample results are below the DCGL, SU-15 meets release criteria, and the area identified as SU-15 was released for "Unrestricted Use."
- While excavating in SU-22 it was discovered that radiological contamination extended past the project boundary fence towards Mountain Avenue. The MSP project team attained the necessary right-of-entry and initiated a "dig and chase" approach to remove as much of the contamination as safely possible. The excavation was halted when clean-up goals were met or when the excavation threatened public utilities (power pole and a man-way).
- Approximately 300 cu yd of soil were removed; however, the team found that elevated areas of contamination existed next to a utility pole and manway adjacent to Mountain Ave. Excavation was halted due to safety concerns, the area was surveyed, sampled, and the two small areas of elevated contamination were covered with plastic and the area was backfilled. A total of seven biased soil samples were collected from the excavation. Areas exhibiting the highest gamma exposure rates were chosen for bias sampling. The bias samples were analyzed using the on-site gamma spectroscopy laboratory and the systematic samples were sent off-site for analysis. The maximum concentration observed in the Elevated Measurement Areas (EMA) was 7.8 pCi/g Ra-226. The extent of the contamination associated with the manway is approximated to be 4 square meters (42 sq ft) around the power pole and under Mountain Avenue, therefore the selected area factor of 10 meters (AF = 4.5) is conservative. This area of contamination underlies approximately 4.5 ft (1.5 meters) of overburden, including the asphalt cover of the road.
- The maximum dose rate from soils left in place was 60 μR/hr; this small EMA was found to be less than 1 square meter (9 sq ft) and was located next to the power pole adjacent to Mountain Avenue.
- The two highest concentrations of Ra-226 were 7.40 pCi/g and 7.80 pCi/g for the biased samples. Given that the area surrounding samples FSS-SU-22-R-1-B-003 and FSS-SU-22-R-1-B-004 passes the EMC and all other sample results are below the DCGL, SU-22 meets release criteria, and the area identified as SU- 22 was released for "Unrestricted Use."

In addition to the two locations described above, the MSP Project team also encountered two additional offsite areas requiring remediation:

- During sediment sampling performed in the spring and fall of 2007 (in support of the MSP Environmental Surveillance Report) elevated concentrations of radiological contaminants were discovered in the effluent stream emanating from the MSP site south outfall structure. The MSP team performed additional sediment sampling in order to determine and bound the extent of down stream radiological contamination. The spatial area of this SU was based on the (SU-23) results of these sediment samples. As a conservative measure, SU-23 boundaries were established slightly beyond the area identified by sediment samples exceeding the DCGL. SU-23 was an abnormally shaped area that extended perpendicular to the south boundary fence for 45 meters (148 ft), makes an approximate 75-degree bend to the west, and continues for an additional 75 meters (246 ft). SU-23 is located south of the MSP on Property Block 318, Lots 1 and 47. The total impacted area measured approximately 120 meters long (394 ft) by 4 meters (13 ft) wide. The survey unit encompassed a surface area of approximately 480 sq meters (5,170 sq ft). The results of the FSS conducted in SU-23 are presented in SU-23 FSS Report (**Appendix M)**. SU-23 passed all FSS Report requirements and the Null Hypothesis was rejected.
- During excavation in SU-16 it was discovered that soils exhibiting elevated gamma readings extended under the western boundary fence toward property owned by Absolute Auto. After securing a right-of–entry, the MSP project team excavated a small area that extended about 1 meter (3 ft) onto the Absolute Auto property. The area of elevated concentration was completely removed and the area surveyed in accordance with the FSSP (ECC, 2006b, -2006d). SU-16 passed all FSS Report requirements and the Null Hypothesis was rejected. The SU-16 FSS Report is included in **Appendix M**.
- All systematic sample results (**Table 5-2**) for SU 16 were below the DCGL. However, the "gross" radium result for sample FSS-SU16-R-1-013 was above the DCGL (5.0 pCi/g). Since evaluations of systematic samples are performed by comparing the "net" activity directly to the DCGL, the appropriate value for regional background is subtracted from the "gross" value. Hence, the "gross" sample activity of bias sample FSS-SU16-R-1-013 (5.35 pCi/g, **Table 5-2**) minus the average regional background (0.90 pCi/g, **Table 5-1**) yields the "net" sample activity of 4.45 pCi/g, which is below the DCGL (5.0 pCi/g, **Section 2.0**), thereby satisfying the RAO. Given that all sample results are below the DCGL, SU-16 meets release criteria, and the area identified as SU-16 was released for "Unrestricted Use."

All 23 SUs met the *MSP Soils OU-1 ROD* (USACE, 2005) promulgated clean up goals for radiological, lead and PAH contamination. A summary of the FSS Report results are presented in **Tables 5-2 through 5-5**. Additionally, the 23 original FSS Reports and six supplemental FSS Reports (from re-impacted areas) are included in **Appendix M**. Results of the FSS GWSs are presented in **Figures 5-4.1 through 5-4.23** as well as in the FSS Reports, presented in **Appendix M**. **Figures 5-5 through 5-12** show site-wide FSS results for all MSP COCs; **Figure 5-5** and **Figure 5-6** show Ra-226 and U-nat results in soil respectively; **Figures 5-7** through **5-11** show the results for five specific PAH COCs in soil; and **Figure 5-12** shows the results for lead in soil.

In addition, CENAN reviewed site characterization and post excavation sampling information at the MSP. This information was compared to the New Jersey Department of Environmental Protection Soil Cleanup Criteria (reference NJAC 7:26D) (NJAC, 2008), promulgated June 2008. All analytical results from soil samples presented in the RI were evaluated, including Site Investigation samples from 1991, 2000, and 2001, combined, totaling approximately 120 samples.

An analysis of RI data compared to final soil excavation survey and post excavation sampling information indicates the following:

- Two samples/results are identified as potentially "left in the ground" (Samples 9508 and PC-49).
- One SVOC compound, benzo(k)fluoranthene, was detected above the RDCSCC in sample 9508, however this is attributed to the presence of surficial asphalt related to historical culvert replacement that was conducted in this area of the site.
- Lead was identified at one location (PC-49) at a sample depth greater than excavation depth. It is important to note that lead was sampled as part of the final status survey for SU-17, and the results for this survey unit were all below the NJDEP residential clean up criteria for lead.
- Given the extent of the removal action performed, the volume of contaminated material removed at the MSP site, and based on lead sampling results from SU-17, the one slightly elevated lead exceedance (PC-49) is considered to be de minimis.

For all SUs, the FSS sample results for both Ra 226 and U-nat were compared individually to the DCGLs, as summarized on **Table 5-2.** As a conservative approach, the project team also evaluated U-nat and Ra-226 (**Table 5-2**). The combined DCGL is based on a SOR approach and set to a unitless value of 1. The individual DCGLs were very rarely exceeded as reported, however, when the more conservative SOR evaluation was performed, the DCGL of 1 was exceeded by 1 or 2 samples in 14 of the SUs. The MARSSIM approach of conducting the WRS test was applied to all SUs, for U-nat and Ra-226 as individuals and as an SOR. None of the SUs failed a WRS test regardless of the approach taken (SOR or separate radionuclide); therefore, the FSS evaluation concludes the post-excavation topographic surface has been remediated to the project cleanup goals.

Given that only 1 or 2 points in each SU only slightly exceeded the SOR DCGL of 1, a spatial evaluation of the data cannot be adequately conducted, thus is not warranted. In other words, there are too few exceedences to show any trends.

5.5 Miscellaneous Surveys

Miscellaneous radiological surveys performed during the remedial activities at the MSP site are discussed in the following sections but not included in this document. Miscellaneous radiological surveys included cursory surveys of transportation vehicles, incoming and outgoing trucks, routine surveys, and legacy equipment surveys. These surveys are stored in the project archive.

5.5.1 Incoming Truck Surveys

Once per week the MSP project team performed cursory surveys on all incoming waste transport vehicles (trucks). Each survey consisted of approximately eight direct readings and eight swipes collected in the cab, exterior, bed and tires of the truck. The results of these surveys indicated that there was no contamination in excess of regulatory limits.

5.5.2 Outgoing Transportation Surveys

The MSP project team performed US Department of Transportation (DOT)-compliant surveys that included gamma dose rates and swipes to ensure COC contaminated soil loaded trucks did not exceed regulatory limits. Additionally, the US Ecology WAC promulgated a limit of 500 µR/hr maximum dose rate on the external surface of any conveyance vehicle. If an HPT identified elevated areas in excess of 500 uR/hr, the load was dumped, the hot spot source was identified (and segregated), and the truck was re-loaded with compliant material.

5.5.3 Routine Surveys

The MSP project team performed routine surveys on a pre-determined basis. These surveys included direct readings, swipes and gamma dose rates. Routine surveys included site perimeter gamma surveys, office trailer surveys, exclusion zone and contamination reduction zone surveys.

5.5.4 Survey of Legacy Equipment

The MSP project team performed surveys on legacy government and contractor equipment. Survey protocol was in accordance with Regulatory Guide 1.86 (NRC, 1974). Equipment that was found to be in excess of unconditional release limits was decontaminated or placed into the contaminated debris stockpile for later disposal with MSP soils.

6.0 PERFORMANCE STANDARDS AND QUALITY CONTROL

Performance standards and QC for the MSP project are described in the following sections.

6.1 Performance Standards

Quality management at the MSP during the remedial actions ensured that remedial and construction activities were performed according to project plans and contract requirements. The QC requirements for project activities conducted at the MSP are presented in the *Contractor Quality Control Plan* (CQCP) *for the Soils Remedial Action at the FUSRAP Middlesex Sampling Plant* (ECC, 2006a). The MSP Quality Assurance / Quality Control (QA/QC) program is outlined and presented in the approved CQCP and supported by the following CENAN and USEPA approved plans:

- Final Status Survey Plan, (ECC, 2006b)
- Project Management Plan, (ECC, 2006c);
- Radionuclide and Chemical Data Management Plan – Part I - Quality Assurance Project Plan (ECC, 2006d);
- Radionuclide and Chemical Data Management Plan – Part II – Field Sampling Plan (ECC, 2006d);
- Remedial Action Work Plan (ECC, 2006e);
- Soil and Erosion Plan (ECC, 2006f);
- Storm Water Management Plan (ECC, 2006g) and
- Site Safety and Health Plan (ECC, 2006h).

The structured QC inspection system described in the *CQCP* (ECC, 2006a) was implemented for each Definable Feature of Work (DFW) activity in coordination with the applicable project work plan to ensure compliance with contract requirements, and the applicable Federal, state, and local rules and regulations. The QC program included; safety and health inspections, field QC inspections, field QC testing, field surveys, and on-site and off-site QA/QC laboratory testing.

6.2 Overall Performance Comparison to Project Cleanup Goals

The following chart presents a comparison of the RAOs and the Remedial Action Performance results.

Remedial Action Objectives	Performance Results
Excavation and offsite disposal of soil and debris that exhibits radiological or chemical contaminant concentrations above the cleanup criteria as identified in the MSP Soil OU-1 ROD.	Remedial activities for OU-1 included the excavation and shipment of 3,405 cu m (4,454 cu yd) of chemically impacted soil and 31,533 cu m (41,244 cu yd) of radiologically impacted soil and debris.
Demolition, removal and off-site disposal of contaminated former storage pads and below-grade structures at licensed and permitted facilities.	Legacy building foundations, drainage structures, and the settling basin were also removed during excavation, and shipped with contaminated soil to off-site disposal facility.

Remedial Action Objectives	Performance Results
Certification of the Property for unrestricted re-use.	Upon completion of excavation activities and prior to backfilling of each survey unit, a FSS of the twenty-three (23) Class 1 impacted SUs was performed in accordance with MARSSIM protocol. The MARSSIM FSS Null Hypothesis was "rejected" for all SUs, which means that remaining soil in all SUs are below the cleanup criteria for radionuclides. Analytical results of final status chemical and lead samples were compared directly to the cleanup criteria for each of the individual PAH/metal constituents. All chemical and metal samples results were well below the cleanup criteria for each of the five PAHs and lead. Following the completion of remediation activities, the site was backfilled with certified clean backfill and was topped and seeded to restore established final grade per final grading levels as required by the contract and approved the township of Middlesex. All soils met MSP Soils OU-1 ROD criteria, which allows for unrestricted re-use of the MSP property.

Table 2-1 presents the *MSP Soils OU-1 ROD* (USACE, 2005) and RI/FS Cleanup Goals. **Tables 5-2 through 5-4** present the FSS Data Summary Results compared to applicable clean up goals. Section 4.3 of this PRAR presents the tonnages of soil and debris shipped, the waste classification, and the off-site disposal facility information.

6.3 Construction Quality Assurance and Quality Control Requirements

This section provides an overview of the construction QA/QC system used during the MSP project as part of the remediation activities completed during the contract period of performance.

The QC requirements for project activities conducted at the MSP were prescribed in the approved MSP *CQCP* (ECC, 2006a). Project contract compliance was monitored through inspection of the project excavation; loading, transportation, and off-site disposal of contaminated materials; and associated sampling and analyses activities. The CQCP was implemented to plan, modify, and complete all DFWs in compliance with contract requirements using proper recordkeeping and reporting procedures. **Table 6-1** lists a record of the preparatory inspection dates as they relate to each DFW of the remedial action.

6.3.1 Quality Control Inspections

The Quality Control System Manager (QCSM) ensured quality during the MSP project through implementation of the Three-Phase Control System. This system was implemented for every task (DFW) performed, as well as for other major tasks and additional scope of work activities developed required throughout the life of the MSP project.

The Three-Phase Control System was conducted prior to and during each task performance. Preparatory Phase, Initial Phase, and Follow-up Phase procedures and inspections were executed

and documented as outlined in the CENAN approved MSP *CQCP* (ECC, 2006a). Results of inspections were recorded on inspection forms or in the Daily Quality Control Reports (DQCRs), as appropriate, and communicated to work crews. DQCRs are included as **Appendix N** of this PRAR (Post Remedial Action Report).

6.3.2 Field Inspections

Field inspections were comprised of both visual observations and field measurements of material, employed techniques, and final products. Field inspections were conducted on a daily basis to ensure successful work performance, and are documented in the DQCRs as **Appendix N.**

6.3.3 Submittal Protocol

All items required by the contract specifications were submitted during the course of the MSP project. Each submittal was verified to be in compliance with contract requirements. The QCSM checked and approved each submittal. Every project submittal to CENAN was accompanied by a completed ENG Form 4025, "Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certificates of Compliance". A submittal register was used to log each submitted item, date of submittal and status of approval. **Table 6-2** presents a complete submittal register for the MSP project.

6.3.4 Problems with and Deviations from the Approved Project Plans

Throughout the execution of the Remedial Action at the MSP, approved project plans were followed with minor exceptions. The following describes the notable deviations from the work planned:

- The initial approach for radiological remediation of site soil was based on Ra-226 concentrations. However, post-excavation soil sampling preformed after initial remediation of the Ra-226 contaminated soils identified some areas with uranium concentrations above the remediation goal. Additional surveying, sampling, and excavation for uranium-contaminated areas were executed for the remediation of these uranium-contaminated soils. Remediation of soil for both Ra-226 and uranium was completed in the first quarter of 2008.
- The quality plans were developed to ensure the proper use of fixed lab and field screening methods to detect the COCs as listed in the *MSP Soils OU-1 ROD* (USACE, 2005) at a threshold below the cleanup criteria. When it was discovered uranium-contaminated soils remained after radium-contaminated soils were removed, the analytical and field screening methods were modified to detect uranium at the recommended cleanup concentration. An amendment to the RAWP was developed, describing the use of instruments and laboratory methods required to detect uranium at the requisite clean-up goal concentration.
- The initial approach for waste disposal included waste segregation (i.e., separation of radiologically contaminated wastes from non-radiologically contaminated waste for the purpose of disposal). However, it was determined during project execution that some of the waste planned to be separated (such as concrete, asphalt and underlying bedding stone) was radiologically impacted, and required disposal as radiological waste.

- During the execution of clean-up activities, an evaluation of radiological survey results indicated that sediment was present in a drainage ditch at SU-23 exceeding remedial action levels. The stream bed was remediated to meet the MSP remedial action criteria. Because the area was outside the MSP site boundaries, a Right-of-Entry Agreement with Middlesex Township was obtained. Right-of-Entry agreements are presented in **Appendix S.**

6.3.5 Project Meetings

MSP project progress meetings were held on-site with representatives from ECC, CENAN and US Corp of Engineers, Kansas City District (CENWK) initially on a weekly, and later on a bi-weekly basis as mutually agreed. The purpose of these meetings was to discuss work progress, schedule, upcoming submittals, health and safety, QC, project modifications, variances and coordination for specific other subjects. Meeting minutes were prepared and distributed to attendees and are included as **Appendix O** of this report. Additional project meetings and job walks were held on an as-needed basis.

6.4 Chemical and Radionuclide Data Quality Assurance and Quality Control Program

The MSP QA/QC program enabled the evaluation of the analytical results to determine whether they were accurate and adequate and to ensure satisfactory execution of the remedial action. The QA/QC program is further detailed in the approved *Quality Assurance Project Plan* (ECC, 2006d). Analytical data reports for all samples were validated by ECC and its subcontractor. The detailed findings are presented in the six Quality Control Summary Reports (QCSRs) included as **Appendix Q** of this report. QCSRs 3 and 4 present the validation results for the FSS Report data.

The following sections describe the QC processes used to validate the chemical and health physics laboratory and field results.

6.4.1 Intended Data Uses

Intended data uses for this project included the following:

- Confirmation of the successful implementation of the remedial action selected in the *MSP Soils OU-1 ROD* (USACE, 2005);
- Confirmation that the remedial action complies with all Federal and state environmental requirements that were Applicable or Relevant and Appropriate Requirements (ARARs) to the hazardous substances, pollutants, or contaminants at the site or to the activities at the MSP site;
- Confirmation that the remedial actions were protective of human health and the environment;
- Confirmation that transporting soil and debris from the site has not contaminated other properties; and
- Health and safety monitoring.

There were two levels of analytical data quality defined by USEPA that were relevant to the data collection activities; screening and definitive data. These are described in the following sections.

6.4.2 Screening Data

Screening data for the MSP project were generated by rapid, less precise methods of analysis with less rigorous sample preparation. Screening data provide analyte identification and quantification, although the quantification may be relatively imprecise. At least 10 percent of the screening data were confirmed using QA/QC procedures by comparison to fixed lab results, and verified by the MDC scan evaluation. Screening data without associated confirmation data were not considered to be of known quality.

The screening data used for characterization purposes included the following general radiological survey techniques:

- Gamma screening conducted by performing general area surveys using a micro-R-meter and 2 in by 2 in NaI or FIDLER detector;
- Random alpha and beta/gamma screening surveys for direct measurements on suspect material, including waste containers and road surfaces;
- Gross alpha screening of air and wipe samples; and
- On-site gamma spectroscopy performed on the radioactive contaminated soil to determine the concentration of the gamma-emitting radionuclides present.

The results from these screening surveys provided the data necessary to determine if more quantifiable measurements were required. Screening methods also entailed laboratory analysis for gross alpha or gross beta, not including specific radioisotopic contributions. It also entailed soil samples to determine the concentration of *MSP Soils OU-1 ROD* (USACE, 2005) listed PAHs present within the soil.

6.4.3 Definitive Data

Definitive data were generated using approved analytical methods. Data were analyte-specific, with confirmation of analyte identity and concentration. Methods produced tangible raw data. Data was generated at the MSP site or at off-site locations, and the QA/QC requirements were satisfied. Analytical or total measurement error was determined for the data to be definitive.

The selected NELAC and State of New Jersey approved laboratories performed the definitive data analysis on the radioactive contaminated soil to determine the concentration of the radionuclides present in soil, in particular the analysis of the FSS data. Off-site radionuclide analysis included the use of alpha spectroscopy and gamma spectroscopy.

The QC performance criteria associated with radiological sampling included quantifiable measurements for parameters such as minimum detectable activity/minimum detectable concentration (MDA/MDC), detection system efficiency, systematic error, and sample measurement uncertainty calculated at the 95 percent confidence level. For example, the format for data presentation includes:

- Specific radionuclide concentration value;
- Estimated uncertainty at the 95 percent CL (confidence level) for that value; and
- Estimated MDA/MDC for the measurement.

On-site screening using gamma spectroscopy met the QC performance criteria. FSS samples were initially screened and then transferred to the off-site laboratory for analysis.

6.4.4 Field Quality Control

QC samples were collected in the field and submitted to the on-site and off-site laboratories for the MSP project. These samples were used to assess the quality of field sampling program and the analytical laboratory data quality. All samples passed the field QC test.

Field duplicate samples were collected and analyzed to assess results reproducibility for each sample matrix. Field duplicate samples were submitted blind to the on-site and off-site laboratories. All field duplicates passed the comparison criteria.

Sample results from the analytical laboratory were compared to results from the on-site laboratory for accuracy and precision. The results were acceptable. Evaluation of replicate sample results is presented in **Appendix Q** (QCSRs 1-6) of this report.

A small percentage of split samples from these field duplicate samples were also sent to the USACE QA laboratory and analyzed for radionuclide and chemical analyses to evaluate the contractor laboratory.

6.4.5 Precision, Accuracy, Representativeness, Completeness, and Comparability Parameters

Quality of analytical data was assessed in terms of precision, accuracy, representativeness, completeness, comparability (PARCC), and sensitivity against the DQOs listed the in Appendix D of the *Remedial Action Work Plan* (ECC, 2006e), and the *Radionuclide and Chemical Data Quality Management Plan, Part 1 – Quality Assurance Project Plan* (ECC, 2006d). A quantitative evaluation was made of precision, accuracy, and completeness. A qualitative evaluation was made of representativeness and comparability based on assessment of precision, accuracy, and completeness. PARCC parameters were evaluated during data validation. **Appendix Q** (QCSRs 1-6) presents the detailed data validation and evaluation information for background, FSS, backfill, waste characterization, and environmental surveillance samples, and Section 6.4.6 of this PRAR presents a summary of the data validation information. With the exception of one sample group presented in QCSR 1, waste characterization samples did not require validation and were not included in the project completeness goals, so those data qualifications are not included in the PARCC parameter evaluation.

The following definitions are provided for PARCC.

Precision

Laboratory precision is evaluated using in terms of relative percent difference (RPD) between Matrix Spike/Matrix Spike Duplicate (MS/MSD), Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD), and lab duplicates. For radionuclides, precision is evaluated in terms of minimum difference (MD) between sample and lab duplicate.

For radionuclide analyses, if the calculated normalized absolute difference (NAD) was greater than 1.96 but less than 3.92, the reported results in all associated samples of the same matrix or

batch were qualified as estimated (J). If the NAD was greater than 3.92, the data associated with the batch was rejected (R). The NAD was applied to the reported analytical results of the laboratory duplicate analysis and the QA/QC split analysis. Confirmatory analyses showed that the data produced for the MSP remedial action was precise and passed the criteria.

QC outliers for precision are presented in QCSRs 1-6 (**Appendix Q**). No sample results were qualified as R (rejected) due to precision.

Accuracy

Accuracy results are evaluated using MS, LCS, and/or surrogate (organics only) recoveries. Accuracy is the degree of agreement of a measurement with an accepted reference or true value. The LCS served as a monitor of the overall accuracy and performance of all steps in the analysis, including the sample preparation. The accuracy of an analytical procedure is determined by the addition of a known amount of material (matrix spike) to a field sample matrix or a standard matrix.

For radionuclide analysis at the on-site laboratory, a reference sample similar in matrix type, volume, and of a traceable quantity of radioactive material was used to measure accuracy for the on-site laboratory. The on-site laboratory also measured accuracy using a method blank to monitor for contamination. Method blanks were analyzed every 20 samples. Analysis showed that there was no contamination present in the counting system.

Reactive cyanide accuracy QC parameters for several backfill samples had low recoveries. However, this did not impact data completeness or confirmation because all samples were non-detect for total cyanide and met accuracy QC limits. In this case, total cyanide analysis is inclusive of reactive cyanide. Detailed data validation information is presented in **Appendix Q** - QCSRs 1-6. All of the data passed the accuracy criteria.

Representativeness

Representativeness is a qualitative component of PARCC and is related to sampling. The representativeness of the data is maintained throughout the investigation by consistent procedures for sample collection and by the application of generally recognized and documented analytical methods. The approved analytical methods used for the analysis of MSP project samples are presented in **Appendix Q** - QCSRs 1-6. The data obtained at the MSP project was representative and passed the criteria.

Completeness

Completeness is a measure of all data obtained from the analysis of the MSP samples submitted to the on-site laboratory. The completeness goal for radionuclides was 100 percent due to the critical nature of the contaminant. This completeness goal was reached – all radionuclide results were acceptable and therefore passed the criteria.

Comparability

Comparability is a qualitative assessment comparing one data set to another data set. The objective of comparability is to ensure results obtained from similar activities were comparable to previous or future studies. Comparability is achieved through the use of approved sampling techniques, analytical methods, consistency in reporting units and analysis of reference materials. All of these items remained consistent throughout the MSP project and thus passed the criteria.

6.4.6 Data Assessment

The following subsections present results of the analytical data quality evaluation against the DQOs listed in Table 3-2 of the Quality Assurance Project Plan (QAPP). The DQOs establish the data evaluation criteria for the PARCC parameters and the completeness goals of the project. The data quality evaluation was performed in accordance with the *Kansas City District Data Quality Evaluation Guidance* (USACE, 2003a) and the *CENWK-EC-EF Data Quality Evaluation Guidance* (USACE, 2001).

Radionuclide data was qualified according to guidelines in the USACE Radionuclide Data Quality Evaluation Guidance for Alpha and Gamma Spectroscopy (USACE, 2004c) and the New Jersey Department of Environmental Protection Requirements for Data Acceptance (NJDEP, 2000). The qualifiers were used during the data review process to indicate to what degree the sample data conformed to QC requirements.

Chemical and radiological data were assessed through the evaluation of various QC samples.

For radiological data, MS LCS, laboratory duplicate samples, and detection limits were evaluated. For chemical data, method blanks, MS/MSD samples, LCS/LCSD samples, holding times, and surrogate samples were evaluated. The following sections present a summary of results by the following sample groups.

- Background samples
- Backfill samples
- FSS samples
- Stockpile samples
- Environmental surveillance samples
- Waste water or groundwater samples

6.4.6.1 Background Samples

Fourteen background samples were analyzed for the following parameters:

- Ra-226 by SW-846 Method 9315 Mod
- Ra-228 by SW-846 Method 9320 Mod
- Isotopic Thorium by alpha spectrometry DOE's Environmental Measurement Laboratory (EML) Method A-01-R-Mod
- U-nat by alpha spectrometry EML A-01-R-Mod

All background sample results are acceptable with no QC outliers resulting in data qualifications. All background data results are presented in **Appendix Q** – QCSRs 1-6.

6.4.6.2 Backfill Samples

Twenty-eight backfill samples were analyzed for 21 parameters, as required by the MSP project *QAPP* (see **Appendix Q** – QCSRs 1-6 for parameter list).

The QC sample outliers and resulting validation qualifiers for backfill samples are presented in QCSRs 1-6 (**Appendix Q**). Backfill sample results are presented in **Appendix K**.

Imported backfill samples were sampled and analyzed routinely by the on-site gamma spectrometer equipment to ensure the backfill met the radiological criteria, as compared to the naturally occurring background activity. Results of these analyses are presented in **Appendix K**.

6.4.6.3 Final Status Survey Samples

The FSS samples are summarized by SUs below. These samples were analyzed for the following parameters:

- Ra-226 by SW-846 Method 9315 Mod
- U-nat by alpha spectrometry EML Method A-01-R-Mod
- PAHs by SW-846 Method 8270C
- Total lead by SW-846 Method 6020

The QC sample outliers and resulting validation qualifiers for FSS samples are presented in QCSRs 3 and 4 (**Appendix Q**). FSS sample results are presented in **Tables 4-2 and 4-3**. FSS sample summaries are presented in **Tables 5-2 through 5-4**. FSS sample scan MDC information is presented in **Table 5-5**. The FSS Reports are included in this document as **Appendix M**. Detailed validation information for FSS sample results is presented in QCSRs 3 and 4 in **Appendix Q**.

6.4.6.4 Stock Pile Samples

Ten stock pile samples were analyzed for PAHs only. All results were acceptable with no qualifications resulting from QC outliers. Stockpile sample results are presented in **Appendix Q** (QCSRs 1- 6).

6.4.6.5 Environmental Surveillance Samples

Groundwater, surface water, and sediment samples were collected in June, August, and November 2007. These samples were analyzed for 13 parameters (See **Appendix Q** [QCSRs 1-6] for the parameter list).

The QC sample outliers and resulting validation qualifiers for environmental surveillance samples are presented in **Appendix Q** (QCSRs 1 - 6). Environmental Surveillance Program Data is presented in **Appendix** R of this report.

6.5 Health and Safety

This section provides an overview of the health and safety program used at MSP as part of the remediation activities during the period of performance.

6.5.1 Middlesex Sampling Plant Project Safety Program

The MSP project *Site Safety and Health Plan* (ECC, 2006h) was prepared by ECC for CENAN for the planned remedial activities at the MSP site which included soil remediation, removal of legacy building foundations and site restoration activities. The plan was based on all available site specific data. Work conducted during this project was performed in accordance with applicable Federal, State, and local safety and occupational health laws and regulations including: Occupational Safety and Health Administration (OSHA) standards (including 29 Code of Federal Regulation (CFR) 1910 and 29 CFR 1926) and the USACE *Safety and Health Requirements Manual* (EM 385-1-1, 3 Nov 2003) (USACE, 2003b).

The purpose of the SSHP and associated safety program was to identify the chemical, radiological, and safety hazards that were present at the site and during remedial construction activities and the precautions needed to be taken to abate these hazards. The safety and health procedures outlined in the SSHP were designed to minimize the potential for ECC employee and subcontractor injury and/or exposure to radiological and/or chemical hazards during field implementation of the environmental restoration activities.

During the period of performance on the MSP project one (1) revision was made to the SSHP. The revision addressed the need for respiratory protection during the handling and packaging of lead shapes and radiologically-impacted soils.

6.5.2 Safety and Health Inspections

As part of the Health and Safety Program safety inspections were conducted on a daily basis and recorded in the Site Safety and Health Specialist's (SSHS) log book. Formal weekly inspections were also performed by the SSHS and documented on an Health and Safety Inspection form. In addition, the Project Manager and Project Superintendent performed monthly inspections of the project site. These inspections were also documented on Health and Safety Inspection forms. All deficiencies noted during the weekly and monthly inspections were recorded on the projects Deficiency Tracking Log, which was posted on the Safety Bulletin Board. Corrective action dates and responsible parties were identified and tracked using the tracking log.

As part of ECC's project safety program, several project safety audits were conducted during periods of the project performance. These audits were conducted by the Project Certified Industrial Hygienist and documented. Any deficiencies were noted, issued to responsible parties, and corrective action dates identified.

6.5.3 Site Health and Safety Meetings

There were several types of health and safety meetings convened on the MSP project. Daily Safety Tailgate meetings were convened at the beginning of each workday. The entire project crew attended these meetings, including subcontractor employees. The meetings addressed the planned activities for the workday, potential hazards associated with the planned activities, and a discussion on a particular safety topic. These daily tailgate meetings were documented and included as an attachment to the DQCR submitted to the CENAN COR. A copy of the Safety Tailgate meeting forms are included with the DQCRs found in **Appendix N**.

Plan of the Day meetings were convened with the project management team to discuss activities planned for the upcoming day, week ahead, and month. At these meetings all participants were asked to provide safety observations, concerns, and suggestions. Safety stand-down meetings were convened three times during the period of performance on the project. A safety stand-down was held in 2006, 2007, and 2008. All project personnel were required to attend, and the CENAN COR's were invited. These stand-down meetings were used to re-emphasize certain aspects of the MSP safety program, to communicate either recent USACE and/or ECC safety incidents, and to allow individuals to discuss their safety concerns and/or suggestions.

6.5.4 Injury and First Aid Record

The ECC MSP project team established an outstanding safety record for the period of performance on the MSP project. The project team achieved zero OSHA Recordable Incidents, and only three First Aid cases for a project that recorded over 55,000 safe work hours. The project also recorded and documented other incidents including High Loss Potential (HIPO), property damage, environmental, quality and security. The chart below summarizes the number of incidents recorded for each incident category during the MSP Soils OU-1 project..

Incident Type	Total Number of Incidents Reported
Injury / Illness	0
First Aid / Doctor	3
HIPO	13
Property Damage	5
Environmental	5
Quality	3
Security	1

Below is an annual roll-up of the incidents that were recorded on the MSP Project's Incident/Accident Log over the duration of the project.

2006				
DATE	**ECC CASE NO.**	**INCIDENT / INJURY DESCRIPTION**	**CATEGORY**	**FOLLOW UP / COMMENTS**
8/23/06	271	Foreign object in eye.	First Aid/Doctor	Treatment onsite with medical clinic follow up. Employee returned to work 8/24/08.
8/23/06	272	Damage to Radiological survey instrument probe.	Property Damage	Determination made to adjust method for insertion of probe into bore holes.
10/4/06	299	Track excavator rode over deenergized power cable.	HIPO – Near Miss	Reviewed incident with crew and emphasized need to inspect work area prior to moving equipment.
10/20/06	314	Damage to onsite rental equipment & offsite vehicles (2) during windy conditions.	Property Damage & Environmental Release	Directed crew as to when light towers are to be lowered (daily) Required the Project Superintendent to verify construction method and securing of temporary covers.
12/26/06	359	Private Vehicle operator drove through perimeter fence.	Security	Installed reflectors on temporary fencing located at the intersection.

2007				
DATE	**ECC CASE NO.**	**INCIDENT / INJURY DESCRIPTION**	**CATEGORY**	**FOLLOW UP / COMMENTS**
2/12/07	378	Personally owned vehicle (POV) drove over step ladder.	HIPO	Reviewed with field crew and reinforced need to store materials / tools away from vehicles / moving equipment.
2/21/07	389	Truck involved in roadway incident (no injuries or 3rd party vehicle damage).	Property Damage (>$500) + HIPO	Responsible transportation subcontractor addressed corrective action. All project notifications were completed.
3/5/07	395	Overturned articulating dump truck.	HIPO	Project Superintendent retrained operator in safe operation of the equipment.
4/5/07	423	Rock rolled onto top of individual's foot while securing stockpile tarp – sustained contusion to top of left foot.	First Aid/Doctor	Prohibited use of use rocks / boulders to secure soil pile tarps. Project Superintendent procured sand bags.
4/16/07	449	Potential contamination release after heavy rain event.	Environmental	Better planning for inclement weather including proper resource coverage, materials, and equipment.
5/17/07	468	Diesel Fuel Spill from Portable Generator.	Environmental	Construct secondary containment and place all generators, storage tanks and piping inside containment.
6/28/07	519	Nickel-Cadmium battery started smoking while being recharged.	HIPO	Changed manufacturer of the power tool.

2007 (Continued)				
DATE	**ECC CASE NO.**	**INCIDENT / INJURY DESCRIPTION**	**CATEGORY**	**FOLLOW UP / COMMENTS**
7/18/07	549	Stinging insect stung laborer under hard hat.	First Aid	Reiterated need to be diligent when working in areas that may house stinging insects. Inspect area for nests prior to working in area.
7/25/07	559	Backfill supplier found to be delivering non-conforming backfill from unapproved source.	Quality	Perform initial and follow up inspections of the backfill source to verify conformance of fill.
8/24/07	585	POV ran through intersection and through the temporary fencing along Mountain Avenue.	HIPO / Property Damage	Reinstalled reflective signs on temporary fencing at the intersection.
9/21/07	616	Forklift cross bar damaged due to excessive weight lifted on forks.	HIPO	Operators to determine weight of load, determine if equipment is capable of lifting load, and lift load in accordance with the equipment operation instructions.
9/26/07	617	While backing up onto stockpile, part of load was spilled because truck drove onto soft spot and dump bed rolled over partially.	HIPO	Project Superintendent to verify that equipment path and soil is capable of supporting load.
9/21/07	639	Loss of telephone & internet connection.	Quality	Work with internal information technology personnel on project expectations and completion / maintenance of systems.
10/22/07	649	Non-compliant discharge from wastewater treatment plant to publicly owned treatment works.	Quality / Environmental	Implement routine monitoring of effluent discharge for pH during processing of water and prior to discharge.
10/24/07	650	Truck driver proceeded to move truck forward without authorization from crew. Driver drove truck over wheel chocks and w/o scaffold being moved away from truck.	HIPO	Adjusted the field procedure for loading and closure of dump trucks (identified a point person to direct truck operators).

2008				
DATE	**ECC CASE NO.**	**INCIDENT / INJURY DESCRIPTION**	**CATEGORY**	**FOLLOW UP / COMMENTS**
1/10/08	706	Crossbar on dump truck damaged during load out activities.	HIPO / Property Damage	Instruct equipment operator as to the limitations associated with loading trucks.
2/28/08	761	Dump truck damaged from dozer while being pushed.	HIPO / Property Damage	Plan out and verify route is safe for trucks to access. Avoid using heavy equipment to move dumps trucks (contact towing service).
3/7/08	770	Articulating Dump damaged after being struck by independent truck driver delivering backfill.	Property Damage	Establish designated equipment laydown area off of active equipment / truck access roads.
3/16/08	780	POV struck by chain-link gate	HIPO	Individual was instructed to ensure tha gate is secured prior to driving through.
4/29/08	832	Improper rigging used during loading of truck scale.	HIPO	Lifting activities were halted and crane company brought in to perform proper rigging and lifting.
5/15/08	859	Release of hydraulic fluid during delivery of heavy equipment.	Environmental	Had equipment vendor clean up spill.

6.5.5 Deficiencies and Corrective Actions

As discussed in Section 6.5.2, all deficiencies identified during the documented safety inspections and audits were incorporated into the project Deficiency Tracking Log. For each deficiency a responsible party was identified and corrective action dates established. All deficiencies were appropriately addressed and closed out.

6.5.6 Project Safe Work Hours

The project recorded over 55,000 safe work hours over the duration of the project performance. These hours were documented to CENAN via bi-weekly safety meetings as well as monthly updates via email. The following chart summarizes the accrued safe work hours for each year of the MSP project period of performance.

Year	Safe Work Hours
2006	11,325
2007	35,106
2008	8,578
Total	**55,009**

7.0 FINAL INSPECTIONS AND WORK ACCEPTANCE

During the MSP Soils OU-1 project, routine initial and follow-up inspections were conducted throughout the remedial action to verify remedial activities were being performed by ECC in accordance with the approved Work Plans. Prior to approving a SU as eligible for backfill, a FSS Report for each SU was completed by the contractor and reviewed by the PHP, QCSM, and ECC Project Manager as well as CENAN. The FSS Report reviews included an evaluation of the analytical data, maps and associated text of the FSS Report. Visual inspections verified impacted waste did not remain in the excavation areas, and that work zone barriers remained in place to avoid cross-contamination of the remediated SUs from heavy equipment, personnel, or surface water from adjacent impacted areas.

7.1 Completion and Acceptance Inspections

Completion inspections were performed towards the end of the MSP project after all the DFWs were completed. Three stages of completion inspections were performed at the MSP Site to verify that the work performed met the requirements of project plans, quality, workmanship, and completeness.

7.1.1 Construction Quality Control Project Completion Inspection

Based on CENAN's concurrence that work was nearing completion and prior to the Pre-Final inspections, the QCSM conducted a detailed inspection for MSP project conformance to contract requirements on May 27, 2008 and June 2, 2008. An itemized punch list was prepared identifying items that did not conform to work plans and/or those that required additional work to meet the desired quality level. The itemized list was discussed with the ECC Project Manager and Site Superintendent and a corrective action plan was generated and implemented. All listed items were corrected prior to the Pre-Final Acceptance Inspection.

7.1.2 Pre-Final Acceptance Inspection

A Pre-Final Acceptance Inspection was conducted at the MSP on June 17, 2008 and again on July 17, 2008. Verbal notice of these inspections was provided to the CENAN COR five days prior to each of the Pre-Final Acceptance Inspections. The CENAN Project Engineer Representative, CENAN New York COR, and the CENAN New York Project Manager attended the Pre-Final Acceptance Inspection. The inspection resulted in a punch list of items to be addressed prior to the Final Acceptance Inspection. **Table 7-1** presents the completed and approved punch list items identified during the two Pre-Final inspections.

7.1.3 Final Acceptance Inspection

The punch list developed in the Pre-Final Acceptance Inspection was used by the ECC QCSM to track the completion status and close out of the listed items. Upon completion of the corrective actions, notice was given to CENAN five days before the Final Acceptance Inspection. The MSP Final Acceptance Inspection was conducted on July 28, 2008. CENAN representatives listed above as well as representatives from the USEPA and NJDEP walked the site with the QCSM to ensure completeness of all the punch list items.

7.2 Work Acceptance

The Final Acceptance Inspection resulted in the acceptance of the work performed at the MSP by CENAN. The CENAN representative's signature and approval of the project completion check list for each DFW at MSP is attached as **Appendix P**.

8.0 OPERATIONS AND MAINTENANCE ACTIVITIES

The MSP Soils OU-1 Remedial Action is complete. No O&M (operations and maintenance) activities are required except to monitor and maintain the grass cover, and the in-place erosion and sediment controls. The Contractor (ECC) was responsible for warranty of these items for one year from the removal of all waste from the MSP SOILS OU-1 site (through April 21, 2009).

9.0 ENVIRONMENTAL SURVEILLANCE PROGRAM

An Environmental Surveillance Program was performed for the MSP Soils OU-1 project under the management of CENAN as part of the FUSRAP. The Environmental Surveillance Program for the site conducted during the MSP SOILS OU-1 remediation included quarterly sampling of air, and semiannual sampling of surface water, groundwater, and streambed sediment to monitor for potential off-site migration of contaminants. Environmental Surveillance Program Data collected over the duration of the MSP Remedial Action activities is included as **Appendix R** of this document.

Site environmental monitoring was terminated May 19, 2008 after the last FSS was accepted by CENAN

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10.0 ADMINISTRATIVE ACTIVITIES

The following sections present an overview of critical administrative activities for the MSP site.

10.1 Administrative Record

The Administrative Record will be updated to include the Environmental Surveillance Reports prepared during the Soils OU-1 Remedial Action and this PRAR. The Preliminary Close Out Report (PCOR) will be added to the Administrative Record after OU-2 groundwater sediment, and surface water activities are completed.

10.2 Monthly Operating Reports

CENAN has issued monthly reports to the USEPA. Weekly or bi-weekly progress meetings were held with participants from the remediation contractor and CENAN as appropriate.

10.3 Right-of-Entry Agreements

"Right-of-Entry" Agreements were obtained by CENAN for adjacent properties requiring project team access for remediation or sampling. These properties included the areas south and west of the MSP site described in Section 5.3 of this PRAR. Right-of-Entry Agreements are included in **Appendix S**.

No other property owner interaction took place.

11.0 SUMMARY OF PROJECT COSTS

This section provides a summary of project cost information and final project costs.

The cost estimate for the selected remedy in the *MSP Soils OU-1 ROD* (USACE, 2005) was $15.9 million. Contractor project costs at the conclusion of the field work were approximately $21.7 million; however project close-out negotiations may result in an adjustment of this value. Costs associated with the off-site disposal of the radiological waste were paid for under separate contract by the United States Government. These costs totaled $5,181,476 paid to US Ecology, and $22,804 paid to Energy Solutions.

The difference in the actual costs and the Soils OU-1 ROD cost estimate were primarily due to the increase radiological waste quantities. It was originally estimated that there would be approximately 18,808 cu m (24,600 cu yd) of radiologically impacted material shipped to US Ecology of Idaho. At project completion, the remediation contractor had excavated, transported and disposed of 31,533 cu m (41,244 cu yd) of radiologically impacted waste. Transportation costs for the radiological waste accounted for approximately 50 percent of the total contract value.

A reduction of anticipated chemical waste quantities occurred during project execution. The contractor discovered less chemically-impacted soil and debris as predicted in the *MSP Soils OU-1 ROD* (USACE, 2005). It was originally estimated that approximately 17,737 cu m (23,200 cu yd) of chemically impacted material required remediation, transportation and off-site disposal at a licensed facility. At project completion, the remediation contractor had excavated and disposed of 3,405 cu m (4,454 cu yd) of chemically impacted soil. The impact due to reduced chemical waste quantities is being addressed during project close out.

Additional cost impacts included:

- Added transportation cost due to the density of soils and debris being higher than anticipated;
- The blending of soils to meet the US Ecology WAC;
- The excavation, handling, packaging and transportation of waste (radiologically impacted soil and debris exceeding the US Ecology that could not be blended) to Energy Solutions in Utah;
- The discovery of two USTs at the MSP site;
- Staging contaminated soil on a temporary lined storage pad on a cleaned portion of the site, which allowed excavation to be completed and the total volume of waste to be quantified;
- The discovery, decontamination and transportation and disposal of the blank ammunition discovered at the MSP site; and
- Schedule extension based on site and contractual conditions.

Cost savings in comparison to the *MSP Soils OU-1 ROD* (USACE, 2005) estimate included:

- A quantity reduction of chemically impacted soil for excavation and off-site disposal; and
- A quantity reduction of water requiring treatment and disposal from the remedial action.

12.0 OBSERVATIONS AND LESSONS LEARNED

The following sections present the cost and performance related lessons learned and additional observations for the MSP project. The following lessons were learned from completion of this project:

1. Due to the un-promulgated rule by Pennsylvania Department of Environmental Protection preventing FUSRAP waste to be disposed of in Pennsylvania, and the Ohio EPA ruling not to allow FUSRAP waste to be disposed in Ohio, the contractor was required to find alternate disposal facilities. The contractor arranged for transportation and disposal of the chemically-impacted material at the Allied Landfill in Niagara, New York. The NYSDEC required additional steps not included in the contractor's basis of estimate and or reflected in their price to execute chemical waste transportation and disposal. Due to these additional steps required by the NYSDEC, additional costs were incurred to ensure material with radiological activity above background levels was not disposed of at the Allied Landfill, in New York. Lessons learned suggest that discussions regarding disposal of FUSRAP waste should be arranged early in the project with State regulators and disposal facilities, and should include the USACE and CENAN representatives in all conversations and meetings.

2. Remedial Action costs were incurred above the *MSP Soils OU-1 ROD* (USACE, 2005) estimate primarily due to additional radiological waste quantities and a higher specific density of this waste than originally anticipated. Radiological waste quantities increased by approximately 41 percent, while the density factor increased by approximately 21 percent above the basis of the contractor's negotiated estimate. Lessons learned suggest waste quantity and density tracking are paramount to understanding project conditions. Timely notification to CENAN by the contractor is essential for programming funding and project support. Also, the contract type should be flexible to account and pay for waste growth as it occurs on projects where significant subsurface unknowns exist.

3. The cost of remedial action progressed faster than funding was made available to the contractor. This caused some activities, such as excavation and transportation, to be delayed until further funding was available, and also required the re-allocation of awarded funds to line items that were under-funded. These contract actions slowed the project progress, decreased efficiency, and ultimately caused additional cost. Lessons learned suggest that when executing a firm fixed-price incrementally funded Task Order, the USACE (CENAN) should issue a schedule of funding to the contractor during the proposal-planning phase, so that remedial action efforts can be developed, scheduled and based on the proposed funding schedule.

4. The use of a performance-based fixed price contract was an inappropriate contract vehicle to complete this Remedial Action. While site conditions and characterization work in the planning and procurement phases supported the use of a performance based contract, actual site conditions and radiological soil volume growth complicate the execution and contracting component of this action.

5. Remedial investigation and historical sampling data and documentation were used during development of the COC criteria for the MSP Remedial project. The FS determined a DCGL of 6.8 pCi/g for Ra-226 and 17 pCi/g for U-nat. However, based on site wide data, an assumption was made that uranium and radium were at or near secular equilibrium. Therefore it was determined that the radium DCGL could be lowered to 5 pCi/g to account for the risk from uranium and used as an effective surrogate for uranium contamination. Simply stated; expectations were if Ra-226 was remediated to a level of less than 5 pCi/g, the uranium content would not exceed 17 pCi/g. Radiological survey and sample analysis plans/procedures were developed based on these assumptions. At least 10 percent of FSS samples were to be analyzed for U-nat according to the original plan. During review of sample analysis data from SUs 20 and 21 it became apparent that approximately 10 percent of uranium data indicated that the use of Ra-226 as a surrogate was not appropriate. This percentage was greater than the project team expected DQO, and as such, instrumentation and survey protocol changes were made to account for the unexpected radium/uranium ratios.

The PHP selected the survey instrument and survey technique to adequately detect residual radioactive contamination due to Ra-226, U-nat, and the respective radioactive progeny. This was established in the RAWP and associated FSSP as the preferred method of monitoring excavation and soil waste management activities. During the execution of the field work it was determined that the radiological monitoring protocols were to be supplemented with the use of a low energy gamma detector Bicron G-5 FIDLER NaI. The FIDLER was connected to a scaler/ratemeter or a microR exposure rate meter to perform the scanning surveys onsite. The FSSP was amended to document the methodology for using the FIDLER detector for in-situ uranium surveys. The FSSP and FIDLER Addendum are presented in **Appendix L**.

6. Proper planning and documentation of communications between stakeholders and the CENAN contractor need to be performed as part of the life cycle project management to insure project continuity. This is especially true for long term FUSRAP cleanups that have multiple project managers that take many years to complete. Capturing knowledge and transferring information between Project Managers is critical to insure successful and efficient execution.

13.0 MIDDLESEX SAMPLING PLANT PROJECT TEAM

The MSP Project team is comprised of three primary organization levels: CENAN, ECC, and subcontractors. CENAN is the contracting management agency for the MSP work and is responsible for all aspects of contract administration and oversight on this project. Key personnel for CENAN (New York) and CENWK (Kansas City) are provided in **Table 13-1**.

ECC is the prime contractor to CENAN, and is responsible for overall management of the contract including, but not limited to, cost, schedule, technical quality, design, construction management, and health and safety. Key ECC personnel are presented in **Table 13-2**. The project organization chart identifying key personnel, responsibilities, and lines of authority for the MSP remediation work for the FUSRAP contract is presented in **Figure 13-1**.

Various types of subcontractors were required to execute the work at MSP. These subcontractors provided a wide range of experience and knowledge that contributed to the remedial action success at MSP. **Table 13-3** presents a list of key subcontractors to ECC and their project related functions.

14.0 REFERENCES

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FIGURES

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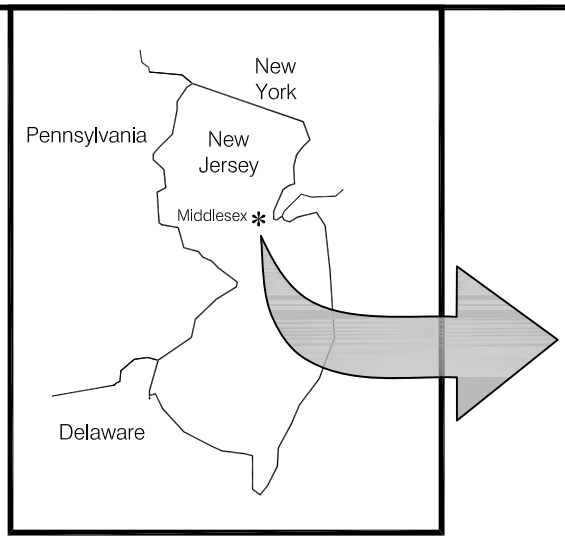

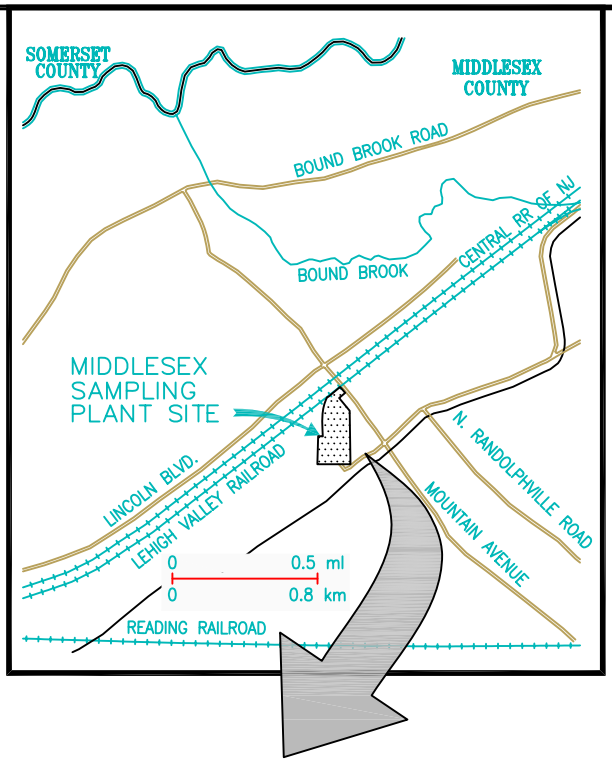

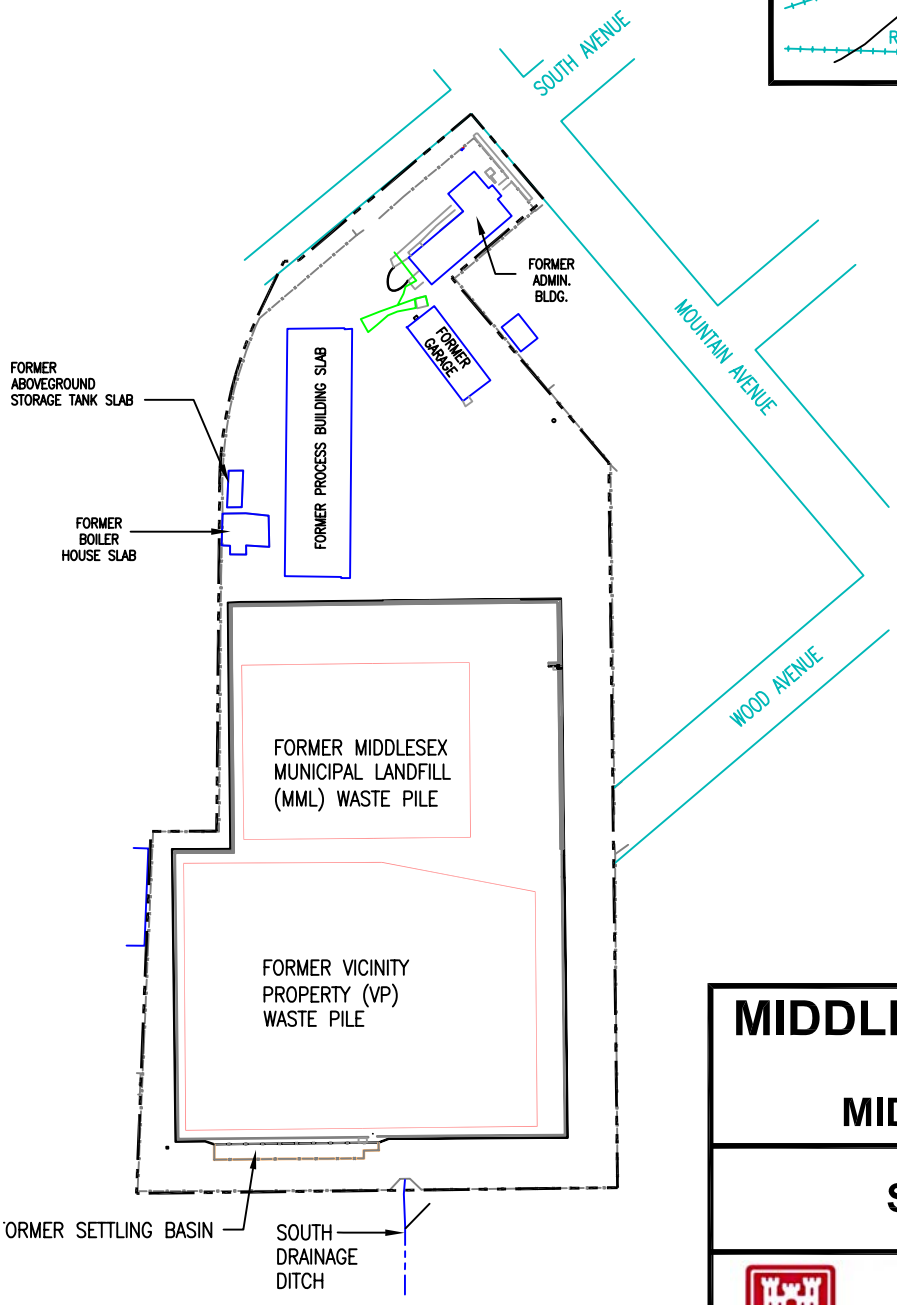

LEGEND:

- FENCE
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- STORM DRAIN AND TRENCH
- CONCRETE BERM

GRAPHIC SCALE

200 0 100 200

(in feet)

REFERENCE:
BASED ON MARCH 2005 USACE FEASIBILITY STUDY REPORT

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

SITE LOCATION MAP

US Army Corps of Engineers
New York District

FUSRAP

DATE: 12/04/2008
PROJ: W912DQ-04-D-0017

FIGURE 1-1

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Legend

- Subject Property Line
- Borough Line
- Right of Way Line (R.O.W.)
- Remediation Grid (Major)
- Former Legacy Building Footprint

N.J.S.P.C.S. 1983

Graphic Scale

80 0 40 80 160

(In Feet)

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

MIDDLESEX SAMPLING PLANT
AERIAL PHOTOGRAPH

US Army Corps of Engineers
New York District

FUSRAP

DATE: 11/25/2008

PROJ: W912DQ-04-D-0017

FIGURE 1-2

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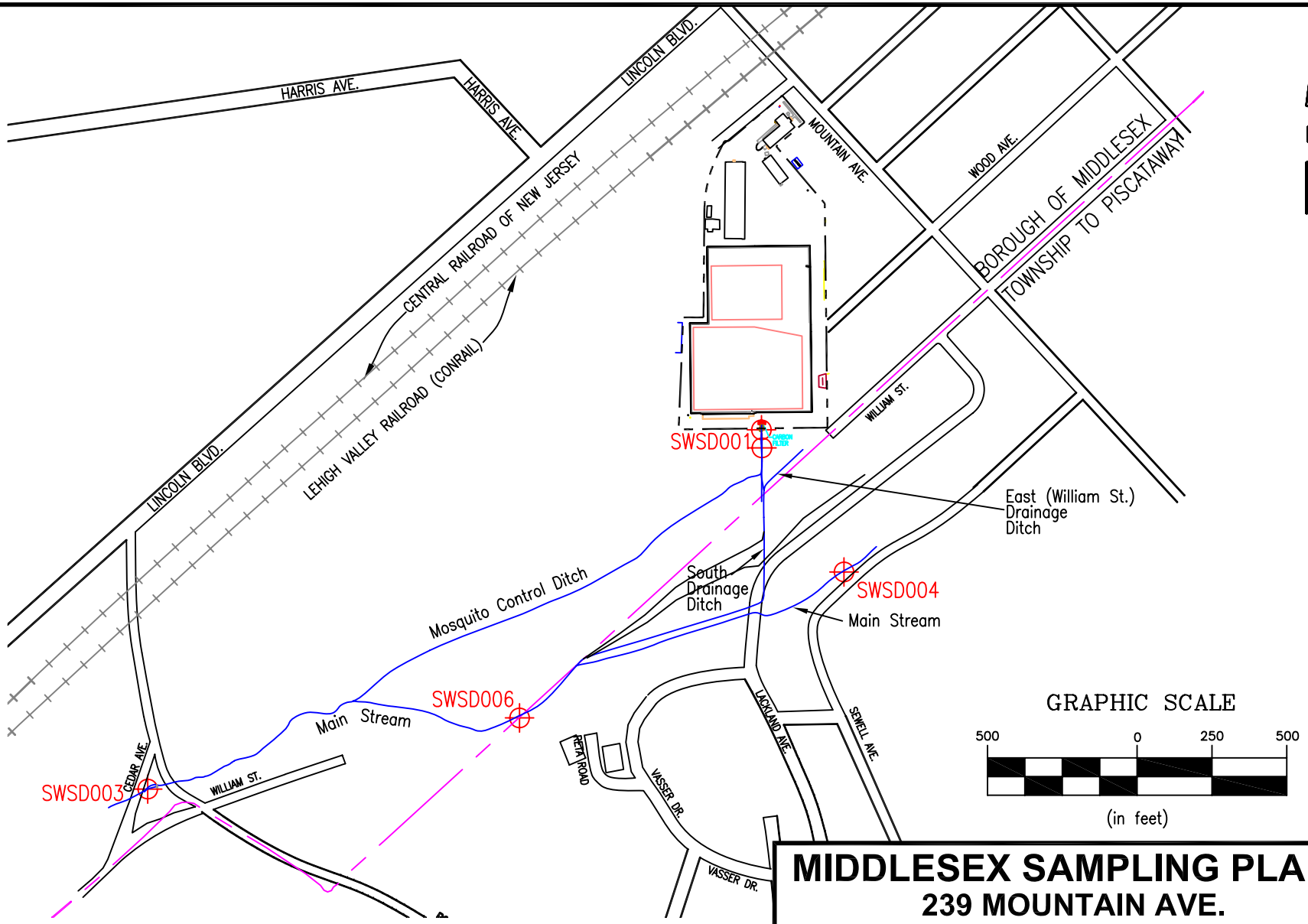

NOTES:

1. SAMPLING LOCATION SWSD004 LOST DUE TO CONSTRUCTION ACTIVITY IN 2002.

LEGEND:

- SURFACE WATER/SEDIMENT SAMPLE LOCATION
- PROPERTY BOUNDARY
- TOWNSHIP BOUNDARY

REFERENCE:

BASED ON MARCH 2005 USACE FEASIBILITY STUDY REPORT

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

FIGURE 1-3

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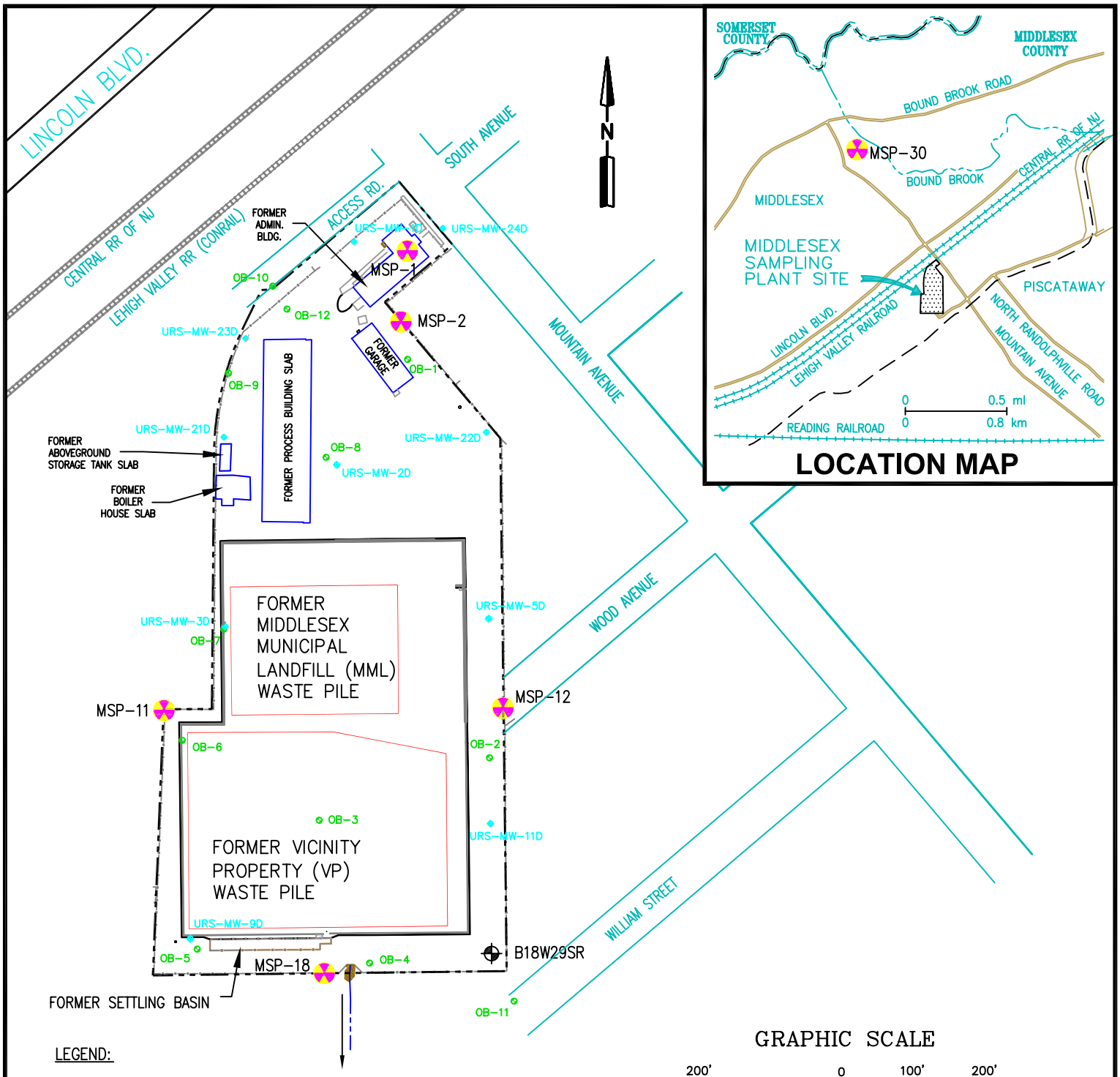

LEGEND:

- FENCE
- GROUNDWATER MONITORING WELL
- BEDROCK (DEEP) MONITORING WELL
- OVERBURDEN (SHALLOW) MONITORING WELL
- GAMMA RADIATION AND RADON SURVEILLANCE LOCATION
- CONCRETE BERM
- PROPERTY BOUNDARY
- SOUTH DRAINAGE DITCH
- STORM DRAIN AND TRENCH
- DRAINAGE FLOW DIRECTION

REFERENCE:
BASED ON MARCH 2005 USACE FEASIBILITY STUDY REPORT

GRAPHIC SCALE

200' 0 100' 200'

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

SITE LAYOUT MAP WITH ENVIRONMENTAL MONITORING STATIONS

US Army Corps of Engineers
New York District

FUSRAP

DATE: 12/04/2008

PROJ: W912DQ-04-D-0017

FIGURE 1-4

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LEGEND

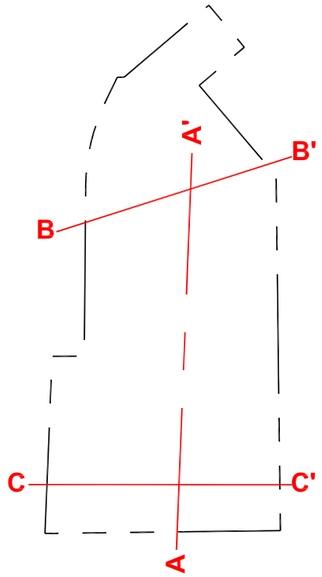
- ASPHALT
- CONCRETE

HISTORIC FILL MATERIAL

- GP – GRAVEL SAND MIXTURES
- GC – CLAYEY GRAVELS
- ML – SILT WITH WOOD AND CONCRETE
- SP – POORLY GRADED SANDS
- CL – CLAY

NATIVE SOIL

- GP – GRAVEL SAND MIXTURES
- ML – SILT
- GM – GRAVEL SILT MIXTURES
- WEATHERED BEDROCK
- VOID DUE TO PRESENCE OF SUBSURFACE PIPE
- INFERRED TOP OF WEATHERED BEDROCK
- INFERRED CONTACT



CROSS SECTION LOCATIONS

GRAPHIC SCALE

80' 0 40' 80'

HORIZONTAL (1 inch = 80 feet)

GRAPHIC SCALE

8' 0 4' 8'

VERTICAL (1 inch = 8 feet)

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GEOLOGIC CROSS SECTION

US Army Corps of Engineers® New York District

FUSRAP

DATE: 11/25/2008

PROJ: W912DQ-04-D-0017

FIGURE 1-5

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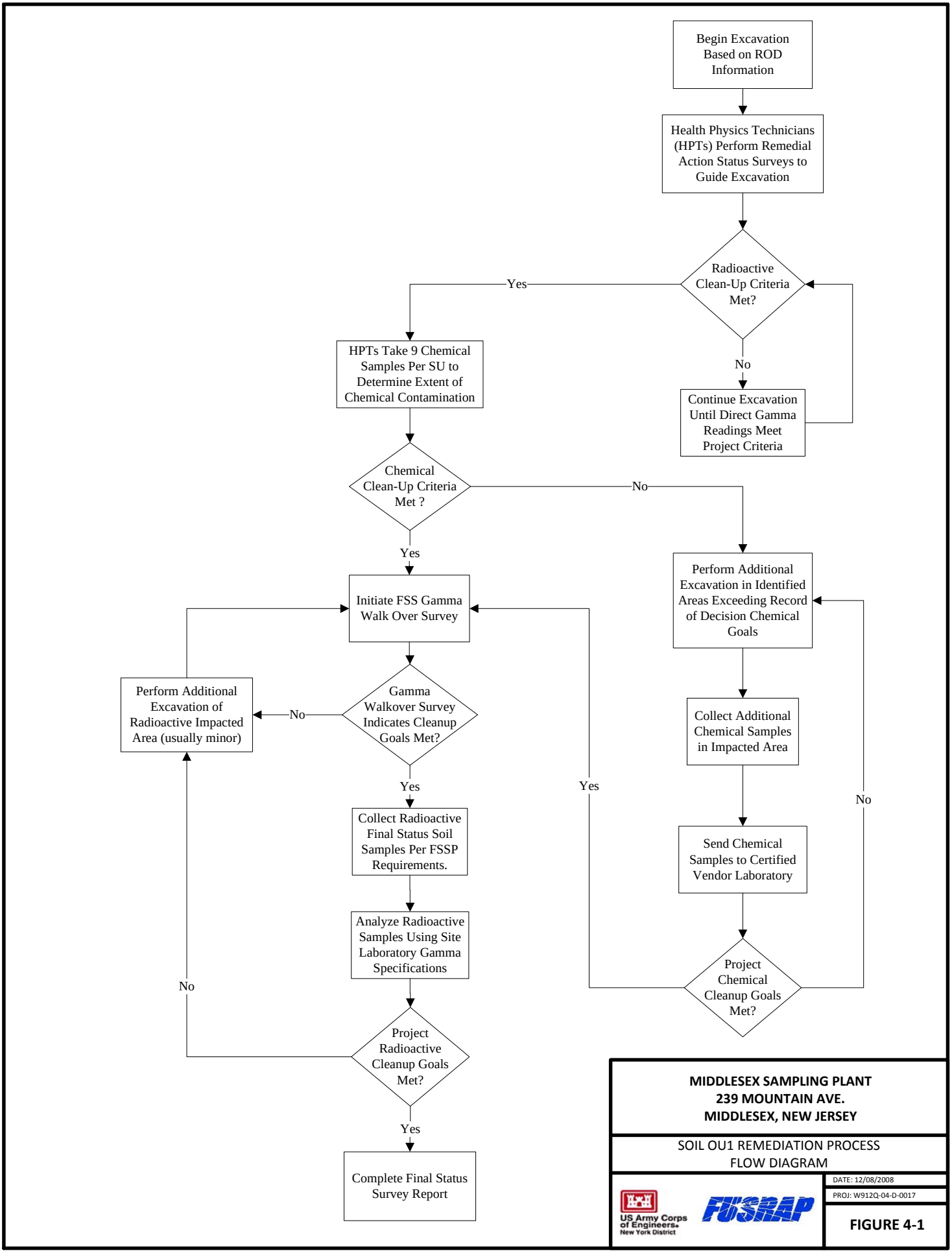
Begin Excavation Based on ROD Information
Health Physics Technicians (HPTs) Perform Remedial Action Status Surveys to Guide Excavation
Radioactive Clean-Up Criteria Met?
Yes
No
HPTs Take 9 Chemical Samples Per SU to Determine Extent of Chemical Contamination
Continue Excavation Until Direct Gamma Readings Meet Project Criteria
Chemical Clean-Up Criteria Met ?
No
Yes
Perform Additional Excavation in Identified Areas Exceeding Record of Decision Chemical Goals
Initiate FSS Gamma Walk Over Survey
Perform Additional Excavation of Radioactive Impacted Area (usually minor)
Gamma Walkover Survey Indicates Cleanup Goals Met?
No
Yes
Collect Additional Chemical Samples in Impacted Area
Collect Radioactive Final Status Soil Samples Per FSSP Requirements.
Send Chemical Samples to Certified Vendor Laboratory
Analyze Radioactive Samples Using Site Laboratory Gamma Specifications
Project Chemical Cleanup Goals Met?
Yes
No
No
Project Radioactive Cleanup Goals Met?
Yes
Complete Final Status Survey Report
MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY
SOIL OU1 REMEDIATION PROCESS FLOW DIAGRAM
US Army Corps of Engineers
New York District
FUSRAP
DATE: 12/08/2008
PROJ: W912Q-04-D-0017
FIGURE 4-1

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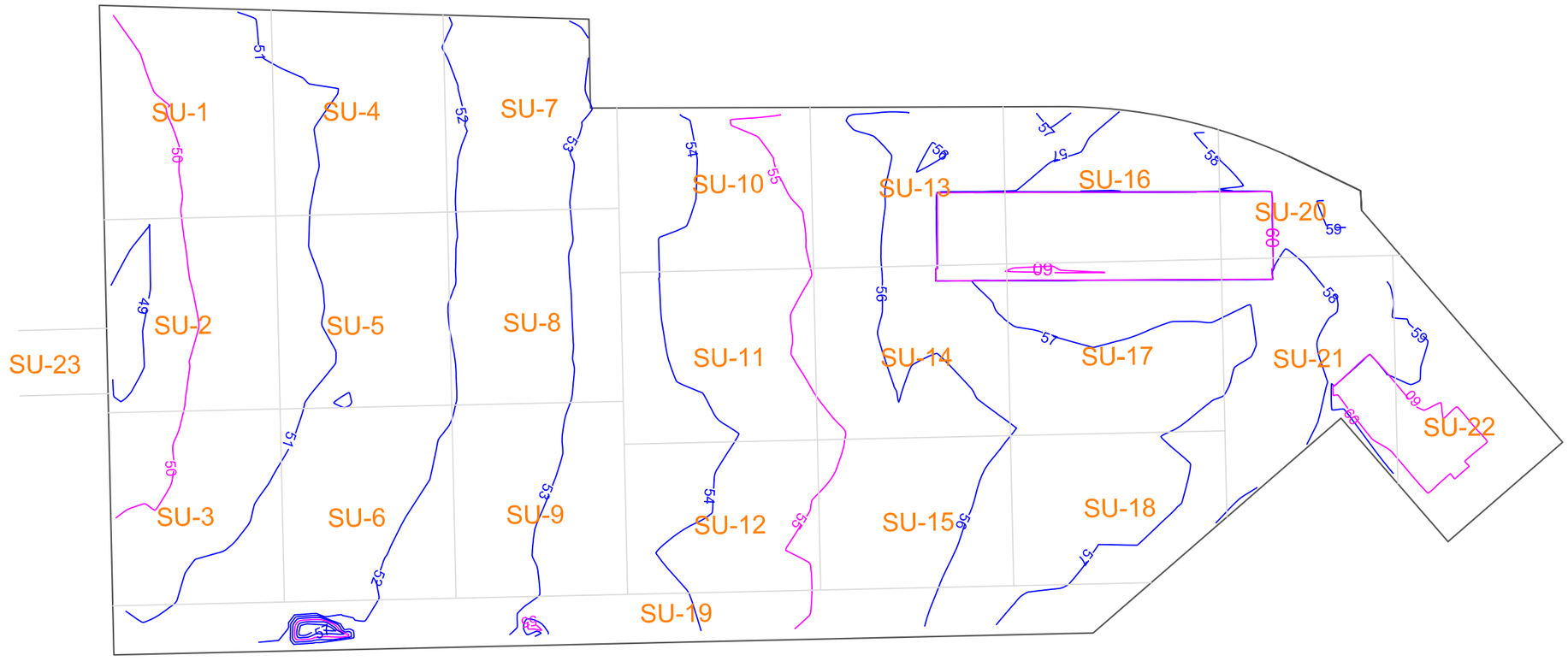
N.J.S.P.C.S. 1983



LEGEND

- Property Boundary Line
- Pre Remediation Major Contour
- Pre Remediation Minor Contour

NOTES:

1) The horizontal Datum is based on the North American Datum of 1983 ('96 adjustment) Zone 2900 New Jersey. The coordinates were determined by a static GPS survey incorporating the following NGS Control stations PID: AG9916, KV2915 and KV6622.
2) All elevations depicted hereon are based on the North American Vertical Datum of 1988 (NAVD 88). The elevations were determined by a static GPS survey incorporating the following NGS Control Benchmarks PID: KV1176, KV0542 and KV1172.
3) Survey units are U.S. Survey Feet.
4) The contour information shown hereon was field surveyed by Geod Corporation.

Graphic Scale

80 0 40 80 160

(In Feet)

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

PRE-REMEDIATION TOPOGRAPHIC SURVEY

US Army Corps of Engineers® New York District

FUSRAP

DATE: 12/08/2008

PROJ: W912DQ-04-D-0017

FIGURE 4-2

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Note: Connect Discharge to MCUA Prior to Flowmeter

Discharge to MCUA

Flow Meter

If Required for retreatment

50,000 Gallon Tank TK-2

50,000 Gallon Tank TK-1

Pump No. 2 P-2

Micron Filters MF-1 and MF-2

Activated Carbon Filter Vessel ACF-1

Ion Exchange Vessel IX-1

Pump No. 1 P-1

Pump No. 3 P-3

Note: Drawing not to scale.

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

WASTEWATER TREATMENT PLANT
PROCESS FLOW DIAGRAM

US Army Corps of Engineers® New York District

FUSRAP

DATE: 11/25/2008

PROJ: W912DQ-04-D-0017

FIGURE 4-3

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N.J.S.P.C.S. 1983

SU-1
SU-2
SU-3
SU-4
SU-5
SU-6
SU-7
SU-8
SU-9
SU-10
SU-11
SU-12
SU-13
SU-14
SU-15
SU-16
SU-17
SU-18
SU-19
SU-20
SU-21
SU-22
SU-23

LEGEND

- SUBJECT PROPERTY LINE
- BOROUGH LINE
- LEGACY BUILDING FOUNDATIONS
- REMEDIATION GRID (MAJOR)
- UNDERGROUND STORAGE TANK
- SMALL ARMS AMMUNITION CACHE

REFERENCE:
BASED ON MARCH 2005 USACE FEASIBILITY STUDY REPORT

Graphic Scale
80 0 40 80 160
(In Feet)

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

LEGACY BUILDING FOUNDATIONS, UNDERGROUND STORAGE TANKS, AND BLANK AMMUNITION LOCATIONS

US Army Corps of Engineers® New York District

FUSRAP

DATE: 10/22/2008
PROJ: W912DQ-04-D-0017

FIGURE 4-4

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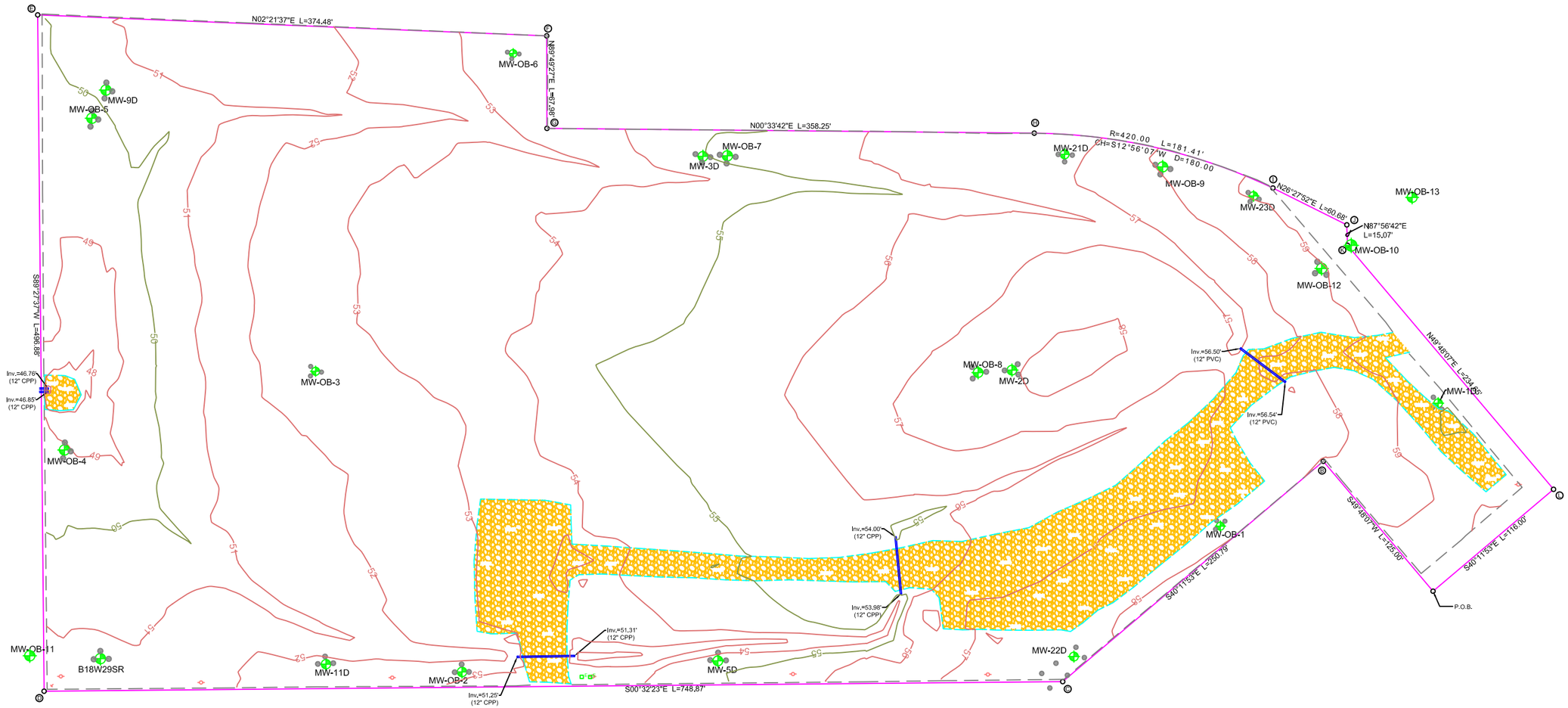

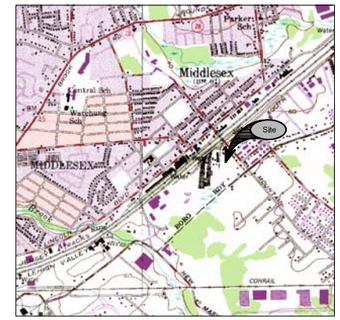

Key Map
(Not to Scale)

Property I.D.	Ground		State Plane		Description
	North	East	North	East	
POB	100,401.15	199,989.78	633,015.70	494,516.78	Nothing Set
B	100,320.47	199,894.30	632,935.03	494,421.31	Nothing Set
C	100,128.92	200,056.17	632,743.49	494,583.16	Rebar w/Cap
D	99,380.08	200,063.23	631,994.73	494,590.22	Rebar w/Cap
E	99,375.40	199,566.37	631,990.05	494,093.41	Rebar w/Cap
F	99,749.57	199,581.79	632,364.18	494,108.83	Dock Spike
G	99,749.77	199,649.77	632,364.39	494,176.81	P.K. Nail
H	100,108.01	199,653.29	632,722.59	494,180.32	Rebar w/Cap
I	100,283.44	199,693.58	632,898.00	494,220.61	Rebar w/Cap
J	100,337.76	199,720.62	632,952.32	494,247.64	P.K. Nail
K	100,338.30	199,735.68	632,952.86	494,262.70	Rebar w/Cap
L	100,489.76	199,914.91	633,104.30	494,441.92	P.K. Nail

Well I.D. No.	NAD 83-96 (N.J. Zone 2900)				NAVD 88		
	Northing	Easting	Latitude	Longitude	Ground	Outer Casing	Inner Casing
B18W29SR	632031.98	494567.06	40-34-06.90	74-29-28.35	51.36	53.97	53.54
MW11D	632202.08	494570.45	40-34-08.58	74-29-28.31	52.42	55.44	n/a
MW-1D	633019.43	494378.82	40-34-16.66	74-29-30.79	59.93	62.04	n/a
MW-21D	632744.95	494195.90	40-34-13.95	74-29-33.16	57.36	59.56	n/a
MW-22D	632751.73	494564.75	40-34-14.01	74-29-28.38	57.75	59.96	n/a
MW-23D	632883.79	494226.37	40-34-15.32	74-29-32.77	59.06	61.55	n/a
MW-2D	632699.51	494354.82	40-34-13.50	74-29-31.10	57.83	60.22	n/a
MW-3D	632478.92	494197.35	40-34-11.32	74-29-33.14	55.02	57.37	n/a
MW-5D	632490.11	494568.39	40-34-11.43	74-29-28.34	55.07	57.91	n/a
MW-9D	632039.86	494151.17	40-34-06.98	74-29-33.74	50.46	53.41	n/a
MW-OB-1	632859.39	494468.97	40-34-15.08	74-29-29.62	57.85	60.01	59.92
MW-OB-2	632301.80	494575.98	40-34-09.57	74-29-28.24	52.96	55.43	55.12
MW-OB-3	632194.17	494355.31	40-34-08.50	74-29-31.10	52.53	55.46	55.14
MW-OB-4	632011.09	494413.26	40-34-06.70	74-29-30.35	49.18	52.05	51.56
MW-OB-5	632029.77	494169.51	40-34-06.88	74-29-33.51	50.06	52.65	52.32
MW-OB-6	632339.54	494121.72	40-34-09.94	74-29-34.12	53.68	56.11	55.94
MW-OB-7	632496.98	494196.93	40-34-11.50	74-29-33.15	55.28	57.76	57.45
MW-OB-8	632685.57	494355.83	40-34-13.36	74-29-31.09	57.75	60.66	60.21
MW-OB-9	632817.02	494204.90	40-34-14.66	74-29-33.05	58.23	60.85	60.64
MW-OB-10	632955.33	494263.09	40-34-16.03	74-29-32.29	59.37	59.45	59.17
MW-OB-11	631985.38	494563.39	40-34-06.44	74-29-28.40	51.24	54.31	53.46
MW-OB-12	632933.77	494279.63	40-34-15.81	74-29-32.08	59.07	61.62	61.30
MW-OB-13	633000.64	494227.49	40-34-16.47	74-29-32.75	60.01	60.04	59.73

Legend

- Contour (Major)
- Contour (Minor)
- Property Boundary Line
- Fence Line
- Edge Gravel
- Monitoring Well
- Protective Post
- Utility Pole
- Electric Box
- Gravel Area

NOTES:

1) All state plane coordinates shown are based on the North American Datum of 1983 ('96 adjustment) Zone 2900 New Jersey. The coordinates were determined by a static GPS survey incorporating the following NGS Control stations PID: AG9916, KV2915 and KV6622.
A project coordinate system was established by dividing the state plane coordinates by the average combined scale factor of 0.999902567 and translating traverse point 5 to N10000.00 E20000.00. All distances labeled hereon are true ground distances. All areas are true ground measurements.

2) All elevations depicted hereon are based on the North American Vertical Datum of 1988 (NAVD 88). The elevations were determined by a static GPS survey incorporating the following NGS Control Benchmarks PID: KV1176, KV0542 and KV1172.

3) The information shown hereon were field surveyed by Geod Corporation from June 30 to July 02, 2008.

4) Survey units are U.S. Survey Feet.

N.J.S.P.C.S. 1983

Graphic Scale

80 0 40 80 160

(In Feet)

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.

MIDDLESEX, NEW JERSEY

FINAL GRADING AS-BUILT

US Army Corps of Engineers
New York District

FUSRAP

DATE: 11/25/2008

PROJ: W912DQ-04-D-0017

FIGURE 4-5

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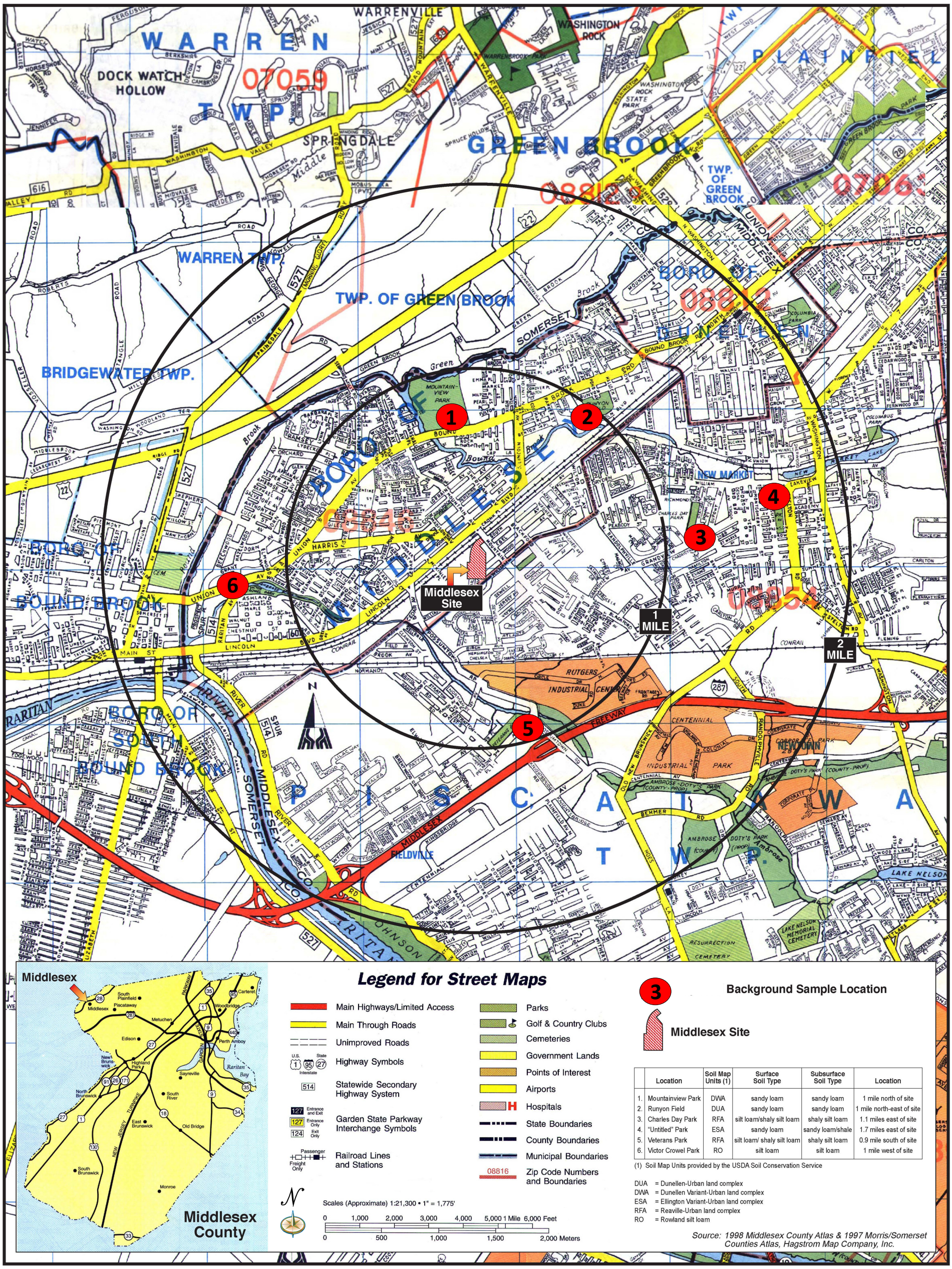

Legend for Street Maps

- Main Highways/Limited Access
- Main Through Roads
- Unimproved Roads
- Highway Symbols (U.S. 1, State 95, 27 Interstate)
- 514 — Statewide Secondary Highway System
- 127 Entrance and Exit; 127 Entrance Only; 124 Exit Only — Garden State Parkway Interchange Symbols
- Passenger / Freight Only — Railroad Lines and Stations
- Parks
- Golf & Country Clubs
- Cemeteries
- Government Lands
- Points of Interest
- Airports
- H — Hospitals
- State Boundaries
- County Boundaries
- Municipal Boundaries
- 08816 — Zip Code Numbers and Boundaries

Scales (Approximate) 1:21,300 • 1" = 1,775'

0 1,000 2,000 3,000 4,000 5,000 1 Mile 6,000 Feet

0 500 1,000 1,500 2,000 Meters

3 — Background Sample Location

Middlesex Site

	Location	Soil Map Units (1)	Surface Soil Type	Subsurface Soil Type	Location
1.	Mountainview Park	DWA	sandy loam	sandy loam	1 mile north of site
2.	Runyon Field	DUA	sandy loam	sandy loam	1 mile north-east of site
3.	Charles Day Park	RFA	silt loam/shaly silt loam	shaly silt loam	1.1 miles east of site
4.	"Untitled" Park	ESA	sandy loam	sandy loam/shale	1.7 miles east of site
5.	Veterans Park	RFA	silt loam/ shaly silt loam	shaly silt loam	0.9 mile south of site
6.	Victor Crowel Park	RO	silt loam	silt loam	1 mile west of site

(1) Soil Map Units provided by the USDA Soil Conservation Service

DUA = Dunellen-Urban land complex
DWA = Dunellen Variant-Urban land complex
ESA = Ellington Variant-Urban land complex
RFA = Reaville-Urban land complex
RO = Rowland silt loam

Source: 1998 Middlesex County Atlas & 1997 Morris/Somerset Counties Atlas, Hagstrom Map Company, Inc.

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

MIDDLESEX SAMPLING PLANT SITE LOCATION
PROXIMITY TO BACKGROUND SAMPLING

US Army Corps of Engineers
New York District

FUSRAP

DATE: 9/9/2008

PROJ: W912Q-04-D-0017

FIGURE 5-1

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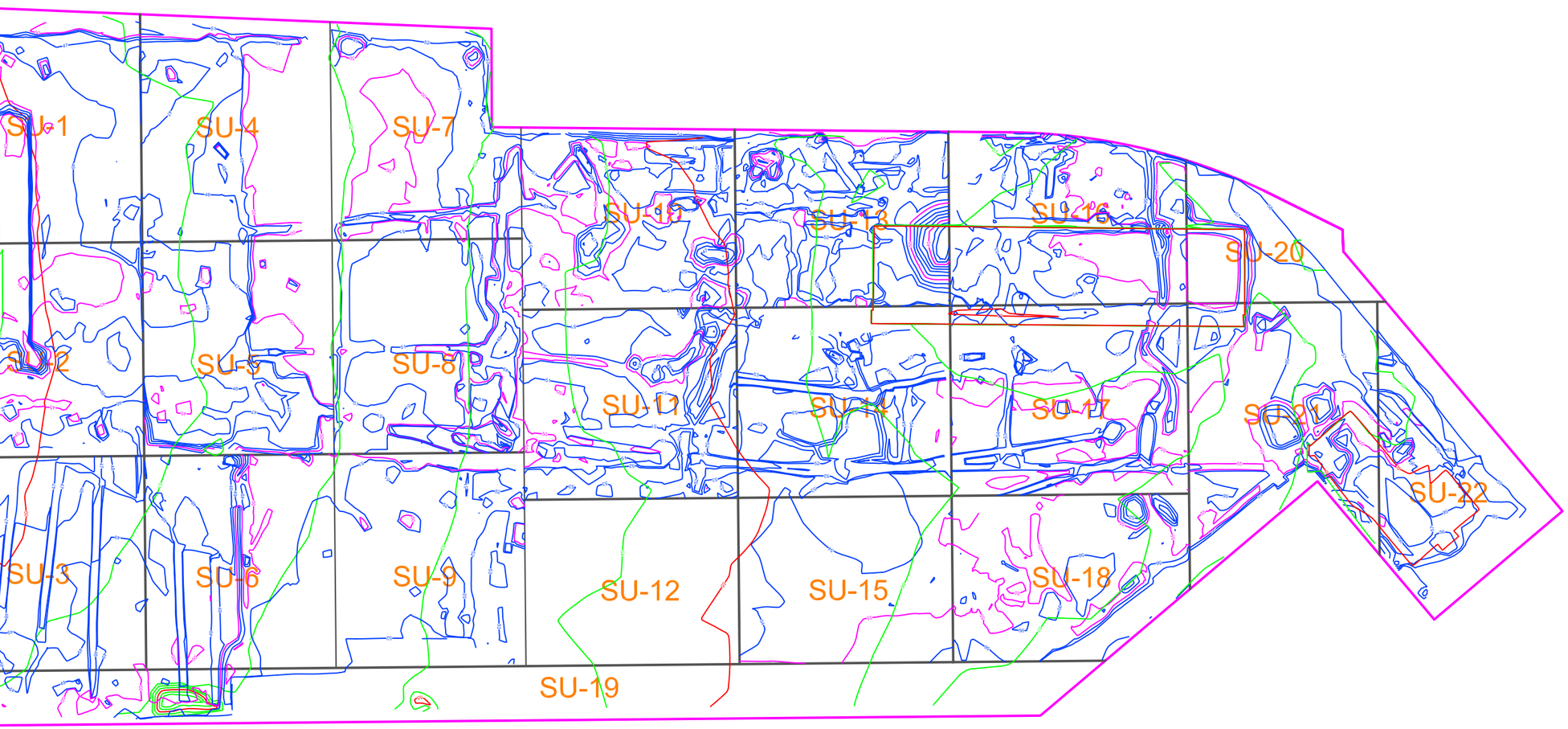

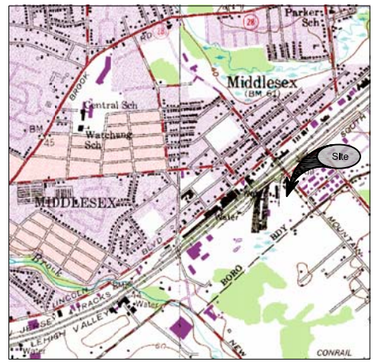

Key Map
(Not to Scale)

Legend

- Property Boundary Line
- Remediation Contour (Major)
- Remediation Contour (Minor)
- Pre Remediation Contour (Major)
- Pre Remediation Contour (Minor)

NOTES:

1) The horizontal Datum is based on the North American Datum of 1983 ('96 adjustment) Zone 2900 New Jersey. The coordinates were determined by a static GPS survey incorporating the following NGS Control stations PID: AG9916, KV2915 and KV6622.

2) All elevations depicted hereon are based on the North American Vertical Datum of 1988 (NAVD 88). The elevations were determined by a static GPS survey incorporating the following NGS Control Benchmarks PID: KV1176, KV0542 and KV1172.

3) Survey units are U.S. Survey Feet.

4) The contour information shown hereon was field surveyed by Geod Corporation.

N.J.S.P.C.S. 1983

Graphic Scale

80 0 40 80 160

(In Feet)

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

RADIOLOGICAL POST-REMEDIATION TOPOGRAPHIC SURFACE

US Army Corps of Engineers
New York District

FUSRAP

DATE: 11/25/2008

PROJ: W912DQ-04-D-0017

FIGURE 5-2

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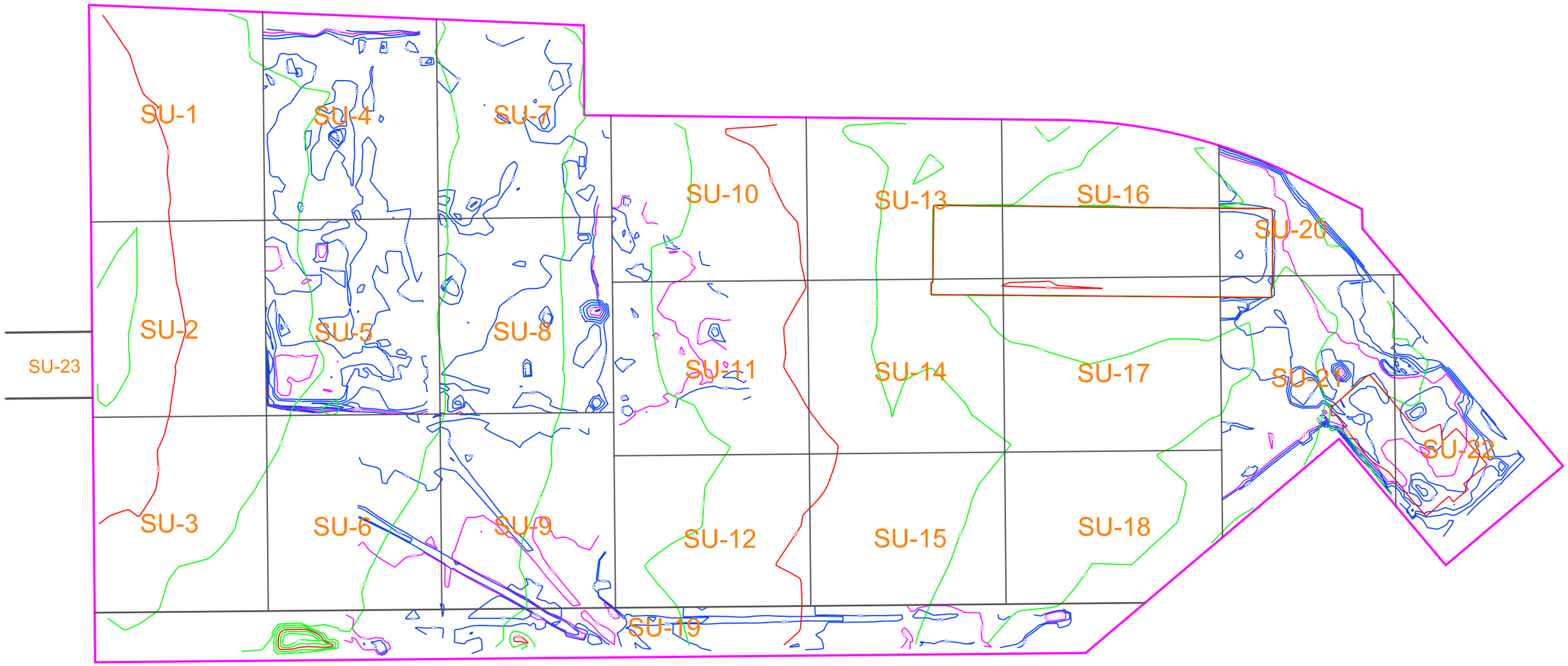

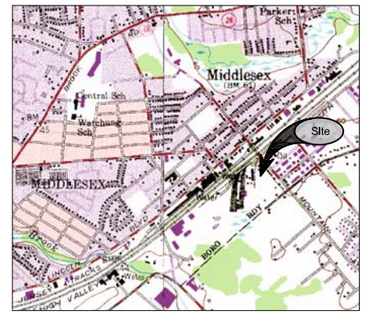

Key Map
(Not to Scale)

N.J.S.P.C.S. 1983

Legend

- Property Boundary Line
- Remediation Contour (Major)
- Remediation Contour (Minor)
- Pre Remediation Contour (Major)
- Pre Remediation Contour (Minor)

NOTES:

1) The horizontal Datum is based on the North American Datum of 1983 ('96 adjustment) Zone 2900 New Jersey. The coordinates were determined by a static GPS survey incorporating the following NGS Control stations PID: AG9916, KV2915 and KV6622.

2) All elevations depicted hereon are based on the North American Vertical Datum of 1988 (NAVD 88). The elevations were determined by a static GPS survey incorporating the following NGS Control Benchmarks PID: KV1176, KV0542 and KV1172.

3) Survey units are U.S. Survey Feet.

4) The contour information shown hereon was field surveyed by Geod Corporation.

Graphic Scale

80 0 40 80 160

(In Feet)

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.

MIDDLESEX, NEW JERSEY

CHEMICAL POST-REMEDIATION TOPOGRAPHIC SURFACE

US Army Corps of Engineers
New York District

FUSRAP

DATE: 11/25/2008

PROJ: W912DQ-04-D-0017

FIGURE 5-3

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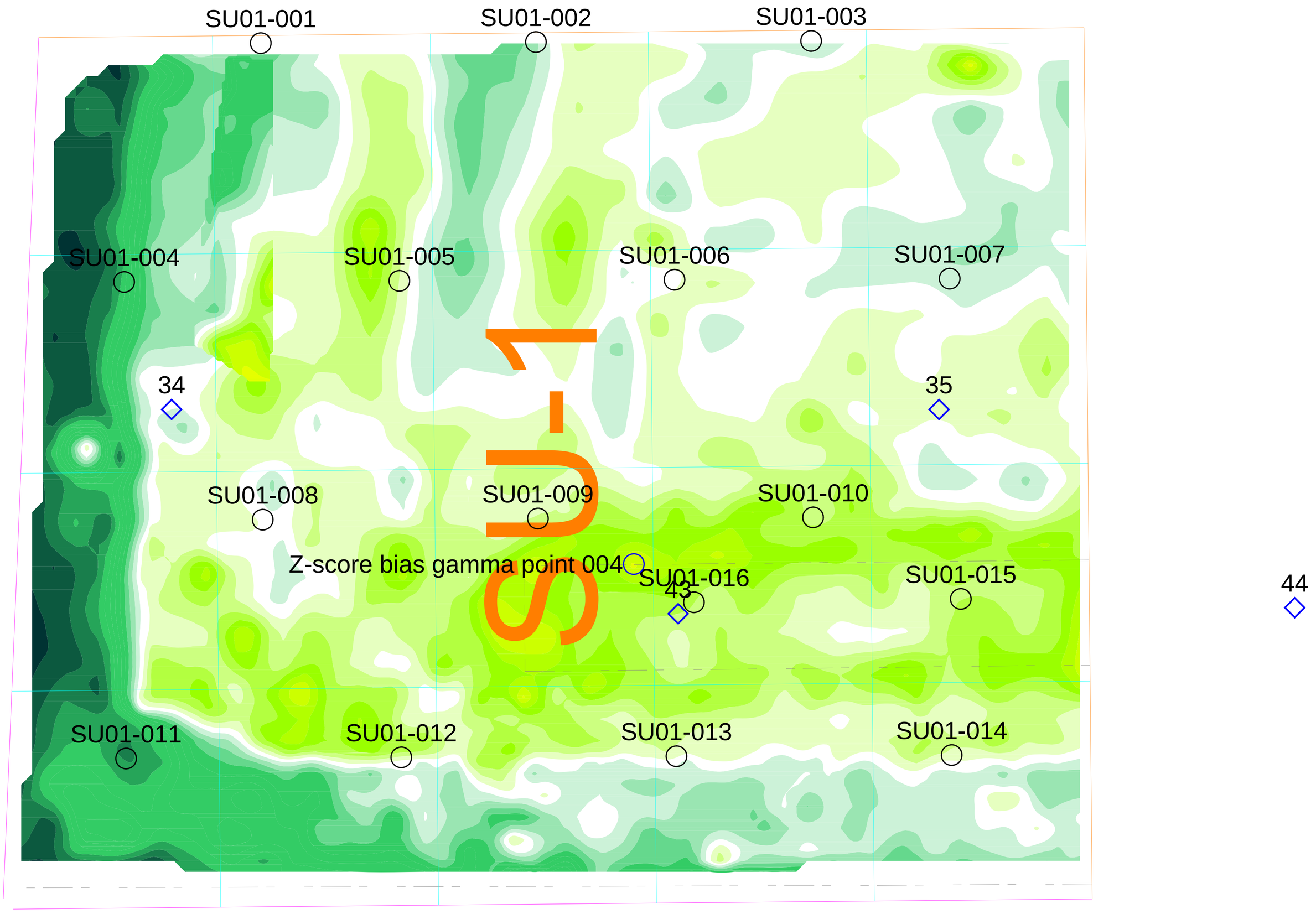


LEGEND AND NOTES

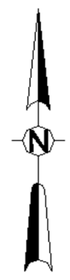


Radiological Sample Location

Chemical Sample Location

SU 1 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-1

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.1

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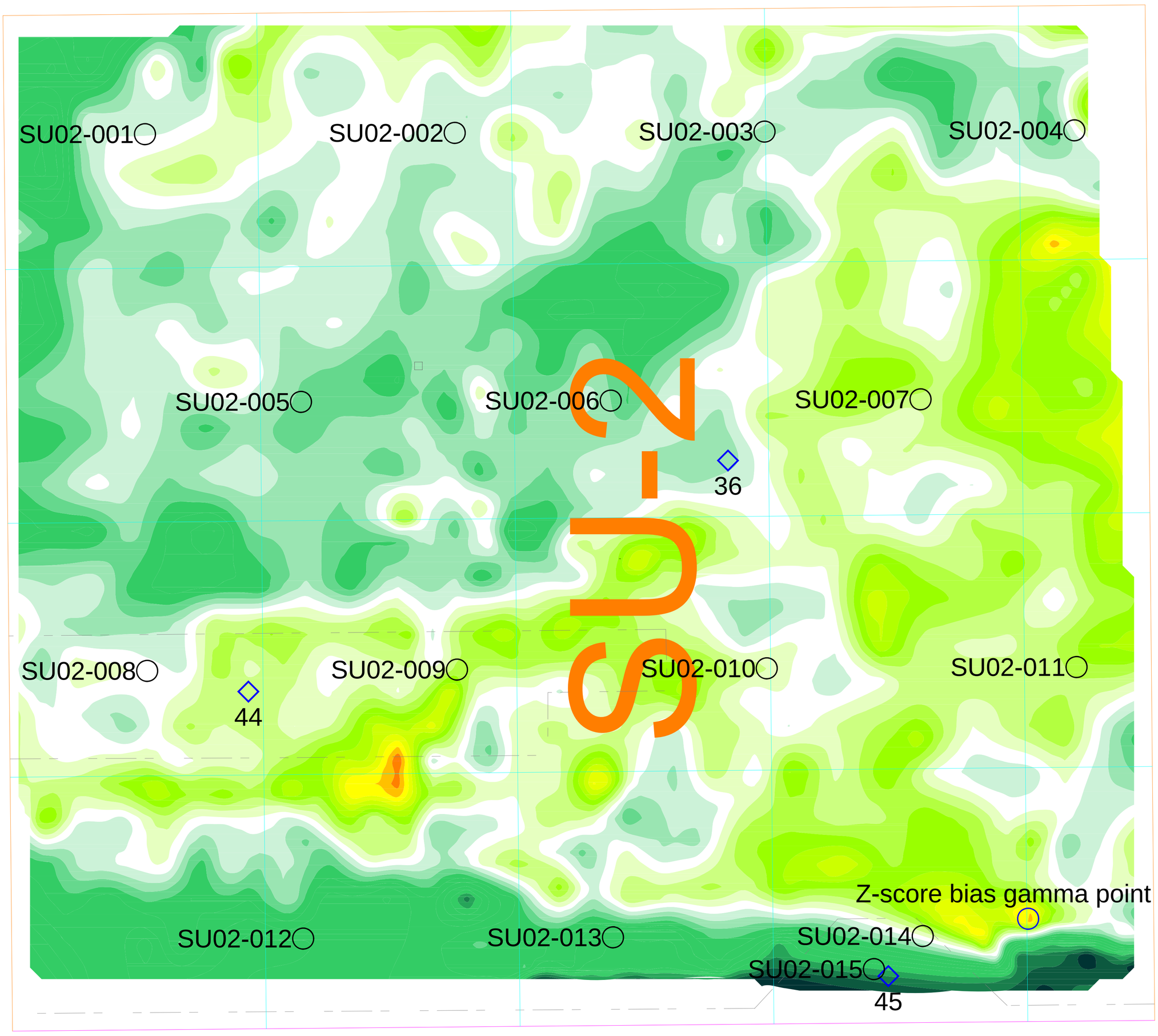
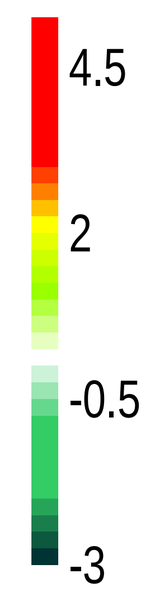


LEGEND AND NOTES

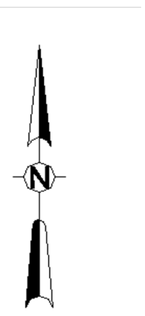


Radiological Sample Location

Chemical Sample Location

SU 2 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-2

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.2

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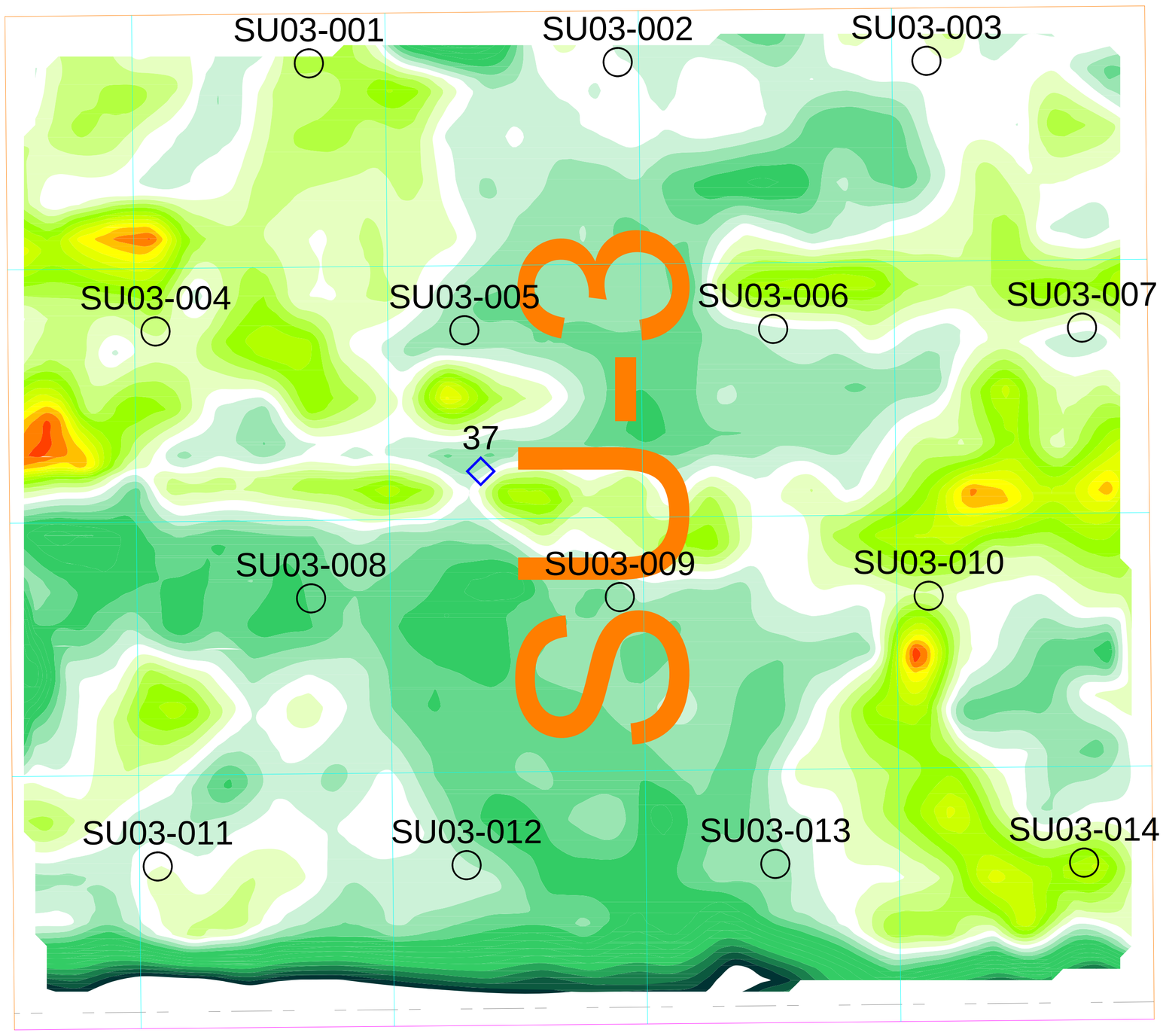


LEGEND AND NOTES

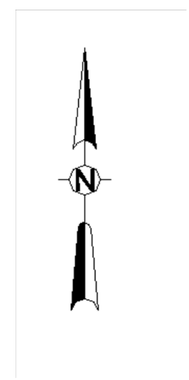


Z-Score

Radiological Sample Location

Chemical Sample Location

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-3

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.3

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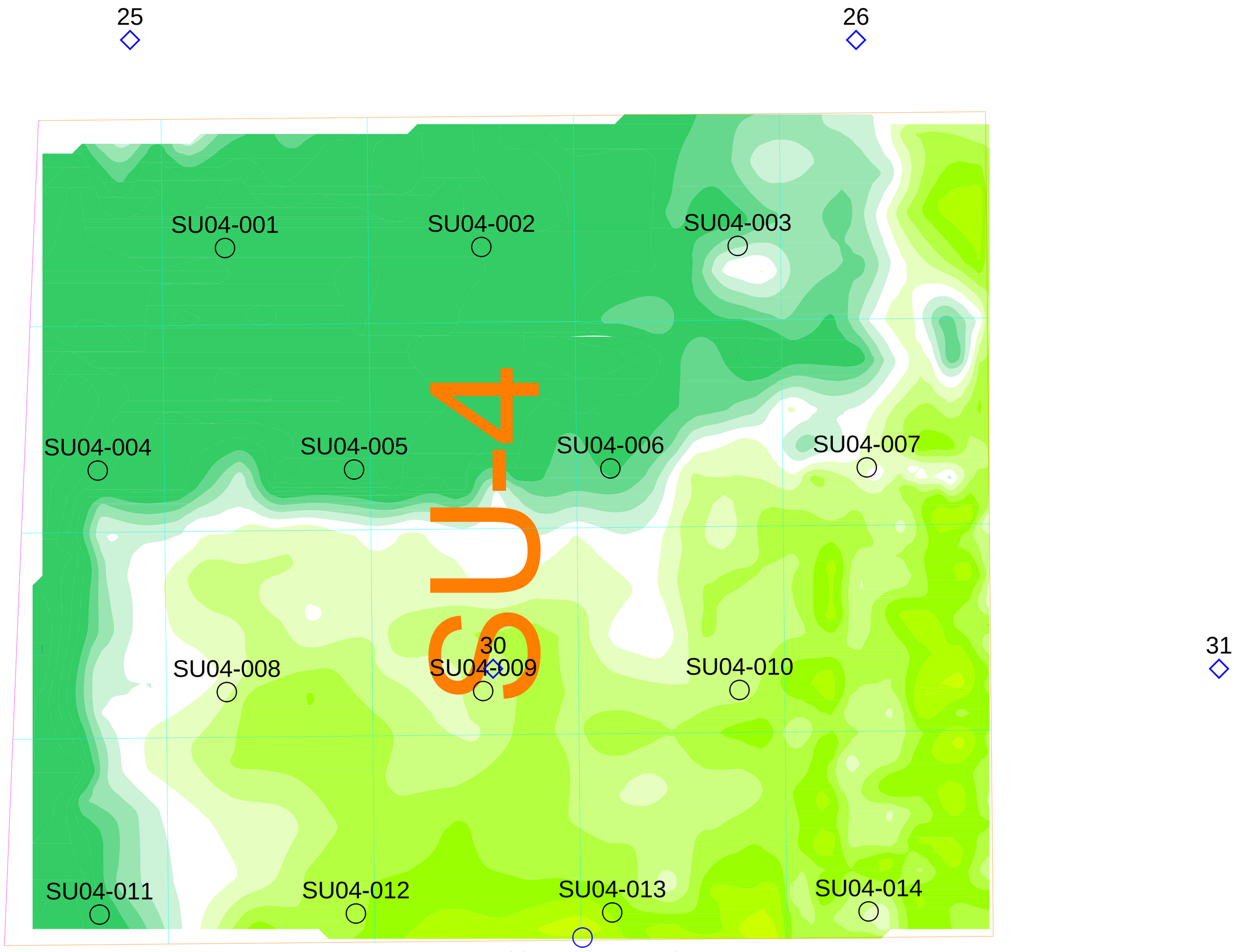
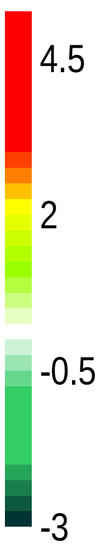


LEGEND AND NOTES

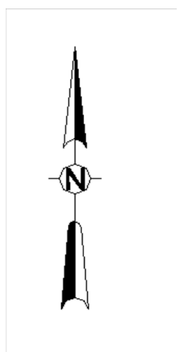


Radiological Sample Location

Chemical Sample Location

SU-4 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-4

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.4

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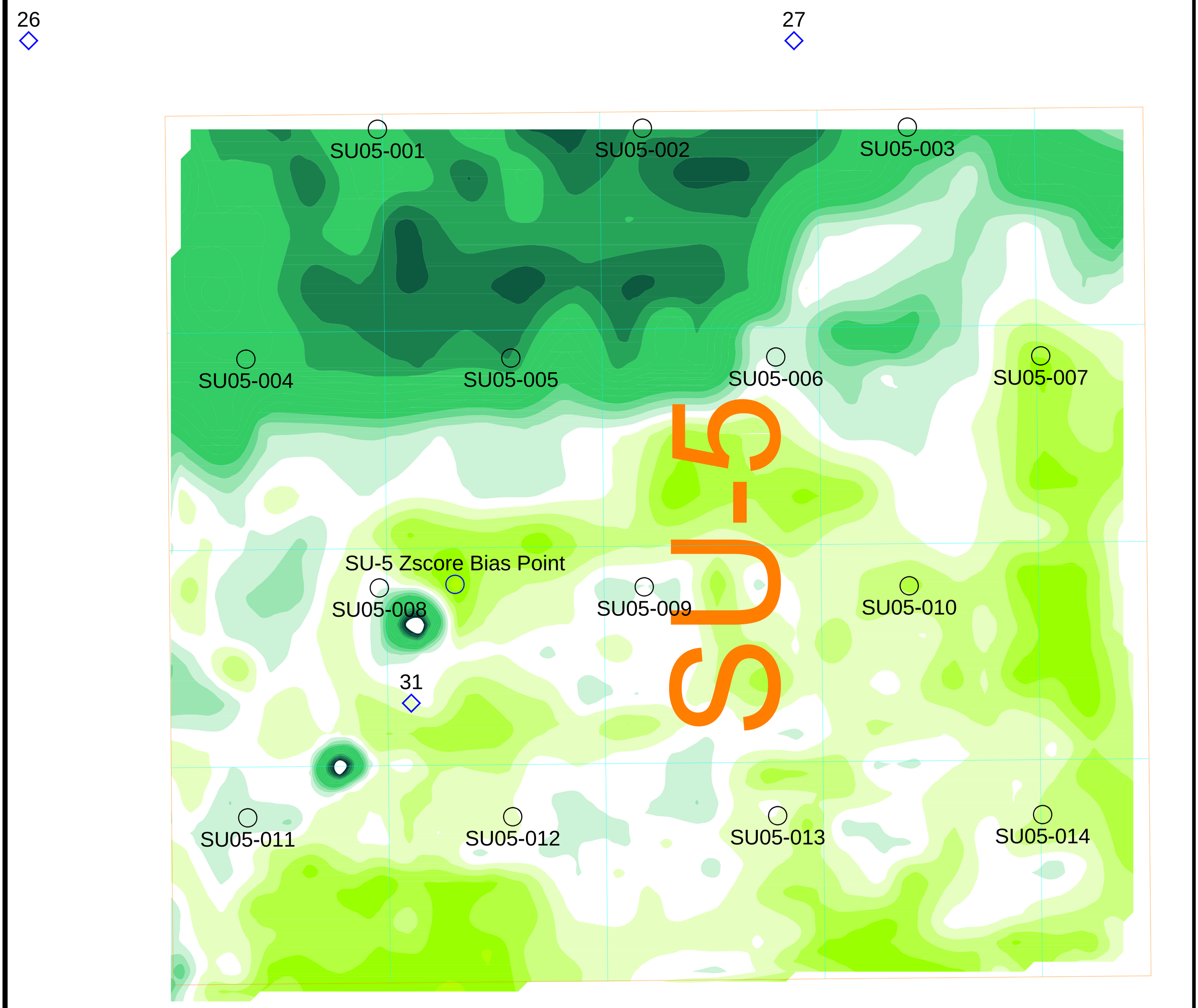
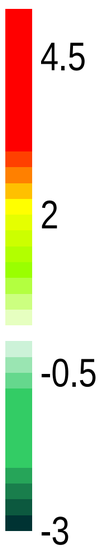


LEGEND AND NOTES

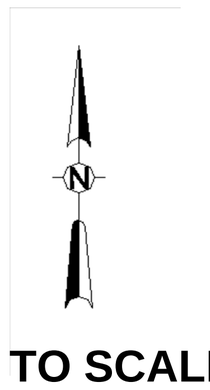


Radiological Sample Location

Chemical Sample Location

SU 5 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-5

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.5

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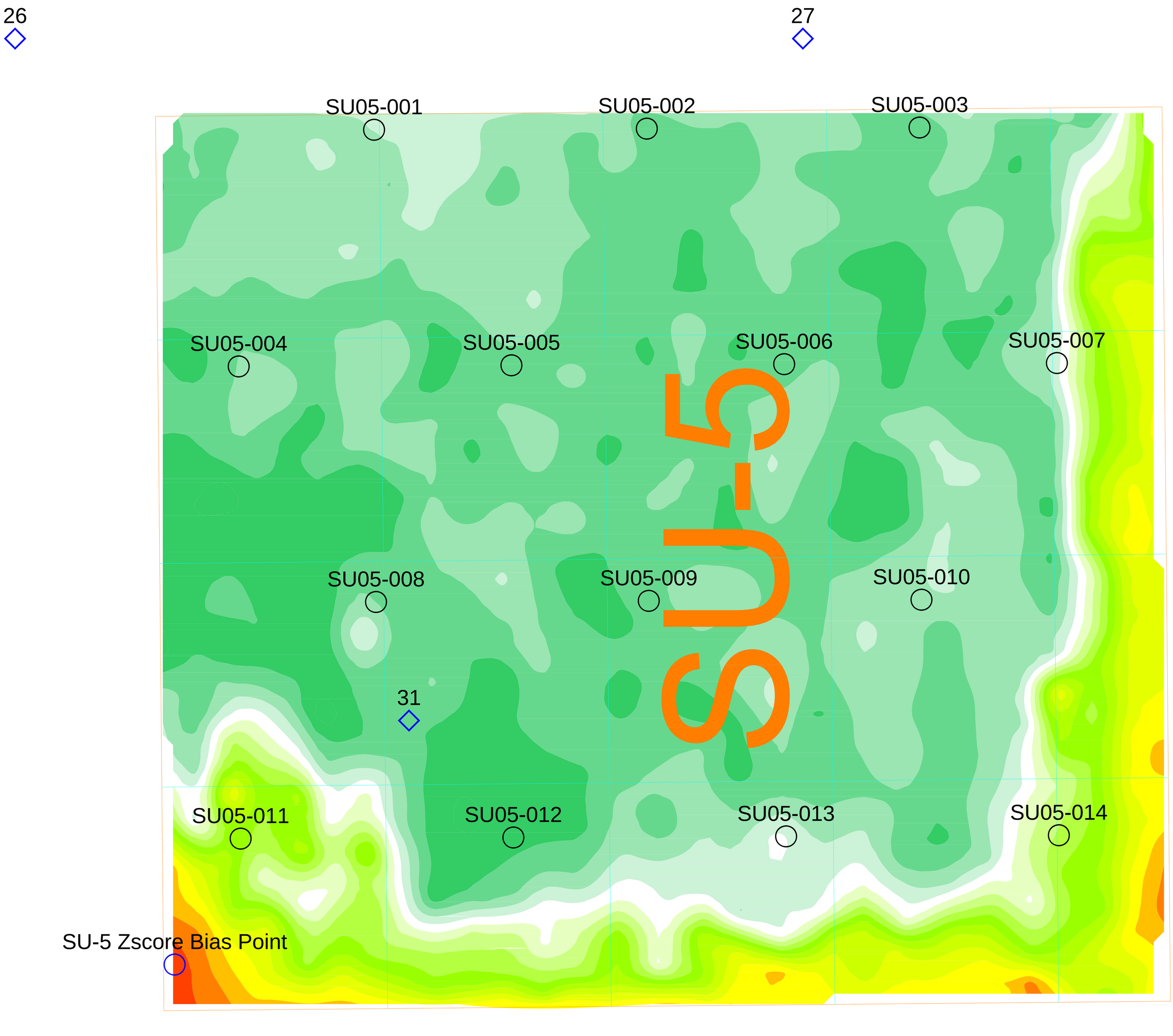


LEGEND AND NOTES



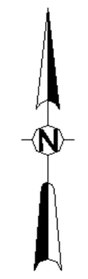
Z-Score

Radiological Sample Location

Chemical Sample Location

SU 5 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-5 SUPPLEMENTAL

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.5a

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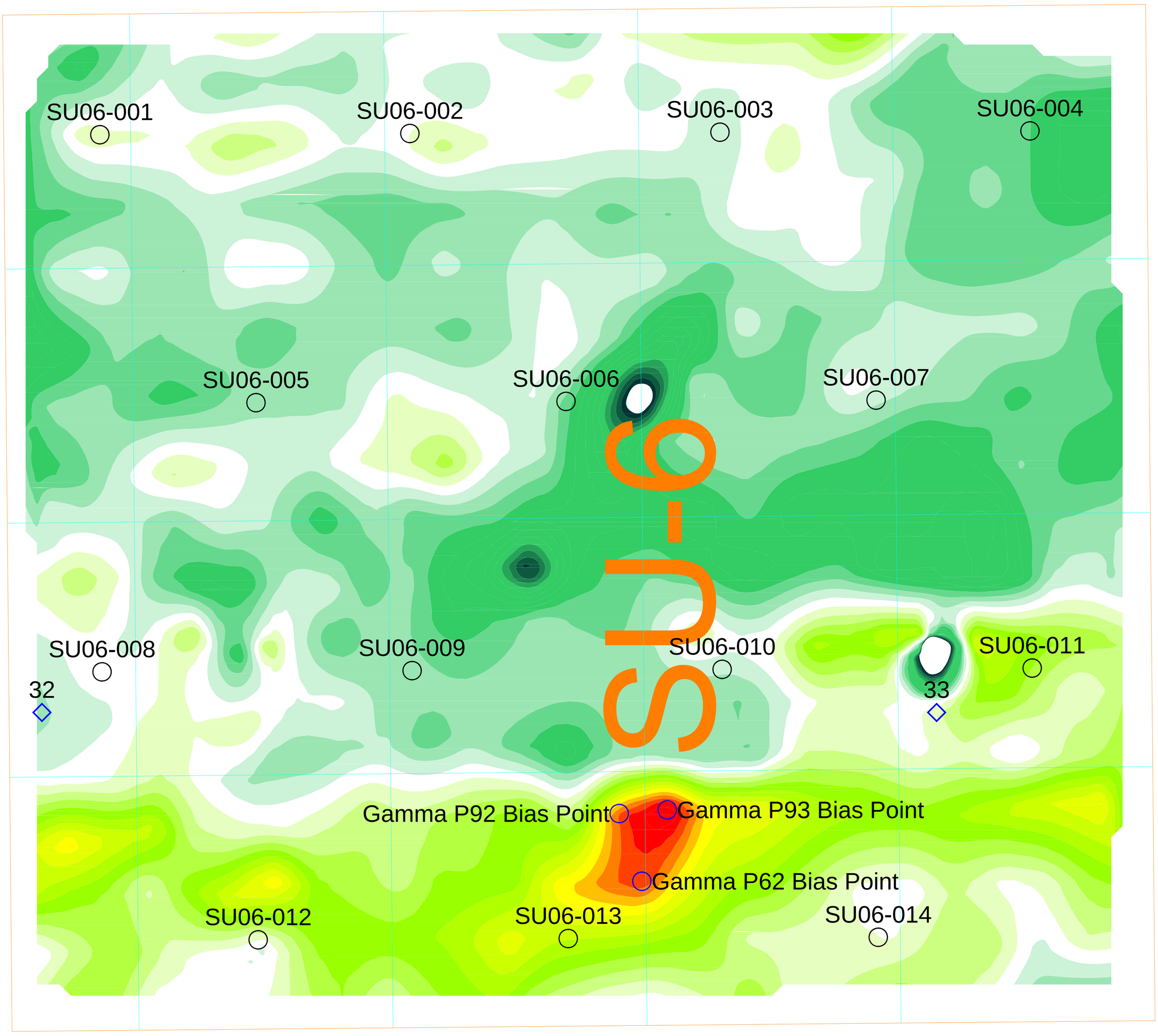


LEGEND AND NOTES

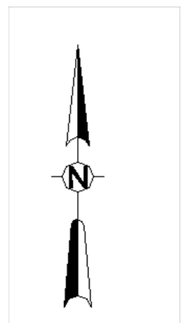
Z-Score

Radiological Sample Location

Chemical Sample Location

SU 6 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-6

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.6

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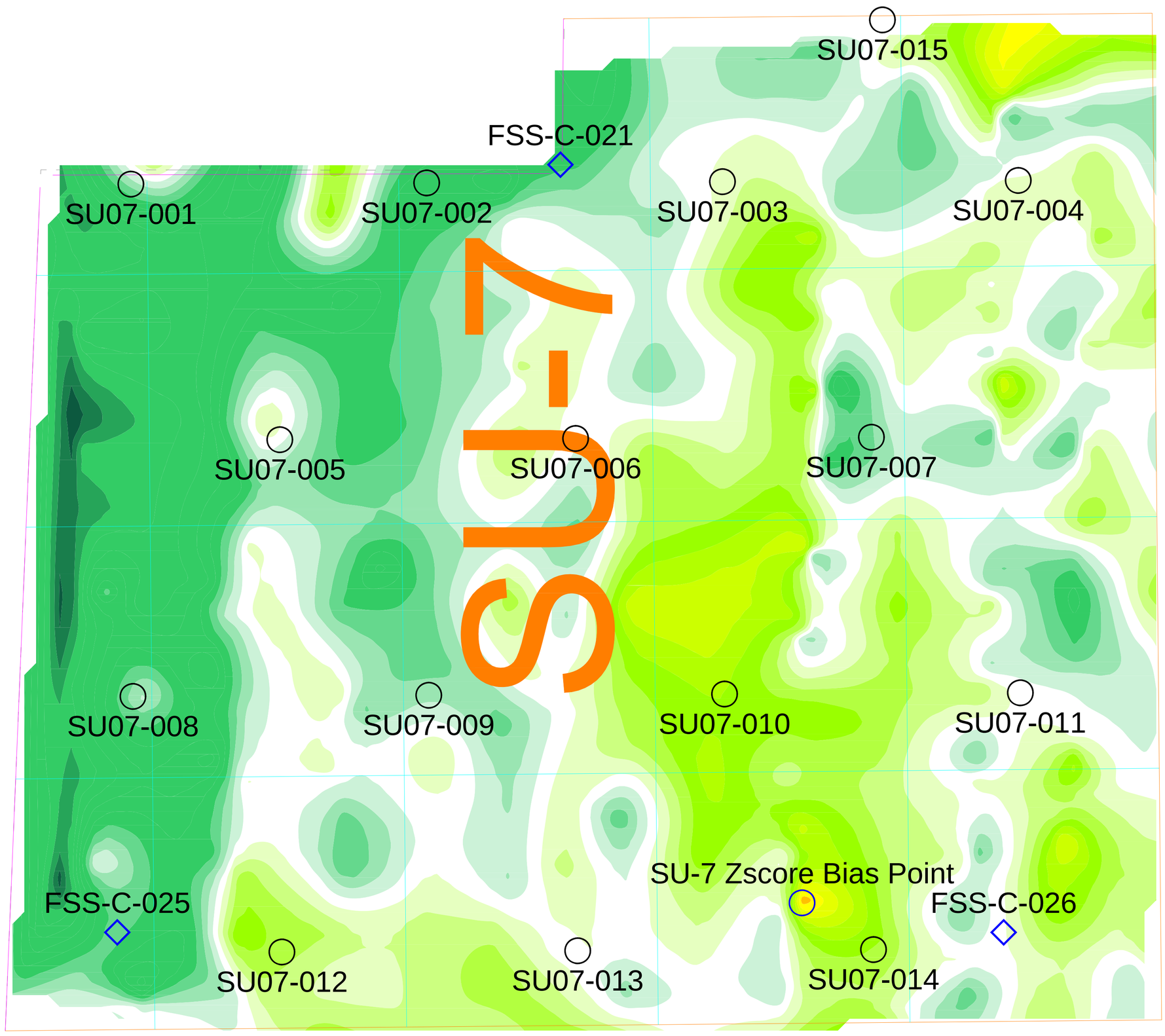


LEGEND AND NOTES

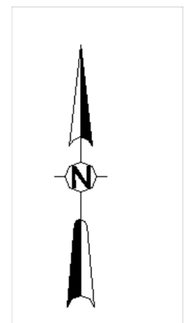


Radiological Sample Location

Chemical Sample Location

SU 7 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-7

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.7

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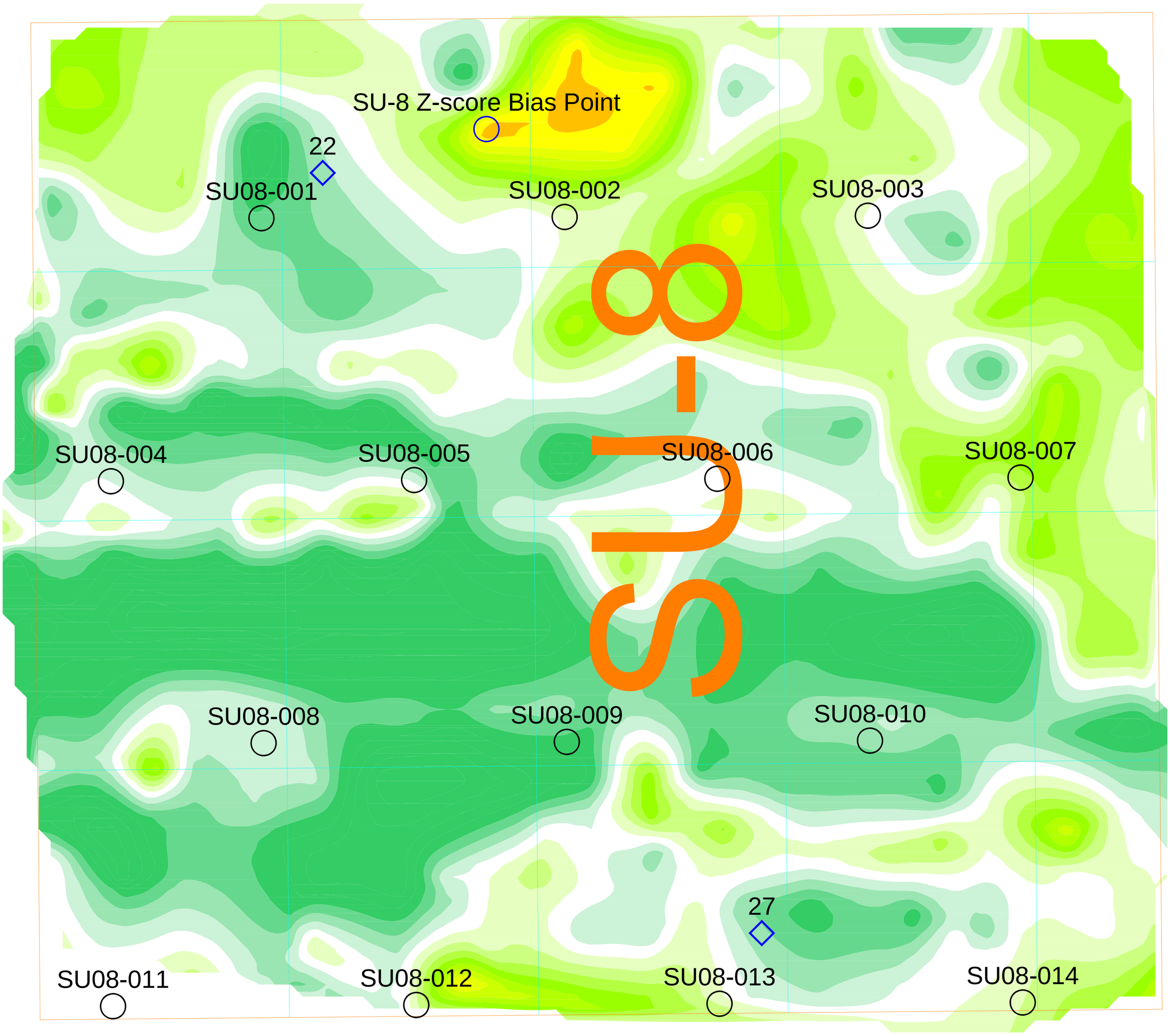
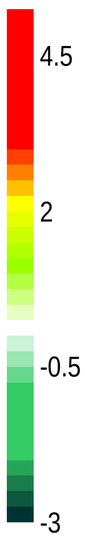


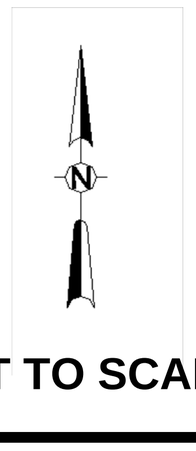
LEGEND AND NOTES



Z-Score

- Radiological Sample Location
- Chemical Sample Location
- SU 8 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-8

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.8

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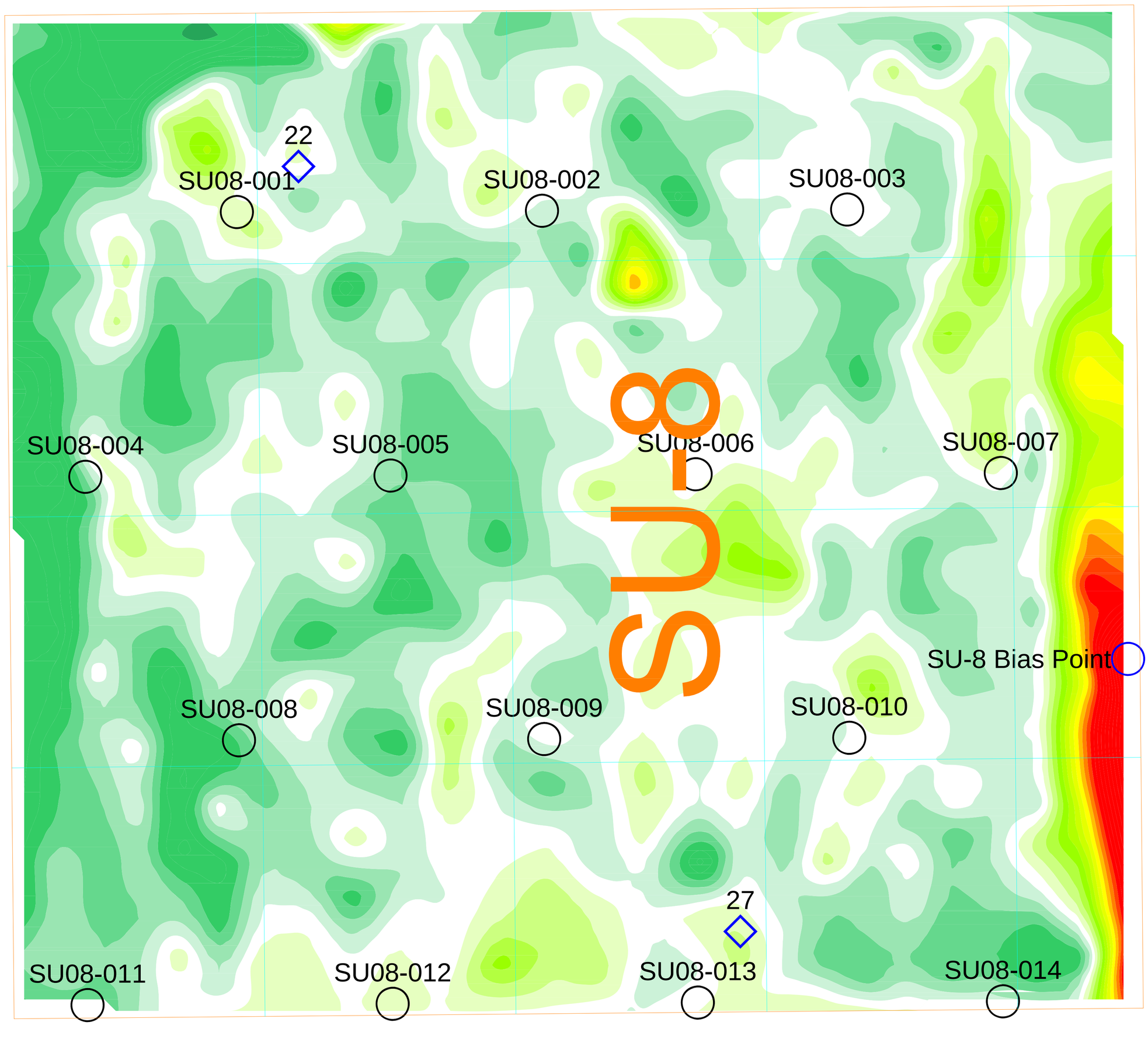

LEGEND AND NOTES

4.5

2

-0.5

-3

Z-Score

Radiological Sample Location

Chemical Sample Location

SU 8 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-8 SUPPLEMENTAL

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.8a

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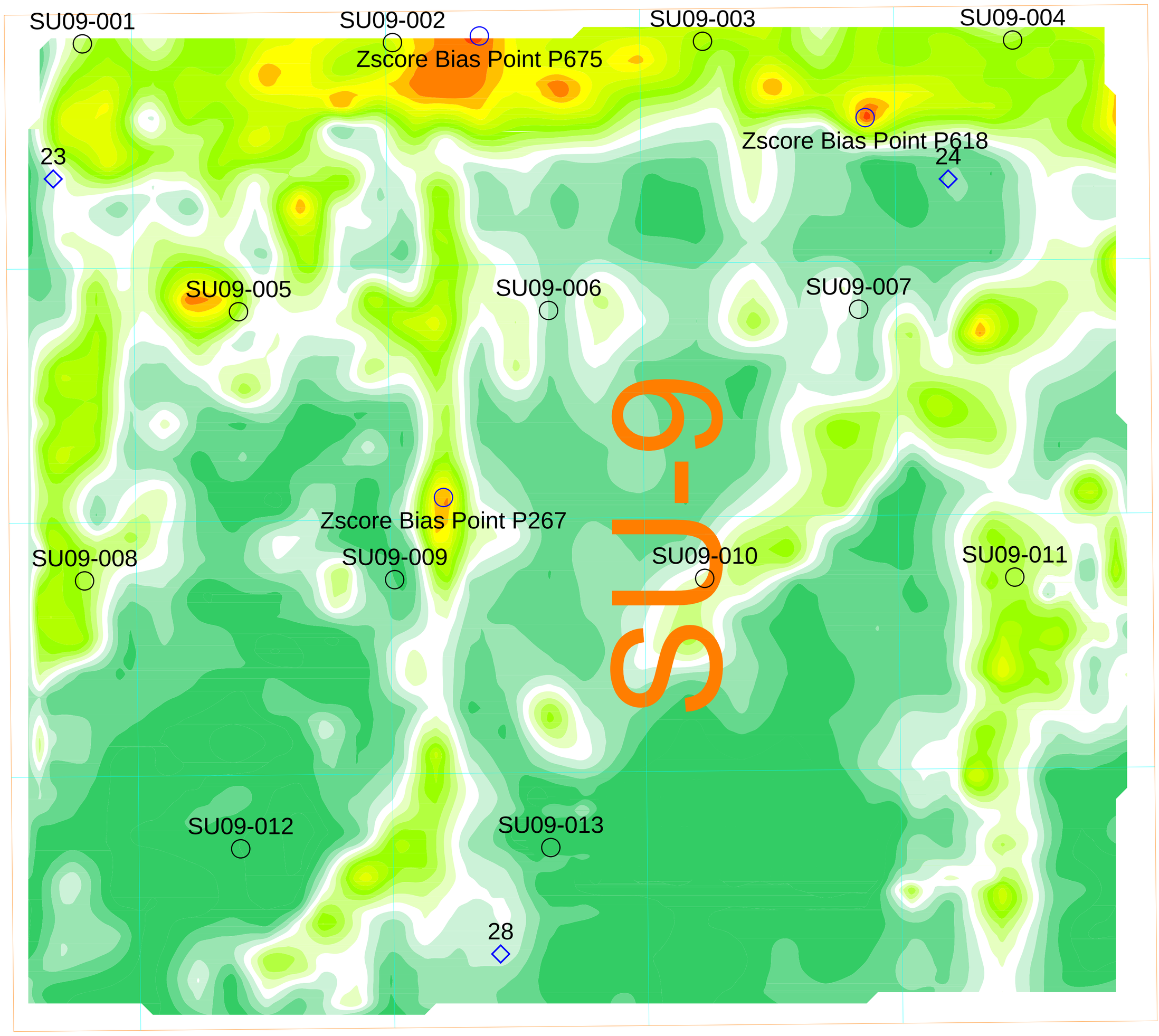


LEGEND AND NOTES

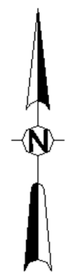


Radiological Sample Location

Chemical Sample Location

SU 9 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-9

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.9

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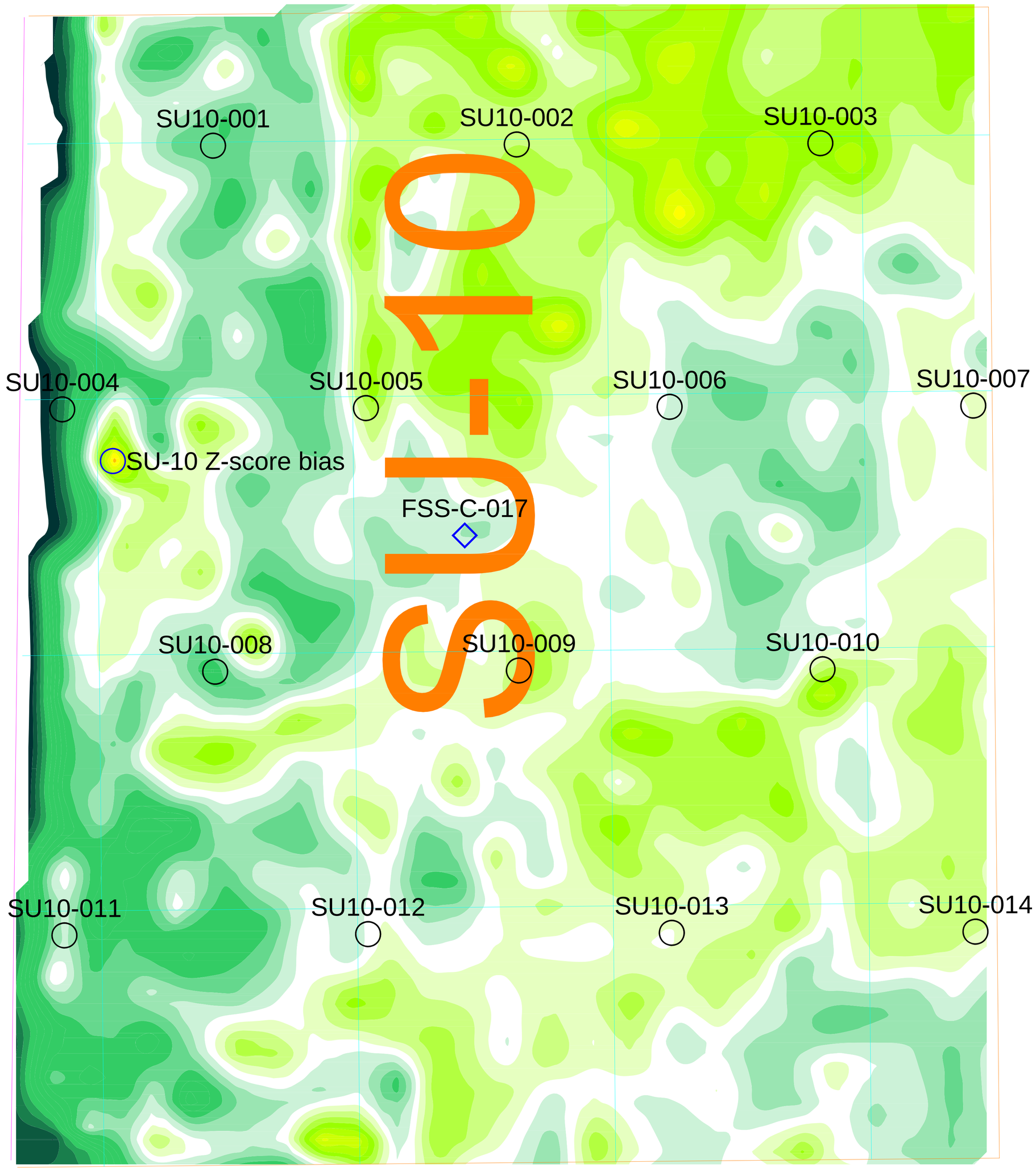

LEGEND AND NOTES

4.5
2
-0.5
-3
Z-Score

Radiological Sample Location

Chemical Sample Location

SU10 Zscore Bias Point

NOT TO SCALE

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-10

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.10

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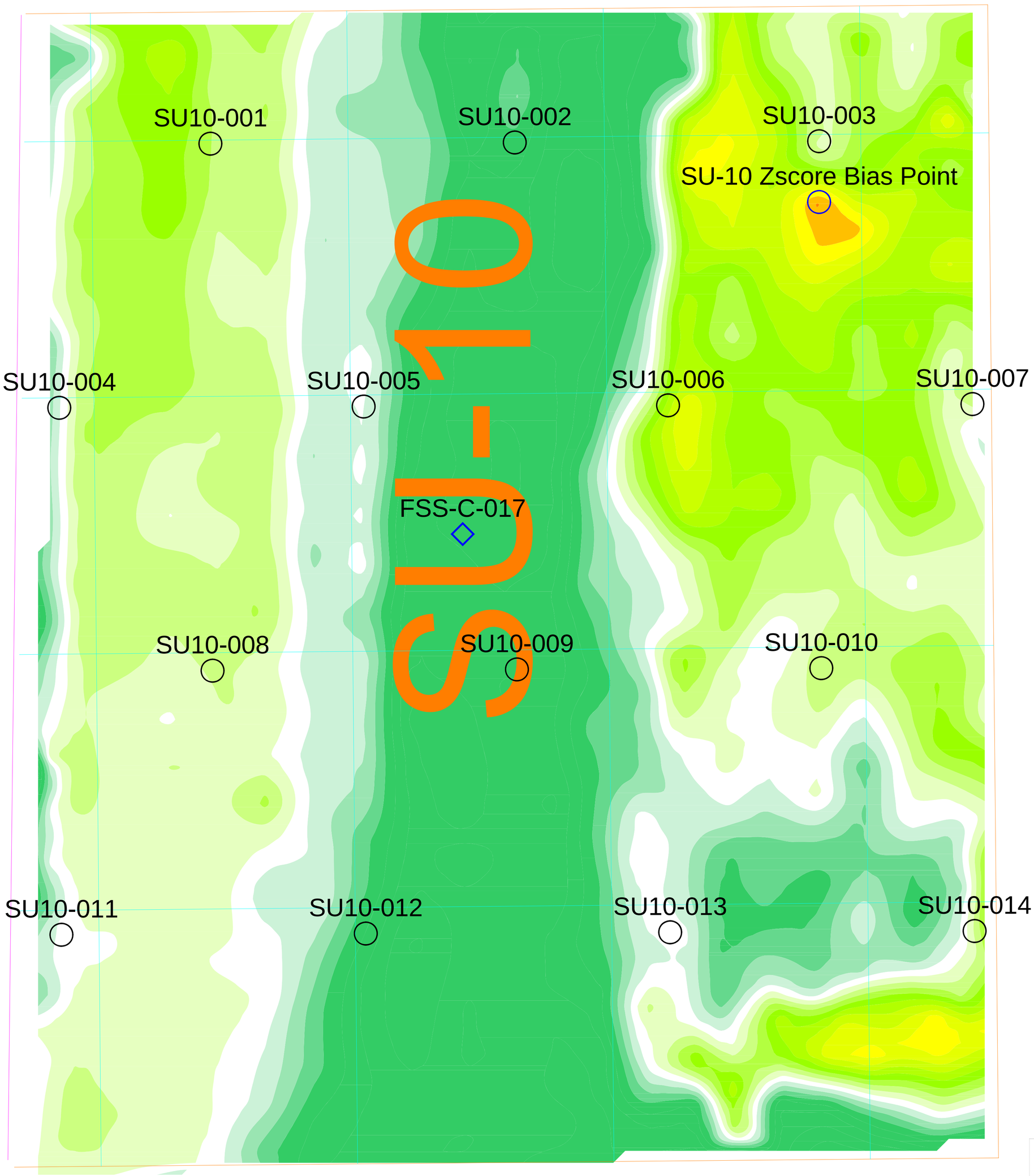

LEGEND AND NOTES

4.5

2

-0.5

-3

Z-Score

Radiological Sample Location

Chemical Sample Location

SU10 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-10 SUPPLEMENTAL

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.10a

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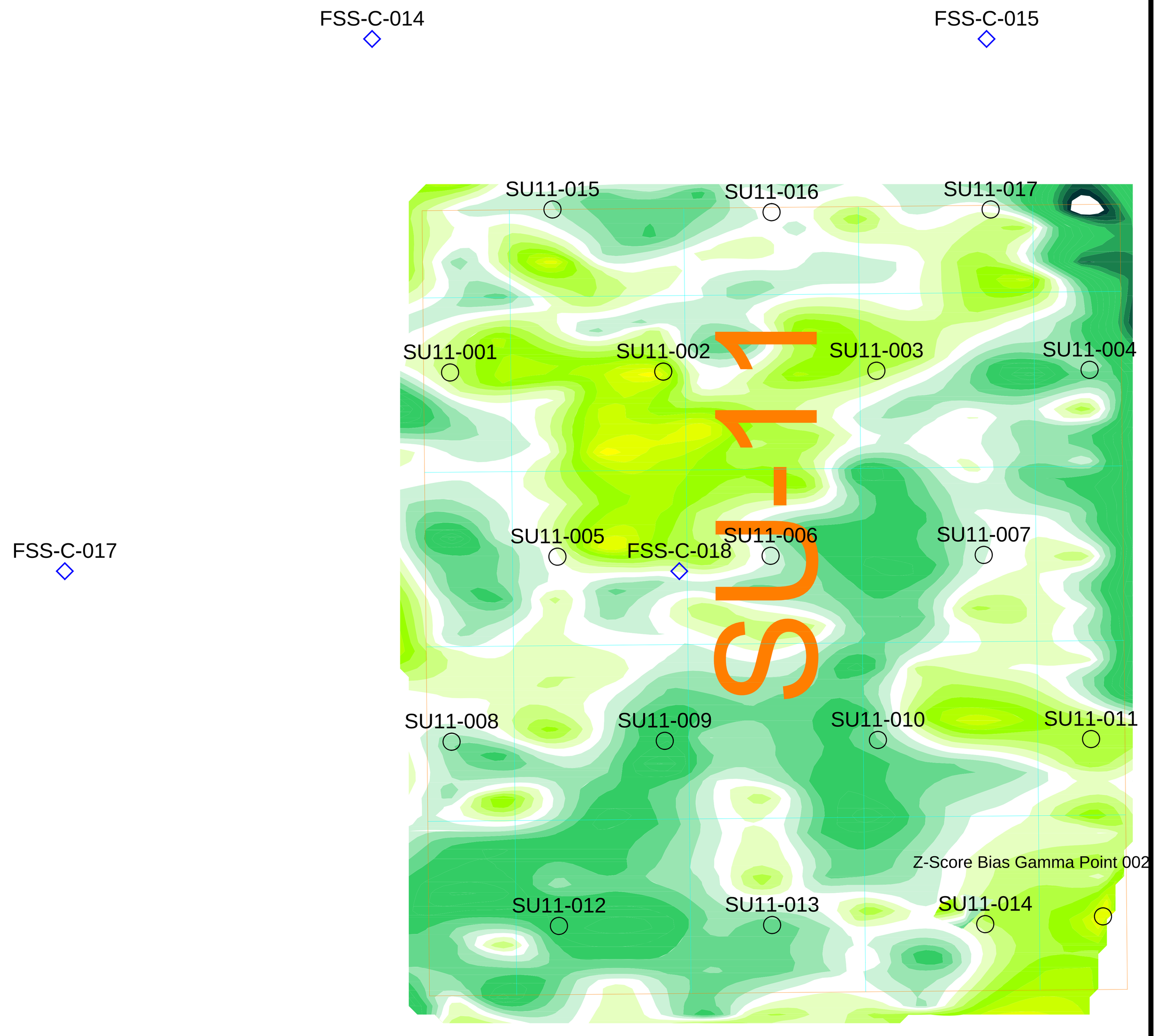
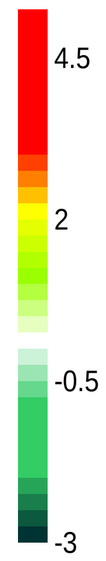


LEGEND AND NOTES

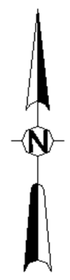


Radiological Sample Location

Chemical Sample Location

SU-11 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-11

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.11

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FSS-C-014

FSS-C-015

SU11-015

SU11-016

SU11-017

SU11-001

SU11-002

SU11-003

SU11-004

FSS-C-017

SU11-005

FSS-C-018

SU11-006

SU11-007

SU11-008

SU11-009

SU11-010

SU11-011

SU11-012

SU11-013

SU11-014

SU-11 Z-score bias

LEGEND AND NOTES

4.5

2

-0.5

-3

Z-Score

Radiological Sample Location

Chemical Sample Location

SU 11 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.

MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-11 SUPPLEMENTAL

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.11a

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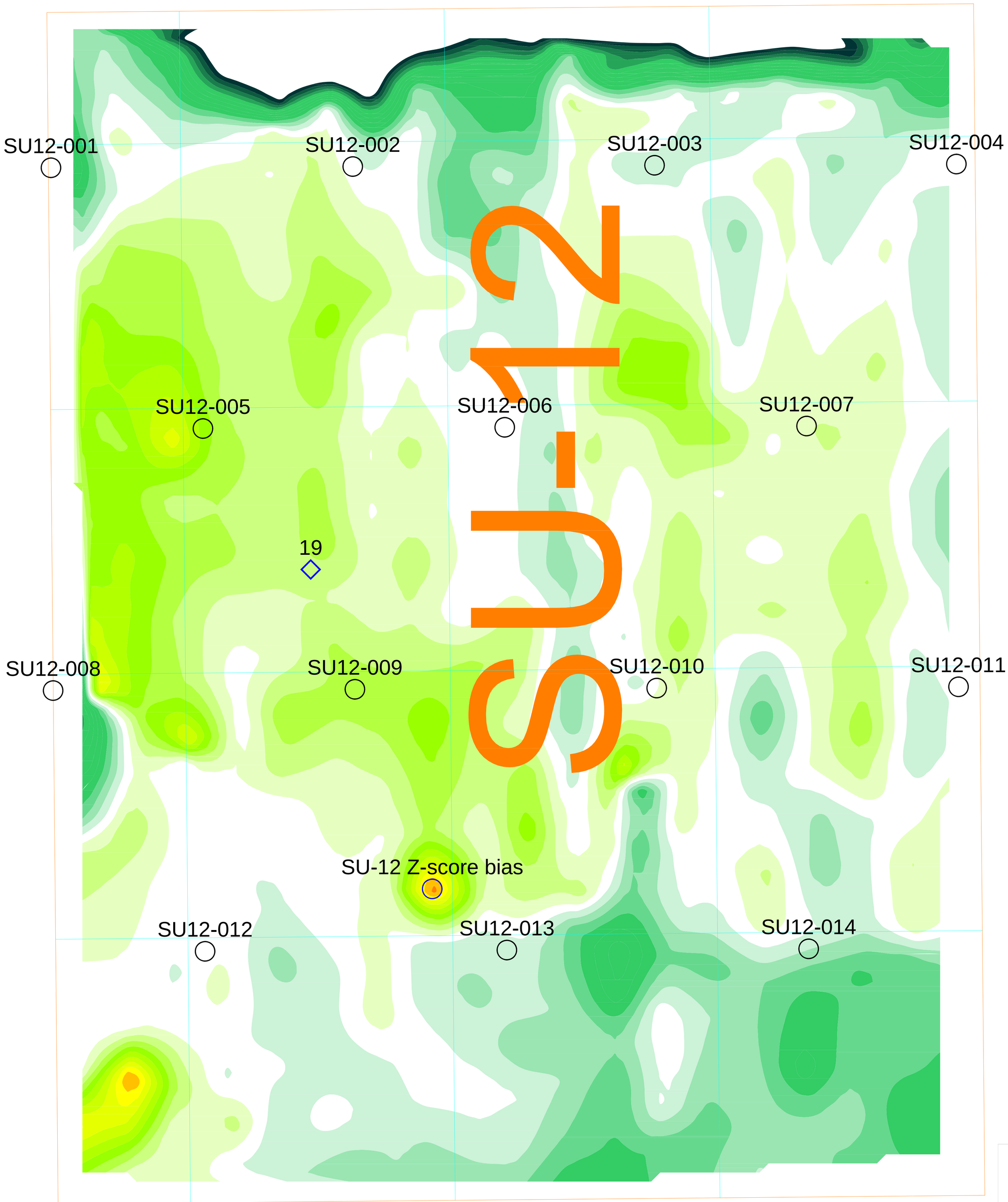

LEGEND AND NOTES

4.5
2
-0.5
-3
Z-Score

Radiological Sample Location

Chemical Sample Location

SU 12 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-12

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.12

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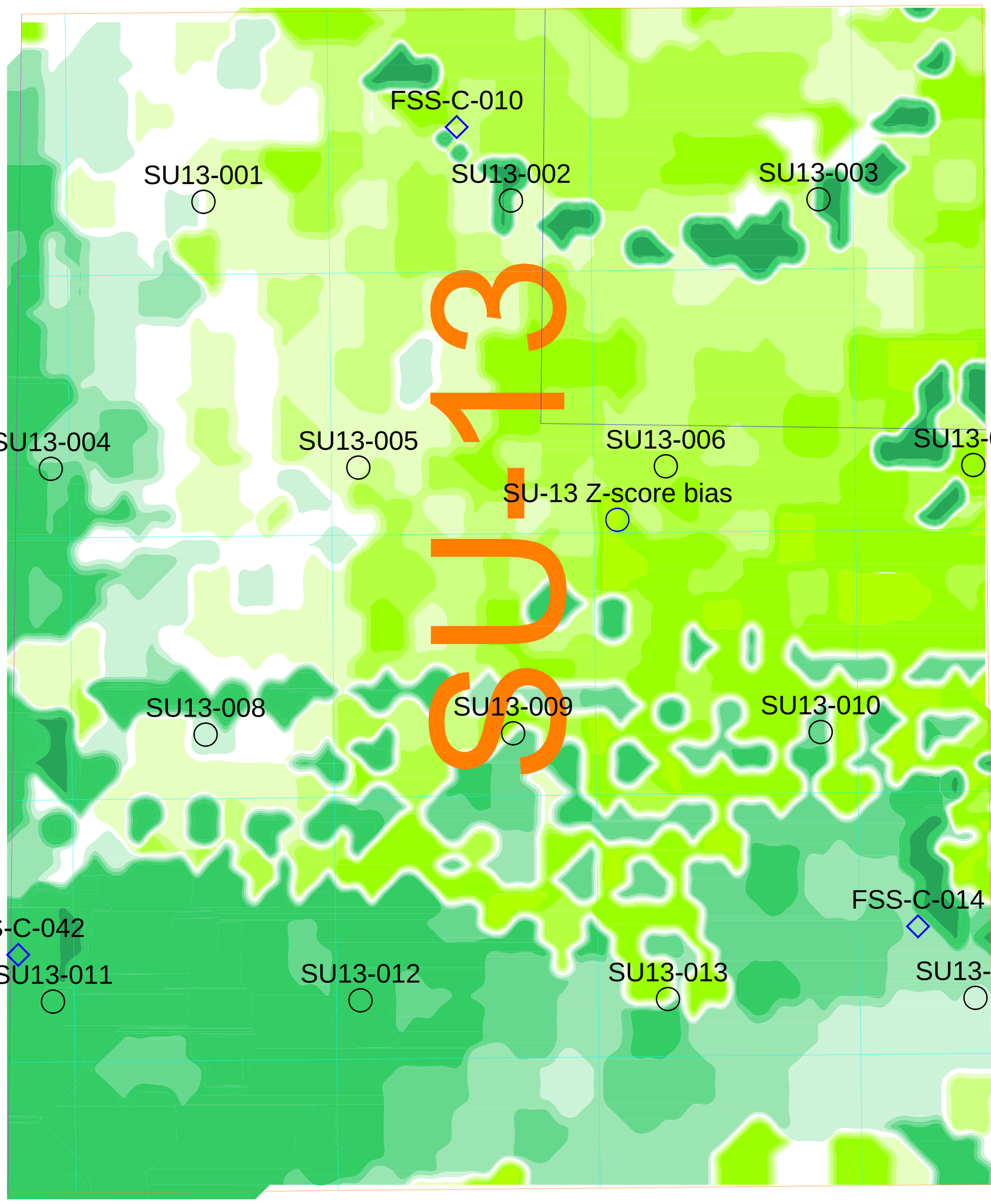

LEGEND AND NOTES

4.5

2

-0.5

-3

Z-Score

Radiological Sample Location

Chemical Sample Location

SU13 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-13

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.13

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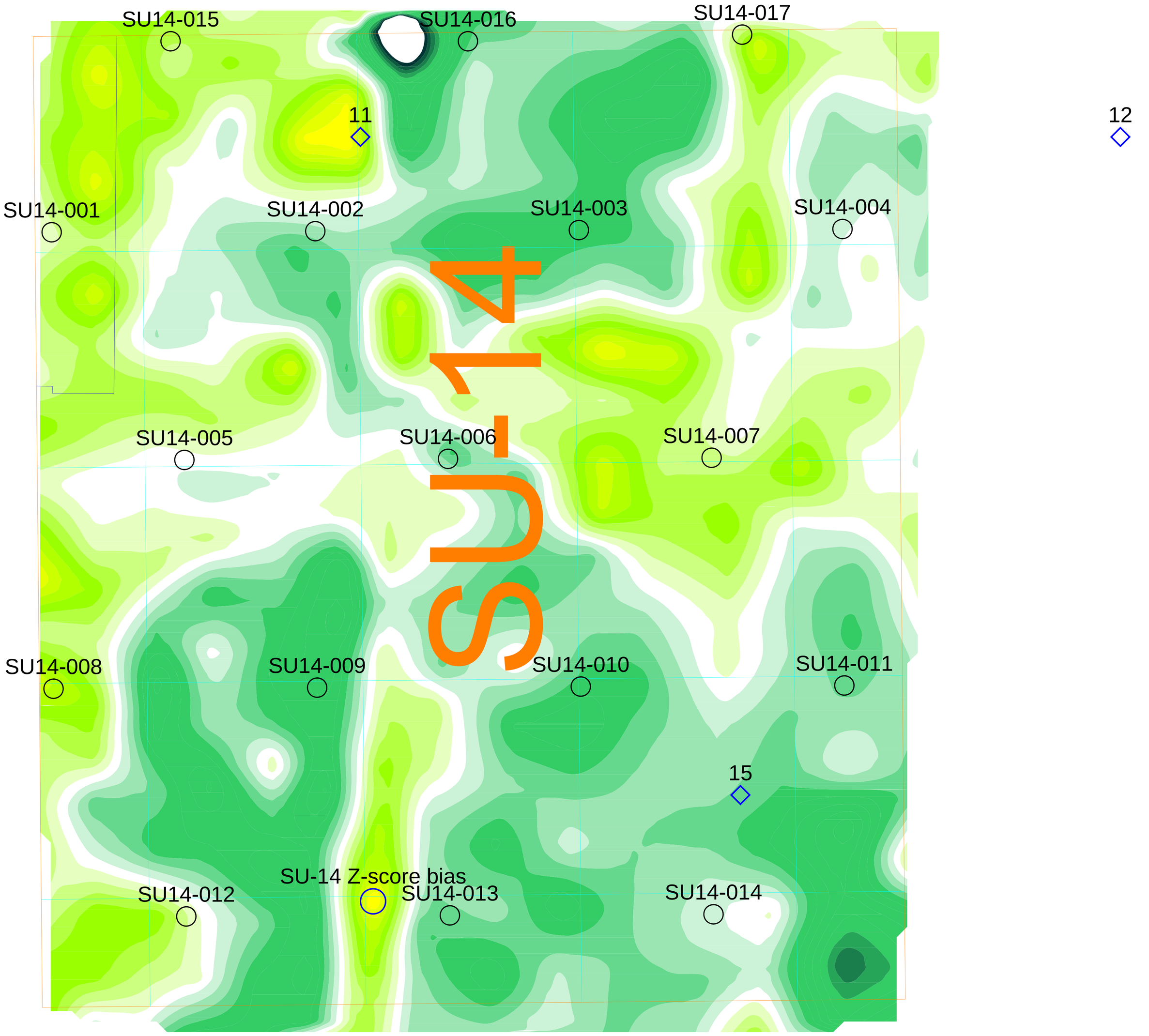

LEGEND AND NOTES

2

-0.5

-3

Z-Score

◯ Radiological Sample Location

◇ Chemical Sample Location

◯ SU 14 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-14

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.14

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SU14-015
SU14-016
SU14-017
11
12
SU14-001
SU14-002
SU14-003
SU14-004
SU-14 Z-score bias
SU14
SU14-005
SU14-006
SU14-007
SU14-008
SU14-009
SU14-010
SU14-011
14
15
SU14-012
SU14-013
SU14-014

LEGEND AND NOTES

4.5
2
-0.5
-3
Z-Score

Radiological Sample Location

Chemical Sample Location

SU 14 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-14 SUPPLEMENTAL

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.14a

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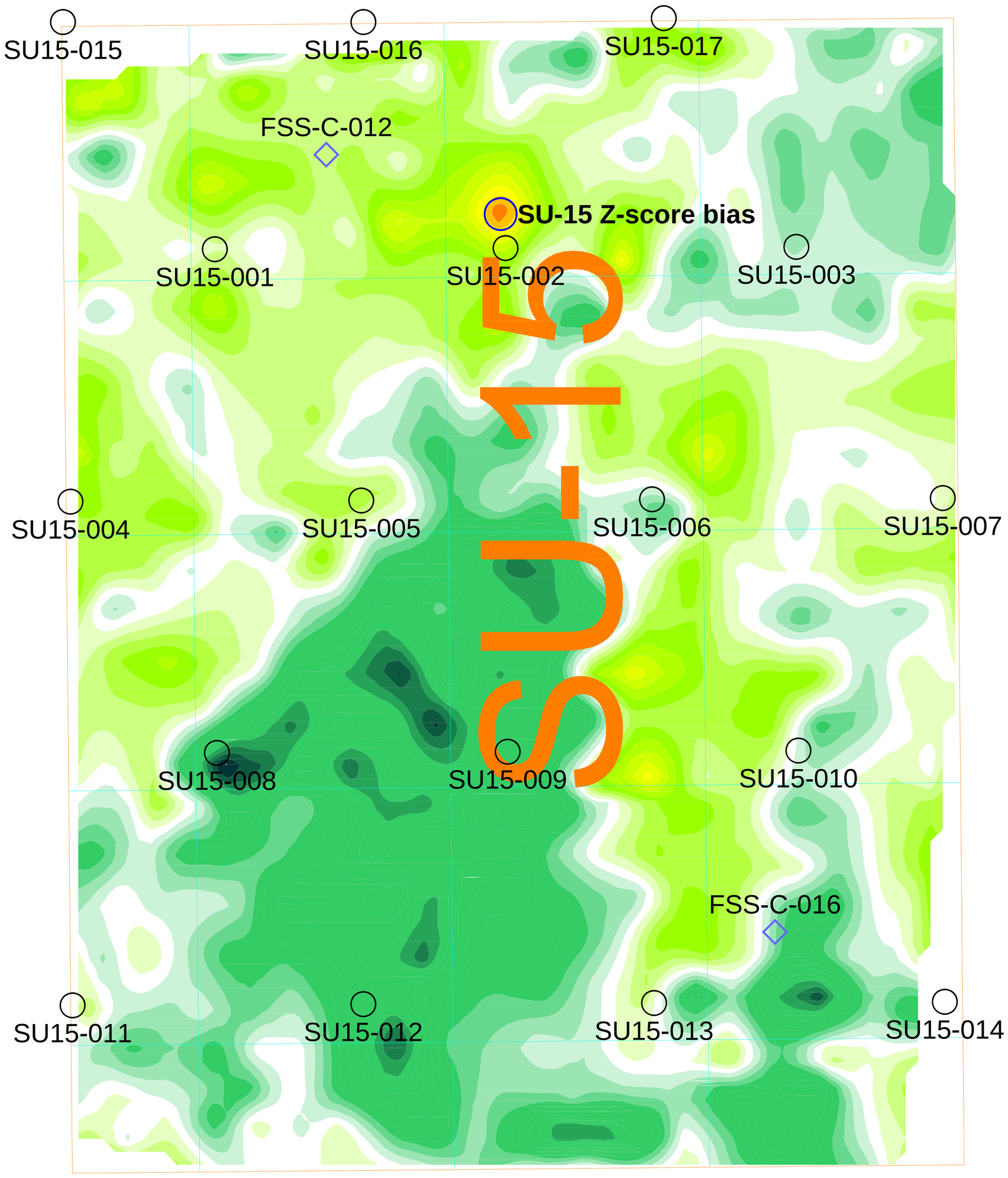


LEGEND AND NOTES

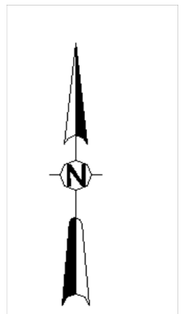


◯ Radiological Sample Location

◇ Chemical Sample Location

○ SU 15 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-15

US Army Corps of Engineers
New York District

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Figure 5- 4.15

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4

5

SU16-015

SU16-001

SU16-002

SU16-003

SU16-004

SU16-005

41

7

SU-16 Z-score bias

SU16-006

SU16-007

SU16-008

SU16-009

SU16-010

SU16-011

SU16-012

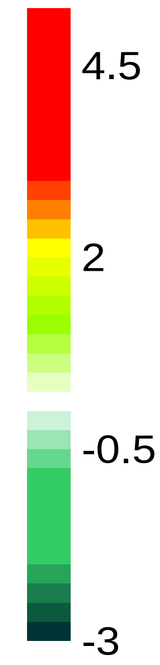
SU16-013

SU16-014

10

11

LEGEND AND NOTES



Z-Score

Radiological Sample Location

Chemical Sample Location

SU 16 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-16

US Army Corps of Engineers
New York District

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PROJ: W912DQ-04-D-0017

Figure 5- 4.16

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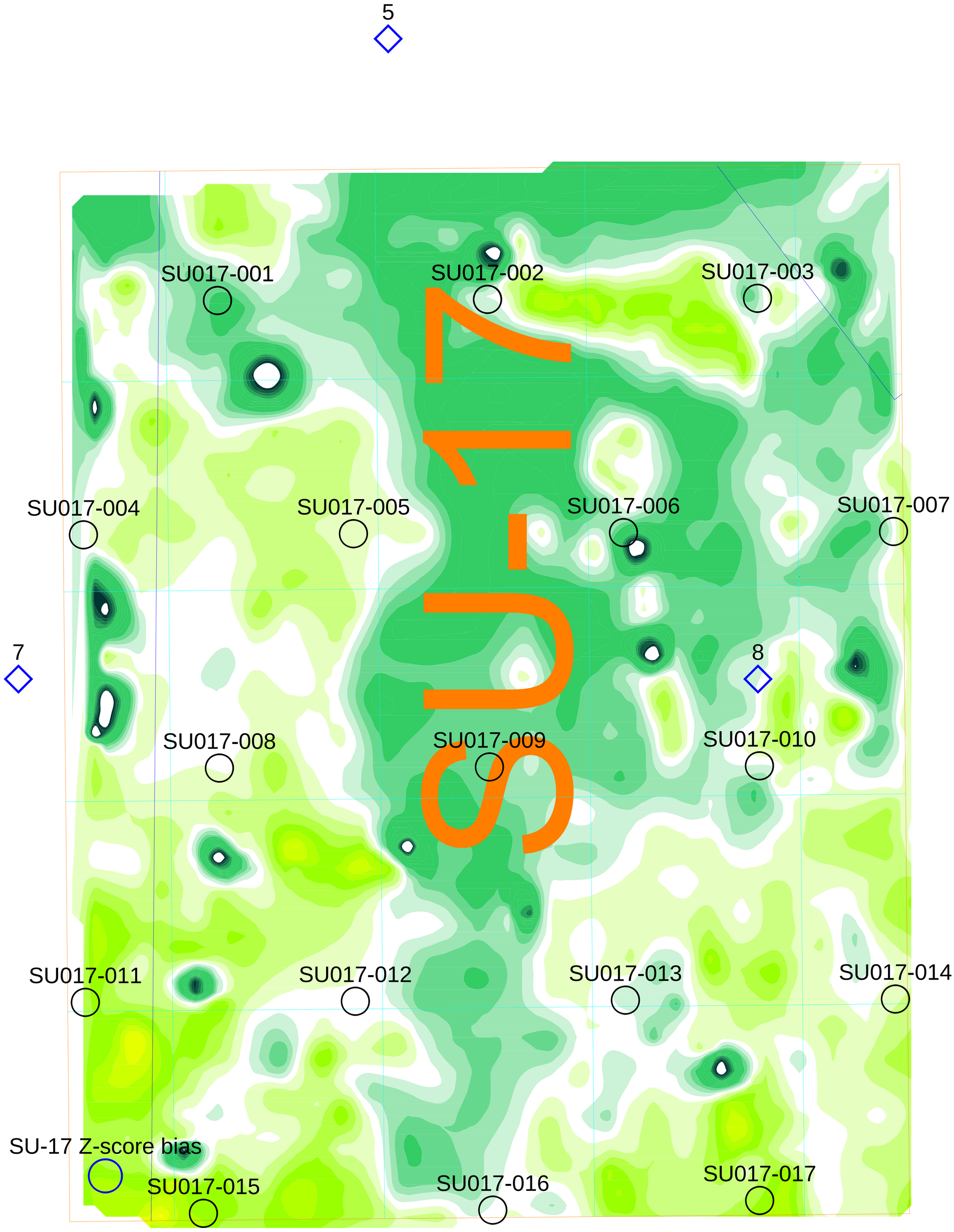

LEGEND AND NOTES



Z-Score

Radiological Sample Location

Chemical Sample Location

SU 17 Zscore Bias Point

11

NOT TO SCALE

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-17

US Army Corps of Engineers
New York District

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.17

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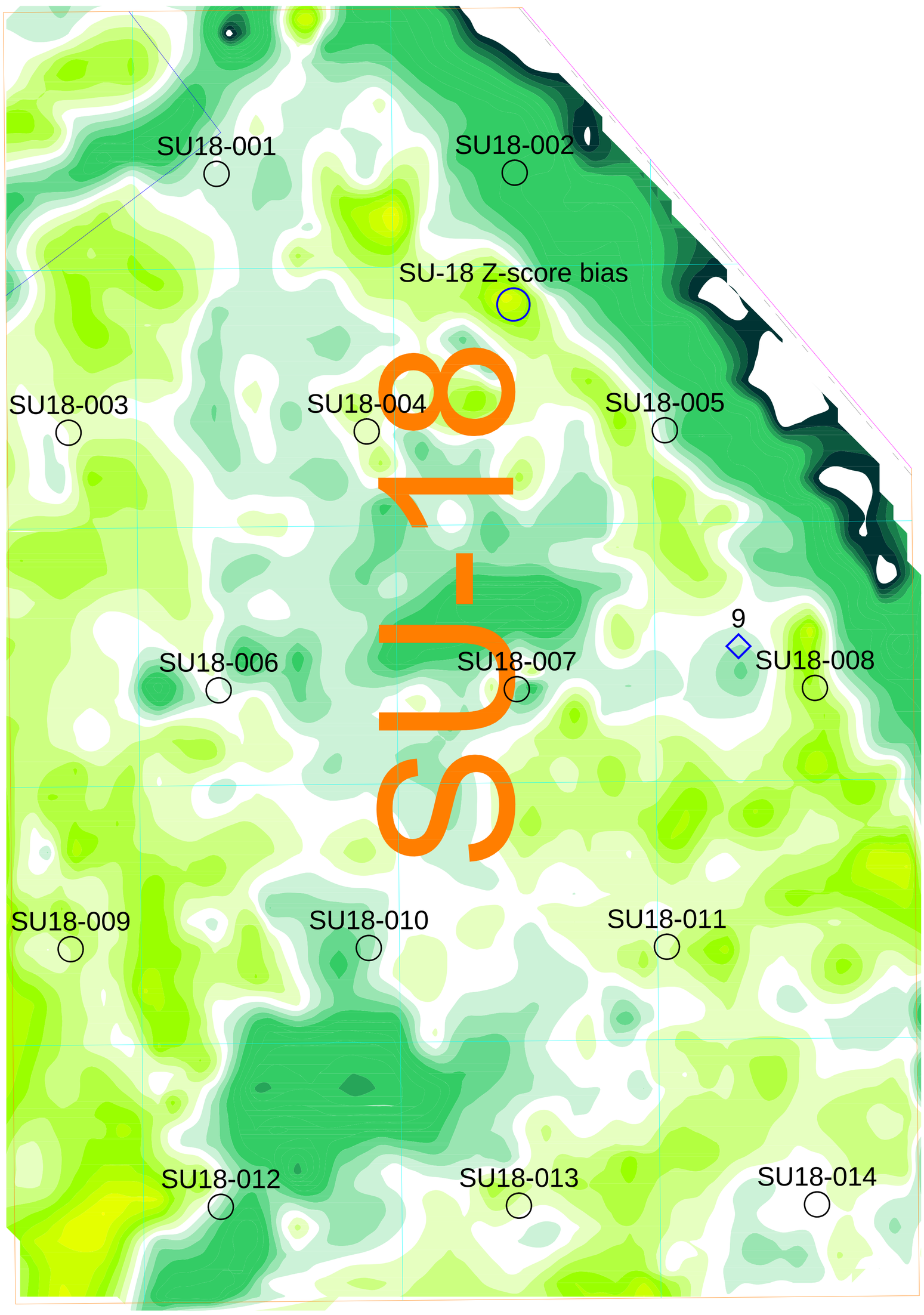

12

13

LEGEND AND NOTES



Z-Score

Radiological Sample Location

Chemical Sample Location

SU18 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-18

US Army Corps of Engineers
New York District

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PROJ: W912DQ-04-D-0017

Figure 5- 4.18

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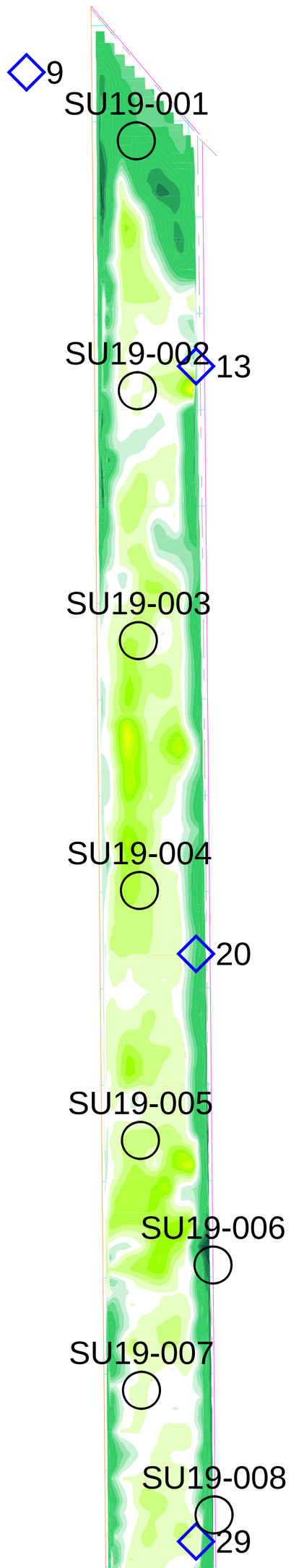


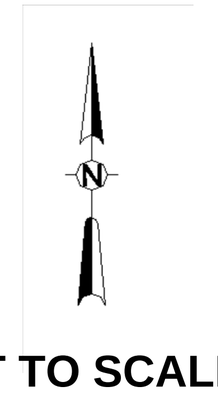
LEGEND AND NOTES

Radiological Sample Location

Chemical Sample Location

SU19 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-19

US Army Corps of Engineers
New York District

FUSRAP

DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.19

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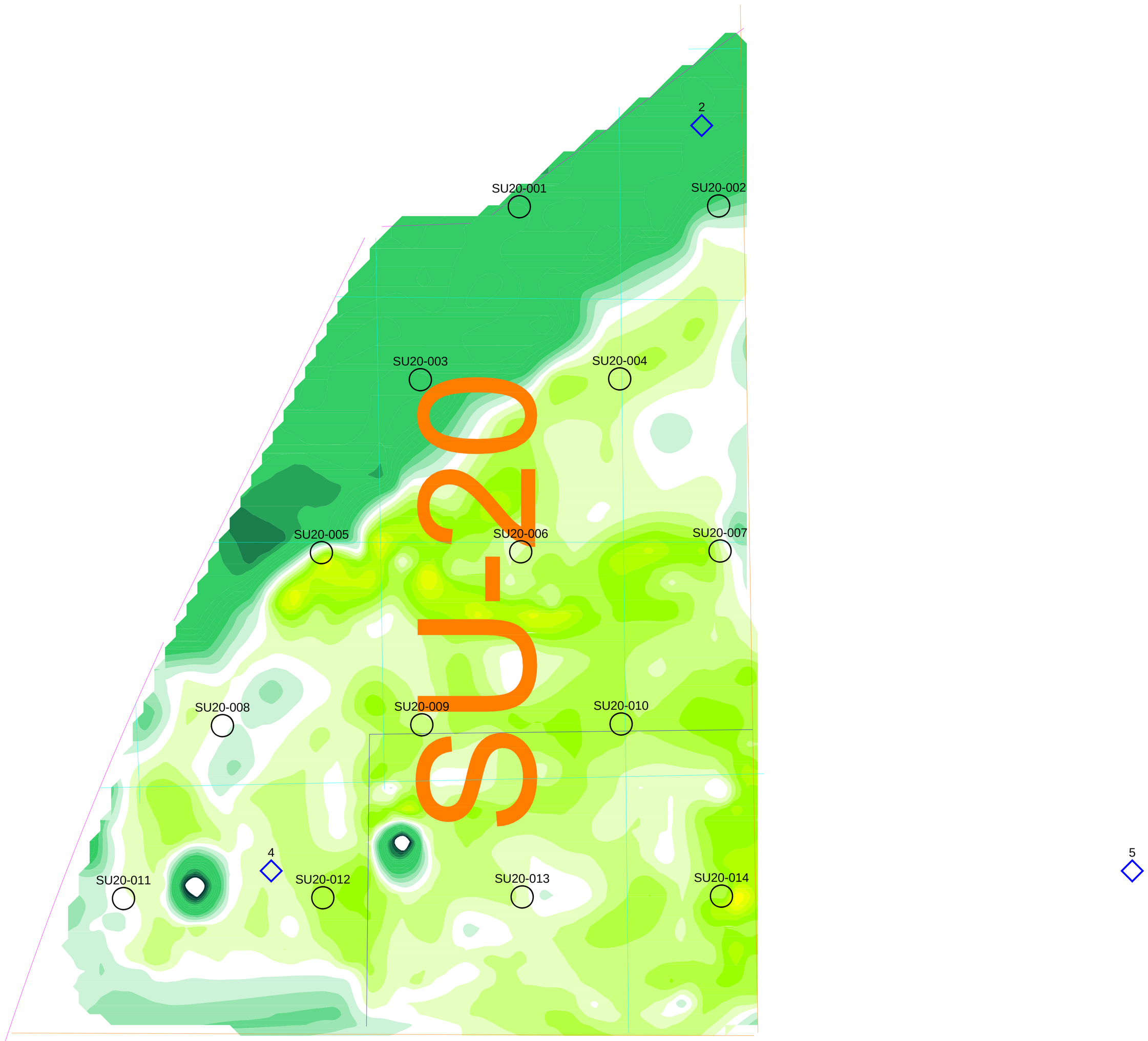
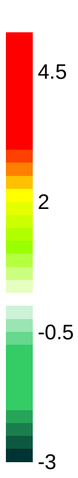


LEGEND AND NOTES

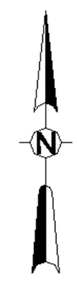


Z-Score

Radiological Sample Location

Chemical Sample Location

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-20

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New York District

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Figure 5- 4.20

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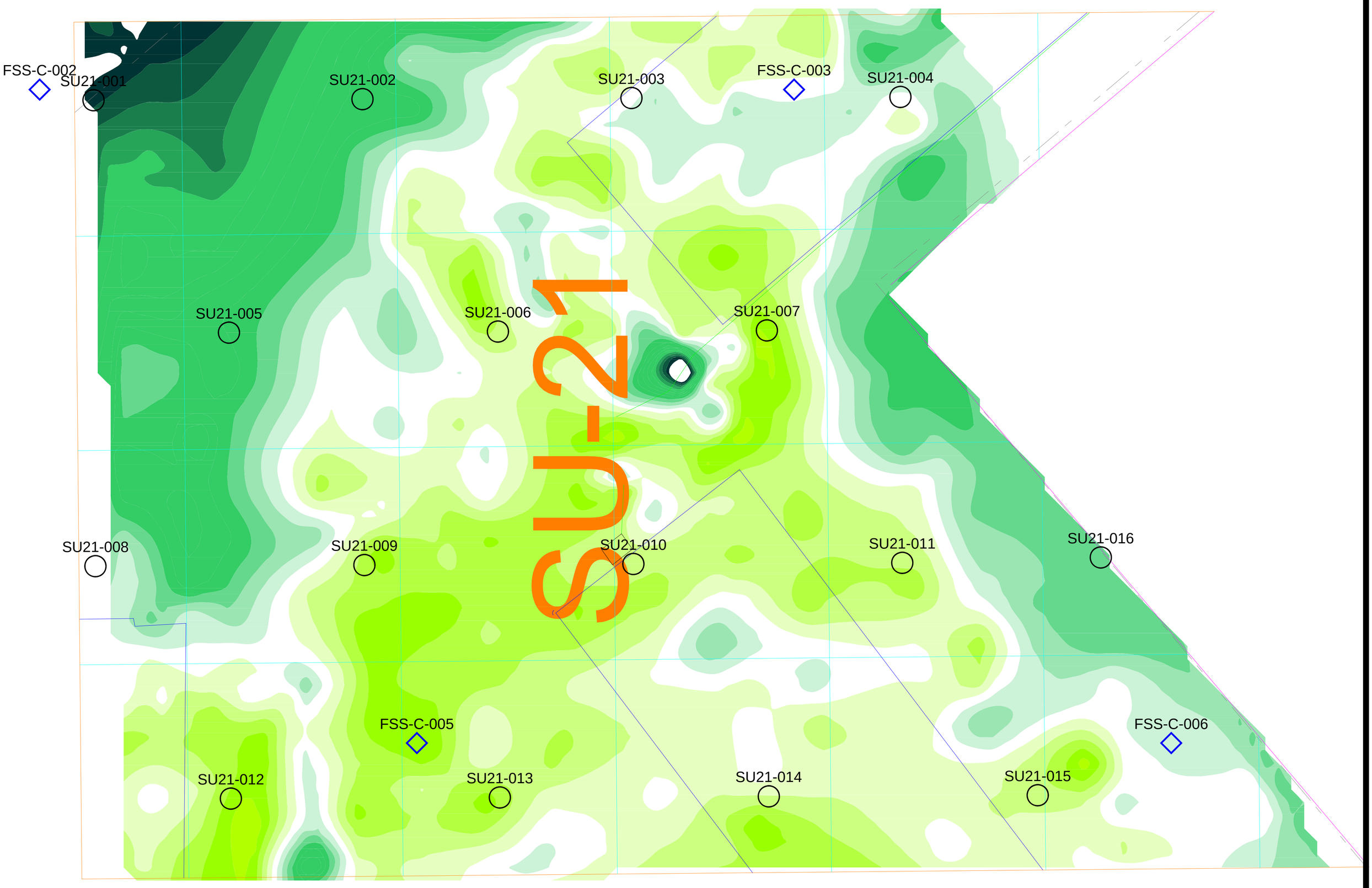


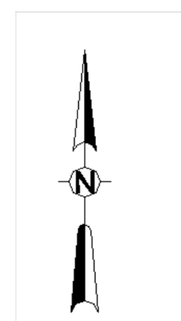
LEGEND AND NOTES

Z-Score

◯ Radiological Sample Location

◇ Chemical Sample Location

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm



NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-21

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Figure 5- 4.21

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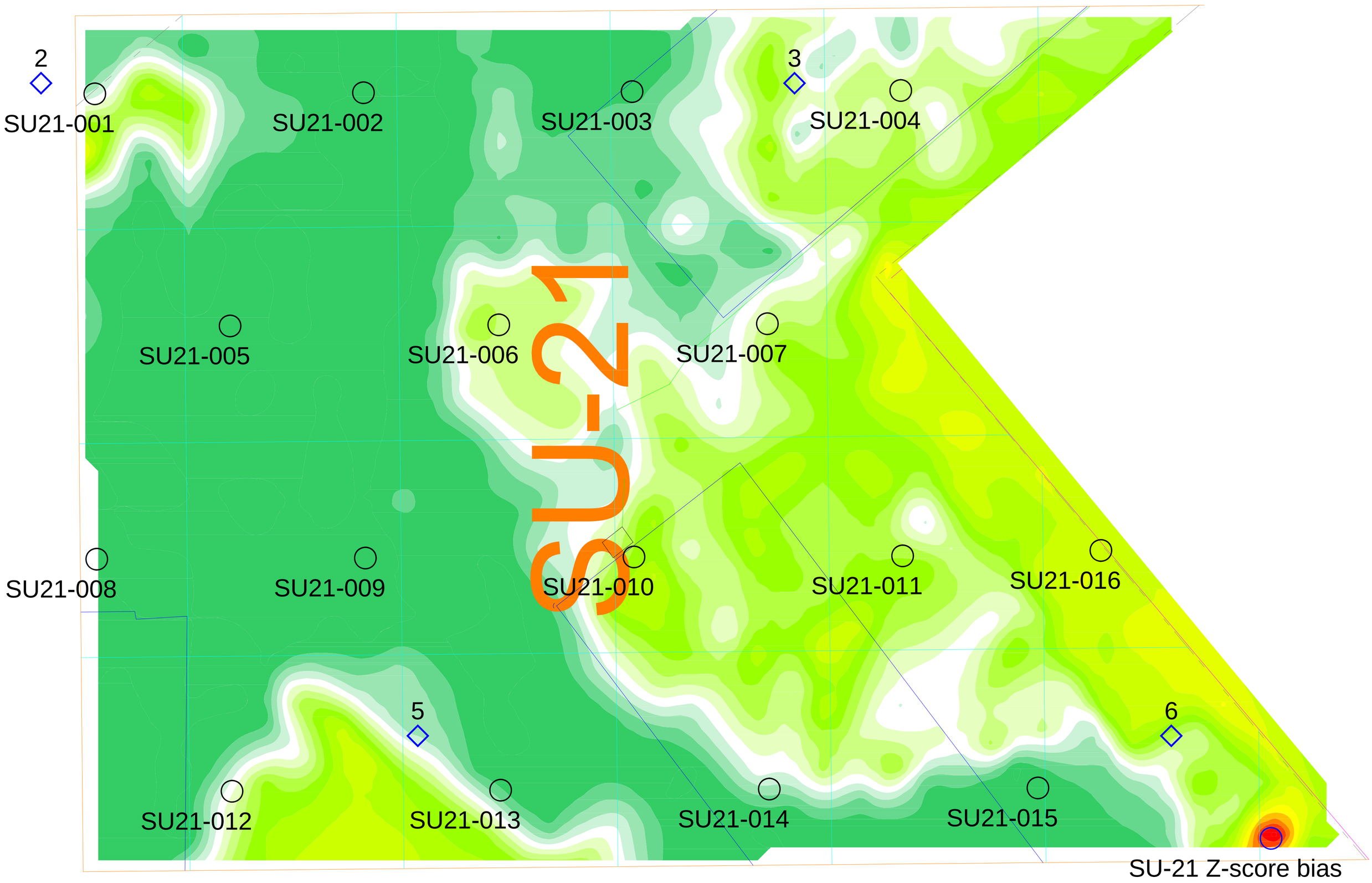

LEGEND AND NOTES

4.5

2

-0.5

-3

Z-Score

Radiological Sample Location

Chemical Sample Location

SU 21 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-21 SUPPLEMENTAL

US Army Corps of Engineers
New York District

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Figure 5- 4.21a

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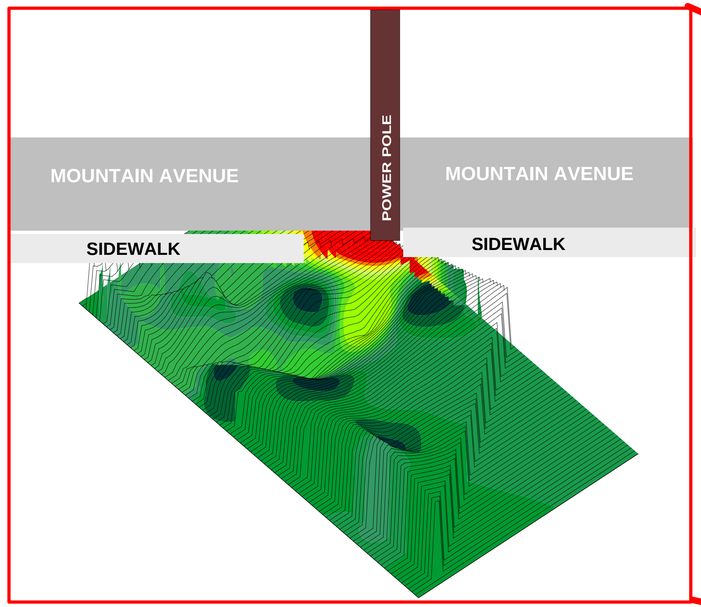
LEGEND

60
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4

uR/hr

◇ Radiological Sample Location



EXPANDED 3D VIEW OF POWER POLE EMC AREA

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-22

US Army Corps of Engineers
New York District

DATE:

PROJ: W912DQ-04-D-0017

Figure 5- 4.22

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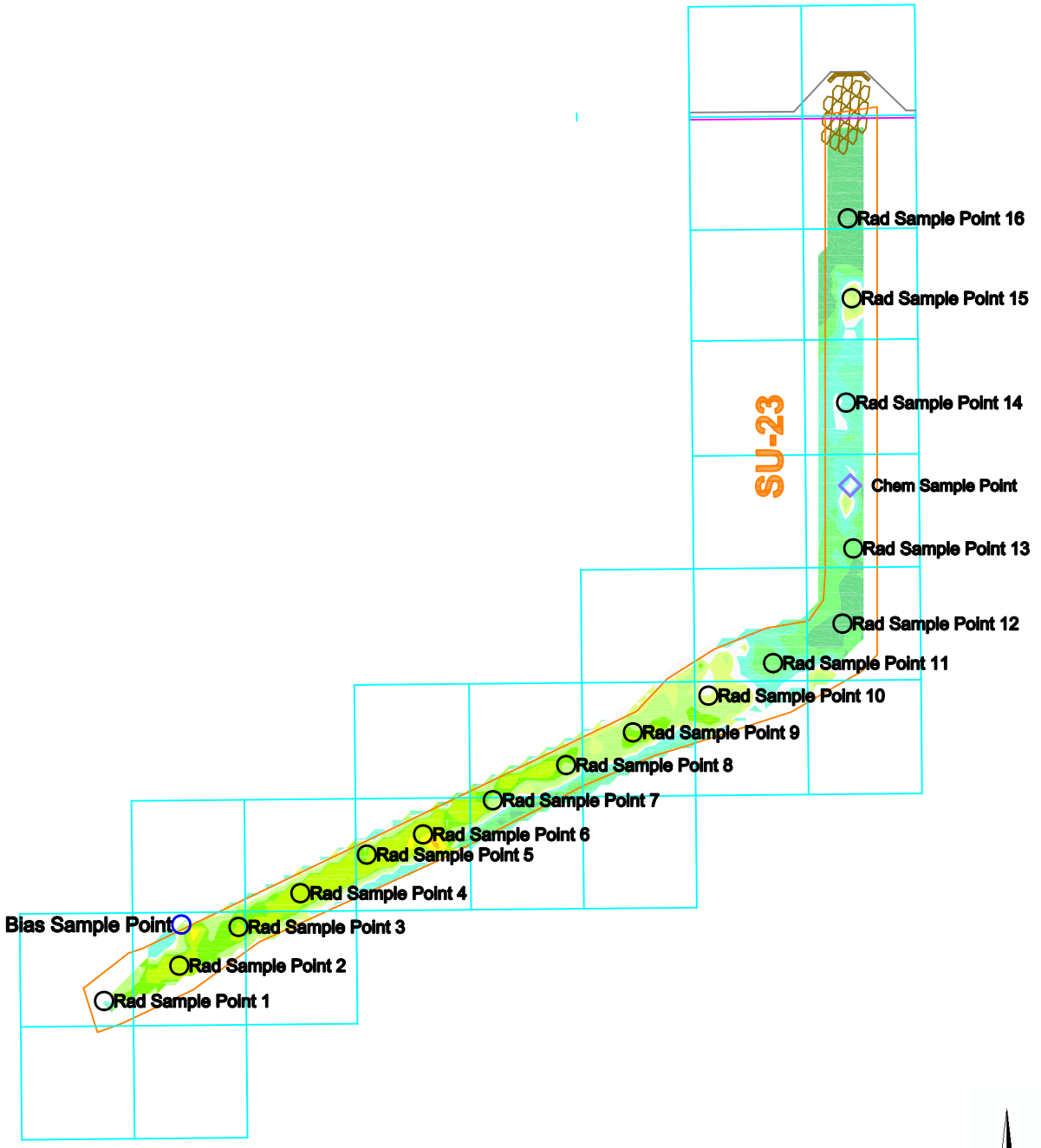
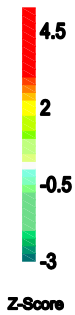


NOT TO SCALE

LEGEND AND NOTES



- Radiological Sample Location
- Chemical Sample Location
- SU-23 Zscore Bias Point

NOTE 1: Data Contour Map Generated Using Natural Neighbor, Default Algorithm

MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

GAMMA WALKOVER SURVEY RESULTS SU-23

US Army Corps of Engineers
New York District

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DATE: 10/22/2008

PROJ: W912DQ-04-D-0017

Figure 5- 4.23

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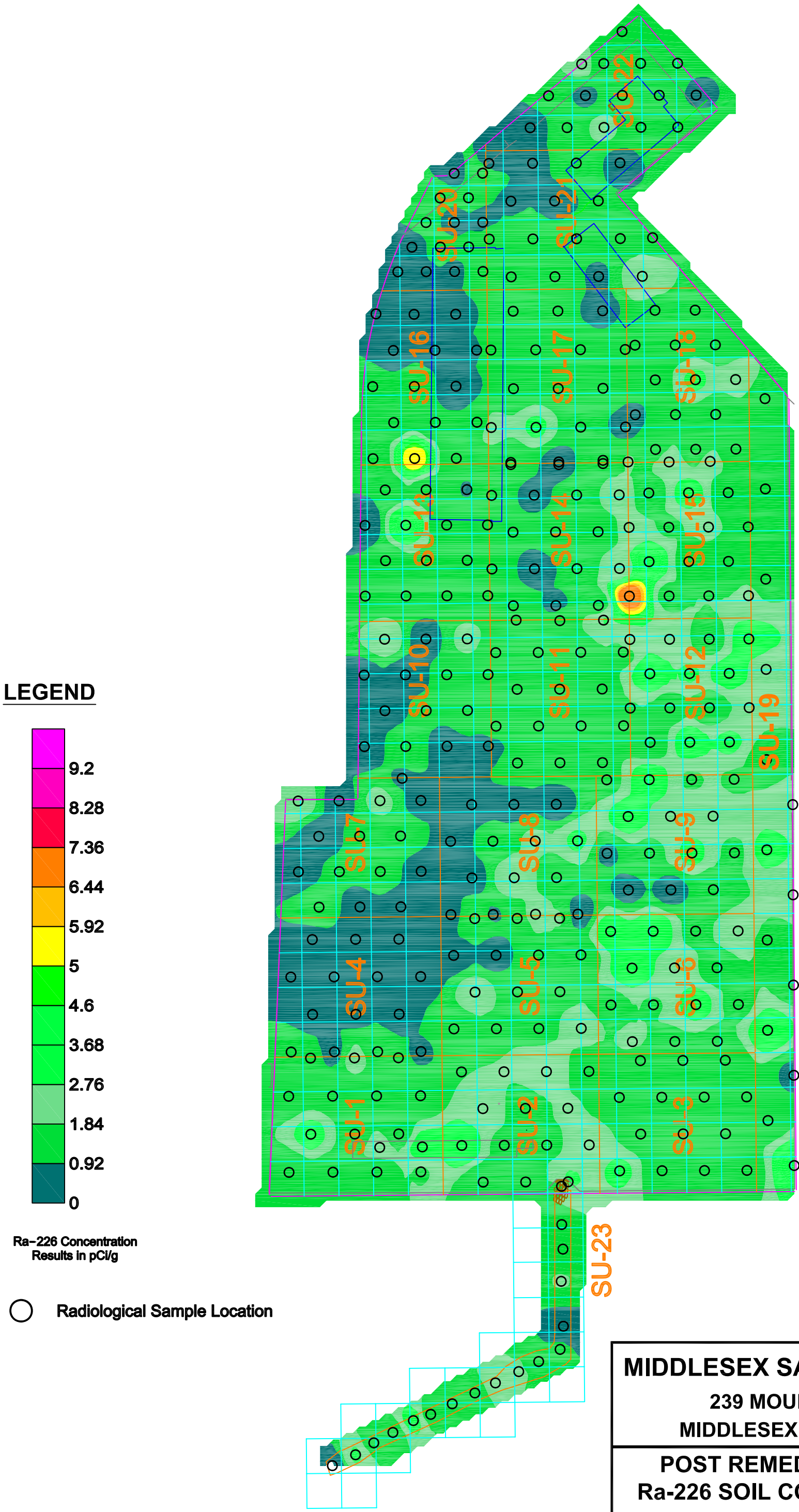

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.

MIDDLESEX, NEW JERSEY

POST REMEDIAL SITE WIDE Ra-226 SOIL CONCENTRATIONS

US Army Corps of Engineers
New York District

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Proj: W912DQ-04-D-0017

FIGURE 5-5

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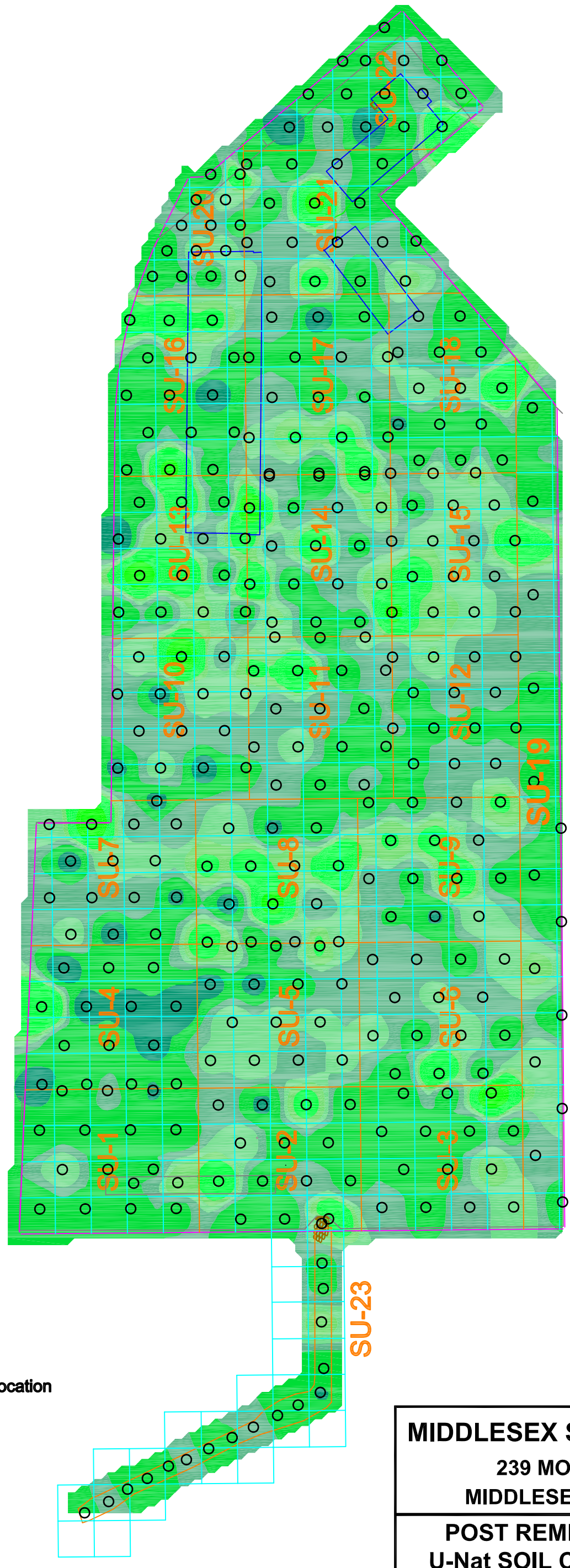

LEGEND

20
18.47
17
16.17
14.7
13.23
11.76
10.29
8.82
7.35
5.88
4.41
2.94
1.47
0

U-Nat. Concentration
Results in pCi/g

○ Radiological Sample Location

N

NOT TO SCALE

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

POST REMEDIAL SITE WIDE U-Nat SOIL CONCENTRATIONS

US Army Corps of Engineers
New York District

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Date: 10/23/08
Proj: W912DQ-04-D-0017

FIGURE 5-6

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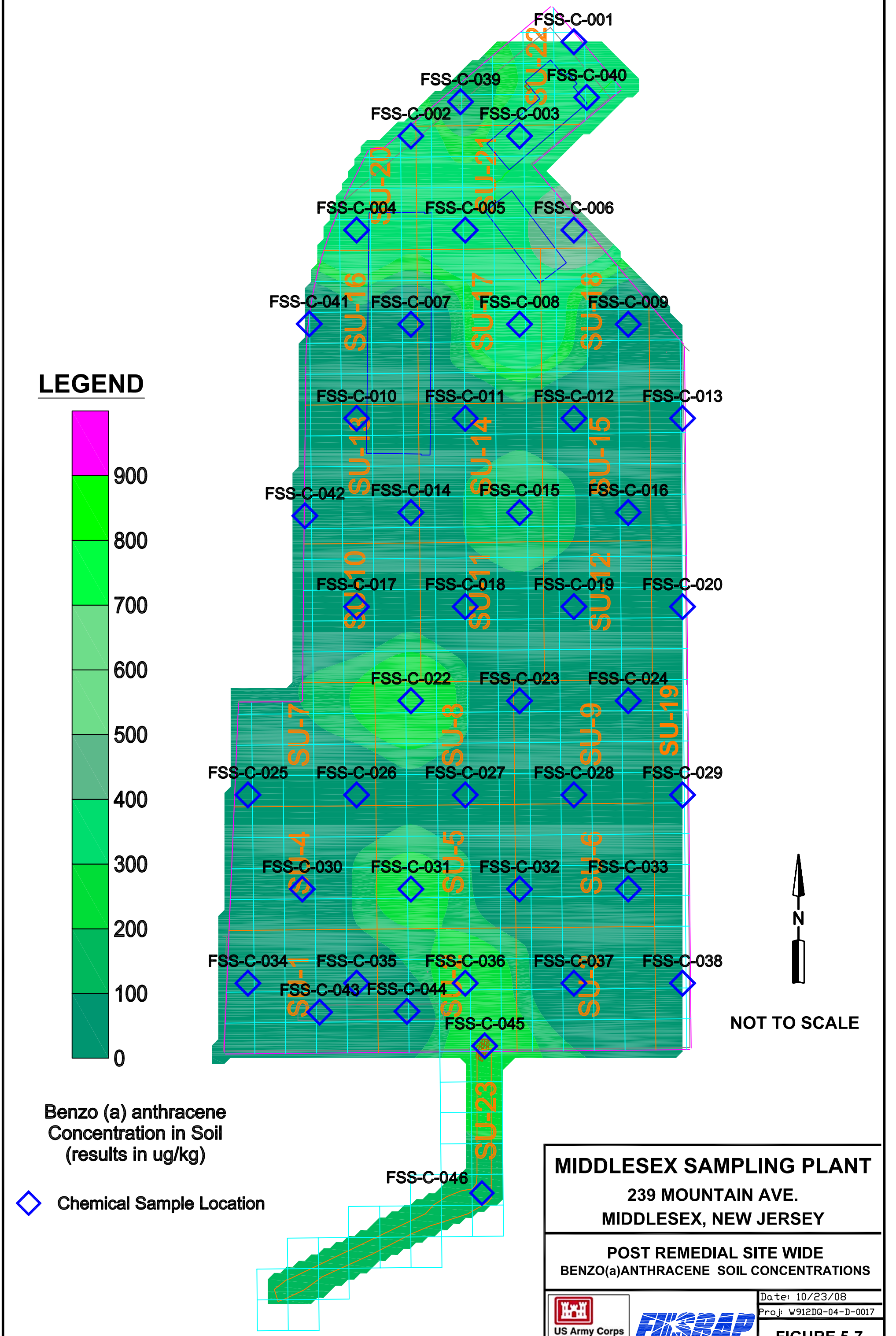

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

POST REMEDIAL SITE WIDE
BENZO(a)ANTHRACENE SOIL CONCENTRATIONS

US Army Corps of Engineers. New York District

FUSRAP

Date: 10/23/08
Proj: W912DQ-04-D-0017

FIGURE 5-7

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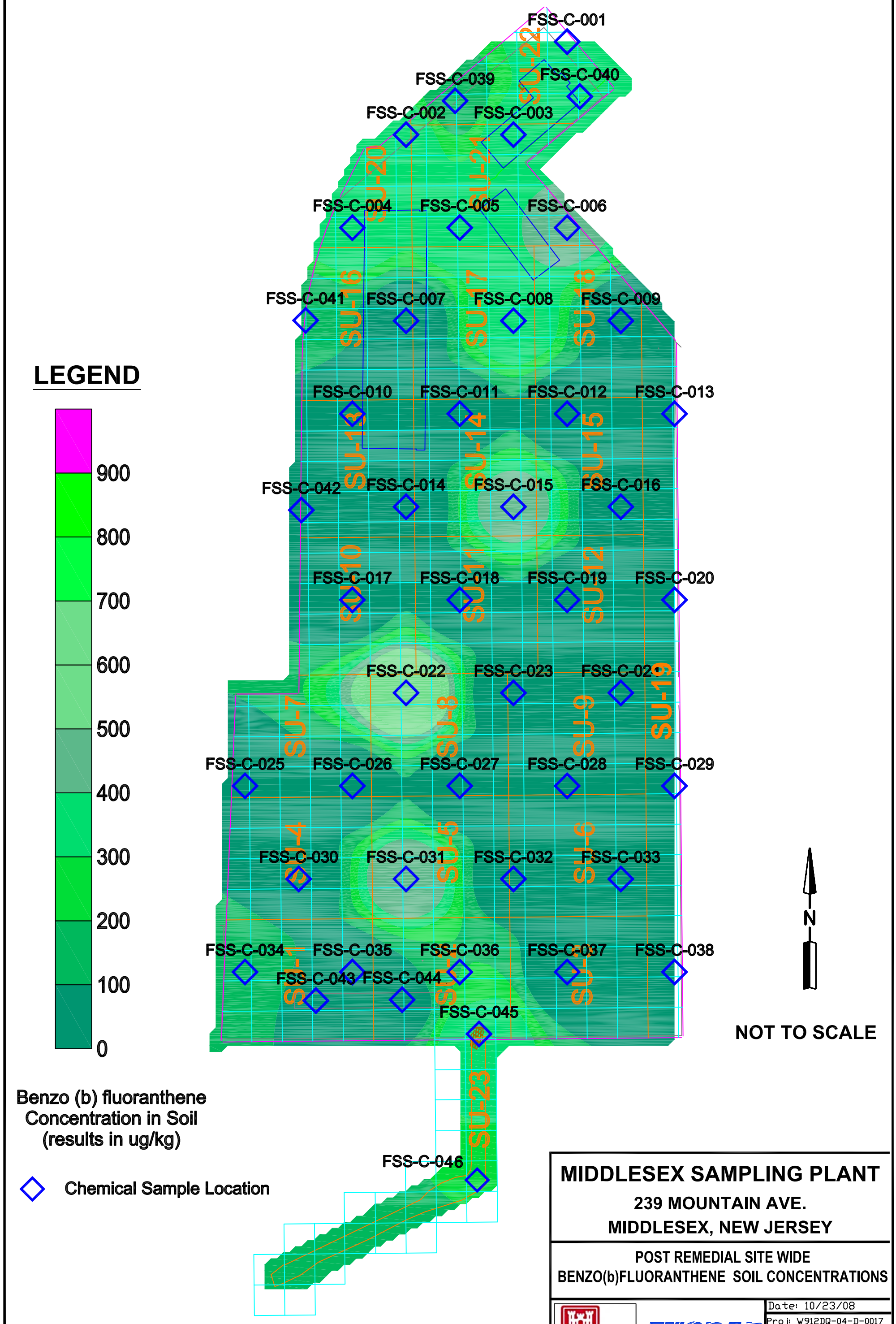
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FSS-C-039
FSS-C-040
FSS-C-002
FSS-C-003
FSS-C-004
FSS-C-005
FSS-C-006
FSS-C-041
FSS-C-007
FSS-C-008
FSS-C-009
FSS-C-010
FSS-C-011
FSS-C-012
FSS-C-013
FSS-C-042
FSS-C-014
FSS-C-015
FSS-C-016
FSS-C-017
FSS-C-018
FSS-C-019
FSS-C-020
FSS-C-022
FSS-C-023
FSS-C-025
FSS-C-026
FSS-C-027
FSS-C-028
FSS-C-029
FSS-C-030
FSS-C-031
FSS-C-032
FSS-C-033
FSS-C-034
FSS-C-035
FSS-C-036
FSS-C-037
FSS-C-038
FSS-C-043
FSS-C-044
FSS-C-045
FSS-C-046
SU-1
SU-2
SU-3
SU-4
SU-5
SU-6
SU-7
SU-8
SU-9
SU-10
SU-11
SU-12
SU-13
SU-14
SU-15
SU-16
SU-17
SU-18
SU-19
SU-20
SU-21
SU-22
SU-23
LEGEND
900
800
700
600
500
400
300
200
100
0
N
NOT TO SCALE
Benzo (b) fluoranthene
Concentration in Soil
(results in ug/kg)
Chemical Sample Location
MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY
POST REMEDIAL SITE WIDE
BENZO(b)FLUORANTHENE SOIL CONCENTRATIONS
US Army Corps of Engineers
New York District
FUSRAP
Date: 10/23/08
Proj: W912DQ-04-D-0017
FIGURE 5-8

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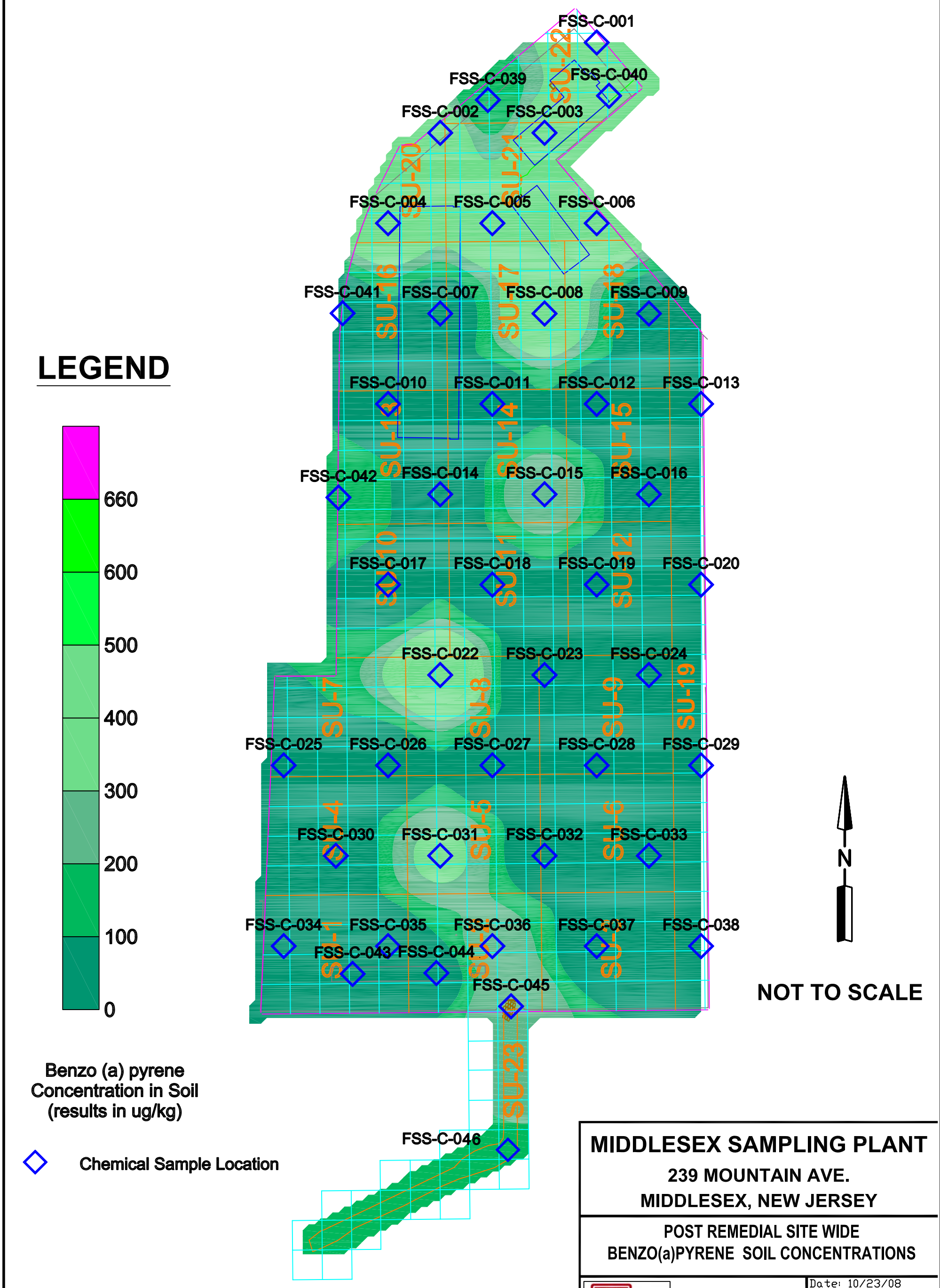

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

POST REMEDIAL SITE WIDE
BENZO(a)PYRENE SOIL CONCENTRATIONS

US Army Corps of Engineers
New York District

FUSRAP

Date: 10/23/08
Proj: W912DQ-04-D-0017

FIGURE 5-9

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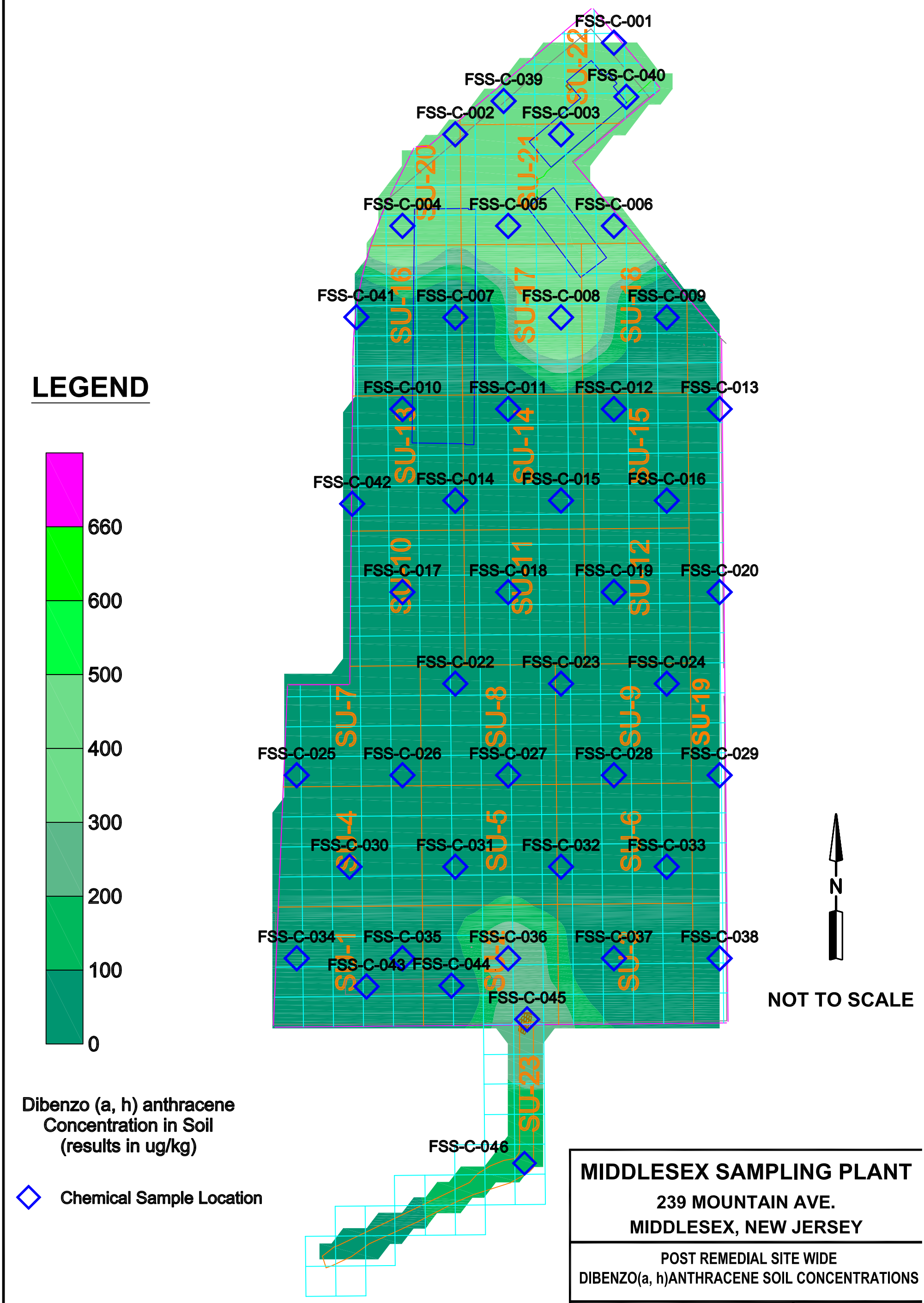

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

POST REMEDIAL SITE WIDE
DIBENZO(a, h)ANTHRACENE SOIL CONCENTRATIONS

US Army Corps of Engineers
New York District

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Date: 10/23/08
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FIGURE 5-10

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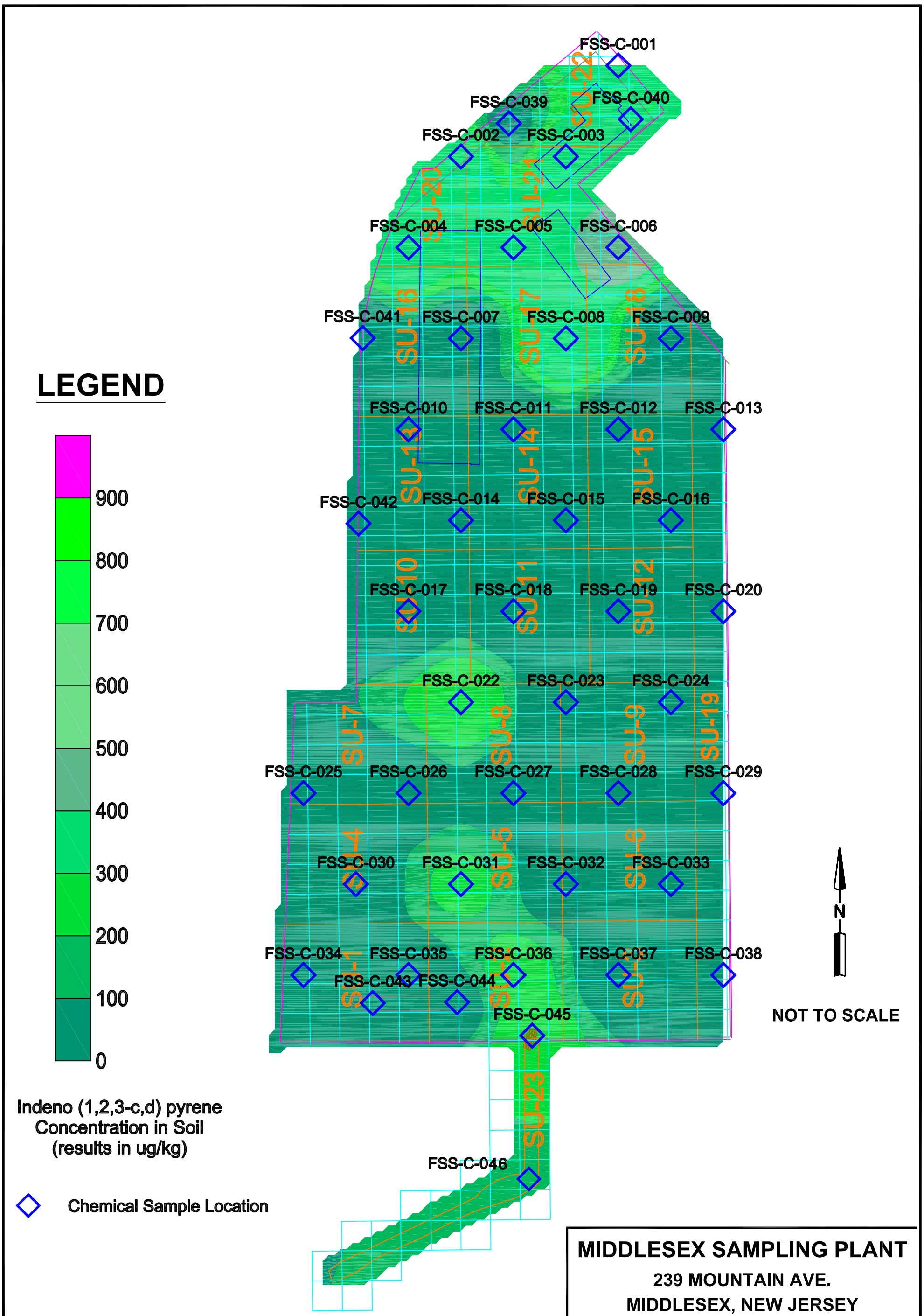

LEGEND

Indeno (1,2,3-c,d) pyrene Concentration in Soil (results in ug/kg)

◇ Chemical Sample Location

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

POST REMEDIAL SITE WIDE
INDENO(1, 2, 3 - c, d)PYRENE SOIL CONCENTRATIONS

US Army Corps of Engineers
New York District

FUSRAP

Date: 10/28/08
Proj: W912DQ-04-D-0017

FIGURE 5-11

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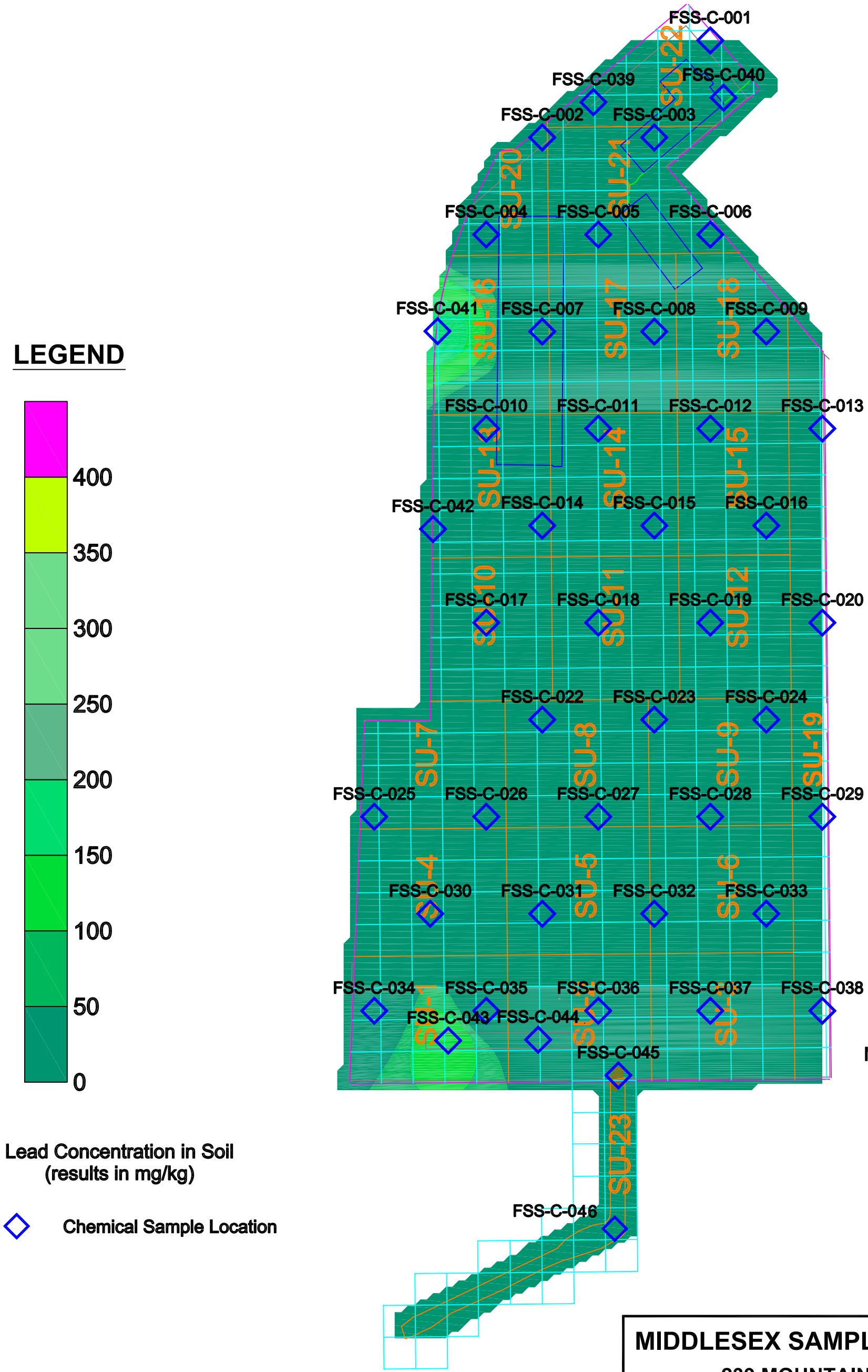

LEGEND

400
350
300
250
200
150
100
50
0

Lead Concentration in Soil
(results in mg/kg)

◇ Chemical Sample Location

NOT TO SCALE

MIDDLESEX SAMPLING PLANT

239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

POST REMEDIAL SITE WIDE
LEAD SOIL CONCENTRATIONS

US Army Corps of Engineers
New York District

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Date: 10/28/08
Proj: W912DQ-04-D-0017

FIGURE 5-12

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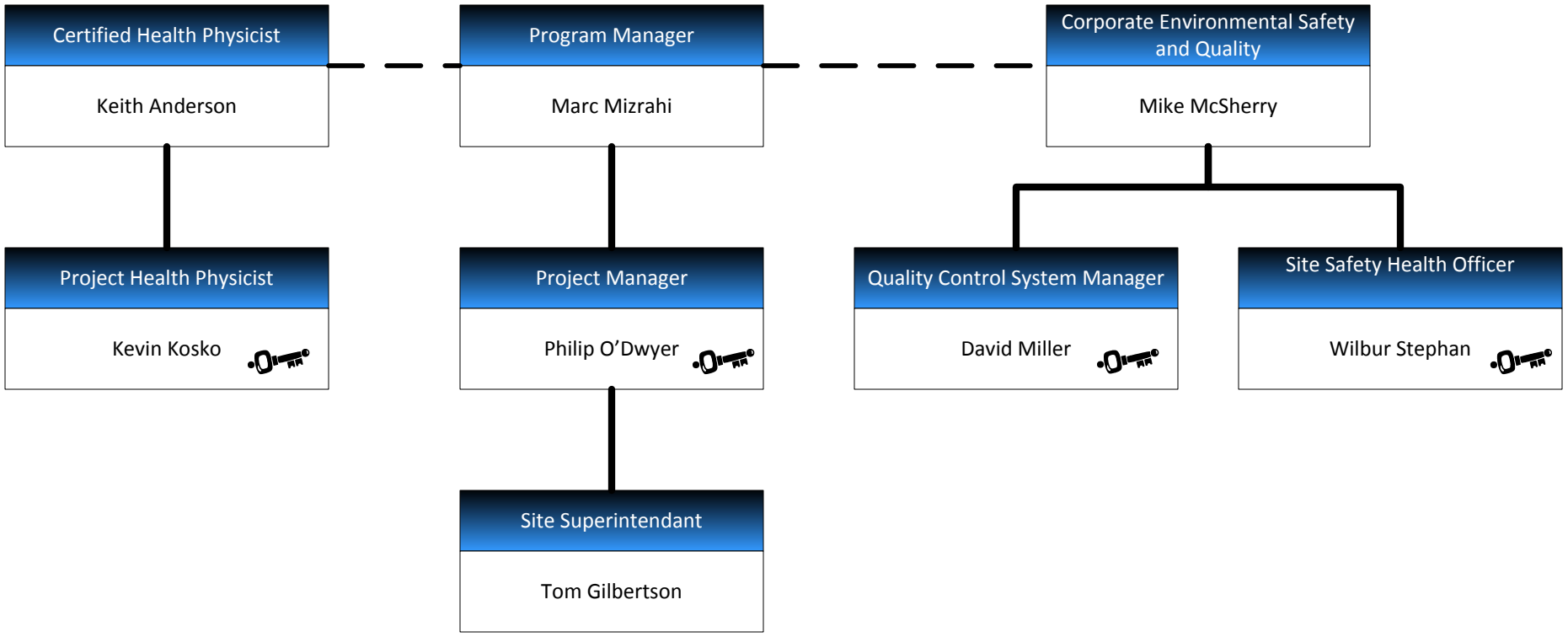
ECC PROJECT ORGANIZATION CHART



MIDDLESEX SAMPLING PLANT
239 MOUNTAIN AVE.
MIDDLESEX, NEW JERSEY

ECC PROJECT ORGANIZATION CHART

US Army Corps of Engineers
New York District

FUSRAP

DATE: 9/9/2008

PROJ: W912DQ-04-D-0017

FIGURE 13-1

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TABLES

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Table 2-1
Record of Decision Soil Cleanup Levels
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

PAHs	Selected Criteria Residential Soil Cleanup (mg/kg)	Units	Basis
Benzo(a)pyrene	0.66	mg/kg	PQL (1×10^{-5} risk)
Benzo(a)anthracene	0.9	mg/kg	1×10^{-6} risk
Dibenzo(a,h)anthracene	0.66	mg/kg	PQL (1×10^{-5} risk)
Benzo(b)fluoranthene	0.9	mg/kg	1×10^{-6} risk
Indeno(1,2,3-c,d)pyrene	0.9	mg/kg	1×10^{-6} risk
Lead	400	mg/kg	1×10^{-6} risk
Radionuclides	**Selected Criteria Residential Soil Cleanup (pCi/g)**	**Units**	**Basis**
Ra-226	5 (above background)	pCi/g	15 mrem/ year dose
U-NAT*	17	pCi/g	

* See Section 2.2.2 of the Final PRAR for a description of the MSP project non-radiological Soil Remediation Goals.

Notes:

mg/kg = milligrams per kilogram

mrem = millirem

PAH = polynuclear aromatic hydrocarbon

pCi/g = picoCurries per gram

PQL = Practical Quantitation Limit

Ra-226 = radium 226

U-NAT = natural uranium

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Table 4-1
Radionuclide Surface Contamination Level Screening Criteria
Demolition Debris and Other Non-Soil Debris
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Nuclide[a]	Average [b,c] dpm/100 cm^2	Maximum [b,d] dpm/100 cm^2	Removable [a,b,e] dpm/100 cm^2
U-238, U-nat, U-235 and associated decay products	5,000	15,000	1,000
Ra-226, Transuranics, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100	300	20
Th-232, Th-nat, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000	15,000	1,000

Notes:

cm^2 = square centimeters

dpm = disintegrations per minute

[a] Where surface contamination by both alpha-and beta-gamma- emitting nuclides exists, the limits established for alpha- and Beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm means the rate of emission by radioactive materials as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each object.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

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Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-1														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-SU1-FSS-R-1-001	1.08	0.27	0.20	1.62	0.29	0.68	0.14	0.02	0.64	0.13	0.02	0.30 J	0.03	0.02
5403-009-SU1-FSS-R-1-002	2.09	0.38	0.18	3.75	0.24	2.00	0.34	0.03	1.67	0.29	0.10	0.08 J	0.05	0.04
5403-009-SU1-FSS-R-1-003	0.96 J	0.27	0.26	1.43	0.29	0.69	0.14	0.02	0.69	0.14	0.02	0.05 J	0.03	0.01
5403-009-SU1-FSS-R-1-004	1.17	0.29	0.22	1.54	0.29	0.78	0.16	0.03	0.71	0.15	0.03	0.05 J	0.04	0.03
5403-009-SU1-FSS-R-1-005	1.40	0.28	0.12	1.96	0.67	0.99	0.20	0.03	0.87	0.19	0.03	0.10	0.06	0.02
5403-009-SU1-FSS-R-1-006	1.18	0.27	0.16	1.65	0.27	0.81	0.15	0.02	0.78	0.15	0.03	0.06 J	0.03	0.01
5403-009-SU1-FSS-R-1-007	1.22	0.26	0.16	1.80	0.27	0.85	0.16	0.02	0.91	0.17	0.03	0.04 J	0.03	0.02
5403-009-SU1-FSS-R-1-008	2.96	0.47	0.14	5.07	0.46	2.48	0.39	0.02	2.44	0.39	0.03	0.15	0.06	0.02
5403-009-SU1-FSS-R-1-009	1.45	0.29	0.12	2.44	0.26	1.28	0.23	0.02	1.12	0.21	0.02	0.04 J	0.03	0.03
5403-009-SU1-FSS-R-1-010	1.34	0.27	0.15	2.87	0.26	1.39	0.25	0.03	1.38	0.25	0.03	0.10 J	0.05	0.03
5403-009-SU1-FSS-R-1-011	0.97 J	0.23	0.15	1.96	0.26	1.00	0.18	0.02	0.91	0.17	0.03	0.05 J	0.03	0.01
5403-009-SU1-FSS-R-1-012	1.32	0.28	0.16	2.27	0.26	1.18	0.21	0.03	1.04	0.19	0.02	0.05 J	0.04	0.02
5403-009-SU1-FSS-R-1-013	1.43	0.29	0.17	2.38	0.26	1.13	0.21	0.02	1.20	0.22	0.03	0.05 J	0.04	0.03
5403-009-SU1-FSS-R-1-014	1.82	0.35	0.16	2.60	0.25	1.26	0.22	0.03	1.25	0.22	0.03	0.09 J	0.05	0.02
5403-009-SU1-FSS-R-1-015	3.18	0.50	0.18	7.01	0.39	3.42	0.50	0.02	3.41	0.50	0.02	0.18	0.06	0.02
5403-009-SU1-FSS-R-1-016	2.16	0.37	0.15	2.94	0.51	1.46	0.24	0.02	1.37	0.23	0.02	0.11	0.05	0.02
	Bias Sample													
5403-009-FSS-SU1-R-1-GP004BIAS	2.71	0.43	0.13	8.08	0.41	3.96	0.62	0.04	3.92	0.62	0.05	0.17	0.07	0.05
	Laboratory Duplicates													
5403-009-SU1-FSS-R-1-001	1.08	0.27	0.20	1.35	0.29	0.68	0.14	0.02	0.64	0.13	0.20	0.03 J	0.03	0.02
5403-009-SU1-FSS-R-1-001 DUP	0.95	0.26	0.24	1.32	0.29	0.63	0.13	0.02	0.68	0.14	0.02	0.01 J	0.02	0.01
	Field Replicates													
5403-009-SU1-FSS-R-1-007	1.22	0.26	0.16	1.80	0.27	0.85	0.16	0.02	0.91	0.17	0.03	0.04 J	0.03	0.02
5403-009-SU1-FSS-R-1-017	1.36	0.29	0.14	2.07	0.25	1.00	0.18	0.02	1.04	0.18	0.01	0.03 J	0.03	0.02
5403-009-SU1-FSS-R-1-008	2.96	0.47	0.14	5.07	0.46	2.48	0.39	0.02	2.44	0.39	0.03	0.15	0.06	0.02
5403-009-SU1-FSS-R-1-018	1.94	0.37	0.18	4.09	0.60	1.94	0.33	0.04	2.04	0.35	0.05	0.11	0.06	0.04

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-2

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-SU2-FSS-R-1-001	2.22	0.39	0.18	3.65	0.22	1.87	0.29	0.02	1.68	0.27	0.02	0.10 J	0.44	0.02
5403-009-SU2-FSS-R-1-002	1.94 J	0.36	0.16	1.39	0.27	0.73	0.14	0.02	0.61	0.12	0.03	0.05 J	0.03	0.01
5403-009-SU2-FSS-R-1-003	2.69 J	0.44	0.18	7.84	0.20	3.96	0.57	0.02	3.67	0.53	0.02	0.21	0.07	0.01
5403-009-SU2-FSS-R-1-004	1.24 J	0.29	0.20	1.72	0.26	0.81	0.15	0.02	0.85	0.16	0.03	0.06 J	0.04	0.03
5403-009-SU2-FSS-R-1-005	2.42 J	0.44	0.24	5.29	0.22	2.80	0.43	0.03	2.38	0.38	0.03	0.11	0.05	0.02
5403-009-SU2-FSS-R-1-006	1.38 J	0.31	0.22	2.15	0.26	1.02	0.19	0.01	1.05	0.19	0.03	0.08 J	0.04	0.01
5403-009-SU2-FSS-R-1-007	1.88	0.55	0.23	2.24	0.35	1.12	0.27	0.04	1.05	0.26	0.03	0.07 J	0.06	0.04
5403-009-SU2-FSS-R-1-008	3.50 J	0.54	0.10	8.87	0.20	4.34	0.62	0.03	4.33	0.62	0.02	0.20	0.07	0.01
5403-009-SU2-FSS-R-1-009	1.71	0.55	0.23	2.41	0.37	1.31	0.33	0.07	1.02	0.28	0.08	0.08 U	0.08	0.08
5403-009-SU2-FSS-R-1-010	1.72 J	0.35	0.21	3.23	0.23	1.63	0.27	0.02	1.50	0.25	0.02	0.10	0.05	0.01
5403-009-SU2-FSS-R-1-011	2.30	0.73	0.30	2.37	0.36	1.09	0.28	0.07	1.22	0.31	0.10	0.06 U	0.06	0.07
5403-009-SU2-FSS-R-1-012	1.21 J	0.29	0.21	1.58	0.28	0.76	0.15	0.02	0.77	0.15	0.02	0.05 J	0.03	0.03
5403-009-SU2-FSS-R-1-013	1.13 J	0.28	0.20	1.61	0.28	0.81	0.16	0.03	0.76	0.15	0.02	0.04 J	0.03	0.01
5403-009-SU2-FSS-R-1-014	2.96 J	0.49	0.26	11.72	0.20	5.71	0.80	0.02	5.73	0.80	0.02	0.28	0.08	0.03
5403-009-SU2-FSS-R-1-015	1.68 J	0.34	0.19	4.06	0.23	2.01	0.32	0.02	1.97	0.32	0.03	0.08 J	0.04	0.02
Biased Sample Results														
5403-009-FSS-SU2-R-1-GP227BIAS	1.36 J	0.30	0.21	2.27	0.25	1.17	0.20	0.02	1.02	0.18	0.01	0.08 J	0.04	0.10
Laboratory Duplicates														
5403-009-SU2-FSS-R-1-001	0.22	0.39	0.18	3.65	0.22	1.87	0.29	0.02	1.68	0.27	0.02	0.10 J	0.44	0.02
5403-009-SU2-FSS-R-1-001 DUP	2.08	0.38	0.18	3.94	0.23	1.90	0.31	0.03	1.91	0.31	0.03	0.13	0.05	0.02
5403-009-SU2-FSS-R-1-007	1.88	0.55	0.23	2.24	0.35	1.12	0.27	0.04	1.05	0.26	0.03	0.07 J	0.06	0.04
5403-009-SU2-FSS-R-1-007 DUP	2.27	0.65	0.24	2.36	0.34	1.09	0.27	0.08	1.24	0.29	0.06	0.03 U	0.04	0.04
5403-009-SU2-FSS-R-1-011	2.30	0.73	0.30	2.37	0.36	1.09	0.28	0.07	1.22	0.31	0.10	0.06 U	0.06	0.07
5403-009-SU2-FSS-R-1-011 DUP	N/A	N/A	N/A	1.84	0.43	1.10	0.30	0.07	0.74	0.24	0.09	0.00 U	0.01	0.08
Field Replicates														
5403-009-SU2-FSS-R-1-006	1.38	0.31	0.22	2.15	0.26	1.02	0.19	0.01	1.05	0.19	0.03	0.08	0.04	0.01
5403-009-SU2-FSS-R-1-016	2.23 J	0.40	0.20	2.63	0.24	1.29	0.22	0.02	1.29	0.22	0.02	0.05 J	0.03	0.02
5403-009-SU2-FSS-R-1-007	1.88	0.55	0.23	2.24	0.35	1.12	0.27	0.04	1.05	0.26	0.03	0.07 J	0.06	0.04
5403-009-SU2-FSS-R-1-017	1.83	0.54	0.21	2.02	2.03	1.09	0.27	0.08	0.91	0.24	0.06	0.02 U	0.04	0.05

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
N/A Duplicate sample was analyzed for Uranium only.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-3														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU3-R-1-001	1.48	0.39	0.20	2.18	0.36	1.12	0.27	0.07	1.11	0.27	0.07	0.01 U	0.03	0.07
5403-009-FSS-SU3-R-1-002	1.11	0.36	0.20	2.25	0.39	1.26	0.33	0.09	0.89	0.26	0.09	0.10	0.09	0.09
5403-009-FSS-SU3-R-1-003	1.25	0.34	0.15	15.72	0.39	7.63	1.25	0.09	7.88	1.28	0.11	0.21	0.12	0.10
5403-009-FSS-SU3-R-1-004	1.13	0.30	0.11	2.62	0.23	1.49	0.36	0.08	1.05	0.28	0.09	0.09 U	0.08	0.09
5403-009-FSS-SU3-R-1-005	1.45	0.39	0.18	2.33	0.36	1.15	0.28	0.06	1.11	0.28	0.10	0.08 U	0.07	0.08
5403-009-FSS-SU3-R-1-006	1.19	0.32	0.16	2.14	0.35	0.94	0.25	0.05	1.13	0.28	0.08	0.07	0.07	0.07
5403-009-FSS-SU3-R-1-007	1.68	0.48	0.26	2.56	0.36	1.13	0.28	0.08	1.36	0.32	0.09	0.07	0.07	0.07
5403-009-FSS-SU3-R-1-008	1.23	0.36	0.16	2.49	0.34	1.17	0.28	0.07	1.20	0.28	0.10	0.12	0.08	0.08
5403-009-FSS-SU3-R-1-009	1.83	0.50	0.17	2.56	0.33	1.17	0.30	0.09	1.34	0.32	0.06	0.09 U	0.06	0.09
5403-009-FSS-SU3-R-1-010	1.32	0.37	0.21	6.26	0.35	3.04	0.59	0.07	3.04	0.59	0.06	0.18	0.11	0.04
5403-009-FSS-SU3-R-1-011	2.84	0.70	0.40	3.45	0.27	1.71	0.38	0.09	1.66	0.38	0.11	0.09	0.08	0.04
5403-009-FSS-SU3-R-1-012	1.13	0.33	0.18	2.56	0.32	1.31	0.31	0.10	1.22	0.30	0.08	0.09 U	0.05	0.09
5403-009-FSS-SU3-R-1-013	1.81	0.52	0.27	3.48	0.34	1.89	0.41	0.06	1.48	0.34	0.09	0.12	0.09	0.08
5403-009-FSS-SU3-R-1-014	1.44	0.41	0.26	5.63	0.32	2.85	0.59	0.11	2.60	0.55	0.12	0.18	0.12	0.11
Biased Sample Results														
5403-009-FSS-SU3-R-1-GP277BIAS	1.57	0.44	0.24	6.54	0.89	3.21	0.65	0.08	3.13	0.64	0.11	0.13	0.11	0.12
Laboratory Duplicates														
5403-009-FSS-SU3-R-1-001	1.48	0.39	0.20	2.18	0.36	1.12	0.27	0.07	1.11	0.27	0.07	0.01 U	0.03	0.07
5403-009-SU1-FSS-R-1-001 DUP	1.25	0.34	0.14	2.27	0.35	1.09	0.27	0.05	1.10	0.27	0.05	0.08 U	0.07	0.08
Field Replicates														
5403-009-FSS-SU3-R-1-005	1.45	0.39	0.18	2.33	1.04	1.15	0.28	0.06	1.11	0.28	0.10	0.07 U	0.07	0.08
5403-009-SU3-FSS-R-1-015	1.09	0.34	0.20	3.95	0.32	1.21	0.30	0.06	2.60	0.52	0.07	0.14	0.10	0.07
5403-009-FSS-SU3-R-1-006	1.19	0.32	0.16	2.14	0.32	0.94	0.25	0.05	1.13	0.28	0.08	0.07	0.07	0.07
5403-009-SU3-FSS-R-1-016	0.97	0.32	0.22	2.06	1.55	1.25	0.30	0.05	0.81	0.24	0.10	0.04 U	0.06	0.11

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-4														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-SU4-FSS-R-1-001	0.75 J	0.26	0.27	0.92	0.51	0.52 J	0.17	0.05	0.36 J	0.14	0.06	0.04 J	0.06	0.04
5403-009-SU4-FSS-R-1-002	0.49 J	0.17	0.16	2.50	0.32	1.36	0.30	0.05	1.11	0.26	0.06	0.03 U	0.05	0.04
5403-009-SU4-FSS-R-1-003	0.47 J	0.16	0.14	2.93	0.33	1.24	0.30	0.06	1.61	0.36	0.06	0.08 J	0.08	0.04
5403-009-SU4-FSS-R-1-004	0.51 J	0.18	0.18	12.73	0.48	5.98	0.92	0.05	6.45	0.98	0.05	0.30 J	0.13	0.06
5403-009-SU4-FSS-R-1-005	0.43 J	0.16	0.16	1.15	0.45	0.58 J	0.18	0.05	0.52 J	0.17	0.06	0.05 J	0.06	0.04
5403-009-SU4-FSS-R-1-006	0.56 J	0.20	0.20	1.07	0.48	0.62 J	0.19	0.05	0.44 J	0.16	0.06	0.01 U	0.03	0.07
5403-009-SU4-FSS-R-1-007	0.50 J	0.18	0.17	0.63	0.59	0.36 J	0.14	0.06	0.25 J	0.11	0.07	0.02 U	0.04	0.08
5403-009-SU4-FSS-R-1-008	0.80 J	0.23	0.19	2.05	0.38	1.01	0.27	0.07	1.00	0.27	0.08	0.04 U	0.06	0.08
5403-009-SU4-FSS-R-1-009	0.81 J	0.26	0.25	1.63	0.38	0.90 J	0.23	0.05	0.72 J	0.20	0.06	0.01 U	0.03	0.07
5403-009-SU4-FSS-R-1-010	0.71 J	0.22	0.20	1.33	0.43	0.67 J	0.20	0.06	0.64 J	0.20	0.07	0.02 U	0.04	0.04
5403-009-SU4-FSS-R-1-011	1.08	0.28	0.21	1.22	0.54	0.65 J	0.24	0.05	0.53 J	0.21	0.09	0.04 U	0.08	0.06
5403-009-SU4-FSS-R-1-012	0.68 J	0.21	0.20	1.59	0.40	0.76 J	0.22	0.03	0.79 J	0.22	0.03	0.04 U	0.06	0.08
5403-009-SU4-FSS-R-1-013	1.35	0.33	0.27	2.05	0.36	1.07	0.27	0.06	0.92 J	0.24	0.05	0.06 U	0.06	0.06
5403-009-SU4-FSS-R-1-014	0.88 J	0.24	0.18	1.90	0.39	1.03	0.27	0.03	0.81 J	0.23	0.03	0.06 U	0.07	0.08
Biased Sample Results														
5403-009-FSS-SU4-R-1-GP424BIAS	1.61	0.49	0.19	2.63	0.34	1.32	0.32	0.07	1.31	0.32	0.08	0.00	0.01	0.07
Laboratory Duplicates														
5403-009-SU4-FSS-R-1-001	0.75 J	0.26	0.27	0.92	0.51	0.52 J	0.17	0.05	0.36 J	0.14	0.06	0.04 J	0.06	0.04
5403-009-SU4-FSS-R-1-001 DUP	0.42	0.17	0.18	1.02	0.49	0.50	0.18	0.07	0.53	0.18	0.07	-0.01 U	0.04	0.08
5403-009-SU4-FSS-R-1-002	NA	NA	NA	2.50	0.32	1.36	0.30	0.05	1.11	0.26	0.06	0.03 U	0.05	0.04
5403-009-SU4-FSS-R-1-002 DUP	NA	NA	NA	2.40	0.33	1.14	0.27	0.07	1.21	0.28	0.07	0.05	0.06	0.07
Field Replicates														
5403-009-SU4-FSS-R-1-005	0.43	0.16	0.16	1.15	0.45	0.58	0.18	0.05	0.52	0.17	0.06	0.05 J	0.06	0.04
5403-009-SU4-FSS-R-1-015	0.35 J	0.19	0.25	0.93	0.49	0.47 J	0.16	0.06	0.45 J	0.16	0.05	0.01 U	0.04	0.04
5403-009-SU4-FSS-R-1-006	0.56	0.20	0.20	1.07	0.48	0.62	0.19	0.05	0.44	0.16	0.06	0.01 U	0.03	0.07
5403-009-SU4-FSS-R-1-016	0.23 J	0.15	0.21	0.92	2.06	0.39 J	0.14	0.03	0.51 J	0.16	0.03	0.02 U	0.04	0.06

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The U-235 concentration was reported as a negative number for sample ID 5403-009-SU4-FSS-R-1-001 DUP; however a value of 0.00 pCi/g was used for statistical purposes.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-5

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-SU5-FSS-R-1-001	1.74	0.32	0.15	6.90	0.40	3.49	0.54	0.02	3.20	0.50	0.02	0.21	0.07	0.02
5403-009-SU5-FSS-R-1-001(SUP)	0.64 J	0.30	0.24	2.06	1.07	0.93	0.25	0.06	1.07	0.27	0.06	0.06	0.06	0.04
5403-009-SU5-FSS-R-1-002	1.02	0.22	0.14	2.76	0.64	1.32	0.23	0.02	1.38	0.24	0.02	0.06 J	0.03	0.02
5403-009-SU5-FSS-R-1-002 (SUP)	0.79 J	0.30	0.25	1.67	0.41	0.75	0.23	0.09	0.87	0.25	0.06	0.05 U	0.06	0.10
5403-009-SU5-FSS-R-1-003	1.87	0.33	0.16	7.58	0.42	3.73	0.61	0.02	3.60	0.59	0.02	0.25	0.09	0.02
5403-009-SU5-FSS-R-1-003 (SUP)	0.53 J	0.25	0.20	2.20	1.22	1.08	0.28	0.06	1.07	0.28	0.09	0.05	0.05	0.04
5403-009-SU5-FSS-R-1-004	0.54 J	0.17	0.14	1.18	0.31	0.53	0.12	0.02	0.65	0.14	0.02	0.00 U	0.01	0.02
5403-009-SU5-FSS-R-1-004 (SUP)	0.92 J	0.30	0.22	1.96	0.38	0.80	0.23	0.07	1.08	0.28	0.07	0.08 U	0.07	0.09
5403-009-SU5-FSS-R-1-005	0.62 J	0.17	0.12	1.29	0.94	0.57	0.12	0.02	0.69	0.14	0.03	0.03 J	0.03	0.01
5403-009-SU5-FSS-R-1-005 (SUP)	1.10 J	0.36	0.26	1.64	0.39	0.75	0.21	0.07	0.85	0.23	0.05	0.04 U	0.05	0.06
5403-009-SU5-FSS-R-1-006	1.57	0.43	0.22	2.46	0.36	1.30	0.32	0.07	1.07	0.28	0.09	0.09 U	0.07	0.07
5403-009-SU5-FSS-R-1-006 (SUP)	1.01 J	0.37	0.19	2.10	0.39	0.89	0.25	0.10	1.14	0.30	0.07	0.08 U	0.07	0.09
5403-009-SU5-FSS-R-1-007	1.25	0.26	0.17	3.25	0.57	1.56	0.28	0.02	1.59	0.29	0.03	0.10	0.05	0.03
5403-009-SU5-FSS-R-1-007 (SUP)	1.02 J	0.36	0.21	2.01	0.40	0.90	0.26	0.06	1.06	0.29	0.06	0.05 U	0.06	0.08
5403-009-SU5-FSS-R-1-008	2.14	0.39	0.18	5.16	0.50	2.59	0.43	0.03	2.44	0.41	0.03	0.13	0.06	0.03
5403-009-SU5-FSS-R-1-008 (SUP)	0.68 J	0.28	0.19	1.75	0.43	0.80	0.25	0.10	0.94	0.28	0.13	0.00 U	0.01	0.09
5403-009-SU5-FSS-R-1-009	1.68	0.31	0.14	4.83	0.61	2.29	0.40	0.02	2.45	0.42	0.03	0.09 J	0.05	0.02
5403-009-SU5-FSS-R-1-009 (SUP)	1.38 J	0.57	0.31	1.87	0.43	0.79	0.25	0.11	0.98	0.29	0.12	0.10 U	0.09	0.12
5403-009-SU5-FSS-R-1-010	1.77	0.34	0.17	4.53	0.53	2.35	0.38	0.02	2.08	0.34	0.02	0.10 J	0.05	0.03
5403-009-SU5-FSS-R-1-010 (SUP)	1.80 J	0.62	0.31	1.83	1.09	0.80	0.24	0.09	0.96	0.26	0.06	0.06	0.06	0.04
5403-009-SU5-FSS-R-1-011	1.51	0.30	0.16	4.55	0.53	2.25	0.37	0.01	2.20	0.36	0.02	0.10	0.05	0.02
5403-009-SU5-FSS-R-1-011 (SUP)	1.26 J	0.40	0.18	1.80	0.43	0.85	0.26	0.10	0.89	0.27	0.12	0.07 U	0.07	0.08
5403-009-SU5-FSS-R-1-012	1.80	0.32	0.14	5.26	0.53	2.69	0.45	0.03	2.45	0.41	0.04	0.12	0.06	0.04
5403-009-SU5-FSS-R-1-012 (SUP)	1.01 J	0.35	0.19	2.46	0.38	0.84	0.25	0.10	1.55	0.37	0.09	0.06 U	0.07	0.09
5403-009-SU5-FSS-R-1-013	1.68	0.30	0.13	3.72	0.58	1.93	0.34	0.01	1.69	0.31	0.03	0.10	0.05	0.02
5403-009-SU5-FSS-R-1-013 (SUP)	0.93 J	0.31	0.17	1.77	0.40	0.88	0.25	0.07	0.86	0.25	0.11	0.04 U	0.06	0.10
5403-009-SU5-FSS-R-1-014	2.04	0.37	0.17	4.55	0.54	2.26	0.39	0.03	2.17	0.37	0.03	0.12	0.06	0.03
5403-009-SU5-FSS-R-1-014 (SUP)	0.92 J	0.35	0.23	2.15	1.08	0.98	0.28	0.04	1.10	0.30	0.11	0.07	0.07	0.05
Biased Sample Results														
5403-009-FSS-SU5-R1-Bias (GP002)	1.44	0.40	0.18	2.54	0.36	1.43	0.35	0.07	1.09	0.29	0.07	0.02 U	0.03	0.05
5403-009-FSS-SU5-R1-GP333	1.68	0.44	0.07	2.90	0.82	1.33	0.36	0.12	1.42	0.37	0.10	0.15	0.11	0.10
Laboratory Duplicates														
5403-009-SU5-FSS-R-1-001	1.74	0.32	0.15	6.90	0.22	3.49	0.54	0.02	3.20	0.50	0.02	0.21	0.07	0.02
5403-009-SU5-FSS-R-1-001 DUP	2.50	0.39	0.15	8.34	0.22	4.06	0.62	0.02	4.14	0.63	0.02	0.14	0.06	0.01
5403-009-SU5-FSS-R-1-001 (SUP)	0.64	0.30	0.24	2.06	0.37	0.93	0.25	0.06	1.07	0.27	0.06	0.06	0.06	0.04
5403-009-SU5-FSS-R-1-001 DUP (SUP)	1.30	0.39	0.17	2.13	0.37	1.06	0.28	0.08	1.02	0.27	0.09	0.05	0.05	0.04
Field Replicates														
5403-009-SU5-FSS-R-1-005	0.62 J	0.17	0.12	1.29	0.94	0.57	0.12	0.02	0.69	0.14	0.03	0.03 J	0.03	0.01
5403-009-SU5-FSS-R-1-015	1.45	0.27	0.15	1.84	0.28	0.89	0.18	0.03	0.92	0.18	0.02	0.03 J	0.03	0.01
5403-009-SU5-FSS-R-1-006	1.57	0.43	0.22	2.46	0.36	1.30	0.32	0.07	1.07	0.28	0.09	0.09 U	0.07	0.07
5403-009-SU5-FSS-R-1-016	2.42	0.37	0.12	4.76	0.60	2.47	0.41	0.03	2.20	0.37	0.02	0.09 J	0.05	0.03
5403-009-SU5-FSS-R-1-003 (SUP)	0.53	0.25	0.20	2.20	0.37	1.08	0.28	0.06	1.07	0.28	0.09	0.05	0.05	0.04
5403-009-SU5-FSS-R-1-015 (SUP)	0.98 J	0.35	0.24	1.97	0.40	1.06	0.29	0.07	0.90	0.26	0.06	0.02 U	0.03	0.05
5403-009-SU5-FSS-R-1-008 (SUP)	0.68	0.28	0.19	1.75	0.43	0.80	0.25	0.10	0.94	0.28	0.13	0.00	0.01	0.09
5403-009-SU5-FSS-R-1-016 (SUP)	0.97 J	0.35	0.26	1.96	0.40	0.93	0.27	0.04	1.03	0.28	0.07	0.00 U	0.01	0.05

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The notation "(SUP)" following the sample number indicates that this result is from a supplimental set of FSS samples completed after waste piles and liners were removed from this survey unit. The survey unit had been previously excavated to cleanup goals prior to placement of the waste pile, and FSS samples were collected and prepared for the FSSR.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-6

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU6-R-1-001	3.25	1.17	0.65	3.76	0.49	1.81	0.63	0.20	1.73	0.61	0.12	0.22	0.22	0.15
5403-009-FSS-SU6-R-1-002	3.50	1.36	0.83	4.34	0.53	2.07	0.76	0.46	1.99	0.75	0.51	0.28	0.28	0.19
5403-009-FSS-SU6-R-1-003	1.68	0.50	0.21	2.30	0.37	1.06	0.28	0.09	1.17	0.30	0.09	0.07 U	0.07	0.10
5403-009-FSS-SU6-R-1-004	2.40	1.13	0.84	5.10	0.49	2.64	0.90	0.45	2.33	0.83	0.33	0.12 U	0.21	0.40
5403-009-FSS-SU6-R-1-005	3.37	1.30	0.88	4.33	0.50	1.91	0.70	0.36	2.20	0.76	0.44	0.22 U	0.26	0.38
5403-009-FSS-SU6-R-1-006	2.49	1.01	0.72	4.78	0.50	2.56	0.85	0.34	1.99	0.74	0.40	0.22 U	0.15	0.46
5403-009-FSS-SU6-R-1-007	1.44	0.76	0.77	4.01	0.50	2.10	0.70	0.30	1.70	0.62	0.28	0.21 U	0.23	0.31
5403-009-FSS-SU6-R-1-008	1.62	0.43	0.20	4.67	0.30	2.41	0.51	0.10	2.14	0.47	0.10	0.13	0.09	0.04
5403-009-FSS-SU6-R-1-009	1.82	0.52	0.19	2.43	0.36	1.20	0.30	0.06	1.15	0.30	0.11	0.07 U	0.07	0.08
5403-009-FSS-SU6-R-1-010	3.06	1.24	0.78	5.73	0.45	2.59 J	0.85	0.38	2.94 J	0.92	0.36	0.20	0.24	0.18
5403-009-FSS-SU6-R-1-011	1.70	0.47	0.20	2.51	0.37	1.23	0.32	0.09	1.27	0.33	0.11	0.01 U	0.04	0.09
5403-009-FSS-SU6-R-1-012	1.90	0.52	0.20	2.20	0.37	1.14 J	0.29	0.06	1.03 J	0.27	0.07	0.03 U	0.04	0.07
5403-009-FSS-SU6-R-1-013	1.78	0.53	0.24	11.89	0.26	5.72 J	1.07	0.11	5.91 J	1.10	0.09	0.26	0.15	0.12
5403-009-FSS-SU6-R-1-014	1.66	0.47	0.23	2.09	0.38	1.13 J	0.29	0.06	0.95 J	0.26	0.08	0.00 U	0.01	0.07
Biased Sample Results														
5403-009-FSS-SU6-R-1-GP063BIAS	3.59	0.86	0.38	2.60	0.37	1.22	0.33	0.04	1.39	0.35	0.08	-0.01 U	0.01	0.11
5403-009-FSS-SU6-R-1-GP092BIAS	2.71	0.73	0.51	2.62	0.37	1.32	0.34	0.10	1.22	0.32	0.12	0.09	0.08	0.05
5403-009-FSS-SU6-R-1-GP093BIAS	2.24	0.57	0.25	4.39	0.28	2.17 J	0.43	0.07	2.15 J	0.43	0.07	0.08	0.07	0.04
Laboratory Duplicates														
5403-009-FSS-SU6-R-1-003	1.68	0.50	0.21	2.33	0.37	1.06	0.28	0.09	1.17	0.30	0.09	0.10 U	0.07	0.10
5403-009-FSS-SU6-R-1-003 DUP	1.75	0.50	0.33	2.55	0.37	1.30	0.33	0.07	1.13	0.30	0.07	0.13	0.10	0.10
5403-009-FSS-SU6-R-1-011	1.70	0.47	0.20	2.11	0.45	1.10 J	0.32	0.09	0.94 J	0.33	0.11	0.07 U	0.04	0.09
5403-009-FSS-SU6-R-1-011 DUP	2.28	0.55	0.30	2.42	0.37	1.23	0.32	0.08	1.18	0.31	0.08	0.02 U	0.03	0.05
Field Replicates														
5403-009-FSS-SU6-R-1-005	3.37	1.30	0.88	4.50	0.50	1.91	0.70	0.36	2.20	0.76	0.44	0.39 U	0.26	0.38
5403-009-FSS-SU6-R-1-015	2.32	0.55	0.22	3.87	0.31	1.96 J	0.43	0.07	1.84 J	0.41	0.09	0.08	0.07	0.07
5403-009-FSS-SU6-R-1-006	2.49	1.01	0.72	5.01	0.50	2.56	0.85	0.34	1.99	0.74	0.40	0.46 U	0.15	0.46
5403-009-FSS-SU6-R-1-016	3.37	1.45	1.22	5.65	1.62	2.74 J	0.85	0.30	2.80 J	0.86	0.30	0.11 U	0.18	0.29

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The U-235 concentration was reported as a negative number for sample ID 5403-009-SU6-FSS-R-1-GP063BIAS; however a value of 0.00 pCi/g was used for statistical purposes.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-7														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-SU7-FSS-R-1-001	2.38	0.41	0.15	5.00	1.00	2.54	0.48	0.07	2.39	0.46	0.05	0.07 J	0.07	0.06
5403-009-SU7-FSS-R-1-002	0.66 J	0.19	0.14	15.31	0.47	7.10	1.10	0.06	7.80	1.20	0.03	0.41 J	0.17	0.07
5403-009-SU7-FSS-R-1-003	1.99	0.48	0.25	4.07	1.07	1.99	0.48	0.10	1.99	0.48	0.08	0.08	0.09	0.06
5403-009-SU7-FSS-R-1-004	0.67 J	0.19	0.15	3.57	0.31	1.87	0.40	0.09	1.67	0.37	0.07	0.03 U	0.05	0.07
5403-009-SU7-FSS-R-1-005	0.56 J	0.17	0.16	1.26	0.41	0.57 J	0.17	0.06	0.66 J	0.19	0.06	0.03 U	0.05	0.04
5403-009-SU7-FSS-R-1-006	1.00	0.24	0.16	5.32	0.68	2.48	0.47	0.07	2.68	0.49	0.06	0.16 J	0.10	0.04
5403-009-SU7-FSS-R-1-007	1.68	0.31	0.12	4.74	0.72	2.22	0.44	0.08	2.37	0.46	0.08	0.15 J	0.10	0.04
5403-009-SU7-FSS-R-1-008	0.64 J	0.19	0.15	3.60	0.30	1.76	0.37	0.06	1.79	0.38	0.06	0.05 U	0.06	0.07
5403-009-SU7-FSS-R-1-009	1.02	0.23	0.14	3.81	1.36	1.82	0.37	0.06	1.95	0.39	0.06	0.04 J	0.06	0.04
5403-009-SU7-FSS-R-1-010	1.53	0.37	0.17	4.04	0.97	1.97	0.48	0.10	1.96	0.48	0.10	0.10	0.09	0.05
5403-009-SU7-FSS-R-1-011	0.49 J	0.16	0.13	1.42	0.41	0.82 J	0.22	0.06	0.57 J	0.18	0.05	0.03 U	0.05	0.04
5403-009-SU7-FSS-R-1-012	1.41	0.28	0.16	4.77	0.70	2.21	0.42	0.05	2.41	0.45	0.06	0.15 J	0.09	0.07
5403-009-SU7-FSS-R-1-013	0.64 J	0.18	0.13	1.24	0.44	0.60 J	0.19	0.08	0.61 J	0.19	0.06	0.03 U	0.05	0.04
5403-009-SU7-FSS-R-1-014	0.52 J	0.16	0.12	2.09	0.40	0.83 J	0.23	0.03	0.84 J	0.24	0.07	0.42 U	0.06	0.08
5403-009-SU7-FSS-R-1-015	0.88 J	0.21	0.13	1.31	0.43	0.73 J	0.21	0.05	0.56 J	0.18	0.05	0.02 U	0.04	0.04
	Biased Sample Results													
5403-009-FSS-SU7-R-1-GP230	0.66	0.26	0.19	1.49	0.46	0.70	0.23	0.10	0.77	0.25	0.10	0.02 U	0.04	0.09
	Laboratory Duplicates													
5403-009-SU7-FSS-R-1-001	2.38	0.41	0.15	5.00	1.00	2.54	0.48	0.07	2.39	0.46	0.05	0.07 J	0.07	0.06
5403-009-SU7-FSS-R-1-001 DUP	2.15	0.38	0.17	5.62	0.81	2.95	0.54	0.08	2.55	0.49	0.07	0.12 J	0.09	0.04
	Field Replicates													
5403-009-SU7-FSS-R-1-006	1.00	0.24	0.16	5.32	0.68	2.48	0.47	0.07	2.68	0.49	0.06	0.16 J	0.10	0.04
5403-009-SU7-FSS-R-1-016	0.70 J	0.19	0.13	5.81	0.93	3.11	0.56	0.08	2.60	0.49	0.07	0.10 J	0.09	0.09
5403-009-SU7-FSS-R-1-007	1.68	0.31	0.12	4.74	0.72	2.22	0.44	0.08	2.37	0.46	0.08	0.15 J	0.10	0.04
5403-009-SU7-FSS-R-1-017	1.02	0.24	0.15	4.35	0.28	2.19	0.43	0.07	2.05	0.41	0.05	0.11 J	0.08	0.06

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-8														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU8-R1-001	0.67 J	0.21	0.19	5.42	0.79	2.72	0.49	0.07	2.59	0.48	0.05	0.11 J	0.08	0.06
5403-009-FSS-SU8-R1-001 (SUP)	1.64	0.57	0.26	1.82	1.23	0.80	0.23	0.07	0.97	0.26	0.07	0.05	0.05	0.04
5403-009-FSS-SU8-R1-002	0.68 J	0.22	0.21	1.40	0.37	0.70 J	0.20	0.05	0.70 J	0.20	0.03	0.00 U	0.03	0.06
5403-009-FSS-SU8-R1-002 (SUP)	1.58	0.58	0.40	1.85	0.39	1.01	0.29	0.11	0.83	0.26	0.07	0.01 U	0.04	0.13
5403-009-FSS-SU8-R1-003	0.51 J	0.19	0.18	2.32	0.80	0.96 J	0.24	0.05	1.25	0.28	0.06	0.11 J	0.08	0.07
5403-009-FSS-SU8-R1-003 (SUP)	1.23	0.43	0.28	1.79	0.35	0.86	0.24	0.05	0.90	0.25	0.09	0.03 U	0.04	0.04
5403-009-FSS-SU8-R1-004	0.69 J	0.23	0.21	7.49	0.65	3.85	0.63	0.07	3.49	0.58	0.05	0.15 J	0.09	0.05
5403-009-FSS-SU8-R1-004 (SUP)	0.98	0.33	0.18	1.79	0.38	0.73	0.23	0.08	1.06	0.29	0.08	-0.01 U	0.01	0.10
5403-009-FSS-SU8-R1-005	1.38	0.40	0.07	8.30	0.72	4.36	0.79	0.09	3.78	0.71	0.07	0.16	0.11	0.07
5403-009-FSS-SU8-R1-005 (SUP)	1.09	0.36	0.17	1.37	0.39	0.63	0.19	0.07	0.70	0.21	0.05	0.04 U	0.05	0.07
5403-009-FSS-SU8-R1-006	1.92	0.46	0.10	6.85	0.95	3.29	0.68	0.08	3.46	0.71	0.09	0.10	0.09	0.04
5403-009-FSS-SU8-R1-006 (SUP)	0.70	0.27	0.15	1.76	0.98	0.69	0.22	0.10	0.97	0.28	0.08	0.10	0.09	0.09
5403-009-FSS-SU8-R1-007	2.82	0.48	0.21	12.62	0.46	6.00	0.91	0.05	6.25	0.94	0.07	0.37 J	0.15	0.03
5403-009-FSS-SU8-R1-007 (SUP)	1.13	0.38	0.14	2.15	0.94	1.04	0.29	0.06	1.00	0.28	0.06	0.10	0.09	0.08
5403-009-FSS-SU8-R1-008	0.68 J	0.21	0.19	1.17	0.38	0.64 J	0.18	0.05	0.52 J	0.16	0.06	0.01 U	0.03	0.05
5403-009-FSS-SU8-R1-008 (SUP)	0.79	0.32	0.29	2.14	0.37	1.08	0.31	0.11	1.01	0.30	0.13	0.05 U	0.07	0.09
5403-009-FSS-SU8-R1-009	2.73	0.46	0.19	13.91	0.44	6.90	1.00	0.07	6.60	1.00	0.07	0.41 J	0.16	0.04
5403-009-FSS-SU8-R1-009 (SUP)	0.98	0.36	0.29	1.64	0.39	0.91	0.26	0.10	0.71	0.23	0.11	0.02 U	0.05	0.11
5403-009-FSS-SU8-R1-010	1.25	0.26	0.14	3.54	0.74	1.62	0.35	0.06	1.78	0.37	0.05	0.14 J	0.10	0.04
5403-009-FSS-SU8-R1-010 (SUP)	0.76	0.32	0.22	1.87	0.36	0.87	0.25	0.10	0.98	0.27	0.06	0.02 U	0.03	0.04
5403-009-FSS-SU8-R1-011	0.64 J	0.18	0.13	8.88	0.60	4.23	0.69	0.07	4.45	0.72	0.05	0.20 J	0.11	0.06
5403-009-FSS-SU8-R1-011 (SUP)	2.14	0.56	0.29	1.62	0.41	0.77	0.24	0.10	0.82	0.25	0.12	0.03 U	0.05	0.08
5403-009-FSS-SU8-R1-012	0.89 J	0.23	0.17	1.66	0.87	0.79 J	0.22	0.06	0.76 J	0.21	0.06	0.11 J	0.08	0.07
5403-009-FSS-SU8-R1-012 (SUP)	1.39	0.47	0.27	1.83	0.43	0.66	0.23	0.11	1.10	0.31	0.10	0.07 U	0.08	0.10
5403-009-FSS-SU8-R1-013	2.31	0.41	0.16	4.29	0.93	2.07	0.41	0.07	2.13	0.42	0.06	0.09 J	0.08	0.04
5403-009-FSS-SU8-R1-013 (SUP)	1.19	0.40	0.30	1.79	0.37	0.99	0.27	0.07	0.78	0.24	0.11	0.02 U	0.05	0.11
5403-009-FSS-SU8-R1-014	0.49 J	0.17	0.16	4.99	0.66	2.38	0.44	0.06	2.45	0.45	0.07	0.16 J	0.10	0.06
5403-009-FSS-SU8-R1-014 (SUP)	0.97	0.34	0.25	2.04	0.42	1.13	0.32	0.04	0.89	0.28	0.13	0.02 U	0.04	0.05
	Bias z-score													
5403-009-FSS-SU8-R1-017 (GP510) SUP	3.71	1.07	0.50	1.93	0.38	0.90	0.27	0.08	0.98	0.28	0.08	0.05 U	0.06	0.09
	Laboratory Duplicates													
5403-009-FSS-SU8-R1-001	0.67 J	0.21	0.19	5.42	0.21	2.72	0.49	0.07	2.59	0.48	0.05	0.11 J	0.08	0.06
5403-009-FSS-SU8-R1-001 DUP	0.76 J	0.23	0.20	5.60	0.21	2.57	0.47	0.07	2.93	0.52	0.06	0.10 J	0.08	0.04
5403-009-FSS-SU8-R1-005	1.38	0.40	0.07	8.30	0.22	4.36	0.79	0.09	3.78	0.71	0.07	0.16	0.11	0.07
5403-009-FSS-SU8-R1-005 DUP	1.06	0.32	0.08	4.36	0.23	4.31	0.82	0.06	4.55	0.86	0.07	0.18	0.12	0.06
5403-009-FSS-SU8-R1-001 (SUP)	1.64	0.57	0.26	1.82	0.36	0.80	0.23	0.07	0.97	0.26	0.07	0.05	0.05	0.04
5403-009-FSS-SU8-R1-001 DUP (SUP)	2.42	0.68	0.35	1.33	0.43	0.68	0.22	0.08	0.63	0.21	0.09	0.02 U	0.03	0.04
	Field Replicates													
5403-009-FSS-SU8-R1-005	1.38	0.40	0.07	8.30	0.22	4.36	0.79	0.09	3.78	0.71	0.07	0.16	0.11	0.07
5403-009-FSS-SU8-R1-015	0.60	0.25	0.08	8.28	0.23	4.08	0.79	0.06	4.00	0.77	0.09	0.20	0.13	0.04
5403-009-FSS-SU8-R1-006	1.92	0.46	0.10	6.85	0.29	3.29	0.68	0.08	3.46	0.71	0.09	0.10	0.09	0.04
5403-009-FSS-SU8-R1-016	1.69	0.44	0.09	7.37	0.27	3.68	0.70	0.09	3.49	0.67	0.08	0.20	0.12	0.07
5403-009-FSS-SU8-R1-015 (SUP)	0.82	0.28	0.12	1.30	2.02	0.02	0.03	0.05	1.21	0.33	0.07	0.07 U	0.08	0.09
5403-009-FSS-SU8-R1-006 (SUP)	0.70	0.27	0.15	1.76	0.43	0.69	0.22	0.10	0.97	0.28	0.08	0.10	0.09	0.09
5403-009-FSS-SU8-R1-016 (SUP)	2.14	0.75	0.29	1.65	0.42	0.78	0.23	0.04	0.85	0.25	0.04	0.02 U	0.03	0.05
5403-009-FSS-SU8-R1-012 (SUP)	1.39	0.47	0.27	1.83	0.45	0.66	0.23	0.11	1.10	0.31	0.10	0.07 U	0.08	0.10

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The U-235 concentration was reported as a negative number for sample ID 5403-009-SU8-FSS-R1-004(SUP);
however a value of 0.00 pCi/g was used for statistical purposes.
Note: The notation "(SUP)" following the sample number indicates that this result is from a supplimental set of FSS samples completed after waste piles and liners were removed from this survey unit. The survey unit had been previously excavated to cleanup goals prior to placement of the waste pile, and FSS samples were collected and prepared for the FSSR.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-9														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU9-R-1-001	1.62	0.50	0.20	2.28	2.04	1.04 J	0.27	0.03	1.22 J	0.30	0.06	0.02 U	0.03	0.04
5403-009-FSS-SU9-R-1-002	3.34	0.87	0.28	2.72	1.60	1.43	0.34	0.06	1.26	0.31	0.08	0.03 U	0.04	0.07
5403-009-FSS-SU9-R-1-003	1.81	0.46	0.21	3.90	0.96	2.04	0.44	0.07	1.79	0.40	0.07	0.08 J	0.07	0.04
5403-009-FSS-SU9-R-1-004	1.80	0.52	0.21	7.47	0.85	4.16 J	0.84	0.10	3.17 J	0.68	0.09	0.15	0.12	0.10
5403-009-FSS-SU9-R-1-005	3.17	1.45	0.97	7.41	0.94	3.32 J	1.03	0.33	3.64 J	1.10	0.33	0.45	0.37	0.20
5403-009-FSS-SU9-R-1-006	2.53	0.60	0.20	7.92	0.89	3.88 J	0.83	0.05	3.90 J	0.84	0.11	0.14	0.12	0.07
5403-009-FSS-SU9-R-1-007	2.33	0.67	0.24	4.11	0.77	1.88 J	0.45	0.07	2.06 J	0.48	0.09	0.18	0.12	0.09
5403-009-FSS-SU9-R-1-008	0.87	0.37	0.21	3.89	1.46	2.03 J	0.48	0.12	1.81 J	0.45	0.10	0.05	0.07	0.12
5403-009-FSS-SU9-R-1-009	1.69	0.57	0.34	2.68	1.30	1.33 J	0.37	0.08	1.30 J	0.36	0.10	0.06 U	0.08	0.10
5403-009-FSS-SU9-R-1-010	2.87	0.60	0.23	9.69	0.90	4.77	0.91	0.04	4.80	0.91	0.08	0.11 J	0.10	0.09
5403-009-FSS-SU9-R-1-011	1.74	0.47	0.25	2.67	1.60	1.34	0.33	0.07	1.30	0.33	0.08	0.03 U	0.05	0.08
5403-009-FSS-SU9-R-1-012	0.77	0.28	0.20	2.91	0.72	1.12	0.30	0.07	1.61	0.38	0.04	0.18 J	0.11	0.08
5403-009-FSS-SU9-R-1-013	0.68	0.26	0.15	1.44	1.49	0.64	0.22	0.09	0.75	0.24	0.07	0.04 U	0.06	0.11
5403-009-FSS-SU9-R-1-014	0.96	0.31	0.19	5.09	0.84	2.40	0.56	0.10	2.53	0.58	0.10	0.16 J	0.13	0.13
Biased Sample Results														
5403-009-FSS-SU9-R-1-GP267BIAS	1.29	0.40	0.17	7.17	0.92	3.88	0.72	0.12	3.20	0.62	0.12	0.09 J	0.08	0.09
5403-009-FSS-SU9-R-1-GP618BIAS	1.43	0.54	0.35	13.32	0.63	6.87	1.20	0.09	6.22	1.10	0.04	0.23 J	0.13	0.05
5403-009-FSS-SU9-R-1-GP675BIAS	2.44	0.70	0.35	5.64	0.66	2.58	0.51	0.06	2.88	0.55	0.07	0.17 J	0.10	0.07
Laboratory Duplicates														
5403-009-FSS-SU9-R-1-001	1.62	0.50	0.20	2.28	2.04	1.04 J	0.27	0.03	1.22 J	0.30	0.06	0.02 U	0.03	0.04
5403-009-SU9-FSS-R-1-001 DUP	1.25	0.34	0.14	2.18	0.95	1.09	0.27	0.05	1.01	0.27	0.05	0.08	0.07	0.08
5403-009-SU9-FSS-R-1-010	2.87	0.60	0.23	9.69	0.90	4.77	0.91	0.04	4.80	0.91	0.08	0.11 J	0.10	0.09
5403-009-SU9-FSS-R-1-010 DUP	2.79	0.62	0.29	10.75	0.56	5.14	0.97	0.07	5.24	0.99	0.07	0.37	0.18	0.11
Field Replicates														
5403-009-FSS-SU9-R-1-005	3.17	1.45	0.97	7.41	0.94	3.32 J	1.03	0.33	3.64 J	1.10	0.33	0.45	0.37	0.20
5403-009-FSS-SU9-R-1-015	1.53	0.47	0.32	8.06	0.74	3.85	0.75	0.07	4.05	0.79	0.07	0.16 J	0.11	0.05
5403-009-FSS-SU9-R-1-006	2.53	0.60	0.20	7.92	0.89	3.88 J	0.83	0.05	3.90 J	0.84	0.11	0.14	0.12	0.07
5403-009-FSS-SU9-R-1-016	2.39	0.51	0.23	6.64	0.65	3.16	0.62	0.10	3.26	0.64	0.10	0.22 J	0.13	0.11

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-10

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-SU10-FSS-R-1-001	1.48	0.32	0.17	2.54	0.35	1.40	0.33	0.06	1.10	0.28	0.06	0.04 U	0.06	0.08
5403-009-SU10-FSS-R-1-001 (SUP)	2.43	0.60	0.30	2.03	0.40	1.03	0.28	0.06	0.95	0.27	0.08	0.05 U	0.06	0.08
5403-009-SU10-FSS-R-1-002	1.16	0.26	0.15	2.02	0.37	1.26	0.29	0.07	0.73 J	0.21	0.06	0.03 U	0.05	0.04
5403-009-SU10-FSS-R-1-002 (SUP)	1.10	0.36	0.21	1.80	0.42	0.87	0.26	0.07	0.84	0.25	0.10	0.10 U	0.09	0.11
5403-009-SU10-FSS-R-1-003	1.55	0.30	0.15	3.40	0.70	1.55	0.34	0.03	1.69	0.36	0.06	0.16 J	0.10	0.07
5403-009-SU10-FSS-R-1-003 (SUP)	1.61	0.46	0.20	3.14	0.86	1.44	0.34	0.07	1.60	0.37	0.06	0.11	0.09	0.07
5403-009-SU10-FSS-R-1-004	1.52	0.32	0.17	15.79	0.46	8.00	1.20	0.06	7.40	1.10	0.05	0.39 J	0.16	0.06
5403-009-SU10-FSS-R-1-004 (SUP)	1.74	0.46	0.21	2.95	0.92	1.38	0.34	0.06	1.48	0.36	0.08	0.10	0.09	0.08
5403-009-SU10-FSS-R-1-005	1.09	0.24	0.13	3.74	0.76	1.80	0.37	0.07	1.81	0.37	0.07	0.13 J	0.09	0.06
5403-009-SU10-FSS-R-1-005 (SUP)	1.09	0.35	0.20	1.57	1.09	0.75	0.22	0.08	0.76	0.22	0.08	0.06	0.06	0.04
5403-009-SU10-FSS-R-1-006	2.50	0.40	0.12	7.94	0.49	3.65	0.63	0.05	3.94	0.67	0.07	0.35 J	0.15	0.07
5403-009-SU10-FSS-R-1-006 (SUP)	1.45	0.43	0.25	2.27	0.88	1.02	0.29	0.10	1.13	0.31	0.08	0.11	0.09	0.07
5403-009-SU10-FSS-R-1-007	1.10	0.25	0.15	3.10	1.17	1.57	0.34	0.07	1.47	0.32	0.06	0.06 J	0.06	0.04
5403-009-SU10-FSS-R-1-007 (SUP)	1.20	0.38	0.15	2.79	1.06	1.41	0.32	0.07	1.33	0.31	0.06	0.06	0.06	0.04
5403-009-SU10-FSS-R-1-008	1.07	0.24	0.13	1.45	0.40	0.71 J	0.20	0.05	0.71 J	0.20	0.07	0.03 U	0.05	0.08
5403-009-SU10-FSS-R-1-008 (SUP)	1.67	0.43	0.17	2.84	0.35	1.30	0.33	0.09	1.48	0.36	0.08	0.06 U	0.07	0.10
5403-009-SU10-FSS-R-1-009	1.41	0.43	0.30	4.52	0.91	2.20	0.48	0.07	2.22	0.48	0.08	0.10 J	0.08	0.05
5403-009-SU10-FSS-R-1-009 (SUP)	1.11	0.37	0.16	2.52	0.42	1.06	0.32	0.08	1.36	0.38	0.05	0.10 U	0.06	0.05
5403-009-SU10-FSS-R-1-010	1.43	0.30	0.14	4.92	0.73	2.47	0.47	0.05	2.30	0.45	0.08	0.15 J	0.10	0.04
5403-009-SU10-FSS-R-1-010 (SUP)	1.26	0.39	0.29	2.66	0.35	1.43	0.35	0.09	1.17	0.30	0.10	0.06 U	0.07	0.11
5403-009-SU10-FSS-R-1-011	1.24	0.37	0.21	3.63	0.99	1.77	0.41	0.05	1.78	0.41	0.08	0.08 J	0.08	0.05
5403-009-SU10-FSS-R-1-011 SUP)	1.75	0.48	0.21	2.22	0.96	1.01	0.27	0.09	1.12	0.29	0.08	0.09	0.08	0.09
5403-009-SU10-FSS-R-1-012	1.56	0.32	0.16	5.80	0.90	2.68	0.50	0.06	3.04	0.55	0.06	0.08 J	0.07	0.06
5403-009-SU10-FSS-R-1-012 SUP)	0.75	0.28	0.17	1.78	0.41	0.75	0.22	0.06	0.98	0.27	0.08	0.06 U	0.06	0.09
5403-009-SU10-FSS-R-1-013	1.55	0.29	0.16	7.48	0.71	3.46	0.61	0.08	3.87	0.66	0.08	0.15 J	0.10	0.06
5403-009-SU10-FSS-R-1-013 SUP)	2.05	0.57	0.31	3.42	0.33	1.62	0.37	0.08	1.65	0.38	0.10	0.15 U	0.10	0.07
5403-009-SU10-FSS-R-1-014	1.48	0.30	0.16	4.01	0.73	2.01	0.41	0.06	1.85	0.39	0.06	0.15 J	0.10	0.04
5403-009-SU10-FSS-R-1-014 (SUP)	1.69	0.53	0.29	2.64	0.92	1.15	0.30	0.10	1.39	0.35	0.09	0.10	0.08	0.05
5403-009-SU10-FSS-R-1-015	1.24	0.27	0.16	2.83	1.03	1.56	0.33	0.06	1.20	0.28	0.07	0.07 J	0.07	0.04
5403-009-SU10-FSS-R-1-016	0.81 J	0.20	0.13	1.52	0.38	0.73 J	0.20	0.04	0.77 J	0.20	0.06	0.02 U	0.04	0.05
5403-009-SU10-FSS-R-1-017	3.08	0.46	0.13	9.89	0.57	4.70	0.76	0.05	4.94	0.79	0.06	0.25 J	0.13	0.04
Biased Sample Results														
5403-009-FSS-SU10-R1-GP002	1.65	0.48	0.30	1.97	0.35	2.21	0.46	0.01	2.11	0.44	0.09	0.17	0.11	0.09
5403-009-FSS-SU10-R1-GP600	0.87 J	0.23	0.17	1.97	0.35	0.88 J	0.22	0.05	1.03	0.25	0.03	0.06 J	0.06	0.06
5403-009-FSS-SU10-R1-017-BIAS (SUP)	1.30	0.41	0.26	2.90	0.35	1.56	0.37	0.04	1.26	0.33	0.10	0.08	0.08	0.08
Laboratory Duplicates														
5403-009-SU10-FSS-R-1-001	1.48	0.32	0.17	2.54	0.35	1.40	0.33	0.06	1.10	0.28	0.06	0.04 U	0.06	0.08
5403-009-SU10-FSS-R-1-001 DUP	1.23	0.30	0.19	2.52	0.36	1.32	0.32	0.04	1.07	0.28	0.07	0.13 J	0.10	0.08
5403-009-SU10-FSS-R-1-001 (SUP)	2.43	0.60	0.30	2.03	0.40	1.03	0.28	0.06	0.95	0.27	0.08	0.05	0.06	0.08
5403-009-SU10-FSS-R-1-001 DUP (SUP)	1.96	0.51	0.23	2.14	0.39	0.89	0.25	0.08	1.16	0.30	0.07	0.09	0.08	0.09
Field Replicates														
5403-009-SU10-FSS-R-1-005	1.09	0.24	0.13	3.74	0.29	1.80	0.37	0.07	1.81	0.37	0.07	0.13 J	0.09	0.06
5403-009-SU10-FSS-R-1-015	1.24	0.27	0.16	2.83	0.31	1.56	0.33	0.06	1.20	0.28	0.07	0.07 J	0.07	0.04
5403-009-SU10-FSS-R-1-008	1.07	0.24	0.13	1.45	0.40	0.71 J	0.20	0.05	0.71 J	0.20	0.07	0.03 U	0.05	0.08
5403-009-SU10-FSS-R-1-016	0.81 J	0.20	0.13	1.52	0.38	0.73 J	0.20	0.04	0.77 J	0.20	0.06	0.02 U	0.04	0.05
5403-009-SU10-FSS-R-1-001 (SUP)	2.43	0.60	0.30	2.03	0.40	1.03	0.28	0.06	0.95	0.27	0.08	0.05 U	0.06	0.08
5403-009-SU10-FSS-R-1-015 (SUP)	1.93	0.54	0.38	2.33	0.39	1.13	0.31	0.09	1.13	0.31	0.14	0.07 U	0.07	0.08
5403-009-SU10-FSS-R-1-006 (SUP)	1.45	0.43	0.25	2.27	0.39	1.02	0.29	0.10	1.13	0.31	0.08	0.11	0.09	0.07
5403-009-SU10-FSS-R-1-016 (SUP)	1.42	0.38	0.13	2.53	0.35	1.26	0.31	0.08	1.20	0.30	0.06	0.08	0.07	0.04

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The notation "(SUP)" following the sample number indicates that this result is from a supplimental set of FSS samples completed after waste piles and liners were removed from this survey unit. The survey unit had been previously excavated to cleanup goals prior to placement of the waste pile, and FSS samples were collected and prepared for the FSSR.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-11

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU11-R1-001	1.34	0.28	0.13	7.55	0.26	3.53	0.65	0.09	3.92	0.71	0.07	0.10 J	0.09	0.07
5403-009-FSS-SU11-R1-001 (SUP)	0.02 U	0.06	0.20	2.00	0.43	1.07	0.31	0.09	0.85	0.27	0.09	0.08 UJ	0.08	0.09
5403-009-FSS-SU11-R1-002	1.44	0.29	0.14	11.04	0.24	5.40	0.90	0.08	5.46	0.91	0.06	0.18 J	0.12	0.04
5403-009-FSS-SU11-R1-002 (SUP)	1.25 J	0.41	0.25	2.31	0.50	1.20	0.41	0.14	1.05	0.38	0.20	0.06 UJ	0.09	0.09
5403-009-FSS-SU11-R1-003	1.31	0.28	0.16	2.32	0.33	1.15	0.27	0.07	1.13	0.26	0.06	0.04 J	0.05	0.04
5403-009-FSS-SU11-R1-003 (SUP)	1.79 J	0.50	0.22	1.99	0.47	1.04	0.33	0.12	0.88	0.30	0.14	0.07 UJ	0.08	0.11
5403-009-FSS-SU11-R1-004	1.48	0.29	0.13	3.71	0.29	1.78	0.37	0.07	1.87	0.38	0.07	0.06 U	0.07	0.08
5403-009-FSS-SU11-R1-004 (SUP)	1.70 J	0.51	0.27	2.61	0.42	1.07	0.34	0.10	1.45	0.41	0.16	0.09 UJ	0.10	0.13
5403-009-FSS-SU11-R1-005	1.43	0.29	0.15	3.60	0.29	1.96	0.38	0.04	1.56	0.33	0.07	0.08 J	0.07	0.04
5403-009-FSS-SU11-R1-005 (SUP)	1.51 J	0.43	0.23	2.15	0.48	1.11	0.37	0.10	1.02	0.35	0.15	0.02 UJ	0.06	0.13
5403-009-FSS-SU11-R1-006	1.11	0.25	0.14	3.70	0.30	1.74	0.37	0.06	1.79	0.38	0.08	0.17 J	0.11	0.04
5403-009-FSS-SU11-R1-006 (SUP)	1.16 J	0.40	0.25	2.23	0.47	0.90	0.31	0.11	1.24	0.38	0.14	0.10 UJ	0.11	0.12
5403-009-FSS-SU11-R1-007	1.54	0.31	0.15	2.87	0.32	1.35	0.31	0.07	1.42	0.32	0.05	0.10 J	0.08	0.06
5403-009-FSS-SU11-R1-007 (SUP)	1.85 J	0.50	0.20	2.06	0.54	0.96	0.37	0.15	1.04	0.39	0.17	0.06 UJ	0.10	0.19
5403-009-FSS-SU11-R1-008	1.61	0.31	0.13	4.28	0.29	2.14	0.43	0.07	2.00	0.41	0.07	0.14 J	0.10	0.04
5403-009-FSS-SU11-R1-008 (SUP)	1.03 J	0.37	0.23	2.17	0.45	1.05	0.34	0.11	1.12	0.35	0.11	0.00 UJ	0.01	0.11
5403-009-FSS-SU11-R1-009	1.33	0.28	0.17	4.80	0.27	2.41	0.45	0.07	2.31	0.44	0.07	0.08 J	0.07	0.06
5403-009-FSS-SU11-R1-009 (SUP)	1.29 J	0.39	0.22	2.48	0.50	1.01	0.38	0.16	1.34	0.45	0.16	0.13 UJ	0.13	0.15
5403-009-FSS-SU11-R1-010	1.34	0.27	0.13	2.32	0.34	1.19	0.28	0.06	1.06	0.26	0.06	0.07 U	0.07	0.07
5403-009-FSS-SU11-R1-010 (SUP)	0.94 J	0.33	0.20	2.06	0.47	0.87	0.30	0.06	1.11	0.35	0.12	0.07 UJ	0.09	0.12
5403-009-FSS-SU11-R1-011	1.58	0.31	0.16	2.77	0.33	1.40	0.32	0.08	1.26	0.30	0.07	0.11 J	0.09	0.04
5403-009-FSS-SU11-R1-011 (SUP)	2.34	0.59	0.24	3.86	0.55	2.15 J	0.79	0.26	1.54	0.64	0.26	0.17 U	0.21	0.27
5403-009-FSS-SU11-R1-012	1.40	0.28	0.13	4.07	0.27	1.92	0.37	0.06	1.98	0.38	0.07	0.17 J	0.10	0.06
5403-009-FSS-SU11-R1-012 SUP)	1.56	0.42	0.21	2.58	0.41	1.15 J	0.34	0.10	1.29	0.37	0.14	0.13 J	0.11	0.06
5403-009-FSS-SU11-R1-013	1.31	0.28	0.15	2.30	0.34	1.12	0.27	0.06	1.08	0.26	0.05	0.10 J	0.08	0.04
5403-009-FSS-SU11-R1-013 (SUP)	1.49	0.51	0.27	2.06	0.47	0.87 J	0.30	0.12	1.04	0.34	0.14	0.14 J	0.12	0.11
5403-009-FSS-SU11-R1-014	1.77	0.33	0.14	3.08	0.33	1.84	0.39	0.05	1.12	0.28	0.07	0.12 J	0.09	0.08
5403-009-FSS-SU11-R1-014 (SUP)	2.54	0.60	0.25	4.74	0.33	2.34 J	0.54	0.09	2.24	0.53	0.14	0.16 J	0.12	0.11
5403-009-FSS-SU11-R1-015	1.65	0.44	0.16	4.51	0.86	2.17	0.49	0.04	2.21	0.50	0.07	0.13	0.10	0.09
5403-009-FSS-SU11-R1-015 (SUP)	1.29	0.40	0.23	2.80	0.44	1.35 J	0.41	0.10	1.32	0.41	0.14	0.13 J	0.12	0.12
5403-009-FSS-SU11-R1-016	1.40	0.29	0.15	2.20	0.34	1.08	0.26	0.05	1.09	0.26	0.05	0.03 U	0.05	0.04
5403-009-FSS-SU11-R1-016 (SUP)	1.06	0.33	0.19	2.09	0.46	1.00 J	0.33	0.11	1.10	0.35	0.13	0.00 U	0.01	0.12
5403-009-FSS-SU11-R1-017	2.77	0.66	0.25	4.60	0.36	2.28	0.58	0.05	2.18	0.56	0.14	0.14 U	0.13	0.15
5403-009-FSS-SU11-R1-017 (SUP)	1.62	0.46	0.20	2.46	0.41	1.16 J	0.33	0.09	1.18	0.34	0.10	0.12 J	0.10	0.11
	Bias Sample													
5403-009-FSS-SU11-R1-GP600	2.33	0.59	0.24	3.74	0.85	1.77	0.47	0.11	1.78	0.47	0.15	0.19 J	0.14	0.13
5403-009-FSS-SU11-R1-BIAS (SUP)	1.83	0.52	0.24	6.15	0.32	2.96 J	0.67	0.05	3.17	0.70	0.11	0.02 U	0.05	0.11
	Laboratory Duplicates													
5403-009-FSS-SU11-R1-001	1.34	0.28	0.13	7.55	0.26	3.53	0.65	0.09	3.92	0.71	0.07	0.10 J	0.09	0.07
5403-009-FSS-SU11-R1-001 DUP	1.28	0.27	0.16	6.81	0.26	3.38	0.63	0.08	3.31	0.62	0.09	0.12 J	0.10	0.05
5403-009-FSS-SU11-R1-015	1.65	0.44	0.16	4.51	0.86	2.17	0.49	0.04	2.21	0.50	0.07	0.13	0.10	0.09
5403-009-FSS-SU11-R1-015 DUP	1.53	0.39	0.15	5.17	0.82	2.53	0.53	0.07	2.52	0.53	0.07	0.12	0.09	0.05
5403-009-FSS-SU11-R1-001 (SUP)	0.02 U	0.06	0.20	2.00	0.43	1.07	0.31	0.09	0.85	0.27	0.09	0.08 U	0.08	0.09
5403-009-FSS-SU11-R1-001DUP (SUP)	0.00 U	0.00	0.13	2.35	0.43	1.36	0.39	0.12	0.98	0.32	0.13	0.01 U	0.05	0.15
5403-009-FSS-SU11-R1-011 (SUP)	2.34	0.59	0.24	3.86	0.55	2.15	0.79	0.26	1.54	0.64	0.26	0.17 U	0.21	0.27
5403-009-FSS-SU11-R1-011DUP (SUP)	2.36	0.54	0.13	3.28	0.38	1.79	0.47	0.11	1.48	0.41	0.12	0.01 U	0.05	0.15
	Field Replicates													
5403-009-FSS-SU11-R1-013	1.31	0.28	0.15	2.30	0.34	1.12	0.27	0.06	1.08	0.26	0.05	0.10 J	0.08	0.04
5403-009-FSS-SU11-R1-018	1.19	0.26	0.15	2.15	0.34	1.12	0.26	0.04	0.98 J	0.24	0.06	0.05 U	0.06	0.06
5403-009-FSS-SU11-R1-001	1.34	0.28	0.13	7.55	0.26	3.53	0.65	0.09	3.92	0.71	0.07	0.10 J	0.09	0.07
5403-009-FSS-SU11-R1-019	1.39	0.30	0.19	7.76	0.27	4.18	0.77	0.10	3.43	0.66	0.10	0.15 J	0.12	0.13
5403-009-FSS-SU11-R1-007	1.54	0.31	0.15	2.87	0.32	1.35	0.31	0.07	1.42	0.32	0.05	0.10 J	0.08	0.06
5403-009-FSS-SU11-R-1-020	0.97 J	0.27	0.25	2.45	0.32	1.13	0.26	0.07	1.26	0.28	0.05	0.06 J	0.06	0.06
5403-009-FSS-SU11-R1-009 (SUP)	1.29	0.39	0.22	2.48	0.50	1.01	0.38	0.16	1.34	0.45	0.16	0.13 U	0.13	0.15
5403-009-FSS-SU11-R1-018 SUP)	1.33	0.39	0.20	2.26	0.39	1.02 J	0.29	0.08	1.23	0.33	0.08	0.02 U	0.04	0.09
5403-009-FSS-SU11-R1-014 (SUP)	2.54	0.60	0.25	4.74	0.33	2.34	0.54	0.09	2.24	0.53	0.14	0.16	0.12	0.11
5403-009-FSS-SU11-R1-019 (SUP)	2.12	0.55	0.26	5.23	0.34	2.46 J	0.59	0.11	2.51	0.60	0.11	0.25 J	0.16	0.11

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The notation "(SUP)" following the sample number indicates that this result is from a supplimental set of FSS samples completed after waste piles and liners were removed from this survey unit. The survey unit had been previously excavated to cleanup goals prior to placement of the waste pile, and FSS samples were collected and prepared for the FSSR.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-12														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU12-R-1-001	2.62	0.66	0.40	3.50	0.33	2.03	0.44	0.08	1.41	0.34	0.11	0.06 U	0.07	0.07
5403-009-FSS-SU12-R-1-002	2.17	0.50	0.18	5.90	0.29	2.95	0.61	0.08	2.87	0.60	0.09	0.09	0.08	0.08
5403-009-FSS-SU12-R-1-003	1.45	0.45	0.25	3.07	0.37	1.62	0.41	0.04	1.42	0.38	0.10	0.04 U	0.06	0.09
5403-009-FSS-SU12-R-1-004	3.27	0.78	0.23	3.34	0.33	1.46	0.35	0.08	1.72	0.39	0.04	0.15	0.10	0.09
5403-009-FSS-SU12-R-1-005	3.51	0.82	0.34	2.48	0.38	1.51	0.37	0.08	0.91	0.27	0.11	0.05 U	0.06	0.08
5403-009-FSS-SU12-R-1-006	2.79	0.64	0.22	3.85	0.31	1.70	0.38	0.08	2.07	0.44	0.08	0.09	0.08	0.07
5403-009-FSS-SU12-R-1-007	3.07	0.74	0.29	3.15	0.33	1.55	0.36	0.07	1.49	0.35	0.07	0.12	0.09	0.08
5403-009-FSS-SU12-R-1-008	1.84	0.54	0.29	2.97	0.36	1.47	0.37	0.09	1.37	0.35	0.10	0.13	0.10	0.05
5403-009-FSS-SU12-R-1-009	1.44	0.42	0.17	2.69	0.35	1.35	0.33	0.08	1.23	0.31	0.04	0.11	0.09	0.09
5403-009-FSS-SU12-R-1-010	1.20	0.36	0.18	2.35	0.37	1.12	0.30	0.09	1.21	0.31	0.08	0.01 U	0.03	0.08
5403-009-FSS-SU12-R-1-011	1.95	0.54	0.24	2.53	0.36	1.24	0.32	0.06	1.22	0.31	0.09	0.07	0.07	0.05
5403-009-FSS-SU12-R-1-012	1.07	0.36	0.15	2.64	0.38	1.09	0.30	0.04	1.45	0.37	0.07	0.10	0.09	0.10
5403-009-FSS-SU12-R-1-013	3.20	0.84	0.40	4.38	0.33	2.30	0.52	0.14	1.95	0.46	0.10	0.13	0.11	0.11
5403-009-FSS-SU12-R-1-014	2.84	0.74	0.40	3.76	0.33	1.88	0.44	0.08	1.82	0.43	0.10	0.07 U	0.08	0.11
Biased Sample Results														
5403-009-FSS-SU12-R-1-GP119BIAS	2.48	0.66	0.30	4.68	0.30	2.54	0.52	0.07	1.97	0.43	0.08	0.17	0.11	0.09
Laboratory Duplicates														
5403-009-SU12-FSS-R-1-001	2.62	0.66	0.40	3.50	0.33	2.03	0.44	0.08	1.41	0.34	0.11	0.06 U	0.07	0.07
5403-009-SU12-FSS-R-1-001 DUP	2.79	0.63	0.22	3.27	0.34	1.74	0.41	0.10	1.43	0.36	0.08	0.10	0.09	0.05
Field Replicates														
5403-009-FSS-SU12-R-1-005	3.51	0.82	0.34	2.48	0.38	1.51	0.37	0.08	0.91	0.27	0.11	0.05 U	0.06	0.08
5403-009-FSS-SU12-R-1-015	1.89	0.55	0.39	3.03	0.36	1.32	0.35	0.14	1.70	0.42	0.17	0.02 U	0.04	0.09
5403-009-FSS-SU12-R-1-006	2.79	0.64	0.22	3.85	0.31	1.70	0.38	0.08	2.07	0.44	0.08	0.09	0.08	0.07
5403-009-FSS-SU12-R-1-016	2.59	0.51	0.23	3.92	0.32	1.89	0.43	0.11	1.95	0.44	0.10	0.08 U	0.08	0.09

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-13														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU13-R-1-001	0.92 J	0.23	0.16	1.49	0.40	0.68 J	0.20	0.05	0.77 J	0.21	0.06	0.04 U	0.05	0.06
5403-009-FSS-SU13-R-1-002	1.39	0.29	0.17	8.96	0.53	4.81	0.77	0.03	3.88	0.65	0.05	0.27 J	0.13	0.06
5403-009-FSS-SU13-R-1-003	0.91 J	0.23	0.17	1.83	0.38	0.98 J	0.25	0.06	0.83 J	0.23	0.06	0.02 U	0.05	0.07
5403-009-FSS-SU13-R-1-004	0.29 J	0.14	0.16	0.61	0.63	0.34 J	0.14	0.06	0.25 U	0.12	0.08	0.02 U	0.05	0.09
5403-009-FSS-SU13-R-1-005	3.79	0.55	0.14	7.24	0.62	3.42	0.57	0.06	3.63	0.60	0.05	0.19 J	0.11	0.03
5403-009-FSS-SU13-R-1-006	1.16	0.25	0.14	3.82	0.30	1.91	0.40	0.03	1.78	0.38	0.07	0.13 J	0.09	0.07
5403-009-FSS-SU13-R-1-007 POST	1.47	0.30	0.14	7.83	0.24	3.99	0.66	0.06	3.65	0.62	0.05	0.19 J	0.11	0.04
5403-009-FSS-SU13-R-1-008	1.20	0.28	0.20	14.48	0.23	7.40	1.20	0.08	6.80	1.10	0.07	0.28 J	0.14	0.07
5403-009-FSS-SU13-R-1-009	1.76	0.35	0.21	10.28	0.61	5.39	0.87	0.05	4.66	0.77	0.07	0.23 J	0.13	0.07
5403-009-FSS-SU13-R-1-010	1.22	0.27	0.17	2.39	0.33	1.30	0.29	0.07	1.04	0.25	0.06	0.05 J	0.06	0.04
5403-009-FSS-SU13-R-1-011	1.17	0.28	0.18	1.94	0.37	1.12	0.27	0.06	0.80 J	0.22	0.07	0.02 U	0.05	0.09
5403-009-FSS-SU13-R-1-012	1.18	0.29	0.22	2.53	0.50	1.42	0.48	0.19	1.07	0.40	0.14	0.04 U	0.10	0.10
5403-009-FSS-SU13-R-1-013 POST	1.09	0.25	0.14	5.91	0.58	2.88	0.50	0.04	2.84	0.50	0.06	0.19 J	0.10	0.06
5403-009-FSS-SU13-R-1-014	1.09	0.27	0.17	2.50	0.33	1.20	0.28	0.07	1.23	0.28	0.06	0.07 J	0.07	0.04
Laboratory Duplicates														
5403-009-FSS-SU13-R-1-001	0.92 J	0.23	0.16	1.49	0.40	0.68 J	0.20	0.05	0.77 J	0.21	0.06	0.04 U	0.05	0.06
5403-009-FSS-SU13-R-1-001 DUP	0.77	0.20	0.14	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5403-009-FSS-SU13-R-1-004	0.29	0.14	0.16	0.61	0.63	0.34 J	0.14	0.06	0.25 J	0.12	0.08	0.02 U	0.05	0.09
5403-009-FSS-SU13-R-1-004 DUP	N/A	N/A	N/A	0.41	0.94	0.17 J	0.12	0.09	0.24 J	0.15	0.10	0.00 U	0.00	0.00
Field Replicates														
5403-009-FSS-SU13-R-1-008	1.20	0.28	0.20	14.48	0.55	7.40	1.20	0.08	6.80	1.10	0.07	0.28	0.14	0.07
5403-009-FSS-SU13-R-1-15	1.22	0.27	0.17	14.13	0.56	6.70	1.00	0.05	7.20	1.10	0.08	0.23 J	0.12	0.04
5403-009-FSS-SU13-R-1-014	1.09	0.27	0.17	2.50	1.05	1.20	0.28	0.07	1.23	0.28	0.06	0.07	0.07	0.04
5403-009-FSS-SU13-R-1-016	1.41	0.29	0.15	1.97	0.35	1.00	0.25	0.06	0.97 J	0.24	0.06	0.00 U	0.30	0.06

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-14

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU14-R-1-001	1.27	0.27	0.15	16.66	0.54	8.20	1.20	0.03	8.20	1.20	0.07	0.26 J	0.13	0.07
5403-009-FSS-SU14-R-1-001 (SUP)	0.80	0.28	0.17	2.30	0.35	1.11	0.28	0.08	1.17	0.29	0.07	0.02 U	0.04	0.10
5403-009-FSS-SU14-R-1-002	0.76 J	0.22	0.18	2.85	1.02	1.15	0.35	0.10	1.56	0.43	0.10	0.14 J	0.13	0.12
5403-009-FSS-SU14-R-1-002 (SUP)	1.48	0.43	0.24	2.56	0.87	1.12	0.29	0.07	1.34	0.33	0.10	0.11 J	0.09	0.07
5403-009-FSS-SU14-R-1-003	1.28	0.29	0.16	3.10	0.82	1.48	0.32	0.07	1.51	0.33	0.06	0.11 J	0.09	0.04
5403-009-FSS-SU14-R-1-003 (SUP)	1.41	0.43	0.20	3.93	0.34	2.01	0.48	0.11	1.89	0.46	0.07	0.03 U	0.06	0.12
5403-009-FSS-SU14-R-1-004	2.34	0.41	0.16	6.64	0.60	3.26	0.54	0.04	3.20 J	0.53	0.05	0.18 J	0.10	0.03
5403-009-FSS-SU14-R-1-004 (SUP)	1.39	0.39	0.20	2.09	0.94	0.99	0.27	0.08	1.00	0.27	0.08	0.09 J	0.08	0.07
5403-009-FSS-SU14-R-1-005	1.08	0.27	0.18	4.04	0.73	2.22	0.41	0.04	1.69	0.34	0.04	0.13 J	0.09	0.03
5403-009-FSS-SU14-R-1-005 (SUP)	1.26	0.38	0.21	2.03	0.38	1.21	0.30	0.07	0.82	0.24	0.10	0.00 U	0.01	0.07
5403-009-FSS-SU14-R-1-006	1.38	0.31	0.23	8.62	0.75	4.72	0.93	0.09	3.67	0.77	0.14	0.23 J	0.16	0.07
5403-009-FSS-SU14-R-1-006 (SUP)	1.49	0.39	0.18	2.79	1.21	1.35	0.33	0.06	1.39	0.34	0.08	0.05 J	0.06	0.04
5403-009-FSS-SU14-R-1-007	1.11	0.29	0.24	2.69	0.33	1.41	0.32	0.06	1.23	0.30	0.07	0.05 U	0.07	0.08
5403-009-FSS-SU14-R-1-007 (SUP)	1.41	0.45	0.22	2.06	0.39	0.98	0.27	0.06	1.02	0.28	0.08	0.06 U	0.07	0.09
5403-009-FSS-SU14-R-1-008	1.60	0.47	0.33	11.67	0.84	5.92	1.15	0.08	5.60	1.10	0.07	0.15 J	0.12	0.05
5403-009-FSS-SU14-R-1-008 (SUP)	0.66	0.27	0.20	0.85	0.57	0.49	0.18	0.10	0.34	0.14	0.09	0.03 U	0.05	0.04
5403-009-FSS-SU14-R-1-009	0.65 J	0.21	0.19	1.77	0.94	0.83 J	0.22	0.07	0.86 J	0.22	0.07	0.08 J	0.07	0.06
5403-009-FSS-SU14-R-1-009 (SUP)	0.41	0.21	0.19	0.84	0.55	0.38	0.15	0.10	0.45	0.17	0.09	0.01 U	0.03	0.07
5403-009-FSS-SU14-R-1-010	0.98 J	0.27	0.24	3.12	1.03	1.63	0.34	0.05	1.42	0.31	0.05	0.07 J	0.07	0.04
5403-009-FSS-SU14-R-1-010 (SUP)	0.87	0.31	0.18	1.04	0.52	0.46	0.17	0.06	0.53	0.19	0.06	0.05 U	0.06	0.08
5403-009-FSS-SU14-R-1-011	2.23	0.42	0.24	7.17	0.68	3.52	0.59	0.06	3.50	0.59	0.07	0.15 J	0.09	0.04
5403-009-FSS-SU14-R-1-011 (SUP)	0.83	0.29	0.18	1.96	0.49	0.93	0.32	0.14	0.94	0.32	0.11	0.09 U	0.11	0.14
5403-009-FSS-SU14-R-1-012	1.27	0.30	0.18	6.31	0.60	3.18	0.54	0.07	2.93	0.51	0.06	0.20 J	0.11	0.08
5403-009-FSS-SU14-R-1-012 (SUP)	1.02	0.34	0.21	1.91	0.43	0.85	0.27	0.11	0.99	0.29	0.10	0.07 U	0.08	0.09
5403-009-FSS-SU14-R-1-013	0.80 J	0.22	0.17	1.95	0.36	1.10	0.27	0.03	0.84 J	0.22	0.05	0.01 U	0.03	0.06
5403-009-FSS-SU14-R-1-013 (SUP)	0.57	0.25	0.21	1.02	0.66	0.47	0.22	0.06	0.50	0.23	0.17	0.06 U	0.08	0.08
5403-009-FSS-SU14-R-1-014	1.27	0.29	0.17	2.41	1.18	1.13	0.27	0.07	1.23 J	0.28	0.05	0.05 J	0.06	0.04
5403-009-FSS-SU14-R-1-014 (SUP)	0.51	0.24	0.25	0.75	0.62	0.33	0.15	0.10	0.40	0.17	0.07	0.02 U	0.04	0.05
5403-009-FSS-SU14-R-1-015	0.96 J	0.24	0.17	4.01	1.00	2.13	0.45	0.07	1.80	0.40	0.08	0.08 J	0.08	0.07
5403-009-FSS-SU14-R-1-015 (SUP)	0.88	0.30	0.19	1.90	1.02	0.92	0.29	0.08	0.87	0.28	0.05	0.11 J	0.10	0.06
5403-009-FSS-SU14-R-1-016	0.78 J	0.22	0.17	2.14	0.36	0.91 J	0.24	0.03	1.22	0.29	0.06	0.01 U	0.03	0.07
5403-009-FSS-SU14-R-1-016 (SUP)	0.94	0.32	0.25	2.31	1.23	1.13	0.33	0.04	1.12	0.32	0.05	0.06 J	0.07	0.06
5403-009-FSS-SU14-R-1-017	2.00	0.37	0.18	6.71	0.67	3.31	0.59	0.07	3.24	0.58	0.07	0.16 J	0.10	0.07
5403-009-FSS-SU14-R-1-017 (SUP)	1.01	0.32	0.15	2.96	0.94	1.39	0.39	0.10	1.44	0.40	0.05	0.13 J	0.12	0.11
Biased Sample Results														
5403-009-FSS-SU14-R-001-GP125	0.81 J	0.22	0.16	2.01	0.31	0.94 J	0.24	0.07	1.00	0.24	0.05	0.07 J	0.06	0.06
5403-009-FSS-SU14-R-001-GP93	1.91	0.58	0.22	1.64	0.47	0.85	0.29	0.10	0.75	0.27	0.05	0.04	0.07	0.13
Laboratory Duplicates														
5403-009-FSS-SU14-R-1-001	3.12	0.48	0.17	20.95	0.26	10.20	1.90	0.10	10.30	1.90	0.10	0.45 J	0.25	0.13
5403-009-FSS-SU14-R-1-001 DUP	3.62	0.54	0.18	19.57	0.23	9.70	1.60	0.04	9.40	1.50	0.08	0.47 J	0.21	0.09
5403-009-FSS-SU14-R-1-004	2.34	0.41	0.16	6.64	0.23	3.26	0.54	0.04	3.20 J	0.53	0.05	0.18 J	0.10	0.03
5403-009-FSS-SU14-R-1-004 DUP	NA	NA	NA	4.31	0.27	2.30	0.43	0.04	1.85	0.37	0.06	0.16 J	0.09	0.06
5403-009-FSS-SU14-R-001-GP125	0.81 J	0.22	0.16	2.01	0.31	0.94 J	0.24	0.07	1.00	0.24	0.05	0.07 J	0.06	0.06
5403-009-FSS-SU14-R-001-GP125 DUP	0.81 J	0.22	0.16	1.91	0.31	0.92 J	0.23	0.06	0.94 J	0.23	0.06	0.05 J	0.06	0.03
5403-009-FSS-SU14-R-1-001(SUP)	0.80	0.28	0.17	2.30	0.35	1.11	0.28	0.08	1.17	0.29	0.07	0.02 U	0.04	0.10
5403-009-FSS-SU14-R-1-001 DUP (SUP)	0.92	0.31	0.11	2.14	0.39	1.07	0.29	0.06	1.03	0.28	0.04	0.05 U	0.06	0.08
5403-009-FSS-SU14-R-1-011 (SUP)	0.83	0.29	0.18	1.96	0.49	0.93	0.32	0.14	0.94	0.32	0.11	0.09 U	0.11	0.14
5403-009-FSS-SU14-R-1-011 DUP (SUP)	0.74	0.26	0.22	1.94	0.40	0.94	0.26	0.04	0.92	0.26	0.08	0.08	0.07	0.04
Field Replicates														
5403-009-FSS-SU14-R-1-010	0.98 J	0.27	0.24	3.12	1.03	1.63	0.34	0.05	1.42	0.31	0.05	0.07 J	0.07	0.04
5403-009-FSS-SU14-R-1-019	0.86 J	0.23	0.18	2.36	0.34	1.22	0.29	0.05	1.14	0.28	0.06	0.00 U	0.03	0.06
5403-009-FSS-SU14-R-1-002 (SUP)	1.48	0.43	0.24	2.56	0.36	1.12	0.29	0.07	1.34	0.33	0.10	0.11	0.09	0.07
5403-009-FSS-SU14-R-1-018 (SUP)	1.38	0.39	0.14	1.98	0.44	1.06	0.32	0.09	0.88	0.28	0.05	0.04 U	0.06	0.06
5403-009-FSS-SU14-R-1-012 (SUP)	1.02	0.34	0.21	1.91	0.43	0.85	0.27	0.11	0.99	0.29	0.10	0.07 U	0.08	0.09
5403-009-FSS-SU14-R-1-019 (SUP)	1.08	0.35	0.15	1.58	0.52	0.58	0.23	0.11	0.94	0.31	0.09	0.06 U	0.09	0.13

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The notation "(SUP)" following the sample number indicates that this result is from a supplimental set of FSS samples completed after waste piles and liners were removed from this survey unit. The survey unit had been previously excavated to cleanup goals prior to placement of the waste pile, and FSS samples were collected and prepared for the FSSR.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-15														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU15-R-1-001	1.33	0.32	0.21	2.45	1.44	1.21	0.31	0.07	1.19	0.31	0.07	0.05 U	0.07	0.09
5403-009-FSS-SU15-R-1-002	3.10	0.49	0.18	5.51	0.78	2.57	0.51	0.08	2.79	0.55	0.08	0.15 J	0.11	0.08
5403-009-FSS-SU15-R-1-003	1.30	0.28	0.16	4.90	0.92	2.38	0.50	0.07	2.41	0.51	0.08	0.11	0.10	0.08
5403-009-FSS-SU15-R-1-004	1.97	0.39	0.24	4.18	0.80	2.24	0.46	0.06	1.81	0.40	0.08	0.13 J	0.10	0.07
5403-009-FSS-SU15-R-1-005	1.79	0.35	0.19	5.86	0.84	2.88	0.56	0.04	2.86	0.56	0.07	0.12 J	0.09	0.07
5403-009-FSS-SU15-R-1-006	1.90	0.38	0.25	3.49	1.06	1.70	0.40	0.07	1.70	0.40	0.07	0.09 U	0.09	0.09
5403-009-FSS-SU15-R-1-007	1.47	0.31	0.18	12.38	0.55	5.96	1.00	0.08	6.10	1.00	0.07	0.32 J	0.16	0.05
5403-009-FSS-SU15-R-1-008	3.95	0.58	0.18	9.43	0.61	4.26	0.74	0.04	4.92	0.83	0.07	0.25 J	0.14	0.08
5403-009-FSS-SU15-R-1-009	1.55	0.35	0.25	5.48	0.73	2.66	0.54	0.07	2.64	0.53	0.06	0.18 J	0.12	0.08
5403-009-FSS-SU15-R-1-010	1.13	0.26	0.17	4.25	0.67	2.07	0.40	0.06	2.00	0.39	0.06	0.18 J	0.11	0.04
5403-009-FSS-SU15-R-1-011	7.05	0.94	0.24	13.60	0.49	6.33	0.98	0.05	6.90	1.10	0.06	0.37 J	0.16	0.04
5403-009-FSS-SU15-R-1-012	1.66	0.35	0.19	6.65	0.64	3.45	0.67	0.10	2.94	0.60	0.09	0.26 J	0.15	0.05
5403-009-FSS-SU15-R-1-013	1.84	0.36	0.17	5.79	0.80	2.90	0.57	0.07	2.73	0.54	0.09	0.16 J	0.12	0.10
5403-009-FSS-SU15-R-1-014	1.87	0.38	0.22	3.60	0.94	1.96	0.41	0.07	1.55	0.35	0.06	0.09 J	0.08	0.04
5403-009-FSS-SU15-R-1-015	1.85	0.36	0.19	3.70	0.95	1.69	0.38	0.09	1.91	0.42	0.07	0.10 J	0.09	0.05
5403-009-FSS-SU15-R-1-016	2.23	0.42	0.24	5.23	0.72	2.61	0.51	0.06	2.47	0.49	0.09	0.15 J	0.10	0.04
5403-009-FSS-SU15-R-1-017	2.02	0.37	0.19	6.28	0.76	3.02	0.58	0.07	3.09	0.60	0.08	0.17 J	0.12	0.10
5403-009-FSS-SU15-R-1-018	1.14	0.27	0.17	6.52	0.68	2.97	0.58	0.08	3.34	0.63	0.08	0.21 J	0.13	0.08
5403-009-FSS-SU15-R-1-019	1.83	0.40	0.24	6.91	0.60	3.26	0.58	0.05	3.41	0.60	0.06	0.24 J	0.13	0.04
	Biased Sample Results													
FSS-SU15-R-1-03B #106	2.00	0.37	0.16	3.05	1.44	1.52	0.32	0.05	1.50	0.32	0.05	0.03 U	0.05	0.06
	Laboratory Duplicates													
5403-009-FSS-SU15-R-1-001	1.33	0.32	0.21	2.45	2.27	1.21	0.31	0.07	1.19	0.31	0.07	0.05	0.07	0.09
5403-009-FSS-SU15-R-1-001 DUP	1.49	0.33	0.21	3.16	1.10	1.48	0.35	0.04	1.58	0.37	0.07	0.10	0.09	0.09
5403-009-FSS-SU15-R-1-004	1.97	0.39	0.24	4.18	0.81	2.24	0.46	0.06	1.81	0.40	0.08	0.13	0.10	0.07
5403-009-FSS-SU15-R-1-004 DUP	NA	NA	NA	3.41	1.24	1.77	0.38	0.07	1.56	0.35	0.07	0.08 J	0.08	0.04
FSS-SU15-R-1-03B #106	2.00	0.37	0.16	3.05	1.44	1.52	0.32	0.05	1.50	0.32	0.05	0.03 U	0.05	0.06
FSS-SU15-R-1-03B #106 DUP	1.74	0.34	0.15	3.20	1.20	1.55	0.33	0.03	1.60	0.34	0.05	0.05 U	0.06	0.07
	Field Replicates													
5403-009-FSS-SU15-R-1-015	1.08	0.25	0.17	1.33	2.19	0.75	0.21	0.07	0.54	0.18	0.06	0.04	0.06	0.04
5403-009-FSS-SU15-R-1-003	1.55	0.34	0.19	5.48	0.69	2.66	0.54	0.07	2.64	0.53	0.06	0.18	0.12	0.08
5403-009-FSS-SU15-R-1-016	1.42	0.32	0.21	4.80	0.82	2.43	0.47	0.06	2.25	0.44	0.08	0.12	0.09	0.04
5403-009-FSS-SU15-R-1-005	1.79	0.35	0.19	5.86	0.87	2.88	0.56	0.04	2.86	0.56	0.07	0.12	0.09	0.07

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-16														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
FSS-SU16-R-1-001	0.77 J	0.22	0.17	9.96	0.67	4.83	0.78	0.05	4.98	0.80	0.06	0.15 J	0.10	0.07
FSS-SU16-R-1-002	0.68	0.45	0.43	7.60	1.22	3.76	1.01	0.13	3.66	1.00	0.26	0.18	0.21	0.16
FSS-SU16-R-1-003	0.49 J	0.19	0.21	2.12	1.33	1.15	0.27	0.05	0.93 J	0.23	0.05	0.04 U	0.05	0.06
FSS-SU16-R-1-004	0.73 J	0.20	0.17	5.53	0.81	2.69	0.49	0.06	2.73	0.50	0.06	0.11 J	0.08	0.07
FSS-SU16-R-1-005	0.83 J	0.21	0.15	2.74	0.95	1.33	0.29	0.06	1.34	0.29	0.04	0.07 J	0.07	0.06
FSS-SU16-R-1-006	1.28	0.29	0.19	1.84	0.37	1.02	0.26	0.07	0.80 J	0.22	0.06	0.02 U	0.04	0.04
FSS-SU16-R-1-007	1.40	0.30	0.16	2.23	0.39	1.18	0.31	0.07	0.98 J	0.28	0.09	0.07 U	0.08	0.08
FSS-SU16-R-1-008	0.47 J	0.17	0.16	0.88	0.49	0.38 J	0.14	0.03	0.50 J	0.16	0.05	-0.01 U	0.03	0.06
FSS-SU16-R-1-009	1.41	0.29	0.16	2.83	0.79	1.36	0.32	0.07	1.33	0.32	0.07	0.14 J	0.10	0.08
FSS-SU16-R-1-010	0.97 J	0.23	0.14	2.51	0.32	1.34	0.30	0.05	1.15	0.27	0.07	0.02 U	0.05	0.08
FSS-SU16-R-1-011	0.94 J	0.25	0.24	1.80	1.18	0.86 J	0.23	0.07	0.88 J	0.23	0.08	0.06 J	0.06	0.04
FSS-SU16-R-1-012	0.96 J	0.23	0.16	1.82	1.39	0.84 J	0.23	0.05	0.93 J	0.25	0.09	0.05 J	0.06	0.04
FSS-SU16-R-1-013	5.35	0.69	0.15	13.54	0.49	6.52	0.99	0.06	6.70	1.00	0.06	0.32 J	0.14	0.04
FSS-SU16-R-1-014	0.97 J	0.24	0.23	2.32	0.34	1.24	0.29	0.06	1.05	0.26	0.07	0.03 U	0.05	0.08
FSS-SU16-R-1-015	0.77 J	0.21	0.17	8.74	0.59	4.36	0.73	0.03	4.16	0.70	0.03	0.22 J	0.12	0.04
	Biased Sample Results													
FSS-SU16-R-1-05B #397	2.06	0.38	0.15	3.93	0.95	2.01	0.41	0.07	1.84	0.38	0.07	0.08 J	0.07	0.07
	Laboratory Duplicates													
5403-009-FSS-SU16-R-1-001	0.77 J	0.22	0.17	9.96	0.67	4.83	0.78	0.05	4.98	0.80	0.06	0.15 J	0.10	0.07
5403-009-FSS-SU16-R-1-001 DUP	0.72	0.20	0.16	9.34	0.55	4.67	0.77	0.06	4.39	0.73	0.06	0.28	0.14	0.04
5403-009-FSS-SU16-R-1-003	0.49 J	N/A	N/A	2.12	0.34	1.15	0.27	0.05	0.93 J	0.23	0.05	0.04 U	0.05	0.06
5403-009-FSS-SU16-R-1-003 DUP	N/A	N/A	N/A	2.04	0.34	1.01	0.24	0.03	0.98	0.24	0.05	0.05 U	0.05	0.05
	Field Replicates													
FSS-SU16-R-1-002	0.68	0.45	0.43	7.60	1.22	3.76	1.01	0.13	3.66	1.00	0.26	0.18	0.21	0.16
FSS-SU16-R-1-017	1.09	0.24	0.15	8.72	0.96	4.05	0.90	0.13	4.50	0.97	0.15	0.17	0.15	0.09
FSS-SU16-R-1-016	1.25	0.25	0.14	2.42	0.37	1.15	0.31	0.08	1.24	0.32	0.08	0.03 U	0.06	0.08
FSS-SU16-R-1-010	0.97 J	0.23	0.14	2.51	0.32	1.34	0.30	0.05	1.15	0.27	0.07	0.02 U	0.05	0.08

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-17

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-SU17-FSS-R-1-001	1.59	0.33	0.17	3.74	1.04	2.01	0.44	0.07	1.64	0.38	0.08	0.09 J	0.09	0.05
5403-009-SU17-FSS-R-1-002	0.98 J	0.24	0.16	1.20	1.19	0.53 J	0.16	0.05	0.62 J	0.18	0.05	0.05 J	0.06	0.03
5403-009-SU17-FSS-R-1-003 POST	0.69 J	0.19	0.13	1.75	0.37	0.88 J	0.23	0.05	0.83 J	0.22	0.06	0.04 U	0.05	0.07
5403-009-SU17-FSS-R-1-004	1.38	0.31	0.23	2.46	0.95	1.27	0.30	0.06	1.10	0.27	0.07	0.09 J	0.08	0.04
5403-009-SU17-FSS-R-1-005	0.94 J	0.27	0.23	1.75	0.38	0.87 J	0.23	0.05	0.84 J	0.23	0.06	0.04 U	0.05	0.06
5403-009-SU17-FSS-R-1-006	1.38	0.31	0.19	3.23	0.86	1.90	0.40	0.03	1.22	0.30	0.09	0.11 J	0.08	0.07
5403-009-SU17-FSS-R-1-007	1.60	0.34	0.19	4.72	0.68	2.35	0.45	0.05	2.21	0.43	0.06	0.16 J	0.10	0.04
5403-009-SU17-FSS-R-1-008	0.97 J	0.28	0.25	3.87	0.28	1.95	0.38	0.05	1.87	0.37	0.06	0.05 U	0.06	0.06
5403-009-SU17-FSS-R-1-009	1.11	0.29	0.23	1.79	0.45	0.97 J	0.29	0.08	0.78 J	0.26	0.10	0.04 U	0.07	0.10
5403-009-SU17-FSS-R-1-010	1.26	0.31	0.23	2.93	0.93	1.20	0.29	0.03	1.64	0.36	0.05	0.09 J	0.08	0.06
5403-009-SU17-FSS-R-1-011	2.28	0.39	0.16	4.98	0.93	2.34	0.44	0.07	2.56	0.47	0.06	0.08 J	0.07	0.04
5403-009-SU17-FSS-R-1-012	2.85	0.45	0.16	7.41	0.68	3.88	0.70	0.07	3.34	0.62	0.07	0.19 J	0.12	0.05
5403-009-SU17-FSS-R-1-013	1.10	0.24	0.15	7.70	0.70	3.88	0.65	0.05	3.67	0.62	0.06	0.15 J	0.10	0.08
5403-009-SU17-FSS-R-1-014	0.74 J	0.20	0.15	1.60	1.18	0.65 J	0.19	0.06	0.90 J	0.22	0.05	0.05 J	0.06	0.04
5403-009-SU17-FSS-R-1-015	1.40	0.29	0.17	4.18	0.78	2.16	0.41	0.06	1.91	0.38	0.05	0.11 J	0.08	0.07
5403-009-SU17-FSS-R-1-016	0.71 J	0.21	0.16	1.42	0.40	0.75 J	0.21	0.06	0.66 J	0.19	0.06	0.01 U	0.03	0.06
5403-009-SU17-FSS-R-1-017	1.00 J	0.25	0.19	12.48	0.48	5.90	0.93	0.06	6.20	0.97	0.06	0.38 J	0.16	0.08
	Biased Sample Results													
5403-009-FSS-SU17-R1-GP383	1.32	0.38	0.27	2.59	0.87	1.40	0.35	0.06	1.08	0.29	0.06	0.11	0.09	0.05
	Laboratory Duplicates													
5403-009-SU17-FSS-R-1-011	2.28	0.39	0.16	4.98	0.93	2.34	0.44	0.07	2.56	0.47	0.06	0.08 J	0.07	0.04
5403-009-SU17-FSS-R-1-011 DUP	2.28	0.41	0.26	4.29	0.73	2.14	0.40	0.04	2.02	0.39	0.07	0.13	0.09	0.04
5403-009-SU17-FSS-R-1-015	1.40	0.29	0.17	4.18	0.78	2.16	0.41	0.06	1.91	0.38	0.05	0.11 J	0.08	0.07
5403-009-SU17-FSS-R-1-015 DUP	NA	NA	NA	4.73	0.68	2.37	0.44	0.04	2.21	0.41	0.06	0.15	0.09	0.07
	Field Replicates													
5403-009-SU17-FSS-R-1-009	1.11	0.29	0.23	1.79	0.45	0.97 J	0.29	0.08	0.78 J	0.26	0.10	0.04 U	0.07	0.10
5403-009-SU17-FSS-R-1-018	0.95 J	0.24	0.18	1.46	0.39	0.69 J	0.19	0.07	0.77 J	0.21	0.07	0.00 U	0.03	0.05

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-18														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-SU18-FSS-R1-001	1.70	0.35	0.20	2.99	0.81	1.34	0.29	0.05	1.55	0.32	0.05	0.10 J	0.08	0.06
5403-009-SU18-FSS-R1-002	1.37	0.32	0.24	2.12	1.47	1.06	0.27	0.07	1.00 J	0.26	0.07	0.06 U	0.06	0.06
5403-009-SU18-FSS-R1-003	1.77	0.36	0.18	4.19	0.82	2.22	0.44	0.05	1.85	0.39	0.07	0.12 J	0.09	0.04
5403-009-SU18-FSS-R1-004	1.31	0.30	0.25	2.83	1.20	1.34	0.31	0.06	1.42	0.32	0.05	0.07 J	0.07	0.06
5403-009-SU18-FSS-R1-005	1.23	0.29	0.23	1.98	1.30	1.08	0.25	0.04	0.84 J	0.22	0.06	0.06 U	0.06	0.06
5403-009-SU18-FSS-R1-006	1.49	0.32	0.25	5.21	0.68	2.36	0.45	0.08	2.71	0.50	0.06	0.14 J	0.10	0.04
5403-009-SU18-FSS-R1-007	2.85	0.48	0.25	4.48	0.78	2.38	0.46	0.07	1.98	0.41	0.09	0.12 J	0.09	0.07
5403-009-SU18-FSS-R1-008	2.07	0.39	0.26	12.06	0.43	6.08	0.96	0.05	5.72	0.92	0.08	0.26 J	0.13	0.04
5403-009-SU18-FSS-R1-009	0.87 J	0.23	0.18	1.40	1.17	0.64 J	0.18	0.05	0.69 J	0.19	0.05	0.07 J	0.06	0.06
5403-009-SU18-FSS-R1-010	1.67	0.33	0.17	2.04	1.65	0.95 J	0.25	0.07	1.04	0.26	0.07	0.05 U	0.06	0.07
5403-009-SU18-FSS-R1-011	1.03	0.25	0.16	1.66	1.51	0.81 J	0.23	0.05	0.79 J	0.23	0.06	0.06 U	0.06	0.07
5403-009-SU18-FSS-R1-012	1.54	0.31	0.16	2.25	1.45	1.24	0.28	0.03	0.96 J	0.24	0.06	0.05 U	0.06	0.06
5403-009-SU18-FSS-R1-013	1.32	0.30	0.19	2.43	3.09	1.31	0.32	0.04	1.09	0.28	0.07	0.03 U	0.05	0.07
5403-009-SU18-FSS-R1-014	1.15	0.29	0.24	2.44	1.10	1.20	0.28	0.06	1.16	0.28	0.06	0.08 J	0.07	0.07
	Biased Sample Results													
5403-009FSS-SU16-R-1-02B #199				3.11	0.73	1.43	0.31	0.05	1.54	0.33	0.05	0.14 J	0.09	0.06
	Laboratory Duplicates													
5403-009-SU18-FSS-R1-009	0.87 J	0.23	0.18	1.40	1.17	0.64 J	0.18	0.05	0.69 J	0.19	0.05	0.07 J	0.06	0.06
5403-009-SU18-FSS-R1-009DUP	1.09	0.26	0.18	1.30	2.31	0.60	0.18	0.03	0.66	0.19	0.05	0.04 U	0.05	0.07
5403-009-SU18-FSS-R1-003	1.77	0.36	0.18	4.19	0.82	2.22	0.44	0.05	1.85	0.39	0.07	0.12 J	0.09	0.04
5403-009-SU18-FSS-R1-003DUP	N/A	N/A	N/A	3.67	1.02	1.68	0.37	0.05	1.90	0.40	0.07	0.09 J	0.08	0.07
5403-009-SU18-FSS-R1-004	1.31	0.30	0.25	2.83	1.20	1.34	0.31	0.06	1.42	0.32	0.05	0.07 J	0.07	0.06
5403-009-SU18-FSS-R1-004DUP	N/A	N/A	N/A	2.44	2.95	1.22	0.29	0.05	1.19	0.29	0.09	0.03 U	0.04	0.06
5403-009-SU18-FSS-R1-012	1.54	0.31	0.16	2.25	1.45	1.24	0.28	0.03	0.96 J	0.24	0.06	0.05 U	0.06	0.06
5403-009-SU18-FSS-R1-012DUP	N/A	N/A	N/A	2.40	0.88	1.25	0.29	0.06	1.04	0.26	0.08	0.11 J	0.08	0.07
	Field Replicates													
5403-009-SU18-FSS-R1-010	1.67	0.33	0.17	2.04	1.65	0.95 J	0.25	0.07	1.04	0.26	0.07	0.05 U	0.06	0.07
5403-009-SU18-FSS-R1-015	1.56	0.35	0.24	2.30	3.46	1.20	0.30	0.07	1.07	0.27	0.06	0.03 U	0.06	0.04
5403-009-SU18-FSS-R1-004	1.31	0.30	0.25	2.83	1.20	1.34	0.31	0.06	1.42	0.32	0.05	0.07 J	0.07	0.06
5403-009-SU18-FSS-R1-016	1.77	0.35	0.18	3.24	0.77	1.47	0.31	0.03	1.66	0.34	0.06	0.11 J	0.08	0.07

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
N/A Duplicate sample was analyzed for Uranium only.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-19

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU19-R-1-001	1.55	0.43	0.27	2.09	0.85	0.95	0.24	0.08	1.05	0.26	0.07	0.09	0.07	0.04
5403-009-FSS-SU19-R-1-002	1.53	0.45	0.28	1.84	1.01	0.91	0.23	0.05	0.87	0.23	0.08	0.06	0.06	0.06
5403-009-FSS-SU19-R-1-003	1.66	0.47	0.23	3.55	0.74	1.60	0.38	0.07	1.78	0.41	0.09	0.17	0.11	0.08
5403-009-FSS-SU19-R-1-004	2.55	0.85	0.49	2.82	0.33	1.42	0.35	0.08	1.37	0.35	0.08	0.03 U	0.05	0.08
5403-009-FSS-SU19-R-1-005	1.35	0.41	0.28	2.46	1.00	1.10	0.28	0.08	1.30	0.31	0.07	0.07	0.07	0.07
5403-009-FSS-SU19-R-1-006	2.32	0.64	0.38	2.74	0.35	1.20	0.37	0.09	1.45	0.42	0.16	0.10 U	0.10	0.12
5403-009-FSS-SU19-R-1-007	2.93	0.79	0.30	1.91	0.42	0.90	0.24	0.07	0.96	0.25	0.07	0.05 U	0.06	0.08
5403-009-FSS-SU19-R-1-008	1.90	0.52	0.25	1.89	0.98	0.93	0.25	0.03	0.89	0.24	0.07	0.07	0.06	0.04
5403-009-FSS-SU19-R-1-009	1.72	0.57	0.27	6.11	0.70	3.19	0.61	0.07	2.77	0.54	0.07	0.15	0.10	0.04
5403-009-FSS-SU19-R-1-010	1.63	0.43	0.22	2.11	0.87	0.91	0.24	0.03	1.11	0.28	0.09	0.10	0.08	0.07
5403-009-FSS-SU19-R-1-011	3.35	0.87	0.40	5.60	0.77	2.88	0.54	0.07	2.62	0.50	0.03	0.11	0.08	0.04
5403-009-FSS-SU19-R-1-012	0.83	0.37	0.30	5.34	0.73	2.61	0.55	0.09	2.56	0.54	0.09	0.18	0.12	0.08
5403-009-FSS-SU19-R-1-013	1.48	0.54	0.33	3.76	0.30	1.90	0.43	0.11	1.80	0.42	0.09	0.06 U	0.07	0.10
5403-009-FSS-SU19-R-1-014	3.77	0.87	0.27	2.54	0.90	1.13	0.28	0.06	1.33	0.31	0.07	0.09	0.07	0.04
Biased Sample Results														
5403-009-FSS-SU19-R-1-GP039BIAS	5.26	1.12	0.37	8.95	0.66	4.44	0.79	0.07	4.33	0.78	0.08	0.18	0.11	0.08
Laboratory Duplicates														
5403-009-FSS-SU19-R-1-001	1.55	0.43	0.27	2.09	0.85	0.95	0.24	0.08	1.05	0.26	0.07	0.09	0.07	0.04
5403-009-FSS-SU19-R-1-001 DUP	1.75	0.47	0.16	2.23	0.36	1.09	0.27	0.05	1.08	0.27	0.03	0.06	0.06	0.07
5403-009-FSS-SU19-R-1-006	2.32	0.64	0.38	2.74	0.36	1.20	0.37	0.09	1.45	0.42	0.16	0.10 U	0.10	0.12
5403-009-FSS-SU19-R-1-006 DUP	2.12	0.58	0.24	2.47	0.42	1.24	0.29	0.05	1.16	0.28	0.05	0.07	0.06	0.04
Field Replicates														
5403-009-FSS-SU19-R-1-005	1.35	0.41	0.28	2.46	0.35	1.10	0.28	0.08	1.30	0.31	0.07	0.07	0.07	0.07
5403-009-FSS-SU19-R-1-015	1.62	0.47	0.26	2.78	0.36	1.26	0.33	0.09	1.49	0.37	0.12	0.03 U	0.05	0.09
5403-009-FSS-SU19-R-1-006	2.32	0.64	0.38	2.74	0.36	1.20	0.37	0.09	1.45	0.42	0.16	0.10 U	0.10	0.12
5403-009-FSS-SU19-R-1-016	0.91	0.43	0.38	1.31	2.00	0.62	0.20	0.08	0.67	0.21	0.08	0.02 U	0.05	0.10

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-20

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU20-R-1-001	0.80 J	0.19	0.13	1.78	1.35	0.89 J	0.23	0.03	0.85 J	0.23	0.07	0.04 U	0.05	0.06
5403-009-FSS-SU20-R-1-002	1.41	0.29	0.16	10.00	0.59	5.05	0.83	0.06	4.71	0.78	0.09	0.24 J	0.13	0.04
5403-009-FSS-SU20-R-1-003	1.10	0.25	0.17	2.66	0.97	1.22	0.29	0.03	1.36	0.31	0.07	0.08 J	0.08	0.07
5403-009-FSS-SU20-R-1-004	1.07	0.25	0.13	4.87	0.66	2.43	0.46	0.07	2.24	0.44	0.05	0.20 J	0.12	0.04
5403-009-FSS-SU20-R-1-005B	1.18	0.30	0.22	2.95	0.94	1.35	0.32	0.07	1.50	0.34	0.08	0.10 J	0.09	0.04
5403-009-FSS-SU20-R-1-006	0.68 J	0.21	0.18	3.95	0.87	2.02	0.40	0.03	1.83	0.38	0.07	0.10 J	0.08	0.04
5403-009-FSS-SU20-R-1-007	0.77 J	0.20	0.15	1.71	1.02	0.81 J	0.21	0.05	0.84 J	0.22	0.07	0.06 J	0.06	0.05
5403-009-FSS-SU20-R-1-008	0.56 J	0.17	0.13	2.43	0.95	1.17	0.26	0.06	1.18	0.27	0.05	0.08 J	0.07	0.03
5403-009-FSS-SU20-R-1-009	1.24	0.33	0.24	5.25	0.81	2.53	0.50	0.06	2.59	0.51	0.09	0.13 J	0.10	0.04
5403-009-FSS-SU20-R-1-010	1.10	0.24	0.15	5.89	0.66	2.93	0.52	0.03	2.81	0.51	0.08	0.15 J	0.09	0.05
5403-009-FSS-SU20-R-1-011	0.43 J	0.14	0.12	1.58	1.03	0.85 J	0.23	0.05	0.66 J	0.20	0.07	0.07 J	0.07	0.07
5403-009-FSS-SU20-R-1-012	0.86 J	0.23	0.18	2.90	0.78	1.43	0.32	0.07	1.33	0.31	0.07	0.14 J	0.10	0.04
5403-009-FSS-SU20-R-1-013	0.82 J	0.25	0.22	2.48	0.79	1.12	0.27	0.07	1.23	0.29	0.06	0.13 J	0.09	0.04
5403-009-FSS-SU20-R-1-014B	1.48	0.37	0.30	5.73	0.68	3.02	0.56	0.06	2.55	0.50	0.07	0.16 J	0.10	0.07
5403-009-FSS-SU20-R-1-015	0.92 J	0.26	0.20	5.76	0.66	2.76	0.52	0.07	2.80	0.53	0.06	0.20 J	0.12	0.04
Laboratory Duplicates														
5403-009-FSS-SU20-R-1-001	0.80 J	0.19	0.13	NA	NA	0.89 J	0.23	0.03	0.85 J	0.23	0.07	0.04 U	0.05	0.06
5403-009-FSS-SU20-R-1-001 DUP	0.57	0.19	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5403-009-FSS-SU20-R-1-010	1.10	0.24	0.15	5.89	0.66	2.93	0.52	0.03	2.81	0.51	0.08	0.15 J	0.09	0.05
5403-009-FSS-SU20-R-1-010 DUP	NA	NA	NA	5.24	0.73	2.59	0.48	0.06	2.53	0.47	0.05	0.12	0.08	0.06
5403-009-FSS-SU20-R-1-007B	1.33	0.33	0.25	1.88	1.02	0.85 J	0.22	0.08	0.96 J	0.24	0.08	0.07 J	0.06	0.06
5403-009-FSS-SU20-R-1-007B DUP				1.67	0.84	0.80 J	0.21	0.05	0.77 J	0.20	0.05	0.10 J	0.08	0.04
Field Replicates														
5403-009-FSS-SU20-R-1-008	0.56 J	0.17	0.13	2.43	0.95	1.17	0.26	0.06	1.18	0.27	0.05	0.08 J	0.07	0.03
5403-009-FSS-SU20-R-1-017	0.98 J	0.23	0.16	5.94	0.68	2.82	0.53	0.05	2.96	0.55	0.06	0.16 J	0.10	0.04

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-21														
Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU21-R1-001	0.73 J	0.19	0.13	1.43	0.43	0.73 J	0.22	0.07	0.67 J	0.21	0.06	0.03 U	0.05	0.08
5403-009-FSS-SU21-R1-001 (SUP)	0.22	0.16	0.20	3.05	0.96	1.53	0.40	0.11	1.41	0.38	0.12	0.11	0.10	0.11
5403-009-FSS-SU21-R1-002	0.77 J	0.21	0.18	2.03	0.36	1.06	0.27	0.07	0.93 J	0.24	0.05	0.04 U	0.06	0.07
5403-009-FSS-SU21-R1-002 (SUP)	0.22 U	0.18	0.27	3.07	0.77	1.32	0.39	0.06	1.50	0.43	0.12	0.25	0.16	0.07
5403-009-FSS-SU21-R1-003	1.46	0.33	0.20	3.09	0.32	1.39	0.32	0.08	1.63	0.36	0.08	0.07 U	0.07	0.08
5403-009-FSS-SU21-R1-003 (SUP)	0.15 U	0.13	0.21	2.93	0.91	1.31	0.38	0.13	1.46	0.41	0.10	0.16	0.13	0.13
5403-009-FSS-SU21-R1-004	0.73 J	0.21	0.16	1.47	0.43	0.76 J	0.22	0.07	0.66 J	0.21	0.08	0.05 U	0.07	0.09
5403-009-FSS-SU21-R1-004 (SUP)	3.48	0.93	0.50	3.72	0.79	1.43	0.39	0.12	2.10	0.51	0.12	0.19	0.14	0.10
5403-009-FSS-SU21-R1-005	0.87 J	0.23	0.19	2.58	0.34	1.28	0.30	0.07	1.24	0.30	0.07	0.06 J	0.07	0.04
5403-009-FSS-SU21-R1-005 (SUP)	0.23	0.18	0.23	2.10	0.84	0.87	0.31	0.06	1.00	0.34	0.16	0.24	0.16	0.07
5403-009-FSS-SU21-R1-006	0.72 J	0.21	0.17	13.64	0.21	6.70	1.00	0.05	6.60	1.00	0.06	0.34 J	0.15	0.04
5403-009-FSS-SU21-R1-006 (SUP)	0.04 U	0.08	0.20	2.19	1.24	1.15	0.33	0.11	0.98	0.30	0.08	0.06	0.07	0.05
5403-009-FSS-SU21-R1-007	0.95 J	0.23	0.16	1.92	0.37	0.90 J	0.24	0.05	0.99 J	0.26	0.09	0.03 U	0.05	0.07
5403-009-FSS-SU21-R1-007 (SUP)	0.16	0.12	0.15	3.49	0.82	1.30	0.42	0.11	1.92	0.55	0.07	0.27	0.19	0.08
5403-009-FSS-SU21-R1-008	1.31	0.34	0.27	3.32	0.78	1.62	0.34	0.05	1.57	0.34	0.06	0.13 J	0.09	0.04
5403-009-FSS-SU21-R1-008 (SUP)	2.18	0.65	0.34	2.03	0.48	0.66	0.25	0.05	1.33	0.39	0.05	0.05 U	0.07	0.07
5403-009-FSS-SU21-R1-009	1.46	0.30	0.18	2.99	1.05	1.40	0.34	0.06	1.50	0.36	0.09	0.09 J	0.09	0.05
5403-009-FSS-SU21-R1-009 (SUP)	2.97	0.82	0.39	2.37	0.90	1.11	0.33	0.10	1.12	0.33	0.05	0.15	0.12	0.10
5403-009-FSS-SU21-R1-010	1.17	0.26	0.17	2.96	0.33	1.42	0.33	0.07	1.49	0.34	0.05	0.05 U	0.06	0.07
5403-009-FSS-SU21-R1-010 (SUP)	2.87	0.79	0.30	2.16	1.11	1.05	0.34	0.11	1.00	0.33	0.06	0.10	0.10	0.07
5403-009-FSS-SU21-R1-011	1.04	0.23	0.14	3.27	0.31	1.61	0.35	0.08	1.63	0.36	0.08	0.03 U	0.05	0.07
5403-009-FSS-SU21-R1-011 (SUP)	1.39	0.38	0.17	2.64	0.86	0.89	0.30	0.10	1.57	0.43	0.10	0.19	0.14	0.11
5403-009-FSS-SU21-R1-012	1.15	0.27	0.19	3.22	1.01	1.60	0.37	0.07	1.53	0.36	0.08	0.09 J	0.09	0.09
5403-009-FSS-SU21-R1-012 (SUP)	1.86	0.49	0.26	2.03	0.94	0.91	0.29	0.09	0.99	0.31	0.13	0.13	0.11	0.06
5403-009-FSS-SU21-R1-013	1.43	0.31	0.15	7.85	0.88	4.10	0.98	0.13	3.49	0.87	0.18	0.26 J	0.21	0.10
5403-009-FSS-SU21-R1-013 (SUP)	1.94	0.51	0.27	3.28	0.88	1.30	0.37	0.11	1.83	0.47	0.13	0.15	0.12	0.10
5403-009-FSS-SU21-R1-014	0.87 J	0.22	0.17	1.99	0.38	0.93 J	0.25	0.08	1.03	0.27	0.07	0.03 U	0.06	0.04
5403-009-FSS-SU21-R1-014 (SUP)	0.63	0.26	0.21	1.58	0.61	0.73	0.31	0.14	0.70	0.31	0.21	0.15 U	0.15	0.18
5403-009-FSS-SU21-R1-015	2.67	0.44	0.15	6.15	0.79	3.08	0.54	0.05	2.97	0.52	0.07	0.10 J	0.08	0.06
5403-009-FSS-SU21-R1-015 (SUP)	0.18 U	0.14	0.20	1.03	0.59	0.53	0.21	0.08	0.44	0.19	0.11	0.06 U	0.07	0.10
5403-009-FSS-SU21-R1-016	1.50	0.30	0.17	2.64	0.36	1.31	0.33	0.09	1.25	0.32	0.09	0.08 U	0.08	0.09
5403-009-FSS-SU21-R1-016 (SUP)	1.76	0.44	0.19	2.62	0.90	1.39	0.40	0.11	1.07	0.34	0.13	0.17	0.13	0.11
Biased Sample Results														
5403-009-FSS-SU21-R-001-GP500	2.16	0.61	0.30	2.70	1.02	1.37	0.38	0.11	1.22	0.35	0.11	0.11	0.10	0.10
Laboratory Duplicates														
5403-009-FSS-SU21-R1-001	0.73 J	0.19	0.13	1.43	0.43	0.73 J	0.22	0.07	0.67 J	0.21	0.06	0.03 U	0.05	0.08
5403-009-FSS-SU21-R1-001 DUP	0.67 J	0.20	0.17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5403-009-FSS-SU21-R1-002	0.77 J	0.21	0.18	2.03	0.36	1.06	0.27	0.07	0.93 J	0.24	0.05	0.04 U	0.06	0.07
5403-009-FSS-SU21-R1-002 DUP	NA	NA	NA	2.36	0.35	1.22	0.29	0.05	1.07	0.27	0.07	0.07 U	0.07	0.08
5403-009-FSS-SU21-R1-005	0.87 J	0.23	0.19	2.58	1.18	1.28	0.30	0.07	1.24	0.30	0.07	0.06 J	0.07	0.04
5403-009-FSS-SU21-R1-005 DUP	NA	NA	NA	2.74	0.33	1.37	0.32	0.07	1.26	0.30	0.06	0.11 J	0.09	0.04
5403-009-FSS-SU21-R1-010	1.17	0.26	0.17	2.96	0.33	1.42	0.33	0.07	1.49	0.34	0.05	0.05 U	0.06	0.07
5403-009-FSS-SU21-R1-010 DUP	NA	NA	NA	2.50	0.35	1.28	0.31	0.05	1.16	0.29	0.07	0.06 U	0.07	0.08
5403-009-FSS-SU21-R1-015	2.67	0.44	0.15	6.15	0.79	3.08	0.54	0.05	2.97	0.52	0.07	0.10 J	0.08	0.06
5403-009-FSS-SU21-R1-015 DUP	NA	NA	NA	5.62	0.81	2.85	0.52	0.05	2.66	0.49	0.07	0.11 J	0.09	0.04
5403-009-FSS-SU21-R1-001 (SUP)	0.22	0.16	0.20	3.05	0.96	1.53	0.40	0.11	1.41	0.38	0.12	0.11	0.10	0.11
5403-009-FSS-SU21-R1-001 DUP (SUP)	0.27 U	0.19	0.28	3.12	1.02	1.62	0.42	0.11	1.40	0.38	0.10	0.10	0.10	0.10
5403-009-FSS-SU21-R1-011 (SUP)	1.39	0.38	0.17	2.64	0.86	0.89	0.30	0.10	1.57	0.43	0.10	0.19	0.14	0.11
5403-009-FSS-SU21-R1-011 DUP (SUP)	1.50	0.43	0.25	2.68	0.43	1.09	0.35	0.12	1.53	0.44	0.13	0.06 U	0.09	0.16
Field Replicates														
5403-009-FSS-SU21-R1-012	1.15	0.27	0.19	3.22	1.01	1.60	0.37	0.07	1.53	0.36	0.08	0.09 J	0.09	0.09
5403-009-FSS-SU-21-R-1-017	1.19	0.27	0.18	2.49	0.34	1.21	0.29	0.07	1.24	0.30	0.08	0.04 U	0.06	0.08
5403-009-FSS-SU21-R1-015	2.67	0.44	0.15	6.15	0.79	3.08	0.54	0.05	2.97	0.52	0.07	0.10 J	0.08	0.06
5403-009-FSS-SU-21-R-1-018	1.19	0.27	0.15	1.74	0.40	0.94 J	0.25	0.05	0.77 J	0.23	0.08	0.03 U	0.06	0.04
5403-009-FSS-SU21-R1-007 (SUP)	0.16	0.12	0.15	3.49	0.82	1.30	0.42	0.11	1.92	0.55	0.07	0.27	0.19	0.08
5403-009-FSS-SU21-R1-017 (SUP)	1.30	0.40	0.20	2.74	0.77	1.29	0.37	0.10	1.21	0.36	0.11	0.24	0.16	0.12
5403-009-FSS-SU21-R1-009 (SUP)	2.97	0.82	0.39	2.37	0.90	1.11	0.33	0.10	1.12	0.33	0.05	0.15	0.12	0.10
5403-009-FSS-SU21-R1-018 (SUP)	1.13	0.35	0.19	2.73	0.76	1.13	0.31	0.08	1.42	0.36	0.08	0.18	0.12	0.08

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The notation "(SUP)" following the sample number indicates that this result is from a supplimental set of FSS samples completed after waste piles and liners were removed from this survey unit. The survey unit had been previously excavated to cleanup goals prior to placement of the waste pile, and FSS samples were collected and prepared for the FSSR.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-22

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU22-R-1-001	1.16	0.28	0.20	2.25	0.94	1.26	0.30	0.30	0.90 J	0.24	0.06	0.09 J	0.08	0.07
5403-009-FSS-SU22-R-1-002	1.41	0.31	0.20	2.70	0.33	1.43	0.33	0.33	1.21	0.29	0.06	0.06 U	0.07	0.08
5403-009-FSS-SU22-R-1-003	1.57	0.34	0.21	2.94	0.33	1.55	0.35	0.35	1.33	0.32	0.10	0.06 U	0.08	0.11
5403-009-FSS-SU22-R-1-004	0.98 J	0.28	0.23	2.32	0.35	1.19	0.29	0.29	1.08	0.27	0.07	0.05 U	0.07	0.08
5403-009-FSS-SU22-R-1-005	1.32	0.33	0.28	2.83	0.32	1.33	0.31	0.31	1.46	0.33	0.08	0.04 U	0.06	0.07
5403-009-FSS-SU22-R-1-006	0.82 J	0.24	0.18	1.61	0.42	0.87 J	0.25	0.25	0.75 J	0.23	0.10	-0.01 U	0.04	0.08
5403-009-FSS-SU22-R-1-007	1.21	0.30	0.22	1.55	0.41	0.73 J	0.22	0.22	0.79 J	0.22	0.07	0.03 U	0.05	0.04
5403-009-FSS-SU22-R-1-008	1.67	0.34	0.19	3.18	1.03	1.57	0.34	0.34	1.54	0.34	0.08	0.07 J	0.07	0.04
5403-009-FSS-SU22-R-1-009	0.86 J	0.26	0.22	2.28	0.81	1.09	0.29	0.29	1.05	0.28	0.06	0.14 J	0.10	0.07
5403-009-FSS-SU22-R-1-010	0.42 J	0.18	0.20	0.61	0.61	0.30 J	0.13	0.13	0.30 J	0.13	0.07	0.01 U	0.03	0.06
5403-009-FSS-SU22-R-1-011	1.60	0.34	0.19	3.60	0.95	1.76	0.35	0.05	1.77	0.36	0.06	0.07 J	0.06	0.04
5403-009-FSS-SU22-R-1-012	2.00	0.40	0.23	1.02	0.47	0.55 J	0.18	0.05	0.47 J	0.16	0.07	0.00 U	0.00	0.03
5403-009-FSS-SU22-R-1-013	1.18	0.33	0.31	1.64	0.87	0.83 J	0.22	0.07	0.70 J	0.20	0.05	0.11 J	0.09	0.04
5403-009-FSS-SU22-R-1-014	1.70	0.41	0.26	12.90	0.64	6.40	1.00	0.08	6.30	1.00	0.06	0.20 J	0.12	0.08
5403-009-FSS-SU22-R-1-015	2.14	0.39	0.19	2.49	1.05	1.38	0.32	0.07	1.03	0.27	0.09	0.08 J	0.08	0.04
Biased Sample Location														
5403-009-FSS-SU22-R-1-016	1.96	0.38	0.21	2.77	1.16	1.39	0.32	0.07	1.32	0.30	0.05	0.06 J	0.07	0.04
Laboratory Duplicates														
5403-009-FSS-SU21-R1-001	0.73 J	0.19	0.13	1.43	0.43	0.73 J	0.22	0.07	0.67 J	0.21	0.06	0.03 U	0.05	0.08
5403-009-FSS-SU21-R1-001 DUP	0.67 J	0.20	0.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5403-009-FSS-SU21-R1-002	0.77 J	0.21	0.18	2.03	0.36	1.06	0.27	0.07	0.93 J	0.24	0.05	0.04 U	0.06	0.07
5403-009-FSS-SU21-R1-002 DUP	N/A	N/A	N/A	2.36	0.35	1.22	0.29	0.05	1.07	0.27	0.07	0.07 U	0.07	0.08
5403-009-FSS-SU21-R1-005	0.87 J	0.23	0.19	2.58	1.18	1.28	0.30	0.07	1.24	0.30	0.07	0.06 J	0.07	0.04
5403-009-FSS-SU21-R1-005 DUP	N/A	N/A	N/A	2.74	0.33	1.37	0.32	0.07	1.26	0.30	0.06	0.11 J	0.09	0.04
5403-009-FSS-SU22-R-1-012	2.00	0.40	0.23	1.02	1.02	0.55 J	0.18	0.05	0.47 J	0.16	0.07	0.00 U	0.00	0.03
5403-009-FSS-SU22-R-1-012 DUP	N/A	N/A	N/A	3.19	2.40	1.60	0.45	0.12	1.52	0.43	0.13	0.07	0.10	0.14
NOTE: Samples analyzed at STL from Survey Units 21 and 22 were processed in the same Lab Batch, therefore duplicate information from SU-21 was utilized in this table														
Field Replicates														
5403-009-FSS-SU22-R-1-008	1.67	0.34	0.19	3.18	1.03	1.57	0.34	0.34	1.54	0.34	0.08	0.07 J	0.07	0.04
5403-009-FSS-SU22-R-1-017	1.08	0.25	0.17	1.33	1.41	0.75 J	0.21	0.07	0.54 J	0.18	0.06	0.04 J	0.06	0.04
5403-009-FSS-SU22-R-1-011	1.60	0.34	0.19	3.60	0.95	1.76	0.35	0.05	1.77	0.36	0.06	0.07 J	0.06	0.04
5403-009-FSS-SU20-R-1-018	1.42	0.32	0.21	4.80	0.81	2.43	0.47	0.06	2.25	0.44	0.08	0.12 J	0.09	0.04

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
N/A Duplicate sample not analyzed for this analyte.
(See Page 23 of 23 for all other acronym definitions)

Table 4-2
Final Excavation Confirmation Results - Radiological
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SU-23

Sample Number	Ra^{226} (pCi/g)	Uncertainty (2 sigma)	MDA	U-Nat (pCi/g)	U- Nat (pCi/g propagated error)	U^{238} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{234} (pCi/g)	Uncertainty (2 sigma)	MDA	U^{235} (pCi/g)	Uncertainty (2 sigma)	MDA
5403-009-FSS-SU23-R-1-001	0.35 U	0.07	0.35	2.07	0.38	0.91	0.25	0.03	1.08	0.28	0.10	0.08	0.07	0.04
5403-009-FSS-SU23-R-1-002	2.82	0.63	0.28	3.59	0.33	1.68	0.39	0.10	1.83	0.42	0.07	0.08 U	0.08	0.10
5403-009-FSS-SU23-R-1-003	1.39	0.42	0.31	2.57	0.35	1.29	0.31	0.07	1.22	0.30	0.03	0.06	0.06	0.04
5403-009-FSS-SU23-R-1-004	1.34	0.42	0.25	2.77	0.35	1.17	0.30	0.06	1.48	0.35	0.04	0.11	0.09	0.07
5403-009-FSS-SU23-R-1-005	3.13	0.85	0.37	2.86	0.34	1.28	0.32	0.07	1.51	0.36	0.09	0.07 U	0.07	0.08
5403-009-FSS-SU23-R-1-006	1.41	0.41	0.22	3.21	0.33	1.54	0.36	0.07	1.54	0.36	0.07	0.12	0.09	0.04
5403-009-FSS-SU23-R-1-007	1.36	0.45	0.23	2.75	0.35	1.42	0.34	0.07	1.27	0.32	0.09	0.06	0.06	0.04
5403-009-FSS-SU23-R-1-008	1.43	0.39	0.17	2.91	0.34	1.19	0.29	0.07	1.60	0.36	0.07	0.13	0.09	0.07
5403-009-FSS-SU23-R-1-009	2.24	0.53	0.21	3.48	0.31	1.76	0.38	0.06	1.63	0.36	0.08	0.09	0.07	0.04
5403-009-FSS-SU23-R-1-010	1.93	0.53	0.18	2.79	0.37	1.22	0.32	0.08	1.46	0.37	0.11	0.11	0.09	0.08
5403-009-FSS-SU23-R-1-011	1.03	0.36	0.23	1.78	0.42	0.73	0.23	0.04	1.02	0.28	0.07	0.03 U	0.05	0.08
5403-009-FSS-SU23-R-1-012	0.95	0.37	0.09	1.46	0.43	0.75	0.22	0.03	0.68	0.21	0.07	0.03 U	0.04	0.08
5403-009-FSS-SU23-R-1-013	0.44	0.23	0.25	2.19	0.40	1.03	0.29	0.10	1.03	0.30	0.14	0.13 J	0.10	0.05
5403-009-FSS-SU23-R-1-014	1.85	0.53	0.36	6.09	0.29	2.85	0.60	0.10	3.08	0.64	0.10	0.16 J	0.12	0.13
5403-009-FSS-SU23-R-1-015	1.68	0.50	0.28	2.86	0.38	1.30	0.36	0.11	1.57	0.41	0.14	-0.01 UJ	0.01	0.11
5403-009-FSS-SU23-R-1-016	1.61	0.47	0.23	2.82	0.39	1.42	0.39	0.12	1.34	0.38	0.12	0.06 UJ	0.08	0.10
	Biased Sample Results													
5403-009-FSS-SU23-R-1-GP419BIAS	1.99	0.58	0.31	2.51	1.22	1.09	0.30	0.07	1.36	0.35	0.08	0.05 J	0.06	0.05
	Laboratory Duplicates													
5403-009-FSS-SU23-R-1-001	0.35 U	0.07	0.35	2.07	0.38	0.91	0.25	0.03	1.08	0.28	0.10	0.08	0.07	0.04
5403-009-FSS-SU23-R-1-001 DUP	0.08	0.13	0.30	2.06	0.40	0.79	0.24	0.10	1.16	0.30	0.09	0.11	0.09	0.09
5403-009-FSS-SU23-R-1-013	0.44	0.23	0.25	2.19	0.40	1.03	0.29	0.10	1.03	0.30	0.14	0.13 J	0.10	0.05
5403-009-FSS-SU23-R-1-013 DUP	0.33	0.20	0.29	2.31	0.36	0.91	0.24	0.08	1.34	0.32	0.06	0.06	0.06	0.04
	Field Replicates													
5403-009-FSS-SU23-R-1-007	1.36	0.45	0.23	2.75	0.35	1.42	0.34	0.07	1.27	0.32	0.09	0.06	0.06	0.04
5403-009-FSS-SU23-R-1-017	1.53	0.48	0.27	2.63	0.39	1.16	0.33	0.11	1.34	0.36	0.09	0.13 J	0.11	0.11
5403-009-FSS-SU23-R-1-008	1.43	0.39	0.17	2.91	0.34	1.19	0.29	0.07	1.60	0.36	0.07	0.13	0.09	0.07
5403-009-FSS-SU23-R-1-018	2.32	0.61	0.20	2.82	0.41	1.19	0.36	0.05	1.56	0.43	0.13	0.07 UJ	0.08	0.11

J Qualifier Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier Result is below the laboratory method detection limit.
Note: The U-235 concentration was reported as a negative number for sample ID 5403-009-SU23-FSS-R-1-015; however a value of 0.00 pCi/g was used for statistical purposes.
BIAS biased sample
DUP duplicate sample
MDA minimum detectable activity
pCi/g pico Curies per gram
U-Nat natural uranium

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Table 4-3
Final Excavation Confirmation Sampling Results - Chemical
Post Remediation Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

		Lead	Benzo (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Dibenzo (a,h) anthracene	Indeno (1,2,3-cd) pyrene
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
	Cleanup Criteria	**400**	**0.90**	**0.66**	**0.90**	**0.66**	**0.90**
Survey Unit	**Sample ID**						
SU-1	5403-009-FSS-SU1-C-1-034	16.7	0.09 J	0.11 J	0.18 J	0.05 U	0.08 J
SU-1	5403-009-FSS-SU1-C-1-035	10.4	0.06 U	0.07 U	0.05 U	0.05 U	0.05 U
SU-1	5403-009-FSS-SU1-C-1-043	126	0.05 U	0.06 U	0.07 J	0.05 U	0.05 J
SU-2	5403-009-FSS-SU2-C-1-036	43.8 J	0.26 U	0.29 U	0.20 U	0.23 U	0.23 U
SU-2	5403-009-FSS-SU2-C-1-044	39.1	0.06 U	0.07 U	0.05 U	0.06 U	0.06 U
SU-2	5403-009-FSS-SU2-C-1-045	27.8 J	0.25 U	0.29 U	0.40 J	0.23 U	0.25 J
SU-3	5403-009-FSS-SU3-C-1-037	7.65	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-4	5403-009-FSS-SU4-C-1-030	12.1	0.05 U	0.05 U	0.04 U	0.04 U	0.04 U
SU-5	5403-009-FSS-SU5-C-1-031	16.1	0.22 J	0.31 J	0.48	0.04 U	0.21 J
SU-6	5403-009-FSS-SU6-C-1-032	13.1 J	0.06 U	0.07 U	0.08 J	0.05 U	0.05 U
SU-6	5403-009-FSS-SU6-1-C-033	10.6 J	0.06 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-7	5403-009-FSS-SU7-C-1-025	16.9	0.05 U	0.06 U	0.07 J	0.05 U	0.05 U
SU-7	5403-009-FSS-SU7-C-1-026-POST	16.3	0.05 U	0.06 U	0.04 U	0.04 U	0.05 U
SU-8	5403-009-FSS-SU8-C-1-022	21.5	0.28 J	0.42	0.67	0.05 U	0.27 J
SU-8	5403-009-FSS-SU8-C-1-027	14.9	0.05 U	0.05 U	0.04 U	0.04 U	0.04 U
SU-9	5403-009-FSS-SU9-C-1-023 POST	10.6	0.01 U	0.01 U	0.03 U	0.03 U	0.01 U
SU-9	5403-009-FSS-SU9-C-1-024 POST	15.7	0.01 U	0.01 U	0.03 U	0.03 U	0.01 U
SU-9	5403-009-FSS-SU9-C-1-028 POST	14.3	0.01 U	0.01 U	0.03 U	0.03 U	0.01 U
SU-10	5403-009-FSS-SU10-C-1-017	12.8	0.06 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-11	5403-009-FSS-SU11-C-1-018	20.7	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-12	5403-009-FSS-SU12-C-1-019	16.6	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-13	5403-009-FSS-SU13-C-1-GPS-010	12.3 J	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-13	5403-009-FSS-SU13-C-1-014	19.1 J	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-13	5403-009-FSS-SU13-C-1-042	20.4 J	0.06 U	0.12 J	0.11 J	0.05 UJ	0.05 U
SU-14	5403-009-FSS-SU14-C-1-005/007	30.1 J	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-14	5403-009-FSS-SU14-C-1-015	18.0	0.17 J	0.27 J	0.49 J	0.05 UJ	0.06 J
SU-15	5403-009-FSS-SU15-C-1-012	18.4	0.05 U	0.06 U	0.08 J	0.05 U	0.05 U
SU-15	5403-009-FSS-SU15-C-1-016	18.4	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-16	5403-009-FSS-SU16-C-1-GPS-007	13.1 J	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-17	5403-009-FSS-SU17-C-1-0122/0123	25.0 J	0.39 U	0.39 U	0.39 U	0.39 U	0.39 U
SU-18	5403-009-FSS-SU18-C-1-009	18.3	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-19	5403-009-FSS-SU19-C-1-013	14.5	0.06 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-19	5403-009-FSS-SU19-C-1-020	19.7	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-19	5403-009-FSS-SU19-C-1-021	7.7	0.05 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-19	5403-009-FSS-SU19-C-1-029	11.3	0.06 U	0.06 U	0.04 U	0.05 U	0.05 U
SU-19	5403-009-FSS-SU19-C-1-038	12.6	0.06 U	0.07 U	0.05 U	0.05 U	0.06 U
SU-20	5403-009-FSS-SU20-C-1-0071/0095	29.4 J	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U
SU-20	5403-009-FSS-SU20-C-1-0072/0073/0096	17.0 J	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
SU-21	5403-009-FSS-SU-21-C-1-0074/0097	20.5 J	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U
SU-21	5403-009-FSS-SU21-C-1-0075/0098	15.5 J	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
SU-21	5403-009-FSS-SU21-C-1-0076/0077/0099	58.5 J	0.43 U	0.43 U	0.43 U	0.43 U	0.43 U
SU-22	5403-009-FSS-SU22-C-1-0078/0100	36.4 J	0.36 U	0.36 U	0.36 U	0.36 U	0.36 U
SU-22	5403-009-FSS-SU22-C-1-0079/0101	34.9 J	0.14 J	0.14 J	0.13 J	0.38 U	0.08 J
SU-22	5403-009-FSS-SU-22-C-1-0080/0102	31.5 J	0.38 U	0.38 U	0.38 U	0.38 U	0.38 U
SU-23	5403-009-FSS-SU23-C-1-046	14.8 J	0.01 U	0.01 U	0.03 U	0.03 U	0.01 U

Notes:
mg/kg = milligrams per kilogram
SU = survey unit
ID = identification

J Qualifier = Result is greater than method detection limit but below reporting limit or was qualiified as estimated during data validation
U Qualifier = Result is below the laboratory method detection limit.

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Table 5-1
Reference and Background Data
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Client ID	Radium 226 pCi/g	Thorium 232 pCi/g	Uranium 233/234 pCi/g	Uranium 235/236 pCi/g	Uranium 238 pCi/g	Average pCi/g	U-Natural pCi/g
5403-009-BKG-MV-R-001	0.770	0.590	0.590	-0.004	0.530	0.591	1.116
5403-009-BKG-MV-R-002	0.730	0.630	0.700	0.030	0.530	0.630	1.260
5403-009-BKG-MV-R-003	0.660	1.080	1.060	0.100	0.700	0.768	1.860
5403-009-BKG-MV-R-004	0.510	0.610	0.500	0.023	0.380	0.527	0.903
5403-009-BKG-MV-R-005	0.740	0.640	0.660	0.003	0.550	0.560	1.213
5403-009-BKG-MV-R-006	0.380	0.360	0.390	-0.002	0.340	0.369	0.728
5403-009-BKG-MV-R-007	0.880	0.960	0.740	0.023	0.630	0.768	1.393
5403-009-BKG-VP-R-001	0.940	1.210	0.620	0.022	0.690	0.849	1.332
5403-009-BKG-VP-R-002	1.300	0.990	0.830	0.007	0.910	0.905	1.747
5403-009-BKG-VP-R-003	1.340	1.150	0.860	0.048	0.880	0.947	1.788
5403-009-BKG-VP-R-004	1.110	1.090	0.900	0.032	0.830	0.973	1.762
5403-009-BKG-VP-R-005	1.160	1.400	0.730	0.084	0.770	0.894	1.584
5403-009-BKG-VP-R-006	1.230	1.330	0.930	0.029	1.130	1.076	2.089
5403-009-BKG-VP-R-007	1.080	0.840	0.800	0.080	0.940	0.904	1.820
Average	0.916	0.920	0.736	0.034	0.701	0.769	1.471
Standard Deviation	0.298	0.314	0.179	0.033	0.225	0.384	0.399
2 Sigma	0.585	0.585	0.585	0.585	0.585	0.585	0.585
Minimum	0.380	0.360	0.390	-0.004	0.340	0.369	0.728
Maximum	1.340	1.400	1.060	0.100	1.130	1.076	2.089
Median	0.910	0.975	0.735	0.026	0.695	0.808	1.489
Mean + 2 Sigma	1.501	1.505	1.321	0.618	1.285	1.353	2.056

Notes:
ID = identification
pCi/g = picoCurries per gram

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Table 5-2
Radiological Sample Summary
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

	Ra-226									
	Ra-226 Delta/Sigma	# of Samples Required	# of Samples Taken	Ra-226 Referance Area Rank Sum	Ra-226 Critical Value	Ra-226 Maximum pCi/g	Ra-226 Average pCi/g	Ra-226 Standard Deviation pCi/g	Ra-226 DCGL Exceeded?	Null Hypothesis Rejected?
Survey Unit										
SU-1	5.5	9	16	329	257	3.18	1.60	0.66	NO	YES
SU-2	5.6	9	15	315	248	3.50	1.90	0.57	NO	YES
SU-3	7.9	9	14	301	239	2.84	1.49	0.46	NO	YES
SU-4	16.5	9	14	301	239	1.35	0.72	0.26	NO	YES
SU-5	6.8	9	14	301	239	2.14	1.50	0.49	NO	YES
SU-5 (SUP)	12.4	9	14	301	239	1.80	1.00	0.33	NO	YES
SU-6	4.2	9	14	301	239	3.50	2.26	0.74	NO	YES
SU-7	7	9	15	315	248	2.38	1.03	0.59	NO	YES
SU-8	5.05	9	14	301	239	2.82	1.26	0.83	NO	YES
SU-8 (SUP)	7.55	9	14	301	239	2.14	1.18	0.52	NO	YES
SU-9	3.7	9	14	301	239	3.34	1.89	0.88	NO	YES
SU-10	9.9	9	14	301	239	2.50	1.43	0.36	NO	YES
SU-10 (SUP)	7.3	9	14	301	239	2.43	1.49	0.46	NO	YES
SU-11	10	9	17	343	265	2.77	1.52	0.36	NO	YES
SU-11 (SUP)	6.2	9	17	343	265	2.54	1.44	0.57	NO	YES
SU-12	3.1	10	14	301	239	3.51	2.31	0.83	NO	YES
SU-13	4.6	9	14	301	239	3.79	1.41	0.84	NO	YES
SU-14	7.4	9	17	343	265	2.34	1.28	0.50	NO	YES
SU-14 (SUP)	12.7	9	17	343	265	1.49	1.00	0.32	NO	YES
SU-15	2.38	11	17	329	265	7.05	1.85	0.70	YES	YES
SU-16	3.43	10	15	315	248	5.35	1.20	1.18	NO	YES
SU-17	6.9	9	17	343	265	2.85	1.29	0.56	NO	YES
SU-18	8.38	9	14	301	239	2.85	1.53	0.30	NO	YES
SU-19	4	9	14	301	239	3.77	2.04	0.83	NO	YES
SU-20	12.6	9	16	329	257	1.48	0.98	0.31	NO	YES
SU-21	8	9	16	329	257	2.67	1.18	0.49	NO	YES
SU-21 (SUP)	4.1	9	16	329	257	3.48	1.27	1.06	NO	YES
SU-22	5.85	9	15	315	248	2.14	1.34	0.46	NO	YES
SU-23	4.6	9	16	329	257	3.13	1.54	0.79	NO	YES

Notes:
DCGL = Derived Concentration Guidelines
pCi/g = picoCurries per gram
Ra-226 = radium 226
SU = survey unit
SUP = supplimental
U-NAT = natural uranium
SOR = Sum of Ratios

Table 5-2
Radiological Sample Summary
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

	U-NAT									
	U-NAT Delta/Sigma	# of Samples Required	# of Samples Taken	U-NAT Referance Area Rank Sum	U-NAT Critical Value	U-NAT Maximum pCi/g	U-NAT Avgerage pCi/g	U-NAT Standard Deviation pCi/g	U-NAT DCGL Exceeded?	Null Hypothesis Rejected?
Survey Unit										
SU-1	15.20	9	16	329	257	7.01	2.71	0.97	NO	YES
SU-2	6.20	9	15	315	248	11.72	4.03	2.35	NO	YES
SU-3	4.00	9	14	301	239	15.72	4.02	3.60	NO	YES
SU-4	5.10	9	14	301	239	12.73	2.41	3.04	NO	YES
SU-5	6.90	9	14	301	239	7.58	4.11	1.81	NO	YES
SU-5 (SUP)	65.40	9	14	301	239	2.46	1.91	0.23	NO	YES
SU-6	5.10	9	14	301	239	11.89	4.28	2.50	NO	YES
SU-7	3.80	9	15	315	248	15.31	4.10	3.43	NO	YES
SU-8	2.96	10	14	301	239	13.91	6.15	5.51	NO	YES
SU-8 (SUP)	62.56	9	14	301	239	2.15	1.81	0.24	NO	YES
SU-9	5.20	9	14	301	239	9.69	4.58	2.54	NO	YES
SU-10	3.60	9	14	301	239	15.79	5.02	3.62	NO	YES
SU-10 (SUP)	26.30	9	14	301	239	3.42	2.47	0.55	NO	YES
SU-11	6.00	9	17	343	265	11.04	4.10	2.22	NO	YES
SU-11 (SUP)	20.20	9	17	343	265	4.74	2.51	0.73	NO	YES
SU-12	14.70	9	14	301	239	5.90	3.33	0.95	NO	YES
SU-13	3.40	10	14	301	239	14.48	5.14	4.10	NO	YES
SU-14	3.20	10	17	343	265	16.66	5.40	4.00	NO	YES
SU-14 (SUP)	23.70	10	17	343	265	3.93	1.96	0.64	NO	YES
SU-15	3.77	10	17	343	265	13.60	5.48	3.06	NO	YES
SU-16	3.83	9	15	315	248	13.54	4.43	3.78	NO	YES
SU-17	4.70	9	17	343	265	12.48	3.95	2.94	NO	YES
SU-18	3.06	10	14	301	239	12.06	3.44	2.77	NO	YES
SU-19	9.70	9	14	301	239	6.11	3.20	1.47	NO	YES
SU-20	6.20	9	16	329	257	10.00	3.86	2.27	NO	YES
SU-21	4.50	9	16	329	257	13.64	3.78	3.11	NO	YES
SU-21 (SUP)	23.60	9	16	329	257	3.72	2.52	0.62	NO	YES
SU-22	2.96	10	15	315	248	12.90	2.91	2.87	NO	YES
SU-23	13.80	9	16	329	257	6.09	2.94	1.03	NO	YES

Notes:
DCGL = Derived Concentration Guidelines
pCi/g = picoCurries per gram
Ra-226 = radium 226
SU = survey unit
SUP = supplimental
U-NAT = natural uranium
SOR = Sum of Ratios

Table 5-2
Radiological Sample Summary
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

	SUM OF RATIOS (SOR)									
	SOR Delta/Sigma	# of Samples Required	# of Samples Taken	SOR Referance Area Rank Sum	SOR Critical Value	SOR Maximum	SOR Average	SOR Standard Deviation	SOR DCGL Exceeded?	Null Hypothesis Rejected?
Survey Unit										
SU-1	5.47	9	16	329	257	1.05	0.40	0.11	YES	YES
SU-2	2.42	11	15	303.5	248	1.28	0.49	0.22	YES	YES
SU-3	3.64	9	14	299	239	1.17	0.46	0.16	YES	YES
SU-4	4.27	9	14	301	239	0.85	0.25	0.18	NO	YES
SU-5	2.09	13	14	301	239	0.82	0.54	0.19	NO	YES
SU-5 (SUP)	10.85	9	14	301	239	0.47	0.31	0.06	NO	YES
SU-6	1.99	13	14	301	239	1.06	0.68	0.20	YES	YES
SU-7	3.83	9	15	315	248	1.03	0.39	0.17	YES	YES
SU-8	2.52	11	14	281.5	239	1.36	0.42	0.23	YES	YES
SU-8 (SUP)	8.75	9	14	301	239	0.52	0.34	0.08	NO	YES
SU-9	1.81	14	14	300	239	1.14	0.57	0.28	NO	YES
SU-10	2.77	10	14	296	239	1.23	0.53	0.18	YES	YES
SU-10 (SUP)	1.89	13	14	301	239	0.75	0.57	0.26	NO	YES
SU-11	8.49	9	17	343	265	0.94	0.48	0.06	NO	YES
SU-11 (SUP)	6.35	9	17	343	265	0.79	0.38	0.09	NO	YES
SU-12	1.28	22	14	301	239	0.90	0.66	0.19	NO	YES
SU-13	2.03	13	14	299	239	1.18	0.49	0.30	YES	YES
SU-14	3.32	10	17	338	265	1.23	0.45	0.18	YES	YES
SU-14 (SUP)	7.90	9	17	343	265	0.51	0.27	0.09	NO	YES
SU-15	4.61	9	17	329	265	1.41	0.32	0.14	YES	YES
SU-16	3.89	9	15	301	247	1.87	0.40	0.17	YES	YES
SU-17	4.58	9	17	343	263	1.01	0.38	0.13	YES	YES
SU-18	3.78	9	14	300	239	1.12	0.46	0.15	YES	YES
SU-19	3.29	9	14	301	239	1.00	0.57	0.15	NO	YES
SU-20	5.56	9	16	329	257	0.87	0.36	0.11	NO	YES
SU-21	6.57	9	16	329	255	0.95	0.36	0.09	NO	YES
SU-21 (SUP)	4.50	9	16	329	255	0.91	0.31	0.17	NO	YES
SU-22	5.30	9	16	329	255	1.10	0.35	0.13	YES	YES
SU-23	3.93	9	16	329	255	0.80	0.41	0.14	NO	YES

Notes:
DCGL = Derived Concentration Guidelines
pCi/g = picoCurries per gram
Ra-226 = radium 226
SU = survey unit
SUP = supplimental
U-NAT = natural uranium
SOR = Sum of Ratios

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Table 5-3
Polynuclear Aromatic Hydrocarbon Sample Summary
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

	Maximum Concentration (mg/kg)				
PAH	**Benzo (a) anthracene**	**Benzo (a) pyrene**	**Benzo (b) fluoranthene**	**Dibenzo (a,h) anthracene**	**Indeno (1,2,3-cd) pyrene**
Cleanup Criteria	**0.90**	**0.66**	**0.90**	**0.66**	**0.90**
Survey Unit					
SU-1	0.09	0.11	0.18	0.05	0.08
SU-2	0.25	0.29	0.40	0.23	0.25
SU-3	0.26	0.29	0.40	0.23	0.25
SU-4	0.22	0.31	0.48	0.04	0.21
SU-5	0.22	0.31	0.48	0.04	0.21
SU-5 (SUP)	0.05	0.06	0.09	0.04	0.05
SU-6	0.06	0.06	0.04	0.05	0.05
SU-7	0.06	0.06	0.07	0.05	0.05
SU-8	0.28	0.42	0.67	0.05	0.27
SU-8 (SUP)	0.28	0.42	0.67	0.05	0.27
SU-9	0.01	0.01	0.03	0.03	0.01
SU-9 (SUP)	0.28	0.42	0.67	0.05	0.27
SU-10	0.06	0.16	0.04	0.05	0.05
SU-10 (SUP)	0.09	0.16	0.15	0.05	0.06
SU-11	0.18	0.24	0.45	0.05	0.05
SU-11 (SUP)	0.09	0.11	0.15	0.05	0.06
SU-12	0.05	0.06	0.04	0.05	0.05
SU-13	0.06	0.16	0.04	0.05	0.05
SU-14	0.18	0.24	0.45	0.05	0.05
SU-14 (SUP)	0.05	0.06	0.08	0.05	0.05
SU-15	0.18	0.24	0.45	0.05	0.05
SU-16	0.38	0.38	0.38	0.38	0.38
SU-17	0.39	0.39	0.39	0.39	0.39
SU-18	0.39	0.39	0.39	0.39	0.39
SU-19	0.06	0.07	0.05	0.05	0.06
SU-20	0.38	0.38	0.38	0.38	0.38
SU-21	0.43	0.43	0.43	0.43	0.43
SU-21 (SUP)	0.35	0.35	0.35	0.35	0.35
SU-22 (SUP)	0.38	0.38	0.38	0.38	0.38
SU-23 (SUP)	0.25	0.29	0.40	0.23	0.25

Notes:
mg/kg = milligrams per kilogram
PAH = polynuclear aromatic hydrocarbon
SU = survey unit
SUP = supplemental

Table 5-3
Polynuclear Aromatic Hydrocarbon Sample Summary
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

	Average Concentration (mg/kg)				
PAH	**Benzo (a) anthracene**	**Benzo (a) pyrene**	**Benzo (b) fluoranthene**	**Dibenz (a,h) anthracene**	**Indeno (1,2,3-cd) pyrene**
Cleanup Criteria	**0.90**	**0.66**	**0.90**	**0.66**	**0.90**
Survey Unit					
SU-1	0.06	0.08	0.09	0.05	0.07
SU-2	0.16	0.16	0.17	0.14	0.15
SU-3	0.19	0.19	0.21	0.17	0.18
SU-4	0.09	0.12	0.16	0.04	0.09
SU-5	0.11	0.14	0.19	0.04	0.10
SU-5 (SUP)	0.03	0.04	0.05	0.03	0.02
SU-6	0.05	0.06	0.04	0.05	0.05
SU-7	0.05	0.06	0.05	0.05	0.05
SU-8	0.13	0.18	0.25	0.04	0.12
SU-8 (SUP)	0.13	0.18	0.25	0.04	0.12
SU-9	0.01	0.01	0.03	0.03	0.01
SU-9 (SUP)	0.13	0.18	0.25	0.04	0.12
SU-10	0.05	0.09	0.04	0.05	0.05
SU-10 (SUP)	0.07	0.11	0.08	0.04	0.05
SU-11	0.08	0.11	0.14	0.05	0.05
SU-11 (SUP)	0.04	0.05	0.06	0.03	0.03
SU-12	0.05	0.06	0.04	0.05	0.05
SU-13	0.05	0.08	0.04	0.05	0.05
SU-14	0.08	0.10	0.15	0.05	0.05
SU-14 (SUP)	0.03	0.04	0.04	0.04	0.03
SU-15	0.08	0.09	0.13	0.05	0.05
SU-16	0.12	0.12	0.12	0.11	0.11
SU-17	0.21	0.22	0.21	0.21	0.21
SU-18	0.23	0.23	0.23	0.23	0.23
SU-19	0.06	0.06	0.04	0.05	0.05
SU-20	0.31	0.31	0.31	0.37	0.30
SU-21	0.34	0.33	0.34	0.38	0.33
SU-21 (SUP)	0.15	0.15	0.16	0.15	0.13
SU-22 (SUP)	0.32	0.31	0.32	0.36	0.30
SU-23 (SUP)	0.11	0.12	0.16	0.11	0.11

Notes:
mg/kg = milligrams pe
PAH = polynuclear arc
SU = survey unit
SUP = supplemental

Table 5-4
Metal Sample Summary
Post Remediation Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

	Maximum Concentration (mg/kg)	Average Concentration (mg/kg)
Cleanup Criteria (Lead)	**400.0**	**400.0**
Survey Unit		
SU-1	126.0	48.0
SU-2	43.8	30.3
SU-3	43.8	26.4
SU-4	16.9	15.4
SU-5	16.3	14.7
SU-5 (SUP)	16.3	14.4
SU-6	19.9	12.7
SU-7	16.9	15.3
SU-8	21.5	17.6
SU-8 (SUP)	21.5	17.6
SU-9	15.7	13.5
SU-9 (SUP)	21.5	17.6
SU-10	20.4	17.4
SU-10 (SUP)	27.4	22.3
SU-11	20.7	17.7
SU-11 (SUP)	27.4	17.0
SU-12	19.7	18.2
SU-13	30.1	20.5
SU-14	19.1	16.8
SU-14 (SUP)	19.1	15.2
SU-15	18.4	17.0
SU-16	157.0	42.2
SU-17	30.1	20.9
SU-18	46.4	27.0
SU-19	14.5	11.5
SU-20	34.9	24.2
SU-21	46.4	29.7
SU-21 (SUP)	48.9	21.7
SU-22 (SUP)	36.4	30.5
SU-23 (SUP)	39.1	27.2

Notes:
mg/kg = milligrams per kilogram
SU = survey unit
SUP = supplemental

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Table 5-5
FSSR Scan Information
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

	Ra-226 MDC_{Scan} (pCi/g)	U-NAT MDC_{Scan} (pCi/g)	Background Range (uR/hr)	Background Average	Maximum Z-Score
Survey Unit					
SU-1	0.5-1.0	6.6-11.2	5.3-15.0	13.4	2.0
SU-2	0.7-1.0	8.5-11.1	8.6-18.0	16.9	2.9
SU-3	0.7-0.9	8.5-11.5	8.7-15.9	14.8	3.4
SU-4	0.6-0.9	7.5-11.8	6.1-14.9	10.6	1.9
SU-5	0.7-1.0	8.5-11.1	8.6-18.6	14.8	1.5
SU-5 (SUP)	0.5-0.5	5.71-6.6	3.9-5.2	4.6	3.1
SU-6	0.7-0.9	9.1-11.2	9.9-14.9	14.1	4.2
SU-7	0.5-0.8	7.2-10.5	5.5	11.8	2.6
SU-8	0.7-0.9	8.48-10.6	8.4-13.3	11.3	2.6
SU-8 (SUP)	0.7-0.9	8.4-10.6	8.4-13.3	11.3	2.6
SU-9	0.7-0.8	8.1-10.5	7.8-13.1	10.9	3.1
SU-9 (SUP)	0.7-0.9	8.4-10.6	8.4-13.3	11.3	2.6
SU-10	0.5-0.9	7.2-12.0	5.5-15.4	13.0	2.5
SU-10 (SUP)	0.5-0.6	5.9-7.8	4.2-7.3	5.9	2.6
SU-11	0.7-0.9	8.8-12.3	8.3-21	16.2	2.4
SU-11 (SUP)	0.5-0.6	6.5-7.9	5.0-7.4	6.5	3.5
SU-12	0.6-0.9	7.0-11.3	5.8-15.2	12.8	2.8
SU-13	0.5-0.9	6.1-11.9	4.0-16.1	10.8	1.4
SU-14	0.8-1.0	10.4-12.7	11.6-17.4	15.9	2.6
SU-14 (SUP)	0.5-0.6	5.9-6.3	4.2-5.8	4.7	2.6
SU-15	0.7-0.9	9.2-11.05	10.3-15.8	14.6	2.9
SU-16	0.6-0.9	7.7-11.5	8.3-14.4	12.6	2.5
SU-17	0.8-0.9	10.1-11.9	10.9-15.3	13.5	2.2
SU-18	0.7-0.9	8.1-11.0	7.9-21.1	14.5	2.6
SU-19	0.5-0.8	6.5-10.5	5.1-13.1	10.2	3.1
SU-20	0.6-0.8	7.6-11.0	6.2-13.0	9.6	1.9
SU-21	1.8-2.8	---	6.8-15.8	13.5	1.6
SU-21 (SUP)	0.4-0.6	5.5-7.1	3.6-6.0	4.5	3.8
SU-22	1.8-2.8	---	4.2-13.3	9.6	4.2
SU-23	0.6-0.8	7.4-9.9	6.5-11.5	9.6	3.2

Notes:
MDC = Minimum Detectable Concentration
uR/hr = microrem per hour
pCi/g = picoCurries per gram
Ra-226 = radium 226
SU = survey unit
SUP = supplemental
U-NAT = natural uranium

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Table 6-1
Definable Features of Work and Record of Preparatory Inspections
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Inspection Date	Definable Feature of Work/Work Activity
8/15/2006	Characterization Sampling/Geoprobe Investigation
8/18/2006	Mobilization
8/18/2006	Excavation
9/19/2006	Transportation and Disposal of Radiologically-Impacted Soil
10/31/2006	Underground Storage Tank Removal
12/7/2006	Transportation and Disposal Chem soil
1/10/2007	Electrical Distribution Work (Temporary)
1/18/2007	Backfilling/Site Restoration Operations
1/31/2007	Wastewater Treatment Facility Install/Operation and Maintenance
6/18/2007	Environmental Surveillance Sampling
4/22/2008	Well Abandonment

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Table 6-2
Submittal Register
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SUBMITTAL REGISTER (ER 415-1-10)				TITLE AND LOCATION: Soil Remedial Action - FUSRAP MSP,Middlesex, NJ							DATE: 17 Dec 2008				
				CONTRACTOR: Environmental Chemical Corporation				CONTRACT NUMBER: W912DQ-04-D-0017 0009							
ACTIVITY No.	TRANS-MITTAL No.	ITEM No.	SPEC PARAGRAPH No.	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL	CLASSI-FICATION FIO GA, DA or CR	CONTRACTOR REVIEWER	CONTRACTOR SCHEDULE DATES: SUBMIT NEEDED BY	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CONTRACTOR ACTION: CODE	CONTRACTOR ACTION: CORPS RECEIVED DATE	GOVERNMENT ACTION: CODE	GOVERNMENT ACTION: CORPS RETURNED DATE
SECTION - 01 41 00			**Regulatory Requirements**											
	3	3	01 41 00 N/A	MCUA TDA 01-07R - Modify	CERTIFICATES	GA	David				A	21 Apr 08	A	21 Apr 08
SECTION - 01 45 00			**Quality Control**											
0301	2	2	01 45 00	Revised Site Safety And Health Plan	REPORTS	GA					A	08 Nov 07	F	08 Nov 07
0070	3	3	01 45 00	Addendum to Site Safety & Health Plan	SAFETY PLAN	FIO					A	08 Nov 07	F	08 Nov 07
SECTION - 01 78 00			**Closeout Submittals**											
	1	1	01 78 00	Final Demolition Closure Report	CLOSEOUT SUBMTL	GA					A	18 Dec 07	A	04 Dec 07
SECTION - 010			**FSSR SU10**											
0310	2	2	010 N/A	FSSR SU-10	REPORTS	GA	David				A	29 Apr 08	A	16 Jul 07
0310	3	3	010 N/A	FSSR SU-10	REPORTS	GA	David				A	23 Apr 08	A	24 Apr 08
SECTION - 011			**FSSR 011**											
0311	2	2	011 N/A	FSSR SU-11 CHEM and RAD	REPORTS	GA					A	29 Apr 08	A	19 Jul 07
0311	3	3	011 N/A	FSSR SU-11	REPORTS	GA	WSTEPHAN				A	08 May 08	A	08 May 08
SECTION - 012			**FSSR 012**											
	2	2	012			FIO					A	13 Dec 07	A	18 Dec 07
SECTION - 013			**FSSR 013**											
0313	1	1	013 N/A	FSSR 13	REPORTS	FIO	David	16 Oct 06	16 Oct 06	16 Oct 06	A	24 May 07	A	29 May 07
SECTION - 014			**FSSR 014**											
0314	1	1	014 N/A	FSSR SU-14	REPORTS	GA	David				A	04 Jun 07	A	07 Jun 07
0314	2	2	014 N/A	FSSR SU-14	TEST REPORTS	GA	David				A	06 May 08	A	06 May 08
SECTION - 015			**FSSR 015**											
0315	3	3	015 N/A	FSSR-15	REPORTS	FIO					A	10 May 07	A	16 May 07
SECTION - 016			**FSSR 016**											
0416	2	2	016 N/A	FSSR-16	REPORTS	GA	David				A	21 May 07	A	23 May 07
SECTION - 017			**FSSR 017**											
0317	1	1	017 N/A	FSSR SU-17	REPORTS	GA	David	09 Oct 06	09 Oct 06	09 Oct 06	A	06 Jun 07	A	11 Jun 07
SECTION - 018			**FSSR 018**											
0318	2	2	018 N/A	Revised FSSR-SU18	REPORTS	FIO	David				A	01 May 07	A	03 May 07
SECTION - 019			**FSSR 019**											
0319	1	1	019	FSSR SU19	REPORTS	GA	David				A	29 Apr 08	A	19 Dec 07
SECTION - 019998			**Back fill Material**											
0321	2	2	019998 01	Backfill Acceptance Data -Maddox/Stavola	PRODUCT DATA	FIO		11 Sep 06	11 Sep 06	11 Sep 06	A	23 Apr 07	A	24 Apr 07
0322	3	3	019998 01	Re-submittal of 19998-2; Maddox/Stavola	PRODUCT DATA	FIO	David	04 Sep 06	04 Sep 06	04 Sep 06	A	11 Jul 07	A	09 Mar 07
0322	4	4	019998 01	Backfill Acceptance Data - CA-Rt. 22	PRODUCT DATA	FIO	David	04 Sep 06	04 Sep 06	04 Sep 06	A	11 Jul 07	A	09 Mar 07
0302	7	7	019998 N/A	Submittal for Backfill "MADUNION"	PRODUCT DATA	GA	David				A	07 Jan 08	A	07 Feb 08
RANGE : COMPLETED													SORT : SECTION & ITEM	

Table 6-2
Submittal Register
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SUBMITTAL REGISTER (ER 415-1-10)

TITLE AND LOCATION: Soil Remedial Action - FUSRAP MSP,Middlesex, NJ

DATE: 17 Dec 2008

CONTRACTOR: Environmental Chemical Corporation

CONTRACT NUMBER: W912DQ-04-D-0017 0009

ACTIVITY No.	TRANS-MITTAL No.	ITEM No.	SPEC PARAGRAPH No.	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL	CLASSI-FICATION FIO GA, DA or CR	CONTRACTOR REVIEWER	CONTRACTOR SCHEDULE DATES: SUBMIT NEEDED BY	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CONTRACTOR ACTION: CODE	CORPS RECEIVED DATE	GOVERNMENT ACTION: CODE	CORPS RETURNED DATE
0301	6	8	019998 N/A	Top Soil	TEST REPORTS	FIO	David				A	21 Apr 08	F	24 Apr 08
0301	8	10	019998 N/A	Seed Mix, Fertilizer, Lime & Phosphate	PRODUCT DATA	FIO	David				A	07 May 08	F	07 May 08
SECTION - 019999			**Pre Construction Plans**											
0100	2	2	019999 01	Revised QASP	PRECON SUBMTL	FIO	David				A	29 Apr 08	A	24 Apr 07
SECTION - 02			**FSSR SU2**											
0302	2	2	02 N/A	Revised SU-2	REPORTS	GA	David				A	12 Dec 07	A	18 Dec 07
SECTION - 020			**FSSR 020**											
0320	2	2	020 N/A	FSSR SU-20	REPORTS	FIO		11 Sep 06	11 Sep 06	11 Sep 06	A	07 May 07	A	10 May 07
SECTION - 021			**FSSR 021**											
0321	5	5	021 N/A	FSSR 021	REPORTS	FIO	David	11 Sep 06	11 Sep 06	11 Sep 06	A	07 May 07	A	10 May 07
0321	6	6	021 N/A	FSSR SU-021	REPORTS	GA	David	11 Sep 06	11 Sep 06	11 Sep 06	A	13 May 08	A	13 May 08
SECTION - 022			**FSSR 022**											
0322	4	4	022 N/A	Revised FSSR-22	REPORTS	FIO	David	04 Sep 06	04 Sep 06	04 Sep 06	A	01 May 07	A	03 May 07
SECTION - 029A			**Draft Env. Surv. Report - 2006**											
1001	4	4	029A N/A	2006 Environmental Surveillance Report	REPORTS	GA	David				A	29 Apr 08	A	31 Jul 07
SECTION - 03			**FSSR SU3**											
0303	1	1	03	FSSR SU-3	REPORTS	GA		11 Sep 07	26 Sep 07	26 Sep 07	A	06 Nov 07	A	07 Nov 07
SECTION - 04			**FSSR SU4**											
0304	4	4	04 N/A	Revised FSSR SU-4	REPORTS	GA					A	29 Apr 08	A	30 Jul 07
0304	6	6	04	Revised FSSR SU-4	REPORTS	GA	David				A	29 Apr 08	A	19 Oct 07
SECTION - 05			**FSSR SU5**											
0305	5	3	05	Revised FSSR- SU5	REPORTS	GA	David				A	21 Apr 08	A	24 Apr 08
0305	4	4	05	FSSR SU5	REPORTS	GA	David				A	06 Sep 07	A	11 Sep 07
SECTION - 06			**FSSR SU6**											
0306	3	1.2	06 N/A	Revised FSSR SU6	REPORTS	GA	David				A	29 Apr 08	A	08 Jan 08
SECTION - 07			**FSSR SU7**											
0307	1	1	07 N/A	FSSR SU-7	REPORTS	FIO	David				A	29 Apr 08	A	11 Jun 07
0307	3	3	07	FSSR SU7	REPORTS	GA					A	14 Aug 07	A	29 Aug 07
0307	5	5	07 N/A	Revised FSSR SU7	REPORTS	GA					A	23 Aug 07	A	29 Aug 07
SECTION - 08			**FSSR 08**											
0308	3	3	08 N/A	Revised FSSR-08	REPORTS	GA	David				A	29 Apr 08	A	26 Jun 07
0308	5	5	08	Revised FSSR SU-8	REPORTS	GA	David				A	29 Apr 08	A	10 Sep 07
0308	6	6	08	Revised FSSR SU-8	REPORTS	GA	David				A	09 Oct 07	A	12 Oct 07
0308	7	7	08	Revised FSSR SU-8	REPORTS	GA	David				A	21 Apr 08	A	24 Apr 08
SECTION - 09			**FSSR SU9**											

RANGE : COMPLETED

SORT : SECTION & ITEM

Table 6-2
Submittal Register
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

SUBMITTAL REGISTER (ER 415-1-10)				TITLE AND LOCATION: Soil Remedial Action - FUSRAP MSP,Middlesex, NJ								DATE: 17 Dec 2008		
				CONTRACTOR: Environmental Chemical Corporation				CONTRACT NUMBER: W912DQ-04-D-0017 0009						
ACTIVITY No.	TRANS-MITTAL No.	ITEM No.	SPEC PARAGRAPH No.	DESCRIPTION OF SUBMITTAL	TYPE OF SUBMITTAL	CLASSI-FICATION FIO GA, DA or CR	CONTRACTOR REVIEWER	CONTRACTOR SCHEDULE DATES: SUBMIT NEEDED BY	APPROVAL NEEDED BY	MATERIAL NEEDED BY	CONTRACTOR ACTION: CODE	CORPS RECEIVED DATE	GOVERNMENT ACTION: CODE	CORPS RETURNED DATE
0309	4	1.3	09 N/A	Revised FSSR SU-9	REPORTS	GA	David				A	29 Apr 08	A	08 Jan 08
0309	2	2	09 N/A	Revised FSSR SU-9	REPORTS	GA	David				A	29 Apr 08	A	19 Dec 07
SECTION - 19996			**MCUA Self Monitoring Report**											
0408	1	1	19996 N/A	MCUA Self Monitoring Report 01 - Apr 07	REPORTS	FIO	David				A	29 Apr 08	A	09 May 07
	2	2	19996 N/A	MCUA Self Monitoring Report 02 - May 07	REPORTS	FIO	David				A	29 Apr 08	A	11 Jun 07
0404	3	3	19996 N/A	MCUA Self Monitoring Report 03 - June 07	REPORTS	GA	David				A	29 Apr 08	A	03 Jul 07
0405	4	4	19996 TDA 01-07	MCUA SMR# 4 - July 2007	REPORTS	FIO					A	29 Apr 08	A	22 Aug 07
0404	5	5	19996 TDA 01-07	MCUA SMR# 5 -August 2007	REPORTS	GA	David				A	29 Apr 08	A	24 Sep 07
0401	6	6	19996 TDA 01-07	MCUA SMR #6-September 2007	REPORTS	FIO	David				A	29 Apr 08	A	24 Oct 07
0402	7	7	19996	MCUA Self Monitoring Report #7	REPORTS	FIO	David				A	29 Apr 08	A	20 Nov 07
0401	8	8	19996 N/A	MCUA Self Monitoring report #8	REPORTS	FIO	David				A	29 Apr 08	A	19 Dec 07
	9	9	19996 N/A	MCUA Self Monitoring Report #9 Dec.07	REPORTS	FIO	David				A	29 Apr 08	A	30 Jan 08
	10	10	19996 N/A	MCUA Self Monitoring Report #10 Jan 2008	REPORTS	DA	David				A	29 Apr 08	A	25 Feb 08
0402	11	11	19996 N/A	MCUA Self Monitoring Report #11 - Feb 08	REPORTS	GA	David				A	29 Apr 08	A	25 Mar 08
0402	12	12	19996 N/A	MCUA Self Monitoring Report #12 - March	REPORTS	GA	David				A	21 Apr 08	A	22 Apr 08
0402	13	13	19996 N/A	MCUA Self Monitoring Report #13 - April	REPORTS	GA	David				A	21 May 08	A	21 May 08
SECTION - 19997			**Final Status Survey Plan**											
0322	2	2	19997 N/A	Final FSSP Addendum	WORK PLAN	FIO	David	04 Sep 06	04 Sep 06	04 Sep 06	A	12 Apr 07	A	26 Apr 07
0301	5	5	19997	Revised FSSR SU-1	REPORTS	FIO					A	07 Nov 07	A	07 Nov 07

RANGE : COMPLETED SORT : SECTION & ITEM

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Table 7-1
Punch List Items from Pre-Final Inspection
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Item Number	Description of Identified Punch Item	Date Identified	Completed? (Yes/No)	Remarks
1	Repair unsightly fence sections (damaged fabric, bent posts or rails, slack barbed wired).	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
2	Remove barbed wire around SU-22 on fence sections near Mountain Ave. Do not install barbed wire along Mountain Ave when installing new fence.	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
3	Remove dead trees and small "scrub trees" around fence perimeter. Do not apply herbicide or otherwise attempt to remove or kill poison ivy on fence perimeter.	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
4	Replace (occasionally) haybales used for silt/sedimentation control for optimum effectiveness.	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
5	Dispose of large wooden project sign (damaged).	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
6	Post site perimeter with warning/no trespassing signs. Detailed signs are to be posted on the three gates, while smaller, less detailed signs are placed every 80 feet along fence perimeter. Exact language reads: USACE New York District Formally Used Site Remedial Action Program Middlesex Sampling Plant Site Middlesex, New Jersey In case of emergency call 1 (917) 790 8007	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008

Table 7-1
Punch List Items from Pre-Final Inspection
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Item Number	Description of Identified Punch Item	Date Identified	Completed? (Yes/No)	Remarks
7	Police site for garbage, debris.	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
8	Secure silt fencing or and/or remove when grass is established.	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
9	Install bollards around remaining existing wells (as well as new wells to be installed).	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
10	Conduct close-out interviews with neighboring businesses/residents.	May 27, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
11	Repair holes in fence; 2 locations by Absolute, one by south end, one by the east gate.	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
12	Improve drainage in swale at north side of site - need excavator.	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
13	Tidy up the rock rip-rap at outfall.	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
14	Repair bent post by east gate behind elec panel - replace top rail cap.	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008

Table 7-1
Punch List Items from Pre-Final Inspection
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Item Number	Description of Identified Punch Item	Date Identified	Completed? (Yes/No)	Remarks
15	Remove large dead pine trees on south of site.	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
16	Place stone/soil at bottom of newly installed fence at south of site to make secure (space at bottom).	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
17	Place stone in drainage swales where (minimal) standing water lies.	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
18	Police site for rocks at surface.	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008
19	Contact PSE&G to remove meter and "safe off" primary power supply.	June 2, 2008	Yes	Completed prior to Final Inspection on July 28, 2008

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Table 13-1
Key USACE Personnel During Soils Remedial Action
Post Remedial Action Report Middlesex Sampling Plant,
Middlesex, New Jersey

KEY USACE PERSONNEL	
Title	**Personnel**
Project Manager (CENWK)	Josephine Newton-Lund
Project Manager (CENAN)	James Moore
Contracting Officer's Representative (CENAN)	Ken Maley
Project Engineer (CENAN)	John Kenney
Health & Safety Manager (CENAN)	Ray Lo
Health Physicist (CENWK)	Dave Hays
Project Chemist (CENWK)	Jerry Montgomery

Notes:
CENWK = U.S. Army Corps of Engineers – Kansas City District
CENAN = U.S. Army Corps of Engineers – New York District

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Table 13-2
Key ECC Personnel During Soils Remedial Action
Post Remedial Action Report Middlesex Sampling Plant,
Middlesex, New Jersey

KEY ECC PERSONNEL	
Title	**Personnel**
Program Manager	Marc S. Mizrahi
Project Manager	Philip O'Dwyer, Jr.
Contractor Quality Control Systems Manager (CQCSM)	Dave Miller
Project Engineer – WWTP	Rinku Shah
Site Safety and Health Officer	Wilbur Stephan
Project Health Physicist	Kevin Kosko
Project Superintendent	Thomas Gilbertson
Field Engineer	David Moore

Notes:
WWTP = waste water treatment plant

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Table 13-3
Key Project Subcontractors and Suppliers
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Key Project Subcontractors and Suppliers	
Function	**Contractors and Suppliers**
On–site Gamma Spec Equipment Support	Canberra Industrial Inc P.O. Box 27746, New York, NY 10087 - 7746
Heavy Equipment Rental	Hertz Equipment Rental 49 West Ferris Street, East Brunswick, NJ 08816
Geoprobe Services	Zebra Environmental Corporation 10 Walker Way, Albany, NY 12205
Land Surveyor	GEOD Consulting 18-24 Kanouse Road, Newfoundland, NJ 07435
Office Trailer Suppliers	Job Site Trailer Sales & Rentals 11 Louise Drive, Milltown, NJ 08850
Radiation Monitoring Equipment	Landauer 2 Science Road, Glenwood, Illinois 60425-1586
Analytical Laboratory (Radiochemistry)	Eberline Services 601 Scarboro Road, Oak Ridge, TN 37830
Radiation Monitoring Equipment	Ludlum Measurement Inc 501 Oak Street, Sweetwater, Texas - 79556
Contract Labor Subcontractor (Health Physics Technicians)	Environmental Dimensions, Inc P.O. Box 6250 Albuquerque, NM 87197
Laboratory Equipment Suppliers	Strategic Diagnostics Inc. 111 Pencader Drive, Newark, DE 19702
Contract Labor Subcontractor (Laborers and Equipment Operators)	DeNuke Contracting Inc. 704 S Illinois Avenue, Suite C203, Oak Ridge, TN 37830
Environmental Equipment Rental	Pine Environmental Services, Inc. 92 North Main Street, Bldg 20, Windsor, NJ 08561
Laboratory Supplies	HI-Q Environmental Products Company 7386 Trade Street, San Diego, CA 92121
Safety Supplies	Field Environmental Instruments, Inc. 301 Brushton Avenue, Pittsburg, PA 15221
Regional Waste and Recycling Company	Regional Waste and Recycling 459 Blackhorse Lane, North Brunswick, NJ 08902
Truck Scale Supplier	Gerhart Scale Corporation 603 Washington Avenue, South Amboy, NJ 08879

Table 13-3
Key Project Subcontractors and Suppliers
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Key Project Subcontractors and Suppliers	
Function	**Contractors and Suppliers**
Electrician	Reliable Electric 388 Rick Road, Milford, NJ 08848
Stone, common backfill, and topsoil Supplier	Maddox Materials, LLC 323 Main Street, Sportswood, NJ 08884
Fuel Supplier	K.W. Rastall Oil P.O. Box 7174 North Brunswick, NJ 08902
Radiological Waste Transporter Vendor	US Ecology Idaho, Inc. 20400 Lemley Road, Grand View, Idaho 83624
Chemical Waste Transportation and Disposal Vendor	MHF Logistical Solutions P.O. Box 644221 Pittsburgh, PA 15264-4221
Laboratory Supplies	LYNX Supply Inc. 233 Warehouse Road, Oak Ridge, TN 37830
Geosynthetic Material Supplier	ESSCO Corporation 1445 Brookville Way, Suite J, Indianapolis, Indiana 46239
Contract Labor Subcontractor (Project Health Physicist, Laborers and Equipment Operators)	K2 Environmental 6006 Deerfield Street, Dayton, OH 45414
Tank Supplier	ModuTank Inc. 41-04 35th Avenue Long Island City, NY 11101
Water Treatment Equipment Supplier	Siemens Water Technology Corporation P.O. Box 360766 Pittsburgh, PA 15250-6766
Radiological Survey Instrumentation	Safety and Ecology Corporation 2800 Solway Road, Knoxville, TN 37931
Landscaping Material Supplier	Sweet Valley Farm 1034 Rt. 202, Ringoes, NJ 08551
Water Treatment Resin Supplier	DOW Chemical Corporation Midland, MI 48640
Analytical Data Validation Vendor	TLI Solutions 560 Golden Ridge Road, Golden, CO 80401
Geosynthetic and Construction Materials Supplier	IWT/Cargo Guard P.O. Box 454 Waretown, NJ 08758
Electrical Contractor	D'ANNA Electric Corporation 721 32nd Street, Union City, NJ 07087

Table 13-3
Key Project Subcontractors and Suppliers
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Key Project Subcontractors and Suppliers	
Function	**Contractors and Suppliers**
Analytical Laboratory	Lionville Laboratory 208 Welsh Pool Road, Exton, PA 19341
Geotechnical Survey	Lippincott & Jacobs Consulting Engineer 1 Pavilion Avenue, Riverside, NJ 08075
Analytical Data Review and Report Writer	The Norland Group 465 Fairchild Drive, Suite 112 Mountain View, CA 94043
Analytical Laboratory	Chemtech 284 Sheffield Street, Mountainside, NJ 07092
Backfill Source Supplier	On Site Supplies 1308 Centennial Avenue, Piscataway, NJ 08854
Underground Storage Tank Removal Contractor	ANCO Environmental Services, Inc. P.O. Box 188, 35 Russo Place, Berkeley Heights, NJ 07922-0188
Heavy Equipment Supplier	Foley Rents 833 Centennial Avenue Piscataway, NJ 08855
Portable Tank Supplier	Adler Tank Rentals 95-123 Firmenich Way, Newark, NJ 07114
Heavy Duty Mill Hose Supplier	Common Wealth Rubber Supply Incorporation P.O. Box 123 Newtown, PA 18940
B25 Box Supplier	Container Products Corporation 112 North College Road, Wilmington, NC 28406
Professional Services	Advance Geo services 1055 Andrew Drive, Suite A, West Chester, PA 19380-4293
Carbon Change Out Contractor	Calgon Carbon Corporation 23713 Network Place Chicago, IL 60673-1237
Portable Tank Supplier	Rain For Rent 1197 Aura Road, Monroeville, NJ 08343
Analytical Laboratory	Test America Laboratories 13715 Rider Trail North Earth City, MO 63045-1205
Fencing Contractor	Somerset Valley Fencework, Inc. 3484 US Hwy. 22 West North Branch, NJ 08876
Landscaping Material Supplier	Cedar Hill Landscaping 127 Cedar Grove Lane, Somerset, NJ 08873

Table 13-3
Key Project Subcontractors and Suppliers
Post Remedial Action Report
Middlesex Sampling Plant, Middlesex, New Jersey

Key Project Subcontractors and Suppliers	
Function	**Contractors and Suppliers**
Paving Contractor	L.N. Rothberg And Son's Inc. 550 Cedar Avenue, Middlesex, NJ 08846
Monitoring Well Abandonment Contractor	Tabasco Well Drilling P.O. Box 1676, Mount Laurel, NJ 08054

APPENDICES

Appendix A

Interim Pile Removal Closure Report

Appendix B

Closure Report for Building Demolition

Appendix C

Well Abandonment Reports

Appendix D

Project Photographs

Appendix E

Storm Water Management, Soil, Erosion, and Sediment Control Plan

Appendix F

MCUA Temporary Discharge Approval

Appendix G

Waste Water Treatment Plant Discharge Monitoring Reports

Appendix H

UST Closure Report

Appendix I

Waste Profiles

Appendix J

Certificates of Disposal and Waste Quantity Documentation

Appendix K

Backfill Acceptance and Compaction Documentation

Appendix L

Final Status Survey Plan (including FIDLER Addendum)

Appendix M

Final Status Survey Reports

Appendix N

Daily Quality Control Reports

Appendix O

Meeting Minutes

Appendix P

Signed Project Completion Check List

Appendix Q

Quality Control Summary Reports (QCSRs 1-6)

Appendix R

EnVironmental Surveillance Program Data 2007

Appendix S

Right-of-Entry Agreements

ATTACHMENTS

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ATTACHMENT 1

CENAN Letter Request for NJDEP Concurrence for OU-1 RA

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DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

February 1, 2010

REPLY TO
ATTENTION OF

Programs and Project Management Division

Ms. Donna Gaffigan
Case Manager
Bureau of Case Management
New Jersey Department of Environmental Protection
401 E State St
Trenton, NJ 08625

Dear Ms. Gaffigan:

The U.S. Army Corps of Engineers, New York District (the Corps), has reviewed site characterization and post excavation sampling information at the Middlesex Sampling Plant Formerly Utilized Site Remedial Action Program site. This information was compared to the New Jersey Department of Environmental Protection Soil Cleanup Criteria (reference NJAC 7:26D), promulgated June 2008. All analytical results from soil samples presented in the RI were evaluated, including Site Investigation samples from 1991, 2000, and 2001, combined, totaling approximately 120 samples. This information is summarized in the attached Table 1.

An analysis of Remedial Investigation data compared to final soil excavation survey and post excavation sampling information indicates the following:

- Two samples/results are identified as potentially "left in the ground" (Samples 9508 and PC-49).
- One SVOC compound, Benzo(k)fluoranthene, was detected above the RDCSCC in sample 9508, however we attribute this to the presence of surfacial asphalt related to historical culvert replacement that was conducted in this area of the site.
- Lead was also identified at one location (PC-49) at a sample depth greater than excavation depth, according to our evaluation. It is important to note that lead was sampled as part of the final status survey for SU-17, and the results for this survey unit were all below the NJDEP residential clean up criteria for lead.

The attached map indicates (red-highlighted samples or locations), where sample results exceed RDCSCC, but may not have been excavated. The Corps respectively requests that NJDEP review this information. Given the extent of the removal action performed and the volume of contaminated material removed at the MSP site, and the fact that we only have one slightly elevated lead exceedance that was not remediated and the lead sampling results from SU-17, we view this to be de minimis. At this time

we request your concurrence to move forward and finalize project documents that recommend no further action for soils.

Your expedited response on this matter is requested. Please call me if you have any questions or need additional information. I can be reached at (917) 790-8332.

Sincerely,

Helen K. Edge
Project Manager

Encl

CF: Helen Shannon, EPA

ATTACHMENT 2

NJDEP Remedial Action Approval Letter

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State of New Jersey

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Case Management
401 East State Street
P.O. Box 028
Trenton, NJ 08625-0028

BOB MARTIN
Commissioner

Helen Edge, Project Manager
U.S. Army Corps of Engineers, NY District
26 Federal Plaza, Room 1811
New York, NY 10278

June 29, 2010

Remedial Action Report Approval

Re: Draft Final Post Remedial Action Report for Soils OU-1 Remedial Action
Middlesex Sampling Plant
239 Mountain Ave
Middlesex Borough, Middlesex County
SRP PI# G000000016
Activity Number Reference: RPC000001

Dear Ms. Edge:

The New Jersey Department of Environmental Protection (Department) has completed its review of the Draft Final Post Remedial Action Report (PRAR) for the Soils Operable Unit (OU) 1 Remedial Action dated March 31, 2009. The Draft PRAR for Soils describes the remedial actions for soils completed by the United States Army Corps of Engineers (USACE) at the Middlesex Sampling Plant, in Middlesex Borough, Middlesex County.

As you might recall, the Department did not concur with the August 2005 Record of Decision for the soil remediation. In a letter dated December 2, 2005, the Department stated that it generally agreed with the selected remedial alternative, which included excavation and off-site disposal of contaminated soils to allow unrestricted use of the site, but could not concur based on concerns regarding the remedial goals identified for the radiological and chemical contaminants present in the soil at the site. At the time, the Department did not believe that the radiation dose limit of 15 millirem per year from N.J.A.C. 7:28-12.8(a)1, which was identified as an Applicable or Relevant and Appropriate Requirement, would be met by using the concentration limit of 5 pCi/g above background for radium-226 as the directly measurable remediation goal. In addition, the Department believed that the USACE should have identified and addressed all chemical contaminants that exceeded the New Jersey Soil Cleanup Criteria (NJSCC) rather than only addressing the six Contaminants of Concern identified in the Baseline Human Health Risk Assessment.

Upon review of the information provided in the Draft Final PRAR for Soils, the Department was pleased to find that despite its initial concerns, the remedial action does meet the Department's radiological criteria for unrestricted release of the site. However, because the post-excavation samples were only analyzed for the six Contaminants of Concern, the data presented in the Draft Final PRAR were insufficient to document that the remedial action meets the all of the NJSCC for the chemical contaminants. Because of this, the Department would be unable to accept the remedial action as complete and voiced this concern to USACE.

In response to this issue, the USACE reviewed all of the existing site characterization and post-excavation sampling information and concluded that any chemical contaminants that exceeded the NJSCC were excavated along with the radiological contamination and were in fact remediated. The results of this evaluation were presented in a letter to the Department dated February 1, 2010. Upon review of the letter, the Department agrees with USACE's conclusion.

Based on the above, the Department has determined that the Draft Final PRAR for Soils in combination with the information provided in the February 1, 2010 letter is in compliance with the Technical Requirements for Site Remediation, N.J.A.C. 7:26E and other applicable requirements. The Department hereby approves the Draft Final PRAR for Soils, effective the date of this letter.

The Department understands that the USACE will be issuing a "Final" PRAR that incorporates the information and conclusions of the February 1, 2010 letter and will provide the Department with a copy.

If you have any questions regarding this matter please feel free to contact me by telephone at (609)633-1494 or by email at donna.gaffigan@dep.state.nj.us.

Sincerely,

Donna L Gaffigan

Donna L. Gaffigan, Case Manager
Bureau of Case Management

C: Helen Shannon, USEPA
Clerk, Middlesex Borough
Health Officer, Middlebrook Regional Health Comm.
Patricia Gardner, NJDEP/BER
Steven Byrnes, NJDEP/BEERA
Gregory Rapp, NJDEP/BGWPA